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Summary Report of Comprehensive Laboratory Testing to Establish the Effectiveness of Proposed Treatment Methods for Unremediated and Remediated Nitrate Salt Waste Streams



Prepared by Kurt Anast, David J. Funk, and Kenneth M. Hargis

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EXECUTIVE SUMMARY

The inadvertent creation of transuranic waste carrying hazardous waste codes D001 and D002 requires the treatment of the material to eliminate the hazardous characteristics and allow its eventual shipment and disposal at the Waste Isolation Pilot Plant (WIPP). This report documents the effectiveness of two treatment methods proposed to stabilize both the unremediated and remediated nitrate salt waste streams (UNS and RNS, respectively) at Los Alamos National Laboratory (LANL). The two technologies include the addition of zeolite (with and without the addition of water as a processing aid) and cementation. Surrogates were developed to evaluate both the solid and liquid fractions expected from parent waste containers, and both the solid and liquid fractions were tested. Both technologies are shown to be effective at eliminating the characteristic of ignitability (D001), and the addition of zeolite was determined to be effective at eliminating corrosivity (D002), with the preferred option[1] of adding zeolite currently planned for implementation at LANL's Waste Characterization, Reduction, and Repackaging Facility (WCRRF). The course of this work verified the need to evaluate and demonstrate the effectiveness of the proposed remedy for debris material, if required. The evaluation determined that WypAlls, cheesecloth, and Celotex absorbed with saturated nitrate salt solutions exhibit the ignitability characteristic (all other expected debris is not classified as ignitable). Finally, liquid surrogates containing saturated nitrate salts did not exhibit the characteristic of ignitability in their pure form (those neutralized with Kolorsafe and mixed with sWheat did exhibit D001).

Sensitivity testing and an analysis were conducted to evaluate the waste form for reactivity. Tests included subjecting surrogate material to mechanical impact, friction, electrostatic discharge and thermal insults. The testing confirmed that the waste does not exhibit the characteristic of reactivity (D003).

Follow-on testing was conducted to demonstrate the effectiveness of zeolite stabilization for ignitable WypAll and cheesecloth debris and additional nitrate salt solutions (those exhibiting the oxidizer characteristic) to demonstrate the effectiveness of the remedy. Follow-on testing also included testing of surrogate materials containing Waste Lock 770, which is present in four of the RNS containers, and potential items of debris such as plywood and Celotex material. Testing to evaluate the effectiveness of the remedy was performed using the specific remediation processes that are planned for use at the WCRRF. Finally, testing was also performed to evaluate the holding capacity of zeolite using a highly acidic surrogate solution and to characterize the composition of gases generated during mixing of zeolite with surrogate solutions. All these tests demonstrated the effectiveness of adding zeolite as the planned remedy.

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1.0 BACKGROUND

On February 14, 2014, a radiological release occurred at the U.S. Department of Energy Waste Isolation Pilot Plant (WIPP). A breached nitrate salt waste container originating from Los Alamos National Laboratory (LANL) was later identified as the source of the release.[2] The waste container in question, drum 68660, was improperly remediated and contained an ignitable mixture of nitrate salt waste and organic absorbent material (sWheat Scoop kitty litter).

At the time of generation, the damp salt wastes from plutonium recovery operations were packaged in plastic bags, placed in lead-lined containers, and put into storage at LANL until a final disposition path could be identified. In 2012, the remediation path for the nitrate salt waste was identified by the LANL–Carlsbad Office Difficult Waste Team to be the addition of kitty litter/zeolite clay to the nitrate salts within the containers and absorption of liquids in the containers also by kitty litter/zeolite clay. These included containers that had previously been remediated using an absorbent called Waste Lock 770. Therefore, before they were shipped to WIPP, the containers were to be opened in a glovebox, free liquids were to be absorbed with kitty litter/zeolite clay, and the salt material was to be mixed with the absorbent in a ratio that would stabilize the salts. Resulting material was to be repackaged to meet the WIPP waste acceptance requirements. Waste processing of many of these containers was conducted, but the absorbent utilized was an organic kitty litter absorbent instead of the Difficult Waste Team's prescription of kitty litter/zeolite clay, resulting in the generation of an incompatible mixture that led to spontaneous combustion of the waste, as documented through investigation into the WIPP event.[2]

From these waste-processing activities, daughter containers were generated that hold the absorbed liquids, nitrate salts mixed with absorbent, and debris from the parent waste container or as generated from the processing of the waste. Containers remaining at LANL include 27 of the original containers, unremediated nitrate salt (UNS) wastes, as well as 60 containers with remediated, absorbed, and repackaged nitrate salt wastes. Containers of remediated nitrate salt (RNS) and UNS waste are characterized as exhibiting the U.S. Environmental Protection Agency (EPA) Hazardous Waste Number (HWN) D001 for ignitability (both RNS and UNS waste) and D002 for corrosivity (RNS and UNS waste containers with liquids only). Mixed transuranic waste with D001 and/or D002 EPA HWNs cannot be accepted for disposal at WIPP; therefore, both RNS and UNS waste must be treated before certification, shipment, and disposal at that facility.

The stabilization treatment methods that are to be examined for their effectiveness in the treatment of both the UNS and RNS wastes include (1) the addition of zeolite (with and without the addition of water) and (2) cementation. Adding zeolite is proposed (and preferred) based on the results of several previous studies and analyses that specifically examined the effectiveness of this process for deactivating nitrate salts.[3] Cementation is also being assessed because of its prevalence as an immobilization method for similar wastes at numerous facilities around the U.S. Department of Energy (DOE) complex, including at LANL. The results of the treatment study with other testing provided the basis for a request to the New Mexico Environment Department Hazardous Waste Bureau for approval of a Resource Conservation and Recovery Act (RCRA) permit modification for the proposed treatment process and the associated facilities.

The specific purpose of this report is to summarize the testing conducted to validate that the proposed treatment methods are effective at safely removing the EPA HWNs D001 and D002 from both the UNS and RNS wastes. These studies also demonstrated that the proposed volumetric quantities for the mixtures are sufficient to ensure removal of EPA HWNs D001 and D002 (ignitability and corrosivity

characteristics) as required for disposal at WIPP (at a minimum).[*] Appendixes A through E to this report provide the test methods used, and Appendixes F through AA provide detailed information on test results.

Testing was conducted by an independent contract laboratory, Southwest Research Institute (SwRI), located in San Antonio, Texas, using nonradioactive surrogate samples to avoid worker safety risks associated with testing, packaging, and transporting samples of actual radioactive waste materials. Results of SwRI testing are provided in Appendixes F through V. Additional characterization, analysis, and sensitivity testing activities were conducted on-site at LANL and at a second independent contract laboratory, Fauske & Associates, LLC, to evaluate the waste form for reactivity. Tests included subjecting surrogate material to mechanical impact, friction, electrostatic discharge and thermal insults, and are discussed below and in Appendixes W through Z. Results of additional testing of zeolite that will be used for treatment are provided in Appendixes AA and AB. Appendix AC describes the determination of the density of calcium nitrate–saturated solution.

2.0 RNS DRUM COMPOSITION

The RNS wastes were created from the UNS waste stream by mixing absorbents and/or neutralizers with the UNS wastes. The blended waste was placed in a fiberboard-insert liner that was placed inside a plastic bag in the 55-gal. drum. The salt/sWheat blend was placed directly into the fiberboard liner without any protective plastic around the waste. Debris waste was also often placed into the drum with the salt/sWheat mixture. Although the debris was typically placed atop the salt/sWheat blend, frequently the debris is intermingled rather than layered in the drum. Based on real-time radiography (RTR) of the drums, 10 RNS drums are estimated to contain over 50 volume-percent debris, and 21 RNS drums contain 20 volume-percent or more debris waste. Twelve RNS containers consist of 12-in. pipe overpack containers (POCs) inside 55-gal. drums.

Free liquid can also be identified using RTR. All but four of the RTR videos of the RNS drums were taken between September 2013 and April 2014. The other four RTR records are of POCs that were taken in 2011 and 2012. Five RNS drums (at that time) were reported to contain liquid: three contain less than 100 mL and two POCs contain about 2 L outside the containment bag within the POC.

The waste in the RNS container largely consists of the following waste matrixes:

- Homogeneous solids—nitrate salts absorbed with organic kitty litter (sWheat)
- Scrap lead
- Leaded gloves
- Rubber gloves
- Scrap metal
- Plastics—rigid liner, plastic bags, plastic sheeting
- Cardboard/fiberboard liner
- Cellulose

[*] "Basis of Knowledge for Evaluating Oxidizing Chemicals in TRU Waste, Revision 0," DOE/WIPP-17-3589, was issued in July 2017, and our remedy for RNS waste is consistent with the guidelines stated within, making our material WIPP compliant after treatment.

3.0 SCOPE OF WORK

SwRI was contracted to provide qualified personnel, equipment, materials, and facilities to formulate and analyze waste surrogates and treatment options in support of LANL's effort to evaluate RNS waste and to provide insight into the effectiveness of treatment options. This effort included formulating surrogate nitrate salts, preparing nitrate salt solutions, neutralizing and blending the nitrated salts or solutions with Spilfyter Kolorsafe, sWheat kitty litter, zeolite, cement, water, or Waste Lock 770. The effectiveness of cementation as a treatment technology and the addition of zeolite were assessed for surrogate nitrate salt wastes and the blends prepared to simulate treatment to ensure that RCRA characteristics of ignitability (and corrosivity, where applicable) are removed from the waste after treatment. Debris waste found in the drums was also submitted for evaluation and examination of the impact of RNS waste and UNS solution on the behavior of the debris when it undergoes reactivity testing.

The test work at SwRI includes the following areas of focus:

- Preparation of surrogate salt known as WB8 identified in the analysis by Weisbrod et al.[4] and evaluated through testing by Brown, et al.[5] This test work is presented in Section 4.1, and the memorandum summarizing the first round of small-scale testing at LANL is included as Appendix W of this report.
- Preparation of surrogate UNS solution utilizing saturated nitrate solutions derived from Reference 4 and neutralized with Spilfyter Kolorsafe, as discussed in Reference 2. This test work is discussed in Section 4.3.
- Preparation and evaluation of surrogate RNS waste prepared from WB8 salt and sWheat kitty litter to simulate the possible RNS waste material found in the 60 RNS drums to be remediated at LANL. This test work is discussed in Section 6.1.
- Preparation and evaluation of blends composed of surrogate RNS waste and zeolite with and without the addition of water to simulate the remediation of RNS waste by blending with zeolite. This test work is discussed in Section 6.2.
- Preparation and evaluation of blends of surrogate RNS waste mixed with water and cement to simulate the remediation of RNS waste by cementation. This test work is discussed in Section 6.3.
- Preparation and evaluation of blends composed of surrogate UNS solution (prepared from the UNS surrogate solution recipe) and sWheat kitty litter and then blended with zeolite. This test work is discussed in Section 6.4.
- Because testing of the UNS surrogate solution showed that it was not a Class 5 Division 5.1 oxidizer, testing with alternate solution blends with zeolite was performed, including a 65% ammonium nitrate solution that was tested and determined to be a Class 5 Division 5.1 oxidizing liquid. This test work is discussed in Section 6.5.
- Preparation of surrogate debris waste to simulate the debris waste found in the RNS waste drums at LANL and evaluation for D001 characteristic. This test work is discussed in Section 7.1, 7.2, and 7.3 and included testing of processes developed to treat debris waste items such as WypAll rags and cheesecloth that tested as ignitable by blending with zeolite to remove the characteristic of ignitability.
- Preparation of blends of zeolite and UNS surrogate solution prepared with 7 molar nitric acid to evaluate the holding capacity of zeolite for highly acidic solutions, and to determine the

composition of gases that evolved during mixing of zeolite with the surrogate solution. This test work is discussed in Section 6.7 and 6.8.

Sensitivity testing was performed on-site at LANL and at an external laboratory to evaluate the waste form for reactivity. Tests included subjecting surrogate material to mechanical impact, friction, electrostatic discharge and thermal insults. This test work is discussed in Section 6.6.

4.0 TEST MATERIALS

Test materials used in the test work conducted by SwRI are described in this section.

4.1 Surrogate Nitrate Salts—WB8

Nitrate salts were removed from UNS drums, mixed with sWheat, and placed in daughter drums now referred to as RNS drums. The recipe for the surrogate nitrate salt WB8 used in all SwRI nitrate salt blends is presented in Table 1. This nitrate salt recipe is based upon previous test work conducted at LANL[4,5,6] and is discussed as a bounding surrogate in "Technical Basis for the Removal of Unremediated Nitrate Salt Sampling (UNS) to Support LANL Treatment Studies."[7] The material selected is supported by studies that evaluated the sensitivity of RNS waste that used sWheat scoop kitty litter as an absorbent. Previous testing has indicated that at least two factors are critical for ignition of the formulation: (1) the ratio of sWheat scoop kitty litter to the nitrate salt and (2) the concentration of lead salts in the formulation. The ratio of sWheat to salt influences the oxygen balance of the formulation and therefore the thermodynamic ability to combust without added oxygen. Prolonged testing indicated that lead nitrate is a catalyst for the ignition process. The amount of lead actually present in the waste is difficult to estimate precisely because of the complexity of its formation. In addition, heating and partial drying of the materials will result in additional worst-case scenarios: previous testing has indicated the dried material is more thermally sensitive.

Table 1
WB8 Surrogate

Material	Milligrams	Grams	Wt%
$Al(NO_3)_3 * 9\ H_20$	2145	2.145	4.21
$Ca(NO_3)_2 * 4\ H_2O$	8530	8.530	16.73
$Cr(NO_3)_3 * 9\ H_2O$	105	0.105	0.21
$Fe(NO_3)_3 * 9\ H_2O$	3258	3.258	6.39
$Mg(NO_3)_2 * 6\ H_2O$	23939	23.939	46.94
$NaNO_3$	5307	5.307	10.41
$Pb(NO_3)_2$	1884	1.884	3.69
$(COOH)_2 * 2\ H_20$	1936	1.936	3.80
K_2CO_3	1010	1.010	1.98
Water	2886	2.886	5.66

Note: This table presents an example of 51 g of WB8.

The recipe to prepare WB8 surrogate follows these steps:

- The masses of nitrate salt components are measured in a plastic or aluminum weigh-boat or on waxed paper using a balance calibrated to ± 1-mg uncertainty. The quantity of material measured will be within 10 mg of the desired quantity of material.
- The weighed portion of nitrate salts is transferred to a container for mixing.
- Once all of the nitrate salts are measured and placed into the mixing container, they are manually mixed together.
- The mass of oxalic acid dihydrate and potassium carbonate is measured in a plastic or aluminum weigh-boat or on waxed paper using a balance calibrated to ± 1-mg uncertainty. The quantity of material measured is within 10 mg of the desired quantity of material as follows:
    - ❖ Water is measured into a tared glass beaker or Nalgene bottle using a balance calibrated to ± 1-mg uncertainty.
    - ❖ Oxalic acid is added to the water and mixed thoroughly.
    - ❖ Potassium carbonate is added in small increments and stirred between each addition until foaming and bubbling subsides.
    - ❖ Potassium carbonate is added in this fashion until all of it has been added. The solution makes a slurry with a fair amount of undissolved chemical remaining on the bottom.
- The potassium oxalate solution formed above is shaken and added to the mixed nitrate salt and manually mixed.

4.2 Control Salt—Potassium Nitrate (Anhydrous)

Potassium nitrate was used as the control salt to compare the response of WB8 salt and WB8 blends during D001 and D002 testing. Potassium nitrate was selected as a control, primarily because it is a good oxidizer (Packing Group II) and it was previously used as a control in similar studies conducted by Walsh when analyzing stabilization of nitrates by zeolite.[3]

4.3 Surrogate Nitrate Salt Solution—UNS Surrogate Solution

The surrogate nitrate salt solution, “UNS Surrogate Solution,” represents the solution expected within UNS drums and is derived from WB8. This surrogate is a simulant of solution collected when UNS drums were opened and absorbed into sWheat kitty litter during the preparation of the RNS drums. The UNS Surrogate Solution consists of a suite of specified salts presented in Table 2 and mixed with water to dissolve most of the solid salts (remains saturated). This surrogate solution is used to prepare UNS Surrogate Solution blends. UNS Surrogate Solution is then used to blend with sWheat and/or zeolite in various ratios and to simulate the RNS material and the zeolite-blended (remediated) product. It is used as prepared but may also be used after it is neutralized with Spilfyter Kolorsafe to represent the neutralized liquid, as discussed in Reference 1. Section 4.8 provides additional details.

Table 2
UNS Surrogate Solution Salt Recipe

Reagent Chemical	Weight (g)	Weight (%)
$Al(NO_3)_3 * 9\ H_20$	2774.2	46.238
$Ca(NO_3)_2 * 4\ H_2O$	280.2	4.670
$Cr(NO_3)_3 * 9\ H_2O$	20.6	0.342
$Fe(NO_3)_3 * 9\ H_2O$	198.4	3.306
H_2O-HNO_3-Al-Ca-Cr-Fe-Mg-Ni	213.8	3.563
$Mg(NO_3)_2 * 6\ H_2O$	1336.2	22.270
HNO_3	21.2	0.354
$NaNO_3$	164.6	2.742
$Ni(NO_3)_2 * 6\ H_2O$	0.80	0.013
$Pb(NO_3)_2$	198.8	3.314
$(COOH)_2 * 2\ H_20$	791.2	13.188
Total	**6000**	**100.000**

Note: This table presents an example of 6000 g of UNS solution salt.

The recipe to prepare UNS Surrogate Solution follows these steps:

1. The masses of reagent chemicals are measured in a plastic or aluminum weigh-boat or on waxed paper using a balance calibrated to ± 1-mg uncertainty. The quantity of material measured will be within 10 mg of the desired quantity of material.
2. The weighed portion of reagent is transferred to a container for mixing.
3. The salt formulation is then dissolved into water using 0.30 g of water per gram of salt.
4. If the salts do not all dissolve, water is added in 10-mL increments until nearly all the salts are dissolved (about 2% remains).

4.4 sWheat Kitty Litter

The cat litter sWheat Scoop Original (sWheat) is made from wheat and was used in the remediation process that created the RNS waste. The amount of sWheat used was not well documented and as a result was included as a variable to establish the effectiveness of the proposed remedy against the range of materials expected in the RNS waste form.

4.5 Zeolite

KMI zeolite from Sandy Valley, Nevada, was used for the SwRI testing and was provided by LANL from the same lot used in blending-process development tests at LANL. It is one of the highest purity zeolites and has high absorptivity. Test analyses performed by SwRI on the KMI zeolite provided are included in Appendix Q (September 21 and 23, 2016, SwRI emails with test results). Analyses include particle-size distribution, moisture content, and clinoptilolite content. KMI also provided x-ray powder diffraction (XRPD) and total organic carbon (TOC) analyses of zeolite samples and these are provided in Appendix AA (Triclinic Labs, XRPD Measurements for Two Clinoptilolite Zeolites, April 10, 2017) and in

Appendix AB (Nelson Laboratories Total Organic Carbon [TOC]; Wet Oxidation Method Final Report, April 11, 2017).

4.6 Waste Lock 770

Waste Lock 770 is a solid, granular cross-linked polyacrylate material that swells and absorbs many times its weight in aqueous solutions. Waste Lock 770 has been engineered to absorb water under pressure and has properties for the absorption and solidification of low-level radioactive waste and other types of waste sludges.

4.7 Portland Cement

Portland Cement Type I/II is a common or general-purpose cement that also meets the low-heat requirements of Type II cement.

4.8 Spilfyter Kolorsafe

Spilfyter Kolorsafe is a liquid product (triethanolamine is the active chemical) that can adjust the pH of an acidic liquid and change color to indicate the pH of the solution. This neutralizer was used to adjust solution pH in the remediation process that created the RNS waste.

4.9 PIG Acid and Base Neutralizers

Before the use of Spilfyter Kolorsafe, a neutralizing absorbent product named PIG Acid Encapsulating/Neutralizing Absorbent that contains sodium carbonate was available at the WCRRF to adjust the pH of an acidic liquid at the time that nitrate salt waste containers were remediated with sWheat kitty litter. In addition, a neutralizing absorbent product named PIG Base Encapsulating/Neutralizing Absorbent that contains citric acid was also available at the WCRRF to adjust the pH of a basic liquid at the time the nitrate salt waste containers were remediated with sWheat kitty litter and may have been used to adjust solution pH in the remediation process that created the RNS waste. While it is unlikely that the product containing citric acid was used because the pH of nitrate salt solutions was usually very low (acidic), testing of surrogate solutions containing citric acid (as well as the sodium carbonate solutions) were included for completeness.

4.10 RNS Waste Debris

The RNS waste drums contain debris typically composed of plastic, cardboard, rubber gloves, WypAll rags, and lead. Some drums may also contain debris composed of cheesecloth, plywood, and Celotex material.

5.0 SAMPLE TESTING

5.1 SW-846 Test Method 1030

SW-846 Test Method 1030 is used to help identify those solids that are “capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burn[s] so vigorously and persistently that it creates a hazard” [40 Code of Federal Regulations 261.21(a) (2)]. It is appropriate for pastes, granular material, solids that can be cut into strips, and powdery substances. The test method is described in Appendix A.

5.2 SW-846 Test Method 1050

SW-846 Test Method 1050 provides a test procedure that may be used to evaluate and categorize liquid and solid wastes that are likely to self-heat or spontaneously combust. The test method is described in Appendix B.

5.3 United Nations O.1 Test for Oxidizing Solids

United Nations (UN) O.1 is designed to measure the potential for a substance to increase the burning rate or burning intensity of a combustible substance when the two are thoroughly mixed. Tests are conducted on the substance to be evaluated mixed with dry fibrous cellulose in ratios of 1:1 and 4:1 by mass of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture by mass of potassium bromate to cellulose. If the burning time is equal to or less than the standard mixture, the burning times are compared with those from the Packing Group I or II reference standards. The test method is described in Appendix C.

5.4 UN O.2 Test for Oxidizing Liquids

UN O.2 is designed to measure the potential for a liquid substance to increase the burning rate or burning intensity of a combustible substance when the two are thoroughly mixed or to form a mixture that spontaneously ignites. The liquid is mixed in a 1:1 ratio by mass with fibrous cellulose and heated in a pressure vessel while the rate of pressure rise is determined. The test method is discussed in Appendix D.

5.5 Test Method 9095B (Paint Filter)

Test Method 9095B is used to determine the presence of free liquids in a representative sample of waste. The test method is discussed in Appendix E.

5.6 Sensitivity Testing

In addition to the ignitability and corrosivity testing described above, sensitivity tests that included Drop Weight Impact, Friction, and Electrostatic Discharge were conducted to evaluate the surrogate's sensitivity to mechanical impact, friction, and spark, and whether the D003 characteristic is applicable to the waste. Sensitivity testing descriptions are outlined in PLAN-TA9-2443 Rev B, Attachment B.[5] In addition, and based on the recommendations of the LANL Explosives Review Committee (ERC), an external laboratory was utilized to conduct testing to evaluate the sensitivity of the material to thermal insults. Tests included the UN DOT Explosive Test Series 1b (Koenen test) and 1c (Time/Pressure test) to evaluate the thermal sensitivity of the surrogates in support of our hazardous waste determination.

6.0 RNS AND UNS WASTE BLEND TESTS

6.1 Surrogate Waste Blends to Simulate RNS and UNS Waste (Blends 1–8, 25)

Nitrate salt and sWheat blends are composed of a WB8 salt or control salt and sWheat. WB8 and the control salt are blended with sWheat in various ratios to simulate the blended nitrate salt material found in RNS drums. The compositions for the surrogate mixtures and the test results from D001 testing are presented in Table 3. The blends were prepared as follows:

1. The appropriate volume of sWheat Scoop kitty litter is transferred to the mixing container (4-L Nalgene bottle).
2. The appropriate volume of WB8 salt or control salt is measured and added to the mixing container and mixed manually.
3. The sWheat scoop kitty litter and salt mixture are heated at an external temperature of 60°C for 16 h in the Nalgene bottle with the cap attached but not securely closed.

Table 3
Surrogate Waste and Test Results

Blend No.	Blend Compositions			Test Results		
	KNO_3 (g)	WB8 Salt (g)	Salt:sWheat Volume Ratio	SW-846 Test Method 1030	SW-846 Test Method 1050	UN O.1 Testing
Blend 1	50	0	1:0	n/a*	n/a	Packing Group II
Blend 2	50	0	1:1	Nonflammable	Not self-heating	Packing Group III
Blend 3	50	0	1:3	Nonflammable	Not self-heating	Not Div. 5.1
Blend 4	50	0	1:4	Nonflammable	Not self-heating	Not Div. 5.1
Blend 5	0	50	1:0	n/a	n/a	Packing Group III
Blend 6	0	50	1:1	Nonflammable	Packing Group III	Not Div. 5.1
Blend 7	0	50	1:3	Nonflammable	Not self-heating	Not Div. 5.1
Blend 8	0	50	1:4	Nonflammable	Not self-heating	Not Div. 5.1
Blend 25	0	50	1:0.5	Nonflammable	Packing Group III	Packing Group II

*n/a = Not applicable.

Details of sample preparation and the testing of Blends 1–8 are included in Appendix F (December 22, 2015, SwRI test report). Blend 25 can be found in Appendix G (January 26, 2016, SwRI test report). It should be noted that the WB8 salts are less oxidizing than KNO_3 (Packing Group II versus Packing Group III) yet create self-heating materials when mixed with sWheat, whereas neat KNO_3 does not.

6.1.1 Surrogate Waste Test Results

As identified in Table 3, neat nitrate salts are good oxidizers (Blends 1 and 5), and when mixed with sWheat in ratios of 1:1 or greater, exhibit the characteristic of ignitability (WB8 fails the 1050 test and KNO_3 fails the UN O.1 test). It is interesting to note that at higher concentrations of sWheat, the material would not be considered ignitable based on these tests (fuel rich materials). Because it is not clear what concentration of sWheat was used in the remediation process, the use of sWheat with nitrates supports application of HWN D001 to this waste form. However, estimates of sWheat to salt ratio in drum 68660 were found to be closer to 1:1, consistent with the most reactive materials identified here.[5]

6.2 Surrogate Blends with Zeolite (Blends 9–24)

Blending waste surrogates with zeolite was assessed for effectiveness to remove the D001, ignitable, designation from the RNS waste.

The surrogate wastes prepared for testing and presented in Table 4 were mixed with zeolite and evaluated to understand the effect on ignitability, spontaneous combustion, and oxidizer testing. Recipes tested for zeolite blending with the surrogate RNS waste (Blends 9–13) include volume ratios of 1:0, 1:1,

1:3, and 1:4 salt to sWheat at constant zeolite addition (3:1 zeolite:RNS). KMI zeolite, 100% multipurpose zeolite (14 × 40 mesh), was used in the testing. Zeolite was manually mixed with the waste surrogate mixtures outlined in Table 4. The blends were then allowed to set for 24 h before tests were performed.

Table 4
Blending Recipes for Surrogates

Blend No.	Surrogate Waste Composition			Zeolite Blend Recipe (S/S = salt/sWheat)		Test Results			
	KNO_3 (g)	WB8 Salt (g)	Salt:sWheat Volume Ratio	Water:(S/S) Volume Ratio	Zeolite:(S/S) Volume Ratio	SW-846 Test Method 1030	SW-846 Test Method 1050	UN O.1 Testing	Paint Filter Test Method 9095B
Blend 9	50	0	1:0	n/a*	3:1	n/a: Salt	n/a: Salt	Not Division 5.1	No water added
Blend 10	0	50	1:0	n/a	3:1	n/a: Salt	n/a: Salt	Not Division 5.1	No water added
Blend 11	0	50	1:1	n/a	3:1	Nonflammable	Not self-heating	Not Division 5.1	No water added
Blend 12	0	50	1:3	n/a	3:1	Nonflammable	Not self-heating	Not Division 5.1	No water added
Blend 13	0	50	1:4	n/a	3:1	Nonflammable	Not self-heating	Not Division 5.1	No water added
Blend 14	0	50	1:1	1:1	6:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 15	0	50	1:3	1:1	6:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 16	0	50	1:4	1:1	6:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 17	0	50	1:1	1:1	4:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 18	0	50	1:3	1:1	4:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 19	0	50	1:4	1:1	4:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 20	0	50	1:1	0.5:1	3:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 20R	0	50	1:1	0.5:1	2:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 21	0	50	1:3	0.5:1	3:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 21R	0	50	1:3	0.5:1	2:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 22	0	50	1:4	0.5:1	3:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 22R	0	50	1:4	0.5:1	2:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 23	0	50	1:0.5	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 24	0	50	1:0.5	0.5:1	3:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids

*n/a = Not applicable.

The addition of water before the addition of zeolite is expected to be beneficial to the blending process as well as reduce the amount of salt (oxidizer) available for the organic sWheat. The intent is to blend the salt/sWheat mixture with water before it is blended with zeolite. Recipes tested for zeolite blending with the surrogate RNS waste (with water) include volume ratios of 1:0.5, 1:1, 1:3, and 1:4 salt to sWheat with water added at ratios of 0.5:1 and 1:1, and zeolite to RNS waste ratios addition of 6:1, 4:1, 4.5:1, 3:1, and 2:1.

Blends 14 through 24 represent those in which water was added to the surrogate waste before it was mixed with zeolite. These blends were prepared as follows:

1. 50 g of the WB8 salt was blended with sWheat kitty litter in the ratios identified in column labeled "Salt:sWheat Volume Ratio" in Table 4 and allowed to rest for 24 h.
2. Once the salt and sWheat blend has rested, it was mixed with an equal volume of water for 5 min using a mechanical agitator at 500 revolutions per minute (rpm).
3. After the mixture agitated for 5 min, zeolite was added and hand mixed into the solution. The blend was allowed to rest for 24 h before evaluation tests were performed.

Details of sample preparation and the testing of Blends 9 through 24 are presented in Appendix F (December 22, 2015, SwRI test report) and in Appendix G (January 26, 2016, SwRI test report). UN O.1 test for Blend 9 was rerun to verify the initial positive results were incorrect and are reported in Appendix I (March 3, 2016, SwRI test report).

6.2.1 Zeolite Blending Test Results

As noted in Table 4, the addition of zeolite in ratios of 2:1 or greater was effective in eliminating the characteristics of ignitability and corrosivity (eliminates liquids). The process was also effective for all blends involving the addition of zeolite using water as a processing aid (the preferred approach as established in Reference 8), demonstrating the robustness of this approach. (Note that Blends 9 and 10 represent solid component for UNS, and Blends 11 through 24 represent solid component for RNS blends.) This result is not surprising given the test results identified in Reference 3, in which zeolite was effective at eliminating the oxidizing potential of nitrates at ratios as low as 1.2:1. Thus, stabilization using zeolite is effective at eliminating D001 and D002 from salt/sWheat mixtures. Its effectiveness for liquids absorbed using sWheat is discussed in Section 6.4.1.

Zeolite to waste ratios greater than 3 were incorrectly prepared by the contractor. The corrected zeolite ratios for the intended blends are denoted as Blends 20R, 21R, 22R in Table 4. Details of testing of the corrected zeolite blend ratios are presented in Appendix R (December 22, 2016, SwRI test report).

6.3 Cementation of Surrogate Blends (Cmnt 6–15)

Cementation (Cmnt) was the other primary treatment option identified and recommended in the Options Assessment Report[1] and reviewed for implementation at LANL in the Engineering Options Assessment Report.[8] Testing of cementation recipes at the bench scale at LANL and identified in the Engineering Options Assessment Report were examined and evaluated at SwRI.

The first five formulations (Cmnt 1–5) were prepared and had problems with the formulation and setting of the cement. Based upon these observations, the preparation instructions were changed and the tests were modified to ensure that the cement set properly.

A total of 10 cementation tests were conducted. Surrogate blends for cementing the surrogate waste with Type I/II Portland cement are shown in Table 5. All the formulations with sWheat maintain a 4:1 water-to-sWheat mass ratio. Testing at LANL previously used a 3.5:1 water-to-sWheat mass ratio. A higher ratio was used to reduce the amount of RNS waste in the cemented product and to ensure better remediation performance. The water-to-cement mass ratio for the tests ranged from 0.5:1 to 0.75:1. The lower ratio should provide a stronger, drier material.

Table 5
Cement Recipes and Reactivity Results for Cementation Tests

Cement Mix Number	RNS Surrogate Waste Composition[a]				Cement Formulation			Test Results		
	KNO_3 (g)	WB8 (g)	sWheat (g)	Salt:sWheat Ratio[b]	Water (g)	Cement (g)	Water: Cement Ratio[b]	SW-846 Test Method 1030	SW-846 Test Method 1050	UN O.1 Testing
Cmnt 6	130	0	0	n/a[c]	373	495	0.75:1	Nonflammable	Not self-heating	Not Div 5.1
Cmnt 7	0	130	0	n/a	373	495	0.75:1	Nonflammable	Not self-heating	Not Div 5.1
Cmnt 8	0	225	75	3:1	300	400	0.75:1	Nonflammable	Not self-heating	Not Div 5.1
Cmnt 9	0	88	88	1:1	352	470	0.75:1	Nonflammable	Not self-heating	Not Div 5.1
Cmnt 10	0	68	91	0.75:1	364	485	0.75:1	Nonflammable	Not self-heating	Not Div 5.1
Cmnt 11	0	82	82	1:1	328	504	0.65:1	Nonflammable	Not self-heating	Not Div 5.1
Cmnt 12	0	72	72	1:1	288	576	0.5:1	Nonflammable	Not self-heating	Not Div 5.1
Cmnt 13	0	212	70	3:1	282	432	0.65:1	Nonflammable	Not self-heating	Not Div 5.1
Cmnt 14	0	63	84	0.75:1	336	517	0.65:1	Nonflammable	Not self-heating	Not Div 5.1
Cmnt 15	0	80	80	1:1	320	530	0.60:1	Nonflammable	Not self-heating	Not Div 5.1

[a] Water-to-sWheat mass ratio = 4:1 for all test mixes.

[b] Mass ratio.

[c] n/a = Not applicable.

Salt or the WB8 surrogate and sWheat in the amounts identified in the Table 5 were mixed together and allowed to dry for 16 h at a temperature of 60 to 65 °C. The dried salt/sWheat mixture was then combined with water, the pH adjusted to a solution pH of 9–11 with NaOH, and mixed with Type I/II Portland cement in a high-shear mixer at about 750 rpm until the cement and waste were well blended.

The cement mixtures were placed in a 32-oz container to set and covered with a plastic lid with a small hole for ventilation. The following observations were made every 24 h, starting 24 h after the mixture was placed in the plastic container:

1. Exterior surface temperature taken at the bottom of the container
2. Picture of the top surface of the mortar in the container
3. Penetrometer (Humboldt H-4134) reading of the top surface of mortar sample

The samples were allowed to cure for 10 d at ~22 °C before testing. The set material was crushed to less than 10 mesh and submitted for SW-846 and UN O.1 tests. Reactivity test results for each cement mix are presented in Table 5. Penetrometer and exterior surface temperature readings for each cement mix are included in Appendix G (January 26, 2016, SwRI test report).

Details of sample preparation and the testing of cement mixes Cmnt 6–15 are presented in Appendix G (January 26, 2016, SwRI test report).

6.3.1 Cementation Results

The results of stabilization with cement are presented in Table 5. In all cases, stabilization was demonstrated to remove the D001 characteristic for this material. Discussions with transuranic waste experts around the complex indicated cementation is not a desirable means of treatment because of potential problems associated with dewatering and void generation within the material. Given the results derived by using zeolite, the option of cementation will not be pursued further.

6.4 UNS Surrogate Solution and Blends with sWheat to Simulate RNS Waste (UNS Blends 1–20)

Blending UNS Surrogate Solution with zeolite was assessed for remedy effectiveness. This Surrogate Solution simulates the free liquid found in the UNS drums and absorbed into sWheat kitty litter during the preparation of the current set of RNS drums located at LANL. The sWheat blends described in this section represent material found in RNS drums.

Because processing at WCRRF often involved neutralizing liquids using Spilfyter Kolorsafe, some of the blend recipes require the addition of Spilfyter Kolorsafe to neutralize the pH of the UNS Surrogate Solution before it is mixed with sWheat to create a representative surrogate. For these formulations, Spilfyter Kolorsafe liquid acid neutralizer addition is added to achieve an apparent pH ~of 4 to 9 as measured with Hydrion pH paper.

In addition to the RNS waste processed with sWheat, four containers were processed with Waste Lock 770 to absorb the free liquids from UNS parent containers. Testing using Waste Lock 770 is included here to establish the effectiveness of adding zeolite to these materials to eliminate the ignitability and corrosivity characteristics.

The UNS Surrogate Solution (pH adjusted if called for) and the sWheat or Waste Lock 770 were combined in a beaker and mixed with a spatula for 2 min to absorb the solution. After resting for 1 d, the salt/sWheat mix was blended with water and/or zeolite according to the blend recipe. The blend composition and test results for the UNS surrogate solution blends are presented in Table 6.

Details of preparation of the samples for UNS Blends 1–14, 16, and 18 and the testing for all except UNS Blends 1 and 14 are included in Appendix H (February 3, 2016, SwRI test report). Details of the testing for UNS Blends 1 and 14 are included in Appendix K (March 29, 2016, SwRI test report), and details of the testing for UNS Blends 19 and 20 are presented in Appendix N (June 29, 2016, SwRI test report).

Table 6
UNS Surrogate Solution and Blend Recipes Test Results

	UNS Blend Formulation					Test Results				
Blend ID	UNS Sol (mL)	sWheat (mL)	Waste Lock 770 (mL)	Water:Waste (Volume Ratio)	Zeolite:Waste (Volume Ratio)	SW-846 Test Method 1030	SW-846 Test Method 1050	UN O.1 Testing	UN O.2 Testing	Paint Filter Method 9095B
UNS Blend 1	50	0	0	0	0	n/a[a]: Solution	n/a:Solution	n/a: Solution	Not Div 5.1	n/a: Solution
UNS Blend 2	50	50	0	0	0	Nonflammable	DOT[b] Packing Grp III	Not Div 5.1	n/a	No free liquids
UNS Blend 3	50	150	0	0	0	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 4	50[c]	50	0	0	0	Nonflammable	DOT Packing Grp III	Not Div 5.1	n/a	No free liquids
UNS Blend 5	50[c]	150	0	0	0	Nonflammable	DOT Packing Grp III	Not Div 5.1	n/a	No free liquids
UNS Blend 6	50	50	0	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 6a	50	50	0	0.5:1	2:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 7	50	150	0	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 7a	50	150	0	0.5:1	2:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 8	50[c]	50	0	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 8a	50	50	0	0.5:1	2:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 9	50[c]	150	0	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 9a	50	150	0	0.5:1	2:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 10	50	50	0	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 11	50	150	0	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 12	50[c]	50	0	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 13	50[c]	150	0	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 14	50	0	3.12	0	0	n/a: Solution	n/a: Solution	n/a: Solution	Not Div 5.1	n/a: Solution
UNS Blend 16	50	0	3.12	0	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 18	50	0	3.12	0	2:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 19	100[d]	50	0	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
UNS Blend 20	100[e]	50	0	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids

[a] n/a = Not applicable.

[b] DOT = U.S. Department of Transportation.

[c] pH-adjusted solution (Spilfyter Kolorsafe).

[d] pH-adjusted solution (citric acid): 50 mL of UNS Surrogate Solution and 50 mL of PIG base neutralizer.

[e] pH-adjusted solution (sodium carbonate): 50 mL of UNS Surrogate Solution and 50 mL of PIG acid neutralizer.

6.4.1 Discussion of UNS Liquid Surrogate Testing

As Table 6 indicates, almost all the liquid surrogate/sWheat mixtures, except for Blend 3, exhibited the characteristic of ignitability through failure of the SW-846 Test Method 1050 test and are classified as self-heating solids. The data indicated that while UNS Blend 2 did not exceed 200 °C, the material expanded significantly and when the expanded product was dissected, it showed charred regions, indicating temperatures greater than 200 °C. The test was rerun using the smaller volume (25-mm cube versus 100-mm cube). The material expanded but the temperature did not exceed 200 °C. It showed no signs of charring after dissection and the material was therefore categorized as a DOT Packing Group III solid (as opposed to DOT Packing Group II). Addition of Spilfyter Kolorsafe led to materials that yielded temperatures in excess of 700 °C in the 1050 test, demonstrating increased chemical reactivity of the acidic salt solutions when neutralized with triethanolamine. The addition of zeolite and use of water as a processing aid demonstrated the elimination of both the ignitability (D001) and corrosivity (D002) characteristics for the surrogate liquid and demonstrated the effectiveness of this stabilization method for these waste forms. Material was not tested without the addition of water because water used as a processing aid was identified before these tests were executed and was determined to be the optimum processing option as discussed in Reference 8. Finally, it was noted that the surrogate solutions did not exhibit the characteristic of ignitability as oxidizers. Additional samples with oxidizing nitrate liquids were prepared and tested to verify the effectiveness of the proposed remedy, and the results are presented in Section 6.5.

Zeolite to waste ratios greater than 3 were incorrectly prepared by the contractor. The corrected zeolite ratios for the intended blends are denoted as 6a, 7a, 8a, and 9a in Table 6. Details of testing of the corrected zeolite-blend ratios are presented in Appendix R (December 22, 2016, SwRI test report).

6.5 Alternate Solution Blends

The UNS surrogate solution of the composition found in Table 2 was not identified as a Class 5 Division 5.1 oxidizer (UNS Blend 1). Consequently, further testing to evaluate the impact of zeolite treatment on the solution was not required. To further examine the effectiveness of zeolite treatments of (1) UNS solutions as well as (2) sWheat mixed with UNS solution, a known Class 5 Division 5.1 liquid oxidizer was evaluated. In the first attempt, a saturated sodium nitrate solution was prepared for these tests. A 45-wt% solution of sodium nitrate was expected to be a Packing Group III Class 5 Division 5.1 oxidizer[9]. Therefore, a saturated sodium nitrate solution is expected to be a more conservative solution than the liquids in the UNS containers. However, it was determined later that 45-wt% sodium nitrate solution should not be categorized as a Division 5.1 oxidizer.[12]

Three nitrate solution formulations were prepared:

- An acidic formulation using 1-molar nitric acid and adding sodium nitrate salt until the solution is saturated and salt will no longer dissolve.
- A basic formulation using 1-molar sodium hydroxide and adding sodium nitrate salt until the solution is saturated and salt will no longer dissolve.
- An acidic formulation that is pH adjusted using Spilfyter Kolorsafe to adjust the pH. This formula was achieved by splitting the well-mixed saturated nitric acid sodium nitrate salt solution in half, resulting in two containers with equal volumes. Half the solution is pH-adjusted with Spilfyter Kolorsafe liquid acid neutralizer to an apparent pH of ~4–9, as measured with Hydrion pH paper. This solution was used for all blend formulations that specified “Neutralized Kolorsafe UNS Liquid.”

These nitrate solutions were then blended with zeolite (Table 7) using a step wise blending approach:

Step 1: Combine the solution and the sWheat in a beaker and mix with a spatula for 2 min to absorb the solution. Let the mixture set for 1 d.

Step 2: After the solution rests for 1 d, add water to the beaker and mix with a spatula for 2 min.

Step 3: Immediately after mixing the water into the mixture, add the zeolite and mix with a spatula for 2 min. Wait 24 h for mixture to set before testing.

The following blends required only the addition of zeolite:

- Sod Nit A - Zeo 1 & 2
- Sod Nit B – Zeo 1 & 2
- Sod Nit A pH – Zeo 1 & 2

Table 7
Alternate Solution Blend Recipes and Test Results

Blend ID	$NaNO_3$ Blend Formulations						Test Results				
	Waste Composition				Additives						
	$NaNO_3$ Acidic (mL)	$NaNO_3$ Basic (mL)	$NaNO_3$ pH Adj. (mL)	sWheat (mL)	Water Vol Ratio H_2O Waste	Zeolite Vol Ratio Zeo Waste	SW-846 Test Method 1030	SW-846 Test Method 1050	UN O.1 Testing	UN O.2 Testin	Paint Filter Test Method 9095B
Sod Nit A	50	0	0	0	0	0	n/a*: Solution	n/a: Solution	n/a: Solution	Not	n/a: Solution
Sod Nit A	50	0	0	0	0	0	n/a: Solution	n/a: Solution	n/a: Solution	Not	n/a: Solution
Sod Nit A-Zeo1	50	0	0	0	0	2:1	No Test	No Test	Not Div 5.1	n/a	No free liquids
Sod Nit A-Zeo2	50	0	0	0	0	3:1	No Test	No Test	Not Div 5.1	n/a	No free liquids
Sod Nit B	0	50	0	0	0	0	n/a: Solution	n/a: Solution	Not Div 5.1	Not	n/a: Solution
Sod Nit B-Zeo1	0	50	0	0	0	2:1	No Test	No Test	Not Div 5.1	n/a	No free liquids
Sod Nit B-Zeo2	0	50	0	0	0	3:1	No Test	No Test	Not Div 5.1	n/a	No free liquids
Sod Nit A pH	0	0	50	0	0	0	n/a: Solution	n/a: Solution	n/a: Solution	Not	n/a: Solution
Sod Nit A pH -	0	0	50	0	0	2:1	No Test	No Test	Not Div 5.1	n/a	No free liquids
Sod Nit A pH-Zeo2	0	0	50	0	0	3:1	No Test	No Test	Not Div 5.1	n/a	No free liquids
Sod Nit A & sWheat	50	0	0	50	0	0	Nonflammable	DOT Packing Grp III	DOT Packing Grp II	n/a	n/a
Sod Nit A Blend 1	50	0	0	50	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
Sod Nit A Blend 2	50	0	0	150	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
Sod Nit A Blend 3	50	0	0	50	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
Sod Nit A Blend 4	50	0	0	150	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
Sod Nit B & sWheat	0	50	0	50	0	0	Nonflammable	Not self-heating	DOT Packing Grp II	n/a	n/a
Sod Nit B Blend 1	0	50	0	50	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
Sod Nit B Blend 2	0	50	0	150	0.5:1	3:1	Nonflammable	n/a: Solution	Not Div 5.1	n/a	No free liquids
Sod Nit B Blend 3	0	50	0	50	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
Sod Nit B Blend 4	0	50	0	150	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
Sod Nit A pH & sWheat	0	0	50	50	0	0	Nonflammable	Not self-heating	DOT Packing Group III	n/a	n/a
Sod Nit A pH	0	0	50	50	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
Sod Nit A pH	0	0	50	150	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
Sod Nit A pH	0	0	50	50	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids
Sod Nit A pH	0	0	50	150	0.5:1	4.5:1	Nonflammable	Not self-heating	Not Div 5.1	n/a	No free liquids

*n/a = Not applicable.

Details of sample preparation and testing of the sodium nitrate solutions and blends are presented in Appendix L (June 27, 2016, SwRI test report 598447); Appendix O (July 5, 2016, SwRI test report); and Appendix R (December 22, 2016, SwRI test report).

6.5.1 Alternate Blend Testing

As noted above, 45-wt% sodium nitrate has previously been categorized as an oxidizing liquid. However, surprisingly, the 45-wt% did not exhibit oxidizing behavior when tested using the UN DOT O.2 protocol. Subsequent discussions with the contractor indicated a comprehensive study had been executed in 2011[12] with a conclusion that 45-wt% sodium nitrate should not be considered an oxidizing liquid. As a result, after further discussions with the contractor, it was decided that additional materials, considered Class 5 Division 5.1 PG III oxidizers (see below), needed to be evaluated. Interestingly, while the liquid was not categorized as oxidizing by the test, when mixed with the sWheat, the resulting product is an ignitable solid (see tests with sWheat and no zeolite) with all three liquids (acidic sodium nitrate, basic sodium nitrate, and acid-neutralized sodium nitrate) categorized as self-heating solids as well as oxidizers. In all cases, the remedy was demonstrated as effective in removing the hazardous characteristics.

A 65-wt% solution of ammonium nitrate was tested and determined to be a Class 5 Division 5.1 oxidizing liquid. This solution was then blended with two volumetric ratios of zeolite to evaluate the effectiveness of zeolite in eliminating the oxidizing characteristic.

The 65-wt% ammonium nitrate solution was prepared by dissolving 650 g of ammonium nitrate in 350 g of deionized water to a final weight of 1000 g of solution. The samples were prepared by blending 200 mL of solution with 400 mL of zeolite to form a sample with 1:2 volumetric ratio of solution to zeolite, and blending 200 mL of solution with 600 mL of zeolite to form a sample with a 1:3 volumetric ratio of solution to zeolite. The blends were allowed to set for 24 h before analysis. The results of the UN O.1 and UN O.2 testing are shown in Table 8. Details of the sample preparation and testing for the ammonium nitrate solution and blends are included in Appendix S (February16, 2017, SwRI test report).

Table 8
Ammonium Nitrate Solution Test Results

Sample ID	Test Results	
	UN O.1 Testing	UN O.2 Testing
65% Ammonium Nitrate	n/a*	Packing Group III
65% Ammonium Nitrate—Zeo 1 (1:2)	Not Div 5.1	n/a
65% Ammonium Nitrate—Zeo 2 (1:3)	Not Div 5.1	n/a

*n/a = Not applicable.

The results of the testing demonstrate that zeolite is effective at ratios of 1:2 and a 1:3 in eliminating the oxidizing characteristic of the 65-wt% ammonium nitrate solution.

6.6 Sensitivity Test Results

While the particle size and nitration levels of these materials precludes them from exhibiting detonable behavior, it was recognized that they could possibly react rapidly and be “capable of detonation or ***explosive reaction*** if it is subjected to a strong initiating source or if heated under confinement (emphasis added).” To evaluate this possibility testing was conducted to evaluate the sensitivity of the

surrogates to mechanical impact, friction, spark, and thermal insults. The testing is used to assess the reactivity of materials to exhibit violent reaction when insulted, and can be used to support the evaluation as to whether the characteristic of reactivity (D003) is applicable to the waste stream. The tests were conducted using a range of RNS and UNS blends, including UNS blends that incorporated neutralization by triethanolamine (generating triethanolamine nitrate) to evaluate the effect of this energetic material on the sensitivity of the UNS:sWheat mixtures.

Drop Weight Impact, Friction, and Electrostatic Discharge testing for RNS Blends with variable sWheat and lead concentrations was conducted to assess mechanical, frictional, and static sensitivity. The testing procedure can be found in Reference 5, with results of the first-round of RNS surrogate testing in Appendix W and the results for UNS Blends neutralized with Kolorsafe (which contains triethanolamine) in Appendixes X (WX-7-AC-51933 Analytical Laboratory Report) and Y (WX-7-AC-52528 Analytical Laboratory Report). Triethanolamine nitrate was also tested and results are also in Appendix X.

RNS surrogates were evaluated for thermal sensitivity using the UN DOT Explosive Test Series 1b (Koenen test) and 1c (Time/Pressure test). The testing was conducted by Fauske & Associates, LLC and documented in a summary of the analysis of the results in Appendix Z.

6.6.1 Drop Weight Impact (DWI) Testing

No RNS surrogates showed any impact sensitivity in any round of testing. Each one showed 15 consecutive No-Go responses when the test weight was dropped from 320 cm. Note that all internal standards showed expected behavior.

6.6.2 Friction Testing

No RNS surrogates showed any friction sensitivity in any round of testing. Each one showed 15 consecutive No-Go responses with the largest weight at the full extent of the lever arm. Note that all internal standards showed expected behavior.

6.6.3 Electrostatic Discharge (ESD) Testing

The RNS surrogates showed some spark sensitivity in all rounds of testing but there were no trends with sWheat content or lead content. Spark sensitivity is not unexpected in samples that have a volatile fraction, and even the insensitive explosive triaminotrinitrobenzene (TATB) exhibits weak ESD sensitivity. In the ESD sample holder, the sample is confined and any reactive gases are trapped until the probe needle discharges through the holder, causing the volatile head space to react. Note that all internal standards showed expected behavior.

6.6.4 UN DOT Explosive Test Series 1b (Koenen test) and 1c (Time/Pressure test)

For thermal testing involving the UN DOT Explosive Test Series 1b (Koenen test) and 1c (Time/Pressure test), a matrix for the testing protocol was developed to evaluate mixtures that were derived from both solid and liquid nitrate salt surrogates (with and w/o neutralization) mixed with sWheat. For the solid RNS surrogates, ratios of salt to sWheat were chosen to maximize 1) chemical reactivity and 2) energy output. A 3:2 salt to sWheat ratio is approximately stoichiometric (oxidizer:fuel) and is expected to yield maximum energy output. However, the RNS waste is expected to have ratios of salt:sWheat that vary between 1:1 and 1:3, based on the remediation process that was in place at the time the RNS waste was created. As a result, testing was also conducted with the 1:1 ratio, which has an expected lower thermal onset behavior then the 3:1 ratio material, based on the trends identified in Reference 5.

As a result of the sensitivity and thermal testing, we have determined that reactivity (D003) is not a characteristic of the RNS Waste.

6.7 Zeolite Liquid Holding Tests

KMI zeolite from Sandy Valley, Nevada was evaluated to determine the amount of surrogate UNS liquid it is capable of holding.

KMI zeolite was mixed with UNS surrogate solution prepared as described in section 4.3 (see Table 2) but prepared with 7 molar nitric acid solution instead of water. Various volumetric ratios of solution and zeolite were blended together and then placed atop a 325 mesh screen with a pan below. The screen with the wetted zeolite and the pan were placed in a plastic bag and observed for 2 weeks. The amount of water that drained from the wetted zeolite and caught on the pan was then weighed. The blend information and the amount of water that reported to the pan is presented in Table 9.

Table 9

Zeolite Surrogate Solution Holding Test Results

Blend ID	Solution : Zeolite Vol Ratio	Water on Drain Pan (g)
UNS/Zeo 1	1:2	31.09
UNS/Zeo 2	1:3	1.54
UNS/Zeo 3	1:4	<0.01
UNS/Zeo 4	1:5	<0.01

The addition of zeolite in a volumetric ratio of at least 1:4 (solution to zeolite) results in no loss of liquid over a two week period. The surrogate solution consisted of 7 molar nitric acid with salts added to saturation. This highly acidic surrogate solution was used to ensure nitric acid salt solution does not reduce the holding capacity of the zeolite.

Details of sample preparation and testing of the zeolite holding tests are presented in Appendix U (August 1, 2017, SwRI test report).

6.8 Zeolite Gas Generation Tests

Gas was observed evolving during testing of the holding capacity of surrogate solutions with zeolite. Tests were initiated to determine the amount and type of gas that was being evolved. Zeolite was added to surrogate liquid used for the Liquid Holding Tests as described in Section 6.7 and the gas that evolved was collected and analyzed. One liter of acidic surrogate solution was added to one liter of zeolite in a one-gallon autoclave vessel that had been purged with nitrogen, evacuated, and sealed. Liquid was added using a pump with a check valve so that no air was introduced during addition of the liquid. Both pressure and temperature were measured and recorded. Approximately 1.5 liter of gas was then recovered from the autoclave and analyzed for hydrogen, oxygen, carbon dioxide, carbon monoxide, nitrogen, and nitrogen oxides. Results of analyses of gas recovered in the testing are shown in Table 10. The composition of the evolved gas other than nitrogen was nearly 100% carbon dioxide, likely derived from carbonate contaminants in the zeolite. Results sum to greater than 100% due to uncertainty associated with the measurements.

Table 10

Zeolite Gas Evolution Composition

Gas	Vol %
Hydrogen	<0.5
Oxygen	<1.0
Nitrogen	50.1
Carbon Dioxide	52.1
Carbon Monoxide	<1.0
NOx	0.12

Details of sample preparation and testing of the zeolite gas generation tests are presented in Appendix U (August 1, 2017, SwRI test report).

7.0 DEBRIS TESTING

The RNS waste drums contain debris typically composed of plastic, cardboard, rubber gloves, rags, and lead. It is unclear if the debris that has comingled with RNS waste should carry the D001 code as an ignitable waste. To examine this aspect of the waste stream, various tests were performed. Samples of the debris types commonly found in RNS waste drums were subjected to environments that simulate the conditions in the RNS drums and were tested to determine how they respond to SW-846 Test Methods 1030 and 1050. The debris waste evaluated included cardboard liner, plastic bags, rubber gloves, WypAll rags, cheesecloth, plywood, and Celotex material.

7.1 Effect of UNS Liquid on Organic Debris

UNS Surrogate Solution was prepared and used to soak test samples of the different types of debris waste. Cardboard, plastic, rubber glove, and rag samples were submerged for 2 h in the UNS Surrogate Solution and then submitted for testing by SW-846 Test Methods 1030 and 1050. Samples of the cardboard liner, Celotex, plywood, plastic, and rubber glove were soaked and then allowed to drain for 1 h, after which they were submitted for testing. The WypAll rags and cheesecloth were soaked, squeezed to remove excess moisture, and submitted for testing.

Test results for the debris soaked in UNS Surrogate Solution are presented in Table 11.

7.2 Effect of RNS Waste on Organic Debris

RNS waste surrogate was prepared using WB8 salt surrogate and sWheat to coat the debris samples. A 1:1 by volume blend of WB8 salt-to-sWheat surrogate was prepared and comingled with the debris to simulate conditions found in the RNS drums.

The debris samples were impregnated into the WB8 salt-to-sWheat surrogate using a rolling pin, and then the material was rolled onto the organic debris in an attempt to impregnate the debris with the RNS surrogate. After the material was rolled, the excess surrogate was shaken off. The debris samples along with samples of untreated materials were then submitted for testing by SW-846 Test Methods 1030 and 1050.

Test results for the debris impregnated with surrogate RNS material are presented in Table 11.

Table 11
Debris Reactivity Test Results

Debris Type	Debris Treatment	SW-846 Test Method 1030	SW-846 Test Method 1050
Cardboard	None	Nonflammable	Not self-heating
Cardboard	Soak in UNS Solution	Nonflammable	Not self-heating
Cardboard	Soak in UNS Solution	Nonflammable	Not self-heating
Cardboard	Comingle with RNS	Nonflammable	Not self-heating
Cardboard	Comingle with RNS	Nonflammable	Not self-heating
Celotex	None	Nonflammable	Not self-heating
Celotex	Soak in UNS Solution	Nonflammable	Not self-heating
Celotex	Soak in UNS Solution	Nonflammable	DOT Packing Group III
Celotex	Comingle with RNS	Nonflammable	Not self-heating
Celotex	Comingle with RNS	Nonflammable	Not self-heating
Plywood	None	Nonflammable	Not self-heating
Plywood	Soak in UNS Solution	Nonflammable	Not self-heating
Plywood	Soak in UNS Solution	Nonflammable	Not self-heating
Plywood	Comingle with RNS	Nonflammable	Not self-heating
Plywood	Comingle with RNS	Nonflammable	Not self-heating
Plastic	None	Nonflammable	Not self-heating
Plastic	Soak in UNS Solution	Nonflammable	Not self-heating
Plastic	Soak in UNS Solution	Nonflammable	Not self-heating
Plastic	Comingle with RNS	Nonflammable	Not self-heating
Plastic	Comingle with RNS	Nonflammable	Not self-heating
Rubber glove	None	Nonflammable	Not self-heating
Rubber glove	Soak in UNS Solution	Nonflammable	Not self-heating
Rubber glove	Soak in UNS Solution	Nonflammable	Not self-heating
Rubber glove	Comingle with RNS	Nonflammable	Not self-heating
Rubber glove	Comingle with RNS	Nonflammable	Not self-heating
WypAll rag	None	Flammable with rate of 3.52 mm/s	Not self-heating
WypAll rag	Soak in UNS Solution	Nonflammable	DOT Packing Group II
WypAll rag	Soak in UNS Solution	Nonflammable	No duplicate test
WypAll rag	Comingle with RNS	Nonflammable	Not self-heating
WypAll rag	Comingle with RNS	Nonflammable	Not self-heating
Cheesecloth	Soak in UNS Solution	Nonflammable	DOT Packing Group III
Cheesecloth	Soak in UNS Solution	Nonflammable	No duplicate Test

Details of the preparation of the samples and testing of cardboard, plastic, rubber glove, and WypAll rag debris surrogates can be found in Appendix J (March 11, 2016, SwRI test report), cheesecloth debris samples in Appendix T (May 17, 2017, SwRI test report) and Celotex and plywood debris samples in Appendix V (September 8, 2017, SwRI test report).

7.3 Debris Test Results

Debris samples provided by LANL from actual materials used during the preparation of the RNS waste drums were treated with UNS solution and RNS surrogate waste to determine if the materials may be considered ignitable (D001). The conditions to which the test materials were subjected were far harsher than what actual materials will endure in the RNS waste drums before they are remediated. The debris was submerged for 2 h during the UNS solution testing and physically impregnated with RNS-blended salt/sWheat material to simulate contamination with RNS waste material. The tested samples were evaluated in duplicate to ensure results could be replicated, unless a positive result was achieved. It is clear from available RTR information that the debris will not encounter free liquids, nor will it be forcefully impregnated with RNS waste material before remediation.

All the tested debris material passed the SW-846 Test Methods 1030 and 1050 testing, except the WypAll rags, cheesecloth and one of the two Celotex samples. This result is expected because these materials are cellulose-based and absorbent. The other materials are less absorbent and contain less cellulose-based material.

Based upon the above results, processes were developed to treat the WypAll rags, cheesecloth and Celotex to remove the characteristic of ignitability. This approach utilized the same type of blending with water and zeolite to take advantage of the equipment and materials to be used to treat the RNS waste. In the case of WypAlls and cheesecloth, additional testing was performed to verify this process is effective and the resulting product passes the tests for ignitability. The other debris waste tested (plastic, cardboard liner, plywood, rubber gloves) is not considered D001 (based on the testing described earlier) and will not be treated by blending with zeolite when encountered during remediation of the RNS drums. Celotex will be segregated (see below).

7.3.1 WypAll Rag Process Testing

To evaluate the effectiveness of the proposed remedy for WypAlls, the following process was followed. WypAll rags soaked with UNS surrogate salt solution were blended with water at a ratio of seven WypAll rags per quart of water. The rags were blended with water in a Waring Model MX1500XTX blender to make a mixture that was then mixed with zeolite in an 8-qt KitchenAid mixer. The WypAll blend was mixed with zeolite at three volumetric WypAll blend-to-water ratios of 3:1, 4:1, and 5:1.

The following steps were followed for this process:

1. Add 1 qt of water to the blender
2. Add 1 rag to the blender
3. Place lid on blender
4. Start blender at 75% speed
5. Blend for 30 s
6. Stop blender
7. Repeat steps 2 through 6 until all seven rags have been added
8. Start blender at 75% speed
9. Increase speed to 90% and let blend 30 s

The blended product was used to prepare the formulations identified in Table 11.

The WypAll blend was mixed with KMI zeolite as follows:

1. Add the WypAll rag blend volume to the mixer bowl
2. Add 1850 mL of KMI zeolite
3. Mix on speed 8 for 10 s
4. Reduce speed to 3
5. Add 1850 mL of zeolite
6. Mix for 30 s on speed 3

7.3.2 WypAll Process Test Results

The "treated" samples of each WypAll blend mixture were tested using SW-846 Test Method 1030, SW-846 Test Method 1050, UN O.1, and Test Method 9095B (paint filter). Mixture compositions and test results are shown in Table 12. Details of preparing the WypAll processing samples and the testing can be found in Appendix M (June 27, 2016 SwRI test report 598466).

Table 12
WypAll Treatment Blend Test Results

WypAll Blend ID (Zeolite:WypAll Mix)	WypAll Mixture (mL)	Zeolite (mL)	SW-846 Test Method 1030	SW-846 Test Method 1050	UN O.1Testing	Paint Filter Test Method 9095B
WB1 (3:1)	1233	3700	Nonflammable	Not Self-heating	Not Div 5.1	No free liquids
WB2 (4:1)	925	3700	Nonflammable	Not Self-heating	Not Div 5.1	No free liquids
WB3 (5:1)	740	3700	Nonflammable	Not Self-heating	Not Div 5.1	No free liquids

The WypAll blend—once mixed with zeolite in a volumetric ratio of 3:1 or greater (zeolite-to-WypAll mix)—passed ignitability testing (SW-846 Test Methods 1030 and 1050 and UN O.1) and paint filter testing.

7.3.3 Cheesecloth Testing

To evaluate the effectiveness of the proposed remedy for cheesecloth, the following process was followed. Cheesecloth (1 rag ~45 grams) soaked with UNS surrogate salt solution was added to 0.7 qt of water in a shallow pan. The rag was then wrung out and 4 quarts of zeolite was added to the shallow pan and hand mixed with the liquid in the pan. The wet cheesecloth was then cut into 1 inch squares and added to the wet zeolite in the shallow pan and hand mixed for 1 minute to incorporate the cheesecloth into the zeolite. The resulting mix of zeolite, liquid and cheesecloth was then dried to a constant weight and submitted for ignitability testing (SW-846 Test Methods 1030 and 1050 and UN O.1) and paint filter testing.

7.3.4 Cheesecloth Process Test Results

The treated cheesecloth material passed testing and was found to be "Nonflammable" (SW-846 Method 1030), "Not Self Heating" (SW-846 Method 1050) and "Not Division 5.1" (UN Div 5.1).

7.3.5 Celotex Testing

Testing of the zeolite-blending process for Celotex debris was not performed because Celotex debris is expected to assay at less than TRU levels of contamination, could then be managed as mixed or low

level waste, and potentially be treated at a commercial RCRA-permitted treatment, storage, and disposal facility. Alternatively, the material will be evaluated from a process knowledge perspective and a determination made as to whether it would be acceptable to ship to WIPP as is. This is possible due to the fact that although one of the duplicate Celotex samples soaked in UNS solution tested as DOT Packing Group III, it is very unlikely that the Celotex debris in RNS drums was in contact with substantial quantities of liquids.

8.0 WASTE-PROCESS TESTING

LANL will use a KitchenAid mixer to process the RNS and UNS waste stored on-site. A preferred process has been identified based upon initial test work at LANL.[11] The intent of this waste process testing is to ensure the blender, KMI zeolite, and proposed recipe provide adequate mixing of the zeolite and the surrogates to achieve expected results as had been achieved with the RNS Surrogate Solution treatment technology testing, UNS Surrogate Solution treatment technology testing, and the debris-zeolite blending tests. The blending tests utilize RNS salt surrogates, UNS Solution Surrogates, and WypAll surrogate materials. The KMI zeolite used for these verification tests was also subjected to an independent evaluation by SwRI to verify particle size, moisture content, and percentage of clinoptilolite. The mixing process used a KitchenAid mixer (8-qt model KSMC895ER) and a flat beater to mix the RNS waste with water and zeolite.

Surrogate salts and solutions were prepared for RNS and UNS process tests (same ratios as those described in Section 6, RNS Waste Blend Tests). The surrogates were prepared in larger quantities and processed in the same make and model of equipment that will be used in glovebox operations at LANL. The process tests simulate the approach to be employed for remediating the waste found in the RNS and UNS drums.

8.1 RNS Waste Surrogate Process Testing

WB8 surrogate salt (without water) and sWheat mixes shown in Table 13 were prepared as feed material for blending with zeolite. The WB8 salt and sWheat were mixed in an 8-qt KitchenAid mixer for 60 s. The sWheat and salt mixture was heated at an external temperature of 60 °C for 16 h in a Nalgene bottle with the cap attached but not securely closed. This material was then used in the RNS surrogate process tests.

Twelve formulations were prepared by blending the prepared surrogate salt/sWheat material with zeolite. Zeolite mixing was achieved by employing an 8-qt KitchenAid mixer (model KSMC895ER) and processing as follows:

1. Add water to bowl (if called for)
2. Add RNS salt/sWheat mixture
3. Blend on speed 3 for 3 min
4. Measure and document solution temperature
5. Measure and document solution pH
6. Add ~half of KMI zeolite volume for the blend
7. Blend on speed 8 for 10 s
8. Reduce speed to 3

9. Add remaining KMI zeolite volume for the blend
10. Blend for 30 s on speed 3
11. Measure and document material temperature

The prepared blends identified in Table 11 were then tested to evaluate their response to SW-846 Test Method 1030, SW-846 Test Method 1050, UN O.1, UN O.2, and Test Method 9095B (paint filter). The resulting temperatures and pH readings measured during the processing operation are presented in Table 14. Details of preparing the RNS process samples and the testing can be found in Appendix P (August 30, 2016, SwRI test report).

8.1.1 RNS Surrogate Waste-Process Test Results

The test results from samples of RNS surrogate process blends are presented in Tables 13 and 14.

Table 13
RNS Surrogate Process Test Results

BVT Blend ID (WB8:sWheat)	Zeolite:Salt Volume Ratio	Zeolite:RNS Waste Volume Ratio	RNS Salt/sWheat		Blend Constituents		Test Results			
			WB8 Salt (mL)	sWheat (mL)	Water (mL)	KMI Zeolite (mL)	SW-846 Test Method 1030	SW-846 Test Method 1050	UN O.1	Test Method 9095B (Paint Filter)
BVT1 (1:0)	1.5:1	n/a[a]	2080	0	100	3120	Nonflammable	Not self-heating	Not Div 5.1	No free liquid[b]
BVT2 (1:0)	1.5:1	n/a	2080	0	0	3120	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
BVT3 (1:0)	2:1	n/a	1730	0	100	3470	Nonflammable	Not self-heating	Not Div 5.1	No free liquid[b]
BVT4 (1:0)	2:1	n/a	1730	0	0	3470	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
BVT5 (1:0)	2.5:1	n/a	1490	0	100	3700	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
BVT6 (1:0)	2.5:1	n/a	1490	0	0	3700	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
BVT7 (1:0)	3:1	n/a	1300	0	100	3900	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
BVT8 (1:0)	3:1	n/a	1300	0	0	3900	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
BVT9 (1:1)	n/a	3:1	700	700	800	4200	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
BVT10 (1:2)	n/a	3:1	467	933	800	4200	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
BVT11 (1:3)	n/a	3:1	350	1050	800	4200	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
BVT12 (1:5)	n/a	3:1	233	1167	800	4200	Nonflammable	Not self-heating	Not Div 5.1	No free liquid

[a] n/a = Not applicable.

[b] No free liquid collected during Method 9095B test, but free liquid observed in the storage bag after 8 d.

None of the zeolite/surrogate-blended materials were found to exhibit the ignitable characteristic (D001), and all passed the paint filter test (no liquids; hence not corrosive, or D002). The remaining blended material was kept in ziplock bags and stored. After 8 d, the bags were examined for the presence of free liquids. BVT1 blend and BVT3 were noted to have some free-liquid release.

Tests BVT1 through BVT8 simulate salts expected in the UNS waste drums. This material was not blended with sWheat before it was mixed with zeolite. Because free water was noticed after 8 d in blends BVT1 and BVT3, the volumetric ratio of zeolite-to-water and zeolite-to-salt both should be considered in determining a process recipe. As shown in Table 1, most of the surrogate salts contain water of hydration that add to the water content of the blend the zeolite must absorb. The addition of water in the recipe helps to dissolve the salts and to provide a mix that is more easily blended into the zeolite. For BVT blends that did not include the addition of water, a zeolite-to-salt ratio of 1.5 or greater is effective at treating the surrogate salt, while a zeolite-to-salt ratio of 2.5 or greater is effective for treating the BVT blends that correspond to surrogate salt with the addition of water. A greater volume of zeolite is required because of the added water.

Tests BVT9 through BVT12 simulate RNS waste expected in the RNS waste drums. All four zeolite/surrogate blends tested were found not to exhibit the ignitable characteristic (D001), and all passed the paint filter test (no liquids; hence, not corrosive, or D002). These tests show that a zeolite-to-RNS waste volumetric ratio of at least 3:1 is effective at treating a range of surrogate RNS blends.

Temperature and pH information for each RNS surrogate blend test is presented in Table 14. The pH for all of the tests was below 1.68, which was the lower limit of the pH meter used. This result is expected because of the acidic nature of the WB8 salt. The zeolite was effective at absorbing the acidic liquid associated with the RNS and water mixture. The water temperature (~37 ^{o}C) was lowered when the RNS surrogate material was added to the bowl because the surrogate was at a lower temperature and the salt dissolution is an endothermic process (~20 ^{o}C). This result also suggests that little or no problematic heating related to acid dissociation occurred. A slight temperature increase was typical after mixing with zeolite, which is known to react exothermically with water. A higher initial temperature was observed for blends BVT 9–12 because 800 mL of water was used in these tests, eight times more than during any previous tests. A temperature drop was noticed during the processing of the blends BVT 9–12, which is expected because of endothermic salt dissolution and heat loss through the mixer bowl.

Table 14
RNS Surrogate Process Blends pH and Temperature

BVT Blend ID	pH Reading	Temperature (^{o}C)	
		Waste and Water	Final Blend Temperature
BVT1	<1.68	12.6	15.7
BVT2	<1.68	16.3	19.2
BVT3	<1.68	10.8	14.7
BVT4	<1.68	19.7	20.2
BVT5	<1.68	9.2	13.7
BVT6	<1.68	19.7	19.9
BVT7	<1.68	10.2	13.9
BVT8	<1.68	19.7	20.1

Table 14 (continued)

BVT Blend ID	pH Reading	Temperature (°C)	
		Waste and Water	Final Blend Temperature
BVT9	<1.68	27.4	25.3
BVT10	<1.68	27.3	23.6
BVT11	<1.68	35.5	29.7
BVT12	<1.68	27.9	24.2

8.2 UNS Surrogate Solution Process Tests

UNS drums contain nitrate liquid solution that is expected to be saturated in salt concentration. The surrogate UNS solution as prepared in Section 1.2.4.1, Formulation of UNS Salt Solution Surrogate, will be used in the UVT blending. The solution will be blended with kitty litter and/or zeolite for these verification tests.

Six gallons of UNS Solution Surrogate was prepared using the ratios found in Table 6 and following the procedure described in Section 1.2.4.1. This solution was used for UNS Surrogate Solution tests and Waste Lock 770 process tests. UNS solution/sWheat mixes presented in Table 15 were prepared and tested. Three UNS Surrogate Solution and sWheat blends were prepared for UVT4, UVT5, and UVT6. These UNS Surrogate Solution and sWheat blends were prepared in the KitchenAid mixer and allowed to set for 48 h.

UNS solution or UNS solution mixed with sWheat were then blended with zeolite for testing. The zeolite blends were prepared as follows:

1. Add 1000 mL warm water to bowl (if called for)
2. Add solution/sWheat or UNS solution
3. Add 1500 mL of solution/sWheat for UVT4, UVT5, and UVT6
4. Specified volume of UNS solution for UVT1, UVT2, and UVT3
5. Blend on speed 4 for 3 min
6. Measure solution temperature and pH
7. Add 1850 mL of KMI zeolite
8. Blend on speed 8 for 10 s
9. Reduce speed to 3
10. Add 1850 mL of zeolite
11. Blend for 30 s on speed 3
12. Measure temperature of contents

The prepared blends identified in Table 15 were then tested to evaluate their response to SW-846 Test Method 1030, SW-846 Test Method 1050, DOT UN O.1, and Test Method 9095B (paint filter). The resulting temperatures and pH readings measured during the processing operation are shown in

Table 16. Details of preparing the UNS process samples and the testing can be found in Appendix P (August 30, 2016, SwRI test report).

8.2.1 Discussion of UNS Surrogate Solution Process Test Results

The test results from samples of UNS Surrogate Solution process blends are presented in Tables 15 and 16.

Table 15
UNS Solution Process Test Results

			UNS Solution/sWheat		Blend Constituents		Test Results			
UVT Blend ID (Sol:sWheat)	Zeolite:Sol Volume Ratio	Zeolite: Sol/sWheat Volume Ratio	UNS Sol (mL)	sWheat (mL)	Water (mL)	Zeolite (mL)	SW-846 Test Method 1030	SW-846 Test Method 1050	UN O.1	Test Method 9095B (Paint Filter)
UVT1 (1:0)	4:1	n/a[a]	1000	0	0	4000	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
UVT2 (1:0)	5:1	n/a	800	0	0	4000	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
UVT3 (1:0)	3:1	n/a	1330	0	0	4000	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
UVT4 (1:1)	n/a	2.5:1	967	967	1000	3700	Nonflammable	Not self-heating	Not Div 5.1	No free liquid[b]
UVT5 (1:3)	n/a	2.5:1	312	937	1000	3700	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
UVT6 (1:5)	n/a	2.5:1	187	937	1000	3700	Nonflammable	Not self-heating	Not Div 5.1	No free liquid

[a] n/a = Not applicable.

[b] No free liquid collected during Method 9095B test, but free liquid observed in the storage bag after 8 d.

All the UNS surrogate process blends were found not to be ignitable and all passed the paint filter test. The remaining blended material was kept in ziplock bags and stored. After 8 d, the bags were examined for the presence of free liquids. UVT4 blend was noted to have some free-liquid release.

Three UNS surrogate process blends (UVT1, UVT2, and UVT3) were prepared by adding UNS liquid directly to zeolite. These blends represent the processing of liquid expected to be found in RNS and UNS waste drums. All these blends were found not to be ignitable, all passed the paint filter test, and all were effective at absorbing the UNS solution. The ratio of zeolite to solution should be 3:1 or greater to ensure dewatering does not occur during UNS liquid processing.

Three UNS surrogate blends (UVT4, UVT5, and UVT6) were blends of UNS solution and sWheat mixed with zeolite. Each sample was prepared with 1500 mL of RNS surrogate material that had swelled after blending the sWheat with the solution. The actual amount of dry sWheat and solution in the 1500 mL added to Blends UVT4, UTV5 and UVT6 are shown in Table 15. These blends represent the process for the material consisting of liquids that were absorbed with sWheat (during initial nitrate salt processing) and expected to be found in RNS waste drums. All these blends were found not to be ignitable, and all passed the paint filter test. Blend UVT4 was later found to have free liquids in the product bag, indicating that the volumetric ratio of zeolite to waste should be above 2.5. Blends UVT4, UVT5, and UVT6 also had the following ratio of liquid material to zeolite (when considering the UNS liquid absorbed in the sWheat and water added to the mixer):

Blend ID	**Volumetric Ratio of Zeolite-to-Liquid**
UVT4	1.88:1
UVT5	2.82:1
UVT6	3.12:1

The addition of water during the RNS processing (for purposes of creating a consistency that blends well and allows for dissolution of nitrate salts) should be kept to a minimum to ensure zeolite-treated material does not become too moist. A zeolite-to-waste volumetric ratio of at least 3 and a zeolite-to-total liquid volumetric ratio 2.3 or greater will ensure the blended material will not dewater.

Temperature and pH information for each UNS surrogate blend test is presented in Table 16. The pH for all of the tests was below 1.68, which was the lower limit of the pH meter used. This result is expected given the acidic nature of the UNS Surrogate Solution salt. A slight temperature increase was observed for the neat solutions mixed with zeolite (heat of adsorption of the water/zeolite), while a slight decrease was observed for the UNS/sWheat blends.

Table 16
pH and Temperature of UNS Solution Surrogate Process Blends

UVT Blend ID	pH Reading	Temperature (°C)	
		Waste and Water	Final Blend
UVT1	<1.68	21.9	26.5
UVT2	<1.68	21.9	26.4
UVT3	<1.68	22.4	25.6
UVT4	<1.68	28.9	27.6
UVT5	<1.68	29.0	28.6
UVT6	<1.68	30.2	28.2

8.3 Waste Lock 770 Surrogate Process Tests

Four RNS drums contain nitrate salts processed with Waste Lock 770. Treatment of these drums will follow a similar approach as that for the sWheat absorbed nitrate salts: blending the Waste Lock 770–containing waste with zeolite.[11]

UNS Surrogate Solution was mixed with Waste Lock 770 in the ratios presented in Table 17. The prepared UNS Solution/Waste Lock 770 mixtures were allowed to set for 48 h before they were mixed with zeolite.

The Waste Lock 770 surrogate blends were prepared as follows:

1. Add water to bowl (if called for)
2. Add 1000 mL of Waste Lock 770–treated material
3. Blend on speed 4 for 1 min
4. Add approximately half the volume of zeolite
5. Blend on speed 8 for 10 s
6. Reduce speed to 3
7. Add the remaining volume of zeolite
8. Blend for 30 s on speed 3

The prepared samples identified in Table 17 were then tested to evaluate how they respond to SW-846 Test Method 1030, SW-846 Test Method 1050, DOT UN O.1, and Test Method 9095B (paint filter). Details of preparing the Waste Lock 770 process samples and the testing can be found in Appendix P (August 30, 2016, SwRI test report).

8.3.1 Waste Lock 770 Surrogate Solution Process Test Results

The reported addition rate of Waste Lock 770 to free liquids recovered from nitrate salt waste was typically 1 c of Waste Lock 770 to 1 gal. of nitrate solution (a volumetric ratio of 16:1 UNS solution to Waste Lock 770). Frequently, more Waste Lock 770 was used. Waste Lock 770 solution blends were designed to simulate the expected solution that will be found during RNS waste treatment.

The addition of zeolite was effective in producing a treated material that was not ignitable. As was found during the initial processing of nitrate liquids with Waste Lock 770 and confirmed during this testing, Waste Lock 770 did not absorb the liquid salt solution because the pH was below 1. Consequently, the Waste Lock 770 solutions acted like UNS liquids. Free liquids were noticed at a volumetric ratio of zeolite to liquid of 2.0. When these solutions are treated, the volumetric ratio of zeolite to Waste Lock 770 solution should be greater than 2.4:1.

Table 17
Waste Lock 770 Solution Process Test Results

UVT Blend ID (UNS Sol:Waste Lock 770)	Blend Constituents			Test Results			
	UNS/Waste Lock 770 Sol (mL)	Water (mL)	Zeolite (mL)	SW-846 Test Method 1030	SW-846 Test Method 1050	UN O.1	Test Method 9095B (Paint Filter)
WLVT1 (16.7:1)	1000	0	3000	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
WLVT2 (8.3:1)	1000	0	3000	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
WLVT3 (4.2:1)	1000	0	3000	Nonflammable	Not self-heating	Not Div 5.1	No free liquid
WLVT4 (12.6:1)	1000	0	2000	Nonflammable	Not self-heating	Not Div 5.1	Contains free liquid
WLVT5 (8.3:1)	1000	250	3000	Nonflammable	Not self-heating	Not Div 5.1	No free liquid

9.0 EVALUATION OF PROPOSED REMEDY FOR CONSISTENCY WITH WIPP'S BASIS OF KNOWLEDGE DOCUMENT FOR OXIDIZING CHEMICALS IN TRANSURANIC WASTE

The planned remedy for stabilization of the LANL RNS and UNS wastes with zeolite was evaluated for compliance with the "Basis of Knowledge for Evaluating Oxidizing Chemicals in TRU Waste, DOE/WIPP-17-3589, Revision 0" issued by the DOE Carlsbad Field Office in July 2017.[13] No direct comparison can be made with LANL's planned remedy and requirements in the Basis of Knowledge (BoK) document because the LANL testing and recipe for treatment are based on volumetric ratios of waste materials to zeolite, while the BoK requirements are expressed in terms of weight percent (wt%) of oxidizing materials and wt% of zeolite.

9.1 LANL's Planned RNS Waste Treatment

The LANL recipe for treating RNS waste combines one volume of RNS waste (1.33 qt) with three volumes of zeolite (1 gal.), as shown in Figure 1. Results of analysis of the zeolite that will be used at LANL by x-ray powder diffraction are presented in Appendix AA (Triclinic Labs, XRPD Measurements for Two Clinoptilolite Zeolites, April 10, 2017) and show >99% of the crystalline mineral content is clinoptilolite. Results of testing of the zeolite for total organic carbon are provided in Appendix AB [Nelson Laboratories Total Organic Carbon (TOC): Wet Oxidation Method Final Report, April 11, 2017] and show total organic carbon <0.001%. The zeolite that will be used for treatment will be provided to LANL by KMI Zeolite in 1-gal. bags. These bags may vary in weight content; therefore, the bags are weighed before use in the RNS treatment process. Bags that contain less than 3100 g of zeolite will not be used for mixing with RNS waste material.

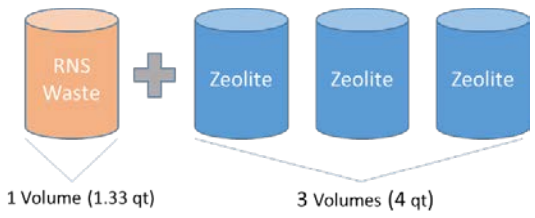


Figure 1 LANL RNS treatment recipe

The RNS waste that will be treated with zeolite consists of a mixture of sWheat kitty litter and nitrate salts that were precipitated by evaporating nitrate salt solution. The RNS waste was prepared by blending the nitrate salts with sWheat in a volumetric ratio of three parts sWheat to one part nitrate salt, as depicted in Figure 2.

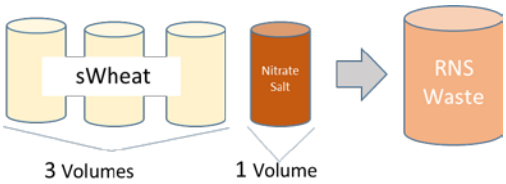


Figure 2 LANL RNS waste

This recipe (three parts sWheat added to one part nitrate salt) was typical but the actual ratio may be different because of a lack of accurate measuring equipment during remediation of the nitrate salt waste. It is possible the ratio of sWheat to nitrate salt in LANL RNS waste may have approached one part sWheat to one part nitrate salt, as depicted in Figure 3.



Figure 3 RNS waste based on volumetric ratio of 1:1

Test work at SwRI and summarized in this report examined the effectiveness of combining RNS waste with zeolite. The testing examined RNS waste that was prepared by mixing sWheat and surrogate nitrate salts in ratios that ranged from 1:1 sWheat-to-nitrate salts to 3:1 sWheat-to-nitrate salt on a volume basis, as depicted in Figure 4.

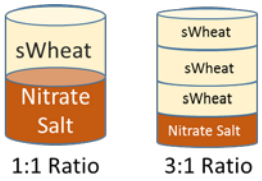


Figure 4 sWheat/nitrate salt blends tested by SwRI ranged from 1:1 to 3:1 sWheat-to-Nitrate salt

The mixture of sWheat and nitrate salt was added to zeolite to verify that zeolite could effectively treat the ignitability (D001) characteristic of the sWheat and nitrate salt mixture. The blended sWheat and nitrate salt were mixed with zeolite in a KitchenAid mixer in ratios of three volumes zeolite to one volume blended sWheat and nitrate salt that was prepared in both 1:1 and 3:1 ratios of sWheat and nitrate salt, as depicted in Figures 5 and 6.

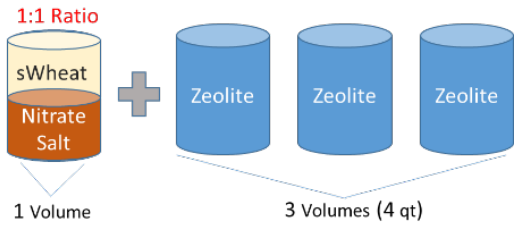


Figure 5 A mixture 1 volume of 1:1 sWheat and nitrate salt mixed with 3 volumes of zeolite

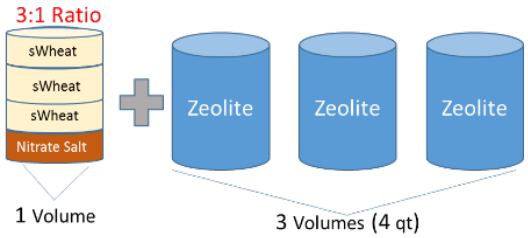


Figure 6 A mixture 1 volume of 3:1 sWheat and nitrate salt mixed with 3 volumes of zeolite

9.2 Basis of Knowledge Evaluation for RNS Solid Material

The BoK uses weight ratios to set requirements that waste-generating sites such as LANL must meet for WIPP to accept treated waste with oxidizing chemicals. To determine the addition rates on a weight basis requires knowing the density of the materials combined in the LANL recipe. The volumetric conversions to a weight basis are as follows based upon the densities of the components:

- Zeolite Bulk density 0.82 g/cm^3 775 g/qt 3100 g/gal.
- sWheat Bulk density 0.55 g/cm^3 520 g/qt
- Nitrate Salts:
  - $Al(NO_3)_3+9H_2O$ Bulk Density = 0.88 g/cm^3 832 g/qt (Particle Density = 1.72)
  - $NaNO_3$ Bulk Density = 1.28 g/cm^3 1211 g/qt (Particle Density = 2.26)
  - KNO_3 Bulk Density = 1.20 g/cm^3 1135 g/qt (Particle Density = 2.11)
  - $Cr(NO_3)_3+9H_2O$ Bulk Density = 0.71 g/cm^3 672 g/qt (Particle Density = 1.85)
  - $Pb(NO_3)_2$ Bulk Density = 2.08 g/cm^3 1968 g/qt (Particle Density = 4.53)
  - $Mg(NO_3)_2+6\ H_2O$ Bulk Density = 0.70 g/cm^3 662 g/qt (Particle Density = 1.46)
  - $Ca(NO_3)_2+4\ H_2O$ Bulk Density = 1.00 g/cm^3 946 g/qt (Particle Density = 1.82)

The resulting weight percentages of nitrate salt and zeolite that would be found in the dry treated RNS waste using the LANL volumetric ratios are shown in Table 18 as a function of the salt bulk density. Section 6.1 of the BoK requires that the zeolite content of the dry treated material must be $\geq$70 weight percent. The maximum salt solid density shown in Table 18 is 2.08 g/cm^3 for lead nitrate. UNS salt is expected to contain less than 10% $Pb(NO_3)_2$ (which results only from dissolution of the Pb liner) and

would result in a bulk density of 1.36 g/cc when conservatively using 10% lead nitrate and 90% sodium nitrate, the salts with the highest bulk densities.

$(0.9 \times 1.28\ g/cm^3) + (0.1 \times 2.08\ g/cm^3) = 1.36\ g/cm^3$ [for 10% $Pb(NO_3)_2$, 90% $NaNO_3$ salt blend]

The following data were also used for the calculations in Table 18:

- KMI zeolite in each batch = 3100 g
- Bulk density of sWheat = 0.55 g/mL = 520 g/qt
- 1.33 qt of salt/sWheat mixture is mixed with 1 gal. of KMI zeolite in each batch

Table 18
Calculated Weight Percentages of
Nitrate Salt/sWheat and Zeolite in Treated LANL RNS Waste Batch

Salt Bulk Density	1:1 Ratio of sWheat to Salt				2:1 Ratio of sWheat to Salt				3:1 Ratio of sWheat to Salt			
	Vol of salt	Weight	NO_3 Salt	Zeolite	Vol of salt	Weight	NO_3 Salt	Zeolite	Vol of salt	Weight	NO_3 Salt	Zeolite
g/cm^3	**qt**	**g**	**wt%**	**wt%**	**qt**	**g**	**wt%**	**wt%**	**qt**	**g**	**wt%**	**wt%**
0.5	0.67	315	8.38	82.41	0.44	210	5.57	82.18	0.33	158	4.17	82.07
1	0.67	631	15.46	76.04	0.44	421	10.55	77.85	0.33	315	8.01	78.78
1.36	0.67	858	19.91	72.04	0.44	572	13.82	75.00	0.33	429	10.58	76.58
1.55	0.67	978	22.08	70.09	0.44	652	15.45	73.58	0.33	489	11.89	75.46
2.08	0.67	1312	27.55	65.17	0.44	875	19.70	69.89	0.33	656	15.33	72.51

The calculated weight percentages of nitrate salt and zeolite (shaded yellow in table) for the nitrate salt components (identified by solid bulk density) show that the weight percentage of the oxidizing salt will be less than 30 wt% and the weight percentage of zeolite will be 70 wt% or greater at a bulk density of 1.55. This bulk density is much greater than the estimated worst-case bulk density of the LANL nitrate salt waste (1.36 g/cm^3) for the 1:1, 2:1, and 3:1 ratios of sWheat to salt.

9.3 Basis of Knowledge Evaluation for RNS Absorbed Liquid Material

Some of the nitrate salt waste treated with sWheat was liquid that had dewatered from the salts. This liquid contains dissolved salts. When combined with sWheat, the liquid is absorbed and causes the sWheat to swell, as depicted in Figure 7, for a 1:1 volume ratio of sWheat and liquid. The resulting mixture of absorbed solution swells to approximately 155% of the initial sWheat volume.

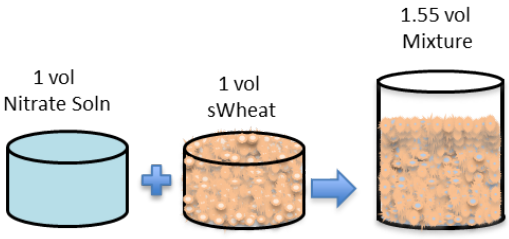


Figure 7 A 1:1 volume ratio of sWheat and liquid swells to 155% of the initial sWheat volume

Tests at various sWheat-to-liquid ratios were completed[14] to determine the approximate percentage increase in bulk volume of the sWheat that is expected. Test results are presented in Table 19.

Table 19
Volume Increase of sWheat After Liquid Addition

sWheat-to-Liquid Ratio	Approximate Increase in Bulk Volume
Volume	%
1:1	55
2:1	65
3:1	66

For sWheat with absorbed liquids containing salt, the resulting weight percentage of nitrate salt that would be found in the dry treated RNS waste is related to the concentration of salt in the liquid. The salt concentration of treated LANL RNS waste was conservatively estimated using (1) the most soluble oxidizing salt in RNS waste (calcium nitrate tetrahydrate) and (2) the sWheat swelling test results. Magnesium nitrate hexahydrate was first considered but was not used because it is not classified as an oxidizer (BoK analysis). Calcium nitrate tetrahydrate has a solubility of 129.3 g in 100 g of water (Perry's Chemical Engineers' Handbook, 7th Edition [Reference 15], which results in a solution concentration of 0.88 g/mL as described in Appendix AC, Calcium Nitrate Saturated Solution Salt Concentration @ 20 °C and Density Measurements). Table 20 shows the resulting zeolite content of dry treated RNS waste at various sWheat-to-solution ratios. Section 6.1 of the BoK requires that the zeolite content of the dry treated material must be greater than or equal to 70 wt%. Table 20 also includes values for a 1:1 sWheat-to-solution blend that can produce free liquid, making this a very conservative blend. The calculated weight percentages of zeolite is shaded in yellow.

The following data was used for the calculations in Table 20:

- KMI zeolite in each batch = 3100 g
- Bulk density of sWheat = 0.55 g/mL = 520 g/qt
- 1.33 qt of salt/sWheat mixture is mixed with 1 gal. of KMI zeolite in each batch
- Calculations take solutions and water added to process to dryness

Table 20
Calculated Weight Percentages of Zeolite in a Dry Treated LANL RNS Waste Batch for Salt Solutions Combined with sWheat at Various sWheat-to-Solution Ratios

Salt Solution		RNS Waste Characteristics				Treated Waste Characteristics			
		Ratio	Swell %	Vol sWheat*	Vol Solution	Salt wt	Zeolite wt	sWheat wt	Zeolite
g/mL	Salt	Sol:sWheat	vol%	qt	qt	g	g	g	wt%
0.88	$Ca(NO_3)_2$	1:1	55	0.86	0.86	716	3100	447	72.70
0.88	$Ca(NO_3)_2$	1:2	65	0.81	0.40	333	3100	422	80.42
0.88	$Ca(NO_3)_2$	1:3	66	0.80	0.27	225	3100	416	82.86

*The volume of sWheat swells to 1.33 quart after addition of the solution in each case.

The calculated weight percentages of zeolite (shaded yellow in the table) for the most soluble oxidizing nitrate salt component (calcium nitrate, 0.88 g/mL) show that the weight percentage of the zeolite in the treated waste will be greater than 70 weight percentage for all three ratios of salt solution to sWheat.

9.4 Basis of Knowledge Evaluation for RNS Free Liquids

Free liquids in the RNS waste are first mixed with zeolite to absorb the free liquids. The zeolite with absorbed liquids is then blended with zeolite following the recipe of 1.33 qt of zeolite with absorbed liquids to 4 qt of dry zeolite. The weight percentage of the chemical oxidizer in the batch of treated free liquid solution is 18.5 wt% based on the very conservative assumptions that the salt in the free liquids is composed of calcium nitrate (0.88 g/mL) and the zeolite has the holding capacity shown in Table 5.4 of the BoK for zeolite with a 4 angstrom (Å) pore size. The KMI zeolite that LANL will use has a typical pore size of 4.0 to 7.0 Å. Table 5.4 of the BoK requires the chemical oxidizer in the treated waste be equal to or less than 35 weight percentage for zeolite with a pore size of 4 Å.

The following data was used for the calculations in treating RNS free liquids:

- 1 gal. of KMI zeolite = 3100 g
- 1 qt of KMI zeolite = 775 g
- 1.33 qt of sorbed zeolite is mixed with 1 gal. of KMI zeolite in each batch
- Zeolite with a holding capacity of 1.15 mL/g (Table 5.4 of the BoK)
- Calculations take solutions to dryness and use hydrated form of salts in denominator as specified in section 5.6.1 of the BoK

1.33 qt of zeolite will hold 1185 mL of saturated calcium nitrate solution:

- 1.33 qt zeolite × 775 g zeolite/qt × 1.15 mL $Ca(NO_3)_2$ sol/g zeolite = 1185 mL solution

1.33 qt of zeolite contains 1043 g $Ca(NO_3)_2$:

- 1185 mL solution × 0.88 g $Ca(NO_3)_2$/mL of solution = 1043 g $Ca(NO_3)_2$

Weight percentage chemical oxidizer in a dry treated LANL batch is 18.5 weight percentage using the liquid holding capacity for zeolite with a pore size of 4 Å in Table 5.4 of the BoK:

- Weight of chemical oxidizer (anhydrous) $Ca(NO_3)_2$ = 1043 g
- Weight of chemical oxidizer (hydrated) $Ca(NO_3)_2$+4 H_2O = 1501 g
- Weight of zeolite = 4131 g = 5.33 qt zeolite × 775 g/qt zeolite
- Weight of a batch = 5632 g = 1501 g $Ca(NO_3)_2$+4 H_2O + 4131 g zeolite
- Weight percentage $Ca(NO_3)_2$ = 18.5 weight percentage = [1043 g $Ca(NO_3)_2$/5632 g batch] × 100

KMI Zeolite that LANL will be using for processing RNS waste has a measured liquid holding capacity of 0.42 mL/g. This is 37% of the holding capacity of the zeolite identified in Table 5-4 of the BoK. The weight percentage chemical oxidizer in a batch of LANL-treated free liquid using KMI zeolite with a liquid holding capacity of 0.42 mL/g is only 8.1 weight percentage—far less than the BoK requirement that the dry treated material contain ≤35 weight percentage oxidizing chemicals. Calculations are not provided because this is less conservative than the above calculations using zeolite with a liquid holding capacity of 1.15 mL/g in Table 5.4 of the BoK.

9.5 Basis of Knowledge Evaluation for Waste Lock 770

Waste Lock 770 was used to solidify free liquid in the waste during the treatment of nitrate salts and is found in some of the RNS drums. Waste Lock 770 was typically found to be ineffective due to the acidic nature of the liquid. In some cases this liquid was then mixed with sWheat to absorb the liquid previously mixed with Waste Lock 770.

Free liquid found in the RNS waste that was previously mixed with Waste Lock 770 will be processed as described in Section 9.4. Any Waste Lock 770 that may be in the liquid will not impact the calculations presented in section 9.4. These calculations show that the free liquid treatment process results in a weight percentage of chemical oxidizer in the treated free liquid solution of 18.5 wt%. This is less than 35 weight percentage as required in Table 5.4 of the BOK and meets Section 6.1 of the BoK.

Liquid solidified by the Waste Lock 770 will be treated as a solid granular material. The treated waste will contain less than 26.3 weight percentage oxidizing chemical and more than 73 weight percentage zeolite, which meets the requirements in Section 6.1 of the BoK and in Table 5.4 of the BoK.

To determine the treatment effectiveness the following conservative assumptions are used:

1. The liquid that the Waste Lock 770 was added to was saturated calcium nitrate solution.
2. The addition of the Waste Lock 770 did not increase the volume of the liquid (conservative estimate).

The following data was used for the calculations associated with liquids solidified with Waste Lock 770:

- 1 gal. of KMI zeolite = 3100 g
- 1.33 qt of solidified liquid is mixed with 1 gal. of KMI zeolite in each batch

1.33 qt of solidified liquid will hold 1107g of $Ca(NO_3)_2$:

- 1.33 qt liquid × 946 ml/qt x 0.88 g $Ca(NO_3)_2$ / ml = 1107 g $Ca(NO_3)_2$

Weight percentage chemical oxidizer in a dry treated LANL batch is 26.3 weight percentage oxidizing chemical and 73.6 weight percentage zeolite:

- Weight of chemical oxidizer $Ca(NO_3)_2$ = 1107 g
- Weight of 1 gallon zeolite = 3100 g
- Weight of a batch = 4207 g = 1107 g $Ca(NO_3)_2$+ 3100 g zeolite
- Weight percentage $Ca(NO_3)_2$ = 26.3 weight percentage = [1107g $Ca(NO_3)_2$/4207 g batch] × 100
- Weight percentage zeolite = 73.6 weight percentage = [3100g zeolite/4207 g batch] × 100

9.6 Basis of Knowledge Evaluation for WypAll Rags

WypAll Rags were used to clean up the glovebox when the LANL RNS waste was created. The rags will be combined with water, blended in a blender, and then mixed with 1 gal. of zeolite. Two cups of rags are blended in water for each batch and then mixed with 1 gal. of zeolite. Two cups of rags is approximately five rags. Each rag weighs 8 g and holds 63 g of water when soaked and 22 g of water when wrung out. The calculated salt and zeolite weight percentage for each batch is based upon a soaked rag containing 0.88 g/mL of calcium nitrate solution.

Each wetted rag contains 55.4 g $Ca(NO_3)_2$ = 63 mL solution × 0.88 g $Ca(NO_3)_2$ / mL solution

- Weight of salt in a batch = 277 g:
  - 5 rags × 55.4 g $Ca(NO_3)_2$ = 277 g of $Ca(NO_3)_2$
- Weight of zeolite in a batch = 3100 g
  - 1 gal. zeolite × 3100 g zeolite/gal. = 3100 g zeolite
- Weight of rags in a batch = 40 g
  - 5 rags × 8 g/dry rag = 40 g rags
- Total weight of a batch is = 3417 g
  - 277 g $Ca(NO_3)_2$ + 40 g rags + 3100 g zeolite = 3417 g

Weight percentage oxidizing chemical in a batch is 8.1 weight percentage = 277 g of $Ca(NO_3)_2$ /3417 g batch

Weight percentage zeolite is 90.7 weight percentage = 3100 g zeolite/3417 g batch

The calculated weight percentage oxidizing salt and zeolite in the dry treated product are 8.1 weight percentage and 90.7 weight percentage respectively, which is well within the BoK requirements (salt ≤30 weight percentage and zeolite ≥70 weight percentage) even when assuming that the WypAll rags are soaked with a calcium nitrate solution.

9.7 Basis of Knowledge Evaluation for Cheesecloth

Cheesecloth was used to clean up the glovebox when the LANL RNS waste was created. The cheesecloth will be combined with water, cut into 1 inch squares, and then mixed with 1 gal. of zeolite. Two cups of cheese cloth are blended in water for each batch and then mixed with 1 gal. of zeolite. Two cups of rags is approximately three rags. Each rag weighs 45 g and holds about 283 ml of water when soaked. The calculated salt and zeolite weight percentage for each batch is based upon a soaked rag containing 0.88 g/mL of calcium nitrate solution.

Each wetted cloth contains 249 g $Ca(NO_3)_2$ = 283 mL solution × 0.88 g $Ca(NO_3)_2$ / mL solution

- Weight of salt in a batch = 747 g:
  - 3 rags × 249 g $Ca(NO_3)_2$ = 747 g of $Ca(NO_3)_2$
- Weight of zeolite in a batch = 3100 g
  - 1 gal. zeolite × 3100 g zeolite/gal. = 3100 g zeolite
- Weight of rags in a batch = 135 g
  - 3 rags × 45 g/dry rag = 135 g rags
- Total weight of a batch is = 3982 g
  - 747 g $Ca(NO_3)_2$ + 135 g rags + 3100 g zeolite = 3982 g

Weight percentage oxidizing chemical in a batch is 18.8 weight percentage = 747 g of $Ca(NO_3)_2$ /3982 g batch

Weight percentage zeolite is 77.9 weight percentage = 3100 g zeolite/3982 g batch

The calculated weight percentage oxidizing salt and weight percentage zeolite in the dry treated product are 18.8 wt% and 77.9 weight percentage respectively, which is well within the BoK requirements (salt

≤30 weight percentage and zeolite ≥70 weight percentage) even when assuming that the cheesecloth is soaked with a calcium nitrate solution.

9.8 Basis of Knowledge Evaluation for Nonabsorbent Debris Waste

LANL intends to recover debris that is not absorbent, brush it off, and wipe it down before placing it in a daughter drum. Test work completed at SwRI on debris material (Section 7.0) found that debris that was not absorbent did not exhibit oxidizing behavior even when it was soaked in nitrate solutions or covered with nitrate salts. Section 5.7.1 of the BoK states that waste that has low porosity and is impermeable to liquids (e.g., glass, plastic, metal, undamaged waterproof lined fiberboard, Tyvek, Plexiglas) will not exhibit oxidizing behavior where there is no observable buildup of oxidizing chemical because of adhesion to the surface. This waste is considered to be surface-contaminated only.

9.9 Basis of Knowledge Evaluation for UNS Solid Waste

The waste found in UNS drums is nitrate salts and free liquids containing saturated nitrate salt solution. LANL plans to treat UNS nitrate salt waste by adding 1.33 qt of UNS salts to 1 gal. of zeolite as depicted in Figure 8. Bags used for UNS processing will be preweighed to ensure they contain at least 3200 g (a change was made from 3100 g to ensure we meet BoK requirements). The salts and zeolite would be blended as described above for RNS waste. The maximum weight percentage of oxidizing chemical in the treated waste is calculated to be 34.8 weight percentage based upon a conservative bulk density of 1.36 g/cc for the UNS salts. Table 5.4 of the BoK requires the weight percentage salt to be $\leq$35 weight percentage for this type of material and inorganic sorbent.

1.33 qt of salt with a bulk density of 1.36 will contain 1711 g of salt

- 1.33 qt salt × 946 mL/qt × 1.36 g salt/mL = 1711 g salt

Each batch will be combined with 3200 g of zeolite

The weight of each batch is 4911 g

- 3200 g zeolite + 1711 g of UNS salt = 4911 g/batch

Weight percentage salt in batch of treated UNS salt is 34.8 weight percentage

- 1711 g of salt / 4911 g batch = 34.8%

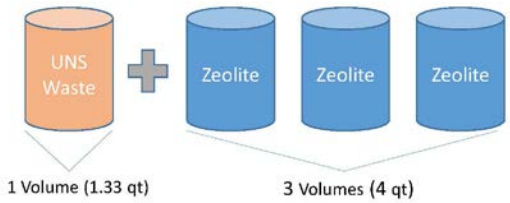


Figure 8 LANL UNS treatment recipe

9.10 Basis of Knowledge Evaluation for UNS Free Liquid Waste

Free liquids in the UNS waste are first mixed with zeolite to absorb the free liquids. The zeolite with absorbed liquids is then blended with zeolite following the recipe of 2.66 qt of zeolite with absorbed liquids to 2 qt of dry zeolite. The weight percentage of the chemical oxidizer in the batch of treated free liquid solution is 31.5 wt% based on the very conservative assumptions that the salt in the free liquids is composed of calcium nitrate (0.88 g/mL) and the zeolite being used has the holding capacity shown in Table 5.4 of the BoK for zeolite with a 4 Å pore size. The KMI zeolite that LANL will use has a typical pore size of 4.0 to 7.0 Å. Table 5.4 of the BoK requires the chemical oxidizer in the treated waste be equal to or less than 35 weight percentage for zeolite with a pore size of 4 Å.

The following data was used for the calculations in treating UNS free liquids:

- 1 gal. of KMI zeolite = 3100 g
- 1 qt of KMI zeolite = 775 g
- 2.66 qt of sorbed zeolite is mixed with 2 qt of KMI zeolite in each batch
- Zeolite with a holding capacity of 1.15 mL/g (Table 5.4 of the BoK)
- Calculations take solutions to dryness and use hydrated form of salts in denominator as specified in section 5.6.1 of the BoK

2.66 qt of zeolite will hold 2371 mL of saturated calcium nitrate solution:

- 2.66 qt zeolite × 775 g zeolite/qt × 1.15 mL $Ca(NO_3)_2$ sol/g zeolite = 2371 mL solution

2.66 qt of zeolite contains 2086 g $Ca(NO_3)_2$:

- 2371 mL solution × 0.88 g $Ca(NO_3)_2$/mL of solution = 2086 g $Ca(NO_3)_2$

Weight percentage chemical oxidizer in a dry treated LANL batch is 31.5 weight percentage using the zeolite in Table 5.4 of the BoK:

- Weight of chemical oxidizer (anhydrous) $Ca(NO_3)_2$ = 2086 g
- Weight of chemical oxidizer (hydrated) $Ca(NO_3)_2$+4 H_2O = 3002 g
- Weight of zeolite = 3612 g = 4.66 qt zeolite × 775 g/qt zeolite
- Weight of a batch = 6614 g = 3002 g $Ca(NO_3)_2$+4 H_2O + 3612 g zeolite
- Weight percentage $Ca(NO_3)_2$ = 31.5 weight percentage = [2086 g $Ca(NO_3)_2$/6614 g batch] × 100

KMI Zeolite that LANL will be using for processing RNS waste has a measured liquid holding capacity of 0.42 mL/g. This is 37% of the holding capacity of the zeolite identified in Table 5-4 of the BoK. The weight percentage chemical oxidizer in a batch of LANL-treated free liquid using KMI zeolite with a liquid holding capacity of 0.42 mL/g is 16.2 weight percentage—much less than the BoK requirement that the dry treated material contain ≤35 weight percentage oxidizing chemicals. Calculations are not provided because this is less conservative than the above calculations using zeolite with a liquid holding capacity of 1.15 mL/g in Table 5.4 of the BoK.

9.11 Effectiveness of Zeolite Sorption of Acidic Saturated Nitrate Salt Solutions

Section 5.4 of the BoK requires neutralization of liquid prior to sorption. In discussion with the authors of the BoK, it was evident that the requirement was derived over concern that a decrease in effectiveness of

sorbents will occur in the presence of strong acids. In our work, we are concerned with the potential of nitric acid (borderline on its characterization as a strong acid) to disrupt the zeolite molecular structure. In discussions with KMI, their studies have demonstrated that zeolite modifications require forcing conditions, including the use of heat. In addition, and as noted previously, we tested the sorption properties of 7 M nitric acid saturated with salt solution and found that at volume ratios of 4:1 zeolite to liquid, that dewatering does not take place.

10. CONCLUSIONS

Small-scale EPA SW-846 and UN DOT testing was conducted (1) to establish the characteristics of surrogates of nitrate salt mixtures and to ensure they bound the expected waste form and (2) to establish the effectiveness of stabilization technologies against the expected components found in both the UNS and RNS waste forms. The preferred option, stabilization using zeolite that uses water as a processing aid, was found to be effective at eliminating both characteristics of D001 and D002 for these materials. Further testing using the specific remediation process planned for use at WCRRF was also conducted to further demonstrate the effectiveness of the planned remedy. The planned remedy for LANL RNS and UNS wastes is also consistent with the BoK guidelines for acceptance of transuranic waste with oxidizing chemicals at WIPP after treatment.

Cementation was found to be effective at removing D001 for a subset of the waste stream. Further testing was suspended after the effectiveness of adding zeolite was demonstrated and after consulting with experts on transuranic waste who identified potential issues with cementation as a remedy (dewatering, void generation, etc.).

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Appendix A
SW 846 Test Method 1030

METHOD 1030

IGNITABILITY OF SOLIDS

1.0 SCOPE AND APPLICATION

1.1 This method is suitable for the determination of the ignitability of solids and is appropriate for pastes, granular materials, solids that can be cut into strips, and powdery substances. This method may be used to meet certain regulatory applications; with respect to the characteristic of ignitability in CFR § 261.21, this method may be used, but is not required, to determine whether a solid waste "when ignited, burns so vigorously and persistently that it creates a hazard." If it is impractical to perform the test because of the physical form of the sample, generator knowledge should be used to determine the ignitability hazard posed by the material.

2.0 SUMMARY OF METHOD

2.1 In a preliminary test, the test material is formed into an unbroken strip or powder train 250 mm in length. An ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within a specified time period. Materials that propagate burning along a 200 mm strip within the specified time period are then subjected to a burning rate test. Materials that do not ignite or propagate combustion as described above do not require further testing. In the burning rate test, the burning time is measured over a distance of 100 mm and the rate of burning is determined. The test method described here is based on the test procedure adopted by the Department of Transportation from the United Nations regulations for the international transportation of dangerous goods and is contained in Appendix E to Part 173 of 49 CFR.

3.0 INTERFERENCES

3.1 In laboratory tests the burning rate of duplicate runs is usually repeatable to within 10%. However, large differences in burning rates may occur if experimental conditions are not held constant. Variation in airflow rates, particle size, and moisture content of the test material will affect test results. Therefore, at least triplicate determinations of the burning rate should be conducted.

3.2 Particle size of test material can affect not only the burning rate, but also the ignition of the material. Therefore, the particle size of the test material should be the same for each test run. The particle size of the test material should be reported in a simple descriptive format (e.g., fine powder, sand, coarse granular).

3.3 Temperature of some test material such as sulfur powder affects the burning rate. For reproducible results, all tests should be performed at approximately the same initial temperature (ambient room or laboratory temperature).

3.4 All tests must be carried out inside a fume hood with the test apparatus situated perpendicular (90°) to the direction of airflow. Airflow parallel (0 °) to the test apparatus results in non-reproducible burning rates.

3.5 The rate of airflow through the fume hood affects the burning rate. Too high an airflow distorts the flame and retards its horizontal propagation. The optimum airflow appears to be in the range of 0.7-1 meter per second.

3.6 Materials that are moisture sensitive (i.e., readily absorb moisture from air) should be tested as quickly as possible after removal from the sample container. All materials should be tested as received by the laboratory.

4.0 APPARATUS AND MATERIALS

4.1 Low-heat conducting, non-combustible, impervious ceramic tile or equivalent material, of approximate dimension of 25 cm x 25 cm x 2.5 cm (the tile must be at least 25 cm in length to support a 250 mm test sample).

4.2 High temperature marker or equivalent marking device for marking ceramic plates.

4.3 Powder Train Mold (see Figure 1) for molding powdered and granular materials for the burn rate test. The material of construction can be aluminum, brass, stainless steel, or plastic. The mold is 250 mm in length and has a triangular cross-section, with a width of 20 mm, and a depth of 10 mm as measured from the bottom of the triangular opening to where the sides meet. On both sides of the mold, in the longitudinal direction, two sheets are mounted as lateral limitations which extend 2 mm beyond the upper edge of the triangular cross-section. This device can be fabricated by most machine shops. The complete burn rate apparatus is available from: Associated Design and Manufacturing Co.; 814 N. Henry Street; Alexandria, Virginia 22314.

4.4 A Bunsen (propane gas and air) burner with a minimum diameter of 5 mm capable of attaining a temperature of at least 1,000^{o}C.

4.5 Stop watch.

4.6 Thermocouple to measure the temperature of the gas flame.

4.7 Thermometer to measure initial temperature of material (i.e., room temperature).

4.8 Anemometer to measure airflow in the fume hood.

5.0 REAGENTS

5.1 No special reagents are required to conduct this test.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 All samples are tested on as-received basis unless requested otherwise. No sample preservation is required, but sample containers should be completely filled and tightly sealed to preserve sample integrity.

6.2 Samples should be tested as soon as possible after removal from the sample container (i.e., samples should not be allowed to dry or absorb moisture for excessive periods or to

lose volatiles). Samples that are chilled or cooled upon receipt to the laboratory should be allowed to equilibrate to the ambient laboratory temperature in the sample container.

7.0 PROCEDURE

SAFETY: Prior to starting the preliminary test, all sample materials must be tested to determine if that material is explosive or extremely flammable. Use a very small portion of material (1 gram or less). If the sample displays explosivity or extreme flammability, do not conduct this test.

7.1 Preliminary Screening Test

7.1.1 The preliminary ignitability test is conducted on all waste materials. On a clean, impervious ceramic tile (Section 4.1), clearly mark a 250 mm long test path. Make another mark at exactly 200 mm from the start of the sample path.

7.1.2 Prepare the test material in its "as received" form by forming an unbroken strip or powder train of sample 250 mm long by 20 mm wide by 10 mm high on the ceramic tile. Use the mold to form the material as in 7.2.3 if appropriate.

7.1.3 Place the ceramic tile with the loaded sample in a fume hood about 20 cm (~8 inches) from the front of the hood and in an area of laminar airflow. Position the sample perpendicular to the airflow. (See Figure 2) The airflow across the perpendicular axis of the sample should sufficient to prevent fumes from escaping into the laboratory and should not be varied during the test. The air velocity should be approximately 0.7 meters/second. Measure the air velocity by an anemometer.

7.1.4 Light the Bunsen burner and adjust the height of the flame (6.5 to 7.5 cm) by adjusting the propane gas and air flows. Measure the temperature of the flame (tip of the flame) by a thermocouple. The temperature of the flame must be at least 1000°C.

7.1.5 Apply the tip of the flame to one end of the sample strip . The test period will depend on the sample matrix as follows:

7.1.6 If the waste is non-metallic, hold the flame tip on the sample strip until the sample ignites or for a maximum of 2 minutes. If combustion occurs, begin timing with a stop watch and note whether the combustion propagates up to the 200 mm mark within the 2 minute test period.

7.1.7 If the waste is a metal or metal-alloy powder, hold the flame tip on the sample strip until the sample ignites or for a maximum of 5 minutes. If combustion occurs, begin timing with a stop watch and note whether the combustion propagates up to the 200 mm mark within the 20 minute test period.

7.1.8 If the waste does not ignite and propagate combustion either by burning with open flame or by smoldering along 200 mm of sample strip within the 2 minute test period (or 20 minute test period for metal powders), the waste is not considered flammable and no further testing is required. If the waste propagates burning of 200 mm of the test strip within

the 2 minute test period (20 minute test period for metals), the material must be evaluated by the burning rate test (Section 7.2).

7.2 Burning Rate Test

7.2.1 The preparation of the test sample for the burning rate test will depend on the physical characteristics of the waste. Wastes that exist in a powdered or granular state are molded in a powder train mold shown in Figure 1. Pasty materials are formed into a rope 250 mm in length with a cross-section of 1 cm^2. All tests for the burn rate test are performed on clean, ambient temperature, ceramic plates.

7.2.2 On a clean, impervious ceramic tile (Section 4.1), clearly mark a 250 mm long test path. Make two additional timing marks at 80 mm and 180 mm from the start of the sample path. The distance between the two marks (100 mm) will be used to calculate the rate of burn in Section 7.2.9.

7.2.3 Tighten the side plates on the mold. For powdered or granular materials: Place the mold on the base plate. Pour the material to fill the triangular cross section of the mold loosely.

7.2.4 Drop the unit from a height of 2 cm onto a solid surface three times to settle the powder. Remove the side supports. Lift the mold off the base plate. Place a clean ceramic test plate with the appropriate timing marks (Section 7.2.2) face down on top of the mold. Invert the setup and remove the mold.

7.2.5 Pasty wastes are prepared by spreading the waste on a marked ceramic tile (Section 7.2.2) in the form of a rope 250 mm in length with a cross-section of 1 cm^2.

7.2.6 Place the ceramic tile with the loaded sample prepared in Sections 7.2.3 or 7.2.5 in a fume hood about 20 cm (~8 inches) from the front of the hood and in an area of laminar airflow. Position the sample perpendicular to the airflow. (See Figure 2) The airflow across the perpendicular axis of the sample should sufficient to prevent fumes from escaping into the laboratory and should not be varied during the test. The air velocity should be approximately 0.7 meters/second. Measure the air velocity with an anemometer.

7.2.7 Light the Bunsen burner and adjust the height of the flame (6.5 to 7.5 cm) by adjusting the propane gas and air flows. Measure the temperature of the flame (tip of the flame) by a thermocouple. The temperature of the flame must be at least 1000°C.

7.2.8 Apply the tip of the flame to one end of the sample strip to ignite the test strip as described in Section 7.1.6 and 7.1.7.

7.2.9 When the test strip or powder train has burned up to the 80 mm time marker, begin timing the rate of combustion with a stop watch. Stop the timer when the burned strip reaches the 180 mm time marker. Record the amount of time (in seconds) required to burn the 100 mm test strip. Calculate the rate of burning by dividing the length of the burn test strip (100 mm) by the total time (seconds). Results of the burn rate test should be reported in mm/sec. Wastes that have a rate of burning of more than 2.2 mm/sec (or burn time of less than 45 seconds for 100 mm) are considered to have a positive result for ignitability

according to DOT regulations. For metals, this time is 10 minutes or less for 100 mm (or a burn rate of more than 0.17 mm/sec).

7.2.10 Report and Calculation Section

Test Material Information

Source of Material: e.g., Company, operation or process
Description of material: e.g., powder or paste, metallic or non-metallic
Particle size: e.g., fine powder, granular, sand, etc.
Preliminary Burning Time: ____ seconds.

Test Conditions

Date of Test:
Temperature of test material (°C):
Air velocity through fume hood (m/s):

Ignitability Test Data				
Test Number	Time (sec) elapsed between application of flame and start of ignition	Burning time over 100 mm (sec)	Burning Rate (mm/sec)	Comments
1				
2				
3				

8.0 QUALITY CONTROL

8.1 All tests must be performed on a clean ceramic plate at room temperature. All samples must have been collected using a sampling plan that addresses the considerations discussed in Chapter Nine of this manual.

8.2 All replicate runs must be at the same initial temperature (ambient laboratory temperature).

8.3 All replicate tests must be run at approximately the same airflow through the fume hood.

8.4 Only materials of the same particle size distribution should be used for all replicate tests.

8.5 The burn rate test must be conducted in triplicate if the preliminary screening test is positive. Any burn rate for non-metallic samples that exceeds 2.2 mm/sec (or a burn time of less than 45 seconds for 100 mm) is considered to have a positive result. For metals, a burn rate of more than 0.17 mm/sec (or burn time of less than 10 minutes for 100 mm) is considered to have a positive result.

9.0 METHOD PERFORMANCE

9.1 An independent laboratory validation was conducted on the robustness of the burn rate test procedure. The materials selected for this evaluation included:

1. A 50/50 mixture of metallic silicon and lead dioxide ($Pb0_2$)
2. Excelsior
3. Dextrin (yellow powder)
4. Sulfur (fine yellow powder)
5. Aluminum metal (coarse)
6. Magnesium metal (coarse)
7. Polyethylene high density (granular)
8. Polyethylene low density (fluffy white powder)
9. Scott fertilizer (32-3-10:N-P-K)
10. JP-4 contaminated soil (approximately 5000 ppm)

Of these materials, the 50/50 mixture of metallic silicon and lead dioxide ($Pb0_2$), elemental sulfur, and excelsior were considered to give a positive ignitability result under the conditions of the test. The remaining materials gave negative (nonflammable) results under the conditions of the test. Several test variables including ignition source, ambient temperature, and apparatus orientation, were studied using these materials. Partial results of this study are summarized in Table 1.

9.2 In another evaluation of the DOT burn rate test, potentially ignitable finishing wastes from the furniture industry were collected and tested for burning rates. Each waste was tested in triplicate to establish a mean value for the burning rate. The results for the flammable wastes are summarized in Table 2.

9.3 In order to evaluate the ruggedness of the DOT burn rate test, select ignitable finishing wastes were split and tested by a state laboratory and an independent contract laboratory. The results of this comparison are summarized in Table 3.

10.0 REFERENCES

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TABLE 1
TEST VARIABLES FOR IGNITABILITY

Material Tested	Test Number	Variable combination[1]	Burn Time over 100 mm (sec)	Burn Rate (mm/sec)
50% Metallic Silicon and 50% Lead IV Oxide	1	ABC	0.84	119
	2	Abc	0.50	200
	3	aBc	0.69	145
	4	abC	0.65	154
Excelsior (wood shavings)	1	ABC	13.45	7.43
	2	Abc	9.14	10.9
	3	aBc	13.37	7.47
	4	abC	13.59	7.36

[1]where:

A-flame ignition
a-hot wire ignition source
B-ambient temperature of 20°C
b-ambient temperature of 100°C
C-orientation of test apparatus of 90° to air flow
c-orientation of test apparatus of 0° to air flow

TABLE 2
BURNING RATES FOR IGNITABLE WASTES

Sample No.	Description of Waste	Burn Time over 100 mm (sec)	Burn Rate (mm/sec)
A2	Segregated Lacquer Dust	4.7	21.3
J2	Segregated Lacquer Dust	4.6	21.7
U	Segregated Lacquer Dust	8.6	11.6
K	Consolidated Lacquer Dust	6.0	16.7
H	Catalyzed Lacquer Dust	6.7	14.9
F	Water Based Lacquer Dust	19.4	5.15
P	Booth Coat-Stain Overspray	12.5	8.0
O	Pallet Covered Cardboard	11.1	9.0
Q	Pallet Covered Cardboard	12.3	8.13

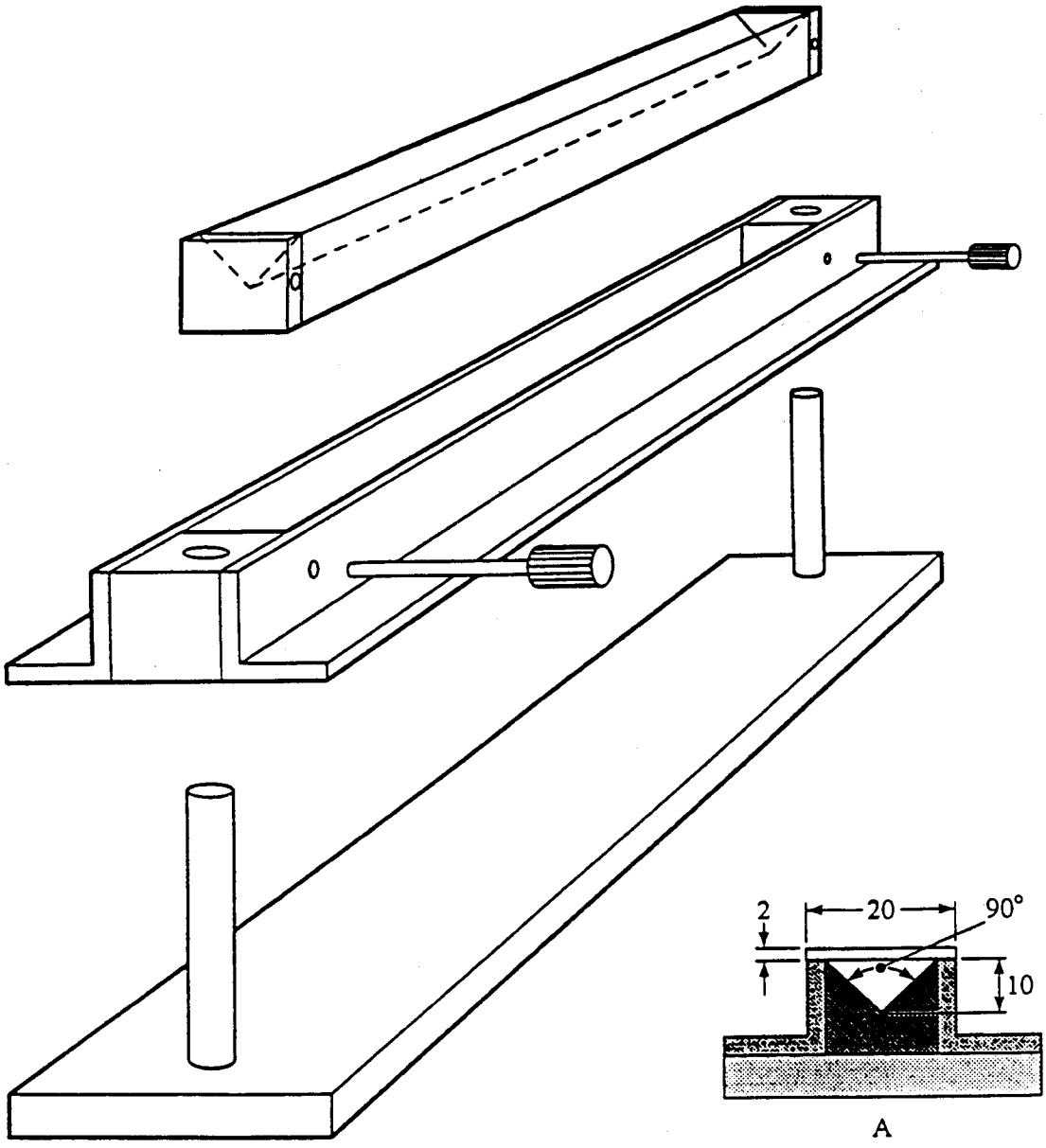
TABLE 3
COMPARISON OF BURN RATES

Sample No.	Description of Waste	Mean Burn Time Over 100 mm in Seconds	
		State Laboratory	Contract Laboratory
A1	Segregated Lacquer Dust	4.7	5
J1	Segregated Lacquer Dust	4.6	4.3
12	Booth Coat-Glaze Overspray	0[1]	0[1]

[1] Waste was found to be nonflammable under conditions of the test.

Figure 1

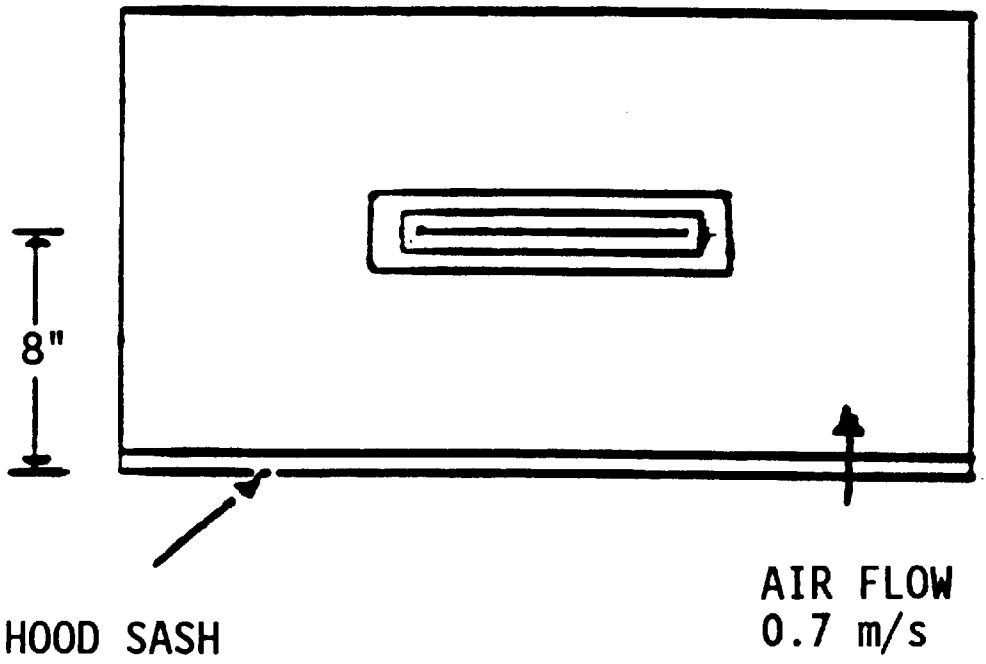
Powder Train Mold



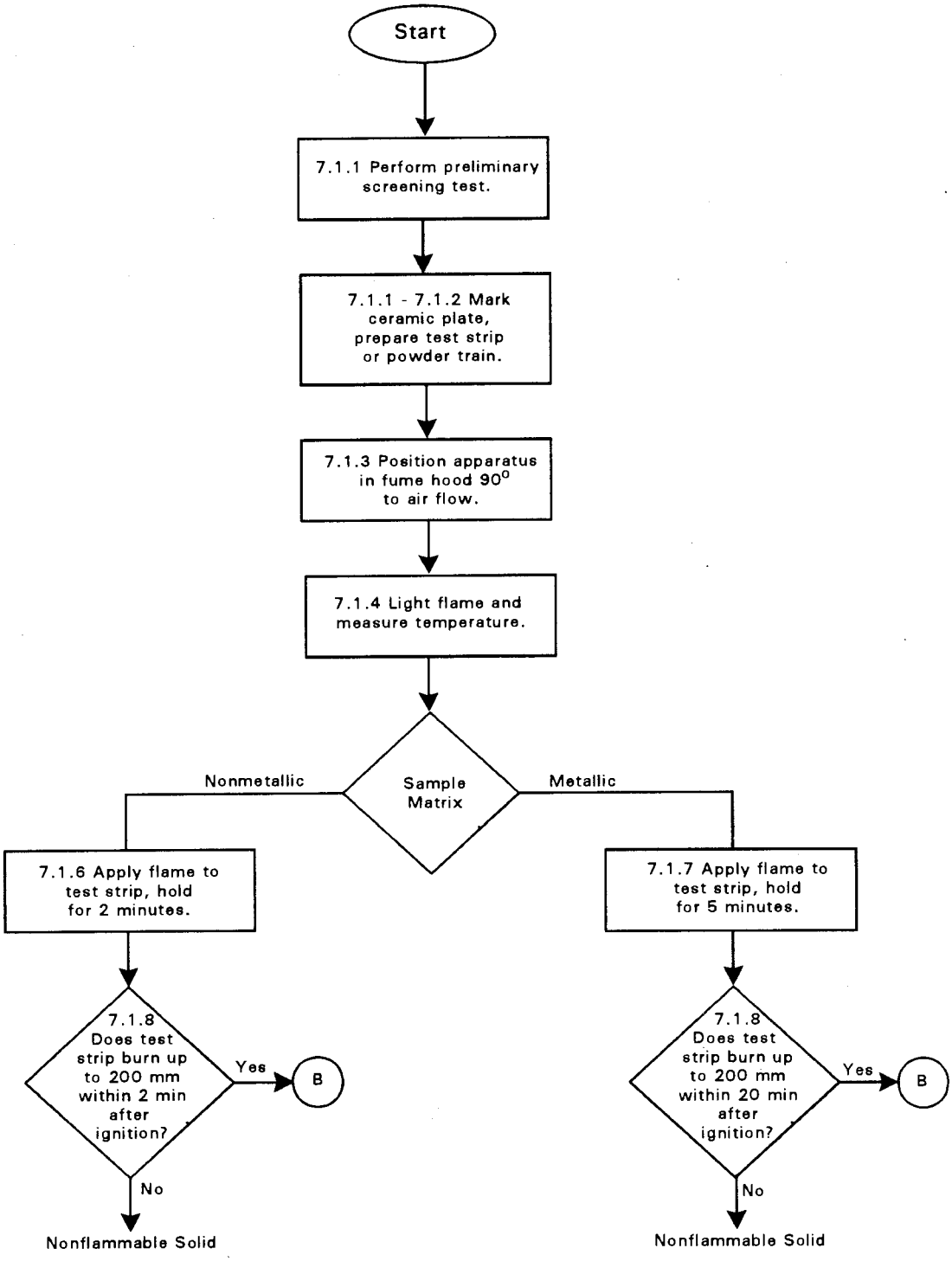
(A) Cross-section of 250 mm long mould

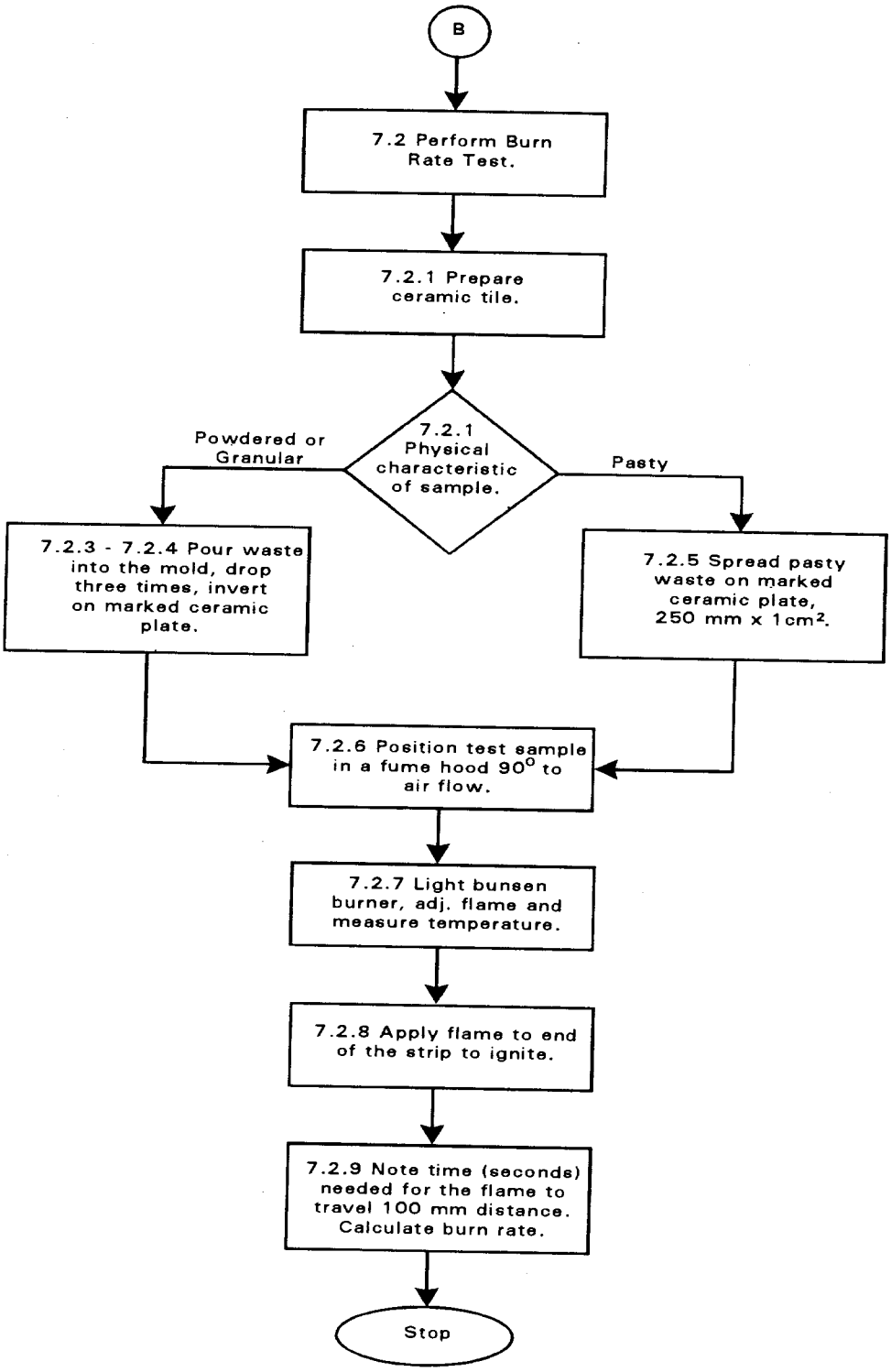
Figure 2

Test Apparatus Position in Fume Hood



SAMPLE 90° TO AIR FLOW


Start
7.1.1 Perform preliminary screening test.
7.1.1 - 7.1.2 Mark ceramic plate, prepare test strip or powder train.
7.1.3 Position apparatus in fume hood 90° to air flow.
7.1.4 Light flame and measure temperature.
Sample Matrix
Nonmetallic
Metallic
7.1.6 Apply flame to test strip, hold for 2 minutes.
7.1.7 Apply flame to test strip, hold for 5 minutes.
7.1.8 Does test strip burn up to 200 mm within 2 min after ignition?
Yes
B
No
Nonflammable Solid
7.1.8 Does test strip burn up to 200 mm within 20 min after ignition?
Yes
B
No
Nonflammable Solid


B
7.2 Perform Burn Rate Test.
7.2.1 Prepare ceramic tile.
7.2.1 Physical characteristic of sample.
Powdered or Granular
Pasty
7.2.3 - 7.2.4 Pour waste into the mold, drop three times, invert on marked ceramic plate.
7.2.5 Spread pasty waste on marked ceramic plate, 250 mm x 1cm².
7.2.6 Position test sample in a fume hood 90° to air flow.
7.2.7 Light bunsen burner, adj. flame and measure temperature.
7.2.8 Apply flame to end of the strip to ignite.
7.2.9 Note time (seconds) needed for the flame to travel 100 mm distance. Calculate burn rate.
Stop

Appendix B
SW 846 Test Method 1050

METHOD 1050

TEST METHODS TO DETERMINE SUBSTANCES LIKELY TO SPONTANEOUSLY COMBUST

SW-846 is not intended to be an analytical training manual. Therefore, method procedures are written based on the assumption that they will be performed by analysts who are formally trained in at least the basic principles of chemical analysis and in the use of the subject technology.

In addition, SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods which contain general information on how to perform an analytical procedure or technique which a laboratory can use as a basic starting point for generating its own detailed Standard Operating Procedure (SOP), either for its own general use or for a specific project application. The performance data included in this method are for guidance purposes only, and are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

1.0 SCOPE AND APPLICATION

1.1 This method provides test procedures which may be used to evaluate and categorize liquid and solid wastes that are likely to spontaneously combust. The method is based on the DOT regulations for the transport of spontaneously combustible materials as provided in 49 CFR Part 173, Appendix E. These test procedures are intended to identify two types of wastes with spontaneous combustion properties:

- Wastes (including mixtures and solutions, liquid or solid) which, even in small quantities, ignite within five minutes of coming in contact with air. These wastes are the most likely to spontaneously combust and are considered to have pyrophoric properties.

- Other solid wastes which, in contact with air and without an energy supply, are susceptible to self-heating. These wastes will ignite only when in large amounts (kilograms) and after long periods of time (hours or days) and are considered to have self-heating properties.

1.2 This method is not required by the Federal regulations to determine if a waste passes or fails the characteristic of ignitability according to the RCRA regulatory definition at 40 CFR 261.21. To clarify, the test results of this method cannot be used to directly classify a waste as a D001 hazardous waste, nor can the results be used by themselves to definitively classify a waste as non-hazardous. No specific test for ignitable solids is required by the RCRA regulations, and only a waste meeting the narrative regulatory definition at 40 CFR 261.21(a)(2) is an ignitable hazardous waste because it is an ignitable solid. In addition, the test in this method for a liquid may be helpful in determining whether a liquid waste has hazardous properties; however, a liquid waste is only a D001 hazardous waste if it is an oxidizer, as defined at 40 CFR 261.21(a)(4), or based on its flash point, as defined at 40 CFR 261.21(a)(1). This test method was developed to specifically illustrate the ignitable properties of materials, including wastes, and its results provide relevant and useful information that may be applied to knowledge of a waste in determining whether a waste meets the 40 CFR 261.21 criteria.

1.3 This method provides three separate test procedures for evaluating the spontaneous combustion properties of solid and liquid wastes. Refer to Sec 3.0 for definitions of some terms.

1.3.1 Test Method A is designed to evaluate the potential of a solid waste to spontaneously combust when exposed to air and may be used to classify pyrophoric solids.

1.3.2 Test Method B is used to evaluate and classify liquids that demonstrate pyrophoric properties.

1.3.3 Test Method C is used to evaluate a solid waste for self-heating properties when exposed to a test temperature of 140 °C and to determine whether the waste will undergo spontaneous ignition under the experimental conditions. Test Method C is not suitable for liquid wastes.

1.4 Prior to employing this method, analysts should consult the disclaimer statement at the front of the manual and the information in Chapter Two for guidance on the intended flexibility in the choice of methods, apparatus, materials, reagents, and supplies, and on the responsibilities of the analyst for demonstrating that the techniques employed are appropriate for the analytical objectives.

In addition, analysts and data users are advised that, except where explicitly specified in a regulation, the use of SW-846 methods is *not* mandatory in response to Federal testing requirements. The information contained in this method is provided by EPA as guidance to be used by the analyst and the regulated community in making judgments necessary to generate results that meet the data quality objectives for the intended application.

1.5 Use of this method is restricted to use by, or under supervision of, properly experienced and trained personnel. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 Test Method A -- Pyrophoric solids

Test Method A is performed to determine if a solid ignites within five minutes of coming in contact with air at ambient room temperature. A representative sample of waste is dropped from a height of one meter onto a non-combustible surface, the waste is observed to determine whether the waste ignites while dropping or within five minutes of settling. If ignition is not observed, this test is repeated five times or until a positive result is obtained, whichever occurs first. The results of this test may be used to classify a solid waste as having pyrophoric properties.

2.2 Test Method B -- Pyrophoric liquids

Test Method B consists of a two part procedure that may be used to determine if a liquid waste ignites when exposed to air at ambient temperature. In the preliminary test, a representative liquid sample is added to an inert carrier in a porcelain cup at ambient temperature and the mixture is observed to determine if the liquid ignites within five minutes. If ignition is not observed, this test is repeated five times or until a positive result is obtained. If no ignition occurs, the liquid waste is then delivered onto a Whatman filter paper to determine whether ignition or charring occurs on the filter paper within five minutes. If ignition or charring is not observed, this part of the test is repeated two times or until a positive result is obtained, whichever occurs first. The results of this test may be used to classify liquids as having pyrophoric properties.

2.3 Test Method C -- Self-heating wastes

CAUTION: Test A must be run before Test C is conducted. If the waste is pyrophoric, then Test C must not be run on the waste. Also, this procedure is not suitable for liquid wastes.

2.3.1 Test Method C may be performed to determine whether a solid waste exhibits self-heating properties. This test procedure is limited to granular solids, pastes, and other solid wastes that can be reduced in particle size to fit into a 25-mm or 100-mm stainless steel cube. Solid wastes that show pyrophoric properties as demonstrated by Test Method A must not be evaluated by this test.

2.3.2 In a preliminary test, a 100-mm sample cube is exposed to a test temperature of 140 ± 2 °C for 24 hours and the sample is observed to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200 °C within 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste. See Table 6 for DOT Classification of self-heating solid wastes.

2.4 The presence of any smoke, incandescence, or flame under the test conditions provided should be interpreted as a positive result for spontaneous combustion. A positive result for Test Method A or B is readily demonstrated by smoke, flame, charring of the paper filter, and a positive result for Test Method C is demonstrated by spontaneous ignition or a significant increase in sample temperature. The analyst should be consistent with ignition recognition and record any visible signs of combustion including smoke, heat, flame, or incandescence. Ignition in any of the trials is considered a positive result, even when the results of the other trials are negative.

3.0 DEFINITIONS

The following definitions are specific to this method and are intended solely as guidance to assist the user in properly classifying wastes that are liable to spontaneous combustion.

3.1 Pyrophoric solids -- For the purpose of this method, a pyrophoric solid is any solid that spontaneously ignites when tested in accordance with the test procedure given in Sec. 11.1 of this method. Ignition is demonstrated by the presence of observable smoke, flame, or incandescence.

3.2 Pyrophoric liquids -- For the purpose of this method, a pyrophoric liquid is any liquid that spontaneously ignites or chars filter paper when tested in accordance with the test procedures given in Secs. 11.2 and 11.3 of this method. Ignition is demonstrated by the presence of observable smoke, flame, incandescence, or the charring of the filter paper.

3.3 Self-heating substances -- For the purpose of this method, a self-heating substance is any solid that spontaneously ignites or shows an increase in temperature above 200 °C when tested in accordance with the test procedure given in Sec. 11.4 of this method.

4.0 INTERFERENCES

No specific interferences for this test have been determined. The presence of any smoke, incandescence, or flame under the test conditions provided should be interpreted as a positive result for spontaneous combustion.

5.0 SAFETY

5.1 This method does not address all safety issues associated with its use. The laboratory is responsible for maintaining a safe work environment.

5.2 This test requires the combustion of potentially highly flammable materials and the possible generation of toxic fumes. All tests must be conducted in a suitable fume hood fitted with a pull-down sash to prevent the escape of toxic fumes into working areas. The analyst should wear appropriate protective clothing, including a laboratory jacket or apron, safety glasses, and protective gloves. The laboratory should have appropriate fire fighting equipment (such as a Class A fire extinguisher) readily available to extinguish small fires.

5.3 This test may need to be conducted in a specially designed facility if proper surveillance and safety precautions are not available in the laboratory. Analysts are encouraged to use a flammability screening test such as ASTM 4982 prior to this procedure to test for highly flammable wastes.

5.4 Once the experiment is started, the oven should not be opened, especially if the sample temperature is observed to rise above 140 °C. Opening the oven when the sample is at an elevated temperature could increase the potential for a fire. Therefore, the oven and sample temperature should be allowed to return to ambient temperature before the oven is opened.

6.0 EQUIPMENT AND SUPPLIES

The mention of trade names or commercial products in this manual is for illustrative purposes only, and does not constitute an EPA endorsement or exclusive recommendation for use. The products and instrument settings cited in SW-846 methods represent those products and settings used during method development or subsequently evaluated by the Agency. Glassware, reagents, supplies, equipment, and settings other than those listed in this manual may be employed provided that method performance appropriate for the intended application has been demonstrated and documented.

This section does not list common laboratory glassware (e.g., beakers and flasks).

6.1 Stop watch or clock -- Any timing device.

6.2 Measuring device, one meter -- Any measuring device capable of measuring one meter.

6.3 Low-heat conducting, non-combustible, impervious ceramic tile or equivalent material of sufficient size to support a 1-2 g test sample dropped from the height of one meter.

6.4 Porcelain or metallic crucible, low, wide form, 250-mL capacity, with a 4-inch (approximately 100-mm) diameter opening, heat resistant.

6.5 Whatman No. 3 filter paper, of sufficient diameter to support 0.5 mL of a test liquid sample.

6.6 Glass beaker with sufficient diameter to support the Whatman No. 3 filter paper across its opening.

6.7 Silica gel, fine granules.

6.8 Syringe, glass dropper, or disposable glass pipet -- To deliver a 5-mL test liquid sample.

6.9 Circulating type of oven with an inner volume of more than 9 L and capable of controlling the internal temperature at 140 ± 2 °C.

6.10 Wire mesh cubic sample containers, 25 mm x 25 mm and 100 mm x 100 mm sizes, made of stainless steel net with a mesh opening of 0.05 mm, with open tops.

6.11 Wire mesh outer container, mesh size 0.595 mm, 150 mm x 150 mm x 250 mm (L x W x H). Used to house the 25-mm and 100-mm wire mesh cube containers.

6.12 Two Chromel-Alumel thermocouples (Omega Engineering part number TJ36-CAIN-18U-18), or equivalent device, for monitoring oven and sample temperatures.

6.13 Two single-point electronic thermometers (Omega Engineering part Number HH-81), or equivalent device, for continuous temperature monitoring and recording.

7.0 REAGENTS AND STANDARDS

This procedure does not require any standards or reagents.

8.0 SAMPLE COLLECTION, PRESERVATION AND STORAGE

8.1 Sample collection

Pyrophoric solids and liquids must be collected, transported and stored in a manner to exclude all contact with air. Due to the obvious safety concerns associated with potentially pyrophoric wastes, the sample size should be minimized to only that amount required to perform the appropriate test. For the pyrophoric solids or liquids test, a sample the size of 10 g or 35 mL is sufficient. For the self-heating test, a sample size of 50 - 100 g may be sufficient.

8.2 Sample preservation

No chemical sample preservation is required for this test.

8.3 Sample storage

The sample must be collected, transported, and stored in a manner to exclude all contact with air. Materials known or suspected to have self-heating properties should be stored in a cool place away from heat sources.

8.4 Holding time

Due to the lack of an established holding time for this parameter, all samples should be analyzed as soon as possible.

9.0 QUALITY CONTROL

9.1 Any effort involving the collection of analytical data should include development of a structured and systematic planning document, such as a Quality Assurance Project Plan (QAPP) or a Sampling and Analysis Plan (SAP), which translates project objectives and specifications into directions for those that will implement the project and assess the results. Each laboratory should maintain a formal quality assurance program. The laboratory should also maintain records to document the quality of the data generated. All data sheets and quality control data should be maintained for reference or inspection.

9.2 Test Methods A and B are conducted using multiple trials, unless a positive result is obtained in one of the trials, no further testing is required. A positive test is indicated by smoke, fire, incandescence, or other observable signs of spontaneous combustion. Ignition in any of the trials is considered a positive result, even when the results of the other trials are negative. These tests are operationally defined and the results of the tests depend on the observations and interpretations made by the analyst. No reference standards are currently available for these tests. No other quality control procedures are required for this procedure.

10.0 CALIBRATION AND STANDARDIZATION

This procedure does not require any external calibration or standardization techniques. Currently, there is no reference material available for this test. EPA does not believe that the use of such a material would enhance the performance of the method because a positive result for Test Methods A or B is readily demonstrated by smoke, flame, charring of the paper filter, and for Test Method C is readily demonstrated by spontaneous ignition or a significant increase in sample temperature. The analyst should be consistent with ignition recognition and record any visible signs of combustion including smoke, heat, flame, or incandescence.

11.0 PROCEDURE

WARNING: This test may need to be conducted in a specially designed facility if proper surveillance and safety precautions are not available in the laboratory. Analysts are encouraged to use a flammability screening test such as ASTM 4982 prior to this procedure to test for highly flammable wastes.

11.1 Test Method A -- Pyrophoric solids

Test Method A is performed to determine if a solid ignites within five minutes of coming in contact with air at ambient room temperature. All tests must be conducted in a fume hood to prevent the escape of toxic fumes or flames into working areas.

11.1.1 The waste should be tested in its "as received" form and should not be dried. If the waste was stored at $\leq$6 °C, it should be allowed to equilibrate to ambient temperature. Under no circumstances should the sample be opened and allowed to come into contact with air prior to conducting the test.

11.1.2 Position a ceramic tile (Sec. 6.3) in a fume hood about 20 cm (approximately 8 in) from the front of the hood in an area of laminar airflow. Airflow across the test area should be minimal, but sufficient to prevent the escape of fumes or smoke into working areas.

11.1.3 From the surface of the ceramic tile, measure a vertical distance equal to one meter above the tile surface. Attach a reference mark on the side of the hood or use some other means to identify this height.

11.1.4 Using a metal spatula or other suitable device, aliquot a 1 to 2 g sample of solid and quickly pour the sample from the height of one meter onto the surface of the ceramic tile.

11.1.5 Observe whether the test sample ignites during dropping or within 5 min of settling. Begin timing as soon as the test sample has settled onto the ceramic tile surface.

11.1.6 Ignition is demonstrated by the presence of observable smoke, flame, or incandescence. If spontaneous combustion is observed within the 5-min test period, no further testing is required. If no observable signs of combustion are initially observed, repeat the test five additional times with a fresh sample each time or until a positive result is observed, whichever occurs first.

11.2 Test Method B -- Pyrophoric liquids, porcelain cup test

11.2.1 All tests must be conducted in a fume hood. Place a porcelain or metallic crucible (Sec. 6.4) into the center of a fume hood. Pour enough silica gel (Sec. 6.7) into the crucible to cover the bottom of the crucible to a depth of approximately 5 mm.

11.2.2 Using a pipet or other suitable measuring device (Sec. 6.8), quickly transfer approximately 5 mL of the liquid waste into the bottom of the crucible containing the bed of silica gel.

11.2.3 Begin timing and observe whether the test sample ignites within 5 min.

11.2.4 Ignition is demonstrated by the presence of observable smoke, flame, or incandescence. If spontaneous combustion is observed within the 5 min test period, no further testing is required. If no observable signs of combustion are observed, repeat the test five additional times with a fresh sample aliquot and silica gel for each test, or until a positive result is observed, whichever occurs first. If the results of all six trials are negative, proceed to the filter paper test for pyrophoric liquids in Sec. 11.3.

11.3 Test Method B -- Pyrophoric liquids, filter paper test

11.3.1 Position a glass beaker (Sec. 6.6) in a fume hood about 20 cm (approximately 8 inches) from the front of the hood in an area of laminar airflow. The glass beaker should be of sufficient diameter to support a circular Whatman No. 3 filter paper, such that both sides of the filter paper are exposed to air. To assist in the placement of the filter paper over the beaker opening, tape or other mechanical devices may be used as long as the tape or mechanical device does not come into contact with the test sample. Airflow across the test area should be minimal, but sufficient to prevent the escape of fumes or smoke into working areas.

11.3.2 Using a pipet or other suitable measuring device (Sec. 6.8), quickly aliquot approximately 0.5 mL of the liquid waste onto the center of the filter paper. Begin timing and observe whether ignition or charring occurs on the filter paper within a 5-min test period. Ignition is demonstrated by the presence of observable smoke, flame, or incandescence. If spontaneous combustion is observed within the 5-min test period, no further testing is required. If ignition or charring is not observed, repeat the test two additional times using a fresh filter paper and sample aliquot, unless a positive test result is obtained prior to the third and final trial.

11.4 Test Method C -- Self-heating substances

CAUTION: Test A must be run before Test C is conducted. If the waste is pyrophoric, then Test C must not be run. Also, this procedure is not suitable for liquid wastes.

11.4.1 Test Method C is performed to determine whether a solid waste exhibits self-heating properties when exposed to a temperature of 140 °C for a period of 24 hrs. This test is based on the Bowes-Cameron cage self-heating test method for carbon. The criterion for self-heating is based on the self-ignition temperature of charcoal, which is 50 °C for a sample cube of 27 m^3 and 140 °C for a one-liter sample. If self-heating occurs using the 100-mm sample cube, then the waste is tested using a 25-mm sample cube to determine the waste classification.

11.4.2 Load the solid sample, in its "as received" form, into the 100-mm stainless steel cage. Particle size reduction may be employed to facilitate the loading of the cage when the waste is presented in large pieces. Fill the cage to the brim with the sample and drop the filled cage three times from a height of 1 to 2 inches. If the waste settles, add additional waste until the cage is filled to the brim.

11.4.3 Insert the loaded cage into the outer steel cage and suspend the assembly in the center of the oven by means of a wire or similar device. No part of the assembly should contact the outer walls or bottom. Insert one of the Chromel-Alumel thermocouples (Sec. 6.12) through the outer cage and through the open top of the inner cage. This thermocouple should be positioned within the center of the waste to be tested (approximately 50 mm into the waste). Position another Chromel-Alumel thermocouple between the sample and the oven wall (the thermocouple should be suspended in mid-air and should not contact the oven surface or the loaded cage).

11.4.4 Turn on the oven and adjust the temperature controller to achieve an oven temperature of 140 ± 2 °C. Maintain this temperature for 24 hrs. During this period, both the oven temperature and the temperature of the sample must be monitored closely. Preferably, both temperatures should be continuously recorded. Electronic thermometers are commercially available that can continuously monitor and record the maximum oven and sample temperatures (refer to Sec. 6.13).

11.4.5 Observe whether the sample temperature exceeds 200 °C during the 24 ± 2 hr test period. Continuous temperature monitoring is required because the sample temperature may exceed 200 °C at any time during the 24-hour test period.

NOTE: If a positive result is obtained (i.e., the sample temperature exceeds 200 °C) prior to the conclusion of the 24 ± 2 hr test period, the experiment may be terminated by turning off the oven. The sample temperature may continue to increase even after the oven is turned off.

WARNING: Once the experiment is started, the oven should not be opened, especially if the sample temperature is observed to rise above 140 °C. Opening the oven when the sample is at an elevated temperature could increase the potential for a fire. Therefore, the oven and sample temperature should be allowed to return to ambient temperature before the oven is opened.

11.4.6 If, at the end of the 24-hr test period, the temperature of the test sample did not exceed 200 °C, then no additional testing is required. The results of the test are negative for self-heating. If the temperature of the test sample exceeds 200 °C within the 24-hour test period, then test a second sample aliquot using a 25-mm stainless steel cube to determine the self-heating classification of the waste.

11.4.7 Load the waste in the 25-mm cage as described in Sec. 11.4.2. Suspend the loaded sample into the oven and heat to 140 ± 2 °C for 24 hrs, as described in Secs. 11.4.2 through 11.4.4.

11.4.8 Observe whether the sample temperature exceeds 200 °C during the 24-hr test period. Continuous temperature monitoring is required because the sample temperature may exceed 200 °C at any time during the 24-hr test period. If the sample temperature exceeds 200 °C prior to the end of the 24-hr test period, then the experiment may be terminated by turning the oven off.

11.4.9 If at the end of the 24-hr test period the temperature of the test sample did not exceed 200 °C, then no additional testing is required. If the temperature of the test sample exceeds 200 °C within the 24-hr test period, then the waste has self-heating properties. Refer to Sec. 12.0 for appropriate waste classifications.

NOTE: If the waste is suspected to have strong self-heating properties, the 25-mm cube test may be performed in lieu of the 100-mm cube test. If the results of this test are positive, then the test using the 100-mm cage need not be performed because the waste has self-heating properties. If the results of the 25-mm cube test are negative, then the waste must be evaluated by the 100-mm cube test in order to make a proper self-heating determination.

12.0 DATA ANALYSIS AND CALCULATIONS

12.1 Method of assessing results for pyrophoric solids

If the sample ignites during any of the tests, then the substance should be considered pyrophoric and classified as a waste with pyrophoric properties.

12.2 Method of assessing results for pyrophoric liquids

If the liquid ignites when mixed with an inert carrier, or if it ignites or chars the filter paper, then it should be classified as a liquid waste having pyrophoric properties.

12.3 Method of assessing results for self-heating wastes

12.3.1 A waste should be classified under DOT Packing Group II (refer to Sec. 1.2) if the sample tests positive for both the 100-mm and 25-mm cubes (or tests positive when tested using the 25-mm cube alone).

12.3.2 A waste should be classified under DOT Packing Group III (refer to Sec. 1.2) if the sample tests positive for the 100-mm cube, but negative for the 25-mm cube.

13.0 METHOD PERFORMANCE

13.1 Performance data and related information are provided in SW-846 methods only as examples and guidance. The data do not represent required performance criteria for users of the methods. Instead, performance criteria should be developed on a project-specific basis, and the laboratory should establish in-house QC performance criteria for the application of this method. These performance data are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

13.2 Pyrophoric solids

Test Method A was applied to various mixtures of manganese ethylene bis/zinc salt complexes. Table 1 shows the results, which were obtained from Ref. 3. These data are provided for guidance purposes only.

13.3 Pyrophoric liquids

Test Method B was applied to various diethyl aluminum chloride/isopentane mixtures and to various triethyl aluminum/heptane mixtures. Table 2 shows the results, which were obtained from Ref. 3. These data are provided for guidance purposes only.

13.4 Self-heating wastes

13.4.1 Test Method C was applied to granular cobalt/molybdenum, nickel catalysts, nickel/vanadium catalysts, nickel/molybdenum catalysts, and manganese ethylene bis/zinc mixtures. Table 3 shows the results, which were obtained from Ref. 3. These data are provided for guidance purposes only.

13.4.2 In a study conducted by the EPA National Enforcement Investigations Center (NEIC), three samples of used Raney® nickel catalyst were evaluated for self-heating using Test Method C. Raney® nickel is widely used as a hydrogenation catalyst and also as a scavenger for undesirable chemical species otherwise left in chemical products. Table 4 shows the results of this study, which were obtained from Ref. 4. These data are provided for guidance purposes only.

13.4.3 In a separate study conducted by EPA, the performance of Test Method C was evaluated by testing simulated wastes consisting of mixtures of charcoal, fish meal, and cotton with linseed oil and tung oil. Fish meal, charcoal, and linseed oil are identified in the 17th Edition of the *National Fire Protection Association Handbook (NFPA)* as materials that have a high tendency of spontaneous heating. Tung oil is classified as having moderate self-heating tendencies. Cotton is not listed in the NFPA handbook and has a low self-heating tendency. A real-world waste consisting of white phosphorus-contaminated soil was also evaluated. Table 5 summarizes the results of this investigation, which were obtained from Ref. 5. These data are provided for guidance purposes only.

14.0 POLLUTION PREVENTION

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity and/or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.

14.2 For information about pollution prevention that may be applicable to laboratories and research institutions consult *Less is Better: Laboratory Chemical Management for Waste Reduction* available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th St., N.W. Washington, D.C. 20036, http://www.acs.org.

15.0 WASTE MANAGEMENT

The Environmental Protection Agency requires that laboratory waste management practices be conducted consistent with all rules and regulations. The Agency urges laboratories to protect the air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management, consult *The Waste Management Manual for Laboratory Personnel* available from the American Chemical Society at the address listed in Sec. 14.2.

16.0 REFERENCES

1. 49 CFR Part 173, Appendix E, "Guidelines for the Classification and Packaging Group Assignment of Class 4 Materials."

2. United Nations Classification Scheme for the Classification of Substances Liable to Spontaneous Combustion, Division 4.2, Sec. 32.3, ST/SG/AC.10/C.3/R.370.

3. United Nations Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, ST/SG/AC.10/11/Rev2, 1995, Classification Procedures, Test Methods, and Criteria Related to Class 4, Substances Liable to Spontaneous Combustion, Division 4.2, Sec. 33.3.

4. U. S. EPA, National Enforcement Investigations Center, "Analytical Results Raney® Nickel Wastes," April 13, 1998.

5. Science Applications International Corporation, "Evaluation of Method 1050," submitted to the U.S. EPA, Office of Solid Waste, June 1998.

6. 62 FR 24690, May 17, 1997, Department of Transportation, Hazardous Materials: Harmonization With the United Nations Recommendations, International Maritime Dangerous Goods Code, and International Civil Aviation Organization's Technical Instructions; Final Rule.

17.0 TABLES, DIAGRAMS, FLOW CHARTS, AND VALIDATION DATA

The following pages contain the tables referenced by this method. A flow diagram of the procedure follows the tables.

TABLE 1

EXAMPLE RESULTS FOR PYROPHORIC SOLIDS

Substance	Time to Ignition	Test Result
Manganese ethylene bis(dithiocarbamate) complex with zinc salt 88% (Mancozeb)	No ignition within 5 minutes	Not Pyrophoric
Manganese ethylene bis(dithiocarbamate) complex with zinc salt 80% (Mancozeb)	No ignition within 5 minutes	Not Pyrophoric
Manganese ethylene bis(dithiocarbamate) complex with zinc salt 75% (Mancozeb)	No ignition within 5 minutes	Not Pyrophoric

Data taken from Ref. 3.

These data are provided for guidance purposes only.

TABLE 2

EXAMPLE TEST RESULTS FOR PYROPHORIC LIQUIDS

Substance	Effect on Exposure to Air	Effect on Filter Paper	Test Result
Diethyl aluminum chloride/isopentane (10/90)	No ignition	No charring	Not pyrophoric
Diethyl aluminum chloride/isopentane (15/85)	No ignition	Charring	Pyrophoric
Diethyl aluminum chloride/isopentane (95/5)	No ignition	Charring	Pyrophoric
Triethyl aluminum/heptane (10/90)	No ignition	No Charring	Not Pyrophoric
Triethyl aluminum/heptane (15/85)	No ignition	Charring	Pyrophoric
Triethyl aluminum/heptane (95/5)	No ignition	Charring	Pyrophoric

These data are provided for guidance purposes only.
Data taken from Ref. 3.

TABLE 3

EXAMPLE TEST RESULTS FOR SELF-HEATING SOLIDS

Substance	Cube Size (mm)	Maximum Sample Temperature (°C)	Result
Cobalt/molybdenum catalyst granules	100	> 200	Positive
	25	181	Negative
Manganese ethylene bis-80% (Maneb)	25	> 200	Positive
Manganese ethylene bis complex with zinc salt (75%) (Mancozeb)	25	> 200	Positive
Nickel catalyst granules with 70% hydrogenated oil	100	140	Negative
Nickel catalyst granules with 50% white oil	100	> 200	Positive
	25	140	Negative
Nickel/molybdenum catalyst granules (spent)	100	> 200	Positive
	25	150	Negative
Nickel/molybdenum catalyst granules (passivated)	100	161	Negative
Nickel/vanadium catalyst granules	25	> 200	Positive

These data are provided for guidance purposes only.
Data taken from Ref. 3.

TABLE 4

EXAMPLE SELF-HEATING TEST RESULTS FOR RANEY® NICKEL WASTES

Sample	Cube Size (mm)	Maximum Sample Temperature (°C)	Results
Sample A (from hydrogenation process)	100	670	Positive
	25	691	Positive
	25	677	Positive
Sample B (from hydrogenation process)	100	630	Positive
	25	620	Positive
Sample C (from tetrahop process)	100	144	Negative

These data are provided for guidance purposes only.
Date taken from Ref. 4.

TABLE 5

EXAMPLE RESULTS FOR SELF-HEATING TESTS OF SIMULATED WASTES

Simulated Waste	Maximum Observed Temperature (°C)		Results (100-mm/25-mm)
	100-mm Cube	25-mm Cube	
Charcoal (alone)	143	NA	negative
9:1 Charcoal:tung oil	144	NA	negative
3:1 Charcoal:tung oil	152	NA	negative
9:1 Charcoal:linseed oil[2]	359	168	positive/negative
3:1 Charcoal:linseed oil[2]	339	227	positive/positive
Pellet Fish Meal (alone)[2]	278	141	positive/negative
9:1 Pellet Fish Meal:tung oil[2]	241	139	positive/negative
3:1 Powdered Fish Meal:tung oil	166	NA	negative
9:1 Powdered Fish Meal:linseed oil	180	NA	negative
3:1 Powered Fish Meal:linseed oil[2]	215	148	positive/negative
9:1 Cotton:tung oil	140	NA	negative
3:1 Cotton:tung oil	143	NA	negative
9:1 Cotton:linseed oil	180	NA	negative
3:1 Cotton:linseed oil[2]	212	137	positive/negative
White phosphorus-contaminated sediment	146	151	negative

[1]Experiments with the 25-mm cube were conducted only if the maximum temperature observed for the 100-mm cube exceeded 200 °C (except for white phosphorus).

[2]100-mm experiments terminated prior to the conclusion of the 24-hour test period because the sample temperature exceeded 200 °C.

These data are provided for guidance purposes only.
Data taken from Ref. 5.

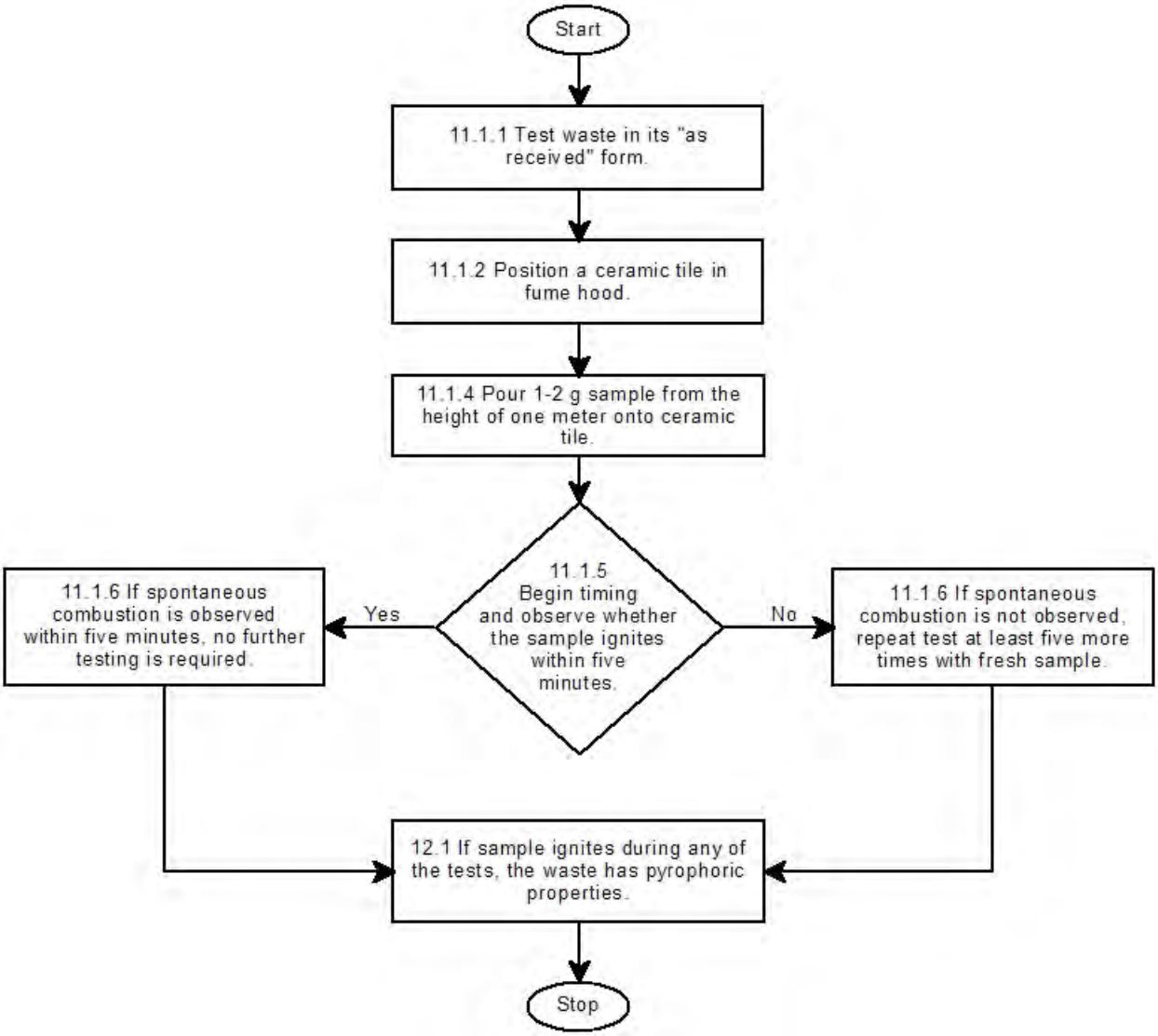
TABLE 6

DOT CLASSIFICATION OF SELF-HEATING SOLID WASTES

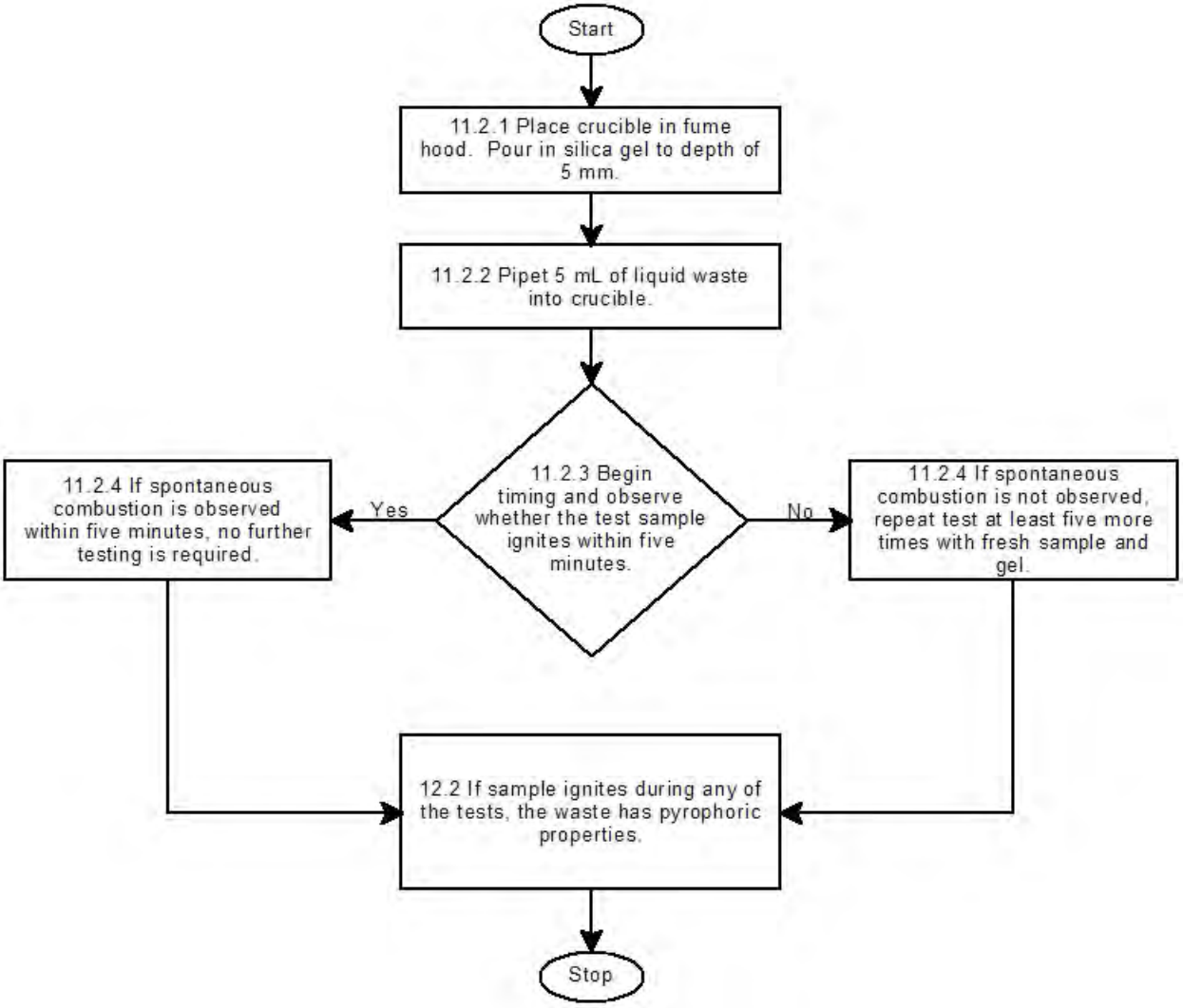
Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm, but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm cube test, if tested alone	II

TEST METHODS TO DETERMINE SUBSTANCES LIKELY TO SPONTANEOUSLY COMBUST

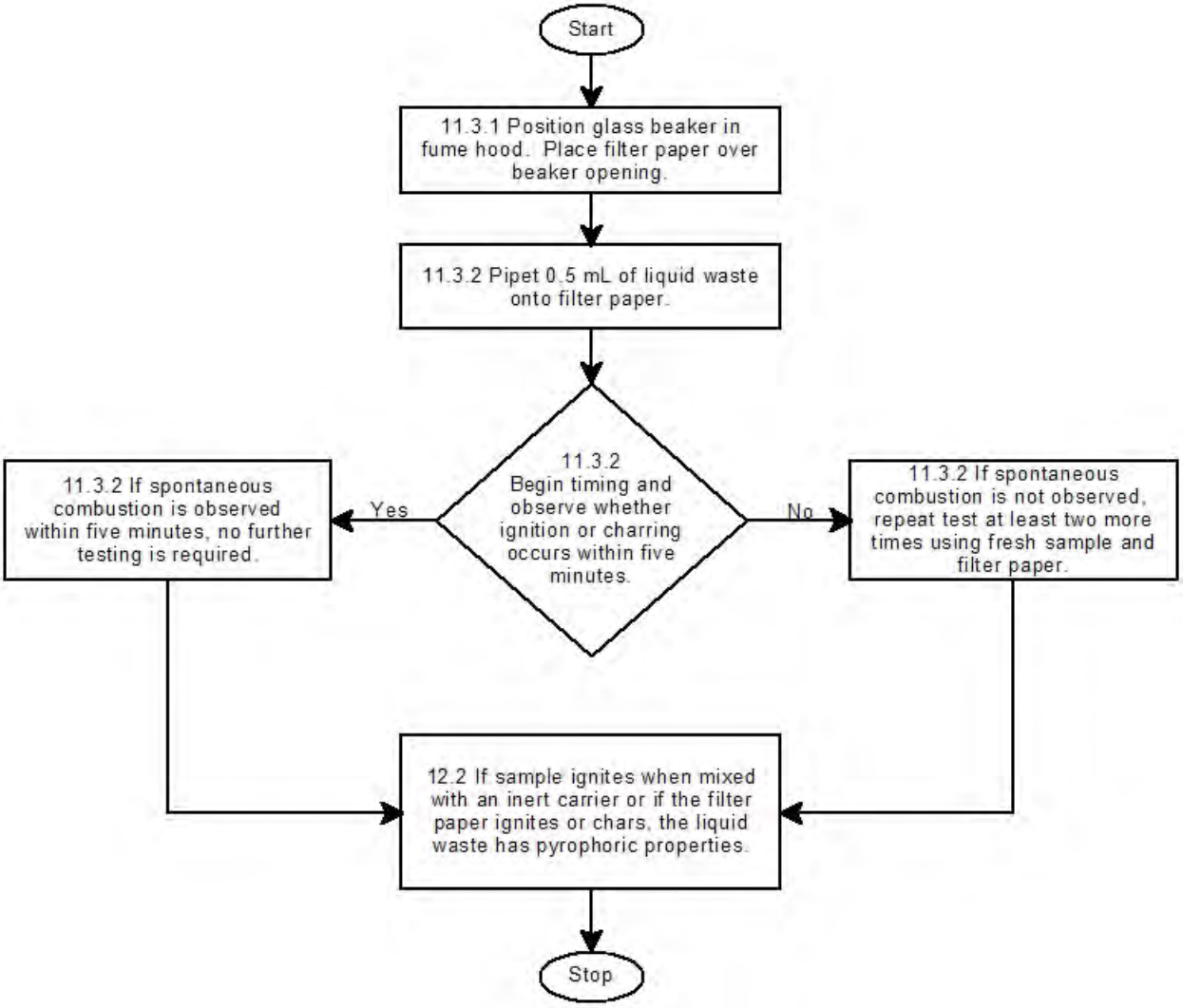
TEST METHOD A -- PYROPHORIC SOLIDS



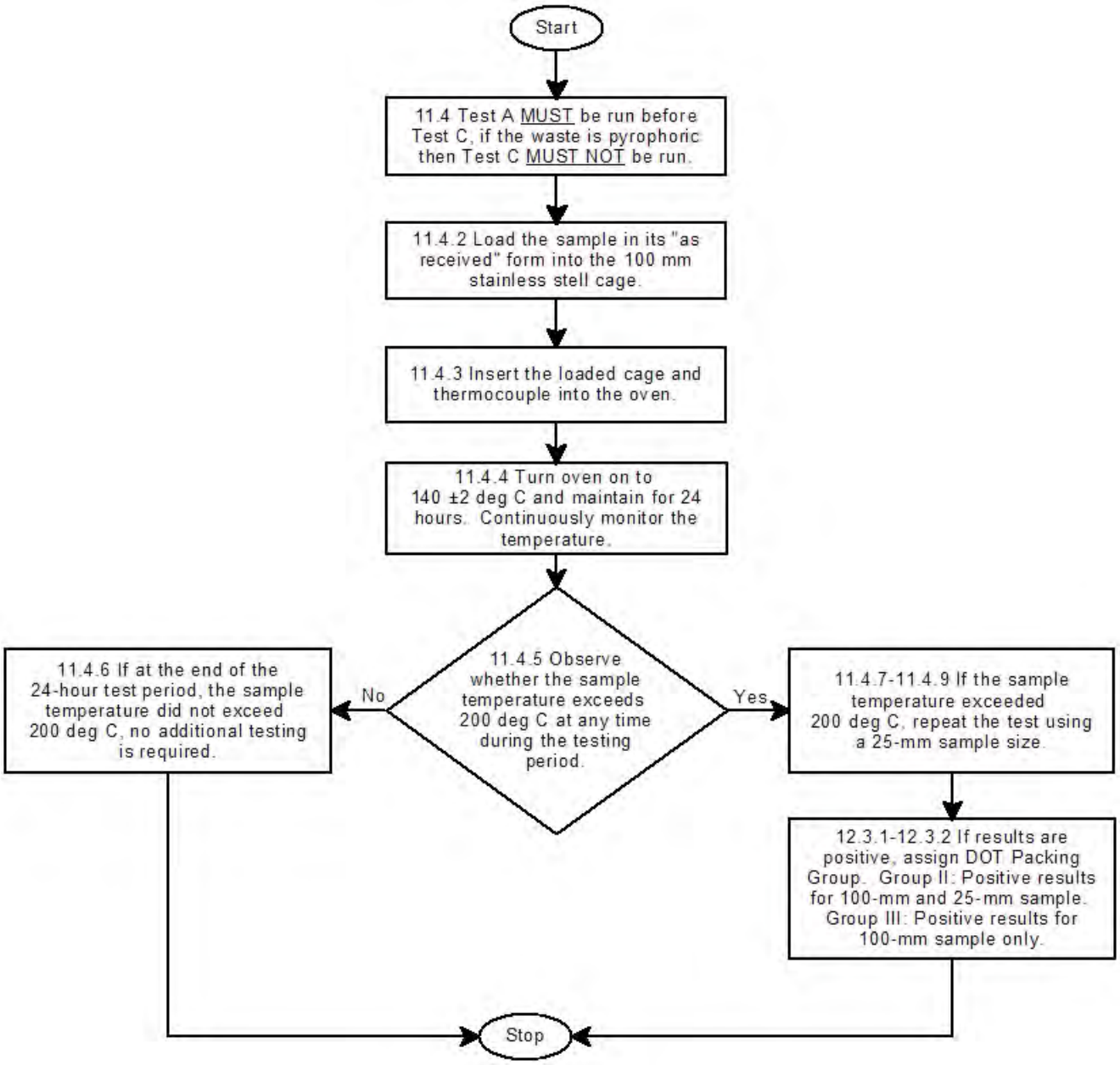
TEST METHOD B -- PYROPHORIC LIQUIDS, PORCELAIN CUP TEST



TEST METHOD B -- PYROPHORIC LIQUIDS, FILTER PAPER TEST



TEST METHOD C -- SELF-HEATING SUBSTANCES
(Not suitable for liquid wastes)



Appendix C
Test Method UN O.1

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34.4 Test methods for oxidizing substances

34.4.1 *Test O.1: Test for oxidizing solids*

34.4.1.1 *Introduction*

This test method is designed to measure the potential for a solid substance to increase the burning rate or burning intensity of a combustible substance when the two are thoroughly mixed. Tests are conducted on the substance to be evaluated mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromate to cellulose. If the burning time is equal to or less than this standard mixture, the burning times should be compared with those from the packing group I or II reference standards, 3:2 and 2:3 ratios, by mass, of potassium bromate to cellulose respectively.

34.4.1.2 *Apparatus and materials*

34.4.1.2.1 Technically pure potassium bromate is required as a reference substance. It should be sieved, but not ground, and the fraction with nominal particle sizes in the range 0.15 to 0.30 mm used as the reference substance. The reference substance is dried at 65 °C to constant mass (for a minimum of 12 hours) and kept in a desiccator (with desiccant) until cool and required for use.

34.4.1.2.2 Dried fibrous cellulose[1], with a fibre length between 50 and 250 µm and a mean diameter of 25 µm, is used as the combustible material. It is dried in a layer no more than 25 mm thick at 105 °C to constant mass (for a minimum of 4 hours) and kept in a desiccator (with desiccant) until cool and required for use. The water content should be less than 0.5% by dry mass. If necessary, the drying time should be prolonged to achieve this.

34.4.1.2.3 An ignition source is required comprising an inert metal wire (e.g. nickel/chromium) connected to an electrical power source and with the following characteristics:

(a)	Length	=	30 ± 1 cm;
(b)	Diameter	=	0.6 ± 0.05 mm;
(c)	Electrical resistance	=	6.0 ± 0.5 Ω/m;
(d)	Electrical power dissipated in the wire	=	150 ± 7 W.

The wire should be shaped as in Figure 34.4.1.1.

34.4.1.2.4 A 60° glass funnel, sealed at the narrow end, with an internal diameter of 70 mm is required to form the mixtures into a truncated conical pile with base diameter of 70 mm on a cool, impervious, low heat conducting plate. A 150 mm by 150 mm plate with a thickness of 6 mm and a thermal conductivity (at a temperature of 0 °C) of 0.23 $W.m^{-1}.K^{-1}$ is suitable. Other plates with a similar conductivity may be used.

34.4.1.2.5 A fume cupboard or other kind of ventilated area is required in which there is some ventilation but with an air stream velocity of 0.5 m/s or less. ***The fume extraction system should be suitable for the capture of toxic fumes.***

34.4.1.2.6 The substance, in the form in which it will be transported, should be inspected for any particles less than 500 µm in diameter. If that powder constitutes more than 10% (mass) of the total, or if the substance is friable, then the whole of the test sample should be ground to a powder before testing to allow for a reduction in particle size during handling and transport.

---

[1] *Source reference available from the national contact for test details in France (see Appendix 4).*

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34.4.1.3 *Procedure*

34.4.1.3.1 30.0 g ± 0.1 g mixtures of the reference substance and cellulose are prepared in the potassium bromate to cellulose ratios of 3:7, 2:3 and 3:2, by mass. 30.0 g ± 0.1 g mixtures of the substance to be tested, in the particle size in which it will be transported (see 34.4.1.2.6), and cellulose are prepared in the oxidizer to cellulose ratios of 4:1 and 1:1, by mass. Each mixture should be mixed mechanically as thoroughly as possible without excessive stress. Each sample mixture should be made individually, used as soon as possible, and not taken from a batch.

34.4.1.3.2 Using the conical funnel, the mixture should be formed into a truncated conical pile, with a base diameter of 70 mm, covering the looped ignition wire resting on the low heat conducting plate. The plate should be placed in a ventilated area and the test performed at atmospheric pressure with the ambient temperature at 20 °C ± 5 °C.

34.4.1.3.3 Power is applied to the ignition wire and is maintained for the duration of the test or for three minutes if the mixture does not ignite and burn. The recorded burning time is taken from when the power is switched on to when the main reaction (e.g. flame, incandescence or glowing combustion) ends. Intermittent reaction, such as sparking or sputtering, after the main reaction should not be taken into account. If the heating wire breaks during the test then the test should be repeated unless breaking of the wire clearly does not effect the result. The test should be performed five times on the substance. Five tests should be performed with each reference mixture required to make the packing group assignment or to determine if the substance should not be classified in Division 5.1.

34.4.1.4 *Test criteria and method of assessing results*

34.4.1.4.1 The results are assessed on the basis of:

(a) The comparison of the mean burning time with those of the reference mixtures; and

(b) Whether the mixture of substance and cellulose ignites and burns.

34.4.1.4.2 The test criteria for determining oxidizing properties of the substance are:

Packing group I:	Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.
Packing group II:	Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I.
Packing group III:	Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to are less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.
Not Division 5.1	Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ratio (by mass) tested, does not ignite and burn, or exhibits mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.

For substances having other risks, e.g. toxicity or corrosivity, the requirements of section 2.0.3 of the Model Regulations should be met.

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34.4.1.5 *Examples of results*

NOTE: *The test results given should be used only as an illustration since the results obtained with a particular oxidizer will depend on the particle size etc.*

Substance	Mean burning times (s)		Results
	4:1	1:1	
Ammonium dichromate	55	189	PG III [a]
Ammonium nitrate (crystalline)	161	74	PG III
Calcium nitrate (anhydrous)	10	25	PG II [b]
Calcium nitrate (tetra hydrate)	268	142	Not 5.1
Ceric ammonium nitrate	10	36	PG II [c]
Chromium trioxide	3	33	PG I [a]
Cobalt nitrate (hexahydrate)	205	390	Not 5.1
Nickel nitrate	101	221	Not 5.1 [b]
Potassium nitrite	8	15	PG II
Potassium perchlorate	9	33	PG II
Potassium permanganate	17	51	PG II
Sodium chlorate	5	13	PG II
Sodium nitrite	15	22	PG II [b]
Sodium nitrate	56	39	PG II [b]
Strontium nitrate (anhydrous)	107	237	Not 5.1 [b]

Burning times for mixtures of reference substance to cellulose

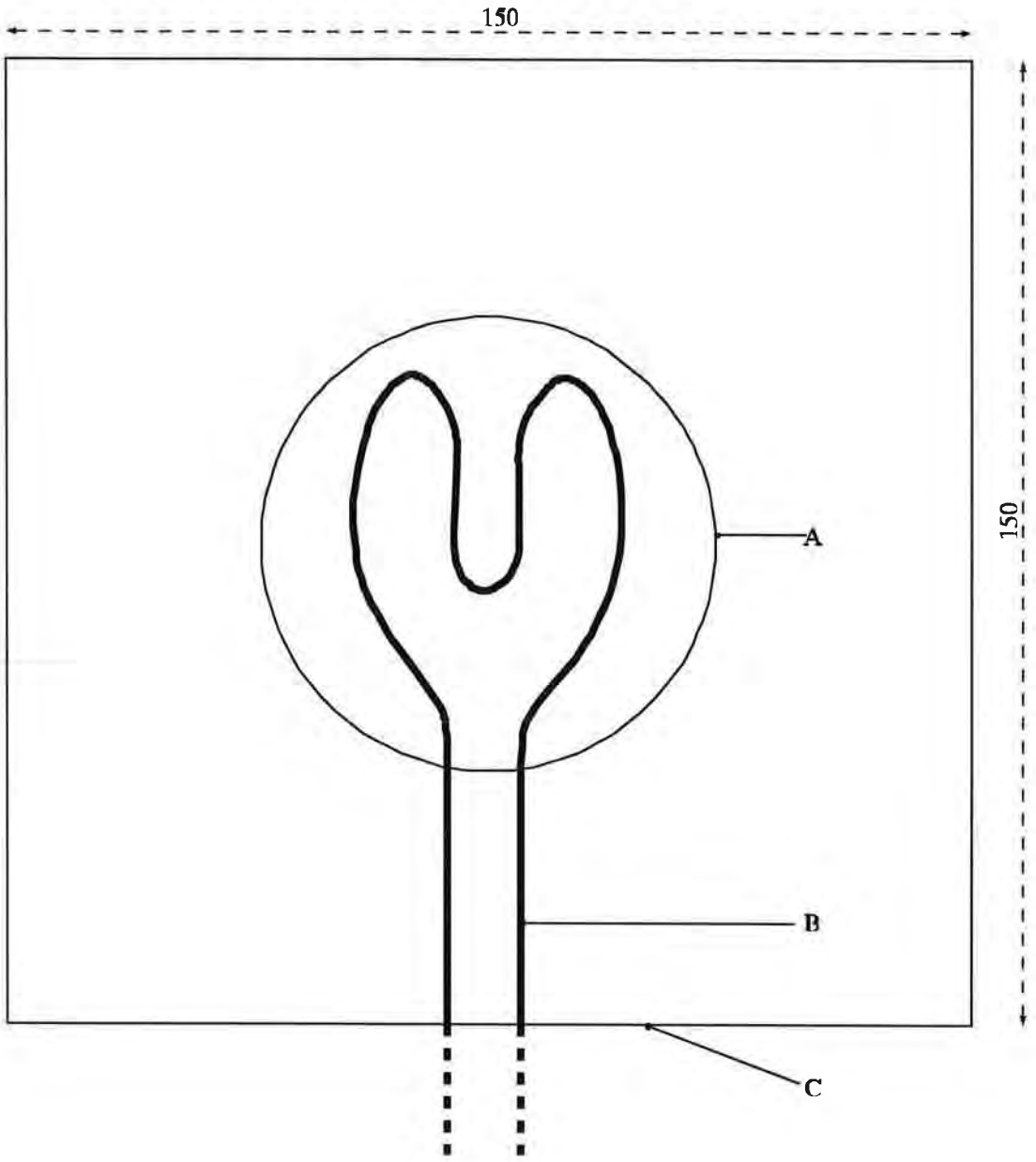
3:7 Potassium bromate/cellulose	100 s
2:3 Potassium bromate/cellulose	54 s
3:2 Potassium bromate/cellulose	4 s

[a] *Currently PG II but borderline.*

[b] *Currently PG III.*

[c] *Not currently classified.*

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(A) Base of sample cone (70 mm diameter)
(B) Heating wire
(C) Low heat conducting plate

Figure 34.4.1.1: TEST PLATE AND IGNITION WIRE

Appendix D
Test Method UN O.2

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34.4.2 ***Test O.2: Test for oxidizing liquids***

34.4.2.1 *Introduction*

This test method is designed to measure the potential for a liquid substance to increase the burning rate or burning intensity of a combustible substance when the two are thoroughly mixed or to form a mixture which spontaneously ignites. The liquid is mixed in a 1 to 1 ratio, by mass, with fibrous cellulose, the mixture heated in a pressure vessel and the rate of pressure rise determined[2].

34.4.2.2 *Apparatus and materials*

34.4.2.2.1 A pressure vessel, as used in the time/pressure test (see Part I, test 1 (c) (i)), is required. It consists of a cylindrical steel pressure vessel 89 mm in length and 60 mm in external diameter (see Figure 34.4.2.1). Two flats are machined on opposite sides (reducing the cross-section of the vessel to 50 mm) to facilitate holding whilst fitting up the firing plug and vent plug. The vessel, which has a bore of 20 mm diameter is internally rebated at either end to a depth of 19 mm and threaded to accept 1" British Standard Pipe (BSP). A pressure take-off, in the form of a side arm, is screwed into the curved face of the pressure vessel 35 mm from one end and at 90° to the machined flats. The socket for this is bored to a depth of 12 mm and threaded to accept the 1/2 " BSP thread on the end of the side-arm. If necessary, an inert seal is fitted to ensure a gastight seal. The side-arm extends 55 mm beyond the pressure vessel body and has a bore of 6 mm. The end of the side-arm is rebated and threaded to accept a diaphragm type pressure transducer. Any pressure-measuring device may be used provided that it is not affected by the hot gases or the decomposition products and is capable of responding to rates of pressure rise of 690-2 070 kPa in not more than 5 ms.

34.4.2.2.2 The end of the pressure vessel furthest from the side-arm is closed with a firing plug which is fitted with two electrodes, one insulated from, and the other earthed to, the plug body. The other end of the pressure vessel is closed by a bursting disc (bursting pressure approximately 2 200 kPa (320 psi)) held in place with a retaining plug which has a 20 mm bore. If necessary, an inert seal is used with the firing plug to ensure a gas-tight fit. A support stand (Figure 34.4.2.2) holds the assembly in the correct attitude during use. This comprises a mild steel base plate measuring 235 mm × 184 mm × 6 mm and a 185 mm length of square hollow section (S.-H.S.) 70 × 70 × 4 mm.

34.4.2.2.3 A section is cut from each of two opposite sides at one end of the length of S.H.S. so that a structure having two flat sided legs surmounted by 86 mm length of intact box section results. The ends of these flat sides are cut to an angle of 60° to the horizontal and welded to the base plate. A slot measuring 22 mm wide × 46 mm deep is machined in one side of the upper end of the base section such that when the pressure vessel assembly is lowered, firing plug end first, into the box section support, the side-arm is accommodated in the slot. A packing piece of steel 30 mm wide and 6 mm thick is welded to the lower internal face of the box section to act as a spacer. Two 7 mm thumb screws, tapped into the opposite face, serve to hold the pressure vessel firmly in place. Two 12 mm wide strips of 6 mm thick steel, welded to the side pieces abutting the base of the box section, support the pressure vessel from beneath.

[2] *In some cases, substances may generate a pressure rise (too high or too low), caused by chemical reactions not characterising the oxidizing properties of the substance. In these cases, it may be necessary to repeat the test with an inert substance, e.g. diatomite (kieselguhr), in place of the cellulose in order to clarify the nature of the reaction.*

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34.4.2.2.4 The ignition system consists of a 25 cm long Ni/Cr wire with a diameter 0.6 mm and a resistance of 3.85 ohm/m. The wire is wound, using a 5 mm diameter rod, in the shape of a coil and is attached to the firing plug electrodes. The coil should have one of the configurations shown in Figure 34.4.2.3. The distance between the bottom of the vessel and the underside of the ignition coil should be 20 mm. If the electrodes are not adjustable, the ends of the ignition wire between the coil and the bottom of the vessel should be insulated by a ceramic sheath. The wire is heated by a constant current power supply able to deliver at least 10 A.

34.4.2.25 Dried, fibrous cellulose[3] with a fibre length between 50 and 250 µm and a mean diameter of 25 µm, is used as the combustible material. It is dried in a layer not more than 25 mm thick at 105 °C for 4 hours and kept in a desiccator, with desiccant, until cool and required for use. The water content of the dried cellulose should be less than 0.5% by dry mass. If necessary, the drying time should be prolonged to achieve this.

34.4.2.2.6 50% perchloric acid, 40% aqueous sodium chlorate solution and 65% aqueous nitric acid are required as reference substances.

34.4.2.2.7 The concentration of the substance tested should be specified in the report. If saturated solutions are tested, they should be prepared at 20 °C.

34.4.2.3 *Procedure*

34.4.2.3.1 The apparatus, assembled complete with pressure transducer and heating system but without the bursting disc in position, is supported firing plug end down. 2.5 g of the liquid to be tested is mixed with 2.5 g of dried cellulose in a glass beaker using a glass stirring rod. ***For safety, the mixing should be performed with a safety shield between the operator and mixture.*** (If the mixture ignites during mixing or filling, no further testing is necessary.) The mixture is added, in small portions with tapping, to the pressure vessel making sure that the mixture is packed around the ignition coil and is in good contact with it. It is important that the coil is not distorted during the packing process. The bursting disc is placed in position and the retaining plug is screwed in tightly. The charged vessel is transferred to the firing support stand, bursting disc uppermost, which should be located in a suitable, armoured fume cupboard or firing cell. The power supply is connected to the external terminals of the firing plug and 10 A applied. The time between the start of mixing and switching the power on should be about 10 minutes.

34.4.2.3.2 The signal produced by the pressure transducer is recorded on a suitable system which allows both evaluation and the generation of a permanent record of the time pressure profile obtained (e.g. a transient recorder coupled to a chart recorder). The mixture is heated until the bursting disc ruptures or until at least 60 s has elapsed. ***If the bursting disc does not rupture, the mixture should be allowed to cool before carefully dismantling the apparatus and precautions taken to allow for any pressurisation.*** Five trials are performed with the mixture and each of the reference substances. The time taken for the pressure rise from 690 kPa to 2 070 kPa above atmospheric is noted. The mean time interval should be used for classification.

34.4.2.4 *Test criteria and method of assessing results*

34.4.2.4.1 The test results are assessed on the basis of:

(a) Whether the mixture of substance and cellulose spontaneously ignites; and

(b) The comparison of the mean time taken for the pressure to rise from 690 kPa to 2 070 kPa gauge with those of the reference substances.

---

[3] *Source reference available from the national contact for test details in Sweden (see Appendix 4).*

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34.4.2.4.2 The test criteria for determining the oxidizing properties of the substance are:

Packing group I:
- Any substance which, in the 1:1 mixture, by mass, of substance and cellulose tested, spontaneously ignites; or
- The mean pressure rise time of a 1:1 mixture, by mass, of substance and cellulose is less than that of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose.

Packing group II:
- Any substance which, in the 1:1 mixture, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chlorate solution and cellulose; and
- The criteria for packing group I are not met.

Packing group III:
- Any substance which, in the 1:1 mixture, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose; and
- The criteria for packing groups I and II are not met.

Not Division 5.1:
- Any substance which, in the 1:1 mixture, by mass, of substance and cellulose tested, exhibits a pressure rise of less than 2 070 kPa gauge; or
- Exhibits a mean pressure rise time greater than the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose.

For substances having additional risks, e.g. toxicity or corrosivity, the requirements of section 2.0.3 of the Model Regulations should be met.

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34.4.2.5 *Examples of results*

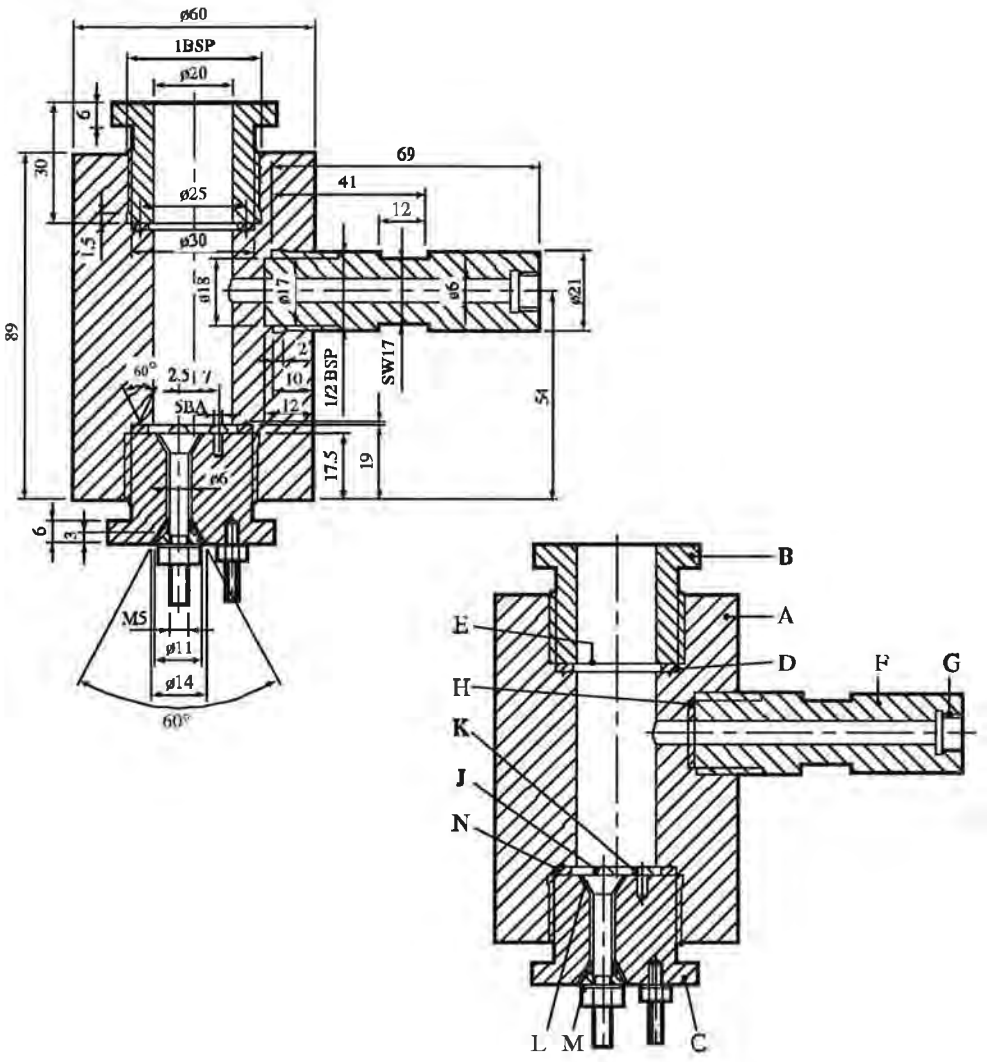
Substance	**Mean pressure rise time for a 1:1 mixture with cellulose (ms)**	**Results**
Ammonium dichromate, saturated aqueous solution	20 800	Not Div. 5.1
Calcium nitrate, saturated aqueous solution	6 700	Not Div. 5.1
Ferric nitrate, saturated aqueous solution	4 133	PG III
Lithium perchlorate, saturated aqueous solution	1 686	PG II
Magnesium perchlorate, saturated aqueous solution	777	PG II
Nickel nitrate, saturated aqueous solution	6 250	Not Div. 5.1
Nitric acid, 65%	4 767 [a]	PG III [b]
Perchloric acid, 50%	121 [a]	PG II
Perchloric acid, 55%	59	PG I
Potassium nitrate, 30% aqueous solution	26 690	Not Div. 5.1
Silver nitrate, saturated aqueous solution	[c]	Not Div. 5.1
Sodium chlorate, 40% aqueous solution	2 555 [a]	PG II
Sodium nitrate, 45% aqueous solution	4 133	PG III
Inert substance		
Water:cellulose	[c]	

[a] *Mean value from inter-laboratory comparative trials.*

[b] *Packing group III by the test but Class 8 by the Precedence of Hazards table.*

[c] *Maximum pressure of 2 070 kPa not reached.*

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(A) Pressure vessel body
(B) Bursting disc retaining plug
(C) Firing plug
(D) Soft lead washer
(E) Bursting disc
(F) Side arm
(G) Pressure transducer thread
(H) Washer
(J) Insulated electrode
(K) Earthed electrode
(L) Insulation
(M) Steel cone
(N) Washer distorting groove

Figure 34.4.2.1: PRESSURE VESSEL

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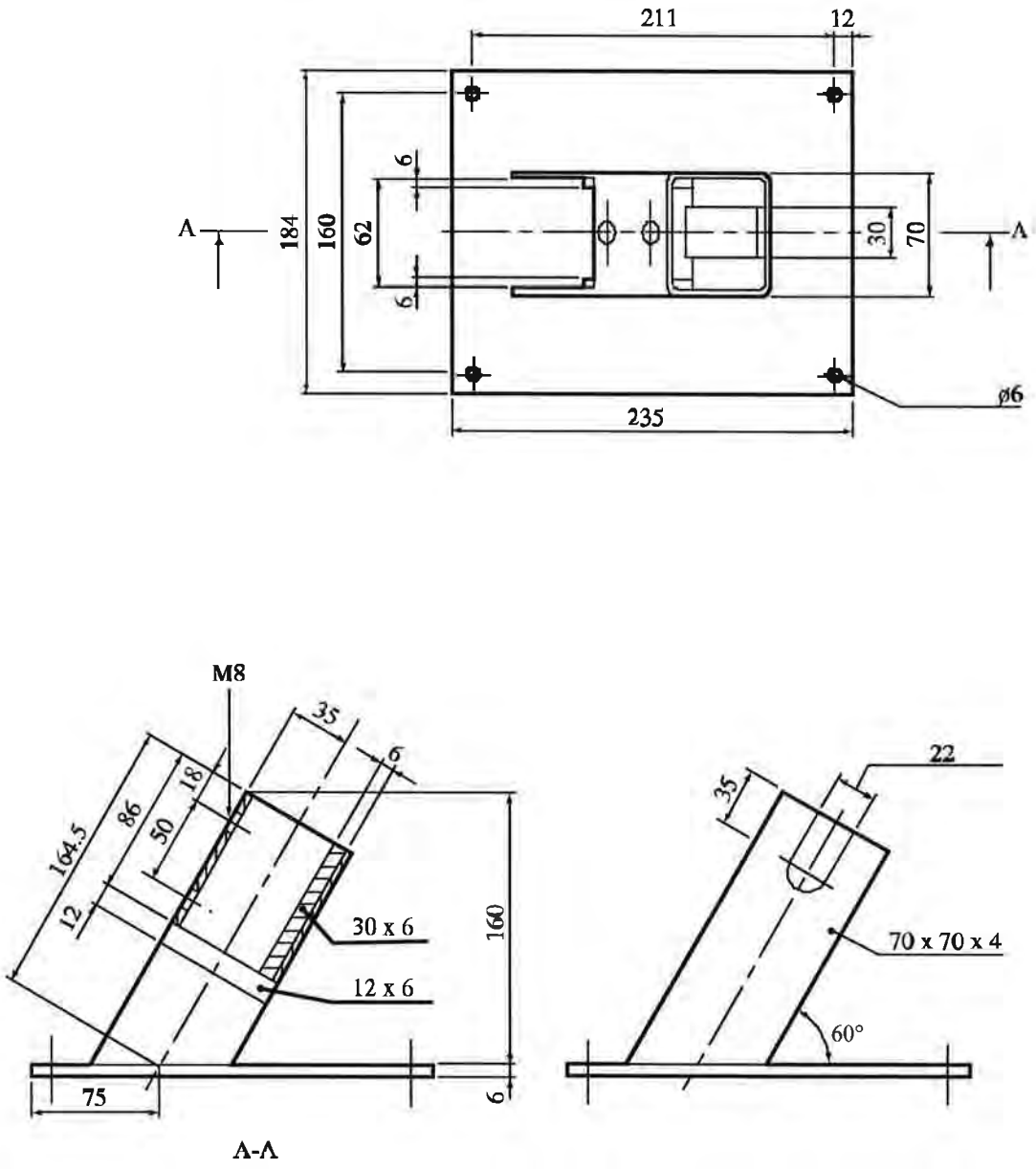
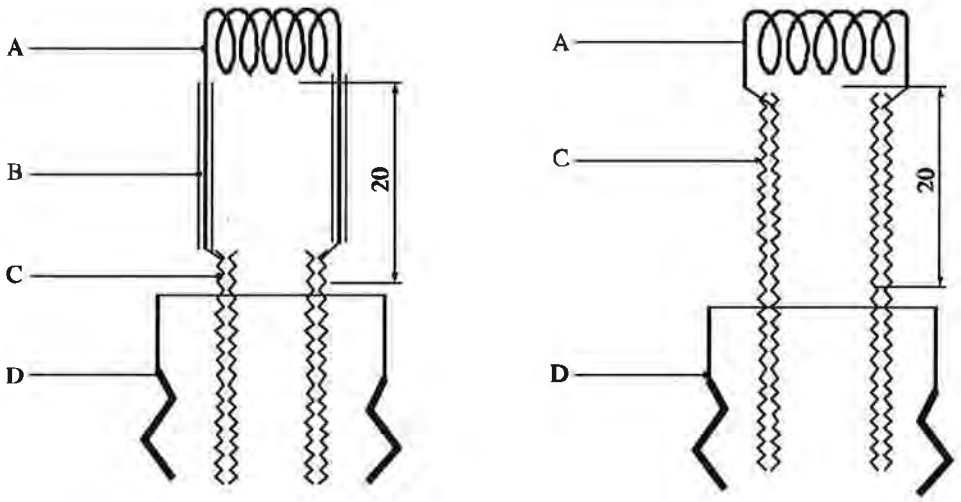


Figure 34.4.2.2: SUPPORT STAND

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NOTE: *Either of these configurations may be used.*

(A) Ignition coil
(B) Insulation
(C) Electrodes
(D) Firing plug

Figure 34.4.2.3: IGNITION SYSTEM

Appendix E
Test Method 9095B (Paint Filter)

METHOD 9095B

PAINT FILTER LIQUIDS TEST

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the presence of free liquids in a representative sample of waste.

1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5-min test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

3.2 Temperature can affect the test results if the test is performed below the freezing point of any liquid in the sample. Tests must be performed above the freezing point and can, but are not required to, exceed room temperature of 25 ^{o}C.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter -- Mesh number 60 +/- 5% (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden.

4.2 Glass funnel -- If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 in. of the filter mesh to protrude should be used to support the filter. The funnel should be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.

4.3 Ring stand and ring, or tripod.

4.4 Graduated cylinder or beaker -- 100-mL.

5.0 REAGENTS

5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

A 100-mL or 100-g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids. If the sample is measured volumetrically, then it should lack major air spaces or voids.

7.0 PROCEDURE

7.1 Assemble test apparatus as shown in Figure 1.

7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter. If the sample is of such light bulk density that it overflows the filter, then the sides of the filter can be extended upward by taping filter paper to the inside of the filter and above the mesh. Settling the sample into the paint filter may be facilitated by lightly tapping the side of the filter as it is being filled.

7.3 In order to assure uniformity and standardization of the test, material such as sorbent pads or pillows which do not conform to the shape of the paint filter should be cut into small pieces and poured into the filter. Sample size reduction may be accomplished by cutting the sorbent material with scissors, shears, a knife, or other such device so as to preserve as much of the original integrity of the sorbent fabric as possible. Sorbents enclosed in a fabric should be mixed with the resultant fabric pieces. The particles to be tested should be reduced smaller than 1 cm (i.e., should be capable of passing through a 9.5 mm (0.375 inch) standard sieve). Grinding sorbent materials should be avoided as this may destroy the integrity of the sorbent and produce many "fine particles" which would normally not be present.

7.4 For brittle materials larger than 1 cm that do not conform to the filter, light crushing to reduce oversize particles is acceptable if it is not practical to cut the material. Materials such as clay, silica gel, and some polymers may fall into this category.

7.5 Allow sample to drain for 5 min into the graduated cylinder.

7.6 If any portion of the test material collects in the graduated cylinder in the 5-min period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

8.1 Duplicate samples should be analyzed on a routine basis.

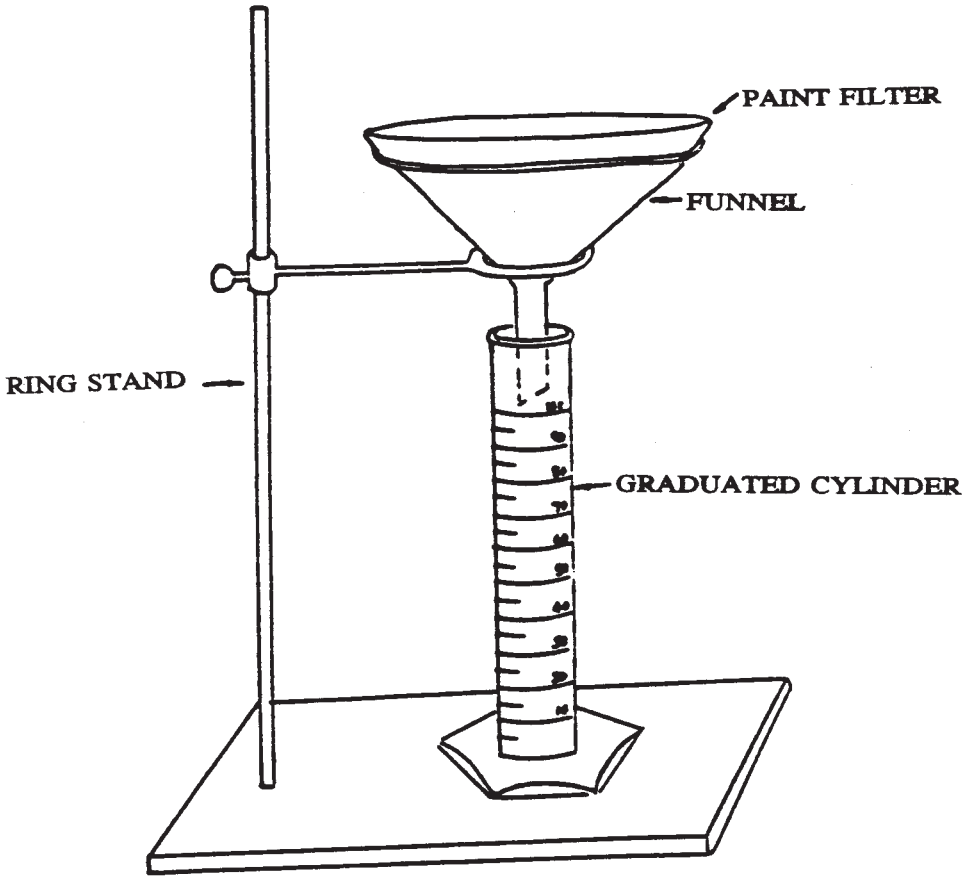
9.0 METHOD PERFORMANCE

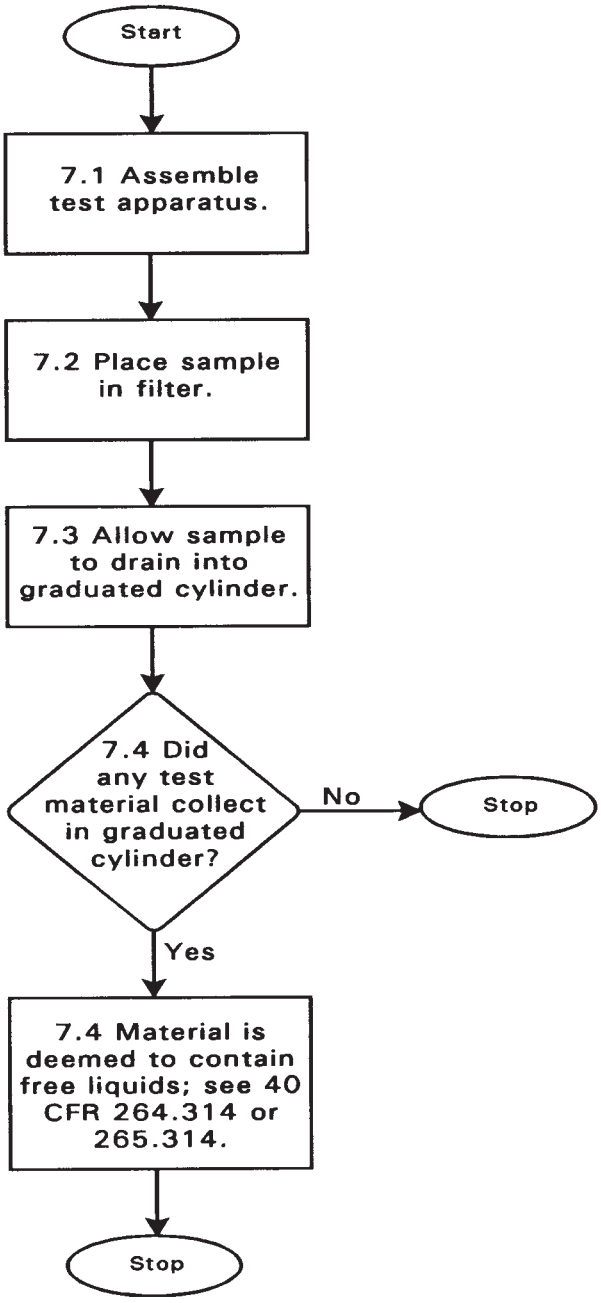
9.1 No data provided.

10.0 REFERENCES

10.1 None provided.

FIGURE 1
PAINT FILTER TEST APPARATUS




Start
7.1 Assemble test apparatus.
7.2 Place sample in filter.
7.3 Allow sample to drain into graduated cylinder.
7.4 Did any test material collect in graduated cylinder?
No
Stop
Yes
7.4 Material is deemed to contain free liquids; see 40 CFR 264.314 or 265.314.
Stop

Appendix F
SwRI Test Report, December 22, 2015

SOUTHWEST RESEARCH INSTITUTE®

6220 CULEBRA ROAD 78238-5166 • P.O. DRAWER 28510 78228-0510 • SAN ANTONIO, TEXAS, USA • (210) 684-5111 • WWW.SWRI.ORG

CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

December 22, 2015

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Ashley Pryor

Subject:		
	Case:	Zeolite
	SwRI Project Number:	21592.01.00X
	SDG:	581318
	SwRI Task Order Number:	150904-4
	SwRI Sample Receipt Number:	56087
	Samples Received:	09.03.2015
	Analysis:	Various Wetchem

Dear Ms. Pryor,

Please find the enclosed results for the overall surrogate samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3051, or via email at herbert.schattenberg@swri.org.

Sincerely,

FOR Herbert J. Schattenberg III
Program Manager

APPROVED:

Michael J. Dammann
Director

HJS: jz
Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

CHAIN-OF-CUSTODY & SAMPLE RECEIPT PAPERWORK

Total Page Count: 010001-
Fraction Withheld Pages: 010184

General Sample Chain of Custody

010002

Ver (8/25/2011)

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

SRR #:	56087	Thermometer:	021056
Project	19869.01.00X	Temperature:	21.2
CASE:	Zeolite	Airbill #:	590817794105
Customer:	Los Alamos National Laboratory	Logged in by:	SDOUGLAS
Samples Received:	Sep 3 2015 8:30AM	Logged in:	Sep 3 2015 9:03AM
Manager:	DAMMANN, MIKE		
Disposal Instructions:	Contact project manager for disposal authority.		

System ID	Customer ID	CED	Matrix	# Cont	Special Requirements	Sample Condition
581291	(UNS Liquid+SWheat 1:1):3 zeolite or cemented		Liquid	1		Intact
581292	(UNS+SWheat 1:1):3 zeolite or cemented		Solid	1		Intact
581293	(UNS+SWheat 1:3):3 zeolite or cemented		Solid	1		Intact
581294	(UNS+SWheat 1:4):3 zeolite or cemented		Solid	1		Intact
581295	1(UNSLQ+SWht 1:1):1 Spillfyter:1 citric acid :3		Liquid	1		Intact
581296	1(UNSLQ+SWht 1:1):1 Spillfyter:3 zeolite or cmtd		Liquid	1		Intact
581297	1 (UNS LQ+Wastelock 16:1):3 zeolite or cemented		Liquid	1		Intact
581298	1 UNS: 3 zeolite or cemented		Solid	1		Intact
581299	Zeolite		Solid	1		Intact
581300	UNS		Solid	1		Intact
581301	UNS+SWheat 1:1		Solid	1		Intact
581302	UNS+SWheat 1:3		Solid	1		Intact
581303	UNS+SWheat 1:4		Solid	1		Intact
581318	(WB8 + SWheat 1:1) cemented		Surrogate	1		Intact
581319	(WB8 + SWheat 1:1):3 zeolite		Surrogate	1		Intact
581320	(WB8 + SWheat 1:3) cemented		Surrogate	1		Intact
581321	(WB8 + SWheat 1:3):3 zeolite		Surrogate	1		Intact
581322	(WB8 + SWheat 1:4) cemented		Surrogate	1		Intact
581323	(WB8 + SWheat 1:4):3 zeolite		Surrogate	1		Intact
581324	1 Potassium Nitrate: 3 zeolite		Surrogate	1		Intact
581325	1 WB8: 3 zeolite		Surrogate	1		Intact
581326	Potassium Nitrate		Surrogate	1		Intact
581327	Potassium Nitrate + SWheat 1:1		Surrogate	1		Intact
581328	Potassium Nitrate + SWheat 1:3		Surrogate	1		Intact
581329	Potassium Nitrate + SWheat 1:4		Surrogate	1		Intact
581330	Potassium Nitrate cemented		Surrogate	1		Intact
581331	WB8		Surrogate	1		Intact
581332	WB8 + SWheat 1:1		Surrogate	1		Intact
581333	WB8 + SWheat 1:3		Surrogate	1		Intact
581334	WB8 + SWheat 1:4		Surrogate	1		Intact
581335	WB8 cemented		Surrogate	1		Intact

Reliquished by (Print/Signature):	Date	Time
[illegible]	9/3/15	0830

010003

	Date	Time
Received by (Print/Signature): Stanley Bos	9/3/15	0830
Reliquished by (Print/Signature):	Date	Time
Received by (Print/Signature):	Date	Time
Reliquished by (Print/Signature):	Date	Time

Southwest Research Institute

Laboratory Task Order

TO #: 150904-4 Revision: 1

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 09/17/15

SDG: 581318
VTSR: 09/03/15
CASE: Zeolite

SRR #'s: 56087
Client(s): Los Alamos National Laboratory

Instructions

Los Alamos National Laboratory _ Subcontract No. 250954

SDG is 581318.

RUSH TAT. 14-day TAT
TENTATIVE _ ALL DATA IS DUE TO THE CLIENT ON 09/17/2015.

1 overall sample _ consisting of Zeolite _ was received on 09/03/2015.
Per the Instructions received with the samples, various Surrogates created, which are listed here.

See Table 4.0 _ Initial Evaluation of Treatment Surrogates:
SW-846 Method 1030
SW-846 Method 1050
DOT O.1 Testing

PRELIMS _ Email prelims to: Keith Greene kgreene@lanl.gov, Nita Patel npatel@lanl.gov

---

See Exhibit "D" Scope of Work and Technical Specifications for Off-Site Analytical Laboratory Services

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Main point-of-contact is Keith R. Greene, kgreene@lanl.gov; Additional contact Nita Patel npatel@lanl.gov
Send Hardcopy & CD TO:
Los Alamos National Laboratory
ATTN: Keith R. Greene
TA-3 SM-271 Drop point 02U
Los Alamos, NM 87545

Documents Related to this task order: 185604[COC for SRR 56087], 185605[SRR Paperwork for SRR 56087], 191181[New Sample IDs], 191404[]

Deliverables --> Hard Copy: -YES- EDD: no PDF: -YES-

Test: COMB_1050 Holding: 180 days from CED
Section: WETCHEM **SW846 1050 Test A & C Spontaneous Combustion** Cnt: 9

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581319		1	Surrogate	Blend 11	NO DATA	NO DATA
581321		1	Surrogate	Blend 12	NO DATA	NO DATA
581323		1	Surrogate	Blend 13	NO DATA	NO DATA
581327		1	Surrogate	Blend 2	NO DATA	NO DATA
581328		1	Surrogate	Blend 3	NO DATA	NO DATA
581329		1	Surrogate	Blend 4	NO DATA	NO DATA
581332		1	Surrogate	Blend 6	NO DATA	NO DATA
581333		1	Surrogate	Blend 7	NO DATA	NO DATA
581334		1	Surrogate	Blend 8	NO DATA	NO DATA

Test: IGNIT_1030 Holding: 180 days from CED
Section: WETCHEM **SW 846 Method 1030 Ignitability of solids** Cnt: 9

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581319		1	Surrogate	Blend 11	NO DATA	NO DATA
581321		1	Surrogate	Blend 12	NO DATA	NO DATA
581323		1	Surrogate	Blend 13	NO DATA	NO DATA
581327		1	Surrogate	Blend 2	NO DATA	NO DATA

Southwest Research Institute

Laboratory Task Order

TO #: 150904-4 Revision: 1

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 09/17/15

SDG: 581318
VTSR: 09/03/15
CASE: Zeolite

SRR #'s: 56087
Client(s): Los Alamos National Laboratory

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581328		1	Surrogate	Blend 3	NO DATA	NO DATA
581329		1	Surrogate	Blend 4	NO DATA	NO DATA
581332		1	Surrogate	Blend 6	NO DATA	NO DATA
581333		1	Surrogate	Blend 7	NO DATA	NO DATA
581334		1	Surrogate	Blend 8	NO DATA	NO DATA

Test: Oxidizer_UN
Section: WETCHEM

Holding: 180 days from CED

United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.

Cnt: 15

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581319		1	Surrogate	Blend 11	NO DATA	NO DATA
581321		1	Surrogate	Blend 12	NO DATA	NO DATA
581323		1	Surrogate	Blend 13	NO DATA	NO DATA
581324		1	Surrogate	Blend 9	NO DATA	NO DATA
581325		1	Surrogate	Blend 10	NO DATA	NO DATA
581326		1	Surrogate	Blend 1	NO DATA	NO DATA
581327		1	Surrogate	Blend 2	NO DATA	NO DATA
581328		1	Surrogate	Blend 3	NO DATA	NO DATA
581329		1	Surrogate	Blend 4	NO DATA	NO DATA
581330		1	Surrogate	Cement 1	NO DATA	NO DATA
581331		1	Surrogate	Blend 5	NO DATA	NO DATA
581332		1	Surrogate	Blend 6	NO DATA	NO DATA
581333		1	Surrogate	Blend 7	NO DATA	NO DATA
581334		1	Surrogate	Blend 8	NO DATA	NO DATA
581335		1	Surrogate	Cement 2	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15

Time: 08:30:00

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

Notes

Sample was delivered intact. (no ice).

Fed Ex #(s):
590817794105 - 21.2 °C

See Task Order for full requirements.

See chain of custody as part of the SRR system for more information.

The Product along with the Section 4.0 of the paperwork provided by the client will be used to create the ADDITIONAL Solid and Liquid Surrogates identified in the Client ID section.

Due to character limitations, the following
1 (UNS LQ+SWheat 1:1):1 Spillfyter :3 zeolite or cemented
was abbreviated to:
1(UNSLQ+SWht 1:1):1 Spillfyter:3 zeolite or cmtd

1 (UNS LQ+SWheat 1:1):1 Spillfyter :1citric acid :3 zeolite or cemented
was abbreviated to:
1(UNSLQ+SWht 1:1):1 Spillfyter:1 citric acid :3

Phases:
001 - admin
002 - extraction
005 - 8082
006 - metals/radchem
007 - drg

Rev. 1
Corrected project number.
REVISION 2, DRmz 12/15/15: New Sample IDs added to the SRR, along with revisions done to previously created IDs, per email from Radonna Spies.

Rev. 3
Added samples and revised sample ID's. See attached email.

Backaround CPM: <100 cpm
Container Wipe CPM: <100 cpm
Total CPM: <100

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
581326	Blend 1		Surrogate	1	
581325	Blend 10		Surrogate	1	
581319	Blend 11		Surrogate	1	
581321	Blend 12		Surrogate	1	
581323	Blend 13		Surrogate	1	
589460	Blend 14		Surrogate	1	
589461	Blend 15		Surrogate	1	
589462	Blend 16		Surrogate	1	
589620	Blend 17		Surrogate	1	

56087 Los Alamos National Laborato

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15

Time: 08:30:00

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
589621	Blend 18		Surrogate	1	
589622	Blend 19		Surrogate	1	
581327	Blend 2		Surrogate	1	
589623	Blend 20		Surrogate	1	
589624	Blend 21		Surrogate	1	
589625	Blend 22		Surrogate	1	
589626	Blend 23		Surrogate	1	
589627	Blend 24		Surrogate	1	
589628	Blend 25		Surrogate	1	
581328	Blend 3		Surrogate	1	
581329	Blend 4		Surrogate	1	
581331	Blend 5		Surrogate	1	
581332	Blend 6		Surrogate	1	
581333	Blend 7		Surrogate	1	
581334	Blend 8		Surrogate	1	
581324	Blend 9		Surrogate	1	
581330	Cement 1		Surrogate	1	
589463	Cement 10		Surrogate	1	
589464	Cement 11		Surrogate	1	
589465	Cement 12		Surrogate	1	
589466	Cement 13		Surrogate	1	
589467	Cement 14		Surrogate	1	
589468	Cement 15		Surrogate	1	
581335	Cement 2		Surrogate	1	
581318	Cement 3		Surrogate	1	
581320	Cement 4		Surrogate	1	
581322	Cement 5		Surrogate	1	
589469	Cement 6		Surrogate	1	
589470	Cement 7		Surrogate	1	
589471	Cement 8		Surrogate	1	
589472	Cement 9		Surrogate	1	
581291	UNS Blend 1		Liquid	1	
581301	UNS Blend 10		Solid	1	
581302	UNS Blend 11		Solid	1	
581303	UNS Blend 12		Solid	1	
589629	UNS Blend 13		Surrogate	1	
589630	UNS Blend 14		Surrogate	1	
589631	UNS Blend 15		Surrogate	1	
589632	UNS Blend 16		Surrogate	1	
589633	UNS Blend 17		Surrogate	1	
589634	UNS Blend 18		Surrogate	1	

56087 Los Alamos National Laborato

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15

Time: 08:30:00

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
589635	UNS Blend 19		Surrogate	1	
581292	UNS Blend 2		Solid	1	
581293	UNS Blend 3		Solid	1	
581294	UNS Blend 4		Solid	1	
581295	UNS Blend 5		Liquid	1	
581296	UNS Blend 6		Liquid	1	
581297	UNS Blend 7		Liquid	1	
581298	UNS Blend 8		Solid	1	
581300	UNS Blend 9		Solid	1	
581299	Zeolite		Solid	1	

Containers: 60 **Samples: 60**

These documents are associated with this receipt: 185604[COC for SRR 56087], 185605[SRR Paperwork for SRR 56087], 191181[New Sample IDs], 191404[]

Thermometer: 021056
Temperature: 21.2

56087 Los Alamos National Laborato

Southwest Research Institute

Traffic Report

010009

Sample Custodian Signature: _____

1. Custody Seal — Present
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: Zeolite / SDG: _____

Sample Receipt: 56087

Airbill: 590817794105

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
09/03/15	08:30:00	Email	UNS Blend 1	N/A	581291	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 2	N/A	581292	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 3	N/A	581293	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 4	N/A	581294	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 5	N/A	581295	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 6	N/A	581296	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 7	N/A	581297	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 8	N/A	581298	YES	Intact
09/03/15	08:30:00	Email	Zeolite	N/A	581299	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 9	N/A	581300	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 10	N/A	581301	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 11	N/A	581302	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 12	N/A	581303	YES	Intact
09/03/15	08:30:00	4.0	Cement 3	N/A	581318	YES	Intact
09/03/15	08:30:00	4.0	Blend 11	N/A	581319	YES	Intact
09/03/15	08:30:00	4.0	Cement 4	N/A	581320	YES	Intact
09/03/15	08:30:00	4.0	Blend 12	N/A	581321	YES	Intact
09/03/15	08:30:00	4.0	Cement 5	N/A	581322	YES	Intact
09/03/15	08:30:00	4.0	Blend 13	N/A	581323	YES	Intact
09/03/15	08:30:00	4.0	Blend 9	N/A	581324	YES	Intact
09/03/15	08:30:00	4.0	Blend 10	N/A	581325	YES	Intact
09/03/15	08:30:00	4.0	Blend 1	N/A	581326	YES	Intact
09/03/15	08:30:00	4.0	Blend 2	N/A	581327	YES	Intact
09/03/15	08:30:00	4.0	Blend 3	N/A	581328	YES	Intact
09/03/15	08:30:00	4.0	Blend 4	N/A	581329	YES	Intact
09/03/15	08:30:00	4.0	Cement 1	N/A	581330	YES	Intact
09/03/15	08:30:00	4.0	Blend 5	N/A	581331	YES	Intact
09/03/15	08:30:00	4.0	Blend 6	N/A	581332	YES	Intact
09/03/15	08:30:00	4.0	Blend 7	N/A	581333	YES	Intact
09/03/15	08:30:00	4.0	Blend 8	N/A	581334	YES	Intact
09/03/15	08:30:00	4.0	Cement 2	N/A	581335	YES	Intact
09/03/15	08:30:00	4.0	Blend 14	N/A	589460	YES	Intact
09/03/15	08:30:00	4.0	Blend 15	N/A	589461	YES	Intact
09/03/15	08:30:00	4.0	Blend 16	N/A	589462	YES	Intact
09/03/15	08:30:00	4.0	Cement 10	N/A	589463	YES	Intact

Southwest Research Institute
Traffic Report

010010

Sample Custodian Signature: _____

Client: Los Alamos National Laboratory
Project: 21592.01.00X
Case: Zeolite / SDG: _____
Sample Receipt: 56087
Airbill: 590817794105

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
				Custody Seal #(s): N/A			
09/03/15	08:30:00	4.0	Cement 11	N/A	589464	YES	Intact
09/03/15	08:30:00	4.0	Cement 12	N/A	589465	YES	Intact
09/03/15	08:30:00	4.0	Cement 13	N/A	589466	YES	Intact
09/03/15	08:30:00	4.0	Cement 14	N/A	589467	YES	Intact
09/03/15	08:30:00	4.0	Cement 15	N/A	589468	YES	Intact
09/03/15	08:30:00	4.0	Cement 6	N/A	589469	YES	Intact
09/03/15	08:30:00	4.0	Cement 7	N/A	589470	YES	Intact
09/03/15	08:30:00	4.0	Cement 8	N/A	589471	YES	Intact
09/03/15	08:30:00	4.0	Cement 9	N/A	589472	YES	Intact
09/03/15	08:30:00	Email	Blend 17	N/A	589620	YES	Intact
09/03/15	08:30:00	Email	Blend 18	N/A	589621	YES	Intact
09/03/15	08:30:00	Email	Blend 19	N/A	589622	YES	Intact
09/03/15	08:30:00	Email	Blend 20	N/A	589623	YES	Intact
09/03/15	08:30:00	Email	Blend 21	N/A	589624	YES	Intact
09/03/15	08:30:00	Email	Blend 22	N/A	589625	YES	Intact
09/03/15	08:30:00	Email	Blend 23	N/A	589626	YES	Intact
09/03/15	08:30:00	Email	Blend 24	N/A	589627	YES	Intact
09/03/15	08:30:00	Email	Blend 25	N/A	589628	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 13	N/A	589629	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 14	N/A	589630	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 15	N/A	589631	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 16	N/A	589632	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 17	N/A	589633	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 18	N/A	589634	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 19	N/A	589635	YES	Intact

SAMPLE LOG-IN SHEET

010011

Lab Name: Southwest Research Institute	Page 1 of 3
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 09/03/2015
Received By (Signature): Steven Douglas	
Case Number: Zeolite	Sample Delivery Group No.: NA
Remarks: 21592.01.00X	SAS Number: NA

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present/Absent*	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	590817794105	
7. Sample Tags	Present/Absent*	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/Leaking	
9. Cooler Temperature	21.2C	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	09/03/2015	
12. Time Received	08:30:00	

Sample Transfer	
Fraction: INORG	Fraction:
Area #: R. Spres	Area #:
By: STEVEN DOUGLAS	By:
On: 09/03/2015	On:

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
UNS Blend 1	N/A	581291	Intact
UNS Blend 2	N/A	581292	Intact
UNS Blend 3	N/A	581293	Intact
UNS Blend 4	N/A	581294	Intact
UNS Blend 5	N/A	581295	Intact
UNS Blend 6	N/A	581296	Intact
UNS Blend 7	N/A	581297	Intact
UNS Blend 8	N/A	581298	Intact
Zeolite	N/A	581299	Intact
UNS Blend 9	N/A	581300	Intact
UNS Blend 10	N/A	581301	Intact
UNS Blend 11	N/A	581302	Intact
UNS Blend 12	N/A	581303	Intact
Cement 3	N/A	581318	Intact
Blend 11	N/A	581319	Intact
Cement 4	N/A	581320	Intact
Blend 12	N/A	581321	Intact
Cement 5	N/A	581322	Intact
Blend 13	N/A	581323	Intact
Blend 9	N/A	581324	Intact
Blend 10	N/A	581325	Intact
Blend 1	N/A	581326	Intact
Blend 2	N/A	581327	Intact

* Contact SMO and attach record of resolution

Reviewed By: Ann Reynolds	Logbook No.: Sample Receipt (56087)
Date: 12.21.15	Logbook Page No.: 9201 SEC 2, 3 OF 4

SAMPLE LOG-IN SHEET

010012

Lab Name: Southwest Research Institute	Page 2 of 3
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 09/03/2015
Received By (Signature):	
Case Number: Zeolite	Sample Delivery Group No.: NA
Remarks: 21592.01.00X	SAS Number: NA

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present/Absent	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	590817794105	
7. Sample Tags	Present/Absent	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/ Leaking	
9. Cooler Temperature	21.2C	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	09/03/2015	
12. Time Received	08:30:00	

Sample Transfer		
Fraction	Fraction	
Area #	Area #	
By: STEVEN	By	
On: DOUGLAS 09/03/2015	On	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Blend 3	N/A	581328	Intact
Blend 4	N/A	581329	Intact
Cement 1	N/A	581330	Intact
Blend 5	N/A	581331	Intact
Blend 6	N/A	581332	Intact
Blend 7	N/A	581333	Intact
Blend 8	N/A	581334	Intact
Cement 2	N/A	581335	Intact
Blend 14	N/A	589460	Intact
Blend 15	N/A	589461	Intact
Blend 16	N/A	589462	Intact
Cement 10	N/A	589463	Intact
Cement 11	N/A	589464	Intact
Cement 12	N/A	589465	Intact
Cement 13	N/A	589466	Intact
Cement 14	N/A	589467	Intact
Cement 15	N/A	589468	Intact
Cement 6	N/A	589469	Intact
Cement 7	N/A	589470	Intact
Cement 8	N/A	589471	Intact
Cement 9	N/A	589472	Intact
Blend 17	N/A	589620	Intact
Blend 18	N/A	589621	Intact

* Contact SMO and attach record of resolution

Reviewed By	Logbook No.: Sample Receipt (56087)
Date: 12.21.15	Logbook Page No.: 9201 SE 2, 3 OF 4

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 3 of 3
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 09/03/2015
Received By (Signature): Steven Douglas	
Case Number: Zeolite	Sample Delivery Group No.: NA
Remarks: 21592.01.00X	SAS Number: NA

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present/Absent*	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	590817794105	
7. Sample Tags	Present/Absent*	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/Leaking	
9. Cooler Temperature	21.2C	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	09/03/2015	
12. Time Received	08:30:00	

Sample Transfer	
Fraction: MMG	Fraction
Area #: B. Spres	Area #
By: STEVEN DOUGLAS	By
On: 09/03/2015	On

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Blend 19	N/A	589622	Intact
Blend 20	N/A	589623	Intact
Blend 21	N/A	589624	Intact
Blend 22	N/A	589625	Intact
Blend 23	N/A	589626	Intact
Blend 24	N/A	589627	Intact
Blend 25	N/A	589628	Intact
UNS Blend 13	N/A	589629	Intact
UNS Blend 14	N/A	589630	Intact
UNS Blend 15	N/A	589631	Intact
UNS Blend 16	N/A	589632	Intact
UNS Blend 17	N/A	589633	Intact
UNS Blend 18	N/A	589634	Intact
UNS Blend 19	N/A	589635	Intact

* Contact SMO and attach record of resolution

Reviewed By: [signature]	Logbook No.: ~~Sample Receipt (56087)~~
Date: 12.22.15	Logbook Page No.: 9201 SEC 2, 3 of 4

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Case Narrative

WETCHEM ANALYSIS

Initial sample preparation

Throughout the course of testing, modifications to the surrogate preparation took place causing multiple preparations and analyses for some surrogates. The number of times each surrogate was made and analyzed can be found in Table 1. After Blends 6, 7, and 8 were initially made and analyzed for most tests, the project issued a revision to the SOW to include drying the Blends at 60°C in Nalgene bottles for 16 hours with the lid loosely attached. The drying was done in order to simulate the aging of the mixture to mimic the actual contents of the drum. When this was done, there was uneven heating that occurred, which resulted in the top portions becoming dry but the lower portions remaining very moist. Also, Blend 6 blew the cap off during this drying process throwing some of the sample onto the oven base. At the direction of the client, the blends were then reprepared and dried in Pyrex pans covered with a layer of saran wrap with holes in it at 65°C for at least 16 hours. This seemed to work well for Blends 7 and 8 but Blend 6 needed additional time heating to become dry. This final method for creating the dried Swheat/WB8 mixture was used later to create Blends 11, 12, 13, 14, 15, and 16. A picture of the drying on the hotplates can be seen in Images 1 and 2.

Issues also arose during the preparation of the cements. All cement blends were initially prepared according to the original SOW using the moist Swheat/WB8 mixture. The amount of sodium hydroxide added to the blends closely matched that identified in the SOW and the cements immediately began to set. However, it was during the 7-day curing period that the project changed the SOW requiring the Swheat/WB8 mixtures be dried prior to analysis. Therefore, Cements 3, 4, and 5 needed to be remade. During the second attempt at making these cement blends, the drying of the Swheat/WB8 mixture caused the loss of nitric acid thus reducing the amount of sodium hydroxide required to make the pH remain between 9 and 11. Once the water was adjusted for this and combined with the cement, it formed a mixture that did not set well. The cements were easily broken apart and crumbled. The project was informed of this, and a third revision to the SOW was made. The revision halted the processing and testing of the first five cement blends and created ten new cement blends, which are pending at the time of this report.

Blends 11-16 used the dried Swheat/WB8 mixtures for their preparation. For Blends 11, 12, and 13, the dried Swheat/WB8 mixtures were mixed with zeolite and allowed to sit for an additional 24 hours prior to analysis. For Blends 14, 15, and 16, the dried Swheat/WB8 mixtures was mixed 1:1 with water for 5 minutes before adding to zeolite and allowing to sit for 24 hours prior to testing.

SW-846 1030: Ignitability of Solids

The surrogate material was formed into an unbroken powder train, 250 mm in length. An ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within 2 minutes. If the material combustion propogated, the burning time was measured over a distance of 100 mm and the rate of burning would be determined.

Table 1. Surrogate creation and analysis table

Surrogate ID	Times made	Methods		
		1030	1050	UN Ox
Blend 1	1			1
Blend 2	1	1	1	1
Blend 3	1	1	1	1
Blend 4	1	1	1	1
Blend 5	1	*	*	1
Blend 6	3	2	2	2
Blend 7	3	2	2	1
Blend 8	3	2	1	1
Blend 9	1	*	*	1
Blend 10	1	*	*	1
Blend 11	1	1	1	1
Blend 12	1	1	1	1
Blend 13	1	1	1	1
Blend 14	1	1	1	*
Blend 15	1	1	1	*
Blend 16	1	1	1	*
Cement 1	1	*	*	1
Cement 2	1	*	*	1
Cement 3	2	0	0	0
Cement 4	2	0	0	0
Cement 5	2	0	0	0

*Testing not required for these methods.

The surrogates were formed in a metal triangular train that is 250mm long. The samples were then placed onto a ceramic tile with marks at 80 and 180 mm in from the end of the train. The ceramic tile was placed about 8 inches deep in a hood with the sash lowered to give an airflow of approximately 0.7 m/sec. The end (0 mm) of the train was exposed to an acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes and if the sample began to burn down the train the time taken to get from the 80 to 180 mm mark was measured to determine the burn rate.

Blends 2, 3, and 4 did begin to propograte down the train at different rates and lengths; however, the burn tes were slow. Some of the readings took 3 minutes to burn approximately 50 mm. The nitrate salts were charring and becoming molten before continuing to burn slowly down the train. Since the rate was so slow, the samples were considered to have a non-flammable. After the burning was complete, a hard melt was left on the ceramic that took some effort to scrap off, see Image 3.

The Swheat/WB8 mixtures did very little burning past the point of the flame initiation. Blends 6 burned immediately in the vicinity of the flame but the ignition did not propogate down the train. The ash like material, from Blend 6, blew to the back of the ceramic tile and can be seen in Image 4. Blends 7 and 8 whitened at the point of the flame and then charred slightly past the flame point and can be seen in

Image 5. Although Blends 6-8 appeared to combust, the material did not propogate; therefore, under the criteria and conditions of the test, the material is considered non-flammable. The Swheat/WB8:Zeolite mixtures (Blends 11, 12, 13, 14,15 and 16) did very little during the burn period. The zeolite whitened and there was little charring as seen in Image 6. These materials were also considered non-flammable.

Fine Excelsior (natural hardwood shavings) were used as a positive control each day testing was performed.

SW-846 1050: Spontaneous combustion and self heating

The surrogates for this analysis were first sprinkled several times onto a ceramic tile to observe if they smoked or flamed and could be considered pyrophoric solids by test Method A. Since none of the samples exhibited these characteristics, they were tested by Method C. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200C within the 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 2.

Table 2. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for then 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cubes were placed into an oven having two thermocouples measuring the oven temperature. Two to four thermocouples inserted into each sample to measure its temperature during the analysis. After several events which caused the contents of the cube to expand out of the cube, lids were made using the same wire mesh as the holders and were placed onto the top of the cubes. Tungsten weights were placed on top to keep the lid on and thermocouples from coming out of the sample during an event. Also, two thermocouples were placed in a tray below the sample in case any sample pushed out of the cube and onto the tray. Image 7 shows a typical setup for the testing. Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for a minimum of 24 hours. Initially, the wet Swheat/WB8 blends did not reach temperature within the 24 hours; therefore, the time was extended to a minimum of 24 hours after the sample reached temperature. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C anytime during the test. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample.

Blends 2, 3, and 4 were all run together and did not exceed 200°C any time during the analysis. The temperature graph is located in Figure 1. The average temperatures of the ovens and blends are overlayed on the graph. The only noticeable change to the sample was the darkening of the Swheat and some compaction of the sample as seen in Image 8. Blends 6, 7, and 8 were initially run together before drying of the Swheat/WB8 mixture was implemented. A little over two hours into the testing an event occurred that caused the oven and Blend 8 to exceed 200°C. The run was ended prior to the 24 hours to examine the contents of the oven. The images of the event can be seen in Image 9. Figures 2-5 are

individual temperature graphs of the Oven, Blend 6, Blend 7 and Blend 8. The temperature of each thermocouple was plotted individually instead of averaged for reference. After this occurrence, testing was performed one sample at a time when the reactivity of the sample was in question. The wet Blend 6 and 8 were retested. In Figure 6, the graph indicates the average temperature of the oven and the temperature of the four thermocouples placed in the sample. While retesting the wet Blend 6, an event occurred at approximately 2 hours into the test. Although the temperature of the sample did not exceed 200°C, the sample expanded out of the cube onto the bottom of the oven. From the graphs, this appears to have occurred when the sample temperature was approximately 70^{o} C since the temperature of the thermocouples in the pan dropped significantly before rising back up to oven temperature (See Figures 6 and 7). The outcome of Blend 6 retest can be seen in Image 10. No incident occurred during the retest of wet Blend 8 (See Figure 8). Blend 7 was not retested wet since it was at this point it was decided to dry all the Swheat/WB8 mixtures.

After repreparing and drying Blends 6, 7, and 8, they were tested individually. Blend 6 had an event occur when the sample reached about 76°C causing the sample to rise well above 600°C (See Figure 6). During this time period, smoke and debris was seen blowing out the back of the oven vents and smoke continued to stream out of the oven vent for some time. The analysis was cut short due to failure of the sample; the event image can be seen in Image 11. Blends 7 and 8 had slight elevation of temperature above 140°C but not exceeding 150°C (See Figures 10 and 11). These two samples darkened during the analysis but did not have the same event occur as that of Blend 6. An Image of Blend 7 after the 1050 testing can be seen Image 12. Blends 11 - 16 were very uneventful and never exceeded 145°C. An image of what Blends 14, 15, and 16 looked like can be seen in Image 13. After all analysis was completed it was seen that only Blend 6 was considered self heating. See Figures 12-17 for the temperature graphs.

Since dried Blend 6 was positive in the 100-mm cube test, it was repeated, in duplicate, using the 25-mm cube (see Image 14). The temperature of the 25-mm cubes did not exceed 145°C (See Figure 18); however, like the 100 mm cube test, the material did expand significantly (see Image 15). Since dried Blend 6 was positive for the 100 mm cube but negative for the 25-mm cube, it received a DOT Packing Group III rating. All other blends were classified as Not a Self-Heating Waste as defined by the conditions of the test method.

DOT UN Oxidation Testing

The Blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the samples mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. The reference mixtures and the sample mixtures were tested five times at each cellulose mixing ratio. If the average burning time is less than the average standard mixture, the burning times should be compared with those from packing group I or II or category I or II oxidizer, reference standards 3:2 and 2:3, by mass, of potassium bromated to cellulose, respectively. Table 3 presents the results for the reference standards. See Table 4 for classification.

Tables 5 and 6 lists the comments the analyst noted for each of the two sample to cellulose ratio burns.

Blend 1 was classified as Packing Group II. Blends 2, 5 and 9 were classified as Packing Group II and the remaining Blends and Cement 1 & 2 were classified as Not Division 5.1

Table 3. Potassium Bromate and Cellulose Standards

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
118.52	56.8	23.55

Table 4. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	UN Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

Table 5. Comments for Sample to Cellulose ratio of 4:1

Sample ID	Comments
Blend 1	Flame, smoke, sparking, charring sample completely burned except for Rep.1
Blend 2	Flame, smoke, sparking, charring.
Blend 3	Flame, smoke, sparking, charring.
Blend 4	Flame, smoke, sparking, charring.
Blend 5	Smoldering, very little smoke, very little sparking
Blend 6	Low flame or no flame, sparking, smoke, smoldering. Rep 1 Time = flaming stopped, Rep 2-5 Time = power off.
Blend 7	Little flame near wire. Smoke, steady low flame near wires. Time = power off
Blend 8	Low flame , smoldering, little smoke, flame cuts off after power if turned off. Time = flaming stopped
Blend 9	Flame, smoke, sparking, charring.
Blend 10	NO3 salts molten. Some sparks. Mainly charring and smoke
Blend 11	Little flame, smoke, smoldering, sparking Rep 1-3 Time = power off
Blend 12	No flame, smoke, smoldering/charing. Time = power off
Blend 13	Low flame, little smoke, smoldering
Cement 1	No flame, no smoke little charring near wires, smoldering
Cement 2	No flame, no smoke little charring near ignition source, smoldering. Time = power turned off.

Table 6 Comments for Sample to Cellulose ratio of 1:1

Sample ID	Comments
Blend 1	Flame, smoke, sparking, charring sample completely burned.
Blend 2	Flame, smoke, sparking, charring.
Blend 3	Flame, smoke, sparking, charring.
Blend 4	Flame, smoke, sparking, charring.
Blend 5	Flame, lots of smoke, sparking, smoldering/charring
Blend 6	Same as 4:1 Rep 1,3 Time = power, Rep 2,4,5 Time = flaming stopped.
Blend 7	Little flame near wire. Smoke, steady low flame near wires. Time = power off. Low flame continued after power was cut off. Time = when low flame cutoff.
Blend 8	Low flame , smoldering, little smoke, flame cuts off after power if turned off. Time = when flaming stopped
Blend 9	Flame, smoke, sparking, charring.
Blend 10	Flame present throughout the test and continued to smolder well after ingition source was off
Blend 11	Low continous flame, little smoke, smoldering, sparking. Time = when low flame stopped.
Blend 12	Low flame near ignition source , smoke, smoldering/charing. Time = Power Off
Blend 13	Low flame, little smoke, smoldering
Cement 1	No flame, no smoke little charring near wires, smoldering
Cement 2	Low flame near ignition source, no smoke little charring, smoldering. Time = when power turned off. Completely charred after power off.

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Image 1: 1:1 (Blend 6) WB8:Swheat mixture drying on the hotplate. Due to it still being more additional time was needed to totally dry.



Image 2: Blend 7 and Blend 8 after drying.



Image 3: 1:3 Method 1030: Blend 3 hard white crust left after burning



Image 4: Method 1030: Blend 6 ashing after heating for 2 minutes



Image 5: Method 1030: Blend 7 and blend 8 appearances after burning



Image 6: Method 1030: Blend 14, 15, and 16 appearance after 2 minute burn.



Image 7: Setup of Method 1050 oven. (Lid was not being used yet on this analysis.)



Image 8: Blends 2 (back left), Blend 3 (back right), and Blend 4 (front right and left) after 1050 analysis.



Image 9: Method 1050: Event that occurred during initial run of (wet) Blends 6, 7, and 8.



Image 10: Method 1050: (wet) Blend 6 (solo retest) event causing sample to expand and spillover



Image 11: Method 1050: (dried) Blend 6 after the sample combusted. Ash remained and note the partial destruction of the inner cage.



Image 12: Method 1050: (dried) Blend 7 post test



Image 13: Method 1050: Blends 14, 15, and 16 post test.



Image 14: Method 1050: Blend 6 in the 25-mm cubes - pretest



Image 15: Method 1050: Blend 6 in the 25-mm cubes - postest

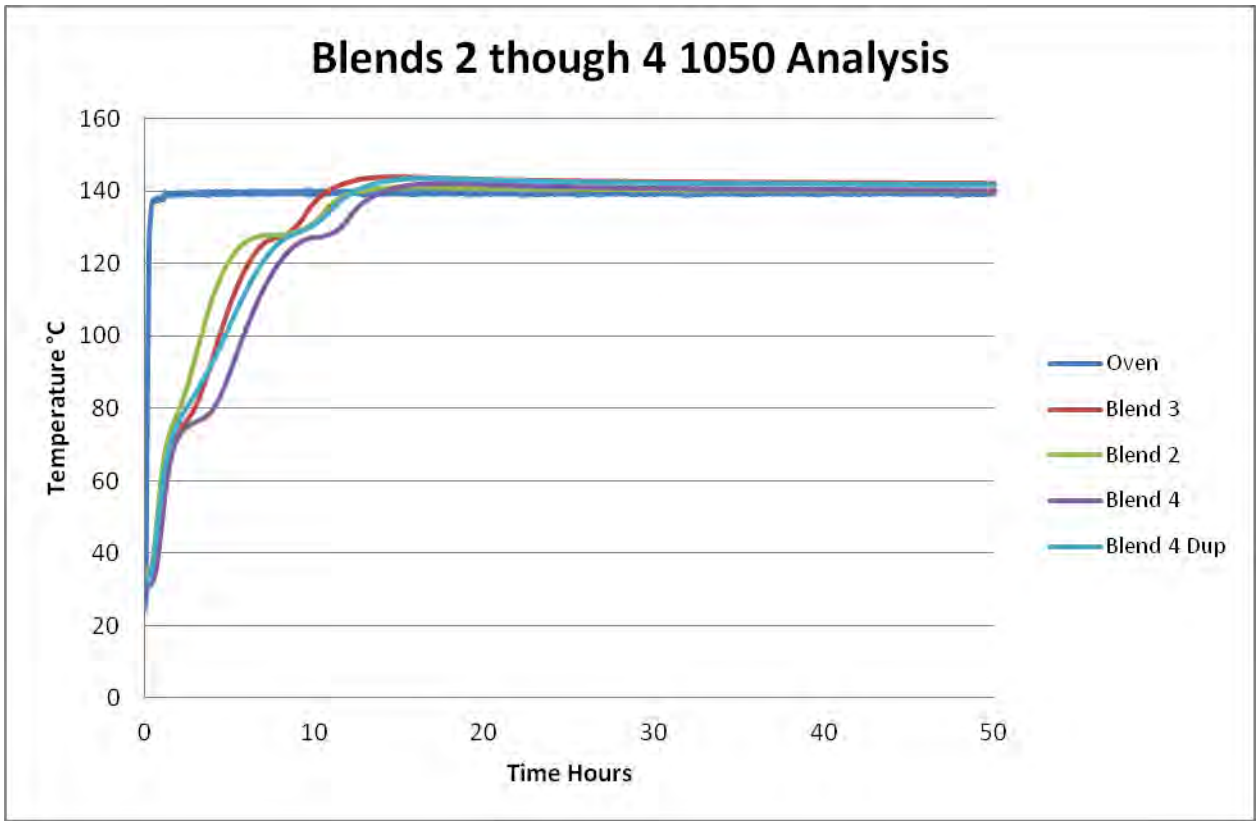


Figure 1. Method 1050 temperature graph for Blends 2, 3, 4 and 5 (100 mm cube). Blends were tested simultaneously with no events.

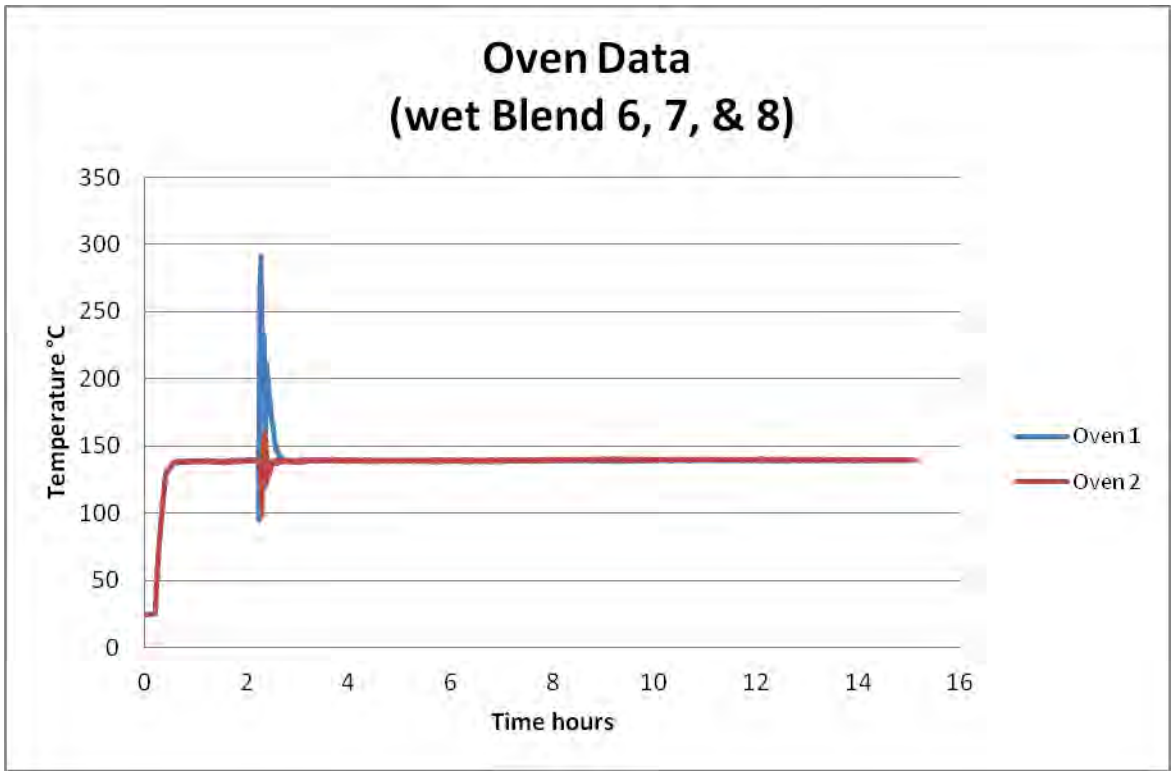


Figure 2. Method 1050 Graph of Oven temperature when (wet) Blends 6, 7 and 8 (100 mm cubes) were tested simultaneously. Note the temperature increase due to an even shortly after 2 hours.

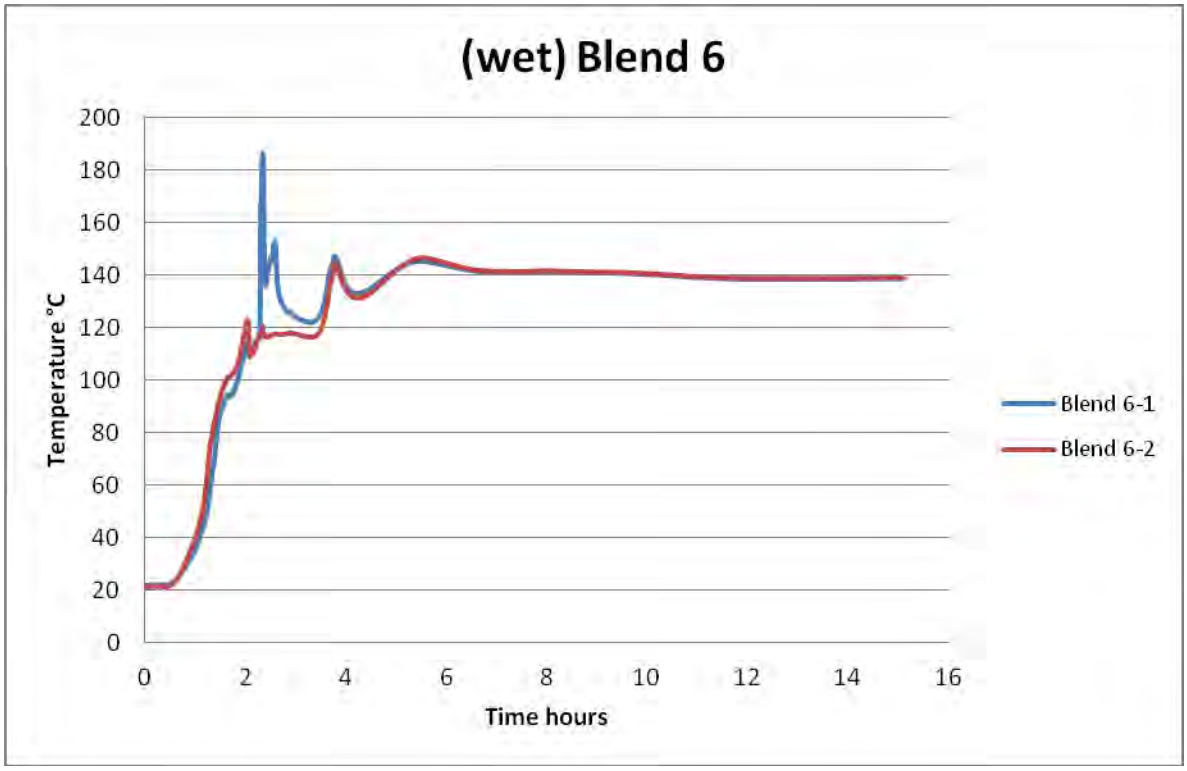


Figure 3. Method 1050 – Temperature of (wet) Blends 6 (100 mm cube) when tested simultaneously with Blend 7 & 8. Note the temperature increase due to an even shortly hour 2.

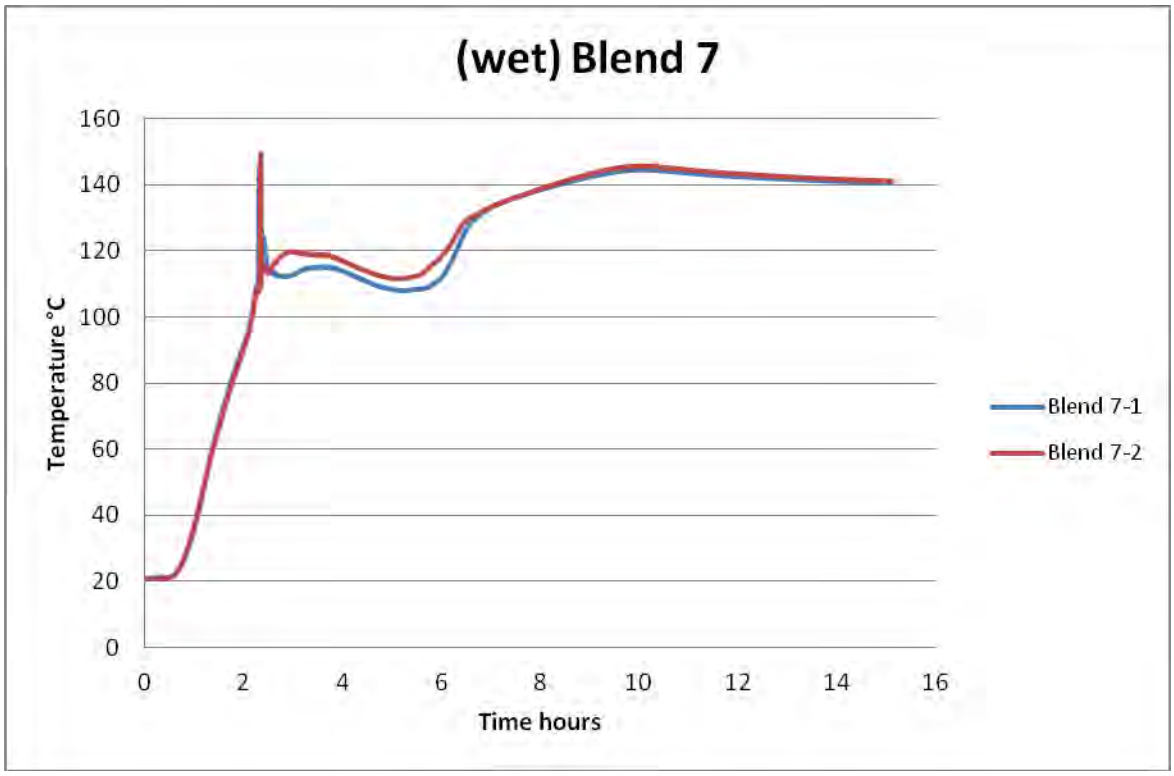


Figure 4. Method 1050 – Temperature of (wet) Blends 7 (100 mm cube) when tested simultaneously with Blend 6 & 8. Note the temperature increase due to an even shortly hour 2.

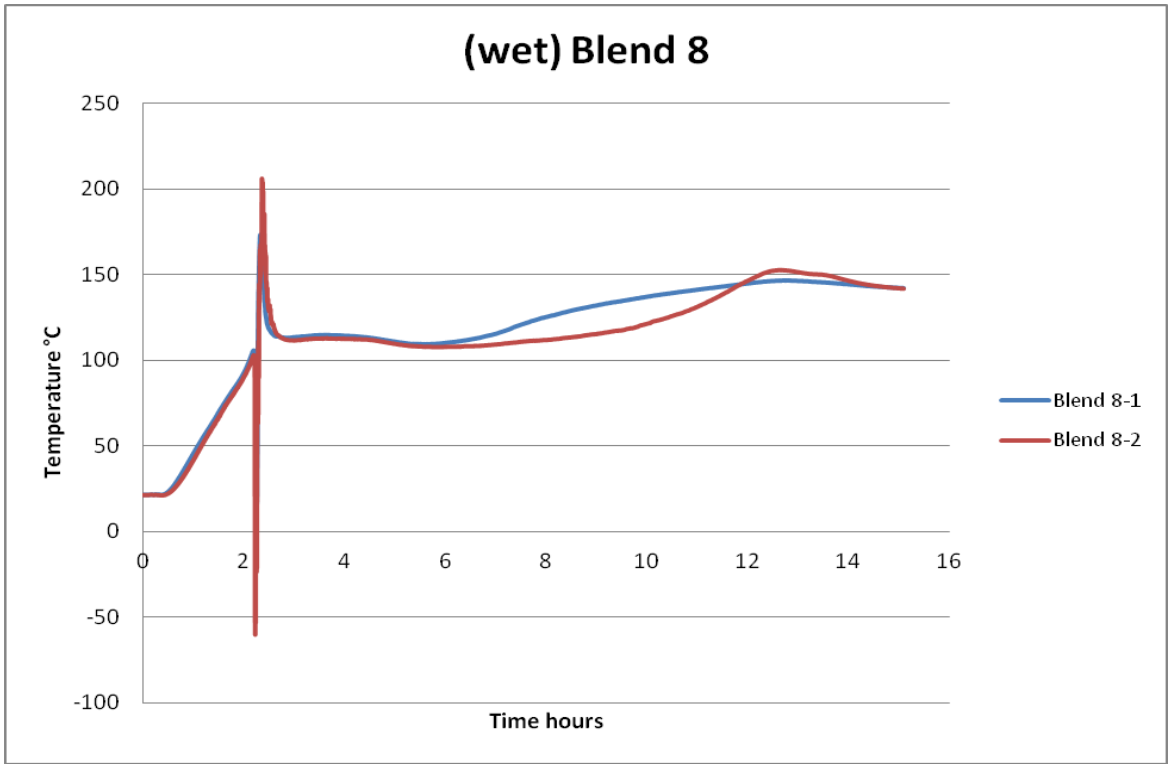


Figure 5. Method 1050 – Temperature of (wet) Blend 8 (100 mm cube) when tested simultaneously with Blend 6 & 7. Note the temperature increase due to an even shortly hour 2.

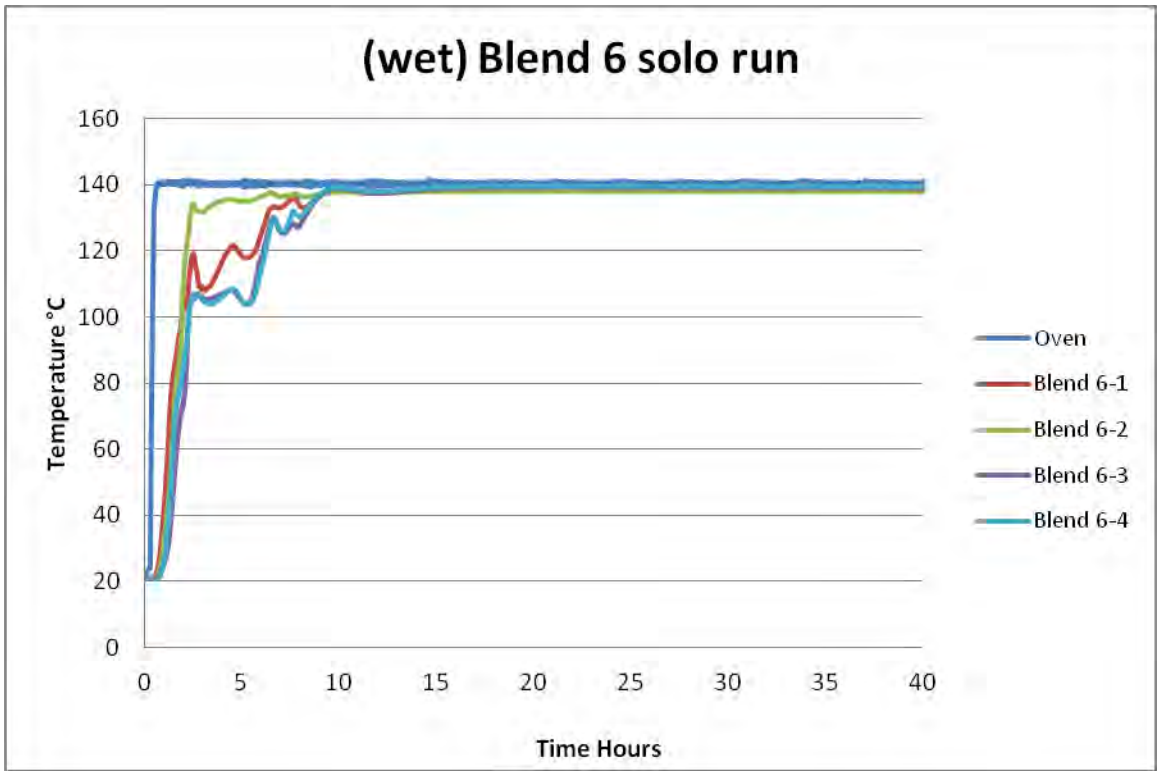


Figure 6. Method 1050 – Temperature of (wet) Blend 6 (100 mm cube) – individual test

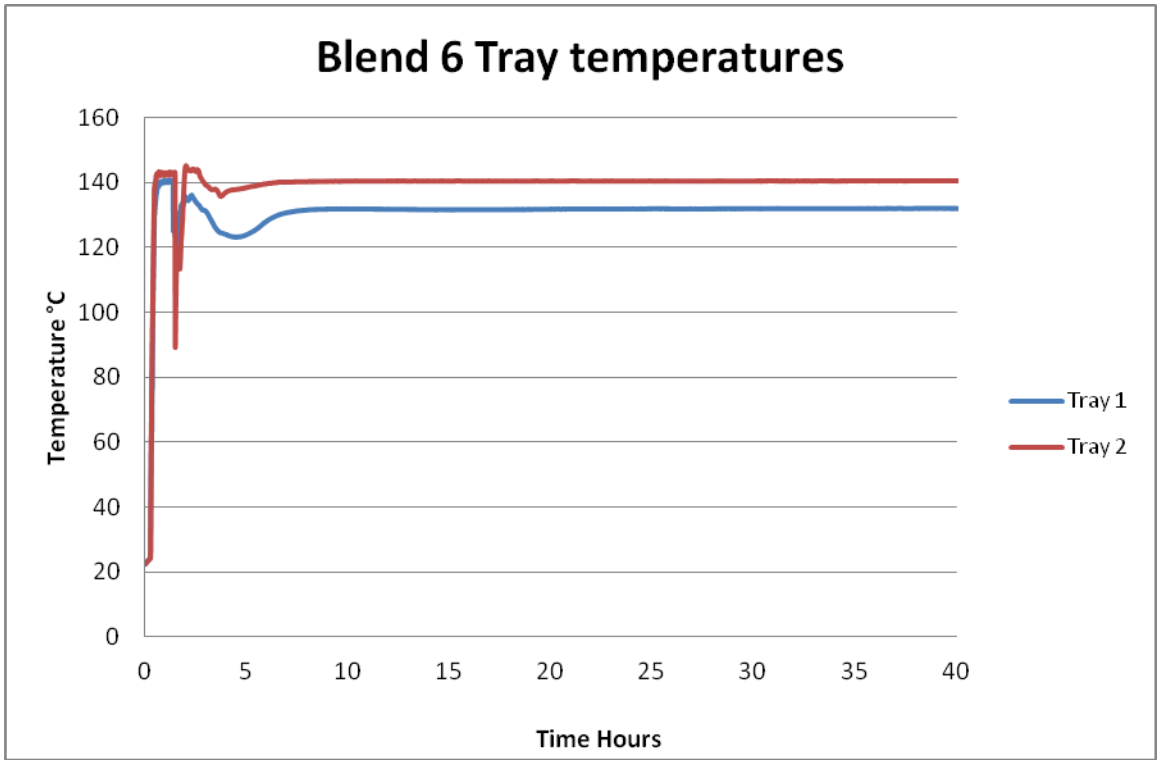


Figure 7. Method 1050 – Temperature of tray probes under the (wet) Blend 6 when tested individually. Note the temperature decrease at approximately 2 hr that signifies when the sample expanded out of the cube.

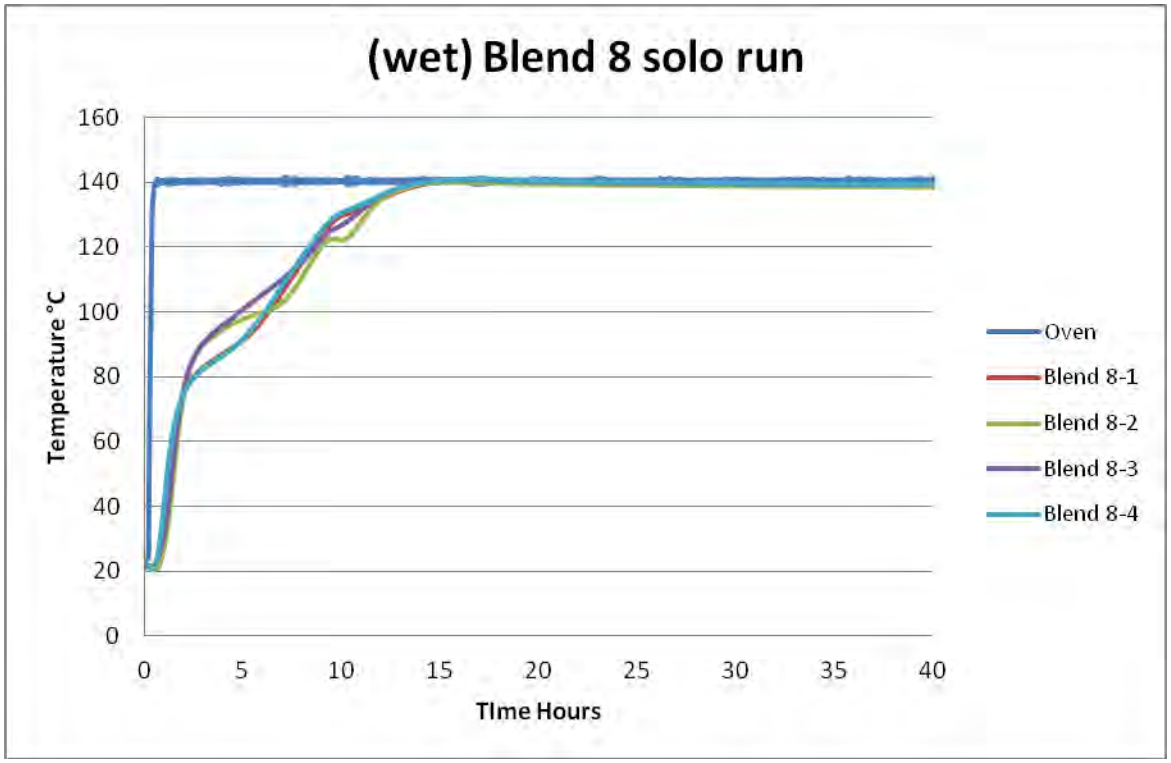


Figure 8. Method 1050 – Temperature of (wet) Blends 8 (100 mm cube) – individual test

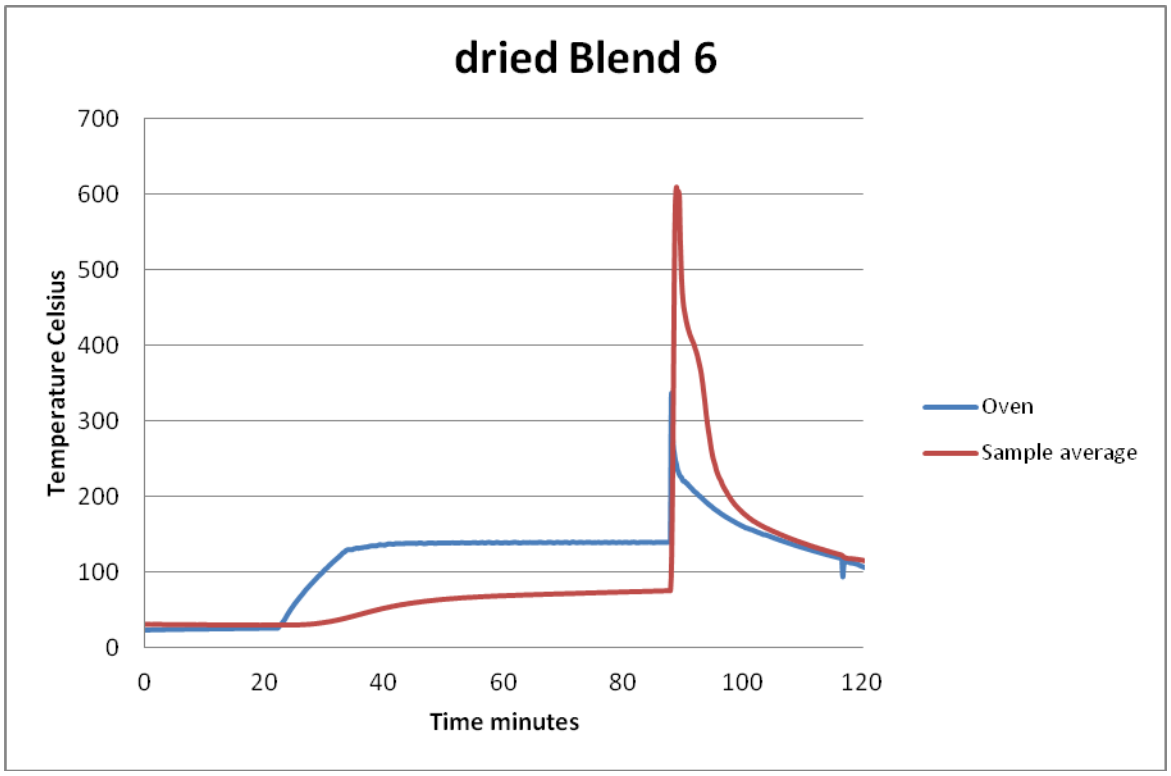


Figure 9. Method 1050 – Temperature of (dried) Blend 6 (100 mm cube). A significant event occurred when the sample reached 76° C

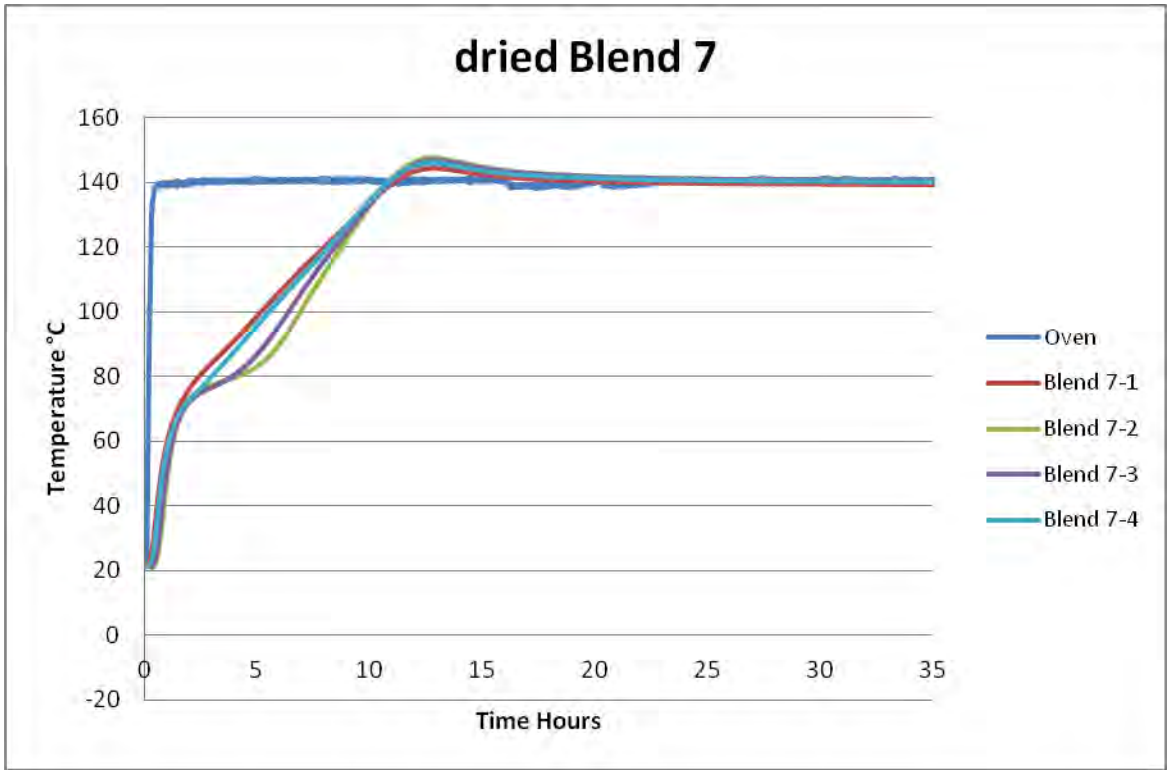


Figure 10. Method 1050 – Temperature of (dried) Blend 7 (100 mm cube)

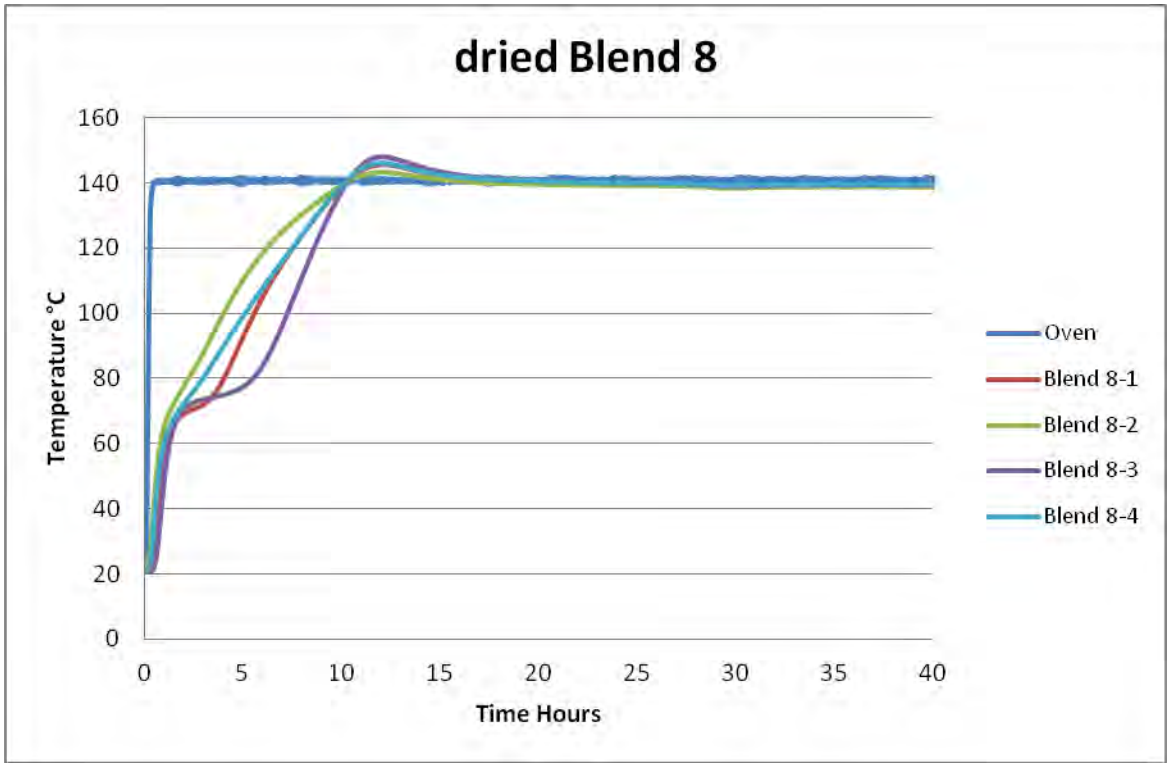


Figure 11. Method 1050 – Temperature of (dried) Blend 8 (100 mm cube)

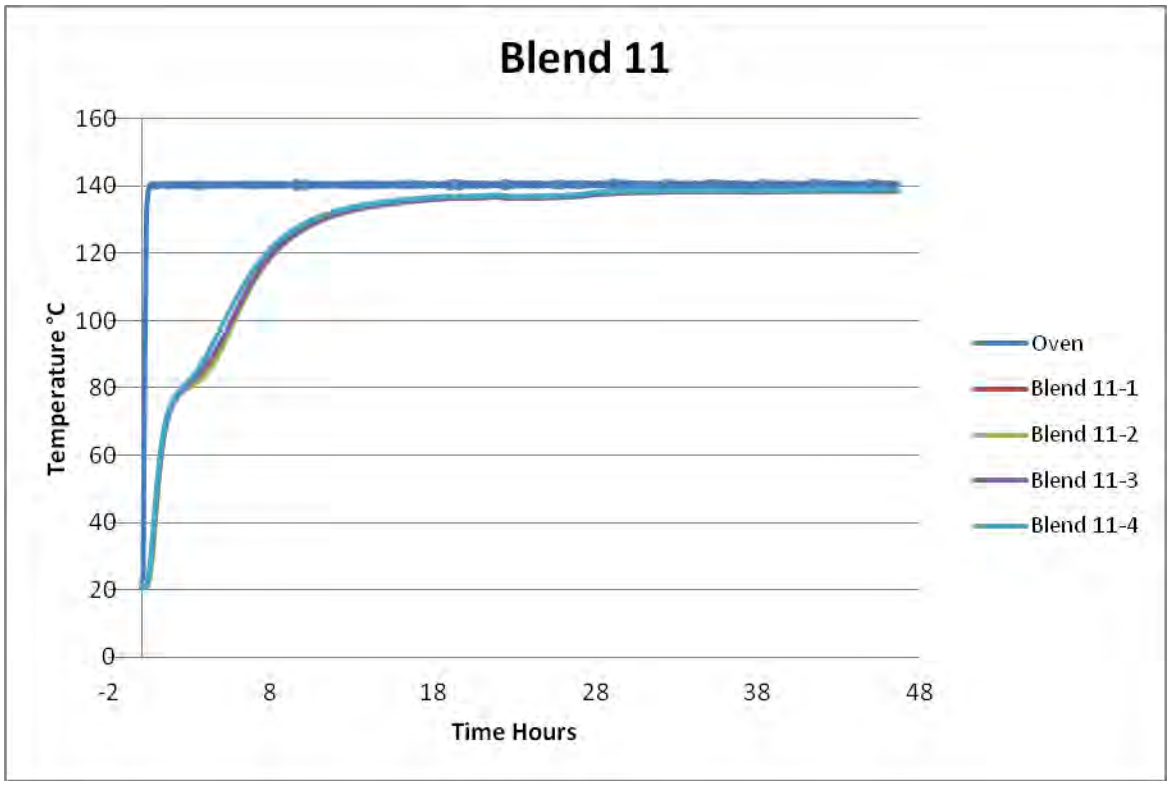


Figure 12. Method 1050 – Temperature of Blend 11 (100 mm cube)

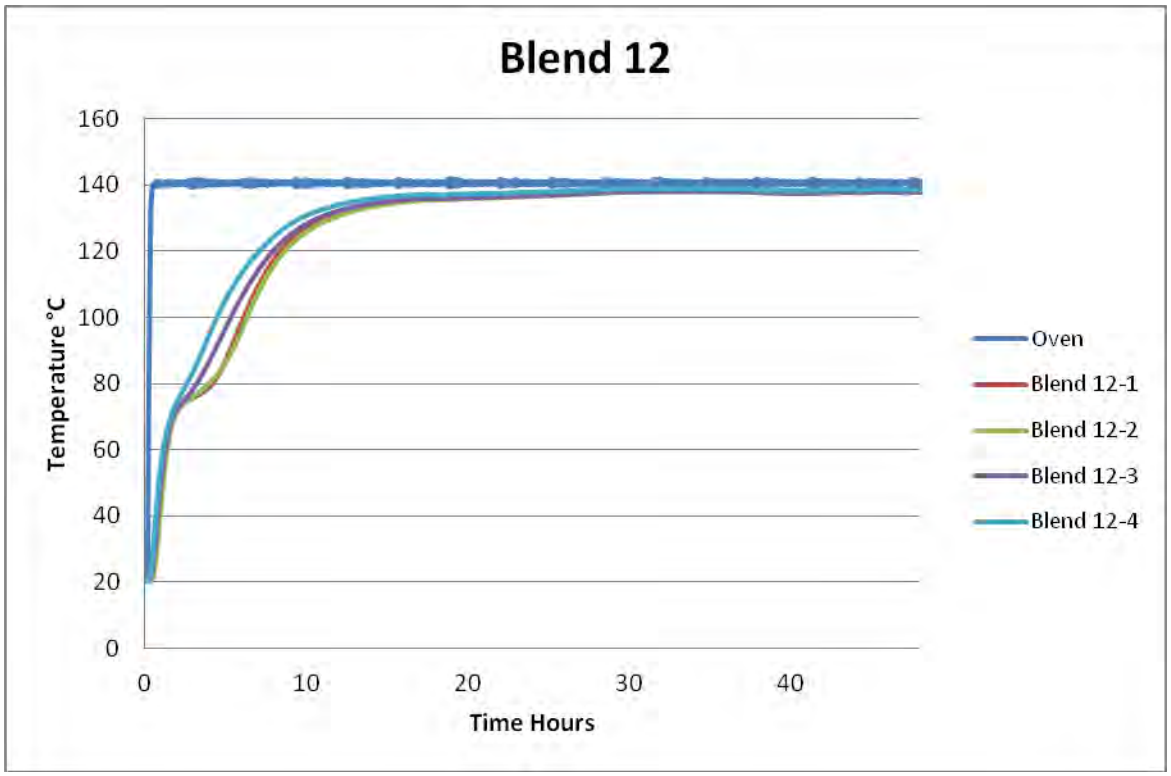


Figure 13. Method 1050 – Temperature of Blend 12 (100 mm cube)

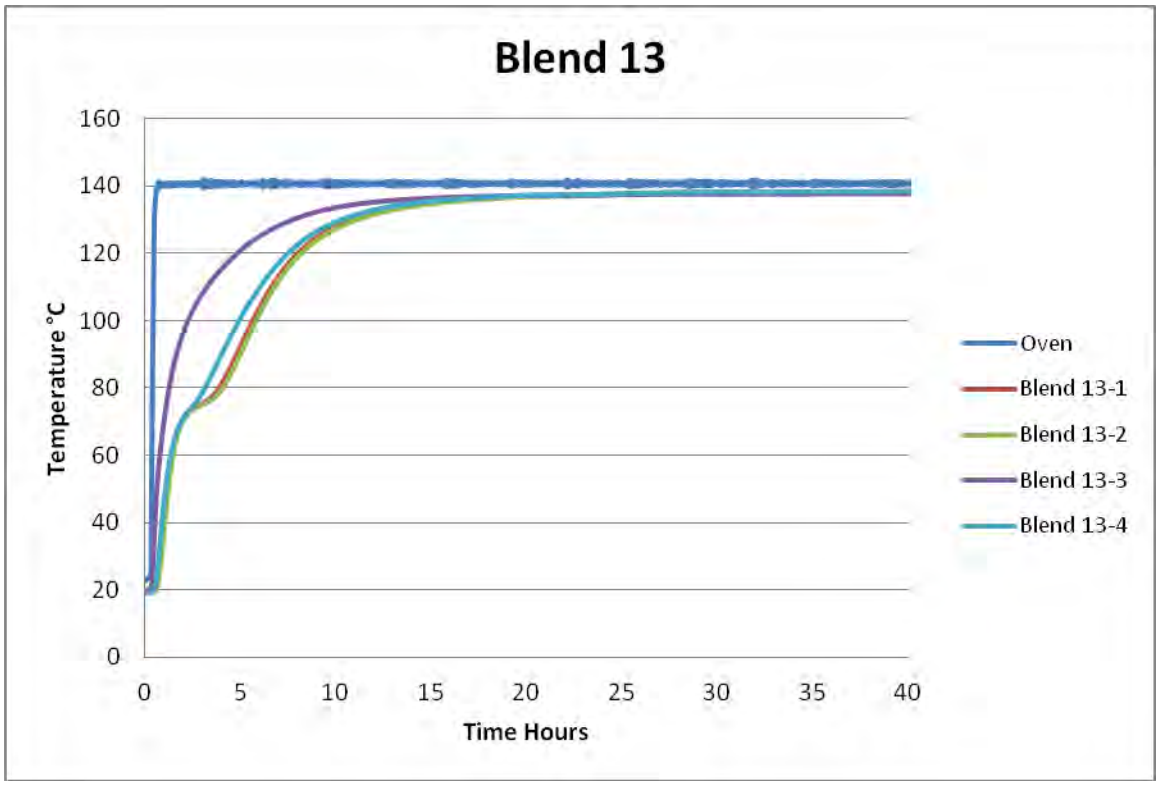


Figure 14. Method 1050 – Temperature of Blend 13 (100 mm cube)

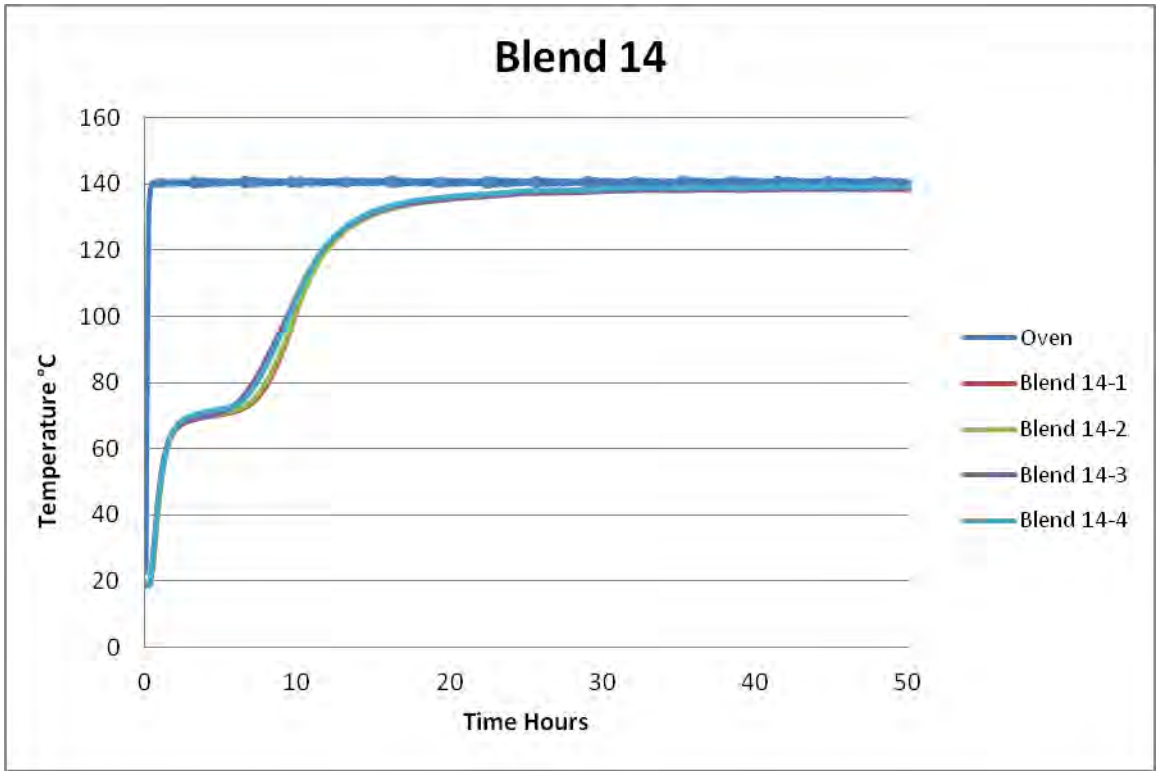


Figure 15. Method 1050 – Temperature of Blend 14 (100 mm cube)

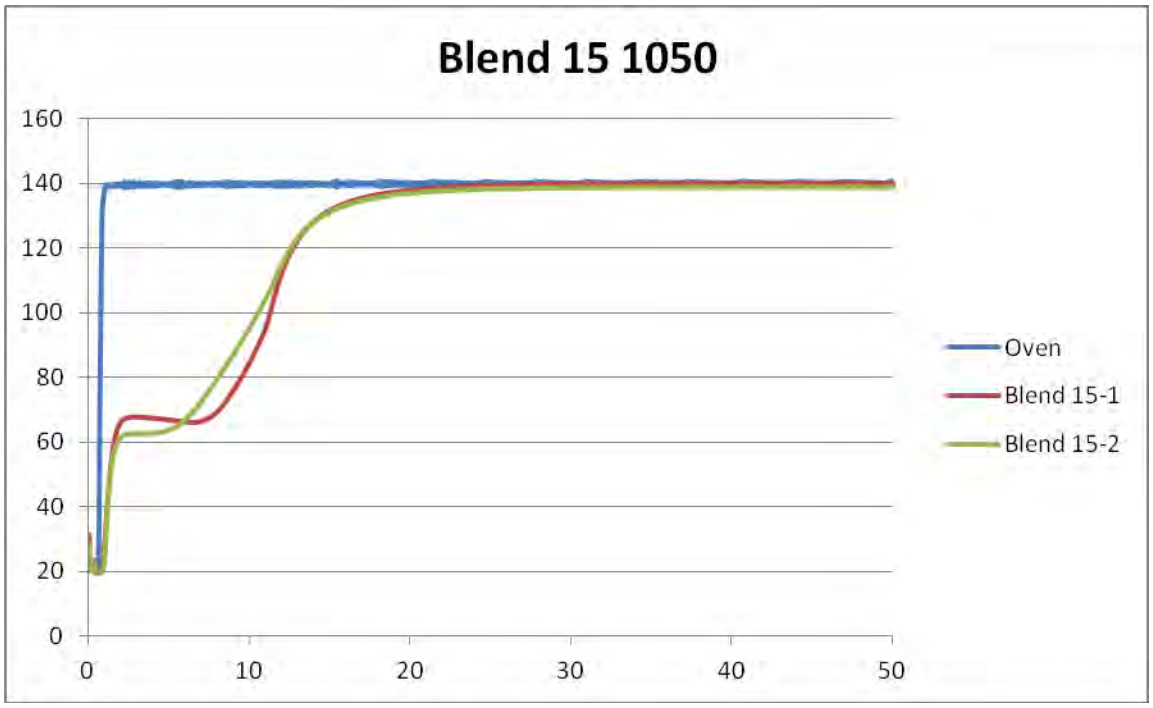


Figure 16. Method 1050 – Temperature of Blend 15 (100 mm cube) - tested concurrently with Blend 16.

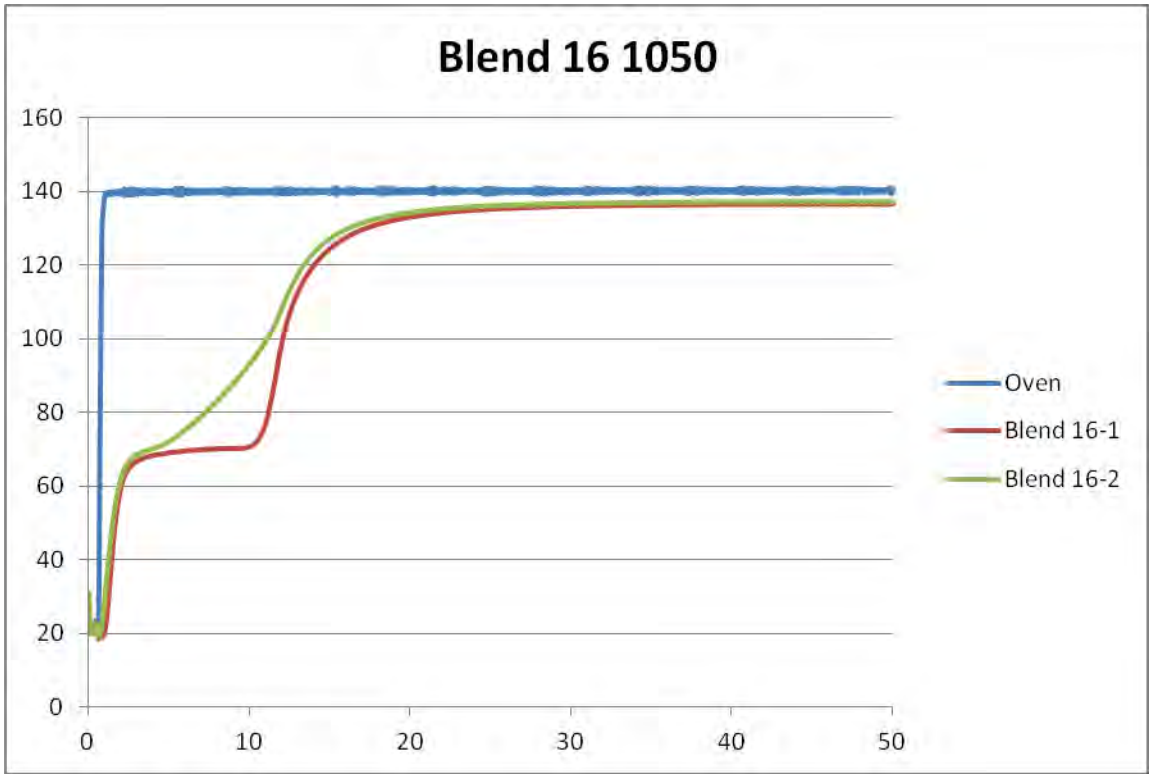


Figure 17. Method 1050 – Temperature of Blend 16 (100 mm cube) - tested concurrently with Blend 15.

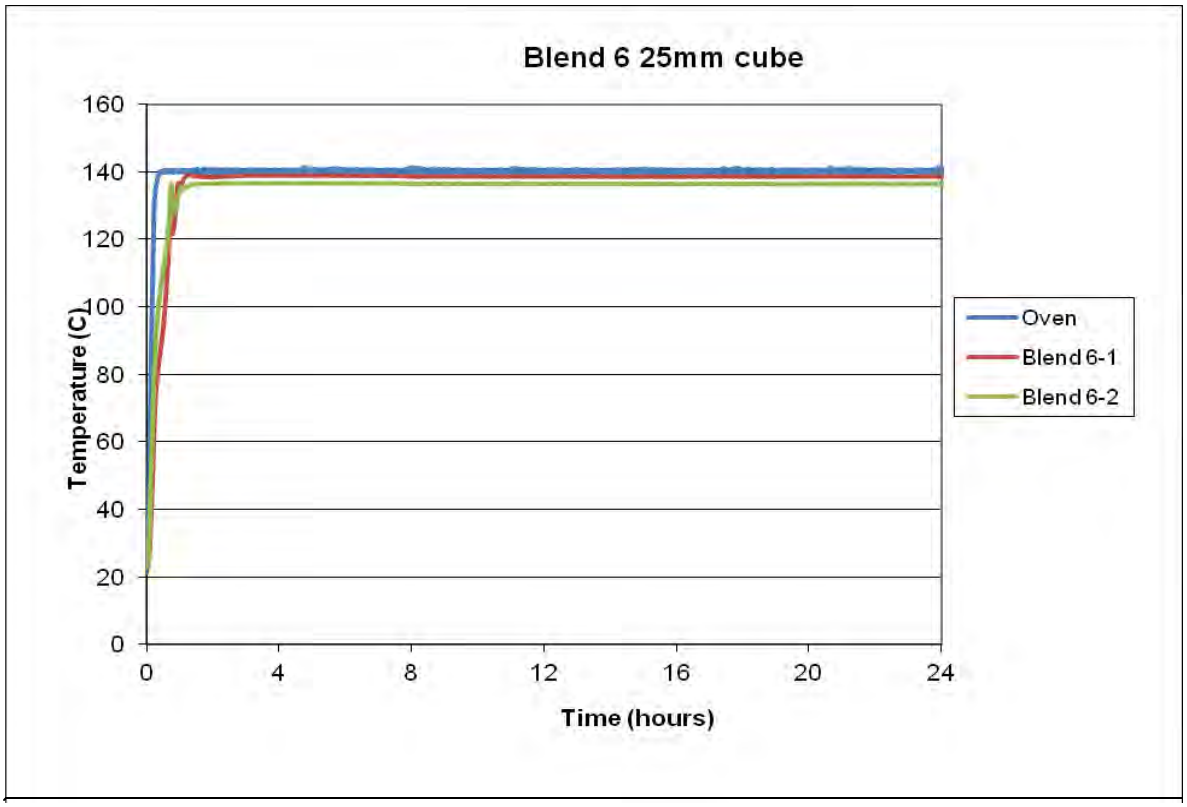


Figure 18. Method 1050 –Temperature of Blend 6 (25mm Cube)

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."

Group Leader **Date** **12/21/15**

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Sample Results

SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 150904-4

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
Blend 2	581327	Nonflammable	09/29/15
Blend 3	581328	Nonflammable	09/29/15
Blend 4	581329	Nonflammable	09/29/15
Blend 6	581332	Nonflammable	10/29/15
Blend 7	581333	Nonflammable	10/29/15
Blend 8	581334	Nonflammable	10/29/15
Blend 11	581319	Nonflammable	11/11/15
Blend 12	581321	Nonflammable	11/11/15
Blend 13	581323	Nonflammable	11/11/15
Blend 14	589460	Nonflammable	11/24/15
Blend 15	589461	Nonflammable	11/24/15
Blend 16	589462	Nonflammable	11/24/15

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 150904-4

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
Blend 2	581327	Not a self-heating waste	09/24/15
Blend 3	581328	Not a self-heating waste	09/24/15
Blend 4	581329	Not a self-heating waste	09/24/15
Blend 6	581332	DOT Packing Group III	10/29/15
Blend 7	581333	Not a self-heating waste	10/26/15
Blend 8	581334	Not a self-heating waste	10/31/15
Blend 11	581319	Not a self-heating waste	11/05/15
Blend 12	581321	Not a self-heating waste	11/07/15
Blend 13	581323	Not a self-heating waste	11/02/15
Blend 14	589460	Not a self-heating waste	11/13/15
Blend 15	589461	Not a self-heating waste	11/24/15
Blend 16	589462	Not a self-heating waste	11/24/15

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

010043

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 150904-4

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
118.52	56.8	23.55

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
Blend 1	581326	46.30	213.06	Packing group II	10/08/15
Blend 2	581327	68.96	252.10	Packing group III	10/09/15
Blend 3	581328	128.60	325.60	Not Division 5.1	10/12/15
Blend 4	581329	192.06	429.35	Not Division 5.1	10/12/15
Blend 5	581331	182.84	98.68	Packing group III	10/23/15
Blend 6	581332	178.07	187.90	Not Division 5.1	10/27/15
Blend 7	581333	180.56	231.16	Not Division 5.1	10/26/15
Blend 8	581334	186.53	202.90	Not Division 5.1	10/27/15
Blend 9	581324	77.20	289.70	Packing group III	10/13/15
Blend 10	581325	180.42	180.74	Not Division 5.1	11/25/15
Blend 11	581319	180.31	202.93	Not Division 5.1	11/03/15
Blend 12	581321	180.35	180.39	Not Division 5.1	11/03/15
Blend 13	581323	180.33	180.40	Not Division 5.1	11/03/15
Cement 1	581330	180.50	180.34	Not Division 5.1	11/10/15
Cement 2	581335	180.45	180.50	Not Division 5.1	11/10/15

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST 010044

LABORATORY CONTROL SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 150904-4

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
95-142 sec	45-68 sec	19-28 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	120.56	60.22	20.09	10/08/15
LCS	115.56	52.22	22.62	10/09/15
LCS	120.90	47.78	23.50	10/12/15
LCS	117.59	54.60	20.69	10/13/15
LCS	114.25	59.19	19.31	10/23/15
LCS	101.13	49.53	21.25	10/26/15
LCS	109.69	54.37	19.02	10/27/15
LCS	110.72	50.57	20.61	11/03/15
LCS	123.28	56.90	19.44	11/10/15
LCS	122.75	54.56	20.43	11/25/15

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SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
UN Oxidizer Testing
Raw Data

010046

Southwest Research Institute

Method: Oxidizer_UN
Project #: 19869.01.006 / 21592.01.006
Client: LANL
TO# 150904-4

v Dspns 10/15/15.

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0329	21.0065	130.75	
3:7	2	9.0734	21.0048	115.12	
3:7	3	9.0052	21.0135	118.75	
3:7	4	9.0173	21.0056	107.37	*burned out about 5 sec. started Again
3:7	5	9.0119	21.0043 (KE)	120.59	BV 10/7/15 (KE)
3:7	**Avg**			BV 10/7/15 118.52	

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0119	18.0088	58.56	
2:3	2	12.0311	18.0075		MISS FIRE see redo 10/7/15 (KE)
2:3	3	12.0018	18.0099	52.47	
2:3	4	12.0009	18.0089	51.84	
2:3	5	12.0252	18.0086	60.94	
2:3	**Avg**	#2 12.0032	18.0054	60.59 56.80	

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0072	12.0073	23.50	
3:2	2	18.0079	12.0098	27.12	
3:2	3	18.0115	12.0065	22.32	
3:2	4	18.0039	12.0014	22.21	
3:2	5	18.0167	12.0049	22.60	
3:2	**Avg**			23.55	

Weighted Samples: B. Villasenor Balance#: 135 Date: 10/7/15
Tested Samples: B. Villasenor Timer ID: 14-649-55 Date: 10/7/15
Potassium Bromate: Inorg# 62823-62824 Dried: > 12 hrs @ 65°C
Cellulose: Inorg# 61124-61129 Dried: > 12 hrs @ 105°C.
Variac Setting: 150 watts # EC10008 (KE) 10/7/15

Southwest Research Institute

010047

Method: Oxidizer_UN
Project #: 19869.01.00 / 21592.01.006
Client: LANL
TO# 150904-4

✓ Dapus 10/15/15

Sample Analysis

System ID: 581326

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0062	6.0017	28.75	NOT ALL mixtured burned
4:1	2	24.0117	6.0069	33.50	FLAME, smoke, charring, sparking
4:1	3	24.0118	6.0194	56.40	
4:1	4	24.0122	6.0171	53.56	
4:1	5	24.0046	6.0157	59.28	
4:1	Avg			46.30	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0027	15.0929	253.06	FLAME, smoke, sparking, charring
1:1	2	15.0018	15.0207	241.97	
1:1	3	15.0249	15.0247	210.60	
1:1	4	15.0350	15.0086	191.25	
1:1	5	15.0113	15.0622	168.41	
1:1	Avg			213.06	

Weighted Samples: B. Villasenor Balance#: 135 Date: 09/08/15
Tested Samples: B. Villasenor Timer ID: 14-649-55 Date: 10/8/15
Sample Dried ? YES NO Dried: > 12 hrs
Cellulose: 9/9/15 Inorg# 61124-61129 Dried: > 12 hrs @ 105°C.
Variac Setting: 150 watts # EC 1000 S

Southwest Research Institute

Method: Oxidizer_UN
Project #: 21592.01.006
Client: LANL
TO# 150904-4

RSpurs
10/15/15

Sample Analysis

System ID: 581327

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0009	6.0137	69.56	Flame, smoking, charring
4:1	2	24.0187	6.0148	65.29	
4:1	3	24.0046	6.0080	68.32	
4:1	4	24.0023	6.0045	70.25	
4:1	5	24.0098	6.0176	71.38	
4:1	Avg			68.96	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0115	15.0507	226.15	Flame, smoking, charring
1:1	2	15.0021	15.0232	232.85	
1:1	3	15.0005	15.0166	300.00	
1:1	4	15.0081	15.0244	280.18	
1:1	5	15.0007	15.0198	221.15	
1:1	Avg			252.1	

Weighted Samples: B. Villasenor Balance#: 135 Date: 10/08/15
Tested Samples: B. Villasenor Timer ID: SN 80494146 Date: 10/09/15
Sample Dried ? YES (NO) Dried:
Cellulose: Inorg# 61124-61129 Dried: overnight @ 105°C.
Variac Setting: 150 watts EC 1000 S

10/19/15 RC

Method: Oxidizer_UN
Project #: 21592.01.006
Client: LANL
TO# 150904-4

√ Deputy 10/15/15

Sample Analysis

System ID: 581328

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0035	6.0128	120.69	Flame, smoke, charing
4:1	2	24.0138	6.0015	123.91	
4:1	3	24.0052	6.0183	144.65	
4:1	4	24.0015	6.0028	122.47	
4:1	5	24.0112	6.0051	131.22	
4:1	Avg			128.6	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0120	15.0088	341.69	Flame, smoke, charing
1:1	2	15.0023	15.0051	327.84	
1:1	3	15.0099	15.0082	313.00	
1:1	4	15.0064	15.0992	333.85	
1:1	5	15.0168	15.0839	311.57	
1:1	Avg			325.6	

Weighted Samples: Bernie Villasenor Balance#: 135 Date: 10/08/15
Tested Samples: Bernie Villasenor Timer ID: S/N 80494146 Date: 10/12/15
Sample Dried ? YES (NO) Dried:
Cellulose: Inorg# 61124-61129 Dried: >12 hrs @ 105°C.
Variac Setting: 150 watts EC1005

Southwest Research Institute

010050

Method: Oxidizer UN
Project #: 21592.01.006
Client: LANL
TO# 150904-4

V. R. Dykes 10/15/15

Sample Analysis

System ID: 581329

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0086	6.0067	202.60	FLAME, SMOKE, SPARKING, CHARRING
4:1	2	24.0023	6.0049	173.07	
4:1	3	24.0029	6.0041	182.87	
4:1	4	24.0039	6.0065	203.25	
4:1	5	24.0052	6.0021	198.50	
4:1	Avg			192.06	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0051	15.0098	491.21	FLAME, SMOKE, SPARKING, CHARRING
1:1	2	15.0051	15.0069	466.60	
1:1	3	15.0069	15.0024	400.63	
1:1	4	15.0092	15.0076	416.85	
1:1	5	15.0057	15.0087	371.69	
1:1	Avg			~~289.7~~ 429.35	RSS RE 10/15/15

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 10/12/15
Tested Samples: Bonnie Dillgsenart Timer ID: S/N 80494146 Date: 10/12/15
Sample Dried ? YES (NO) Dried:
Cellulose: Inorg# 61124-61129 Dried: > 12 hrs. @ 105°C
Variac Setting: 150 Watts #EC1000S

Southwest Research Institute

010051

Method: UN-oxidizer
Project #: 21592.01.006
Client: LANL
TO# 150904-4

Sample Analysis

✓ BJ 10/30/15

System ID: 581331

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0443	6.0060	189.49 *	smoldering, very little smoke, very little sparking
4:1	2	24.0059	6.0015	183.19 *	
4:1	3	24.0296	6.0008	180.53 *	
4:1	4	24.0135	6.0082	180.57 *	
4:1	5	24.0187	6.0085	180.40 *	
4:1	Avg			182.84	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0260	15.0089	104.81	FLAME, Lots of smoke, SPARKING, SMOLDERING
1:1	2	15.0077	15.0063	104.97	
1:1	3	15.0223	15.0086	102.78	
1:1	4	15.0123	15.0031	92.13	
1:1	5	15.0341	15.0112	88.69	
1:1	Avg			98.68	

* time is when voltage was turned off. Since there was no reaction sample allowed to heat for 3 min.

Weighted Samples: Bernie Jillaseno Balance#: 135 Date: 10/23/15

Tested Samples: Bernie Jillaseno Timer ID: S/N 80493988 Date: 10/23/15

Sample Dried ? YES (NO) Dried:

Cellulose: Inorg# 61124-61129 Dried: > 12 hrs @ 105°C.

Variac Setting: 150 watts & EC 10005

Southwest Research Institute

010052

Method: UN_oxidizer
Project #: 21592.01.006
Client: LANL
TO# 150904-4

DSpurs 11/7/15

LCS RSS 11/7/15

Sample Analysis

System ID: 581332 (1:1)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0083	6.0056	169.59	LOW FLAME, SPARKING, SMOLDERING, LOW SMOKE
4:1	2	24.0176	6.0186	180.13 *	NO FLAME, SPARKING, SMOKE, SMOLDERING
4:1	3	24.0136	6.0051	180.09 *	NO FLAME, SPARKING, SMOKE, SMOLDERING
4:1	4	24.0026	6.0010	180.25 *	
4:1	5	24.0012	6.0077	180.28 *	
4:1	Avg			178.07	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0280	15.0055	180.32 *	LOW FLAME, SMOKE, SMOLDERING, SPARKING
1:1	2	15.0084	15.0036	205.68	FLAME CONTINED AFTER POWER OFF SMOKE, SMOLDERING, SPARKING.
1:1	3	15.0078	15.0143	182.00 *	SAME AS (1)
1:1	4	15.0175	15.0019	187.40	SAME AS (2)
1:1	5	15.0364	15.0092	184.12	SAME AS (2)
1:1	Avg			187.90	

* TIME POWER TURNED OFF

Weighted Samples: Bernie Jillasenor Balance#: 88 Date: 10/27/15

Tested Samples: Bernie Jillasenor Timer ID: SN 80494146 Date: 10/27/15

Sample Dried ? (YES) NO Dried:

Cellulose: Inorg# 61124-61129 Dried: > 12 hrs @ 105°C.

Variac Setting: 150 watts EC1000S

Southwest Research Institute 010053

Method: UN-OXIDIZER
Project #: 21592.01.006
Client: LANL
TO# 150904-4

VRSpies 11/7/15

Sample Analysis

System ID: 581333 (3:1)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0067	6.0059	180.69 *	Little Flame near wire, smoldering, smoke
4:1	2	24.0101	6.0017	180.63 *	steady low Flame between wires, smoldering
4:1	3	24.0132	6.0069	180.47 *	Low flame near wires, smoldering, smoke - some smoke
4:1	4	24.0059	6.0088	180.50 *	↓
4:1	5	24.0134	6.0026	180.51 *	↓
4:1	Avg			180.56	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0064	15.0089	180.94	Low steady Flame near wires, smoldering, some smoke.
1:1	2	15.0082	15.0023	215.44	Low Flame entire sample, smoldering, little smoke
1:1	3	15.0097	15.0079	364.94	Flame continues after, power off.
1:1	4	15.0036	15.0043	187.50	same as #1. Flame out a few seconds after power off.
1:1	5	15.0115	15.0039	206.97	Low Flame most of sample, smoldering little smoke, Flame out a few seconds after power out.
1:1	Avg			231.16	

* Burn time is time power was cut off. M 10/26/15

All 10 samples continue to smolder after burn times.

Weighted Samples: Bernie Villasenor Balance#: 135 Date: 10-26-15

Tested Samples: Bernie Villasenor Timer ID: S/N 80493988 Date: 10-26-15

Sample Dried ? (YES) NO Moisture Dried:

Cellulose: Inorg# 61124-61129 Dried: > 12 hrs @ 105°C

Variac Setting: 150 watts #EC1005

Southwest Research Institute

010054

Method: UN-oxidizer
Project #: 21592.01.006
Client: LANL
TO# 150904-4

11/7/15

Sample Analysis

System ID: 581334 (4:1)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0267	6.0043	186.47	LOW FLAME, SMOLDERING, little SMOKE FLAME OUT AFTER Power off.
4:1	2	24.0023	6.0058	190.28	
4:1	3	24.0371	6.0059	185.31	
4:1	4	24.0306	6.0096	187.07	
4:1	5	24.0169	6.0020	183.50	
4:1	Avg			186.53	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0209	15.0094	189.75	LOW FLAME, SMOLDERING, little SMOKE FLAME OUT AFTER Power off
1:1	2	15.0115	15.0024	186.66	
1:1	3	15.0052	15.0023	185.94	
1:1	4	15.0019	15.0065	217.47	
1:1	5	15.0041	15.0041	234.68	
1:1	Avg			202.90	

Weighted Samples: Bernie Jillasenor Balance#: 135 Date: 10/27/15

Tested Samples: Bernie Jillasenor Timer ID: S/N 80494146 Date: 10/27/15

Sample Dried ? (YES) / NO Dried:

Cellulose: Inorg# 61124-61129 Dried: > 12 hrs @ 105°C.

Variac Setting: 150 watts EC1000S

Southwest Research Institute 010055

Method: Oxidizer_UN
Project #: 21592.01.006
Client: LANL
TO# 150904-4

✓ RAPMER 10/30/15

Sample Analysis

System ID: 581324

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0071	6.0063	82.52	FLAME, SMOKE, SPARKING, CHARRING
4:1	2	24.0082	6.0019	78.60	
4:1	3	24.0071	6.0044	61.22	
4:1	4	24.0075	6.0074	78.81	
4:1	5	24.0034	6.0022	85.04	
4:1	Avg			77.2	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0056	15.0047	271.16	FLAME, SMOKE, SPARKING, CHARRING
1:1	2	15.0096	15.0085	277.13	
1:1	3	15.0047	15.0057	289.13	
1:1	4	15.0066	15.0033	310.79	
1:1	5	15.0010	15.0042	300.40	
1:1	Avg			289.7	

Weighted Samples: B. Villasenor Balance#: 135 Date: 10-13-15
Tested Samples: B. Villasenor Timer ID: S/N 80494146 Date: 10-13-15
Sample Dried ? YES / (NO) Dried:
Cellulose: Inorg# 61124-61129 Dried: >12 hrs @ 105°C.
Variac Setting: 150 watts #EC1000 S

Southwest Research Institute

010056

RSpin 11/25/15

Method: un oxidized
Project #: 21592.01.006
Client: LANL
TO# 150904-4

Sample Analysis

#581325

System ID: Blend 10

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0616	6.0227	180.09 *	Sparks shot off from sample, but mainly charring and smoke. No real sustained flame. Sample would also bubble and spit in some areas
4:1	2	24.0318	6.0124	180.34 *	
4:1	3	24.0127	6.0147	180.87 *	did this thrughout the analysis
4:1	4	24.0129	6.0271	180.59 *	
4:1	5	24.0271	6.0197	180.19 *	
4:1	Avg			180.42	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0329	15.0219	180.42 *	flame present throughout analysis, maintained smoldering and glowing more than a minute after analysis
1:1	2	15.0521	15.0231	180.55 *	
1:1	3	15.0363	15.0426	181.71 *	
1:1	4	15.0256	15.0237	180.09 *	
1:1	5	15.0321	15.0119	180.94 *	
1:1	Avg			180.74	

* timer & power turned off

Weighted Samples: Jenna Mata Balance#: 135 Date: 11/25/15

Tested Samples: Jenna Mata Timer ID: SN 80493988 Date: 11/25/15

Sample Dried ? YES (NO) Dried: let sit for 24hr at room temp after mixing

Cellulose: Inorg# Dried:

Variac Setting: 180 watts EC1000s

Classification:

Southwest Research Institute

010057

Method: UN-Oxidizer
Project #: 21592.01.006
Client: LANL
TO# 150904-4

VRS 11/7/15

Sample Analysis

System ID: 581319

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0092	6.0094	180.39 *	Little flame, smoke, smoldering or sparking
4:1	2	24.0168	6.0015	180.47 *	
4:1	3	24.0069	6.0047	180.02 *	
4:1	4	24.0074	6.0092	180.33	
4:1	5	24.0071	6.0020	180.35	
4:1	Avg			180.31	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0118	15.0024	240.72	Low continuous flame, little smoke, smoldering or sparking. Continues to smolder after
1:1	2	15.0065	15.0058	193.50	Power is off. Some flame low, smoldering does not complete.
1:1	3	15.0064	15.0046	208.65	
1:1	4	15.0099	15.0048	182.56	
1:1	5	15.0059	15.0052	189.22	
1:1	Avg			202.93.	

* TIME POWER TURNED OFF

Weighted Samples: Bernie Villasenor Balance#: 88 Date: 11-3-15
Tested Samples: Bernie Villasenor Timer ID: S/N 80494146 Date: 11-3-15
Sample Dried ? YES (NO) Dried:
Cellulose: Inorg# 61124-61129 Dried: > 12 hrs @ 105°C.
Variac Setting: 150 watts EC1000S

Method: UN_Oxidizer
Project #: 21592.01.006
Client: LANL
TO# 150904-4

DDpur 11/7/15

Sample Analysis

System ID: 581321

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0088	6.0128	180.34 *	some charring, little smoke, smoldering
4:1	2	24.0033	6.0088	180.35 *	NO FLAME
4:1	3	24.0095	6.0104	180.28 *	
4:1	4	24.0051	6.0063	180.56 *	
4:1	5	24.0092	6.0034	180.22 *	
4:1	Avg			180.35	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0021	15.0048	180.50 *	LOW FLAME, more smoldering, charring little smoke -
1:1	2	15.0044	15.0081	180.37 *	
1:1	3	15.0096	15.0110	180.47 *	
1:1	4	15.0033	15.0077	180.34 *	
1:1	5	15.0068	15.0044	180.28 *	
1:1	Avg			180.39	

* TIME POWER TURNED OFF

Weighted Samples: Bernie Villasenor Balance#: 88 Date: 11-3-15
Tested Samples: Bernie Villasenor Timer ID: SIN 80494146 Date: 11-3-15
Sample Dried ? YES (NO) Dried:
Cellulose: Inorg# 61124-61129 Dried: > 12 hrs @ 105°C.
Variac Setting: 150 watts EC1000S

Southwest Research Institute

010059

Method: UN-Oxidizer
Project #: 21592.01.006
Client: LANL
TO# 180904-4

√ RSpurs 11/7/15

Sample Analysis

System ID: 581323

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0063	6.0111	180.35 *	very little flame, smoke, smoldering no sparking
4:1	2	24.0074	6.0038	180.47 *	
4:1	3	24.0018	6.0085	180.25 *	
4:1	4	24.0068	6.0073	180.32 *	
4:1	5	24.0028	6.0075	180.25 *	
4:1	Avg			180.33	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0034	15.0015	180.40 *	Low, steady flame new wires, little smoke little smoldering.
1:1	2	15.0031	15.0055	180.41 *	
1:1	3	15.0023	15.0025	180.28 *	
1:1	4	15.0031	15.0063	180.38 *	
1:1	5	15.0046	15.0064	180.53 *	
1:1	Avg			180.40.	

* Time Power turned off

Weighted Samples: Bernie Villasenor Balance#: 88 Date: 11-3-15
Tested Samples: Bernie Villasenor Timer ID: S/N 80494146 Date: 11-3-15
Sample Dried ? YES (NO) Dried:
Cellulose: Inorg# 61124-61129 Dried: >12 hrs. @ 105°C.
Variac Setting: 150 watts EC 1000S

Southwest Research Institute

010060

Method: UN_Oxidizer
Project #: 21592.01-006
Client: LANL
TO# 150904-4

R. Spies
11/24/15

Sample Analysis

System ID: 581330.
Cement #1

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0040	6.0005	180.44 *	no flame, little smoke, little charring near wires
4:1	2	24.0032	6.0082	180.88 *	
4:1	3	24.0097	6.0060	180.35 *	
4:1	4	24.0039	6.0065	180.41 *	
4:1	5	24.0042	6.0066	180.47 *	
4:1	Avg			180.50	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0018	15.0082	180.37 *	no flame, little smoke, little more smoldering
1:1	2	15.0047	15.0090	180.34 *	charring then 4:1. smoldered completely after power off
1:1	3	15.0045	15.0073	180.34 *	
1:1	4	15.0037	15.0075	180.40 *	
1:1	5	15.0049	15.0067	180.47 *	
1:1	Avg			180.34	

* Time Power Turned Off

Weighted Samples: Bernie Jillasenor Balance#: 88 Date: 11-10-15
Tested Samples: Bernie Jillasenor Timer ID: S/N 80494146 Date: 11-10-15
Sample Dried ? YES / NO Dried:
Cellulose: Inorg# 61124-61129 Dried: 7 12 hrs 105°C.
Variac Setting: 150 watts ± EC1000S

Southwest Research Institute

010061

Method: UN-Oxidizer
Project #: 21592.01.006
Client: LANL
TO# 150904-4

✓ Rapus 11/24/15

Sample Analysis

System ID: 581335 Cement 2
#2

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0075	6.0079	180.43 *	NO FLAME, little smoke, smoldering/charring
4:1	2	24.0071	6.0064	180.41 *	
4:1	3	24.0099	6.0012	180.34 *	
4:1	4	24.0093	6.0077	180.62 *	
4:1	5	24.0024	6.0038	180.44 *	
4:1	Avg			180.45	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0031	15.0031	180.56 *	LOW FLAME NEAR WIRES, smoldering/charring
1:1	2	15.0064	15.0006	180.47 *	little SMOKE. samples smoldered completely after power off.
1:1	3	15.0072	15.0083	180.59 *	
1:1	4	15.0043	15.0045	180.40 *	
1:1	5	15.0097	15.0078	180.47 *	
1:1	Avg			180.50	

* Time when power turned off

Weighted Samples: Bernie Villasenor Balance#: 88 Date: 11-10-15
Tested Samples: Bernie Villasenor Timer ID: S/N 80494146 Date: 11-10-15
Sample Dried ? YES / NO Dried:
Cellulose: Inorg# 61124-61129 Dried: >12hrs @ 105°C.
Variac Setting: 150 watts #EC1000S

Southwest Research Institute

010062

Method: Oxidizer_UN
Project #: 21592.01.006
Client: LANL
TO# 150904-2

Daily QC ck

LCS.

RDiPrete 10/15/15

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0055	21.0030	120.56	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0114	18.0012	60.22	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0373	12.0027	20.09	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: T. Villasenor Balance#: 159 Date: 10-8-15
Tested Samples: B. Villasenor Timer ID: 14-649-55 Date: 10-8-15
Potassium Bromate: Inorg# 62823-62824 Dried: >12 hrs @ 65°C.
Cellulose: Inorg# 61124-61129 Dried: >12 hrs @ 105°C.
Variac Setting: 150 watts #EC1005

Southwest Research Institute

010063

Method: Oxidizer_UN
Project #: 21592.01.006
Client: LANL
TO# 150904-4

DAILY QC

Reference Substance ✓ 10/15/15

z LCS.

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0218	21.0125	115.56	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0074	18.0036	52.22	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0066	12.0028	22.62	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: B. Villasenor Balance#: 135 Date: 10-8-15

Tested Samples: B. Villasenor 62823-62824 Timer ID: SN 80494146 Date: 10-9-15

Potassium Bromate: Inorg# ~~61124-61129~~ EC9 10/9/15 Dried: overnight e 65°c

Cellulose: Inorg# 61124-61129 Dried: overnight e 105°c

Variac Setting: 150 watts EC1600S

Southwest Research Institute

010064

Method: Oxidizer – UN
Project #: 21592.01.006
Client: LANL
TO# 150904-4

✓ RDpw 10/15/15

LCS

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0089	21.0030	120.90	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0051	18.0082	47.78	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0133	12.0235	23.50	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: B. Villaseñor Balance#: 135 Date: 10-9-15
Tested Samples: B. Villaseñor Timer ID: S/N 80494146 Date: 10-12-15
Potassium Bromate: Inorg# 62823-62824 Dried: Overnight @ 65°C
Cellulose: Inorg# 61124-61129 Dried: Overnight @ 105°C
Variac Setting: 50 watts #EC1000S

Southwest Research Institute

010065

Method: Oxidizer - UN
Project #: 21592.01.006
Client: LANL
TO# 150904-4

✓ Rajpurs 10/30/15

LCS.

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0063	21.0055	117.59	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0046	18.0033	54.60	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0021	12.0010	20.69	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: B. Villasenor Balance#: 135 Date: 10-13-15
Tested Samples: B. Villasenor Timer ID: S/N 80494146 Date: 10-13-15
Potassium Bromate: Inorg# 62823-62824 Dried: > 12 hrs @ 65°C.
Cellulose: Inorg# 61124-61129 Dried: > 12 hrs. @ 105°C.
Variac Setting: 150 watts #EC 1000S

Southwest Research Institute

010066

Method: UN_oxidizer
Project #: 21592.01.006
Client: LANL
TO# 150904-4

10/30/15

LCS.

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g (10/23/15)	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1 (RE) MV	~~21.0046~~	21.0046	88.66	DATA NOT USED STOP WATCH BLANKED OUT.
3:7	2	9.0013			See Redo 10/28/15 MV
3:7	3	9.0124	21.0028	114.25	
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0042	18.0006	59.19	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0041	12.0084	17.50	Flash, violent reaction. See redo.
3:2	2	18.0104	12.0066	19.31	
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Bernie Villasenor Balance#: 135 Date: 10-23-15
Tested Samples: Bernie Villasenor Timer ID: S/N 80493988 Date: 10-23-15
Potassium Bromate: Inorg# 63454 Dried: > 12 hrs @ 65°C.
Cellulose: Inorg# 61124-61129 Dried: > 12 hrs @ 105°C.
Variac Setting: 150 watts #EC10005

Southwest Research Institute

010067

Method: UN_OXIDIZER
Project #: 21592.01.006
Client: LANL
TO# 150904-4

✓ D Apres
11/7/15

LCS

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0020	21.0079	101.13	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0061	18.0079	49.53	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0054	12.0035	21.26	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Bernie Villasenor Balance#: 135 Date: 10-26-15
Tested Samples: Bernie Villasenor Timer ID: S/N 80493988 Date: 10-26-15
Potassium Bromate: Inorg# 63454 Dried: > 12 hrs @ 65°C.
Cellulose: Inorg# 61124-61129 Dried: > 12 hrs @ 105°C.
Variac Setting: 150 watts # EC 10005

Southwest Research Institute

010068

Method: UN-oxidizer
Project #: 21592.01.006
Client: LANL
TO# 150904-4

DDpris
11/7/15

LCS.

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0073	21.0028	109.69	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0041	18.0078	54.37	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0062	12.0093	19.02	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Bernie Villasenor Balance#: 88 Date: 10/27/15
Tested Samples: Bernie Villasenor Timer ID: s/N 80493988 Date: 10/27/15
Potassium Bromate: Inorg# 63454 Dried: > 12 hrs @ 65°C.
Cellulose: Inorg# 61124-61129 Dried: > 12 hrs @ 105°C.
Variac Setting: 150 watts #EC 1000S

Southwest Research Institute

010069

Method: UN-Oxidizer
Project #: 21592.01.006
Client: LANL
TO# 150904-4

RSpies 11/7/15

LCS

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0022	21.0078	110.72	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0068	18.0081	50.57	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0098	12.0108	20.61	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Bernie Villasenor Balance#: 88 Date: 11-3-15
Tested Samples: Bernie Villasenor Timer ID: S/N 80494146 Date: 11-3-15
Potassium Bromate: Inorg# 63454 Dried: >12 hrs e 65°C.
Cellulose: Inorg# 61124-61129 Dried: >12 hrs e 105°C.
Variac Setting: 150 watts # EC1000S

Southwest Research Institute

010070

Method: UN_Oxidizer
Project #: 21592.01.006
Client: LANL
TO# 150904-4

RiSpris 11/24/15

LCS

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0040	21.0016	1203.28	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0049	18.0027	56.90	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0073	12.0048	19.44	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Bernie Villasenor Balance#: 88 Date: 11/10/15
Tested Samples: Bernie Villasenor Timer ID: s/n 80494146 Date: 11/10/15
Potassium Bromate: Inorg# 63454 Dried: >12 hrs @ 65°C.
Cellulose: Inorg# 61124-61129 Dried: >12 hrs @ 105°C.
Variac Setting: 150 #EC1000S units

Southwest Research Institute

010071

Method: UN oxidation
Project #: 21592.01.006
Client: LANL
TO# 150904-4

Dsplus 11/25/15

LCS

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0168	21.0243	122.75	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0264	18.0122	54.56	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0060	12.0027	20.43	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Jane Mah Balance#: 135 Date: 11/25/15
Tested Samples: Jane Mah Timer ID: 14-649-50 Date: 11/25/15
Potassium Bromate: Inorg# 68454 Dried: 7 12 hrs @ 65°C
Cellulose: Inorg# 61124 - 61129 Dried: 7 12 hrs @ 105°C
Variac Setting: 150 * EC1005
Watts

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Method 1030
Raw Data

Southwest Research Institute®
Logbook: Physical Testing

010073

Analysis / Method: Ignitability 1030 Project# OHDO1.113

Client: LANL TO# 150904-4

LCS Info: #61753 fire excelsior TV= positive Balance#: N/A

Notes:

solids with burn rate > 2.2mm/sec are considered positive for ignitability

Sample ID	glowing	propagated past heat zone	flame	time over 100mm	burn rate mm/sec
DOC 1	Yes	Yes	Yes	21.75sec	4.60
DOC 2	Yes	Yes	Yes	10.07sec	9.93
DOC 3	Yes	Yes	Yes	7.19sec	13.91
DOC 4	Yes	Yes	Yes	15.59sec	6.41
DOC 5	Yes	Yes	Yes	13.97sec	7.16
thermocouple bk	#010209	cal due 2/20/16		temp	>1000°C
thermocouple	#022474	cal due 9/9/16			

JAM 9/28/15

Calculation:

Analyst Signature: James Spruce Date: 9/26/15

Reviewed by: R Spruce Date: 9/28/15

Book I.D. 14-0406-021 Book/ Page : 12 00164

Southwest Research Institute®
Logbook: Physical Testing

010074

Analysis / Method: Ignitability 1030 Project# ~~21592.01.006~~ 21592.01.006 TBSM 11/27/15

Client: LANL TO# 150901-4

LCS Info: #61753 fire excelcior TV= positive Balance#:

Notes: ~~Hoods tested~~ for airflow using Alnor Compuflow 8570

Hood 26 70-40 : 0.722 m/sec ID: 00#251 cal due : 8/21/16

Hood 42 70-19 : 0.694 m/sec

Sample ID	glowing	propigated past burner point	flame	time over 100mm	burn rate mm/sec
LCS	Yes	Yes	Yes	25.09	
581328 1:3	Yes	Yes	Yes	229.13	
581327 ~~Dup~~ 1:1	Yes	No	Yes		
581327D 1:1	Yes	No	Yes		
581328D 1:3	Yes	No	Yes		
581329 ~~Dup~~ 1:4	Yes	Yes	Yes	Did not burn to the end of the 100 mm.	
581329D 1:4	Yes	Yes	Yes	Did not burn to the end of the 100mm	
thermocouple box	ID 022024 cal due 2/20/16				
	thermocouple ID 022474 cal due 9/9/16				
~~Original~~ test 65	TBSM 11/27/15				

Calculation:

Analyst Signature: Date: 9/29/15

Reviewed by: Date: 10/15/15

Book I.D.____14-0406-021_____ Book/ Page :___12____00168_____

010075

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1030 Project# ~~19864.01.006~~ 21592.01.006 JEJAM 11/23/15

Client: LANL TO# 150904-4

LCS Info: 61753 fine excelsior TV= positive Balance#:

Notes: Hood 42 70.19; 0.6944 m/sec ID 0007251

Sample ID	glowing	propagated past burn point	flame	time ave. 100mm	
LCS	Yes	Yes	Yes	22.82 sec	
Blend 6 — 581332	NO	NO	NO	Sample formed fine powder as it was burning and a heat point.	
581332D	NO	NO	NO	No propagation past burn zone	
Blend 7 — 581333	Yes	No	NO	sample crackled during and after burning. Would smoke and spark after flame removal but no flame was formed	
581333D	Yes	No	NO		
Blend 8 — 581334	No	No	JEJAM 11/23/15 ~~Yes~~ NO		
581334D	No	No	~~Yes~~ NO	Similar to 1:3 ratio but very little smoke and sparking after removal of the flame.	
WB8 - wet	condition				
Samples	reanalyzed on		10/29/15	(dry WB8/Swheat)	

Calculation:

Analyst Signature: [signature] Date: 9/30/15

Reviewed by: [signature] Date: 10/15/15

Southwest Research Institute®
Logbook: Physical Testing

010076

Analysis / Method: 1030 Project# ~~21592.01.006~~ 21592.01.006 TESAM 11/23/15

Client: LANL TO# 150904-4

LCS Info: 61753 fine excel TV= positive Balance#:

Notes:

hood 70-40 0.722m/sec ID 007251

burn rate greater than 2.2 mm/sec considered positive

Sample ID	glowing past burn point	propigat past burn point	flame	time over 100mm	rate mm/sec
LCS	Yes	Yes	Yes	12.10 sec	8.26
blend #6 581332	No	slight / No	No		
581333	No	No	NO	NA	NA
Blend #7 581333D	No	No	NO	NA	NA
blend #8 581334	No	No	NO	NA	NA
Sample 581332 had the burn point turn to ash and move off the plate. Slight propagation occured past the					
Sample 581333 charred white and black at the burn points. Slight propagation was seen after the flame was removed through the form of charging the kitty litter from a brown to a white color. Smoke was over every now and then up to 5min after removal of the flame.					
Sample 581334 was similar to 581333 in the color change but all activity Stoped within 30sec after removing the flame.					
Calculation:					

Analyst Signature: Date: 10/29/15

Reviewed by: Date: 11/15/15

Book I.D. 14-0406-021 Book/ Page : 12 00180

Southwest Research Institute®
Logbook: Physical Testing

010077

Analysis / Method: 1030 Project# 21542.01.006 TESAM 11/11/15

Client: LANL TO# ~~TTT~~ 150404-4 TESAM 11/11/15

LCS Info: 61753 fine excelsior TV= positive Balance#:

Notes:

hood 70-40 0.722 m/sec ID 607251

burn rate greater than 2.2mm/sec positive

Sample ID	glowing past burn point	propagate past burn point	Flames	time over 100mm	rate mm/sec
LCO	Yes	Yes	Yes	10.81 sec	
Blend #11 581319	No	No	No		
581319D	No	No	No		
Sample did not burn to the start line. The sample had violent little sparks shoot off as the nitrates heated and this would shoot out a little Zeolite. Did not last long after flame was removed.					
581320 TESAM 11/11/15	No	No	No		
Blend #12 581320D	No	No	No		
Sample did not burn to the start line. Beside the glowing at the burn point and discoloration in the zeolite after removing the flame. Little activity was observed					
581323	No	No	No		
Blend #13 581323D	No	No	No		
Sample did not burn to the start line. Same as blend #12.					

Calculation:

Analyst Signature: Date: 11/11/15

Reviewed by: Date: 11/25/15

Southwest Research Institute®
Logbook: Physical Testing

010078

Analysis / Method: 1030 Project# 21592.01.006

Client: LA NL TO# 150904-4

LCS Info: 61753 fire excel STV= positive Balance#: N/A

Notes:

hood 70-40 0.722 m/sec ID 007251

burn rate greater than 2.2mm/sec positive

Sample ID	glowing past burn point	propagate past burn point	flames	time over 100mm	rate mm/sec
LCS	Yes	Yes	Yes	12.7 sec	7.87
Blend 14	No	No	No		
Blend 14D	No	No	No		
Blend 15	No	No	No		
Blend 15D	No	No	No		
Blend 16	No	No	No		
Blend 16D	No	No	No		
all three samples glowed and charred at the flame but only a little discoloration past that point. Samples did not burn to the start line.					

Calculation:

Analyst Signature: [signature] Date: 11/24/15

Reviewed by: [signature] Date: 12/17/15

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Method 1050
Raw Data

010080

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050, initial KNO_3:Swheat mix Project# ~~14969.01.006~~ 21592.01.006 TE SAM 11/23/15

Client: LANL TO# 15090Y-4

LCS Info: N/A TV= N/A Balance#:

Notes: oven # 38 cal due 2/2/16

temperature calibrator: Fluke 724 ID: 012017

cal due 12/23/15

Sample ID	channel		channel		channel		channel		calibration for board #231
temp °C	1	2	3	4	5	6	7	8	
0	-0.2	-0.2	-0.4	-0.7	-0.8	-0.6	-0.4	-0.2	
50	49.9	49.8	49.7	49.4	49.2	49.5	49.7	49.8	
100	99.8	99.8	99.6	99.3	99.1	99.4	99.7	99.7	
200	199.8	199.8	199.7	199.3	199.2	199.4	199.7	199.8	
300	299.9	299.8	299.7	299.4	299.3	299.5	299.7	299.8	
	~~1:1 KNO_3: Swheat~~ TE SAM 9/24/15								
							thermocouple		
					oven		1		
Cage 1	Blend ~~1~~ 2 (1:1 KNO_3 : Swheat) TE SAM 9/24/15						2,3		
Cage 2	Blend 3 (1:3 KNO_3 : Swheat)						4,5		
Cage 3	Blend 4 (1:4 KNO_3 : Swheat)						6		
cage 4	Blend 4 (1:4 KNO_3 : Swheat)						7,8		
					KNO_3 (mL)		Swheat (mL)		combined #61137 → 34031
			1:1		800		800		
			1:3		500		1500		
			1:4		600		2400		

Calculation: Continues on page 12_00165 after data analysis and removal from oven

Analyst Signature: [signature] Date: 9/24/15

Reviewed by: [signature] Date: 10/15/15

Southwest Research Institute®
Logbook: Physical Testing

010081

TE JAM 11/23/15 21592.01.006

Analysis / Method: 1050 cont from 9/24/15 Project# ~~19869.01.005~~

Client: LANL TO# 150901-4

LCS Info: N/A TV= N/A Balance#: N/A

Notes: continued from page 12 - 00161

Sample ID					
	Client	SWRI			
Cage 1	Blend 2	581327	Start:	15:30	9/24/15
Cage 2	Blend 3	581328	Stop:	17:31	9/26/15
Cage 3	Blend 4	581329	Oven #38	cal due	2/2/16
Cage 4	Blend 4 D	581329D			
Test Method A					
None of the ~~five~~ TGD AM 9/29/15 samples 581327, 581328, or 581329 did not show any signs of having spontaneous combustion properties					
Test Method C					
All three of the samples were analyzed for 48 hrs and none of them had a temperature exceed 200°C. The kitty litter in all three samples went from a light brown to a dark brown color. All three samples are negative for self heating.					

Calculation:

Analyst Signature: [signature] Date: 9/29/15

Reviewed by: [signature] Date: 10/15/15

Book I.D. 14-0406-021 Book/ Page : 12 00166

010082

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050 ½ prep of WB8: Subset Project# 21592.01.006 TB 11/23/15 ~~21592.01.006~~

Client: LANL TO# 150904-4

LCS Info: TV= Balance#:

Notes: mixing samples for WB8 + Subset

temp calibrator: 012017 cal due 12123115

Sample ID									
					WB8		Subset		
1:1	Blend 6		581332		700		700		
1:3	Blend 7		581333		400		1200		
1:4	Blend 8		581334		300		1200		
	channel								
temp °C	1	2	3	4	5	6	7	8	
0	-0.3	-0.3	-0.5	-0.6	-0.7	TB 11/23/15 ~~-0.7~~ -0.7	-0.3	-0.1	
50	49.7	49.8	49.6	49.3	49.2	49.5	49.7	49.9	
100	99.7	99.7	99.5	99.3	99.2	99.3	99.7	99.9	
200	199.7	199.7	199.5	199.3	199.2	199.3	199.7	199.9	
300	299.8	299.8	299.5	299.4	299.3	299.4	299.8	299.9	
Oven	1 & 2								
581332	3 & 4		cage 2				Start: 10:30		9/30/15
581333	5 & 6		3				Stop: 6:36		10/1/15
581334	7 & 8		4				Oven # 38		cal due 2/2/16
Upon opening each cubic container after sitting overnight, a hissing of gas was heard when loosening the lids.									
* WB8 - Wet									

Calculation: 10/5/15 Samples went volatile around 2½ hrs into testing. Sample came out of the cages and onto the bottom of the oven.

Analyst Signature: Date: 9/29/15

Reviewed by: Date: 10/15/15

Book I.D. 14-0406-021

Book/ Page : 12 00170

010083

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050

Project# 21592.01.006 ~~19464.01.006~~ TSJAM 11/23/15

Client: LANL

TO# 15-0904-4

LCS Info: N/A TV= N/A Balance#: N/A

Notes: after volatility of initial testing it was decided to run each of the WBB ratios by themselves.

Sample ID
581333 Blend 7 1:3 WBB: Subeast Cage #3
↳ analyzed alone with 4 thermocouples per sample, two in the oven, and two in a tray at the bottom of the oven.
Start: 14:46 10/6/15 Stop: 9:59 10/7/15 Oven # 38
Once removed sample appeared darkened blackish with some areas being fluffy and soft.
581332 Blend 6 1:1 WBB: Subeast Start: 12:22 10/7/15 Stop: 7:21 10/8/15
Cage #4
Sample blew out of the cage and filled a pan below that had thermocouples reading the temperature of the fallen sample. Sample was fluffy and brittle.
581334 Blend 8 1:4 WBB: Subeast Start: 13:27 10/9/15 Stop: 12:04 10/11/15
Similar appearance to the 1:3 blend
* WBB - Wet.
all three samples did not exceed 200°C therefore are not considered self heating or spontaneously combustable.

Calculation:

Analyst Signature: [signature] Date: 10/7/15 1:3 10/15/15 1:1

Reviewed by: [signature] Date: 11/15/15

Southwest Research Institute®
Logbook: Physical Testing

010084

Analysis / Method: 1050 Project# ~~14866.01.006~~ 21592.01.006 TEJAM 11/24/15

Client: LANL TO# 100964-4

LCS Info: N/A TV= N/A Balance#:

Notes: Sample dried on hot plate prior to analysis

temperature calibrator ID: 012017

0

Sample ID									
1									
temp°C	1	2	3	4	5	6	7	8	
0	TEJAM 10/26/15 ~~2.4~~ <0.4	-0.1	-0.7	-0.8	-0.7	-0.6	-0.1	0.2	
50	49.7	49.9	49.3	49.1	49.4	49.5	49.9	50.3	
100	99.6	99.9	99.3	99.1	99.3	99.4	99.8	100.2	
200	199.5	199.9	199.2	199.1	199.3	199.4	199.8	200.2	
300	299.7	300.0	299.3	299.1	299.3	299.5	299.9	300.2	
	~~7~~		~~3~~	3		dried			
Blend # ~~8~~ 8	TEJAM 10/26/15	56/35 ~~4~~	TEJAM 10/26/15	1:4 ~~3~~ 4	TEJAM 10/26/15	WP50 : Subject		Oven #38	
					Start: 15:23 10/26/15			Stop: 16:41 10/28/15	
	The sample appeared blackened and darker than when								
it began. Did not exceed 200°C during the analysis. Not									
considered spontaneously combustible or self heating.									

Calculation:

Analyst Signature: Date: 10/26/15

Reviewed by: Date: 11/15/15

Book I.D. 14-0406-021

Book/ Page : 12 00176

010085

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050

Project# ~~19369.01.006~~ 21594.01.006 TBJ 1/27/16

Client: LANL

TO# 150904-4

LCS Info: TV= Balance#:

Notes: Due to computer being needed for another project temperature calibration check was reperformed calibrator: 012017

Sample ID									
temp °C	1	2	3	4	5	6	7	8	
0	0.1	0.2	-0.2	-0.4	-0.7	-0.6	0.1	0.4	
50	50.2	50.3	49.8	49.7	49.4	49.6	50.2	50.4	
100	100.0	100.3	99.8	99.5	99.4	99.4	100.1	100.4	
200	2000	200.4	199.9	199.5	199.4	199.4	200.1	200.3	
300	300.1	300.4	299.9	299.6	299.5	299.4	300.1	300.4	
Blend #6	581332		1:1 WBS	Solvent					
					Start: 15:26 10/29/15				Stop: 17:48 10/29/15
Sample dried on hotplate prior to analysis an event occured less than 2hr into the test causing temperature spikes of up to 6.2°C. Sample wash ash in the hood.									
Calculation:									

Analyst Signature: Date: 10/29/15

Reviewed by: Date: 11/15/15

Book I.D. 14-0406-021 Book/ Page : 12 00178

010086

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050 Project# 21592.03.006 ~~19816.101.006~~ TBJohn 11/23/15

Client: LANL TO# 150904-4

LCS Info: N/A TV= N/A Balance#: N/A

Notes: Due to lid event, cleaning and recalibration needed calibration 8/2017

Sample dried on hot plate prior to analysis

Sample ID									
temp °C	1	2	3	4	5	6	7	8	
0	-0.0	-0.1	-0.3	-0.5	-0.4	-0.3	0.2	0.5	
50	50.0	50.1	49.8	49.7	49.6	49.8	50.3	50.6	
100	100.0	100.0	99.7	99.6	99.5	99.8	100.2	100.5	
200	200.0	200.0	199.7	199.6	199.5	199.8	200.3	200.5	
300	300.1	300.1	299.7	299.7	299.6	300.8	300.0	300.5	
							3 TBJohn 11/4/15		
1:4 WBS : Sawdust			Blend #8				Start 10:17 10/31/15		Stop 11:21 11/6/15
Sample did not exceed 200°C anytime during the analysis. The sample appears to have blackened a little and shrivels up during the analysis. Sample B deemed not spontaneously combustable or self heating.									
Calculation:									

Analyst Signature: Dana Grant Date: 10/31/15

Reviewed by: [signature] Date: 11/15/15

Southwest Research Institute®
Logbook: Physical Testing

010087

Analysis / Method: 1050 Project# 21592.01.006 TEJAM 11/23/15 ~~14869.01.006~~

Client: LANL TO# 150904-4

LCS Info: N/A TV= N/A Balance#: N/A

Notes: Samples dried on hotplate prior to mixing with zeolite and allowing to sit for 24 hours befor analysis.

Sample ID					
Blend #13	3parts zealite and 1 part		1:4 WB8 to solvent		11/2/15 TEJAM 11/2/15
			Start 17:02 11/2/15		~~Stop~~ Stop 7:08 11/4/15
Upon completion of the test the sample was removed after not exceeding 200°C at any point during the analysis. The sample did not appear to change much during the analysis. Sample is not considered self heating or spontaneously combustable					
Blend #11	3part zealite and 1prt		1:1 WB8 : solvent		11/5/15
			Start ~~17:02~~ 8:43 11/5/15 TEJAM 11/9/15		Stop 7:08 23 11/9/15 TEJAM 11/9/15
Blend #12	3part zealite	and 1part	1:3 WB8 to solvent		
			start: 8:53 11/7/15		stop 10:53 11/9/15
Blend #11 & #12 similar in appearance to blend #13 and call are considered non self heating					
Calculation:					

Analyst Signature: Jana Mark Date: 11/2/15

Reviewed by: [signature] Date: 11/15/15

Southwest Research Institute®
Logbook: Physical Testing

010088

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 150904-4

LCS Info: N/A TV= Balance#:

Notes: WBB mixeded with sweat outte and then blended with water for 5 minutes, Then samples mixed with zeolite and allowed to sit out room temp for 24 hr.

Sample ID					
Blend 14	1:1 WBB : sweat outte blend : 3 part zeolite				
Start:	11/13/15	11:14			
Stop:	11/15/15	13:14			
Blend 15	1:3 WBB : sweat blended : 3 part zeolite				
Blend 16	1:4 WBB : sweat blended : 3 part zeolite				
Start:	11/24/15	10:37			
Stop:	11/26/15	12:37			
All three samples did not exceed 200°C during the course of the analysis. All thee samples became a little lighter in color after the analysis but no noticeable changes occured during analysis. The thee samples are not considered spontaneously combustable or self heating.					
Calculation:					

Analyst Signature: [signature] Date: 11/24/15

Reviewed by: [signature] Date: 12/7/15

Southwest Research Institute®
Logbook: Physical Testing

010089

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 150904-4

LCS Info: TV= Balance#:

Notes:

Calibrator : 01/2017

runs of dry 1:1 sucrose / WBB Blend 6 in 25mm cube

Sample ID									
temp	0	1	2	3	4	5	6	7	
0	0.81	-0.8	-0.6	-0.6	-0.6	-0.1	-0.2	0.0	
50	50.1	49.2	49.4	49.5	49.5	49.9	49.9	50.1	
100	100.1	99.2	99.4	99.4	99.4	99.9	99.8	100.0	
200	200.2	199.2	199.4	199.5	199.5	199.9	199.8	200.0	
300	300.2	299.2	299.4	299.5	299.5	299.9	299.9	300.1	
Blend 6	start:		12/15/15		14:37				
	stop		12/16/15		15:41				
two 25mm cups were filled and tested. Neither exceeded 200°C. So the sample is given a DOT packing group rating of III. since it was positive in the 100mm cube but negative in the 25mm. After test completion the sample was removed from the oven. The sample expanded out of the 1/7 the cubes but did not appear to have ignited.									

Calculation:

Analyst Signature: James Mar Date: 12/15/15

Reviewed by: R Spera Date: 12/17/15

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES

Daily Balance Verification Logs

010091

Book I.D.: 14-0406-020

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
9/25/15	JAM	199.9994	1.99999	0.01996
9/26/15	JAM	199.9996	1.99998	0.01995
9/28/15	JAM	199.9998	1.99998	0.01996
9/29/15	JAM	199.9993	1.99999	0.02002
9/30/15	JAM	199.9997	1.99998	0.01998
10/1/15	JAM	199.9998	1.99998	0.02001
10/2/15	JAM	199.9996	1.99999	0.02002
10/5/15	JAM	199.9993	1.99998	0.02001
10/6/15	JAM	199.9995	2.00002	0.02000
10/7/15	JAM	199.9994	1.99997	0.02002
10/8/15	JAM	199.9995	1.99995	0.01999
10/9/15	JAM	199.9998	1.99996	0.01997
10/10/15	JAM	199.9996	1.99999	0.02002
10/12/15	JAM	199.9996	1.99996	0.01997
10/13/15	JAM	199.9997	1.99996	0.02002
10/14/15	MG	200.0000	1.99997	0.01999
10/15/15	JAM	199.9996	1.99996	0.02002
10/16/15	JAM	199.9994	1.99992	0.02000
10/18/15	JAM	199.9999	1.99996	0.02000
10/19/15	JAM	199.9993	JAM 10/19/15 1.99994	0.01999
10/20/15	JAM	199.9996	2.00003	0.02000
10/21/15	JAM	199.9993	1.99992	0.01998

Comments:

Book I.D.: 14-0406-020 010092

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
10/22/15	KE	199.9995	1.99992	0.01999
10-23-15	KE	199.9995	1.99992	0.01999
10/26/15	JAM	199.9998	1.99998	0.01996
10/27/15	JAM	199.9997	2.00000	0.02001
10/28/15	JAM	199.9999	1.99999	0.02002
10/30/15	JAM	199.9996	1.99998	0.02001
11/2/15	JAM	199.9997	1.99993	0.02003
11/3/15	JAM	199.9993	1.99998	0.01999
11/4/15	EA	199.9999	2.00000	0.02001
11/5/15	JAM	199.9995	1.99992	0.02001
11/6/15	KE	199.9997	1.99996	0.02002
11/7/15	JAM	199.9994	2.00001	0.02001
11/9/15	JAM	199.9996	1.99997	0.01998
11/10/15	JAM	199.9998	1.99995	0.01999
11/11/15	MG	199.9999	1.99998	0.02000
11-12-15	JK	199.9995	2.00008	0.02004
11/13/15	JAM	199.9993	2.00003	0.01998
11/16/15	MG	199.9996	1.99996	0.02000
11/17/15	MG	200.0003	2.00001	0.02004
11/18/15	MG	199.9993	1.99996	0.01998
11/19/15	EA	199.9992	2.00008	0.01999
11/20/15	JAM	199.9999	1.99998	0.01997

Comments:

010093

Book I.D.: 14-0406-020

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
11/22/15	MG	199.9996	2.00005	0.01996
11/23/15	MG	199.9993	2.00000	0.01999
11/24/15	JAM	199.9994	1.99996	0.02001
11/25/15	KE	199.9998	1.99999	0.01999
11/28/15	JAM	199.9996	1.99999	0.02001
11/30/15	JAM	199.9996	1.99996	0.02001
12/1/15	JAM	199.9995	1.99992	0.02002
12/2/15	JAM	199.9996	2.00007	0.01998
12/3/15	JAM	199.9995	1.99998	0.01997
12/4/15	JAM	199.9995	1.99999	0.01998
12/5/15	JAM	200.0016	2.00000	0.02003
12/7/15	JAM	200.0016	2.00001	0.02001
12/8/15	JAM	199.9997	1.99998	0.01999
12-9-15	JK	199.9995	2.00003	0.01997
12/10/15	JAM	199.9998	1.99999	0.01999
12/11/15	JAM	199.9998	1.99995	0.01997

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010094

Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
9-16-15.	JA	1999.99	1.999
9-17-15-	JA	1999.99	2.001
9-18-15-	JA	2000.00	1.999
9-19-15-	JA	2000.00	1.999
9-21-15	JA	2000.00	2.000
9-22-15.	JA	2000.00	2.000
9/23/15	KE	2000.00	2.000
9-28-15.	JA	2000.00	2.000
9-29-15.	JA	2000.00	1.999
9/30/15 KE 9/30/15 (KE)	KE	2000.00	2.001
10-1-15.	JA	1999.99	1.999
10-2-15.	JA	2000.00	2.000
10/5/15	KE	1999.98	2.000
10-6-15-	JA	1999.99	2.000
10/7/15	KE	1999.99	1.999
10/8/15	KE	1999.99	2.001
10-9-15-	JA	1999.99	1.999
10/12/15	KE	1999.99	2.000
10-13-15.	JA	1999.99	2.000
10-14-15.	JA	1999.96	1.999
10-16-15.	JA	1999.99	1.999
10/16/15	JAM	1999.98	* 2.000

Comments: * use weight #020641 due to 011999 needing calibration

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010095

Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
10-19-15	JK	1999.98	1.999 *
10-20-15	JK	1999.97	2.006 *
10-21-15	JK	1999.98	1.999 *
10-22-15	JK	1999.99	1.999 *
10-23-15	KE	1999.99	2.000 *
10-26-15	DM	1999.98	1.998 *
10-27-15	JK	1999.99	1.999 *
10-28-15	KE	1999.99	2.0041 * KE 10/28/15
10-29-15	JK	1999.98	2.000 *
10-30-15	JK	1999.99	1.999 *
10/31/15	SAM	1999.99	2.000 *
11-2-15	KE	1999.98	1999 *
11-3-15	JK	1999.98	1.999 *
11-4-15	JK	1999.98	1.999 *
11-5-15	KE	1999.99	2.000 *
11/6/15	KE	1999.98	1.999 *
11-8-15	JK	1999.97	1.999 *
11-9-15	KE	1999.97	2.000 **
11-10-15	JK	1999.98	1.998 **
11-11-15	KE	1999.99	2.000
11-12-15	KE	1999.96	2.000 KE 11/12/15
11-13-15	JK	1999.95	2.000

Comments: * USED WEIGHT # 020641, WEIGHT 011999 OUT FOR CALIBRATION
**2g weight is back

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010096

Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
11/16/15	JW	1999.95	2.0004 JW 11/16/15
11-17-15	JK	1999.95	2.000
11-18-15	JK	1999.95	2.000
11-19-15	JK	1999.95	1.999
11-20-15	JK	1999.97	1.999
11-23-15	KE	1999.93	2.003
11-24-15	JK	1999.94	2.000
11-25-15	JK	1999.96	1.999
12-1-15	JK	1999.95	1.999
12-2-15	JK	1999.94	2.001
12-3-15	JK	1999.93	2.000
12-4-15	JK	1999.93	2.000
12-7-15	KE	1999.94	2.000
12-8-15	JK	1999.94	1.999
12-9-15	KE	1999.95	2.001
12-10-15	JK	1999.96	2.000
12-11-15	JK	1999.97	2.001

Comments:

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Certificates of Analysis
Chemicals Used For Surrogate

SwRI Chem ID: 63912

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Potassium carbonate - ACS reagent, ≥99.0%

K_2CO_3

Product Number:	**209619**
Batch Number:	**SLBM3461V**
Brand:	SIAL
CAS Number:	584-08-7
MDL Number:	MFCD00011382
Formula:	CK2O3
Formula Weight:	138.21 g/mol
Quality Release Date:	28 JAN 2015
Recommended Retest Date:	JAN 2018

SwRI Chem ID: 63912

Test	Specification	Result
Assay	≥ 99.0 %	99.8 %
Insoluble Matter < or = 0.01%	Pass	Pass
Chloride (Cl) < or = 0.003%	Pass	Pass
Phosphate (PO4) < or = 0.001%	Pass	Pass
Silica < or = 0.005%	Pass	Pass
Sulfur coumpounds < or = 0.004%	Pass	Pass
Calcium < or = 0.005%	Pass	Pass
Magnesium < or = 0.002%	Pass	Pass
Sodium < or = 0.02%	Pass	Pass
Iron (Fe) < or = 5 ppm	Pass	Pass
Heavy Metals (as Lead)	< = 5 ppm	< 5 ppm

SwRI Chem ID: 63912

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SwRI Chem ID: 63912

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Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 63912

Certificate of Analysis

Product Number: **209619**
Batch Number: **SLBM3461V**

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

SwRI Chem ID: 63912

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Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBN0101V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	02 MAY 2014
Recommended Retest Date:	APR 2020

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	99.4 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	MEETS REQUIREMENTS OF ACS 10TH ED
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	PASSED
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 54983
SwRI Chem ID: 54983
SwRI Chem ID: 54983



Certificate of Analysis

Product 42353
Calcium nitrate tetrahydrate,99+%,ACS reagent

General Product Data

Version	0
CAS No	13477-34-4
Country of origin	SPAIN
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
Linear formula	Ca(NO3)2.4H2O

Product Specifications

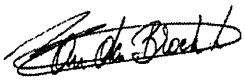
Appearance	white crystals
Assay Complexometry	99.0 to 103.0 %
Heavy metals (as Pb)	=<5 ppm
pH	5.0 to 7.0 (5% soln. at 25°C)
Insoluble matter	=<0.005 %
Trace analysis	Type: Cl measure =< 50 ppm
	Type: SO4 measure =< 20 ppm
	Type: Ba measure =< 50 ppm
	Type: Fe measure =< 5 ppm
	Type: NO2 measure =< 10 ppm
	Type: Mg measure =< 500 ppm
	Type: K measure =< 50 ppm
	Type: Na measure =< 100 ppm
	Type: Sr measure =< 500 ppm

Lot Specific Data : A0303920

Appearance	white crystals
Assay Complexometry	99.9 %
Heavy metals (as Pb)	=<2 ppm
pH	5.9 (5% soln. at 25°C)
Insoluble matter	=<0.005 %
Trace analysis	Type: Cl measure =< 2 ppm
	Type: SO4 measure =< 20 ppm
	Type: Ba measure =< 10 ppm
	Type: Fe measure =< 2 ppm
	Type: NO2 measure =< 10 ppm
	Type: Mg measure 1 ppm
	Type: K measure 3 ppm
	Type: Na measure 6 ppm
	Type: Sr measure =< 1 ppm

Issued: 21-09-12
L. Van den Broek, QA Manager

SwRI Chem ID: 36657
SwRI Chem ID: 36657
SwRI Chem ID: 36657



Acros Organics

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SwRI Chem ID: 61751

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Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

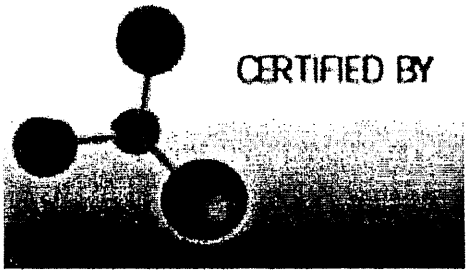
Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm

SwRI Chem ID: 61751

SwRI Chem ID: 61751

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Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)



L. Van den Broek, QA Manager Issued: 4 September 2015

Acros Organics
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Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 61751
SwRI Chem ID: 61751
SwRI Chem ID: 61751

SwRI Chem ID: 62881

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate - ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBV6056V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	27 MAY 2015

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 62881

SwRI Chem ID: 62881

SwRI Chem ID: 63069

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Website: www.sigmaaldrich.com
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Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Magnesium nitrate hexahydrate – ACS reagent, 99%

$Mg(NO_3)_2 \cdot 6H_2O$

Product Number:	**237175**
Batch Number:	**MKBW3613V**
Brand:	SIAL
CAS Number:	13446-18-9
MDL Number:	MFCD00149779
Formula:	MgN2O6 · 6H2O
Formula Weight:	256.41 g/mol
Quality Release Date:	24 AUG 2015

SwRI Chem ID: 63069

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Chips or Crystals	Conforms to Requirements	Crystals
X-Ray Diffraction	Conforms to Structure	Conforms
Complexometric EDTA	98.0 - 102.0 %	100.4 %
Insoluble Matter C= 10%, H2O	≤ 0.005 %	0.002 %
Barium	≤ 0.005 %	< 0.001 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Chloride Content	≤ 0.001 %	< 0.001 %
Iron (Fe)	≤ 5 ppm	< 1 ppm
Heavy Metals as Pb	≤ 5 ppm	< 4 ppm
Potassium (K)	≤ 0.005 %	< 0.001 %
Manganese (Mn)	≤ 5 ppm	< 4 ppm
Sodium (Na)	≤ 0.005 %	< 0.001 %
Ammonia (NH4)	≤ 0.003 %	< 0.003 %
pH C= 5%, H2O @ 25 Deg C	5.0 - 8.2	5.4
Phosphate (PO4)	≤ 5 ppm	< 5 ppm
Strontium (Sr)	≤ 0.005 %	< 0.001 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %

SwRI Chem ID: 63069

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SwRI Chem ID: 63069

SwRI Chem ID: 63069

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Certificate of Analysis

Product Number: 237175
Batch Number: MKBW3613V

Test	Specification	Result
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 63069

SwRI Chem ID: 63069

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Certificate of Analysis

SIGMA-ALDRICH

Product Name	Sodium nitrate, ACS reagent, ≥99.0%
Product Number	221341
Product Brand	Sigma-Aldrich
CAS Number	7631-99-4
Molecular Formula	$NaNO_3$
Molecular Weight	84.99

INORGANIC LABS/RADCHEM LABS
DATE RECEIVED: 10/24/08
DATE EXPIRED: 10/24/2018
DATE OPENED: 11/7/08
INORG: 7246/7247 PO: N/A from 12.16

TEST	LOT 07030MH RESULTS
APPEARANCE	WHITE CRYSTALLINE POWDER
TITRATION	99.7% (WITH NAOH) *
ICP ASSAY	CONFIRMS SODIUM COMPONENT
INSOLUBLE MATTER	0.003% (20%, H2O) *
CALCIUM	0.003% *
CHLORIDE	0.0002% *
IRON	1 PPM *
HEAVY METALS	3 PPM (AS PB) *
IODATE	2 PPM *
MAGNESIUM	0.001% *
NITRITE	0.0005% *
PH	6.0 @ 25 DEG C (5% H2O) *
PHOSPHATE	2 PPM *
SULFATE	0.001% *
	* SUPPLIER DATA
	MEETS REQUIREMENTS OF ACS 10TH ED
QC RELEASE DATE	NOVEMBER 2007

Barbara Rajzer

Barbara Rajzer, Supervisor
Quality Control
Milwaukee, Wisconsin USA

SwRI Chem ID: 33384
SwRI Chem ID: 33384
SwRI Chem ID: 33384

010109

SwRI Chem ID: 61750

ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

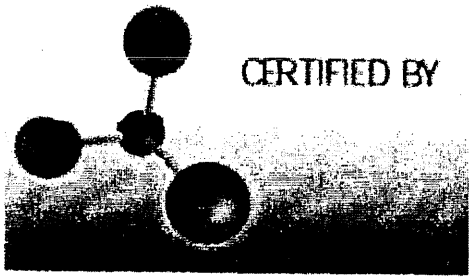
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Catalog Number	21156	**Quality Test / Release Date**	9 July 2015
Lot Number	A0349449	**Suggested Retest Date**	July 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	**Specifications**	**Test Value**
Appearance	white crystalline powder	white crystalline powder
Titration Complexometric	>=99 %	99.2 %
Trace analysis	Type: Cl measure =< 10 ppm	Type: Cl measure =< 10 ppm
Trace analysis	Type: Fe measure =< 5 ppm	Type: Fe measure =< 5 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 4 September 2015

Acros Organics
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Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 61750

SwRI Chem ID: 61750

010110

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

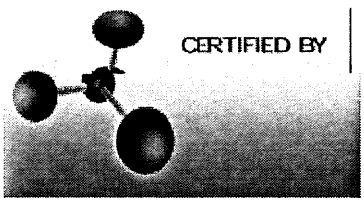
Certificate of Analysis

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Catalog Number	**P208**	**Mfg. Date**	**9/8/2011**
Lot Number	**114872**		
Description	**POTASSIUM CARBONATE, ANHYDROUS, A.C.S.**		
Country of Origin	**United States**	**Recommended Retest Date**	**Sep-2016**
Chemical Origin	**Inorganic-non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	FINE WHITE GRANULAR POWDER
ASSAY	%	>= 99.0	100.0
CALCIUM	%	<= 0.005	0.001
CHLORIDE	%	<= 0.003	<0.0030
HEAVY METALS (as Pb)	ppm	<= 5	<5.0
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.01	0.002
IRON (Fe)	ppm	<= 5	<5.0
MAGNESIUM	%	<= 0.002	0.0002
PHOSPHATE (PO4)	%	<= 0.001	<0.0010
SILICA (SiO2)	%	<= 0.005	<0.005
SODIUM (Na)	%	<= 0.02	0.004
SULFUR COMPOUNDS	%	<= 0.004	<0.0040



Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.

SwRI Chem ID: 61752
SwRI Chem ID: 61752
SwRI Chem ID: 61752

010111

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

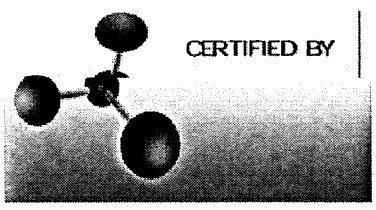
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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Catalog Number	**A219**	**Mfg. Date**	**6/26/2013**
Lot Number	**134700**		
Description	**OXALIC ACID, A.C.S**		
Country of Origin	**India**	**Recommended Retest Date**	**Jun-2018**
Chemical Origin	**Organic - non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 99.5 - 102.5	100.8
CALCIUM	%	<= 0.001	<0.0010
CHLORIDE	%	<= 0.002	<0.0020
HEAVY METALS (as Pb)	ppm	<= 5	<5
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
IGNITION RESIDUE	%	<= 0.01	0.008
INSOLUBLE MATTER	%	<= 0.005	0.004
IRON (Fe)	ppm	<= 2	<2
NITROGEN COMPOUNDS	%	<= 0.001	<0.0010
SUBSTANCES DARKENED BY H2SO4	PASS/FAIL	= PASS TEST	PASS TEST
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.

SwRI Chem ID: 47355
SwRI Chem ID: 47355
SwRI Chem ID: 47355

010112

Fisher Scientific

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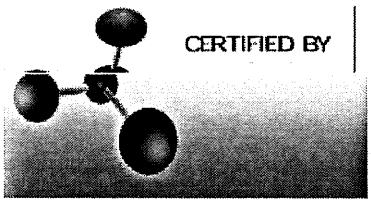
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A219**	**Quality Test / Release Date**	**12/18/2013**
Lot Number	**138974**		
Description	**OXALIC ACID, A.C.S**		
Country of Origin	**India**	*** Suggested Retest Date**	**Dec-2018**
Chemical Origin	**Organic - non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 99.5 - 102.5	100.1
CALCIUM	%	<= 0.001	0.0008
CHLORIDE	%	<= 0.002	<0.0020
HEAVY METALS (as Pb)	ppm	<= 5	<5
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
IGNITION RESIDUE	%	<= 0.01	0.002
INSOLUBLE MATTER	%	<= 0.005	0.001
IRON (Fe)	ppm	<= 2	<2
NITROGEN COMPOUNDS	%	<= 0.001	<0.0010
SUBSTANCES DARKENED BY H2SO4	PASS/FAIL	= PASS TEST	PASS TEST
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 51425
SwRI Chem ID: 51425
SwRI Chem ID: 51425

SwRI Chem ID: 61136

010113

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Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate - ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBV6056V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	27 MAY 2015

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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SwRI Chem ID: 61136
SwRI Chem ID: 61136

010114

SwRI Chem ID: 63604

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

SwRI Chem ID: 63604

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 63604

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 62882

Certificate of Analysis

Product Name:
Potassium nitrate – ReagentPlus®, ≥99.0%

KNO_3

Product Number:	**P8394**
Batch Number:	**MKBT3182V**
Brand:	SIAL
CAS Number:	7757-79-1
MDL Number:	MFCD00011409
Formula:	KNO3
Formula Weight:	101.10 g/mol
Quality Release Date:	20 NOV 2014
Recommended Retest Date:	NOV 2018

SwRI Chem ID: 62882

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form)	Powder or Crystals	Powder
Titration	≥ 99.0 %	99.5 %
Solubility (Turbidity) 20 g per 150 ml of water	Clear	Clear
Solubility (Color)	Colorless	Colorless
Recommended Retest Period 4 Years	----------	----------

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 62882

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 62882

010116

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Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 61137

Certificate of Analysis

Product Name:
Magnesium nitrate hexahydrate - ACS reagent, 99%

$Mg(NO_3)_2 \cdot 6H_2O$

Product Number:	**237175**
Batch Number:	**MKBW3613V**
Brand:	SIAL
CAS Number:	13446-18-9
MDL Number:	MFCD00149779
Formula:	MgN2O6 · 6H2O
Formula Weight:	256.41 g/mol
Quality Release Date:	24 AUG 2015

SwRI Chem ID: 61137

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Chips or Crystals	Conforms to Requirements	Crystals
X-Ray Diffraction	Conforms to Structure	Conforms
Complexometric EDTA	98.0 - 102.0 %	100.4 %
Insoluble Matter C= 10%, H2O	≤ 0.005 %	0.002 %
Barium	≤ 0.005 %	< 0.001 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Chloride Content	≤ 0.001 %	< 0.001 %
Iron (Fe)	≤ 5 ppm	< 1 ppm
Heavy Metals as Pb	≤ 5 ppm	< 4 ppm
Potassium (K)	≤ 0.005 %	< 0.001 %
Manganese (Mn)	≤ 5 ppm	< 4 ppm
Sodium (Na)	≤ 0.005 %	< 0.001 %
Ammonia (NH4)	≤ 0.003 %	< 0.003 %
pH C= 5%, H2O @ 25 Deg C	5.0 - 8.2	5.4
Phosphate (PO4)	≤ 5 ppm	< 5 ppm
Strontium (Sr)	≤ 0.005 %	< 0.001 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %

SwRI Chem ID: 61137

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 61137

SIGMA-ALDRICH®

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 61137

Certificate of Analysis

Product Number: 237175
Batch Number: MKBW3613V

Test	Specification	Result
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 61137

SwRI Chem ID: 61137

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

Certificate of Analysis

Alfa Aesar®
A Johnson Matthey Company

010118

SwRI Chem ID: 62824

Product No.: A18258

Product: Potassium bromate, 99%

Lot No.: 10191952

Appearance: White crystalline powder

Assay (Iodometric titration): 99.7%

SwRI Chem ID: 62824

SwRI Chem ID: 62824

Certificate of Analysis

Alfa Aesar®
A Johnson Matthey Company

010119

SwRI Ch 628
SwRI Chem ID: 628324
SwRI Chem ID: 628324
SwRI C

Product No.: A18258

Product: Potassium bromate, 99%

Lot No.: 10191952

Appearance: White crystalline powder

Assay (Iodometric titration): 99.7%

GFS Chemicals, Inc.
Columbus, Ohio 43223

010120

LOT ANALYSIS

ITEM: 555 POTASSIUM BROMATE, REAGENT (ACS)

LOT#:C577499

Test	PASS/FAIL	NUMERICAL RESULT
Assay (dried basis) 99.8% min.	PASS	100.9%
pH of 5% solution 5.0-9.0	PASS	6.5
Insoluble 0.005%	PASS	<0.005%
Bromide Pass test	PASS	pass test
Sulfate 0.005%	PASS	<0.005%
Heavy metals 0.0005%	PASS	<0.0005%
Iron 0.002%	PASS	<0.002%
Sodium 0.01%	PASS	<0.01%

TRACEABLE TO N.I.S.T. (Y/N)? Y
Comment:
Reported by: Nicholas E. Dangler
QC Supervisor: Charles Fontaine
Quality Assured to Retest Point: 60 months from shipment
C/A Print Date: 10/22/2015

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SwRI Chem ID: 63457
SwRI Chem ID: 63457
SwRI Chem ID: 63457

Certificate of Analysis

Alfa Aesar
A Johnson Matthey Company

SwRI Chem ID: 61135

Product No.: A18258

Product: Potassium bromate, 99%

Lot No.: 10181451

Appearance	White, crystalline powder
Assay (redox titration)	99.6 %

SwRI Chem ID: 61135

This document has been electronically generated and does not require a signature.

SwRI Chem ID: 61135

010122

SwRI Chem ID: 61128

SIGMA-ALDRICH®

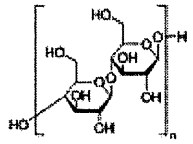
sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Cellulose - fibers, (medium)

Product Number:	**C6288**
Batch Number:	**SLBL2989V**
Brand:	SIGMA
CAS Number:	9004-34-6
MDL Number:	MFCD00081512
Quality Release Date:	25 AUG 2014



Test	Specification	Result
Appearance (Color)	White to Off White	White
Appearance (Form)	Powder or Solid	Powder
Moisture Content	≤ 10 %	4 %

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

SwRI Chem ID: 61128

SwRI Chem ID: 61128

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010123

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Surrogate Preparation
Logbook Pages

Work continued from Page

SWRI

122-01-WRS11 TOC Reagent

25.0118 g sodium persulfate (#49824) + 9mL phosphoric acid (#49825) + 213mL DI H_2O (#54571)

Epp. 5000-R balance # 135 exp. 10/28/15

122-02-WCS11 Acid Reagent

188mL DI H_2O (#54571) + 37mL phosphoric acid (#49825)

Epp 5000-R exp 10/5/15

122-03-WCS11 . WB8

A 73.8574 g $AlNO_3$ (54983) +

293.6998 g $CaNO_3$ (36657) +

3.6136 g $CrNO_3$ (61751) +

112.1790 g $FeNO_3$ (61136) +

824.2515 g $MgNO_3$ (61137) +

182.7284 g $NaNO_3$ (33384) +

64.8653 g $PbNO_3$ (61750) to mixing container & mix

B 66.6593 g COOH (47355) +

34.7754 g K_2CO_3 (61752) +

99.3687 g DI H_2O into a bottle until fully dissolved (mix)

carefully reacts violently

Once dissolved add to nitrate mixture A and mix thoroughly.

balance # 135

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SIGNATURE James Mah DATE 9/28/15

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 10/7/15

Work continued from Page

SWRI

126-01-WCS11 WB8

	36.9262	g $AlNO_3$ (54983) +
	146.8547	g $CaNO_3$ (36657) +
A	1.8077	g $CrNO_3$ (61751) +
	56.0842	g $FeNO_3$ (61136) +
	412.1212	g $MgNO_3$ (61137) +
	91.3633	g $NaNO_3$ (33384) +
	32.4302	g $PbNO_3$ (61750) to mixing container & mix

B	33.3353	g CCOH (# 47355) +
	17.3872	g K_2CO_3 (# 61752) +
	49.6810	g DI H_2O mix into a slurry

Combine A & B and mix.

balance #135

126-02-WCS11 TOC Reagent

25.0305 g sodium persulfate (# 49824) + 9mL phosporic acid (# 49825) to 213mL DI (# 54571)

Balance #135 exp 10/29/15

JAM 9/30/15

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Work continued to Page

SIGNATURE DATE 9/29/15

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 10/7/15

Work continued from Page

SWRI

132-01-WRSH WB8

36.9283 g $AlNO_3$ (54983) +
146.8503 g $CaNO_3$ (36657) +
1.8088 g $CrNO_3$ (61751) +
56.6833 g $FeNO_3$ (61136) +
412.1279 g $MgNO_3$ (61137) +
91.3619 g $NaNO_3$ (33384) +
32.4368 g $PbNO_3$ (61750) to mixing container

33.3394 g COOH (47355) +
17.3855 g K_2CO_3 (61752) +
49.6892 g DI H_2O mix into slurry

combine A & B and mix
balance # 135 exp 11/10/15

10/7/15

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Work continued to Page

SIGNATURE [signature] DATE 10/6/15

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SWRI
010127

Work continued from Page

135-01-wcs11 hypochlorite

10 mL bleach + 20mL DI H_2O
Epp 5000-R exp daily

135-02wcs11 10M NaOH

400.3416 g NaOH (#61579) to F.V. 1L with DI H_2O
balance #135 exp 10/18/16

135-03wcs11 WB8

	73.8594	g $AlNO_3$ (54983) +
	293.6947	g $CaNO_3$ (36657) +
	3.6138 (from 10 mL)	g $CrNO_3$ (61751) +
A	112.1709	g $FeNO_3$ (61136) +
	824.2514	g $MgNO_3$ (61137) +
	182.7251	g $NaNO_3$ (33384) +
	64.8650	g $PbNO_3$ (61750) to container ⅛ mix

	66.6518	g COOH (47355) +
B	34.7786	g K_2CO_3 (61752) +
	99.3672	g DI H_2O to make slurry

mix A & B together & shake.

balance #135 exp 12/8/15

SIGNATURE [signature] DATE 10/8/15

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Work continued from Page

SWRI

136-01-WCS11 cement # 5

300.01g WB8 (#135-03-WCS11) + 399.226g sweat added to a 4L bottle. 2/3 of the needed water 1060.43g added mixed and allowed to sit for 1hr. 165g NaOH added and pH read 9.5. Final 405.3g of DI H_2O added.

2130.07g cement added and mixed

balance #135 Set date 10/9/15 17:00

136-02-WCS11 cement #4

300.32g WB8 (#135-02-WCS11) + 300.267g sweat added to a 4L bottle. 2/3 of the needed water 800.01g added mixed and allowed to sit for 1hr. 165g NaOH added and pH read 9.45. Final 275.5g of water added.

~~1200.168g~~ 1605.379g cement added and mixed

Balance #135 Set date 10/9/15 16:40

136-03-WCS11 cement #3

297.119g sweat + 900.277g WB8 (135-03-WCS11) added to 4L bottle. 2/3 of the water needed 798.00g added and mixed. allowed to sit for 1hr 495g NaOH added pH was 9.08 Final 174.9g of water added

added 1593.71g cement and mixed

balance #135 Start date 10/9/15 17:13

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Work continued to Page

SIGNATURE DATE 10/9/15

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 10/15/15

Work continued from Page

SWRI

010129

made by Bernie

141-01-WC511 WB8

$AlNO_3$ (#54988) 190.7845g +
$CaNO_3$ (#36657) 440.5423g +
$CrNO_3$ (#61751) 5.4205g +
$FeNO_3$ (#62881) 160.2701g + A
$MgNO_3$ (#63069) 1236.381g +
$NaNO_3$ (#33384) 274.0901g +
$PbNO_3$ (#61750) 97.3005g all mixed together

potassium carbonate (#61752) 52.1630g +
water 149.050g +
oxalic acid (#47355) 99.9924g

mixed slowly and then added to mix tare A and shaken balance #135

141-02-WC511 1:1 Blend 6

750mL solvent + 750mL WB8 (141-01-WC511)
In: 5:30pm 10/15/15 @ 9:00 am 10/16/15 oven was opened and it was seen that the cap was blown off and sample was in the tray under the bottle even though the cap was not screwed on.

141-03-WC511 potassium chloride

25.0235 g KCl (#60103) to F.V. 250 mL with DI H_2O
balance #135 exp 10/15/16

Top part of sample was hard and no moisture while the bottom was very moist. Sample was placed into a tray to dry for an additional two hours. a thermocouple under the bottle showed a 7°C increase during the heating.

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SIGNATURE James Neu DATE 10/15/15

DISCLOSED TO AND UNDERSTOOD BY Kelly Allen DATE WITNESS DATE 10/15/15

Work continued from Page

SWRI

146-01-WCS11 1:3 WB88 : Swheat

400 mL WB88 (* 141-01-WCS11) + 1200mL Swheat

146-02-WCS11 1:4 WB88 : Swheat

300mL WB88 (* 141-01-WCS11) + 1200mL Swheat

placed into oven #31 at 60°C for 16 hours

Start: 15:00 10/18/15
stop 7:10 10/19/15

JAM 10/20/15

SWRI

154-01-WCS11 TL WB8

✓ 110.7773	g	$AlNO_3$ (#54983) +
✓ 440.541	g	$CaNO_3$ (#36657) +
✓ 5.422	g	$CrNO_3$ (#61751) +
✓ 168.273	g	$FeNO_3$ (#61136) +
✓ 1236.380	g	$MgNO_3$ (#63069) +
✓ 274.090	g	$NaNO_3$ (#33384) +
✓ 97.304	g	$PbNO_3$ (#61750)

all mixed on 10/20/15 by bernie

52.16	g	potassium carbonate (#61752) +
✓ 149.05	g	water +
✓ 99.99	g	oxalic acid (#47355)

balance #135

154-02-WCS11 1:1 WB8 : SWheat

750mL WB8 to 750mL SWheat

154-03-WCS11 1:3 WB8 : SWheat

400mL WB8 to 1200mL SWheat

154-04-WCS11 1:4 WB8 : SWheat

300mL WB8 to 1200mL SWheat

all WB8 used is from above. Placed into pans and covered with Saranwrap with holes punch in it. Placed onto hotblock @ 60°C at 18:00 on 10/22/15 The 1:3 & 1:4 were taken off the hotplate after 20 hours of being on. This was done because at 16 hours they were not entirely crispy. The 1:1 was still moist after 48 hours after being placed on the hotplate. It was placed into oven #31 @ 60°C on 10/25/15 @ 9:45am.

Work continued from Page

WD JAM 10/29/15

SWRI 010132

TITLE

PROJECT NO. 21592.01.006 31
BOOK NO. 15-0406-036

Work continued from Page TO# 150904-4 LANL UN-OXIDIZER

SWRI

163-01-WB11

A

METHOD-A Balance #05, 135

	WT-(G)	T.V	
Aluminum Nitrate	110.778	(110.78)	#54983
Calcium Nitrate	440.541	(440.54)	#36657
Chromium Nitrate	5.422	(5.42)	#61751
Iron Nitrate	168.270	(168.27)	#63604
Magnesium Nitrate	1236.39	(1236.35)	#62882
Sodium Nitrate	274.091	(274.090)	#7274
Lead Nitrate	97.302	(97.30)	#61750

B

Potassium Carbamate	52.1614	(52.16)	
Oxalic Acid	99.9933	(99.99)	#47355, #51425
Water	149.05	(149.05)	#63912

10/29/15

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Work continued to Page

SIGNATURE DATE 10/29/15

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 10/24/15

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Work continued to Page

SIGNATURE DATE 10/29/15

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 10/30/15

Work continued from Page

SWRI

balance #5 #4,5 dry start; 10/29/15 19:30
Stop 10/30/15 11:30

164-01-WCS11 ~~lit WB8 : subeat~~ TESAM 10/29/15 cemented #3

297.037g subeat + 900.12 WB8 (163-01-WCS11) let dry @ 65°C
added 798.4 g DI H_2O. added 127.89 g NaOH (135-02-WCS11)
added remaining 321.9g DI H_2O.
added 1593g cement
PH 9.20

balance #5

~~164-02-WCS11 1:3 WB8 subeat~~ TESAM 10/29/15 cemented #4 remake SAM 10/30/15

(163-01-WCS11)
300.325g subeat + 300.291g WB8 let dry at 65C for at least 16 Hr
added 800.41 g ~~DI~~ H_2O & let ~~sit~~ for 1hr ~~165.03g~~ 10N NaOH
(135-02-WCS11) added. Final ~~275.5g~~ H_2O added. 165 g overshot PH, remake

TESAM 10/29/15

164-03-WCS11 ~~lit WB8 : subeat~~ cemented #5

(163-01-WCS11)
399.368g subeat + 300.031 g WB8 let dry at 65°C for at least 16hr
added 1060.52g DI H_2O & let sit for 1hr add ~~165.12g~~ ~~30.15g~~ 71.95g 10N NaOH
(135-02-WCS11) added. Added last ~~499.72g~~ 486.31g DI H_2O. PH 10.19.
added 2130g cement

TESAM 10/29/15 TESAM 10/29/15

164-04-WCS11 Cement # ~~62882~~ TESAM 10/29/15

balance #5

100.012g KNO_3 (# 62882) + 200.017g DI H_2O let sit for 1hr
added 0.08 g 10N NaOH (135-02-WCS11) then added last 100.031g DI H_2O
pH 10.45. added 400.17g cement.

TESAM 10/31/15 ~~added 400.17g~~

balance #5

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Work continued to Page

SIGNATURE [signature] DATE 10/29/15

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 10/30/15

Work continued from Page

SWRI

010134

165-01-WCS11 TKN digestion solution

1.0032 g mercuric oxide (# 525160) + 200mL DI H_2O.

add 101.25mL H_2SO_4 (# 63463). Then add 66.5808 g potassium sulfate (# 54194) and F.V. 500mL with DI H_2O

cement #1 165-03-WCS11

start 10/30/15 3:15 pm
stop 10/31/15 9:25 am

300.012 current + 300.114 g WBB (163-01-WCS11) let dry @ 65°C for at least 16hr. added 800.04 g DI H_2O and let sit for 1hr added 49.88 g NaOH (# 135-02-WCS11) then added remaining 370.0 g DI H_2O pH 9.96

added 1605 g cement

balance #5

cement #2 165-02-WCS11

100.015 g WBB (#163-01-WCS11) + 200.077 g DI H_2O let sit for 1hr, added 19.68g 10N NaOH added last 88.15g DI H_2O pH. 10.82 added 400.02 g cement

balance #5

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Work continued to Page

SIGNATURE James Ard DATE 10/29/15

DISCLOSED TO AND UNDERSTOOD BY M. Grebalder DATE WITNESS DATE 11/11/15

Work continued from Page

SWRI

010135

167-01-WCS11 Blend # 11

400mL 1:1 (154-02-WCS11) to 1200mL zeolite

167-02-WCS11 Blend #12

400mL 1:3 (154-03-WCS11) to 1200mL zeolite

167-03-WCS11 Blend #13

400mL 1:4 (154-04-WCS11) to 1200mL zeolite

all made on 10/31/15
analysis began on 11/2/15

dell 11/2/15

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Work continued to Page

SIGNATURE

DATE 10/31/15

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE 11/2/15

SWRI

192-01-WCS11 - Blend #10

300mL zeolite to 100mL of WBS8 (# 141-01-WCS11)
exp 11/22/16

Start: 10:40 am 11/22/15
Stop: 10:45 am 11/23/15

192-C3-WCS11 Blend # 15

300mL 1:3 sweat: salt (# 154-03-WCS11) + 300mL DI mix for 5 minutes using stir pak. then took 400mL of that mixture and added 1200mL zeolite. Let sit for 24 hr.

192-03-WCS11 Blend #16

300mL 1:4 sweat to salt (154-04-WCS11) + 300mL DI H_2O mix for 5 minutes using stir pak. then took 400mL of that mixture and added 1200mL zeolite. Let sit for 24 hr.

Start: 11:40 11/22/15
Stop 11:40 11/23/15

JAM 11/23/15

TO #150904-4

Work continued from Page LANL - Oxidizer_UN

SWRI TO #150904-4

010137

(6)

1. WB8A

Aluminum Nitrate #54983	100.7845
Calcium Nitrate #36657	440.5423
Chromium Nitrate #61751	5.4205
Iron Nitrate #62881	168.2701
Magnesium Nitrate #63069	1236.381
Sodium Nitrate #33384	274.0901
Lead Nitrate #61750	97.3005

2. WB8B

Potassium Carbonate #61752	52.1630
Water	149.050
Oxalic Acid #47395	~~617.52~~ 99.9924

3. A+B above combined with

4. Mix in 4 liter plastic bottle set in oven # @ 60°C.
Note: Reactimix oven caused lid to come off most material remained in bottle. Transfer to aluminum pan. Sample used for experiments with approval from M. DAMMANN.

Work continued from Page TO # 150904-4 LANL UN-OXIDIZER

SWRI

010138

A		T.V.
Aluminum Nitrate #54983	110.7773	(110.78)
Calcium Nitrate #36657	440.541	(440.54)
Chromium Nitrate #61751	5.422	(5.42)
Iron Nitrate # 61136	168.273	(168.27)
Magnesium Nitrate #63069	1236.38	(1236.38)
Sodium Nitrate #7247	274.090	(274.09)
Lead Nitrate #61750	97.304	(97.30)

Note: Large Amts transfered to foil pan and crushed with pestal.

10/20/15

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Work continued to Page

SIGNATURE

DATE 10/20/15

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DATE

WITNESS

DATE 11/10/15

Work continued from Page LANL UN_Oxidizer 010139

SWRI Sieve & Dry KBrO3

LOT #10191952 #63454

Transfer entire bottle of KBrO3 into a 300µM sieve w/ 100 µm sieve and pan attached put lid on 300 µm sieve and shake.

Transfer what is left on top of 100 µm sieve to a clean dry aluminum pan.

Place in oven #22 @ 65°C. till needed

START time 5:30 p.m.

10/22/15

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Work continued to Page

SIGNATURE DATE 10/22/15

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 11/10/15

Work continued from Page TO#150904-4 LANL UN_OXIDIZER

SWRI

010140

A

METHOD-A

Balance #05, 135

	WT (G)	T.V	
Aluminum Nitrate	110.778	(110.78)	#54983
Calcium Nitrate	440.541	(440.54)	#36657
Chromium Nitrate	5.422	(5.42)	#61751
Iron Nitrate	168.270	(168.27)	#63604
Magnesium Nitrate	1236.39	(1236.35)	#62882
Sodium Nitrate	274.091	(274.090)	#7274
Lead Nitrate	97.302	(97.30)	#61750

B

Potassium Carbomate	52.1614	(52.16)	#63912
Oxalic Acid	99.9933	(99.99)	#47355, #51425
Water	149.05	(149.05)	~~#63912~~ 10/29/15 (CE)

10/29/15

SIGNATURE [signature] DATE 10/29/15

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 10/29/15

Work continued from Page

LANL UN-OXIDIZER

SWRI TO # 150904-4

BAL. # 05

Cement 400 g
400 g
1593 g
1605 g
2130 g

ALAMO Cement Co
Portland Cement
Type I & II Low ALKALA

10/30/15 pw

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Work continued to Page

SIGNATURE [signature] DATE 10/30/15

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE 11/10/15 WITNESS

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Calibration Certificates

010143

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	24071
Asset Number:	018344	Calibrated:	2/3/2015
Description:	OVEN	Calibration Due:	2/3/2016
Manufacturer:	THERMO SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	HERATHERM OMS60	Temp./RH:	70 °F / 15 %
Serial Number:	41241291	Work Order #	403129130
Calibration Procedure:	OVENS, CHAMBERS, INCUBA		

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
015454	HART SCIENTIFIC	5627A	THERMOMETER PRT	2/17/2015
018495	FLUKE	1523	TEMPERATURE METER	2/17/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403129130	Mfr:	Thermo Scientific	Technician:	RRV
Asset No:	018344	Model:	Heratherm OMS60	Type Data:	Found-left
Serial No:	41241291	Type:	Oven Chamber	Cal Date:	2-Feb-15

Remarks: Calibration limits per customer request. Chamber exceeds 70% of limit at the 200 °C test point. Customer to determine if the result found meets their requirements. Temperature uniformity not calibrated

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
50 °C	50.3	50.0	-0.3	2.0	0.18	Pass	15%
100 °C	100.9	100.0	-0.9				45%
200 °C	201.6	200.0	-1.6				80%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	37141
Asset Number:	007251	Calibrated:	8/21/2015
Description:	ANEMOMETER, HOTWIRE	Calibration Due:	8/21/2016
Manufacturer:	ALNOR	Data Type:	FOUND / LEFT
Model Number:	8570	Temp./RH:	72.1°F / 52 %
Serial Number:	99017063	Work Order #	403133835
Calibration Procedure:	AIR VELOCITY		

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
011558	VAISALA	HMP77B	HUMIDITY/TEMPERATURE PROB	3/7/2016
014484	TSI	8390/8495	WIND TUNNEL CALIBRATION SYS	11/28/2021
014485	TSI	8495	TRANSDUCER DISPLAY & MONIT	9/2/2015
014486	MKS	220D	PRESSURE TRANSDUCER	2/19/2016
021448	FLUKE	PPC4	Pressure Controller	11/3/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133835	Mfr:	Alnor	Tech:	Mark Romero
Asset No:	007251	Model:	8570	Type Data:	Found-left
Serial No:	99017063	Type:	Anemometer	Cal Date:	21-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Linearity	ft/min	ft/min	ft/min	ft/min	ft/min		
2000	2028	2020	-8	61	37	Pass	13%
4000	3965	4035	70	119	71	Pass	59%
6000	6019	6040	21	181	108	Pass	12%
8000	8010	7940	-70	240	144	Pass	29%
10000	9585	9555	-30	288	173	Pass	10%
Temperature	°F	°F	°F	°F	°F		
Ambient	73.0	73.0	0.0	0.5	0.33	Pass	0%

END OF REPORT

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Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	22158
Asset Number:	012017	Calibrated:	12/23/2014
Description:	CALIBRATOR, TEMPERATURE	Calibration Due:	12/23/2015
Manufacturer:	FLUKE	Data Type:	FOUND / LEFT
Model Number:	724	Temp./RH:	73 °F / 42 %
Serial Number:	8776066	Work Order #	403128276
Calibration Procedure:	FLUKE 724, 725, 726		

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Remarks:
Ohm source not calibrated below 240 Ohms per customer.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
015482	AGILENT-HP	3458A OPT 002	MULTIMETER	10/24/2015
021436	FLUKE	5522A	MULTI-PRODUCT CALIBRATOR	11/3/2015

Approved By

Calibrated By: JRG
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report.

Work Order:	403128276	Mfr:	Fluke	Technician:	JRG
Asset No:	012017	Model:	724	Type Data:	Found-left
Serial No:	8776066	Type:	Calibrator	Cal Date:	23-Dec-14
Remarks: Ohm source not calibrated below 240 Ohms per customer.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
V DC Measure	V	V	V	V	V		
Upper Display	0	0.000	0.000	0.002	0.0012	Pass	0%
	15	15.000	0.000	0.005	0.0013	Pass	0%
	30	30.000	0.000	0.008	0.0013	Pass	0%
mV DC Measure	mV	mV	mV	mV	mV		
Lower Display	0	0.00	0.00	0.02	0.012	Pass	0%
	50	49.99	-0.01	0.03	0.013	Pass	33%
	89	88.99	-0.01	0.04	0.013	Pass	25%
V DC Measure	V	V	V	V	V		
Lower Display	0	0.000	0.000	0.002	0.0012	Pass	0%
	10	9.999	-0.001	0.004	0.0013	Pass	25%
	20	19.999	-0.001	0.006	0.0013	Pass	17%
mA DC Measure	mA	mA	mA	mA	mA		
Upper Display	4	4.000	0.000	0.003	0.0014	Pass	0%
	12	12.001	0.001	0.005	0.0020	Pass	20%
	24	24.003	0.003	0.007	0.0033	Pass	43%
Resistance	Ω	Ω	Ω	Ω	Ω		
4-Wire Measure	15	14.98	-0.02	0.10	0.01	Pass	20%
Lower Display	350	349.96	-0.04	0.10	0.036	Pass	40%
	500	499.9	-0.1	0.5	0.10	Pass	20%
	1500	1499.9	-0.1	0.5	0.12	Pass	20%
	3200	3199.8	-0.2	1.0	0.20	Pass	20%
3-Wire RTD	Ω	Ω	Ω	Ω	Ω		
Lower Display	350	349.94	-0.06	0.20	0.036	Pass	30%
Type J TC Measure	°C	°C	°C	°C	°C		
Lower Display	0	0.0	0.0	0.7	0.22	Pass	0%
Type J TC Source	°C	°C	°C	°C	°C		
Lower Display	0	0.01	0.01	0.70	0.17	Pass	1%
mV DC Source	mV	mV	mV	mV	mV		
Lower Display	0	-0.002	-0.002	0.020	0.0004	Pass	10%
	45	44.999	-0.001	0.030	0.002	Pass	3%
	100	99.999	-0.001	0.040	0.002	Pass	3%

Southwest Research Institute
Calibration Laboratory
Measurement Report.

Work Order:	403128276	Mfr:	Fluke	Technician:	JRG
Asset No:	012017	Model:	724	Type Data:	Found-left
Serial No:	8776066	Type:	Calibrator	Cal Date:	23-Dec-14

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
V DC Source	V	V	V	V	V		
Lower Display	0	0.0000	0.0000	0.0020	0.00001	Pass	0%
	5	4.9999	-0.0001	0.0030	0.00006	Pass	3%
	10	9.9999	-0.0001	0.0040	0.00006	Pass	3%
Resistance Source	Ω	Ω	Ω	Ω	Ω		
Lower Display	15	n/a	#VALUE!	0.100	0.006	######	######
	360	359.996	-0.004	0.100	0.006	Pass	4%
	500	499.83	-0.17	0.50	0.04	Pass	34%
	1500	1500.10	0.10	0.50	0.04	Pass	20%
	3200	3200.11	0.11	1.00	0.07	Pass	11%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	34387
Asset Number:	020918	Calibrated:	7/9/2015
Description:	MULTIMETER	Calibration Due:	7/9/2016
Manufacturer:	FLUKE	Data Type:	FOUND / LEFT
Model Number:	87 V	Temp./RH:	73.1°F / 40 %
Serial Number:	13430067	Work Order #	403132809
Calibration Procedure:	FLUKE 80 SERIES V		

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
021436	FLUKE	5522A	MULTI-PRODUCT CALIBRATOR	11/3/2015

Approved By

Calibrated By: CER
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132809	Mfr:	Fluke	Technician:	CER
Asset No:	020918	Model:	87 V	Type Data:	Found-left
Serial No:	13430067	Type:	Multimeter	Cal Date:	9-Jul-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
AC 600 mV	mV	mV	mV	mV	mV		
60 Hz	330	329.7	-0.3	2.7	0.2	Pass	11%
13 kHz	600	607.4	7.4	14	0.2	Pass	53%
AC 6 V	V	V	V	V	V		
60 Hz	3.3	3.297	-0.003	0.025	0.001	Pass	12%
20 kHz	3.3	3.294	-0.006	0.086	0.002	Pass	7%
AC 60 V							
60 Hz	33	32.97	-0.03	0.25	0.01	Pass	12%
20 kHz	33	32.90	-0.10	0.86	0.02	Pass	12%
AC 600 V							
60 Hz	330	329.7	-0.3	2.5	0.2	Pass	12%
2.5 kHz	330	330.0	0.0	7.0	0.1	Pass	0%
AC 1000 V							
60 Hz	500	499	-1	6	0.9	Pass	17%
1 kHz	1000	1001	1	14	1.0	Pass	7%
Frequency	kHz	kHz	kHz	kHz	kHz		
150 mV	99.95	99.95	0.00	0.02	0.013	Pass	0%
	199.5	199.50	0.00	0.02	0.009	Pass	0%
Sensitivity	kHz	kHz	kHz	kHz	kHz		
AC 6 V with 700 mV	99.95	99.95	0.00	0.02	0.013	Pass	0%
AC 60 V with 7 V	99.95	99.95	0.00	0.02	0.013	Pass	0%
Trigger Level	Hz	Hz	Hz	Hz	Hz		
3.4 V Sq. Wave	1000	1000.0	0.0	0.2	0.12	Pass	0%
Duty Cycle	%	%	%	%	%		
5 V Sq Wave	50	50.1	0.1	0.3	0.068	Pass	33%
DC V	V	V	V	V	V		
6 V	3.3	3.300	0.000	0.003	0.0008	Pass	0%
60 V	33	33.00	0.00	0.03	0.008	Pass	0%
600 V	330	330.0	0.0	0.3	0.09	Pass	0%
1000 V	1000	1000	0	2	0.9	Pass	0%
	mV	mV	mV	mV	mV		
600 mV	33	33.0	0.0	0.1	0.09	Pass	0%
	330	330.0	0.0	0.4	0.09	Pass	0%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132809	Mfr:	Fluke	Technician:	CER
Asset No:	020918	Model:	87 V	Type Data:	Found-left
Serial No:	13430067	Type:	Multimeter	Cal Date:	9-Jul-15

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Resistance	Ω	Ω	Ω	Ω	Ω		
600	330	330.0	0.0	0.9	0.08	Pass	0%
	kΩ	kΩ	kΩ	kΩ	kΩ		
6 k	3.3	3.300	0.000	0.008	0.0008	Pass	0%
60 k	33	33.00	0.00	0.08	0.01	Pass	0%
600 k	330	329.9	-0.1	2.1	0.1	Pass	5%
	MΩ	MΩ	MΩ	MΩ	MΩ		
6 M	3.3	3.298	-0.002	0.021	0.002	Pass	10%
50 M	30	29.94	-0.06	0.33	0.01	Pass	18%
Conductance nS	nS	nS	nS	nS	nS		
Open Input	0	0.04	0.04	0.3	0.01	Pass	13%
	10	10.01	0.01	0.4	0.01	Pass	3%
Diode	V	V	V	V	V		
6 V Range	3	3.000	0.000	0.061	0.0008	Pass	0%
AC A	A	A	A	A	A		
6 A @ 60 Hz	3	3.000	0.000	0.032	0.004	Pass	0%
DC A	A	A	A	A	A		
6 A	3	3.002	0.002	0.01	0.002	Pass	20%
10 A	10	10.00	0.00	0.04	0.01	Pass	0%
AC mA	mA	mA	mA	mA	mA		
60 mA @ 60 Hz	33	33.00	0.00	0.35	0.04	Pass	0%
400 mA @ 60 Hz	330	330.1	0.1	3.5	0.3	Pass	3%
DC mA	mA	mA	mA	mA	mA		
60 mA	33	33.00	0.00	0.11	0.01	Pass	0%
400 mA	330	329.9	-0.1	0.9	0.2	Pass	11%
AC µA	µA	µA	µA	µA	µA		
600 µA @ 60 Hz	330	330.0	0.0	3.5	0.6	Pass	0%
6000 µA @ 60 Hz	3300	3301	1	35	4.0	Pass	3%
DC µA	µA	µA	µA	µA	µA		
600 µA	330	330.0	0.0	1.1	0.1	Pass	0%
6000 µA	3300	3299	-1	9	1.0	Pass	11%
Capacitance	nF	nF	nF	nF	nF		
Open Input 10 nF	0.26	0.26	0.00	0.05	0.006	Pass	0%
100 nF	5	5.0	0.0	0.3	0.06	Pass	0%
	µF	µF	µF	µF	µF		
100 uF	9.5	9.5	0.0	0.3	0.1	Pass	0%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132809	Mfr:	Fluke	Technician:	CER
Asset No:	020918	Model:	87 V	Type Data:	Found-left
Serial No:	13430067	Type:	Multimeter	Cal Date:	9-Jul-15

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Low Pass Filter	V	V	V	V	V		
400 V @ 400 Hz	392	382	-10	16	0.6	Pass	63%
400 V @ 800 Hz	283	290	7	57	0.6	Pass	12%
Peak Min/Max DC	V	V	V	V	V		
Max	6	6.031	0.031	0.104	0.068	Pass	30%
Min	-2	-2.004	-0.004	0.102	0.068	Pass	4%
Temperature Type K	°C	°C	°C	°C	°C		
	0	0.2	0.2	1	0.3	Pass	20%
	100	100.1	0.1	2	0.3	Pass	5%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36974
Asset Number:	022396	Calibrated:	8/19/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/19/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	73.6°F / 58 %
Serial Number:	22396	Work Order #	403133757
Calibration Procedure:	TEMPERATURE PROBES		

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Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-found
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	2.2	0.5	Fail	159%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	3.0	1.3	Fail?	100%
	699.3	702.6	3.3	5.2	1.3	Pass	63%
	1002.6	1002.4	-0.2	7.5	1.3	Pass	3%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-left
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	19-Aug-15
Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	4.0	0.5	Pass	88%
	-44.4	-42.8	1.6	2.2	0.5	Pass	73%
	-0.1	0.3	0.4	2.2	0.5	Pass	18%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	20.0	1.3	Pass	15%
	699.3	702.6	3.3	35.0	1.3	Pass	9%
	1002.6	1002.4	-0.2	50.0	1.3	Pass	0%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38118
Asset Number:	022473	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22473	Work Order #	403134196
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134196	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022473	Model	08516-96	Type Data:	Found-left
Serial No.	22473	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.7	0.8	3.7	1.3	Pass	20%
	750.3	750.9	0.6	5.6	1.3	Pass	11%
	1002.9	1001.5	-1.4	7.5	1.3	Pass	19%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38183
Asset Number:	022487	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22487	Work Order #	403134273
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134273	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022487	Model	08516-96	Type Data:	Found-left
Serial No.	22487	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	98.7	-1.0	2.2	0.5	Pass	46%
	498.0	499.0	1.0	3.7	1.3	Pass	27%
	750.3	751.7	1.4	5.6	1.3	Pass	25%
	1002.9	1002.2	-0.7	7.5	1.3	Pass	9%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38185
Asset Number:	022489	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22489	Work Order #	403134275
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134275	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022489	Model	08516-96	Type Data:	Found-left
Serial No.	22489	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.1	-0.6	2.2	0.5	Pass	28%
	498.0	499.5	1.6	3.7	1.3	Pass	42%
	750.3	752.8	2.5	5.6	1.3	Pass	44%
	1002.9	1003.7	0.8	7.5	1.3	Pass	11%

END OF REPORT

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Calibration Certificate

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Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38120
Asset Number:	022475	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22475	Work Order #	403134198
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134198	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022475	Model	08516-96	Type Data:	Found-left
Serial No.	22475	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	98.6	-1.1	2.2	0.5	Pass	51%
	498.0	497.9	-0.1	3.7	1.3	Pass	1%
	750.3	749.8	-0.5	5.6	1.3	Pass	9%
	1002.9	999.4	-3.5	7.5	1.3	Pass	47%

END OF REPORT

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Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38186
Asset Number:	022490	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22490	Work Order #	403134278
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134278	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022490	Model	08516-96	Type Data:	Found-left
Serial No.	22490	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.1	1.7	2.2	0.5	Pass	77%
	99.7	99.1	-0.6	2.2	0.5	Pass	28%
	498.0	497.2	-0.8	3.7	1.3	Pass	20%
	750.3	751.9	1.6	5.6	1.3	Pass	28%
	1002.9	1000.2	-2.7	7.5	1.3	Pass	36%

END OF REPORT

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Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38184
Asset Number:	022488	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22488	Work Order #	403134274
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134274	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022488	Model	08516-96	Type Data:	Found-left
Serial No.	22488	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.3	0.4	3.7	1.3	Pass	9%
	750.3	749.9	-0.4	5.6	1.3	Pass	7%
	1002.9	1000.5	-2.4	7.5	1.3	Pass	32%

END OF REPORT

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Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38121
Asset Number:	022476	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22476	Work Order #	403134199
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134199	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022476	Model	08516-96	Type Data:	Found-left
Serial No.	22476	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.0	-0.7	2.2	0.5	Pass	33%
	498.0	497.7	-0.3	3.7	1.3	Pass	7%
	750.3	749.6	-0.7	5.6	1.3	Pass	12%
	1002.9	999.9	-3.0	7.5	1.3	Pass	40%

END OF REPORT

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Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	25221
Asset Number:	010209	Calibrated:	2/20/2015
Description:	TEMPERATURE METER	Calibration Due:	2/20/2016
Manufacturer:	COLE-PARMER	Data Type:	FOUND / LEFT
Model Number:	91100-50	Temp./RH:	73.8°F / 41 %
Serial Number:	W01003226	Work Order #	403129356
Calibration Procedure:	DIGITAL THERMOMETERS-MO		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
TC Type J, K, T & E Calibrated Only

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date

Approved By

Calibrated By: CER
Metrology Technician

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

021436	FLUKE	5522A	MULTI-PRODUCT CALIBRATOR	11/3/2015

Approved By

Calibrated By: CER
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403129356	Mfr:	Cole-Parmer	Technician:	CER
Asset No:	010209	Model:	91100-50	Data Type:	Found-left
Serial No:	W01003226	Type:	Thermocouple Thermometer	Cal Date:	20-Feb-15
Remarks: Type J, K, T, and E only per customer request.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
T1	°F	°F	°F	°F	°F		
Type J	-300	-301	1	3	1	Pass	33%
	110	109.6	0.4	0.8	0.4	Pass	49%
	525	524.4	0.6	1.2	0.4	Pass	49%
	940	939.3	0.7	1.6	0.4	Pass	43%
	1750	1749	1	3	1	Pass	33%
	°C	°C	°C	°C	°C		
	-150	-150	0	2	1	Pass	0%
	40	39.8	-0.2	0.4	0.2	Pass	45%
	275	274.7	-0.3	0.7	0.2	Pass	44%
	510	509.7	-0.3	0.9	0.2	Pass	33%
	950	949.7	-0.3	1.4	0.3	Pass	22%
	°F	°F	°F	°F	°F		
Type K	-300	-301	1	3	1	Pass	33%
	390	389.3	0.7	1.1	0.6	Pass	64%
	1075	1074	1	2	1	Pass	50%
	1760	1759	1	3	1	Pass	33%
	2100	2098	2	3	1	Pass	67%
	°C	°C	°C	°C	°C		
	-200	-200	0	2	1	Pass	0%
	210	209.7	-0.3	0.6	0.3	Pass	49%
	575	574.4	-0.6	1.0	0.3	Pass	62%
	940	939.1	-0.9	1.3	0.3	Pass	67%
	1350	1349	-1	2	1	Pass	50%
	°F	°F	°F	°F	°F		
Type T	-300	-300	0	3	2	Pass	0%
	-50	-50.3	0.3	0.8	0.5	Pass	40%
	200	199.5	0.5	0.9	0.4	Pass	56%
	450	449.4	0.6	1.2	0.3	Pass	52%
	700	699.3	0.7	1.4	0.3	Pass	50%
	°C	°C	°C	°C	°C		
	-200	-200	0	2	1	Pass	0%
	-45	-45.1	-0.1	0.4	0.3	Pass	22%
	100	99.8	-0.2	0.5	0.2	Pass	40%
	245	244.8	-0.2	0.6	0.2	Pass	31%
	390	389.6	-0.4	0.8	0.2	Pass	51%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403129356	Mfr:	Cole-Parmer	Technician:	CER
Asset No:	010209	Model:	91100-50	Data Type:	Found-left
Serial No:	W01003226	Type:	Thermocouple Thermometer	Cal Date:	20-Feb-15

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
T1 (*Cont.*)	°F	°F	°F	°F	°F		
Type E	-300	-301	1	3	1	Pass	33%
	-50	-50.3	0.3	0.7	0.4	Pass	46%
	300	299.5	0.5	1.0	0.3	Pass	50%
	990	989.3	0.7	1.7	0.3	Pass	41%
	1800	1799	1	3	1	Pass	33%
	°C	°C	°C	°C	°C		
	-200	-200	0	2	1	Pass	0%
	0	-0.2	-0.2	0.4	0.2	Pass	50%
	100	99.9	-0.1	0.5	0.2	Pass	20%
	600	599.5	-0.5	1.0	0.2	Pass	50%
	950	949.3	-0.7	1.4	0.3	Pass	52%
T2	°F	°F	°F	°F	°F		
Type J	-300	-300	0	3.0	1	Pass	0%
	110	109.8	0.2	0.8	0.4	Pass	25%
	525	524.8	0.2	1.2	0.4	Pass	16%
	940	939.6	0.4	1.6	0.4	Pass	24%
	1750	1750	0	3	1	Pass	0%
	°C	°C	°C	°C	°C		
	-150	-150	0	2	1	Pass	0%
	40	39.9	-0.1	0.4	0.2	Pass	23%
	275	274.7	-0.3	0.7	0.2	Pass	44%
	510	509.7	-0.3	0.9	0.2	Pass	33%
	950	949.7	-0.3	1.4	0.3	Pass	22%
	°F	°F	°F	°F	°F		
Type K	-300	-301	1	3	1	Pass	33%
	390	389.4	0.6	1.1	0.6	Pass	55%
	1075	1074	1	2	1	Pass	50%
	1760	1759	1	3	1	Pass	33%
	2100	2099	1	3	1	Pass	33%
	°C	°C	°C	°C	°C		
	-200	-200	0	2	1	Pass	0%
	210	209.7	-0.3	0.6	0.3	Pass	49%
	575	574.5	-0.5	1.0	0.3	Pass	51%
	940	939.5	-0.5	1.3	0.3	Pass	37%
	1350	1349	-1	2	1	Pass	50%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403129356	Mfr:	Cole-Parmer	Technician:	CER
Asset No:	010209	Model:	91100-50	Data Type:	Found-left
Serial No:	W01003226	Type:	Thermocouple Thermometer	Cal Date:	20-Feb-15

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
T2 (*Cont.*)	°F	°F	°F	°F	°F		
Type T	-300	-300	0	3	2	Pass	0%
	-50	-49.9	0.1	0.8	0.5	Pass	13%
	200	199.8	0.2	0.9	0.4	Pass	22%
	450	449.5	0.5	1.2	0.3	Pass	43%
	700	699.5	0.5	1.4	0.3	Pass	36%
	°C	°C	°C	°C	°C		
	-200	-201	-1	2	1	Pass	50%
	-45	-45.2	-0.2	0.4	0.3	Pass	45%
	100	99.8	-0.2	0.5	0.2	Pass	40%
	245	244.8	-0.2	0.6	0.2	Pass	31%
	390	389.7	-0.3	0.8	0.2	Pass	38%
	°F	°F	°F	°F	°F		
Type E	-300	-300	0	3	1	Pass	0%
	-50	-50.2	0.2	0.7	0.4	Pass	31%
	300	299.6	0.4	1.0	0.3	Pass	40%
	990	989.5	0.5	1.7	0.3	Pass	30%
	1800	1799	1	3	1	Pass	33%
	°C	°C	°C	°C	°C		
	-200	-201	-1	2	1	Pass	50%
	0	-0.2	-0.2	0.4	0.2	Pass	50%
	100	99.8	-0.2	0.5	0.2	Pass	40%
	600	599.7	-0.3	1.0	0.2	Pass	30%
	950	949.6	-0.4	1.4	0.3	Pass	30%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38119
Asset Number:	022474	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22474	Work Order #	403134197
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134197	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022474	Model	08516-96	Type Data:	Found-left
Serial No.	22474	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	98.9	-0.8	2.2	0.5	Pass	37%
	498.0	498.3	0.4	3.7	1.3	Pass	9%
	750.3	750.2	-0.1	5.6	1.3	Pass	2%
	1002.9	999.9	-3.0	7.5	1.3	Pass	40%

END OF REPORT

010178

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	27648
Asset Number:	011485	Calibrated:	3/23/2015
Description:	TEMPERATURE CONTROLLER	Calibration Due:	3/23/2016
Manufacturer:	LOVE CONTROLS	Data Type:	FOUND / LEFT
Model Number:	32B	Temp./RH:	72 °F / 50 %
Serial Number:	11485	Work Order #	403130390A
Calibration Procedure:	DIGITAL THERMOMETERS-MO		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
Control display cal'd only per Mike Damman. Cal'd to ± 2 °C. Amended Certificate to correct due date.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

010329	FLUKE	525A	CALIBRATOR, TEMP/PRESS	6/4/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403130390	Mfr:	Love Controls	Technician:	RRV
Asset No.:	011485	Model:	32B	Type Data:	Found-left
Serial No.:	11485	Type:	Controller	Cal Date:	23-Mar-15
Remarks: Control display calibrated only. Test range and limits are specified per Mike Dammann.					

Function/Range	Set Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
Type K	50	49.7	-0.3	2.0	0.33	Pass	15%
	95	94.8	-0.2			Pass	10%
	135	134.9	-0.1			Pass	5%
	220	219.9	-0.1			Pass	5%
	305	305.2	0.2			Pass	10%
	400	400.3	0.3			Pass	15%

END OF REPORT

010181

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	41145
Asset Number:	019204	Calibrated:	10/28/2015
Description:	TEMPERATURE CONTROLLER	Calibration Due:	10/28/2016
Manufacturer:	LOVE CONTROLS	Data Type:	FOUND / LEFT
Model Number:	32B	Temp./RH:	71 °F / 58 %
Serial Number:	19204	Work Order #	403135345
Calibration Procedure:	DIGITAL THERMOMETERS-MO		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
Control display calibrated only. Calibrated to ±2°C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
017979	FLUKE	525B	CALIBRATOR, TEMPERATURE/PF	9/23/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403135345	Mfr:	Love Controls	Technician:	RRV
Asset No.:	019204	Model:	32B	Type Data:	Found-left
Serial No.:	19204	Type:	Controller	Cal Date:	28-Oct-15
Remarks: Control display calibrated only. Test range and limits are specified per Mike Dammann.					

Function/Range	Set Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
Type K	50	48.6	-1.4	2.0	0.33	Pass	70%
	95	93.5	-1.5			Pass	75%
	135	133.5	-1.5			Pass	75%
	220	218.5	-1.5			Pass	75%
	305	303.7	-1.3			Pass	65%
	400	398.6	-1.4			Pass	70%

END OF REPORT

010183

Southwest Research Institute
Calibration Certificate

NVLAP LAB CODE 200950.0

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	19117
Asset Number:	019204	Calibrated:	10/31/2014
Description:	TEMPERATURE CONTROLLER	Calibration Due:	10/31/2015
Manufacturer:	LOVE CONTROLS	Data Type:	FOUND / LEFT
Model Number:	32B	Temp./RH:	71 °F / 49 %
Serial Number:	19204	Work Order #	403127210
Calibration Procedure:	DIGITAL THERMOMETERS-MO		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
Control display calibrated only. Calibrated to ±2°C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
017979	FLUKE	525B	CALIBRATOR, TEMPERATURE/PF	9/26/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403127210	Mfr:	Love Controls	Technician:	RRV
Asset No.:	019204	Model:	32B	Type Data:	Found-left
Serial No.:	19204	Type:	Controller	Cal Date:	31-Oct-14

Remarks: Control display calibrated only. Calibrated to ±2°C. Test range and limits are specified per Mike Dammann.

Function/Range	Set Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
Type K	50	49.0	-1.0	2.0	0.33	Pass	50%
	95	94.1	-0.9			Pass	45%
	135	134.1	-0.9			Pass	45%
	220	219.0	-1.0			Pass	50%
	305	304.0	-1.0			Pass	50%
	400	399.0	-1.0			Pass	50%

END OF REPORT

Appendix G
SwRI Test Report, January 26, 2016

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

January 26, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Ashley Pryor

Subject:		
	Case:	Zeolite
	SwRI Project Number:	21592.01.00X
	SDG:	589620
	SwRI Task Order Number:	151222-14
	SwRI Sample Receipt Number:	56087
	Samples Received:	09.03.2015
	Analysis:	Various Wetchem

Dear Ms. Pryor,

Please find the enclosed results for the overall surrogate samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3051, or via email at herbert.schattenberg@swri.org.

Sincerely,

Herbert J. Schattenberg III
Program Manager

APPROVED:

Michael J. Dammann
Director

HJS: mg
Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

CHAIN-OF-CUSTODY & SAMPLE RECEIPT PAPERWORK

Total Page Count:
Fraction: Welchem Report Pages: 010001-010211

010002

General Sample Chain of Custody

Ver (8/25/2011)

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

SRR #:	56087	Thermometer:	021056
Project	19869.01.00X	Temperature:	21.2
CASE:	Zeolite	Airbill #:	590817794105
Customer:	Los Alamos National Laboratory	Logged in by:	SDOUGLAS
Samples Received:	Sep 3 2015 8:30AM	Logged in:	Sep 3 2015 9:03AM
Manager:	DAMMANN, MIKE		
Disposal Instructions:	Contact project manager for disposal authority.		

System ID	Customer ID	CED	Matrix	# Cont	Special Requirements	Sample Condition
581291	(UNS Liquid+SWheat 1:1):3 zeolite or cemented		Liquid	1		Intact
581292	(UNS+SWheat 1:1):3 zeolite or cemented		Solid	1		Intact
581293	(UNS+SWheat 1:3):3 zeolite or cemented		Solid	1		Intact
581294	(UNS+SWheat 1:4):3 zeolite or cemented		Solid	1		Intact
581295	1(UNSLQ+SWht 1:1):1 Spillfyter:1 citric acid :3		Liquid	1		Intact
581296	1(UNSLQ+SWht 1:1):1 Spillfyter:3 zeolite or cmtd		Liquid	1		Intact
581297	1 (UNS LQ+Wastelock 16:1):3 zeolite or cemented		Liquid	1		Intact
581298	1 UNS: 3 zeolite or cemented		Solid	1		Intact
581299	Zeolite		Solid	1		Intact
581300	UNS		Solid	1		Intact
581301	UNS+SWheat 1:1		Solid	1		Intact
581302	UNS+SWheat 1:3		Solid	1		Intact
581303	UNS+SWheat 1:4		Solid	1		Intact
581318	(WB8 + SWheat 1:1) cemented		Surrogate	1		Intact
581319	(WB8 + SWheat 1:1):3 zeolite		Surrogate	1		Intact
581320	(WB8 + SWheat 1:3) cemented		Surrogate	1		Intact
581321	(WB8 + SWheat 1:3):3 zeolite		Surrogate	1		Intact
581322	(WB8 + SWheat 1:4) cemented		Surrogate	1		Intact
581323	(WB8 + SWheat 1:4):3 zeolite		Surrogate	1		Intact
581324	1 Potassium Nitrate: 3 zeolite		Surrogate	1		Intact
581325	1 WB8: 3 zeolite		Surrogate	1		Intact
581326	Potassium Nitrate		Surrogate	1		Intact
581327	Potassium Nitrate + SWheat 1:1		Surrogate	1		Intact
581328	Potassium Nitrate + SWheat 1:3		Surrogate	1		Intact
581329	Potassium Nitrate + SWheat 1:4		Surrogate	1		Intact
581330	Potassium Nitrate cemented		Surrogate	1		Intact
581331	WB8		Surrogate	1		Intact
581332	WB8 + SWheat 1:1		Surrogate	1		Intact
581333	WB8 + SWheat 1:3		Surrogate	1		Intact
581334	WB8 + SWheat 1:4		Surrogate	1		Intact
581335	WB8 cemented		Surrogate	1		Intact

Reliquished by (Print/Signature): [signature]

Date 9/3/15

Time 0830

	Date	Time
Received by (Print/Signature):		
Reliquished by (Print/Signature):	9/3/15	0830
Received by (Print/Signature):	Date	Time
Reliquished by (Print/Signature):	Date	Time
	Date	Time

Southwest Research Institute

Laboratory Task Order

010004

TO #: 151222-14 Revision: 1

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 01/08/16

SDG: 589620

SRR #'s: 56087
Client(s): Los Alamos National Laboratory

Instructions

Results to be sent to Ashley Pryor and Nita Patel

Documents Related to this task order: 185604[COC for SRR 56087], 185605[SRR Paperwork for SRR 56087], 191181[New Sample IDs], 191404[]

Deliverables --> Hard Copy: -YES- EDD: no PDF: no

Test: EPA 1050
Section: FT ADMIN

Holding: 30 days from VTSR

Test Methods to Determine Substances likely to Spontaneously Combust

Cnt: 17

System ID	Type	Cont	Matrix	Customer ID	VTSR	Method Date
589463		1	Surrogate	Cement 10	03 Sep 15	03 Oct 15
589464		1	Surrogate	Cement 11	03 Sep 15	03 Oct 15
589465		1	Surrogate	Cement 12	03 Sep 15	03 Oct 15
589466		1	Surrogate	Cement 13	03 Sep 15	03 Oct 15
589467		1	Surrogate	Cement 14	03 Sep 15	03 Oct 15
589468		1	Surrogate	Cement 15	03 Sep 15	03 Oct 15
589471		1	Surrogate	Cement 8	03 Sep 15	03 Oct 15
589472		1	Surrogate	Cement 9	03 Sep 15	03 Oct 15
589620		1	Surrogate	Blend 17	03 Sep 15	03 Oct 15
589621		1	Surrogate	Blend 18	03 Sep 15	03 Oct 15
589622		1	Surrogate	Blend 19	03 Sep 15	03 Oct 15
589623		1	Surrogate	Blend 20	03 Sep 15	03 Oct 15
589624		1	Surrogate	Blend 21	03 Sep 15	03 Oct 15
589625		1	Surrogate	Blend 22	03 Sep 15	03 Oct 15
589626		1	Surrogate	Blend 23	03 Sep 15	03 Oct 15
589627		1	Surrogate	Blend 24	03 Sep 15	03 Oct 15
589628		1	Surrogate	Blend 25	03 Sep 15	03 Oct 15

Test: HOLD-WETCHEM
Section: WETCHEM

Holding: 365 days from CED

Samples are on hold until further instructions are received from client to proceed

Cnt: 3

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581318		1	Surrogate	Cement 3	NO DATA	NO DATA
581320		1	Surrogate	Cement 4	NO DATA	NO DATA
581322		1	Surrogate	Cement 5	NO DATA	NO DATA

Test: IGNIT_1030
Section: WETCHEM

Holding: 180 days from CED

SW 846 Method 1030 Ignitability of solids

Cnt: 17

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
589463		1	Surrogate	Cement 10	NO DATA	NO DATA
589464		1	Surrogate	Cement 11	NO DATA	NO DATA
589465		1	Surrogate	Cement 12	NO DATA	NO DATA
589466		1	Surrogate	Cement 13	NO DATA	NO DATA
589467		1	Surrogate	Cement 14	NO DATA	NO DATA
589468		1	Surrogate	Cement 15	NO DATA	NO DATA
589471		1	Surrogate	Cement 8	NO DATA	NO DATA
589472		1	Surrogate	Cement 9	NO DATA	NO DATA
589620		1	Surrogate	Blend 17	NO DATA	NO DATA

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
589621		1	Surrogate	Blend 18	NO DATA	NO DATA
589622		1	Surrogate	Blend 19	NO DATA	NO DATA
589623		1	Surrogate	Blend 20	NO DATA	NO DATA
589624		1	Surrogate	Blend 21	NO DATA	NO DATA
589625		1	Surrogate	Blend 22	NO DATA	NO DATA
589626		1	Surrogate	Blend 23	NO DATA	NO DATA
589627		1	Surrogate	Blend 24	NO DATA	NO DATA
589628		1	Surrogate	Blend 25	NO DATA	NO DATA

Test: Oxidizer_UN
Section: WETCHEM

Holding: 180 days from CED

United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.

Cnt: 19

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
589463		1	Surrogate	Cement 10	NO DATA	NO DATA
589464		1	Surrogate	Cement 11	NO DATA	NO DATA
589465		1	Surrogate	Cement 12	NO DATA	NO DATA
589466		1	Surrogate	Cement 13	NO DATA	NO DATA
589467		1	Surrogate	Cement 14	NO DATA	NO DATA
589468		1	Surrogate	Cement 15	NO DATA	NO DATA
589469		1	Surrogate	Cement 6	NO DATA	NO DATA
589470		1	Surrogate	Cement 7	NO DATA	NO DATA
589471		1	Surrogate	Cement 8	NO DATA	NO DATA
589472		1	Surrogate	Cement 9	NO DATA	NO DATA
589620		1	Surrogate	Blend 17	NO DATA	NO DATA
589621		1	Surrogate	Blend 18	NO DATA	NO DATA
589622		1	Surrogate	Blend 19	NO DATA	NO DATA
589623		1	Surrogate	Blend 20	NO DATA	NO DATA
589624		1	Surrogate	Blend 21	NO DATA	NO DATA
589625		1	Surrogate	Blend 22	NO DATA	NO DATA
589626		1	Surrogate	Blend 23	NO DATA	NO DATA
589627		1	Surrogate	Blend 24	NO DATA	NO DATA
589628		1	Surrogate	Blend 25	NO DATA	NO DATA

Sample Receipt

010006

Southwest Research Institute

VTSR: 09/03/15 Time: 08:30:00

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

Notes

Sample was delivered intact. (no ice).

Fed Ex #(s):
590817794105 - 21.2 °C

See Task Order for full requirements.

See chain of custody as part of the SRR system for more information.

The Product along with the Section 4.0 of the paperwork provided by the client will be used to create the ADDITIONAL Solid and Liquid Surrogates identified in the Client ID section.

Due to character limitations, the following
1 (UNS LQ+SWheat 1:1):1 Spillfyter :3 zeolite or cemented
was abbreviated to:
1(UNSLQ+SWht 1:1):1 Spillfyter:3 zeolite or cmtd

1 (UNS LQ+SWheat 1:1):1 Spillfyter :1citric acid :3 zeolite or cemented
was abbreviated to:
1(UNSLQ+SWht 1:1):1 Spillfyter:1 citric acid :3

Phases:
001 - admin
002 - extraction
005 - 8082
006 - metals/radchem
007 - drg

Rev. 1
Corrected project number.
REVISION 2, DRmz 12/15/15: New Sample IDs added to the SRR, along with revisions done to previously created IDs, per email from Radonna Spies.

Rev. 3
Added samples and revised sample ID's. See attached email.

Background CPM: <100 cpm
Container Wipe CPM: <100 cpm
Total CPM: <100

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
581326	Blend 1		Surrogate	1	
581325	Blend 10		Surrogate	1	
581319	Blend 11		Surrogate	1	
581321	Blend 12		Surrogate	1	
581323	Blend 13		Surrogate	1	
589460	Blend 14		Surrogate	1	
589461	Blend 15		Surrogate	1	
589462	Blend 16		Surrogate	1	
589620	Blend 17		Surrogate	1	

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ver: (7/18/2014)

56087 Los Alamos National Laborato

Sample Receipt

Southwest Research Institute

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15

Time: 08:30:00

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
589621	Blend 18		Surrogate	1	
589622	Blend 19		Surrogate	1	
581327	Blend 2		Surrogate	1	
589623	Blend 20		Surrogate	1	
589624	Blend 21		Surrogate	1	
589625	Blend 22		Surrogate	1	
589626	Blend 23		Surrogate	1	
589627	Blend 24		Surrogate	1	
589628	Blend 25		Surrogate	1	
581328	Blend 3		Surrogate	1	
581329	Blend 4		Surrogate	1	
581331	Blend 5		Surrogate	1	
581332	Blend 6		Surrogate	1	
581333	Blend 7		Surrogate	1	
581334	Blend 8		Surrogate	1	
581324	Blend 9		Surrogate	1	
581330	Cement 1		Surrogate	1	
589463	Cement 10		Surrogate	1	
589464	Cement 11		Surrogate	1	
589465	Cement 12		Surrogate	1	
589466	Cement 13		Surrogate	1	
589467	Cement 14		Surrogate	1	
589468	Cement 15		Surrogate	1	
581335	Cement 2		Surrogate	1	
581318	Cement 3		Surrogate	1	
581320	Cement 4		Surrogate	1	
581322	Cement 5		Surrogate	1	
589469	Cement 6		Surrogate	1	
589470	Cement 7		Surrogate	1	
589471	Cement 8		Surrogate	1	
589472	Cement 9		Surrogate	1	
581291	UNS Blend 1		Liquid	1	
581301	UNS Blend 10		Solid	1	
581302	UNS Blend 11		Solid	1	
581303	UNS Blend 12		Solid	1	
589629	UNS Blend 13		Surrogate	1	
589630	UNS Blend 14		Surrogate	1	
589631	UNS Blend 15		Surrogate	1	
589632	UNS Blend 16		Surrogate	1	
589633	UNS Blend 17		Surrogate	1	
589634	UNS Blend 18		Surrogate	1	

56087 Los Alamos National Laborato

010008

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15 Time: 08:30:00

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
589635	UNS Blend 19		Surrogate	1	
581292	UNS Blend 2		Solid	1	
581293	UNS Blend 3		Solid	1	
581294	UNS Blend 4		Solid	1	
581295	UNS Blend 5		Liquid	1	
581296	UNS Blend 6		Liquid	1	
581297	UNS Blend 7		Liquid	1	
581298	UNS Blend 8		Solid	1	
581300	UNS Blend 9		Solid	1	
581299	Zeolite		Solid	1	

Containers: 60 **Samples: 60**

These documents are associated with this receipt: 185604[COC for SRR 56087], 185605[SRR Paperwork for SRR 56087], 191181[New Sample IDs], 191404[]

Thermometer: 021056
Temperature: 21.2

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ver: (7/18/2014)

56087 Los Alamos National Laborato

010009

Southwest Research Institute

Traffic Report

Sample Custodian Signature: _____

1. Custody Seal — Present
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: Zeolite / SDG: _____

Sample Receipt: 56087

Airbill: 590817794105

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
09/03/15	08:30:00	Email	UNS Blend 1	N/A	581291	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 2	N/A	581292	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 3	N/A	581293	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 4	N/A	581294	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 5	N/A	581295	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 6	N/A	581296	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 7	N/A	581297	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 8	N/A	581298	YES	Intact
09/03/15	08:30:00	Email	Zeolite	N/A	581299	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 9	N/A	581300	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 10	N/A	581301	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 11	N/A	581302	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 12	N/A	581303	YES	ntact
09/03/15	08:30:00	4.0	Cement 3	N/A	581318	YES	Intact
09/03/15	08:30:00	4.0	Blend 11	N/A	581319	YES	Intact
09/03/15	08:30:00	4.0	Cement 4	N/A	581320	YES	Intact
09/03/15	08:30:00	4.0	Blend 12	N/A	581321	YES	Intact
09/03/15	08:30:00	4.0	Cement 5	N/A	581322	YES	Intact
09/03/15	08:30:00	4.0	Blend 13	N/A	581323	YES	Intact
09/03/15	08:30:00	4.0	Blend 9	N/A	581324	YES	Intact
09/03/15	08:30:00	4.0	Blend 10	N/A	581325	YES	Intact
09/03/15	08:30:00	4.0	Blend 1	N/A	581326	YES	Intact
09/03/15	08:30:00	4.0	Blend 2	N/A	581327	YES	Intact
09/03/15	08:30:00	4.0	Blend 3	N/A	581328	YES	Intact
09/03/15	08:30:00	4.0	Blend 4	N/A	581329	YES	Intact
09/03/15	08:30:00	4.0	Cement 1	N/A	581330	YES	Intact
09/03/15	08:30:00	4.0	Blend 5	N/A	581331	YES	Intact
09/03/15	08:30:00	4.0	Blend 6	N/A	581332	YES	Intact
09/03/15	08:30:00	4.0	Blend 7	N/A	581333	YES	Intact
09/03/15	08:30:00	4.0	Blend 8	N/A	581334	YES	Intact
09/03/15	08:30:00	4.0	Cement 2	N/A	581335	YES	Intact
09/03/15	08:30:00	4.0	Blend 14	N/A	589460	YES	Intact
09/03/15	08:30:00	4.0	Blend 15	N/A	589461	YES	Intact
09/03/15	08:30:00	4.0	Blend 16	N/A	589462	YES	Intact
09/03/15	08:30:00	4.0	Cement 10	N/A	589463	YES	Intact

Southwest Research Institute

Traffic Report

Sample Custodian Signature: _____

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: Zeolite / SDG: _____

Sample Receipt: 56087

Airbill: 590817794105

Date Received	Time Received	COC Record	SMO Sample #	Corresponding Sample Tag #	Corresponding Custody Seal # / SwRI # N/A	Traffic Rpt, Tags, COC Agree	Sample Condition
09/03/15	08:30:00	4.0	Cement 11	N/A	589464	YES	Intact
09/03/15	08:30:00	4.0	Cement 12	N/A	589465	YES	Intact
09/03/15	08:30:00	4.0	Cement 13	N/A	589466	YES	Intact
09/03/15	08:30:00	4.0	Cement 14	N/A	589467	YES	Intact
09/03/15	08:30:00	4.0	Cement 15	N/A	589468	YES	Intact
09/03/15	08:30:00	4.0	Cement 6	N/A	589469	YES	Intact
09/03/15	08:30:00	4.0	Cement 7	N/A	589470	YES	Intact
09/03/15	08:30:00	4.0	Cement 8	N/A	589471	YES	Intact
09/03/15	08:30:00	4.0	Cement 9	N/A	589472	YES	Intact
09/03/15	08:30:00	Email	Blend 17	N/A	589620	YES	Intact
09/03/15	08:30:00	Email	Blend 18	N/A	589621	YES	Intact
09/03/15	08:30:00	Email	Blend 19	N/A	589622	YES	Intact
09/03/15	08:30:00	Email	Blend 20	N/A	589623	YES	Intact
09/03/15	08:30:00	Email	Blend 21	N/A	589624	YES	Intact
09/03/15	08:30:00	Email	Blend 22	N/A	589625	YES	Intact
09/03/15	08:30:00	Email	Blend 23	N/A	589626	YES	Intact
09/03/15	08:30:00	Email	Blend 24	N/A	589627	YES	Intact
09/03/15	08:30:00	Email	Blend 25	N/A	589628	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 13	N/A	589629	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 14	N/A	589630	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 15	N/A	589631	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 16	N/A	589632	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 17	N/A	589633	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 18	N/A	589634	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 19	N/A	589635	YES	Intact

010011

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 3
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 09/03/2015
Received By (Signature):	
Case Number: Zeolite	Sample Delivery Group No.: NA
	SAS Number: NA

Remarks: 21592.01.00X

1.	Custody Seal(s)	Present/Absent* Intact/Broken
2.	Custody Seal Nos.	N/A
3.	Chain-of Custody Records	Present/Absent*
4.	Traffic Reports or Packing Lists	Present/Absent*
5.	Airbill	Airbill/Sticker Present/Absent*
6.	Airbill No.	590817794105
7.	Sample Tags	Present/Absent*
	Sample Tag Numbers	Listed/Not listed on Chain of Custody
8.	Sample Condition	Intact/Broken*/ Leaking
9.	Cooler Temperature	21.2C
10.	Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*
11.	Date Received at Lab	09/03/2015
12.	Time Received	08:30:00

Sample Transfer		
Fraction: INORG	Fraction	
Area #: R. Spres	Area #	
By: STEVEN DOUGLAS	By	
On: 09/03/2015	On	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
UNS Blend 1	N/A	581291	Intact
UNS Blend 2	N/A	581292	Intact
UNS Blend 3	N/A	581293	Intact
UNS Blend 4	N/A	581294	Intact
UNS Blend 5	N/A	581295	Intact
UNS Blend 6	N/A	581296	Intact
UNS Blend 7	N/A	581297	Intact
UNS Blend 8	N/A	581298	Intact
Zeolite	N/A	581299	Intact
UNS Blend 9	N/A	581300	Intact
UNS Blend 10	N/A	581301	Intact
UNS Blend 11	N/A	581302	Intact
UNS Blend 12	N/A	581303	Intact
Cement 3	N/A	581318	Intact
Blend 11	N/A	581319	Intact
Cement 4	N/A	581320	Intact
Blend 12	N/A	581321	Intact
Cement 5	N/A	581322	Intact
Blend 13	N/A	581323	Intact
Blend 9	N/A	581324	Intact
Blend 10	N/A	581325	Intact
Blend 1	N/A	581326	Intact
Blend 2	N/A	581327	Intact

* Contact SMO and attach record of resolution

Reviewed By:	Logbook No.: Sample Receipt (56087)
Date: 12.21.15	Logbook Page No.: 9201 SEC 2 3 OF 4

FORM DC-I

OLMO4.2

SAMPLE LOG-IN SHEET

010012

Lab Name: Southwest Research Institute	Page 2 of 3
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 09/03/2015
Received By (Signature):	
Case Number: Zeolite	Sample Delivery Group No.: NA
Remarks: 21592.01.00X	SAS Number: NA

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present/Absent	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	590817794105	
7. Sample Tags	Present/Absent	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/ Leaking	
9. Cooler Temperature	21.2C	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	09/03/2015	
12. Time Received	08:30:00	

Sample Transfer		
Fraction: Inorg	Fraction:	
Area #: E. Spies	Area #:	
By: STEVEN DOUGLAS	By:	
On: 09/03/2015	On:	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Blend 3	N/A	581328	Intact
Blend 4	N/A	581329	Intact
Cement 1	N/A	581330	Intact
Blend 5	N/A	581331	Intact
Blend 6	N/A	581332	Intact
Blend 7	N/A	581333	Intact
Blend 8	N/A	581334	Intact
Cement 2	N/A	581335	Intact
Blend 14	N/A	589460	Intact
Blend 15	N/A	589461	Intact
Blend 16	N/A	589462	Intact
Cement 10	N/A	589463	Intact
Cement 11	N/A	589464	Intact
Cement 12	N/A	589465	Intact
Cement 13	N/A	589466	Intact
Cement 14	N/A	589467	Intact
Cement 15	N/A	589468	Intact
Cement 6	N/A	589469	Intact
Cement 7	N/A	589470	Intact
Cement 8	N/A	589471	Intact
Cement 9	N/A	589472	Intact
Blend 17	N/A	589620	Intact
Blend 18	N/A	589621	Intact

* Contact SMO and attach record of resolution

Reviewed By:	Logbook No.: Sample Receipt (56087)
Date: 12.21.15	Logbook Page No.: 92035E 2 3 OF 4

SAMPLE LOG-IN SHEET

010013

Lab Name: Southwest Research Institute	Page 3 of 3
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 09/03/2015
Received By (Signature): S Douglas	
Case Number: Zeolite	Sample Delivery Group No.: N/A
Remarks: 21592.01.00X	SAS Number: N/A

1. Custody Seal(s)	Present/Absent* (Intact)/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	(Present)/Absent*	
4. Traffic Reports or Packing Lists	Present (Absent)	
5. Airbill	Airbill/Sticker (Present)/Absent*	
6. Airbill No.	590817794105	
7. Sample Tags	Present (Absent)	
Sample Tag Numbers	Listed/(Not listed on Chain of Custody)	
8. Sample Condition	(Intact)/Broken*/Leaking	
9. Cooler Temperature	21.2C	
10. Does Information on custody records, traffic reports, and sample tags agree?	(Yes)/No*	
11. Date Received at Lab	09/03/2015	
12. Time Received	08:30:00	

Sample Transfer		
Fraction: 1 NIRG	Fraction:	
Area #: 10 Spres	Area #:	
By: STEVEN DOUGLAS	By:	
On: 09/03/2015	On:	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Blend 19	N/A	589622	Intact
Blend 20	N/A	589623	Intact
Blend 21	N/A	589624	Intact
Blend 22	N/A	589625	Intact
Blend 23	N/A	589626	Intact
Blend 24	N/A	589627	Intact
Blend 25	N/A	589628	Intact
UNS Blend 13	N/A	589629	Intact
UNS Blend 14	N/A	589630	Intact
UNS Blend 15	N/A	589631	Intact
UNS Blend 16	N/A	589632	Intact
UNS Blend 17	N/A	589633	Intact
UNS Blend 18	N/A	589634	Intact
UNS Blend 19	N/A	589635	Intact

* Contact SMO and attach record of resolution

Reviewed By: [signature]	Logbook No.: Sample Receipt (56087)
Date: 12/2/15	Logbook Page No.: 9201 SEC 2, 3 of 4

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 151222-14

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of Cements 6 through 15 and then RNS surrogate Blends 17 though 25. For the cements blend, the dried Swheat/WB8 mixtures was utilized. The dried Swheat/WB8 mixtures were prepared by mixing the WB8 and Swheat together and drying on a hotplate at 60-65°C for a minimum of 16 hours. For the cements, two-thirds of the required amount of water was added to the dried Swheat/WB8 mixture before adjusting the pH to between 9 and 11 with 40% NaOH. Each of the cements required more NaOH then was required in the recipe, which was likely due varying degrees of dryness of the mixture. After pH was adjusted, the remaining amount of water that was specified was added to each mixture prior to adding the cements. The cements were mixed for several minutes to thoroughly homogenize before pouring 32-oz wide mouth polypropylene jars (Fisher Scientific #02-891F) with a ¼' diameter hole in the lid. To ensure there was adequate amount of sample for the testing, extra volume was prepared for Cements 8 through 15, which required two of the polypropylene jars per sample. In addition to photos of the top surface of the mortar in each container, the exterior temperature of the cement, taken on the bottom of the container, and Humbolt J-4134 Penetrometer readings of the surface of the mortar were taken daily for ten consecutive days. The photos are located in Attachment A, and the data is located in Attachment B. After the ten days, the cements were crushed into particles less than a 10- mesh. When crushing the cements, it was noted that only Cement 6 and 7 required the jaw crusher. Cements 8 through 15 were able broken up with a hammer then crushed by pestle or by hand (Image 1 & 2). These cements still contained moisture that caused them to smear inside the jaw crusher rather than crushing. A strong ammonia odor was also given off by Cements 8 through 15 as they were being broken up. LANL was notified about the "soft-setting" cement issue, and we were instructed to continue with the analyses.

Blends 17 though 22 were made by first preparing large batches of dried 1:1, 1:3, and 1:4 WB8/Swheat mixtures. The mixtures were dried on a hotplate at 60-65°C with periodically mixing until the desired dryness was achieved, which was longer greater than 24 hours. These Swheat/WB8 mixtures were then added to the required amount of water and mixed for 5 minutes before being measured and added to zeolite. After adding the zeolite, the blends were allowed to sit for 24 hours prior to analysis. The 2:1 WB8/Swheat mixture required for Blends 23 though 25 was also dried on a hotplate at 60-65°C with periodic mixing until the desired dryness was achieved. Since this WB8/Swheat was moister than the 1:1, the drying took more than 10 days to achieve the desired dryness.

Table 1. Surrogate preparation and analysis table

Surrogate ID	Times made	Methods		
		1030	1050	UN Ox
Cement 6	1	*	*	1
Cement 7	1	*	*	1
Cement 8	1	1	1	1

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Table 1. (continued)

Surrogate ID	Times made	Methods		
		1030	1050	UN Ox
Cement 9	1	1	1	1
Cement 10	1	1	1	1
Cement 11	1	1	1	1
Cement 12	1	1	1	1
Cement 13	1	1	1	1
Cement 14	1	1	1	1
Cement 15	1	1	1	1
Blend 17	1	1	1	1
Blend 18	1	1	1	1
Blend 19	1	1	1	1
Blend 20	1	1	1	1
Blend 21	1	1	1	1
Blend 22	1	1	1	1
Blend 23	1	1	1	1
Blend 24	1	1	1	1
Blend 25	1	1	1	1

*Testing not required for these methods.

SW-846 1030: Ignitability of Solids

The surrogate material was formed into an unbroken powder train, 250 mm in length. An ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within 2 minutes. If the material combustion propogated, the burning time was measured over a distance of 100 mm and the rate of burning would be determined. The samples were then placed onto a ceramic tile with marks at the 80 and 180 mm in from the end of the train. The ceramic tile was placed about 8 inches in a hood with the sash lowered to give an airflow of about 0.7 m/sec. One end of the train was exposed to the end of a acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes and if the sample began to burn down the train the time taken to get from the 80 to 180 mm mark was measure to determine the burn rate.

Cements 8 though 15 did not burn past the point of the flame and are all considered to be non ignitable. The area being burned changed in color from darker wet looking cement to different shades of brown and grey (Image 3). Little activity occurred during the 2 minute burn period. Blends 17 though 24 did not burn past the point of the flame but as the test was being performed the nitrates would make popping sounds and sparks would shoot off every now and then from the sample. After the burn period the burn area was whitened, grayed, and blackened (Image 4). Blend 25 mainly ashed and bubbled in the area of heating but it did not propagate past that point (Image 5). Since none of the blends even burned into the 100mm zone all of them are considered non-flammable under the test conditions and criteria outlined in Method 1030.

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Fine Excelsior (natural hardwood shavings) were used as a positive control each day testing was performed.

SW-846 1050: Spontaneous combustion and self heating

The surrogates for this analysis were first sprinkled several times onto a ceramic tile to observe if they smoked or flamed and could be considered pyrophoric solids by test Method A. Since none of the samples exhibited these characteristics, they were tested by Method C. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200C within the 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 2.

Table 2. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cube was placed into an oven with two thermocouples measuring the oven temp and up to four thermocouples inserted into each sample to measure its temperature during the analysis. Lids were placed onto the top of the later test cubes and tungsten weights were placed on top to keep the thermocouples and lids from coming off the sample in case an event occurred. Also two thermocouples were placed in a tray below the sample in case any sample pushed out of the cube and onto the tray. The Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for 24-48 hours depending on when the sample reached temperature. Although the method states testing to be conducted for 24 hours, many of the samples not reaching 140°C ± 2°C during the initial 24 hour period, therefore the testing was extended to a minimum of 12 hours after the sample had reached temperature. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C during the time of testing. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample. The oven and sample temperature graphs are located in Attachment C.

Cements 8 though 15 were analyzed two at a time since they were not expected to have any violent reactions during analysis. It took around 24 hours for the cements to get to temperature due to the amount of moisture that was still present throughout the samples. At the end the test, it was noted the when from a moist dark grey cement to dry light grey cement. It was also noticed that there was a slight reduction in sample volume during the cement analysis. Therefore, all cement analysis carried on for at least 40 hours (Figure 1 though 8 in Attachment C). Since none of the cements exceeded 200°C during the analysis all cements were classified as “Not a Self-Heating Waste” as defined by Method 1050.

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Blends 17 though 24 were also analyzed two samples at a time since prior blends with zeolite showed no reactions taking place during analysis. Since the zeolite blends had moisture present in them they were tested for at a minimum of 40 hours as well in order to ensure that no self heating occurred after the samples reach temperature (Figure 9 through 16 in Attachment C). Blend 17 and Blend 24 post-test solidified in the cube and had to be broken apart to remove from the cube (see Image 6). Since none of these blends exceeded 200°C during the course of the analysis they were classified as "Not a Self-Heating Waste" as defined by Method 1050.

Blend 25 had a similar formula to a prior sample that was self-heating and burned during analysis. Therefore, the 25mm cube test was performed first in duplicate. This initial analysis showed the samples expand out of the cube and darken in color (Images 7 and 8). Since temperatures of the 25 mm cubes did not exceed 200°C (Figure 17 in Attachment C), the 100mm cube was tested with four thermocouples. At approximately an hour and a half into the test, when the sample temperature reached (60-70 ^{o}C), the recorded temperatures became erratic and thermocouples placed in the bottom tray of the oven recorded a slight temperature decrease, indicating the sample material had spilled out of the sample cube. As the temperature of the sample was reaching 140°C, an event occurred causing the thermocouples in the sample and in the oven to exceed 550°C (Figure 18 in Attachment C). Black smoke and a few flames shot out of the back vents of the oven. At this point, the oven was turned off and the analysis was ended. When the sample was removed from the oven, the material did not appear charred but did have an ash-like consistency, (Images 9 and 10). Since this Blend 25 was positive for the 100mm cube test, but negative of the 25mm cube it is given a "DOT Packing Group III" classification.

DOT UN Oxidation testing

The cement and blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the samples mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. If the burning time is less than the standard mixture, the burning times should be compared with those from packing group I or II or category I or II oxidizer, reference standards 3:2 and 2:3, by mass, of potassium bromated to cellulose, respectively. See Table 3 for classification. Table 4 presents the results for the reference standards. Tables 5 and 6 lists the comments the analyst noted for each of the two sample to cellulose ratio burns.

All cements and blends, with the exception of Blend 25, were classified as "Not Division 5.1". Blend 25 was classified as "Packing group II".

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Table 3. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	UN Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

Table 4. Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
113.57	54.09	19.44

Table 5. Comments for Sample to Cellulose ratio of 4:1

Sample ID	Comment 4:1
Cement 6	no flame, light smoke, charring near ignition source.
Cement 7	no flame, light smoke, charring near ignition source.
Cement 8	no flame, light smoke, charring near ignition source.
Cement 9	no flame, light smoke, charring near ignition source.
Cement 10	no flame, light smoke, charring near ignition source.
Cement 11	no flame, light smoke, charring near ignition source.
Cement 12	no flame, light smoke, charring near ignition source.
Cement 13	no flame, light smoke, charring near ignition source.
Cement 14	no flame, light smoke, charring near ignition source.
Cement 15	no flame, light smoke, charring near ignition source.
Blend 17	no flame, light smoke, charring near ignition source.
Blend 18	no flame, light smoke, charring near ignition source.
Blend 19	no flame, light smoke, charring near ignition source.
Blend 20	charring near ignition wire, spontaneous flames and sparking, light smoke
Blend 21	no flame, light smoke, charring near ignition source.
Blend 22	no flame, light smoke, charring near ignition source.
Blend 23	charring, spontaneous flames and sparking near ignition wire, light smoke. Power turned off reaction stopped
Blend 24	charring, spontaneous flames and sparking near ignition wire, light smoke. Power turned off reaction stopped
Blend 25	Lots of sparking and some flames. Violent reaction. Ignition wire broke on all around same spot

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Table 6 Comments for Sample to Cellulose ratio of 1:1

Sample ID	COMMENT 1:1
Cement 6	no flame, light smoke, charring near ignition source.
Cement 7	no flame, light smoke, charring near ignition source.
Cement 8	low flame and charring near ignition source, some smoke, smoldering. Flame didn't propagate and extinguished when power turned off at 180sec
Cement 9	low flame and charring near ignition source, some smoke, smoldering. Flame didn't propagate and extinguished when power turned off at 180sec
Cement 10	low flame and charring near ignition source, some smoke, smoldering. Flame didn't propagate and extinguished when power turned off at 180sec
Cement 11	low flame and charring near ignition source, some smoke, smoldering. Flame didn't propagate and extinguished when power turned off at 180sec
Cement 12	low flame and charring near ignition source, some smoke, smoldering. Flame didn't propagate and extinguished when power turned off at 180sec
Cement 13	low flame and charring near ignition source, some smoke, smoldering. Flame didn't propagate and extinguished when power turned off at 180sec
Cement 14	low flame and charring near ignition source, some smoke, smoldering. Flame didn't propagate and extinguished when power turned off at 180sec
Cement 15	low flame and charring near ignition source, some smoke, smoldering. Flame didn't propagate and extinguished when power turned off at 180sec
Blend 17	no flame, charring near ignition source, more smoke produced than 4:1 ratio but still light smoke
Blend 18	Reps 1,4 &5 had a low flame propagate. Reps 2 &3 low flame and charring around ignition source. All flames extinguished soon after power was turned off
Blend 19	Reps 1 &4 charring only near ignition source. Reps 2&5 low flames and charring at ignition source. Rep 3 flame propagated. Reactions stoppped soon after power was turning off.
Blend 20	low flame and charring near ignition source, smoke, smoldering. Rep 2 had flames produce away from the ignition source at ~170secs.
Blend 21	low flame and charring near ignition source. Reps 1, 3, and 5 continued to burn beyond >240sec and reps. 2 and 4 burned >180sec but <240sec
Blend 22	low flame and charring near ignition source. Reps 2 and 4 continued to burn beyond >240sec and reps. 1,2 and 5 burned >180sec but <240sec
Blend 23	low flame and charring near ignition source, some smoke, smoldering. Power turned off at 180sec., reps 1,3,4 and 5 burned >240sec., rep 2 >180 but <240sec
Blend 24	flames and charring near ignition source, some smoke. Reps. 2-4 extiguished soon after power turned off. Reps 1 and 5 flames proagated after power off
Blend 25	Flames and sparking. Sample fully burned, reaction stopping point more apparent vs. 4:1 ratio. Wire did not break

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Image 1: (Cement #15) Example of Cement 8 though 15 being split with a hammer.



Image 2: (Cement #15) Example of Cement 8 though 15 being crush up by hand after splitting with a hammer.

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Image 3: (Cement #10) Flame region of the sample after 2 minute 1030 burn period.



Image 4: (Blend 18) Flame region after testing wash blackened, grayed, and whitened.

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Image 5: Blend 25 ashed burn point after 2 minute 1030 burn.



Image 6: Blend 17 after 1050 analysis.

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Image 7: Blend 25 in 25mm cubes prior to 1050 analysis.



Image 8: Blend 25 in 25mm cubes after 1050 analysis.

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Image 9: Blend 25 after event in the hood.

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Image 10: Sample 25 capture tin and oven after analysis in 100mm cube.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 151222-14

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Group Leader **Date** **01/25/16**

Attachment A

Daily Photos of Cement Curing



Image 1: Cement 6 Day 1



Image 2: Cement 6 Day 2



Image 3: Cement 6 Day 3



Image 4: Cement 6 Day 4

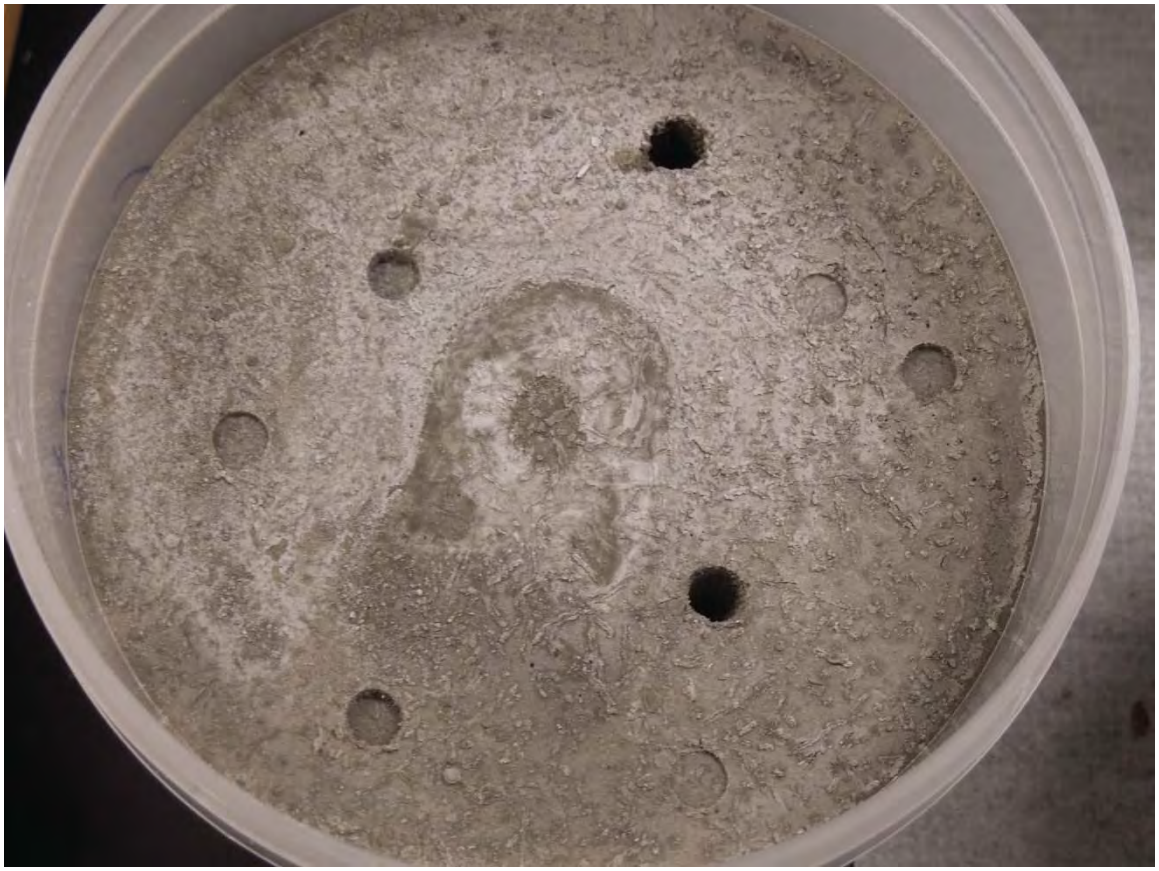


Image 5: Cement 6 Day 5



Image 6: Cement 6 Day 6



Image 7: Cement 6 Day 7



Image 8: Cement 6 Day 8

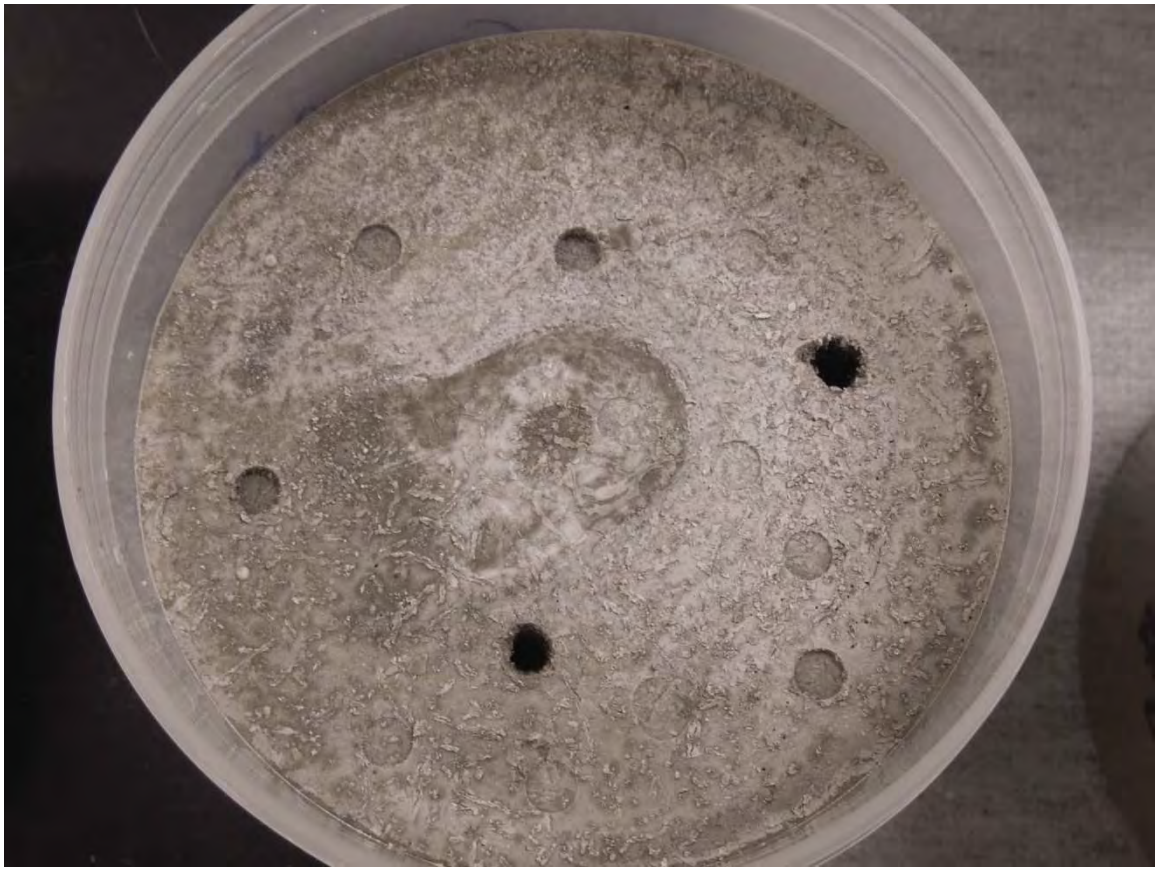


Image 9: Cement 6 Day 9

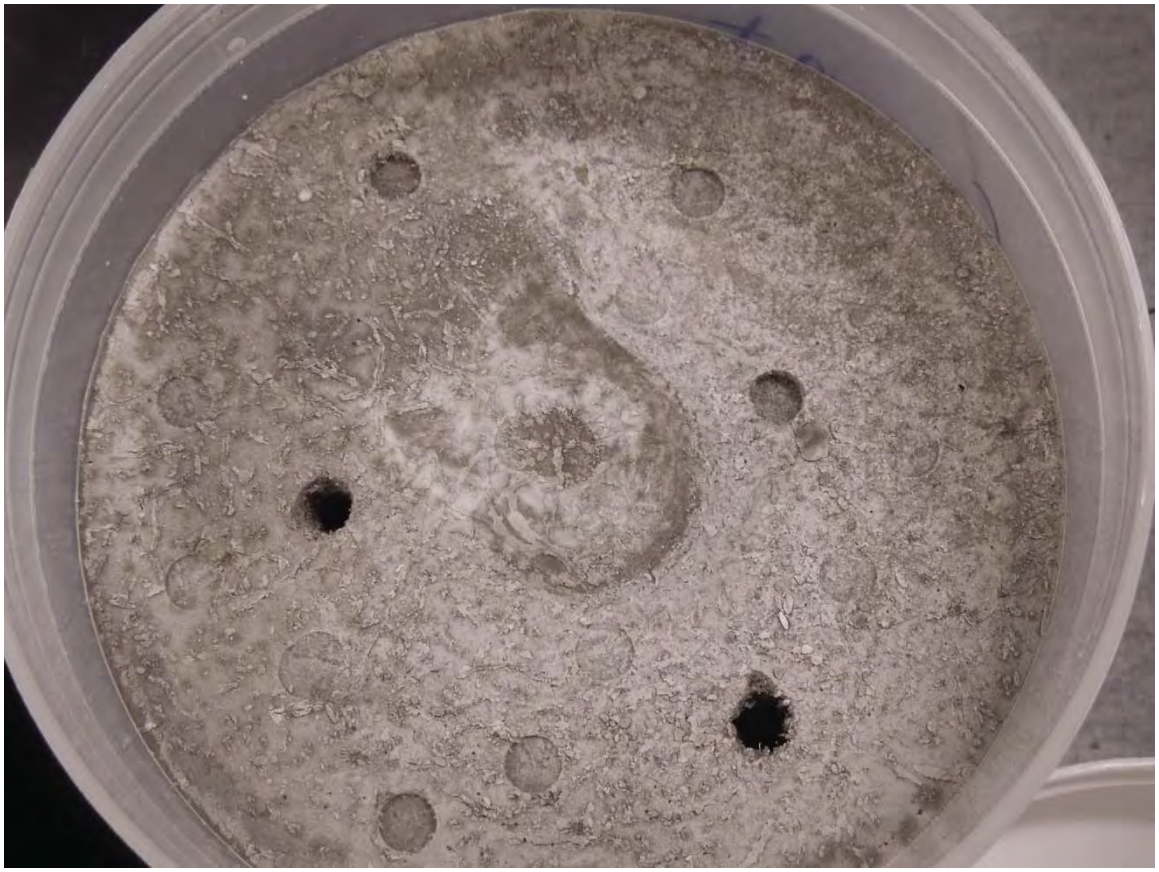


Image 10: Cement 6 Day 10



Image 11: Cement 7   Day 1



Image 12: Cement 7 Day 2



Image 13: Cement 7 Day 3

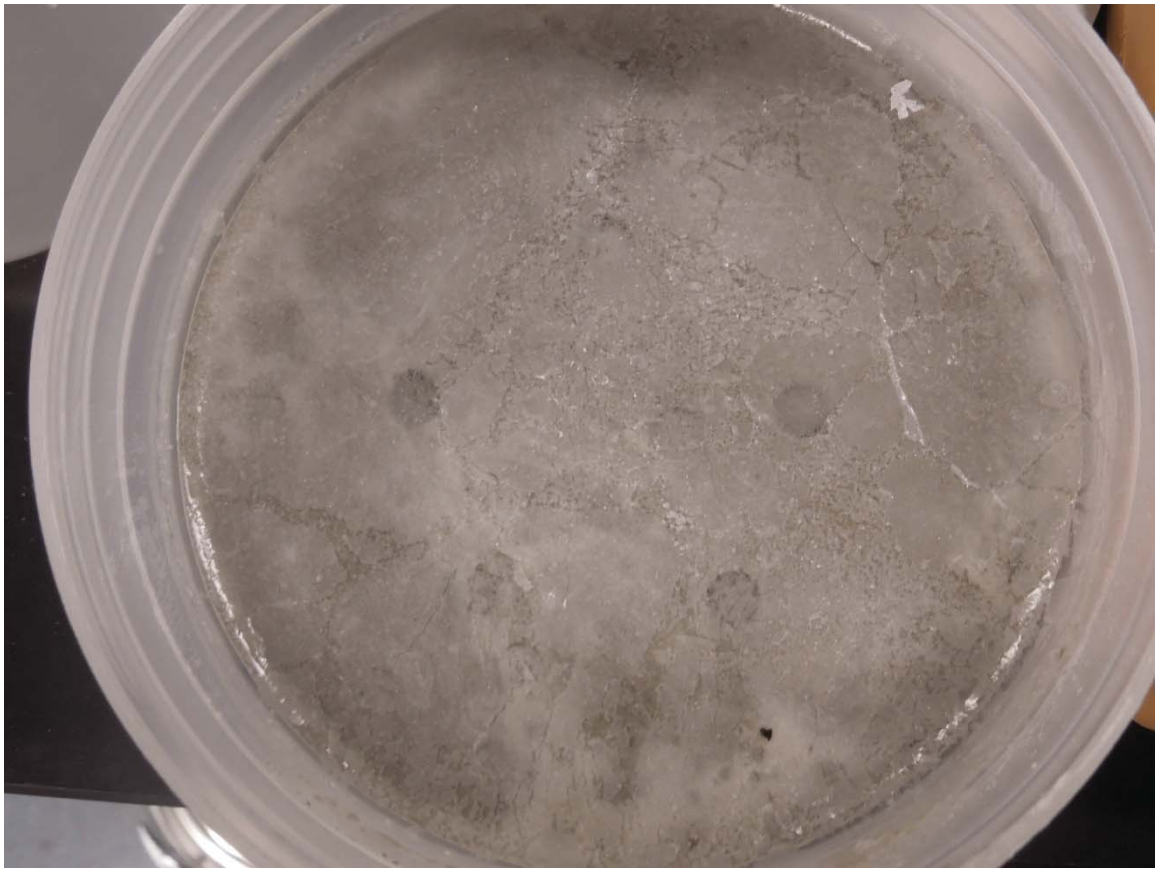


Image 14: Cement 7 Day 4

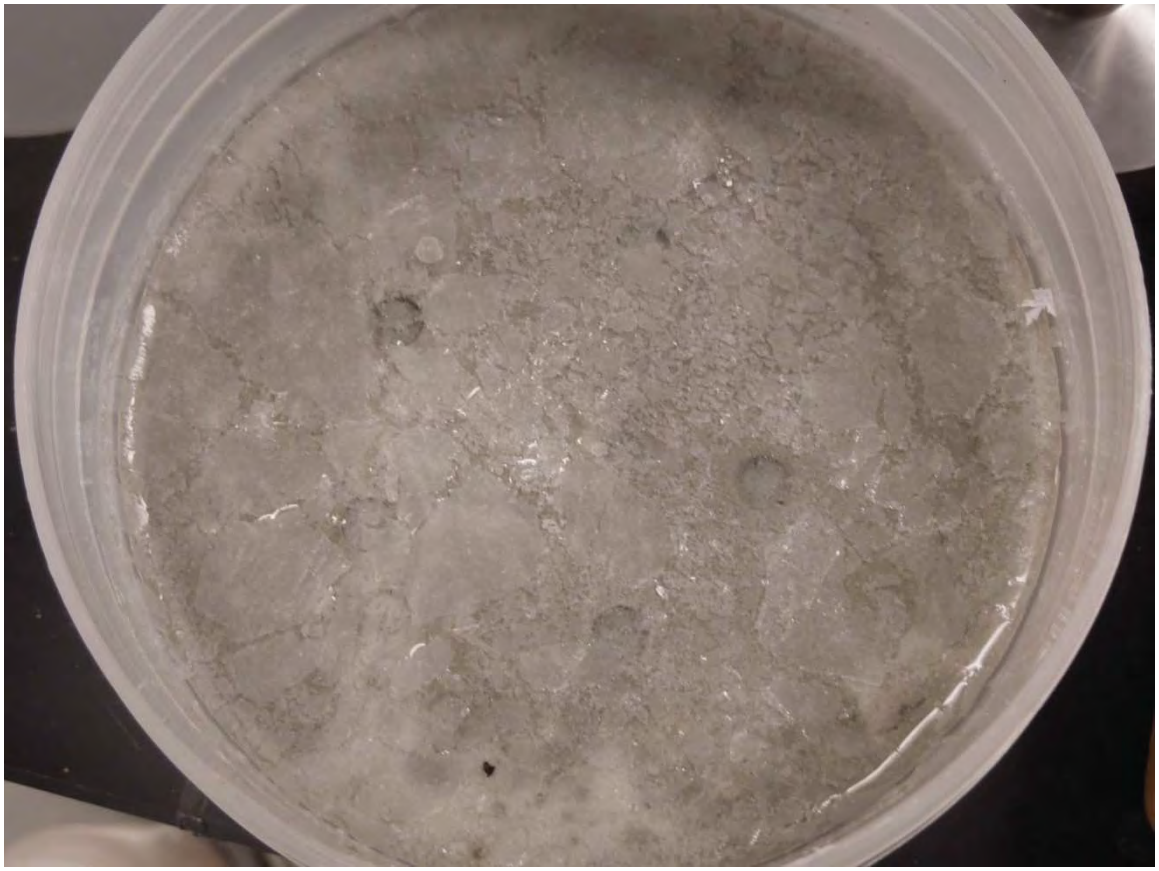


Image 15: Cement 7 Day 5



Image 16: Cement 7 Day 6



Image 17: Cement 7 Day 7

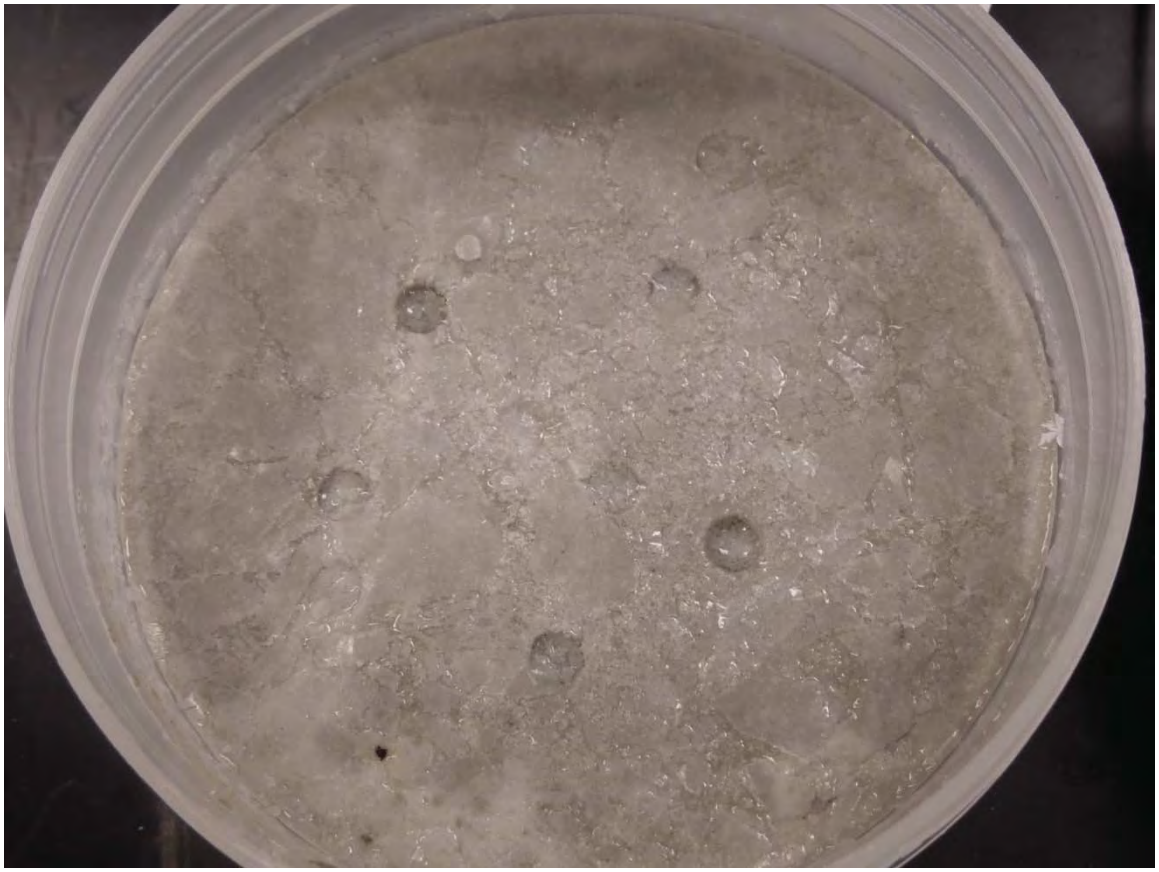


Image 18: Cement 7 Day 8

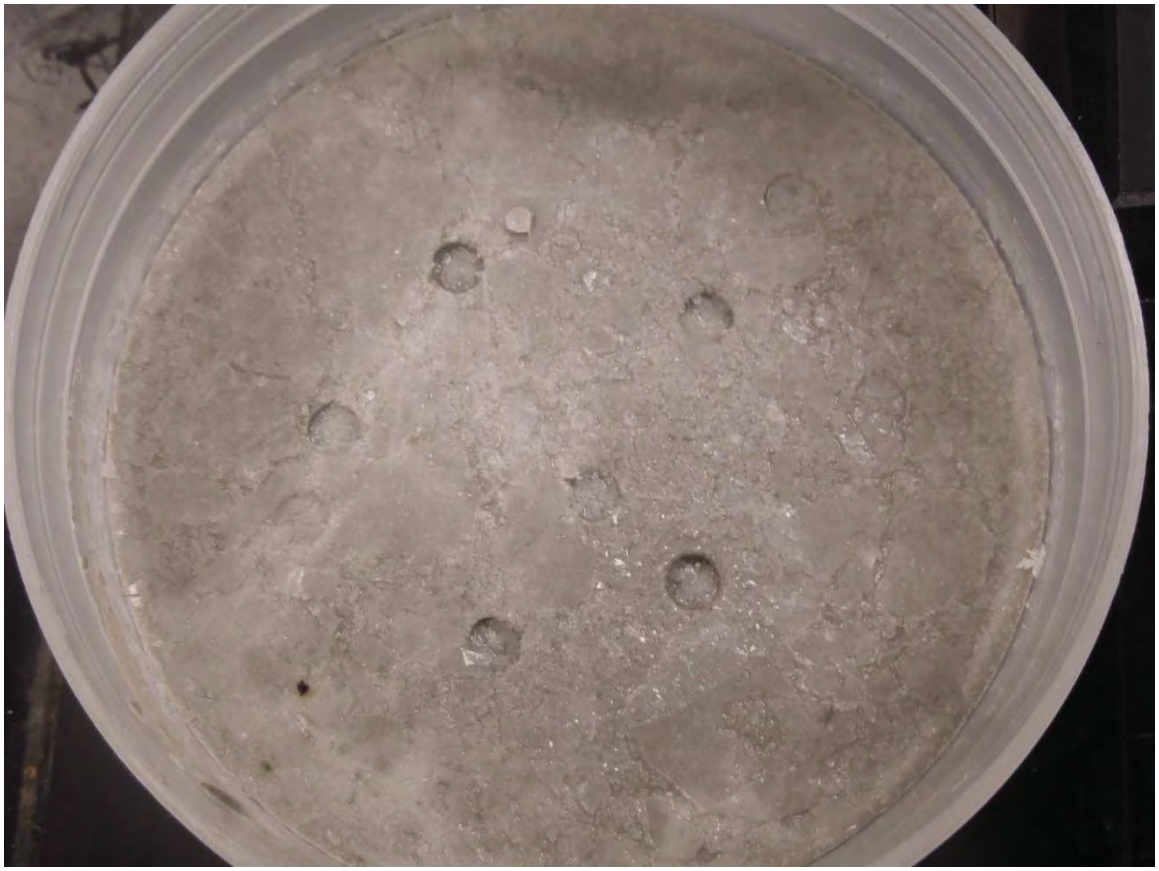


Image 19: Cement 7 Day 9



Image 20: Cement 7 Day 10

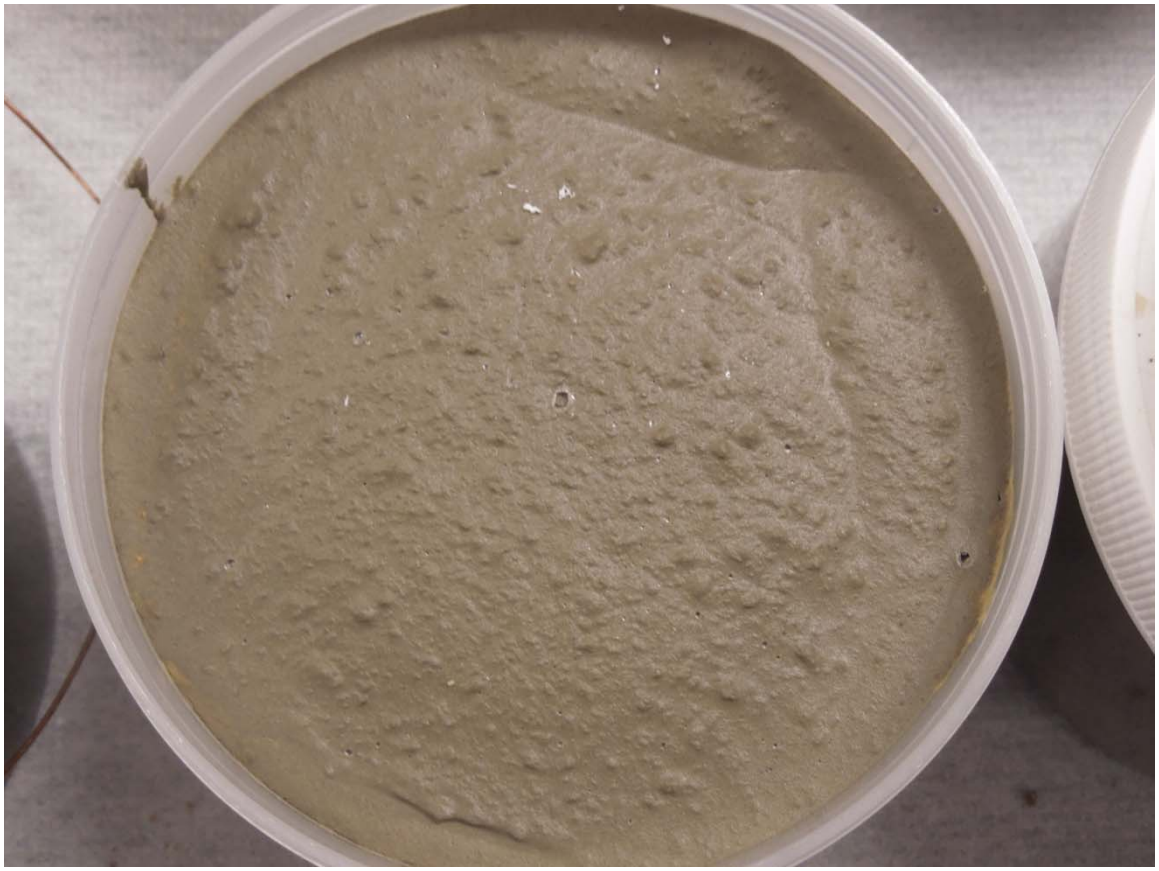


Image 21: Cement 8 Day 1



Image 22: Cement 8 Day 2

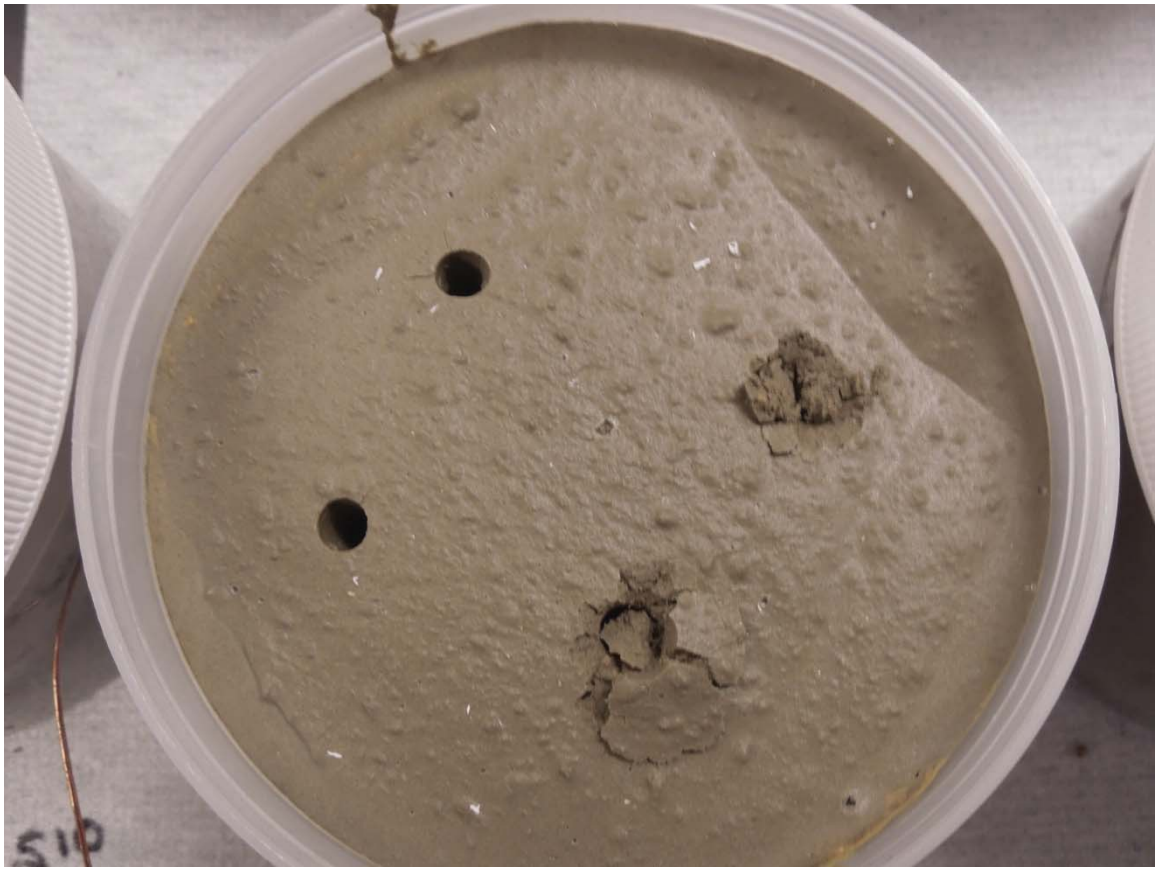


Image 23: Cement 8 Day 3



Image 24: Cement 8 Day 4



Image 25: Cement 8 Day 5



Image 26: Cement 8 Day 6



Image 27: Cement 8 Day 7



Image 28: Cement 8 Day 8



Image 29: Cement 8 Day 9



Image 30: Cement 8 Day 10



Image 31: Cement 9 Day 1



Image 32: Cement 9   Day 2



Image 33: Cement 9   Day 3



Image 34: Cement 9   Day 4



Image 35: Cement 9 Day 5



Image 36: Cement 9 Day 6



Image 37: Cement 9 Day 7



Image 38: Cement 9 Day 8

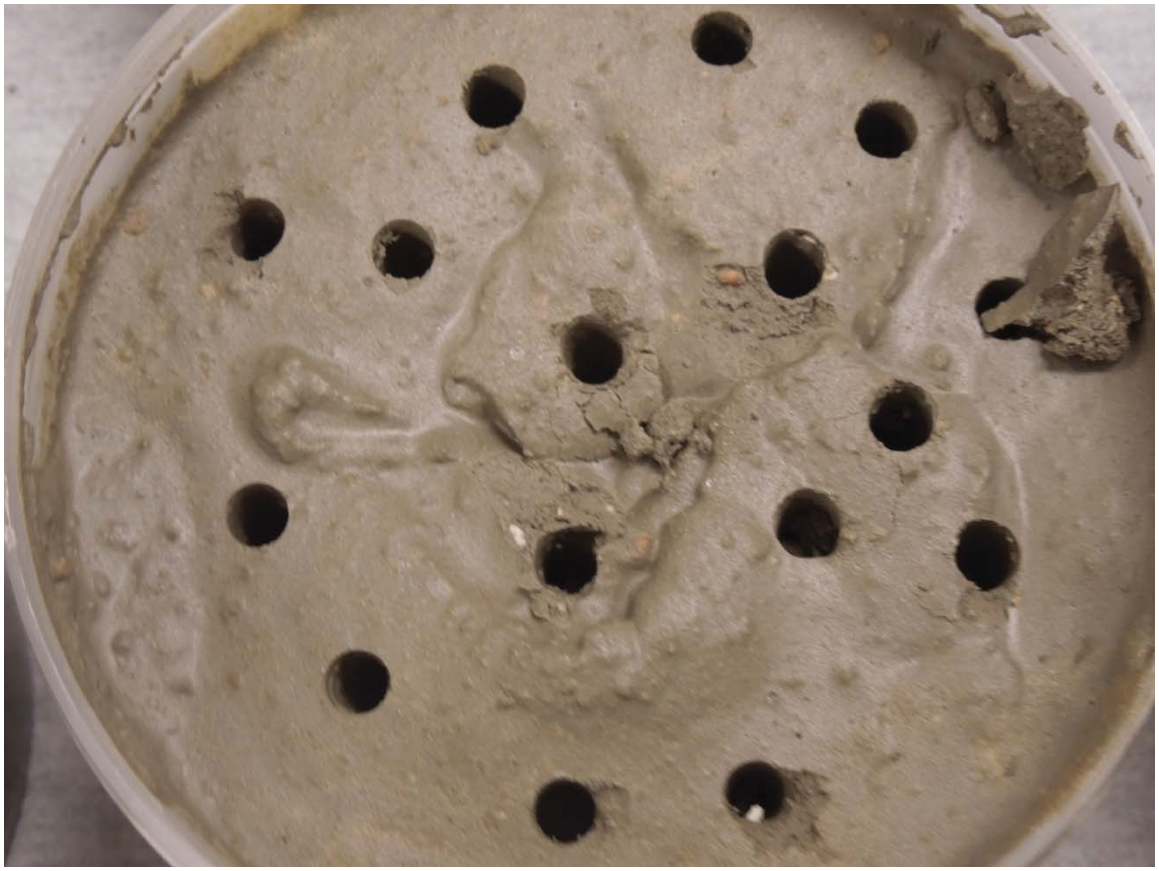


Image 39: Cement 9 Day 9



Image 40: Cement 9 Day 10



Image 41: Cement 10 Day 1



Image 42: Cement 10 Day 2



Image 43: Cement 10 Day 3



Image 44: Cement 10 Day 4



Image 45: Cement 10 Day 5



Image 46: Cement 10 Day 6



Image 47: Cement 10   Day 7



Image 48: Cement 10   Day 8



Image 49: Cement 10 Day 9



Image 50: Cement 10 Day 10



Image 51: Cement 11 Day 1



Image 52: Cement 11 Day 2



Image 53: Cement 11 Day 3



Image 54: Cement 11 Day 4



Image 55: Cement 11 Day 5



Image 56: Cement 11 Day 6



Image 57: Cement 11 Day 7



Image 58: Cement 11 Day 8



Image 59: Cement 11 Day 9



Image 60: Cement 11 Day 10



Image 61: Cement 12   Day 1



Image 62: Cement 12   Day 2



Image 63: Cement 12 Day 3



Image 64: Cement 12 Day 4



Image 65: Cement 12 Day 5



Image 66: Cement 12 Day 6



Image 67: Cement 12 Day 7



Image 68: Cement 12 Day 8



Image 69: Cement 12 Day 9



Image 70: Cement 12 Day 10



Image 71: Cement 13   Day 1



Image 72: Cement 13   Day 2



Image 73: Cement 13 Day 3



Image 74: Cement 13 Day 4



Image 75: Cement 13 Day 5



Image 76: Cement 13 Day 6



Image 77: Cement 13   Day 7



Image 78: Cement 13   Day 8



Image 79: Cement 13 Day 9



Image 80: Cement 13   Day 10



Image 81: Cement 14   Day 1



Image 82: Cement 14   Day 2



Image 83: Cement 14   Day 3



Image 84: Cement 14   Day 4



Image 85: Cement 14 Day 5



Image 86: Cement 14 Day 6



Image 87: Cement 14 Day 7



Image 88: Cement 14 Day 8



Image 89: Cement 14   Day 9



Image 90: Cement 14   Day 10



Image 91: Cement 15 Day 1



Image 92: Cement 15 Day 2



Image 93: Cement 15 Day 3



Image 94: Cement 15 Day 4



Image 95: Cement 15 Day 5



Image 96: Cement 15 Day 6



Image 97: Cement 15 Day 7



Image 98: Cement 15 Day 8



Image 99: Cement 15   Day 9



Image 100: Cement 15   Day 10

Attachment B

Daily Cement Curing Data

Daily Exterior Surface Temperature (bottom of container) and Penetrometer Readings for Cements

Day #	Room Temp	Cement #6		Cement #7		Cement #8 - 1		Cement #8 - 2	
	°C	°C	psi	°C	psi	°C	psi	°C	psi
1	21.1	22.3	515	22.2	> 700	21.3	30	21.2	20
2	20.2	21.2	> 700	21.3	> 700	21.0	50	20.8	60
3	20.7	21.3	> 700	21.4	> 700	21.1	125	20.9	125
4	21.4	21.6	> 700	21.6	> 700	21.6	345	21.5	390
5	21.2	21.6	> 700	21.6	> 700	21.4	535	21.3	550
6	21.1	21.5	> 700	21.5	> 700	21.4	610	21.3	610
7	21.2	21.2	> 700	21.2	> 700	21.2	650	21.1	665
8	21.1	21.2	> 700	21.2	> 700	21.1	650	21.0	670
9	20.5	21.0	> 700	21.0	> 700	20.9	660	21.0	660
10	20.8	21.0	> 700	21.0	> 700	20.9	670	20.9	655

Day #	Room Temp	Cement #9 -1		Cement #9 -2		Cement #10 -1		Cement #10 -2	
	°C	°C	psi	°C	psi	°C	psi	°C	psi
1	21.1	21.2	105	21.1	100	21.3	405	21.1	380
2	20.2	21	215	20.8	210	20.9	575	20.7	530
3	20.7	21	420	20.8	410	20.8	665	20.8	690
4	21.4	21.4	550	21.3	560	21.4	695	21.2	690
5	21.2	21.3	654	21.3	625	21.3	700	21.2	> 700
6	21.1	21.4	670	21.3	630	21.3	> 700	21.2	> 700
7	21.2	21.1	670	21.1	650	21.1	> 700	21.1	> 700
8	21.1	21.1	690	21.1	670	21.1	> 700	21.0	> 700
9	20.5	21.0	695	21.0	690	20.9	> 700	20.9	> 700
10	20.8	20.9	695	20.9	695	20.8	> 700	20.8	> 700

Day #	Room Temp	Cement #11 -1		Cement #11 -2		Cement #12-1		Cement #12-2	
	°C	°C	psi	°C	psi	°C	psi	°C	psi
1	21.1	21.4	655	21.2	595	21.2	> 700	21.1	> 700
2	20.2	20.9	700	20.7	700	20.9	> 700	20.7	> 700
3	20.7	20.9	> 700	20.8	> 700	20.9	> 700	20.8	> 700
4	21.4	21.3	> 700	21.2	> 700	21.4	> 700	21.3	> 700
5	21.2	21.3	> 700	21.2	> 700	21.3	> 700	21.2	> 700
6	21.1	21.3	> 700	21.2	> 700	21.3	> 700	21.2	> 700
7	21.2	21.1	> 700	21.0	> 700	21.1	> 700	21.1	> 700
8	21.1	21.0	> 700	21.1	> 700	21.1	> 700	21.1	> 700
9	20.5	20.8	> 700	20.9	> 700	20.8	> 700	20.8	> 700
10	20.8	20.8	> 700	20.9	> 700	20.9	> 700	20.9	> 700

Daily Exterior Surface Temperature (bottom of container) and Penetrometer Readings for Cements

Day #	Room Temp	Cement #13-1		Cement #13-2		Cement #14-1		Cement #14-2	
	°C	°C	psi	°C	psi	°C	psi	°C	psi
1	21.1	21.2	20	21.4	20	21.2	450	21.1	425
2	20.2	20.8	50	20.8	45	20.9	560	20.8	560
3	20.7	21.0	115	20.8	125	20.9	655	20.8	640
4	21.4	21.6	290	21.5	330	21.4	695	21.3	695
5	21.2	21.4	440	21.3	500	21.3	> 700	21.3	700
6	21.1	21.3	595	21.2	575	21.3	> 700	21.3	700
7	21.2	21.1	605	21.1	615	21.1	> 700	21.1	690
8	21.1	21.1	660	21.1	635	21.1	> 700	21.0	695
9	20.5	20.8	660	20.8	645	20.8	> 700	20.7	> 700
10	20.8	20.9	660	20.9	665	20.9	> 700	20.9	> 700

Day #	Room Temp	Cement #15-1		Cement #15-2	
	°C	°C	psi	°C	psi
1	21.1	21.4	520	21.3	530
2	20.2	21.0	700	20.9	> 700
3	20.7	20.9	> 700	20.9	> 700
4	21.4	21.4	> 700	21.3	> 700
5	21.2	21.3	> 700	21.2	> 700
6	21.1	21.3	> 700	21.3	> 700
7	21.2	21.1	> 700	21.1	> 700
8	21.1	21.1	> 700	21.1	> 700
9	20.5	20.9	> 700	20.9	> 700
10	20.8	20.9	> 700	20.9	> 700

Attachment C

Method 1050 Graphs

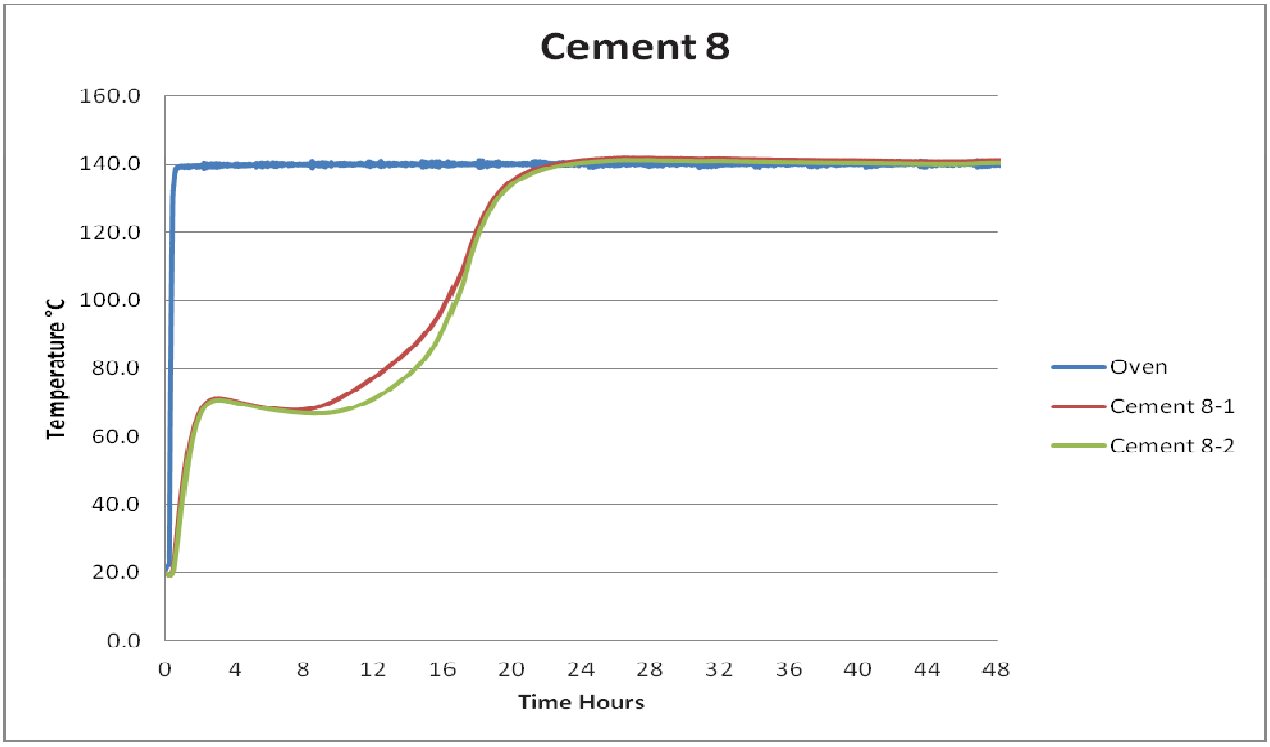


Figure 1. Method 1050 – Temperature of Cement 8 (100 mm cube) after ten days of setting and observations.

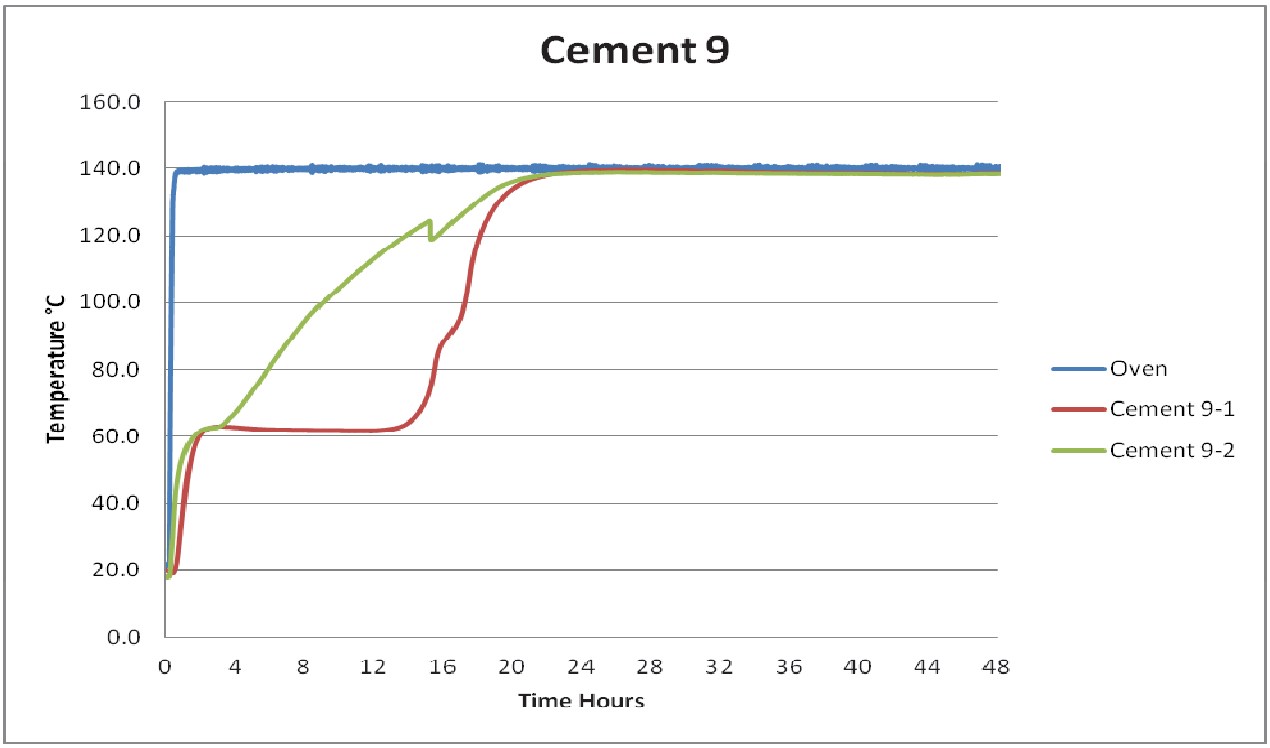


Figure 2. Method 1050 – Temperature of Cement 9 (100 mm cube) after ten days of setting and observations.

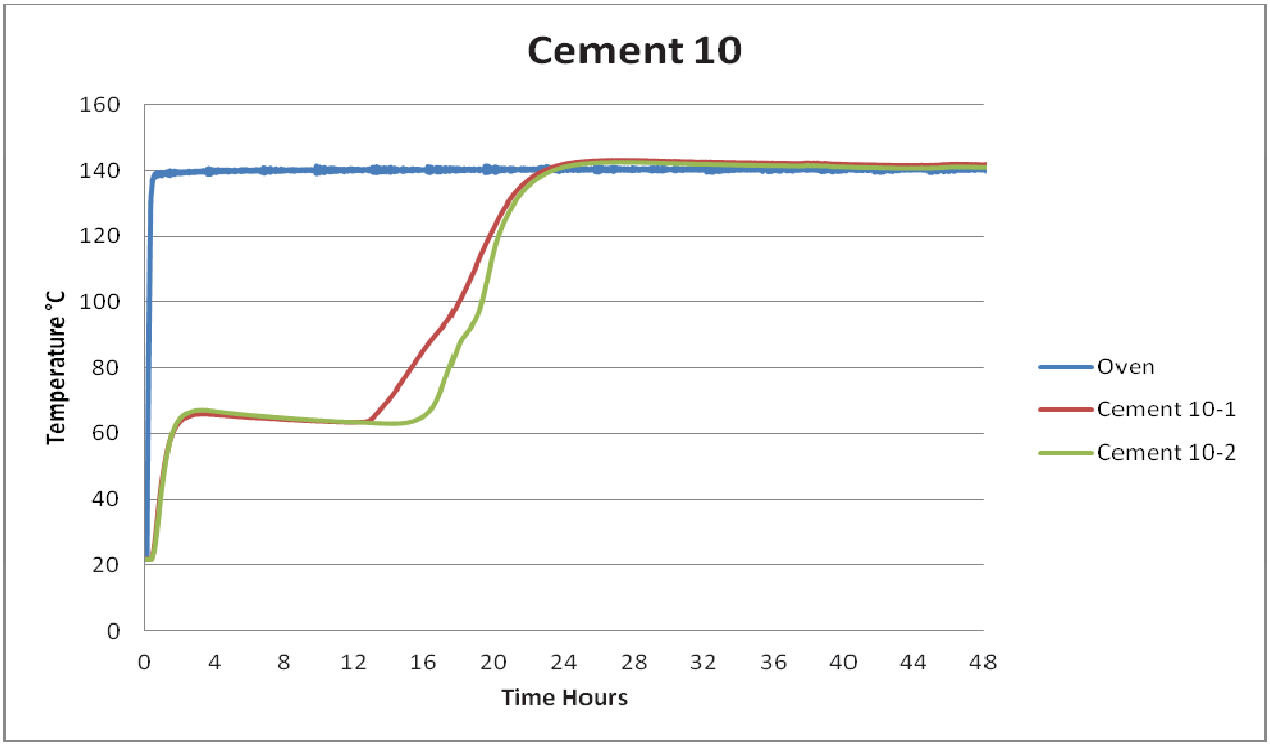


Figure 3. Method 1050 – Temperature of Cement 10 (100 mm cube) after ten days of setting and observations.

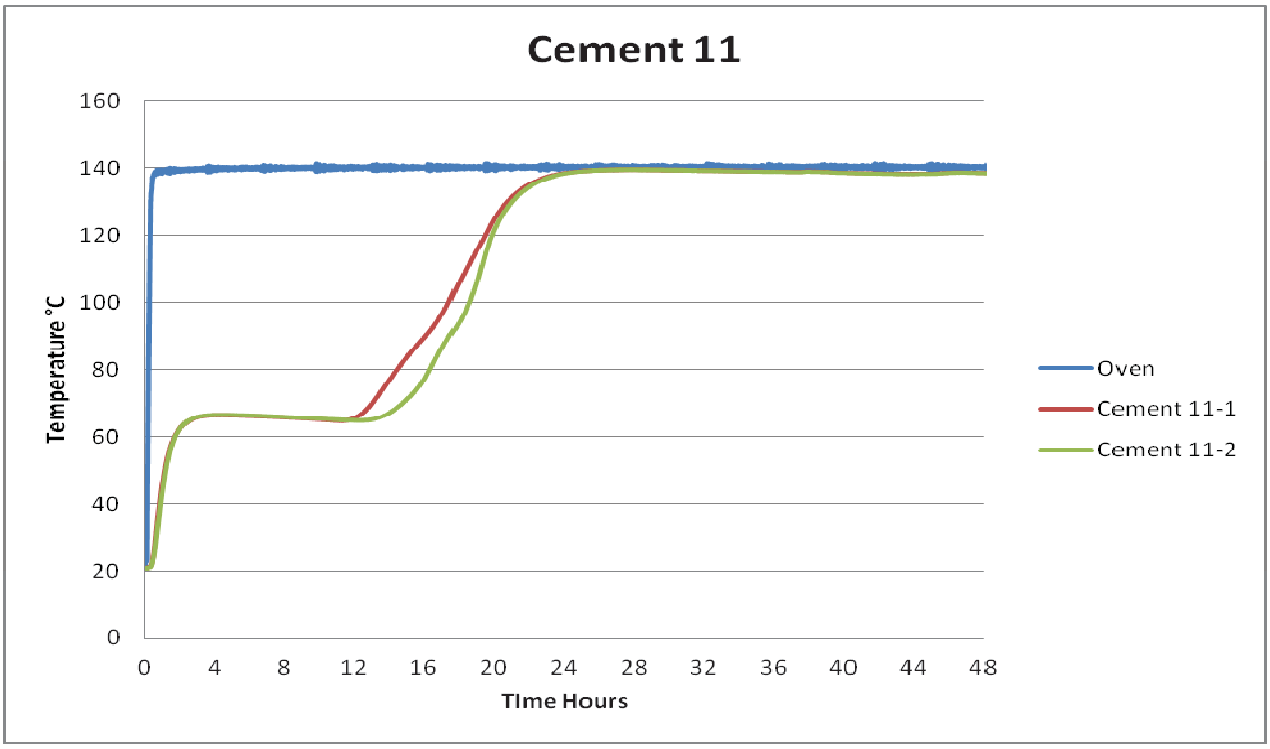


Figure 4. Method 1050 – Temperature of Cement 11 (100 mm cube) after ten days of setting and observations.

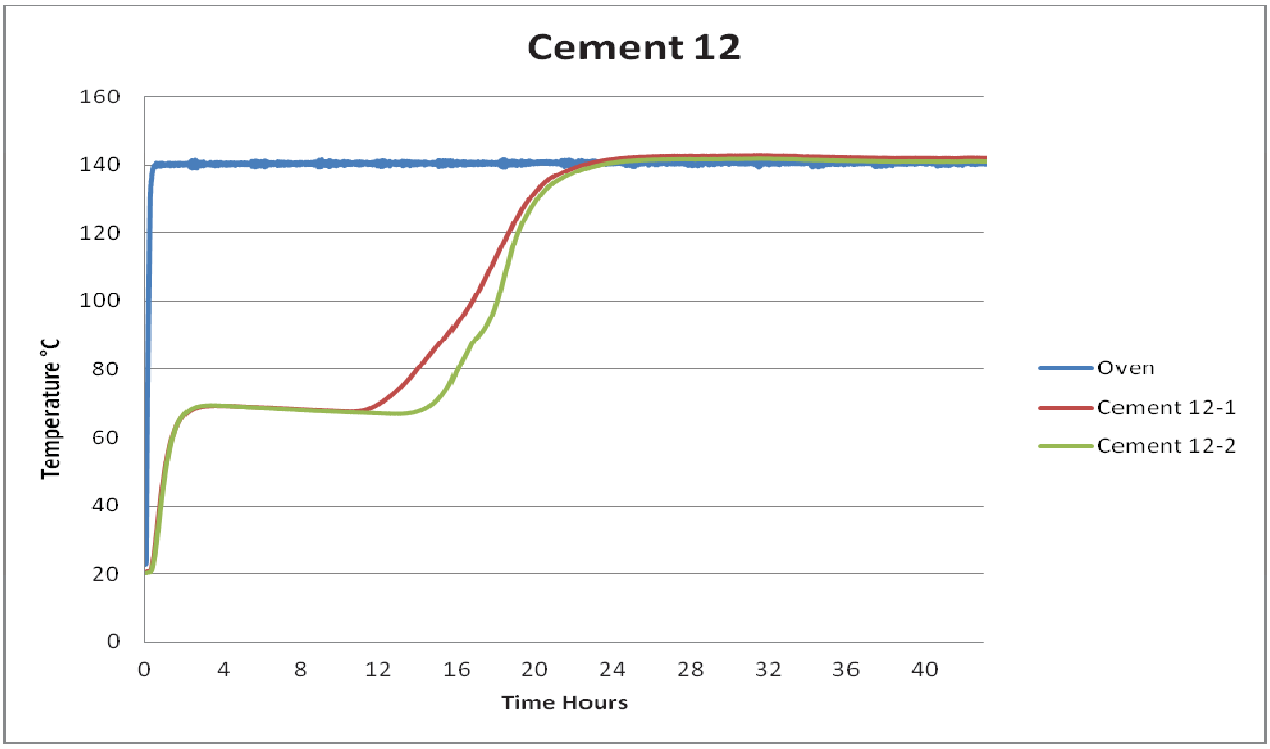


Figure 5. Method 1050 – Temperature of Cement 12 (100 mm cube) after ten days of setting and observations.

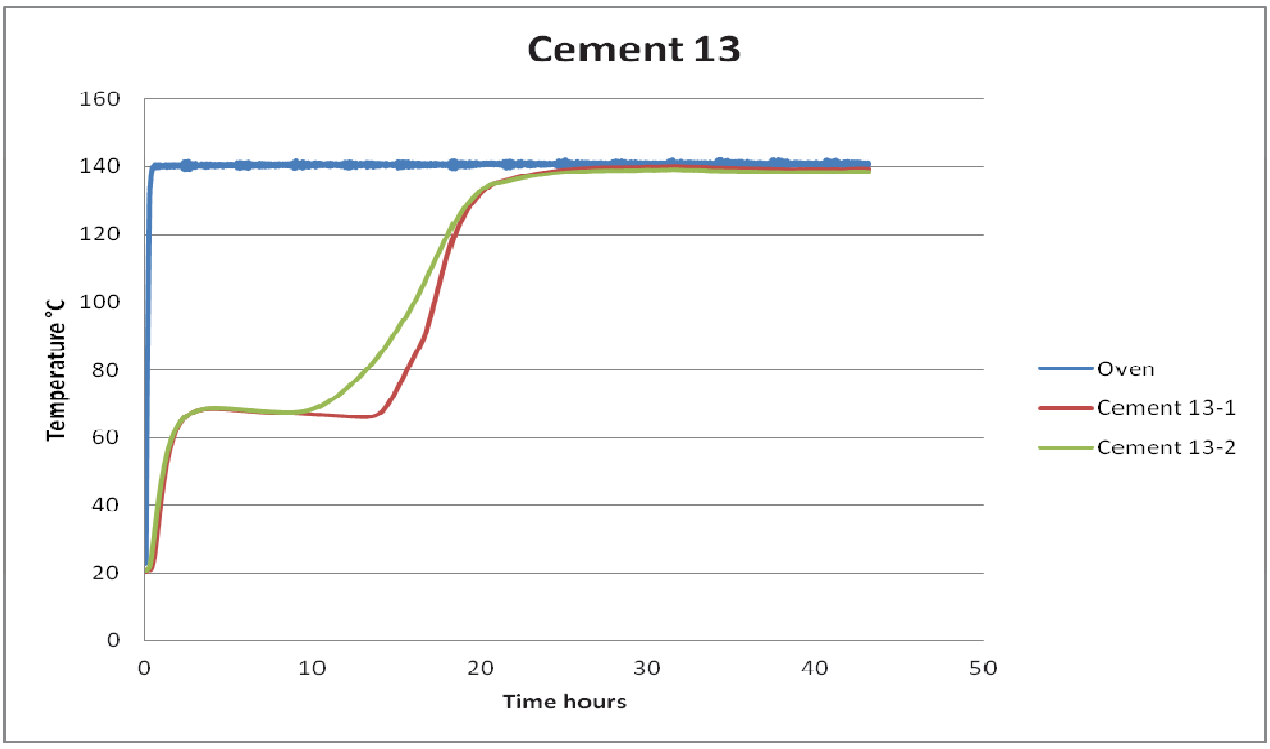


Figure 6. Method 1050 – Temperature of Cement 13 (100 mm cube) after ten days of setting and observations.

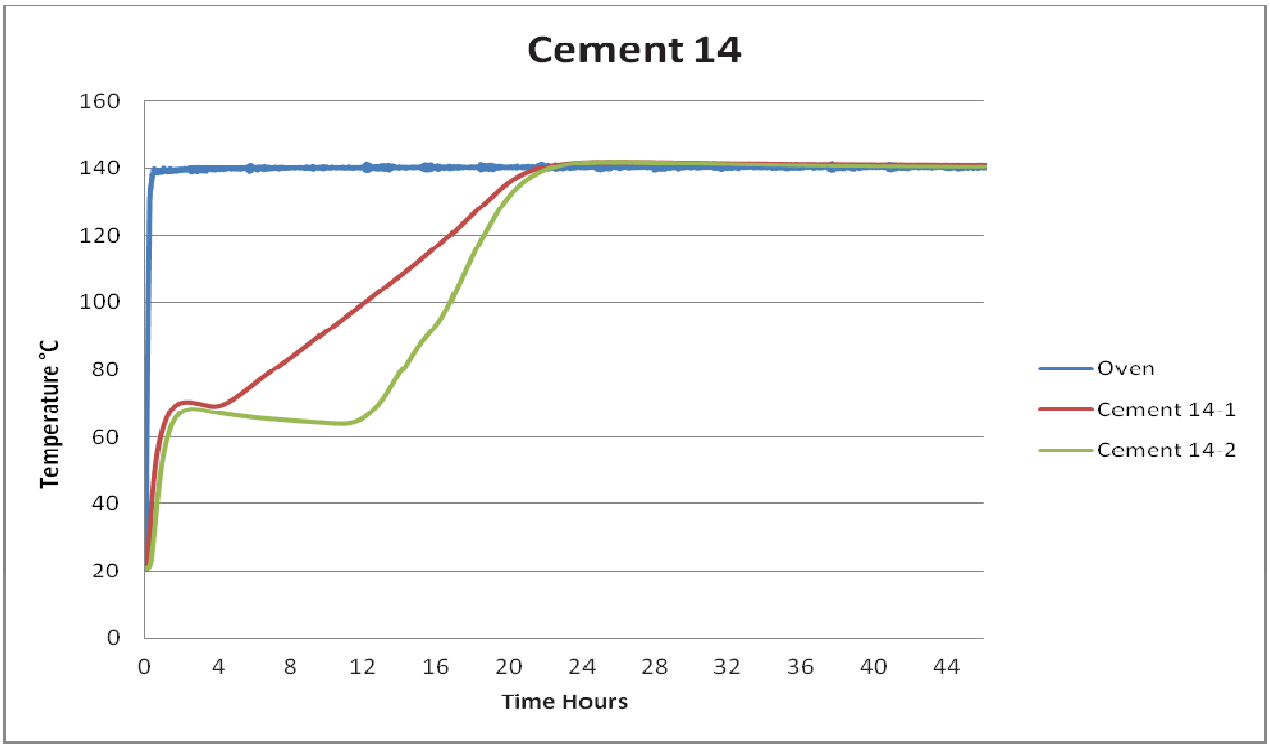


Figure 7. Method 1050 – Temperature of Cement 14 (100 mm cube) after ten days of setting and observations.

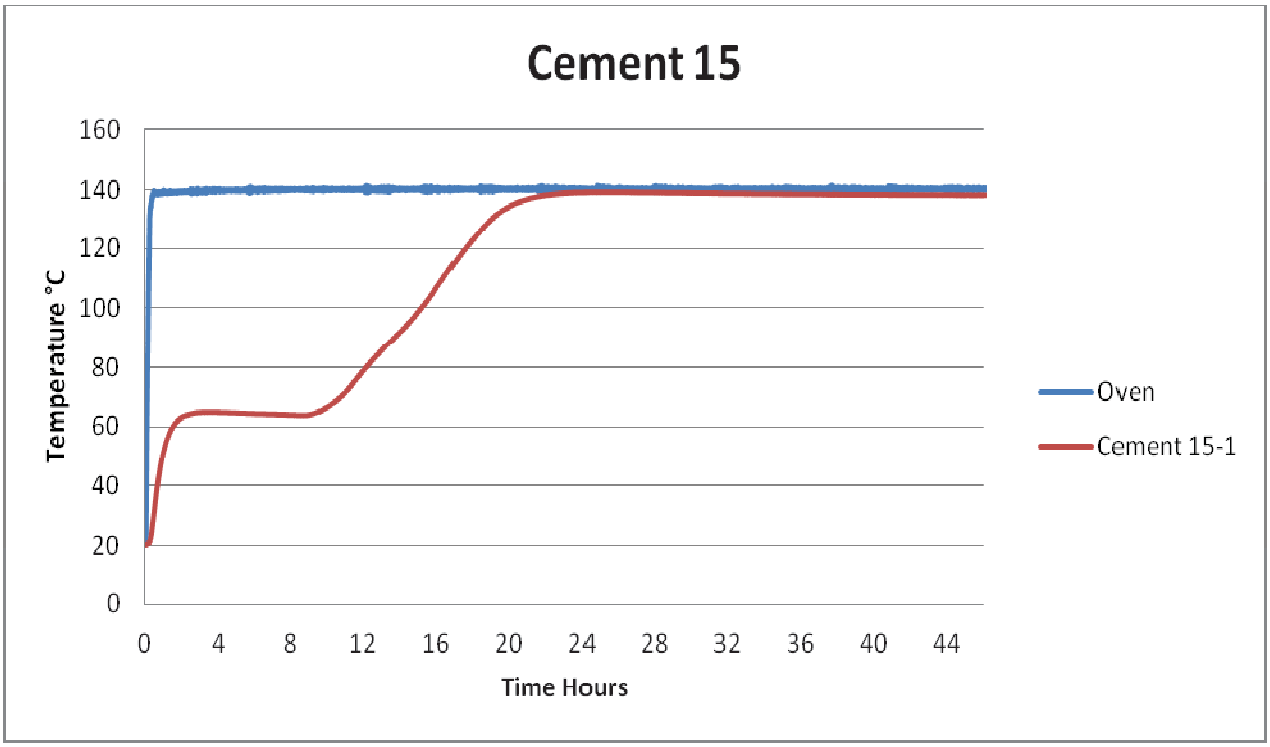


Figure 8. Method 1050 – Temperature of Cement 15 (100 mm cube) after ten days of setting and observations. One thermocouple came out of the sample during the analysis so only data from the one was used.

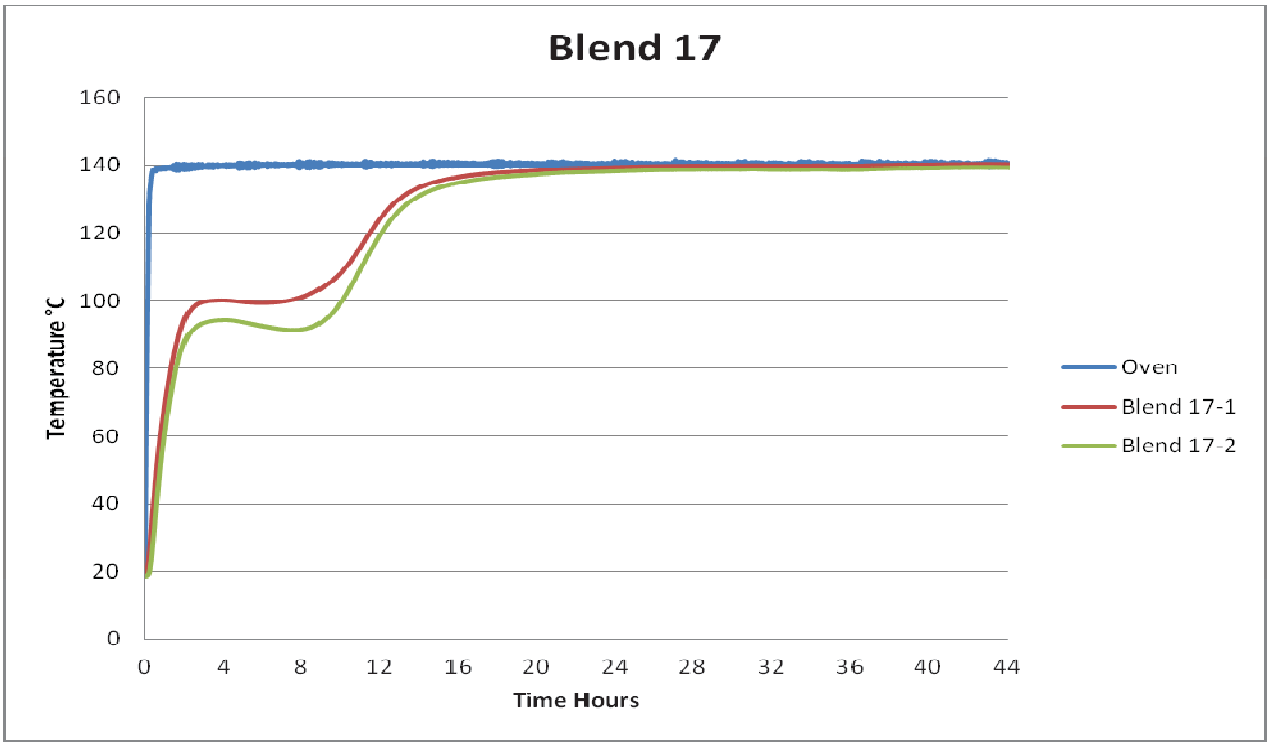


Figure 9. Method 1050 – Temperature of Blend 17 (100 mm cube)



Figure 10. Method 1050 – Temperature of Blend 18 (100 mm cube)



Figure 11. Method 1050 – Temperature of Blend 19 (100 mm cube)

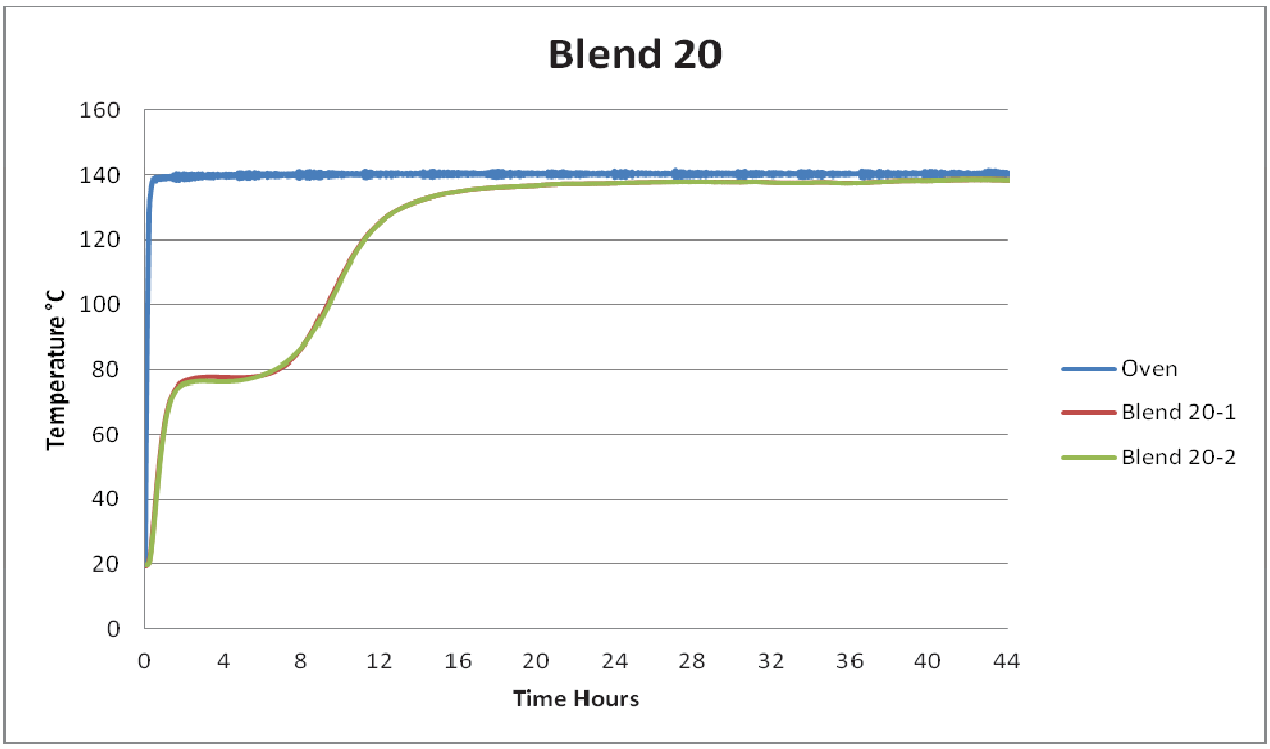


Figure 12. Method 1050 – Temperature of Blend 20 (100 mm cube)

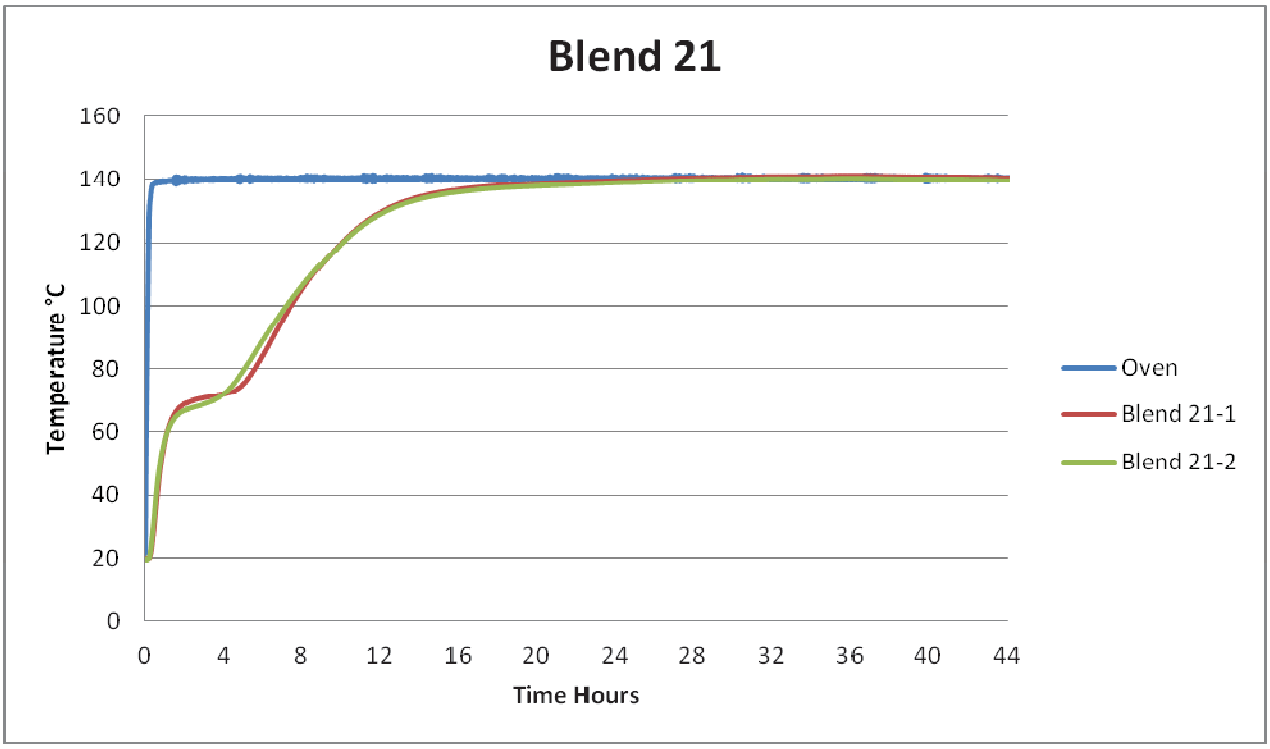


Figure 13. Method 1050 – Temperature of Blend 21 (100 mm cube)

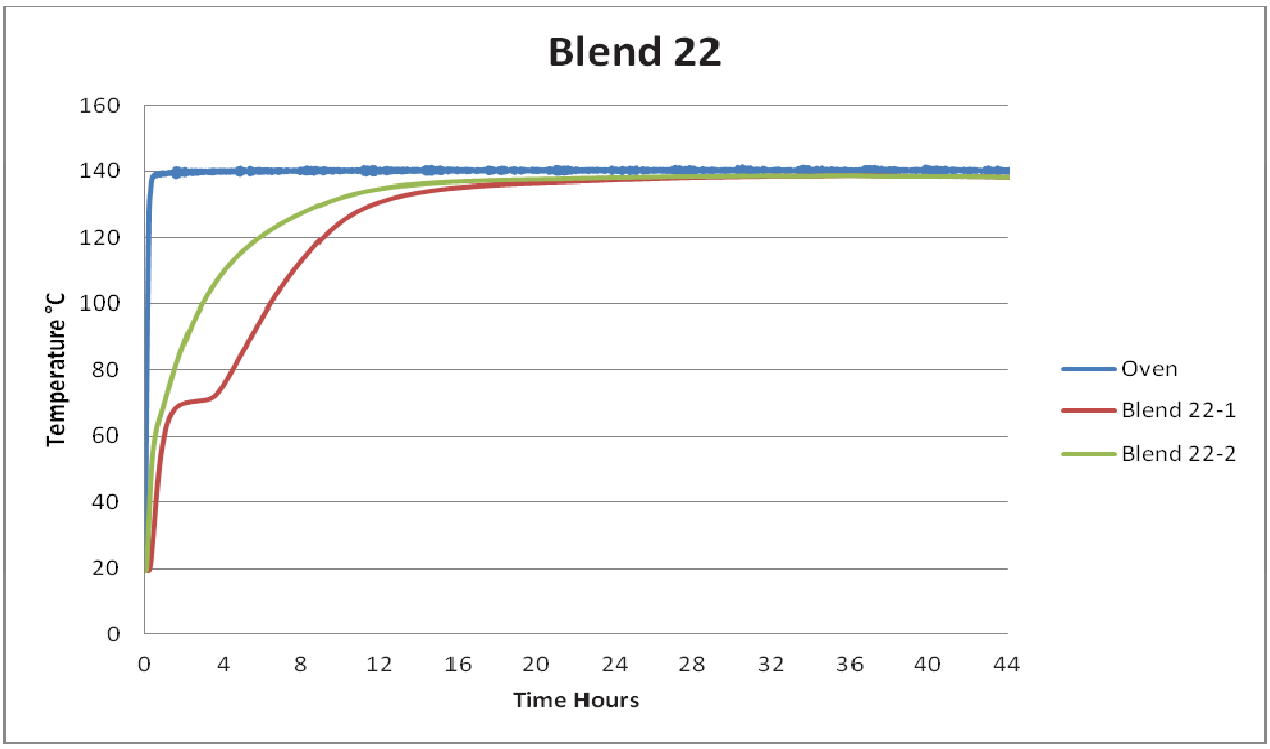


Figure 14. Method 1050 – Temperature of Blend 22 (100 mm cube)

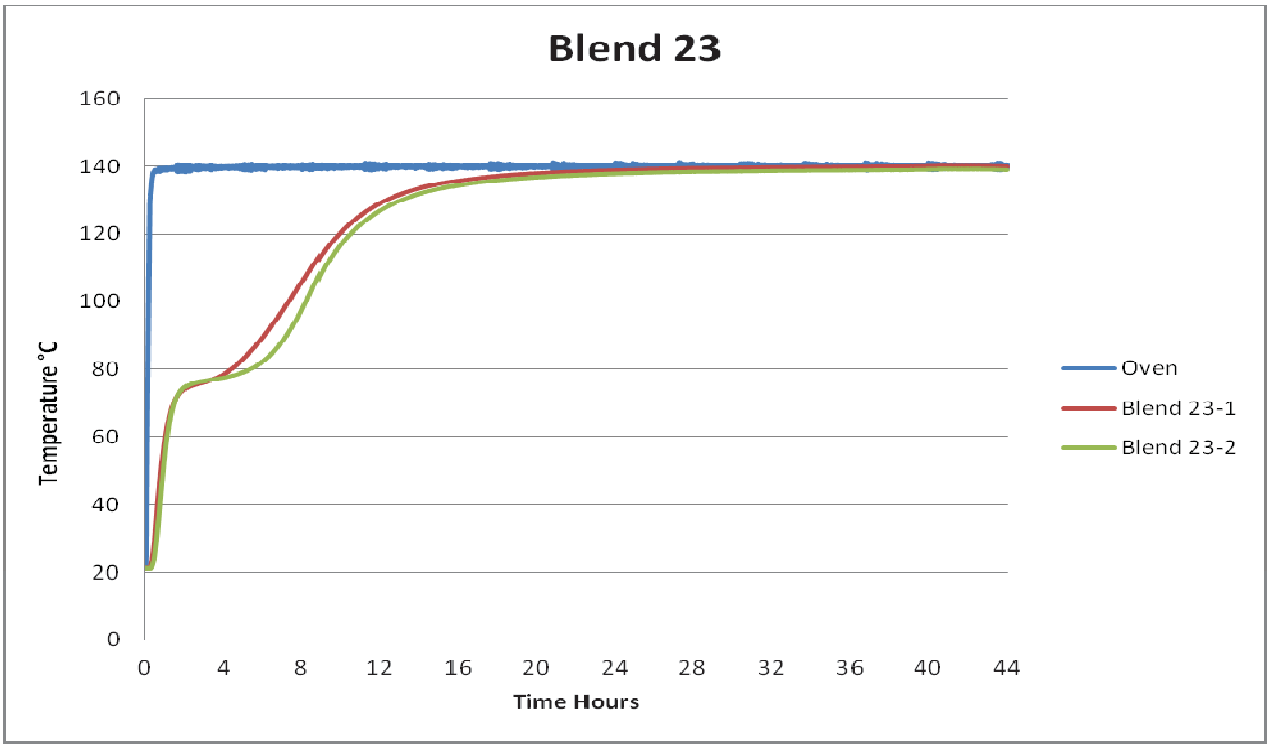


Figure 15. Method 1050 – Temperature of Blend 23 (100 mm cube)

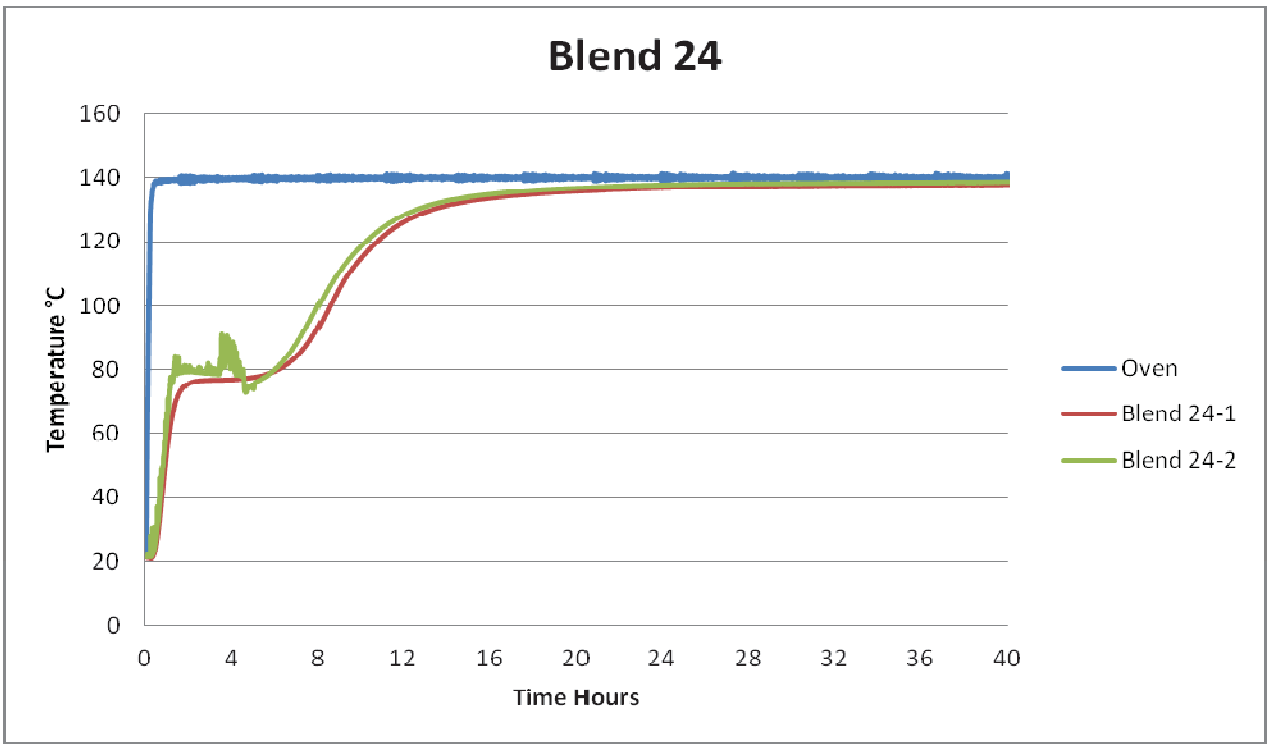


Figure 16. Method 1050 – Temperature of Blend 24 (100 mm cube)

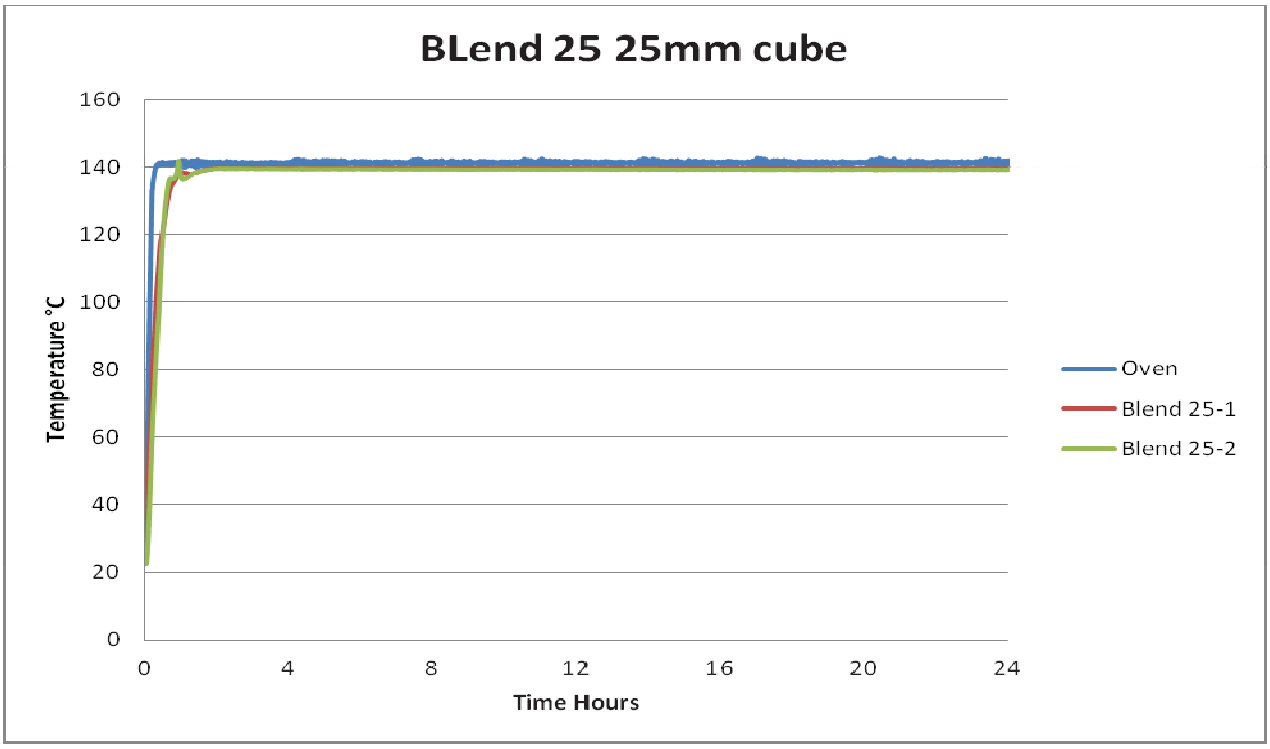


Figure 17. Method 1050 – Temperature of Blend 25 (25 mm cube). Since no event occurred sample was then analyzed in the 100 mm cube.

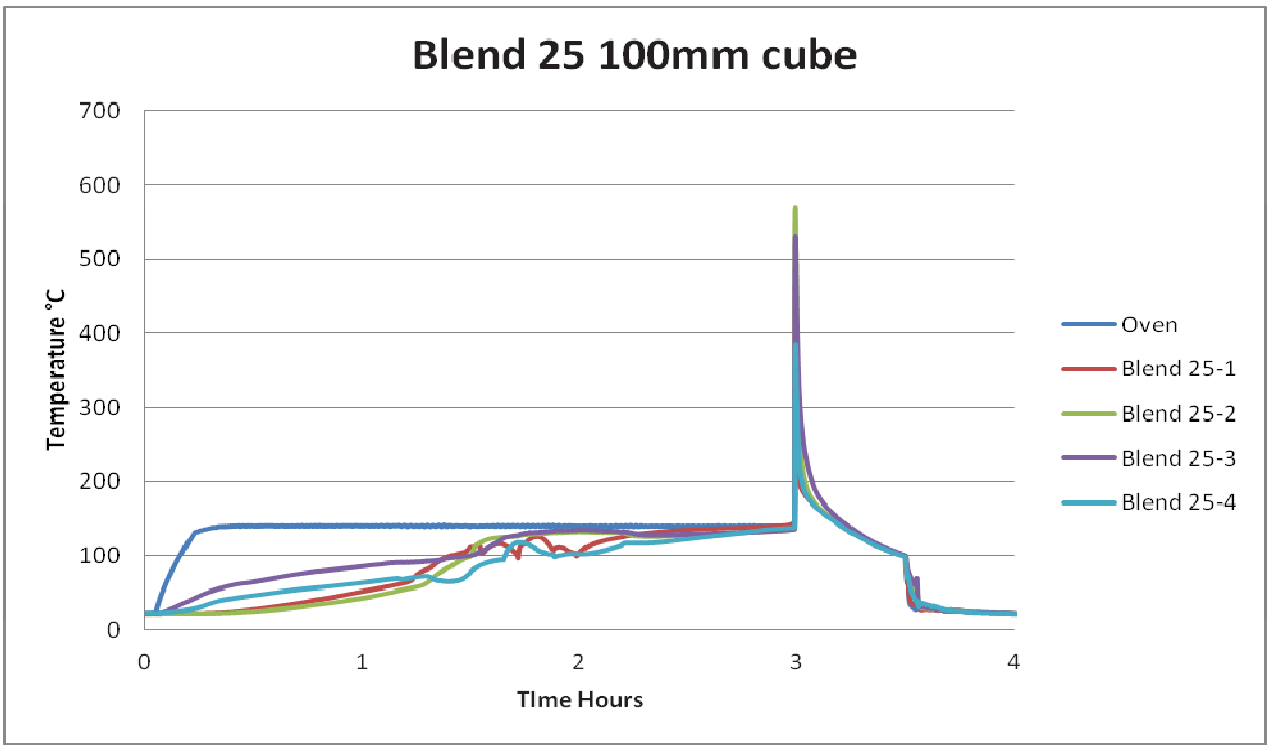


Figure 18. Method 1050 – Temperature of Blend 25 (100 mm cube). An event occurred at around 3 hours as the sample was just reaching 140°C. All sample and oven thermocouples exceeded 200°C.

010092

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Sample Results

SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET 010094

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 151222-14

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
Cement 8	589471	Nonflammable	12/17/15
Cement 9	589472	Nonflammable	12/17/15
Cement 10	589463	Nonflammable	12/17/15
Cement 11	589464	Nonflammable	12/17/15
Cement 12	589465	Nonflammable	12/17/15
Cement 13	589466	Nonflammable	12/17/15
Cement 14	589467	Nonflammable	12/17/15
Cement 15	589468	Nonflammable	12/17/15
Blend 17	589620	Nonflammable	12/17/15
Blend 18	589621	Nonflammable	12/17/15
Blend 19	589622	Nonflammable	12/17/15
Blend 20	589623	Nonflammable	12/17/15
Blend 21	589624	Nonflammable	12/17/15
Blend 22	589625	Nonflammable	12/17/15
Blend 23	589626	Nonflammable	12/31/15
Blend 24	589627	Nonflammable	12/31/15
Blend 25	589628	Nonflammable	12/31/15

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET 010095

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 151222-14

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
Cement 8	589471	Not a self-heating waste	12/17/15
Cement 9	589472	Not a self-heating waste	12/17/15
Cement 10	589463	Not a self-heating waste	12/20/15
Cement 11	589464	Not a self-heating waste	12/20/15
Cement 12	589465	Not a self-heating waste	12/22/15
Cement 13	589466	Not a self-heating waste	12/22/15
Cement 14	589467	Not a self-heating waste	12/24/15
Cement 15	589468	Not a self-heating waste	12/24/15
Blend 17	589620	Not a self-heating waste	01/06/16
Blend 18	589621	Not a self-heating waste	12/26/15
Blend 19	589622	Not a self-heating waste	12/26/15
Blend 20	589623	Not a self-heating waste	01/06/16
Blend 21	589624	Not a self-heating waste	01/04/16
Blend 22	589625	Not a self-heating waste	01/04/16
Blend 23	589626	Not a self-heating waste	12/30/15
Blend 24	589627	Not a self-heating waste	12/30/15
Blend 25	589628	DOT Packing Group III	12/28/15 & 12/29/15

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

SAMPLE DATA SHEET

010096

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 151222-14

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
113.57	54.09	19.44

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
Cement 6	589469	no reaction	no reaction	Not Division 5.1	12/15/15
Cement 7	589470	no reaction	no reaction	Not Division 5.1	12/15/15
Cement 8	589471	no reaction	>180	Not Division 5.1	12/18/15
Cement 9	589472	no reaction	>180	Not Division 5.1	12/18/15
Cement 10	589463	no reaction	>180	Not Division 5.1	12/23/15
Cement 11	589464	no reaction	>180	Not Division 5.1	12/23/15
Cement 12	589465	no reaction	>180	Not Division 5.1	12/23/15
Cement 13	589466	no reaction	>180	Not Division 5.1	12/29/15
Cement 14	589467	no reaction	>180	Not Division 5.1	12/29/15
Cement 15	589468	no reaction	>180	Not Division 5.1	12/29/15
Blend 17	589620	no reaction	no reaction	Not Division 5.1	12/16/15
Blend 18	589621	no reaction	185.3	Not Division 5.1	12/16/15
Blend 19	589622	no reaction	>180	Not Division 5.1	12/31/15
Blend 20	589623	>180	>180	Not Division 5.1	12/31/15
Blend 21	589624	no reaction	>180	Not Division 5.1	01/05/16
Blend 22	589625	no reaction	>180	Not Division 5.1	01/05/16
Blend 23	589626	>180	>180	Not Division 5.1	01/05/16
Blend 24	589627	>180	>180	Not Division 5.1	01/06/16
Blend 25	589628	53.40	87.51	Packing group II	01/14/16 & 01/07/16

The test criteria for determining oxidizing properties of the substance are:	**Classification**
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST 010097

LABORATORY CONTROL SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 151222-14

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
91-136 sec	43-65 sec	15-23 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	116.97	51.79	20.84	12/15/15
LCS	115.47	60.03	18.84	12/16/16
LCS	96.50	56.07	18.16	12/18/15
LCS	120.06	54.47	21.57	12/23/15
LCS	118.13	60.22	20.94	12/29/15
LCS	133.03	49.53	21.66	12/31/15
LCS	110.75	48.91	18.12	01/05/16
LCS	130.34	59.84	19.81	01/06/16
LCS	101.28	47.66	18.19	01/07/16
LCS	112.81	59.72	21.53	01/14/16

010098

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES

UN Oxidizer

Logbook Pages

Southwest Research Institute

010099

Method: Oxidizer (UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0044	21.0025	109.59	
3:7	2	9.0118	21.0086	101.03	
3:7	3	9.0059	21.0047	124.84	
3:7	4	9.0099	21.0058	117.81	
3:7	5	9.0060	21.0047	114.59	
3:7	**Avg**			113.57	90.86 - 136.28

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0037	18.0056	55.75	
2:3	2	12.0048	18.0039	51.60	
2:3	3	12.0084	18.0064	49.28	
2:3	4	12.0060	18.0071	53.72	
2:3	5	12.0076	18.0061	60.10	
2:3	**Avg**			54.09	43.27 - 64.908

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0085	12.0039	18.81	
3:2	2	18.0022	12.0045	19.59	
3:2	3	18.0088	12.0047	17.56	
3:2	4	18.0070	12.0039	20.25	
3:2	5	18.0049	12.0020	21.00	
3:2	**Avg**			19.44	15.55 - 23.328

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/11/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/11/15
Potassium Bromate: Inorg# 63455-63457 Dried: >12hrs. @ 65°C
Cellulose: Inorg# 61128 Dried: 105°C ; >4hrs.
Variac Setting: 150 I 7 W

Southwest Research Institute

010100

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0034	21.0032	116.97	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0039	18.0070	51.79	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0060	12.0093	20.84	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Grabaldon Balance#: 135 Date: 12/15/15
Tested Samples: Monica Grabaldon Timer ID: 80493988 Date: 12/15/15
Potassium Bromate: Inorg# 63455-63457 Dried: >12 hrs @ 65°C
Cellulose: Inorg# 61128 Dried: 105°C, >hrs.
Variac Setting: 150 ± 7 W

Southwest Research Institute

010101

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Sample Analysis

System ID: Cement #6

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0016	6.0095	>180 *	very light smoke, no flames, light sparks
4:1	2	24.0059	6.0021	>180 *	very light smoke, no flames, light sparks
4:1	3	24.0089	6.0030	>180 *	" " "
4:1	4	24.0076	6.0097	>180 *	very light smoke, no flames, sparks
4:1	5	24.0074	6.0078	>180 *	" " , light sparks
4:1	Avg	No reaction		>180 *	Charring only around wire rep 1-5

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0061	15.0056	>180 *	no flames, charring only around wire
1:1	2	15.0062	15.0051	>180 *	↓
1:1	3	15.0061	15.0066	>180 *	↓
1:1	4	15.0012	15.0043	>180 *	↓
1:1	5	15.0043	15.0061	>180 *	↓
1:1	Avg	No reaction		>180 *	

* Heat source on for full 3min/180sec. No Reaction observed.

Weighted Samples: Monica Babaldon Balance#: 135 Date: 12/15/15
Tested Samples: Monica Babaldon Timer ID: 80493988 Date: 12/15/15
Sample Dried ? (YES) NO Dried: @ Room temp. for 10 days
Cellulose: Inorg# 61128 Dried: 74hrs. @ 105°C
Variac Setting: 150±7w

Classification: Not Division 5.1

Southwest Research Institute 010102

Method: Oxidizer UN
Project #: 21592.01.0006
Client: Los Alamos
TO# 151222-14

Sample Analysis

System ID: Cement #7

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0061	6.0051	>180 *	Small amount of smoke, charring only around wire
4:1	2	24.0070	6.0142	>180 *	
4:1	3	24.0080	6.0044	>180 *	
4:1	4	24.0031	6.0048	>180 *	
4:1	5	24.0079	6.0124	>180 *	
4:1	Avg	No Reaction		>180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0026	15.0054	>180 *	Small amount of smoke, charring only around wire, no flame
1:1	2	15.0036	15.0034	>180 *	
1:1	3	15.0077	15.0054	718 2.31	+ lone flame produced @ 2min
1:1	4	15.0029	15.0032	>180 *	(No flame)
1:1	5	15.0056	15.0057	>180 *	↓ (no flame)
1:1	Avg			>180	1, 2, 4, & 5 NO Reaction; Rep 3 had flame

* Heat source left on for full 3min/180 sec. No reaction observed

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/15/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/15/15
Sample Dried ? (YES) / NO Dried: @ Room temp for 10 days
Cellulose: Inorg# 61128 Dried: 74hrs. @ 105°C
Variac Setting: 150 ± 7 W

Classification: Not Division 5.1

Southwest Research Institute 010103

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0099	21.0100	115.47	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0131	18.0099	60.03	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0048	12.0069	18.84	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/16/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/16/15
Potassium Bromate: Inorg# 63455-63457 Dried: >12hrs. @ 58°C * WO 12/16/15 mg
Cellulose: Inorg# 61128 Dried: 105°C, >4hrs.
Variac Setting: 150 ± 7 W

Southwest Research Institute 010104

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 151222-14

Sample Analysis

System ID: Blend 17

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0110	6.0097	>180 *	NO flame, charring around wire, light smoke
4:1	2	24.0115	6.0128	>180 *	↓
4:1	3	24.0016	6.0029	>180 *	↓
4:1	4	24.0107	6.0112	>180 *	↓
4:1	5	24.0105	6.0089	>180 *	↓
4:1	Avg			NO Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0081	15.0084	>180 *	NO flame, charring around wire, light smoke
1:1	2	15.0098	15.0062	>180 *	↓
1:1	3	15.0099	15.0132	>180 *	↓
1:1	4	15.0076	15.0090	>180 *	↓
1:1	5	15.0029	15.0043	>180 *	↓
1:1	Avg			NO Reaction	

* Heat source was left on for full 3 mins/180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/16/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/16/15
Sample Dried ? (YES) NO Dried: @ room temp for 1 day
Cellulose: Inorg# 61128 Dried: >4hrs. @105° C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute 010105

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 151222-14

Sample Analysis

System ID: Blend 18

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0102	6.0071	>180 *	No flame, charring only around wire, light
4:1	2	24.0036	6.0073	>180 *	Smoke
4:1	3	24.0080	6.0058	>180 *	↓
4:1	4	24.0118	6.0129	>180 *	
4:1	5	24.0083	6.0109	>180 *	
4:1	Avg			No Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
					charring around wire
1:1	1	15.0029	15.0088	180.47	One low flame propagated along Rt. side
1:1	2	15.0033	15.0029	185.28	Small flame @ wire leads + charring
1:1	3	15.0021	15.0042	183.31	↓
1:1	4	15.0041	15.0039	190.50	same as rep #1
1:1	5	15.0030	15.0047	186.75	same as rep #1
1:1	Avg			185.3	All flames extinguished soon after power turned off.

* Heat source off at 3min / 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/16/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/16/15
Sample Dried ? (YES) NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 611128 Dried: >4hrs. @105° C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010106

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0073	21.0076	96.50	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0046	18.0019	56.07	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0071	12.0041	18.16	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica ~~M~~ Gabaldon (WO 12/18/15 mh) Balance#: 135 Date: 12/18/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/18/15
Potassium Bromate: Inorg# 63455 - 63457 Dried: 12 hrs @ 65°C
Cellulose: Inorg# 61128 Dried: >4hrs @ 105°C
Variac Setting: 150 ± 7w

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 151222-14

Sample Analysis

System ID: Cement 8 (Blue)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.6104	6.0084	7180 *	No flames, charring only around wire, light smoke
4:1	2	24.6052	6.0058	7180 *	
4:1	3	24.0205	6.0188	7180 *	
4:1	4	24.0018	6.0061	7180 *	
4:1	5	24.0022	6.0033	7180 *	
4:1	Avg			No Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0080	15.0109	180.41	flames at wire leads, did not propagate, smoke + charring.
1:1	2	15.0229	15.0194	180.38	
1:1	3	15.0097	15.0059	180.49	When power turned off flames
1:1	4	15.0199	15.0172	180.25	stopped.
1:1	5	15.0123	15.0148	180.47	
1:1	Avg			180.4	

* Heat source left on for full 3min / 180 sec.

Weighted Samples: Monica Grabaldon Balance#: 135 Date: 12/17/15
Tested Samples: Monica Grabaldon Timer ID: 80493988 Date: 12/18/15
Sample Dried ? (YES) NO Dried: @ room temp for 10 days
Cellulose: Inorg# 61128 Dried: >4hrs. @105° C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010108

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 151222-14

Sample Analysis

System ID: Cement 9 (black)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0003	6.0041	>180 *	No flame, charring around wire +
4:1	2	24.0056	6.0059	>180 *	light smoke
4:1	3	24.0048	6.0074	>180 *	↓
4:1	4	24.0053	6.0044	>180 *	↓
4:1	5	24.0375	6.0213	>180 *	↓
4:1	Avg			No Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0079	15.0065	181.07	Flames produced at wire leads into
1:1	2	15.0179	15.0152	180.93	sample but did not propagate around.
1:1	3	15.0144	15.0049	180.52	Smoke
1:1	4	15.0112	15.0110	181.22	↓
1:1	5	15.0119	15.0154	181.16	↓
1:1	Avg			180.98	flames stopped soon after power turned o

* Heat source was left on for full 3 min / 180 sec.

Weighted Samples: Monica Grabaldon Balance#: 135 Date: 12/17/15
Tested Samples: Monica Grabalden Timer ID: 80493988 Date: 12/18/15
Sample Dried ? (YES) NO Dried: @ Room temp for 10 days
Cellulose: Inorg# 60128 Dried: >4hrs. @105° C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010109

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0104	21.0054	120.00	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0154	18.0090	54.47	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0067	12.0030	21.57	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Grabaldon Balance#: 135 Date: 12/23/15
Tested Samples: Monica Grabaldon Timer ID: 86493988 Date: 12/23/15
Potassium Bromate: Inorg# 63455-63457 Dried: >12hrs. @ 65°C
Cellulose: Inorg# 61128 Dried: >4hrs. @ 105°C
Variac Setting: 150W ± 7

Southwest Research Institute 010110

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 151222-14

Sample Analysis

System ID: Cement 10 (Blue)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0049	6.0059	>180	No flames, charring around wire,
4:1	2	24.0021	6.0050	>180	light smoke
4:1	3	24.0073	6.0105	>180	↓
4:1	4	24.0066	6.0012	>180	↓
4:1	5	24.0087	6.0017	>180	↓
4:1	Avg			No Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g (re-weighed 12/21/15 mc)	Burning Time, sec	Comment
1:1	1	15.0155	15.0018	181.20	flames + charring around around
1:1	2	15.0011	15.0074	181.13	ignition source, flames did not
1:1	3	15.0067	15.0110	180.86	propagate, smoke
1:1	4	15.0045	15.0033	181.37	↓
1:1	5	15.0023	15.0082	181.22	↓
1:1	Avg			181.16	flames stopped soon after power turned off

Weighted Samples: Monica Garbaldon Balance#: 135 Date: 12/21/15
Tested Samples: Monica Garbaldon Timer ID: 80493988 Date: 12/23/15
Sample Dried ? (YES) NO Dried: @ Room temp for 10 days
Cellulose: Inorg# 611 28 Dried: >4hrs. @105° C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 151222-14

Sample Analysis

System ID: Cement II (Black)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0078	6.0061	>180 *	NO flames, Charring around wire
4:1	2	24.0060	6.0041	>180 *	light smoke
4:1	3	24.0135	6.0079	>180 *	↓
4:1	4	24.0080	6.0079	>180 *	↓
4:1	5	24.0031	6.0046	>180 *	↓
4:1	Avg			NO Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0024	15.0084	181.09	flames produced where wire leads into
1:1	2	15.0044	15.0052	182.55	sample but didn't propagate, smoke
1:1	3	15.0045	15.0059	181.94	↓
1:1	4	15.0096	15.0062	181.42	↓
1:1	5	15.0061	15.0027	182.19	↓
1:1	Avg			181.84	

* Heat source left on for full 3min / 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/21/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/23/15
Sample Dried ? (YES) / NO Dried: @ Room temp for 10 days
Cellulose: Inorg# Le1128 Dried: >4hrs. @105° C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute 010112

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 151222-14

Sample Analysis

System ID: Cement 12 (Green)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0013	6.0058	>180 *	NO flames, charring around wire,
4:1	2	24.0060	6.0069	>180 *	light smoke
4:1	3	24.0050	6.0037	>180 *	↓
4:1	4	24.0032	6.0009	>180 *	↓
4:1	5	24.0036	6.0059	>180 *	↓
4:1	Avg			No Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0023	15.0008	180.09	flames only at wire leads + didn't
1:1	2	15.0023	15.0013	180.12	propagate. Charring + smoke
1:1	3	15.0190	15.0060	180.08	↓
1:1	4	15.0104	15.0075	180.56	↓
1:1	5	15.0039	15.0010	180.37	↓
1:1	Avg			180.24	Flames stopped soon after power turned off.

* Heat source left on for full 3min/180sec.

Weighted Samples: Monica Gabaldon/Villasenor Balance#: 135 Date: 12/23/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/23/15
Sample Dried ? (YES) NO Dried: @ Room temp for 10 days
Cellulose: Inorg# 601128 Dried: >4hrs. @105° C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010113

Method: Oxidizer UN
Project #: 21592.01.006
Client: LOS Alamos
TO# 151222-14

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0046	21.0051	118.13	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0099	18.0070	60.22	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0098	12.0050	20.94	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Grabaldon Balance#: 135 Date: 12/29/15
Tested Samples: Monica Grabaldon Timer ID: 81493988 Date: 12/29/15
Potassium Bromate: Inorg# 63455-63457 Dried: >12hrs. @ 65°C
Cellulose: Inorg# 65519 Dried: >4 hrs. @ 105°C
Variac Setting: 150 ± 7 W

Southwest Research Institute · 010114

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 151222-14

Sample Analysis

System ID: Cement 13 (Blue)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0041	6.0040	>180 *	No flames, charring around wire,
4:1	2	24.0004	6.0038	>180 *	light Smoke
4:1	3	24.0093	6.0035	>180 *	↓
4:1	4	24.0013	6.0052	>180 *	↓
4:1	5	24.0021	6.0036	>180 *	↓
4:1	Avg			No Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0015	15.0033	180.44	Flames produced where wire enters
1:1	2	15.0091	15.0033	180.35	sample mound but didn't propagate.
1:1	3	15.0054	15.0016	180.41	Smoke & Charring
1:1	4	15.0015	15.0029	180.88	↓
1:1	5	15.0010	15.0013	180.37	↓
1:1	Avg			180.49	Flames stopped soon after power was turned off.

* Heat ~~source~~ WO source left on for full 3min/180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/23/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/29/15
Sample Dried ? (YES) NO Dried: @ Room temp for 10 days
Cellulose: Inorg# 65519 Dried: >4hrs. @105° C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010115

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 151222-14

Sample Analysis

System ID: Cement 14 (Green)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0039	6.0025	>180 *	No flames, charring around
4:1	2	24.0008	6.0019	>180 *	wire, light smoke
4:1	3	24.0035	6.0020	>180 *	↓
4:1	4	24.0041	6.0051	>180 *	↓
4:1	5	24.0011	6.0023	>180 *	↓
4:1	Avg			NO Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0038	15.0029	180.32	flames at wire leads, charring &
1:1	2	15.0121	15.0047	180.38	smoke. flames didn't propagate
1:1	3	15.0101	15.0122	180.43	↓
1:1	4	15.0043	15.0017	180.26	↓
1:1	5	15.0037	15.0036	180.35	↓
1:1	Avg			180.35	Flames stopped soon after power was turned off.

*Heat source left on for full 3min/180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/28/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/29/15
Sample Dried ? (YES) NO Dried: @ room temp for 10 days
Cellulose: Inorg# 105519 Dried: >4hrs. @105° C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute 010116

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Sample Analysis

System ID: Cement 15 (Black)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0081	6.0034	>180 *	Charring only around wire, light smoke, no flames
4:1	2	24.0024	6.0062	>180 *	
4:1	3	24.0039	6.0054	>180 *	
4:1	4	24.0090	6.0039	>180 *	
4:1	5	24.0012	6.0075	>180 *	
4:1	Avg			NO Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0038	15.0055	>180.22	Flames produced where wires lead into sample mound, did not propagate, smoke
1:1	2	15.0062	15.0046	>180.56	
1:1	3	15.0144	15.0126	>180.28	
1:1	4	15.0057	15.0088	>180.35	
1:1	5	15.0083	15.0067	>180.34	
1:1	Avg			>180.35	Flames stopped soon after power was turned off.

* Heat source left on for full 3min/180sec. (w/o initials)

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/28/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/29/15
Sample Dried ? (YES) NO Dried: @ Room temp for 10 days
Cellulose: Inorg# 65519 Dried: >4hrs. @ 105°C
Variac Setting: 150 ± 7 W

Not Division 5.1

Southwest Research Institute

010117

Method: Oxidizer UN
Project #: 21592.01.006
Client: LOS Alamos
TO# 151222-14

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	~~21.0076~~	21.0076	133.03	
3:7	2	9.0091 RE 12/31/15 mg			
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	~~18.~~ RE 12/31/15 mg	18.0081	49.53	
2:3	2	12.6075			
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	~~12.~~ RE 12/31/15 mg	12.0031	21.66	
3:2	2	18.0043			
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/31/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/31/15
Potassium Bromate: Inorg# 63455-63457 Dried: >12 hrs. @ 65°C
Cellulose: Inorg# 65519 Dried: 74 hrs. @ 105°C
Variac Setting: 150 ± 7w

Southwest Research Institute 010118

Method: Oxidizer WN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Sample Analysis

System ID: Blend 19 (Black)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0060	6.0074	>180 *	Charring only around wire, light smoke
4:1	2	24.0085	6.0153	>180 *	
4:1	3	24.0042	6.0137	>180 *	
4:1	4	24.0108	6.0122	>180 *	
4:1	5	24.0013	6.0202	>180 *	
4:1	Avg			No Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0104	15.0115	>180 *	charring only around wire, smoke
1:1	2	15.0142	15.0127	>180.31	small flames at wire leads, charring
1:1	3	15.0041	15.0113	>180.94	↓ + flame on Rt side propagated
1:1	4	15.0068	15.0166	>180 *	charring only around wire, smoke
1:1	5	15.0042	15.0131	>180.23	small flames at wire leads, charring
1:1	Avg			>180	Reaction stopped soon after power was turned off.

* Power/heat source left on for full 3min/180sec. No reaction observed.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/31/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/31/15
Sample Dried ? (YES) NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 65519 Dried: >4hrs. @ 105°C
Variac Setting: 150 ± 7W

Not Division 5.1

Southwest Research Institute 010119

Method: Oxidizer UN
Project #: 21592.01.606
Client: Los Alamos
TO# 151222-14

Sample Analysis

System ID: Blend 20 (Green)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0119	6.0041	>180.34	Charring around wire only, smoke
4:1	2	24.0069	6.0180	>180.40	+ spontaneous sparks + flames
4:1	3	24.0039	6.0143	>180.41	↓
4:1	4	24.0068	6.0144	>180.62	↓
4:1	5	24.0118	6.0026	>180.47	↓
4:1	Avg			>180.45	Reaction stopped after power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0056	15.0178	>180.55	Flames produced at wire leads, charring + smoke
1:1	2	15.0075	15.0073	>180.91	↓ + @ ~170sec. flames produced on sides
1:1	3	15.0040	15.0078	>180.27	↓
1:1	4	15.0031	15.0032	>180.33	↓
1:1	5	15.0036	15.0062	>180.36	↓
1:1	Avg			>180.48	Reaction stopped when power turned off.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/31/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/31/15
Sample Dried ? (YES) / NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 65519 Dried: >4hrs. @ 105°C
Variac Setting: 150 ± 7 W

Not Division 5.1

Southwest Research Institute 010120

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0073	21.0054	110.75	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0159	18.0051	48.91	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0069	12.0030	18.12	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 1/5/16
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/5/16
Potassium Bromate: Inorg# 63455 – 63457 Dried: >12hrs. @ 85°C
Cellulose: Inorg# 65519 Dried: >4hrs. @ 105°C
Variac Setting: 150 ± 7W

Southwest Research Institute 010121

Method: Oxidizer UN
Project #: 21592 01.0006
Client: Los Alamos
TO# 151222-14

Sample Analysis

System ID: Blend 21 (Blue)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0055	6.0094	>180	charring around wire, smoke, no flames
4:1	2	24.0084	6.0012	>180	↓
4:1	3	24.0110	6.0052	>180	↓
4:1	4	24.0047	6.0024	>180	↓
4:1	5	24.0173	6.0032	>180	↓
4:1	Avg			No Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec (RE 1/5/16 mg)	Comment (stopped timer at 4mins; continued to burn w/o power on for ≥)
1:1	1	15.0036	15.0119	~~>180~~ 240	flames at wire leads, ~~didn't~~ propagated
1:1	2	15.0031	15.0211	235.87	flames at wire leads, propagated, charring
1:1	3	15.0095	15.0052	>240	flames at wire, didn't propagate, charring
1:1	4	15.0077	15.0252	203.32	flames at wire, didn't propagate, charring
1:1	5	15.0054	15.0070	>240	flames at wire & propagated slightly, charring
1:1	Avg			231.84	

>240 = continued to burn after 4mins WD 1/4/16 mg

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 1/4/16
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/5/16
Sample Dried ? (YES) / NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 65519 Dried: 74hrs. @ 105°C
Variac Setting: 150 ± 7W

Power turned off at 3min/180sec for all samples. continued to take time to a max of 4mins/240 sec. if reaction/flame continued. CI 1/5/16 mg

Not Division 5.1

Southwest Research Institute

010122

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Sample Analysis

System ID: Blend 22 (Black)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.6036	6.0025	Power on	Charring only around wire, smoke, no flame
4:1	2	24.0109	6.0021	for >180 sec.	↓
4:1	3	24.0170	6.0048	↓	↓
4:1	4	24.0067	6.0157	↓	↓
4:1	5	24.0055	6.0049	↓	↓
4:1	Avg			NO Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0032	15.0100	209.90	flames at wires didn't propagate, smoke, char
1:1	2	15.0105	15.0045	7240	flames at wires & propagated, charring, smoke
1:1	3	15.0071	15.0001	197.34	flames at wires didn't propagate, charring & smok
1:1	4	15.0033	15.0037	>240	flame at wire didn't propagate, small flame after po
1:1	5	15.0040	15.0076	221.50	turned off & ↓
1:1	Avg			221.75	after power turned off very small flame remain

>240 = continued to burn after 4min. (@ 3mins power turned off)

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 1/4/16
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/5/16
Sample Dried ? (YES) NO Dried: @ Room temp for 1 day
Cellulose: Inorg# L55519 Dried: 74hrs. @105°C
Variac Setting: 150 ± 7 W

Power turned off at 3min/180sec. for all samples. Continued to take time to a max of 4mins/240 sec. if reaction/flame continued.

Not Division 5.1

Southwest Research Institute 010123

Method: WN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Sample Analysis

System ID: Blend 23 (Green)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0143	6.0063	>180.11	charring around wire only, smoke, no flame; yes sparks
4:1	2	24.0054	6.0040	>180.27	spontaneous flames/sparks, charring & smoke
4:1	3	24.0145	6.0027	>180.08	↓ at wire leads
4:1	4	24.0084	6.0045	>180.56	↓
4:1	5	24.0083	6.0056	>180.35	↓
4:1	Avg			>180.27	reaction stopped once power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0096	15.0102	>240	flames at wire leads didn't propagate. Charring. Smoke.
1:1	2	15.0065	15.0073	222.56	↓ very small flame left after power off
1:1	3	15.0075	15.0187	>240	↓ small flame remained burning @ 4min.
1:1	4	15.0063	15.0072	>240	flames @ wire leads propagated, charring & smoke
1:1	5	15.0135	15.0012	>240	↓ burned over 4 mins
1:1	Avg	>240 = continued to burn after 4 mins		~~>240~~ 236.51	

Power off for all at 3min/180sec. Time cont. if reaction continued to a max of 4min/240

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 1/4/16
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/5/16
Sample Dried ? (YES) NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 65519 Dried: 74hrs. @ 105°C
Variac Setting: 150±7w

WO 1/8/16 mg
Not ~~Divist~~ Division 5.1

Southwest Research Institute

010124

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	89.0095	21.0054	130.34	
3:7	2	RE 1/6/16 mG			
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0082	18.0065	59.84	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0225	12.0046	189.81	
3:2	2			RE 1/6/15 mG	
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 1/6/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/6/15
Potassium Bromate: Inorg# 63455-63457 Dried: >12hrs. @ 65°C
Cellulose: Inorg# 65519 Dried: 74hrs. @ 105°C
Variac Setting: 150 ± 7w

Southwest Research Institute 010125

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Sample Analysis

System ID: Blend 24 (Blue)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0127	6.0113	>180.22	charring around wire, spontanious sparks, smoke
4:1	2	24.6103	6.0087	>180.37	Spontanious sparks + flames stopped when power
4:1	3	24.0079	6.0107	>180.10	turned off at 180 sec.
4:1	4	24.0107	6.0031	>180.18	↓
4:1	5	24.0033	6.0038	>180.26	↓
4:1	Avg			>180.23	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0121	15.0057	>240	#1: Flame propagated after power turned off Flames at wire leads, charring & smoke
1:1	2	15.0047	15.0047	204.40	↓ + flame extinguished soon after power off
1:1	3	15.0036	15.0041	185.93	↓ + ↓
1:1	4	15.0161	15.0123	203.40	↓ + ↓
1:1	5	15.0029	15.0044	234.28	↓ + flames propagated after power turned off
1:1	Avg			213.6	

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 1/5/16
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/6/16
Sample Dried ? (YES) NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 65519 Dried: 74 hrs. @105°C
Variac Setting: 150 ± 7W

Not Division 5.1

Southwest Research Institute 010126

Method: Oxidizer UN
Project #: 21592.01.006
Client: LOS Alamos
TO# 151222-14

Sample Analysis

System ID: Blend 25 (orange)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0128	6.0143	Wire broke	at 42.32 sec. lots of sparking & flames
4:1	2	24.0048	6.0045	Wire broke	at 41.78 sec.
4:1	3	24.0065	6.0019	Wire broke	at 32.41 sec } All need to be
4:1	4	24.0019	6.0040	Wire broke	at 39 sec } re-analyzed
4:1	5	24.0125	6.0179		
4:1	Avg			See 1/8/16	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0165	15.0108	94.84	sample fully burned, reaction stopping
1:1	2	15.0092	15.0079	88.90	point very apparent. Flames +
1:1	3	15.0095	15.0189	82.40	sparking.
1:1	4	15.0123	15.0037	80.91	
1:1	5	15.0171	15.0164	90.50	
1:1	Avg			87.51	

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 1/5/16
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/6/16
Sample Dried ? (YES) / NO Dried: @ Room temp for 1 day? WD 1/7/16
Cellulose: Inorg# 165519 Dried: 74hrs. @105°C MG
Variac Setting: 150 ± 7w

Classification on 1/8/16 page w/ 4:1 ratio data.

Southwest Research Institute 010127

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0860	21.0365	112.81	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.1384	18.0125	59.72	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0098	12.0356	21.53	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: James Moker Balance#: 135 Date: 1-14-16
Tested Samples: James Moker Timer ID: 80494146 Date: 1-14-16
Potassium Bromate: Inorg# 63455-63457 Dried: 7 12hrs 65°C
Cellulose: Inorg# 61174 Dried: 7 4hrs 105°C
Variac Setting: 150 ± 7W WO 1/21/16 MG

Southwest Research Institute 010128

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 151222-14

Sample Analysis

System ID: Blend #25

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

used new wire

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0774	6.0372	54.14	initial flame and then constant sparks and smoldering. Timer stoped after main flame and sparking subsided. Burning sample after analysis was ashlike
4:1	2	24.0651	6.0092	45.53	
4:1	3	24.0791	6.0269	62.44	
4:1	4	24.0671	6.0203	47.37	
4:1	5	24.0411	6.0124	52.51	
4:1	Avg			53.40	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1				
1:1	2				
1:1	3				
1:1	4				
1:1	5				
1:1	Avg				

Weighted Samples: James Maker Balance#: 88 Date: 1/14/16
Tested Samples: James Maker Timer ID: 30494M6 Date: 1/14/16
Sample Dried ? (YES) / NO Dried: room temp for 1 day
Cellulose: Inorg# 61124 Dried: >4hrs. @105° C
Variac Setting: 150 ± 7 Watts

Classification: Packing group II

010129

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Method 1030
Logbook Pages

Book I.D. 14-0406-021 Book/ Page : 12 00190

Southwest Research Institute®
Logbook: Physical Testing

010130

Analysis / Method: 1030 Project# 21592.01.006

Client: LANL TO# 151232-14

LCS Info: fine excelsior wood #61753 TV= positive Balance#: N/A

Notes: burn rate greater than 2.2 mm/sec is positive

humidity retr : 020917 38% RH, 22.1°C

Sample ID	glowing post burn point	propagation post burn	flame	time over 100mm	burn rate mm/sec
LCS	Yes	Yes	Yes	11.18	8.94
Cement #8	No	No	No		
Cement #10	No	No	No		
Cement #9	No	No	No		
Cement #10	No	No	No		
Cement #11	No	No	No	cement turned a diter faint grey color with	
Cement #12	No	No	No	charring primarily	
Cement #13	No	No	No	on the side of the	
Cement #14	No	No	No	flame	
Cement #15	No	No	No		
Blend #17	No	No	No		
Blend #18	No	No	No		
Blend #19	No	No	No	few sparks shot off from the	
Blend #20	No	No	No	nitrated but only charring	
Blend #21	No	No	No	and discoloration	
Blend #22	No	No	No	was left on the side of the flame.	

Calculation:

Analyst Signature: Date: 12/17/15

Reviewed by: Date: 1/20/16

Southwest Research Institute®
Logbook: Physical Testing

010131

Analysis / Method: 1030 Project# 21542.01.006

Client: LANL TO# 151222-H

LCS Info: excelsior fine #61753 TV= positive Balance#: N18

Notes: burn rate greater than 2.2mm/sec is positive

RH= 30.2% temp 77.4°F

meter ID 020917

Sample ID	glowing post burn point	Propagation post burn	flame	time	rate
LCS	Yes	Yes	Yes	10.94	9.14mm/sec
Blend 23	NO	No	No	some pepping of nitrates but only charge was sample became wet at the burn point	
Blend 24	NO	NO	NO		
Blend 25	NO	No	No	sample bubbled and acted to the back of the plate burned and nibbled endured but left inside moist	
iNS Blend #2	No	No	No		
Blend #3	No	No	Yes	flame maintained several seconds after removal of torch	
Blend #4	NO	NO	NO	high moisture most likely prevented much burning.	
Blend #5	No	No	Yes	flame maintained briefly after removing torch burnt sample area	
Blend #6	No	No	NO		
Blend #7	No	No	No		
Blend #8	No	No	No		
Blend #9	No	No	NO	Charred the zeolite with some pepping of the nitrates but little ester charge.	
Blend #10	NO	NO	NO		
Blend #11	NO	NO	No		
Blend #12	No	NO	NO		
Blend #13	NO	No	NO		

Calculation:

Analyst Signature: James Gee Date: 12/31/15

Reviewed by: J Rapus Date: 1/20/16

010132

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES

Method 1050

Logbook Pages

Southwest Research Institute®
Logbook: Physical Testing

010133

Analysis / Method: 1050 Project# 21542.01.006

Client: LANL TO# 151227-14

LCS Info: N/A TV= N/A Balance#: N/A

Notes:

Calibration: 01/2017

Sample ID									
temp °C	0	1	2	3	4	5	6	7	
0	-0.5	-0.3	-0.7	-0.8	-0.6	-0.8	-0.6	-0.5	
50	49.6	49.8	49.4	49.2	49.6	49.1	49.4	49.6	
100	99.5	99.8	99.3	99.1	99.5	99.1	99.4	99.6	
200	199.5	199.8	199.3	199.1	199.6	199.1	199.4	199.6	
3800 TESTED 12/17/15	299.6	299.8	299.3	299.2	299.6	299.1	299.4	299.6	
Cement #8	& #9		cuye #1 =		cement #8		start : 10:40		12/17/15
			cuye #3 =		cement #9		stop: 12:40		12/19/15
Very little change to sample appearance occurred during testing. main difference was the cement was now a dry grey instead of wet. Did not exceed 200°C during testing so sample is considered non self heating.									
cement #10	& #11		cuye 1 = #10		start		10:36		12/20/15
			cuye 3 = #11		stop		12:36		12/22/15
Same as	cement #8 / #9								

Calculation:

Analyst Signature: [signature] Date: 12/17/15 WD SAM 12/17/15

Reviewed by: [signature] Date: 1/20/16

Book I.D. 14-0406-021 Book/ Page : 12 00192

Southwest Research Institute®
Logbook: Physical Testing

010134

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 151222-14

LCS Info: N/A TV= N/A Balance#: N/A

Notes:

Sample ID					
Cement #12	; cement #13		Cage 1 = cement #12 Cage 3 = cement #13		
	start:	11:47 12/22/15			
	Stop:	9:54 12/24/15			
Same results as cement #8 ; 9		pg: 12-00191			
Cement #14 ;	cement #15		Cage 1 = cement #14 Cage 3 = cement #15		
	start:	9:54 12/24/15			
	stop:	7:57 12/26/15			
Same results as cement #8 ; 9		pg 12-00191			
Blend #18 ; #19			Cage 1 = cement #18 Cage 3 = cement #19		
	Start:	10:42 12/26/15			
	stop:	10:23 12/28/15			
Sample was now dry after the heating and all moisture was gone. Temps did not exceed 200°C anytime during the analysis and are therefore considered non self heating.					
Calculation:					

Analyst Signature: Date: 12/22/15

Reviewed by: Date: 1/20/16

RSS

Southwest Research Institute®
Logbook: Physical Testing

010135

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 151222-14

LCS Info: N/A TV= N/A Balance#: N/A

Notes:

Sample ID					
Blend #25	25mm cube used twice				
		start:	12:23	12/29/15	
		stop:	12:41	12/29/15	
Sample expanded out of the cube, but did not exceed 200°C in temperature during the testing.					
Blend #25	100mm cube				
		start:	13:43	12/29/15	
		stop:	18:24	12/29/15	
Sample expanded out of the cube for a while causing the weighted down top to raise up and the thermocouples to have 20°C increases and decreases, as the sample reached 140°C an event occured causing large amounts of smoke and some flames. Sample temperatures exceeded 500°C. Since the sample was positive for the 100mm cube but negative for the 25mm cube it gets a DOT packing group classification of "III".					

Calculation:

Analyst Signature: James Mah Date: 12/28/15

Reviewed by: R Spies Date: 1/20/16

Book I.D. 14-0406-021 Book/ Page : 12 00194

Southwest Research Institute®
Logbook: Physical Testing

010136

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 151222-14

LCS Info: N/A TV= N/A Balance#: N/A

Notes:

Sample ID					
Blend # 23	24	Cage 1 #23 Cage 3 #24	Start Stop	12:51 8:50	12/30/15 1/1/15
Samples did not exceed 200°C during the analysis. Samples both turned brown in color and Bld 24 became hard and formed the shape of the cube. Had to be broken up to remove.					
Blend #17	20	Cage #1 #17 Cage #3 #20	Start Stop	12:AM 1-1-16	
(X) Data lost during "saving". Void.					

Calculation:

Analyst Signature: Dana Mar Date: 12/30/15

Reviewed by: [signature] Date: 1/20/16

Work continued from Page

SWRI

010137

1/4/16 - Lost data for Blend 17 + Blend 20.

Need to reprepare..

1/4/16

Blend 21 > started at ~~9:30am~~ RSS 1/4/16 9:30am 1/4/16 RE
Blend 22 ✓

Blend 21 : 208-02-WCS11
Blend 22 : 208-04-WCS11.

Turned off 1/6/16 RSS 1/6/16

Blend 17 18-02-WCS12 > started at 6pm.
Blend 18 18-03-WCS13

RSS. 1/6/1

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SIGNATURE DATE 1/4/16

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 1/6/16

010138

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Sample Preparation
Logbook Copies

Work continued from Page

SWRI

010139

197-01-WC611 10N NaOH

400.2197 g NaOH (#61580) to F.V. 1L with DI H_2O
balance #135 exp 12/3/16

197-02-WC611 Cement #6 balance # 05, 135

130.0048 g KNO_3 (#62282) + 2/3 water 246.2 g mix and let sit for at least 1 hr
9:30-10:30 ~1 g NaOH added pH 9.75 added remainirg 126.8mL DI H_2O
let sit and then added 495 g cement. mixed and poured into plastic containers
balance #05

197-03-WC611 cement #7

130.116 g WB8 (#1 book 15-0406-036 pg. 53) + 2/3 water 246.2 g mix and let sit at least 1 hr
9:30-10:30 added 62g NaOH pH 9.04 added remainirg 89.6g DI H_2O let sit and then added 495g cement. mixed and poured into plastic containers.
balance #05

197-04-WC611 cement #8

Subtract WB8 prep pg. 50 book 15-0106-036 + 2/3 water 594.0g mix and let sit 1 hr
10:00 - 11:00 added 360g NaOH pH 9.12 added remainirg 90mL DI H_2O let sit and then added 1200 g cement. mixed and poured into plastic containers
balance #05

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SIGNATURE DATE 12/3/16

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 1/20/16

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SWRI

010140

199-01-WC811 Cement #9

WBB: Solvent mixture made pg 50 book # 15-0406-036 + 2/3 water 697 g mix and let sit at least 1hr 10:00 - 11:00 added 110 g NaOH pH 9.01. added remaining 293 g water. let sit and then mixed in 1410 g cement. Then poured into plastic containers.
balance #05

199-02-WC811 Cement #10

WBB: solvent mixture made pg 50 book # 15-0406-036 + 2/3 water 720.7 g mix let sit at least 1 hr 10:00 - 11:00 added 72.8 g NaOH pH 8.99. added remaining 327.6 g DI H_2O Let sit and then mixed in 1455 g cement. Then poured into plastic containers
balance #05

199-03-WC811 Cement #11

WBB: solvent mixture made pg 50 book # 15-0406-036 + 2/3 water 649.4 g mix let sit at least 1 hr 10:00-11:00 added 106 g NaOH pH 9.11. added remaining 271 g DI H_2O let sit and then mix in 1512 g cement. Then poured into plastic containers.
balance #05

199-04-WC811 Cement #12

WBB: solvent mixture made pg 50 book # 15-0406-036 + 2/3 water 576.2 g mix let sit 1 hr 17:00 - 18:00. added 89.6 g NaOH pH 9.11 added remaining water 240 g. Let sit and then mixed in 1728 g cement. Then poured into plastic containers.
balance #05

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Work continued to Page

SIGNATURE James Green **DATE** 12/31/15

DISCLOSED TO AND UNDERSTOOD BY **DATE** **WITNESS** **DATE** 1/20/16

200 TITLE LANL Litter

PROJECT NO. 21592.01.006

BOOK NO. 15-0406-~~036~~ 021 TO DATE 4/5/15

Work continued from Page

SWRI

010141

200-01-WCS11 cement #13

WB6: subcast mixture made on pg. 50 book# 15-0406-036 + 2/3 water 588.4g let sit 1hr 17:00-18:00 added 325.2g NaOH. pH 9.68 added remaining water 92.5g Let sit and then added in 1296g cement. Then poured into plastic containers.

balance #05

200-02-WCS11 cement #14

WB8: subcast mixture made on pg. 50 book# 15-0406-036 + 2/3 DI water 665.3g let sit 1hr 17:00-18:00 added 72.5g NaOH pH. 9.35. added remaining water 299g. Let sit and then poured in 1551g cement. Then poured into plastic containers.

balance #05

200-03-WCS11 cement #15

WB8: subcast mixture made on pg. 50 book# 15-0406-036 + 2/3 DI water 693.6g let sit 1hr 17:00-18:00 added 80.3g NaOH pH 9.01. added remaining water 278.2g. Let sit and then mixed in 1590g cement. Then poured into plastic containers.

balance #05

200-04-WCS11 40g/L hexametaphosphate

40.0279 g hexametaphosphate (# 26258) to F.V. 1L with DI H_2O

balance #135 exp 12/31/16

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Work continued to Page

SIGNATURE

DATE 12/30/15

DISCLOSED TO AND UNDERSTOOD BY

WITNESS

DATE 1/20/16

Work continued from Page

205-01-WC011 WB8

SWRI

010142

4.2963

TE SAM 12/10/15 ~~2.1745~~ g $AlNO_3$ (#54983)

17.0682 g $CaNO_3$ (63613)

0.2168 g $CrNO_3$ (61751)

6.5123 g $FeNO_3$ (63604)

47.8885 g $MgNO_3$ (63605)

10.6408 g $NaNO_3$ (33384)

3.7696 g $PbNO_3$ (64108)

} A

5.77 g DI H_2O

3.8782 g COOH (#63608)

2.0214 g K_2CO_3 (63914)

} B

added A to B balance #135

16.8 g current ground

50.8 g ~~current~~ WB8 TE SAM 12/10/15

placed into 1L Beaker and put on hotplate at 68°C TE SAM 12/10/15

16.5 g current as is

49.9 g WB's

placed into 1L Beaker and put on hotplate @ 60°C

SIGNATURE [signature] DATE 12/10/15

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 1/20/16

1:3 WB8 : Swheat - 206-01-WCS11

(205-01-WCS11)
400mL WB8 to 1200 mL Swheat tray #11

1:4 WB8 : Swheat 206-02-WCS11

(205-01-WCS11)
300mL WB8 to 1200mL Swheat tray #8

1:1 WB8 : Swheat

(205-01-WCS11)
400mL WB8 to 400mL Swheat tray #12

placed on hotplates @ 60°C to dry
Starting at 15:30 12/10/15

JAM 12/31/15

208-01-WCS11 Blend 18

400mL 1:3 wB8/surfact (# 206-01-WCS11) + 400mL DI H_2O mix for 5min. Take 520 mL of this mixture and add 1040 mL of zeolite. Let sit for 24 hr, tray 11

208-02-WCS11 Blend 21

600mL 1:3 wB8/surfact (#206-01-WCS11) + 300mL DI H_2O mix for 5min. Take 510 mL of this mixture and add 1020 mL zeolite, mix & let sit for 24 hr. tray 15

208-03-WCS11 Blend 19

400mL 1:4 wB8/surfact (#206-02-WCS11) + 400mL DI H_2O mix for 5min, Take 550 mL of this mixture and add 1100 mL zeolite mix and lets it for 24hrs. tray #8

12/14/15 to 12/15/15 17:20

208-04-WCS11 Blend 22

500mL 1:4 wB8/surfact (#206-02-WCS11) + 250mL DI H_2O mix for 5min, Take . mL of this mixture and add mL zeolite mix and let sit for 24hr. tray # 13

208-05-WCS11 Blend 17

400mL 1:1 wB8/surfact (#206-03-WCS11) + 400mL DI H_2O mix for 5min. Take 490 mL of this mixture and add 980 mL zeolite mix and let sit for 24 hr. tray #10, 9

12/15/15 to 12/16/15 4:00

208-06-WCS11 Blend 20

500mL 1:1 wB8: surfact (206-03-WCS11) + 250mL DI H_2O mix and add 410 mL of this to 820 mL zeolite, mix and let sit for 24 hr tray #12

Work continued from Page

SWRI

010145

1-01-WCS12 - TISAB

37.0192 g KCl (# 60103) +
68.0225 g sodium acetate (#58845) +
36.0421 g DCTA (# 5814))
to FV. 1L with DI H_2O adjust pH to 5.5 ± 0.2
balance #135 exp 12/16/16

1-02-WCS12 2:1 WB8. solvent

1000 TDSM 12/16/15 L2-5 01-WCS12 5 TDSM 12/16/15
~~500~~ mL WB8 to ~~1000~~ mL solvent mixed and then placed on a hotplate @ 60°C for 4 days. 3days with saran wrap on and one day with it off. Came off slightly moist tried to dry it more to a crispy state. Placed it in to several pans and Let it bake over christmas break to become crispy & granular.

SAM 1/20/16

SIGNATURE James Grad DATE 12/16/15

DISCLOSED TO AND UNDERSTOOD BY D Bowles DATE WITNESS DATE 1/20/16

Work continued from Page

9-01-WCS12 Blend # 23

010146 SWRI

300mL of 2:1 salt : solvent (1-02-WCS12) added 150mL DI H_2O and mixed for 5min. TOOK 430 mL of this and added it to 1240mL zeolite. let sit for 24 hr tray # 11

9-02-WCS12 Blend # 24

400mL of 2:1 salt : solvent (1-02-WCS12) added 200mL DI H_2O and mixed for 5min. TOOK 520mL of this and added it to 1040mL zeolite. let sit for 24 hr . tray # 15

JAM 12/31/15

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SIGNATURE

DATE 12/28/15

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE 1/20/16

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010147

SWRI

18-01-WCS12 1:1 Swheat:Salt(W138)

4 1/4/16 RSS pg 400mL W138 (205-01-WC011) + 4 RSS 1/4/16 pg 400mL Swheat. Mixed well and placed in Pyrex dish & Placed on hot plate @ 60.°C, covered with saran wrap.

on hotplate: 9:15am RSS 1/4/16 1/4/16
off hotplate 10:15am 1st 1/5/16 removed saran wrap and placed in forced air oven #35 @ 60°C RSS 1/5/16 to dry a bit more.

Removed from oven @ 4:30 pm 1/5/16 to make blends

18-02-WCS12
Blend 17

500mL of 1:1 swheat/WB8 (18-01-WCS12) + 500mL DI H_2O mixed for 5min. Took 500mL of thix mixture and added 500mL of zeolite, hand mixed an let sit for 24hrs. (Tray)
1/5/16 @ 530

18-03-WCS12
Blend 20.

500mL of 1:1 swheat/WB8 (18-01-WCS12) + 250 RSS 1/5/16 ~~500~~mL DI mixed for 5min. Took 420mL of this + ~~840~~ 1/5/16 mixed with 840mL zeolite. Hand mixed. @ 6PM let sit 24 hrs.

* more Blend #7 & 20 were needed because Method 1050 problem saving lost data. Reanalyze

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SIGNATURE [signature] DATE 1/4/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 1/5/16

1/20/11

50 TITLE

LANL

PROJECT NO. 21592.01.006
BOOK NO. 15-0406-036

Work continued from Page

SWRI TO # ~~150904-4~~ 151222-14 01 JAM 11/20/15

010148

Blends

	RSS	~~MIXTURES~~	(G) WB8	(G) Sunheat	HOT PLATE ON		HOT PLATE OFF	
5	1/4/16	8	675	225	12:00	12/1/2015	18~~8~~7:30 JE JAM 12/14/15	12/2/15
		9.	264	264	"	"		
		10.	204	273	"	"		
10		11.	246	246	New bag ~~Wheat~~ Sunheat	15:30	12/1/15	
		12.	216	216	"	"		
15		13.	636	210	"	"		
		14.	189	252	18:30	12/2/15	16:21	12/3/15
		15.	240	240	18:30	12/2/15		

20

1. mix both WG8 & Sunheat in a glass Pyrex tray.

2. Distribute evenly on tray ~~Wrap with Al foil~~ MV 12/1/15 Cover with Saran wrap and poke holes in S. wrap.

25

3. Place on hot plate @ 65°C min of 16 hrs.

4. Remove when crunchy.

30

12/1/15 MV

35

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SIGNATURE B [signature] DATE 12/1/15

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010149

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
D.I. Water Balance Verification Logs

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

010150

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
11/25/15 1315	DRmZ	17.91	✓	✓	—	n/A	—
11/30/15 1731	DRmZ	17.91	✓	—	—	n/A	—
12/1/15 1810	DRmZ	17.91	✓	—	—	n/A	—
12/2/15 1854	DRmZ	17.95	✓	X	✓	n/A	✓ ver. fy.
12/3/15 1901	DRmZ	17.91	✓	X	✓	n/A	X-change needed
12/4/15 1747	DRmZ	17.91	✓	X	—	n/A	SAME AS ABOVE.
12/7/15 1500	DRmZ	17.90	✓	X	✓	n/A	Pending service
12/8/15 1830	DRmZ	17.91	✓	X	—	n/A	Pending service
12/9/15 1810	DRmZ	17.90	—	X	✓	n/A	SAME
12/10/15 1751	DRmZ	17.90	✓	X	—	n/A	Pending exchange
12/11/15 1649	DRmZ	17.96	✓	X	✓	n/A	SAME
12/14/15 1801	DRmZ	17.90	—	X	✓	n/A	SAME
12/15/15 1835	DRmZ	17.90	✓	X	✓	n/A	pending
12/16/15 1831	DRmZ	17.95	✓	✓	✓	n/A	V-TANK replaced ✓
12/17/15 1811	DRmZ	17.96	—	✓	✓	n/A	—
12/18/15 1650	DRmZ	17.96	—	X	✓	n/A	X-change needed??

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
11/25/15 1317	DRmZ	✓	✓ 17.5	36925.3	—
11/30/15 1733	DRmZ	✓	✓ 18.0	36926.7	—
12/1/15 1811	DRmZ	✓	✓ 18.0	36930.8	—
12/2/15 1855	DRmZ	✓	✓ 18.0	36939.5	—
12/3/15 1902	DRmZ	✓	✓ 18.0	36941.3	—
12/4/15 1748	DRmZ	✓	✓ 18.0	36956.1	—
12/7/15 1501	DRmZ	✓	✓ 18.0	36958.2	—
12/8/15 1831	DRmZ	✓	✓ 18.0	36970.4	—
12/9/15 1811	DRmZ	✓	✓ 18.0	36975.3	—
12/10/15 1750	DRmZ	✓	✓ 18.0	36975.6	✓
12/11/15 1650	DRmZ	✓	✓ 18.0	36976.7	—
12/14/15 1803	DRmZ	✓	✓ 18.0	36979.4	—
12/15/15 1836	DRmZ	✓	✓ 18.0	36980.3	—
12/16/15 1833	DRmZ	✓	✓ 18.0	36989.5	—
12/17/15 1812	DRmZ	✓	✓ 18.0 (18.0 DRmZ)	~~36~~ 37001.1	—
12/18/15 1652	DRmZ	✓	✓ 18.0	37001.7	—

Legend: Check = Green (OK); X = Red (call for service)

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

010151

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
12/21/15 1816	DRmZ	17.95	✓	X	✓	n/A	X-change needed
12/22/15 1705	DRmZ	17.95	✓	X	✓	n/A	Pending service
12/23/15 1710	DRmZ	17.95	✓	X	✓	n/A	Pending
12/28/15 1702	DRmZ	17.96	✓	X	✓	n/A	Pending
12/29/15 1809	DRmZ	17.96	✓	X	✓	n/A	Same
12/30/15 1812	DRmZ	17.96	✓	X	✓	n/A	Pending
12/31/15 1510	DRmZ	17.97	✓	X	✓	n/A	Same
1/5/2016 1812	DRmZ	17.97	✓	X	✓	n/A	Incorrect tank brought over.
1/6/2016 1815	DRmZ	17.97	✓	X	✓	n/A	Pending
1/7/2016 1810	DRmZ	17.97	✓	X	✓	n/A	Service call placed
1/8/2016 1801	DRmZ	17.97	✓	✓	✓	n/A	CARBON, 2 MIXED tanks exchanged
1/11/2016 1831	DRmZ	17.96	✓	✓	✓	n/A	✓
1/12/2016 1858	DRmZ	17.96	✓	✓	✓	n/A	✓
1/13/2016 1810	DRmZ	17.97	✓	✓	✓	n/A	✓
1/14/2016 1750	DRmZ	17.96	✓	✓	✓	n/A	✓
1/15/2016 1830	DRmZ	17.96	✓	✓	✓	n/A	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
12/21/15 1817	DRmZ	✓	✓ 17.5	37003.1	✓
12/22/15 1706	DRmZ	✓	✓ 17.5	37003.7	✓
12/23/15 1701	DRmZ	✓	✓ 17.5	37006.0	✓
12/28/15 1703	DRmZ	✓	✓ 17.5	37007.5	✓
12/29/15 1810	DRmZ	✓	✓ 18.0	37015.3	✓
12/30/15 1813	DRmZ	✓	✓ 18.0	37024.0	✓
12/31/15 1511	DRmZ	✓	✓ 18.0	37024.9	✓
1/5/16 1811	DRmZ	✓	✓ 17.5	37049.8	✓
1/6/16 1816	DRmZ	✓	✓ 17.5	37052.1	✓
1/7/16 1811	DRmZ	✓	✓ 17.5	37053.0	✓
1/8/16 1803	DRmZ	✓	✓ 18.0	37058.8	✓
1/11/16 1832	DRmZ	✓	✓ 18.0	37060.3	✓
1/12/16 1859	DRmZ	✓	✓ 18.0	37063.7	✓
1/13/16 1811	DRmZ	✓	✓ 18.0	37064.8	✓
1/14/16 1751	DRmZ	✓	✓ 18.0	37082.0	✓
1/15/16 1831	DRmZ	✓	✓ 18.0	37083.1	✓

Legend: Check = Green (OK); X = Red (call for service)

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010152

Book I.D.: 14-0406-020

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
11/22/15	MG	199.9996	2.00005	0.01996
11/23/15	MG	199.9993	2.00000	0.01999
11/24/15	JCM	199.9994	1.99996	0.02001
11/25/15	KE	199.9998	1.99999	0.01999
11/28/15	JAM	199.9996	1.99999	0.02001
11/30/15	JCM	199.9996	1.99996	0.02001
12/1/15	JAM	199.9995	1.99992	0.02002
12/2/15	JCM	199.9996	2.00007	0.01998
12/3/15	JAM	199.9995	1.99998	0.01997
12/4/15	JAM	199.9995	1.99999	0.01998
12/5/15	JAM	200.0016	2.00000	0.02003
12/7/15	JAM	200.0016	2.00001	0.02001
12/8/15	JAM	199.9997	1.99998	0.01999
12-9-15	JK	199.9995	2.00003	0.01997
12/10/15	JAM	199.9996	1.99999	0.01999
12/11/15	JAM	199.9998	1.99995	0.01997
12/12/15	JCM	199.9999	1.99997	0.01999
12/13/15	JCM	199.9997	1.99999	0.02001
12/14/15	JCM	199.9997	1.99999	0.01997
12/15/15	MG	199.9999	2.00003	0.02000
12/16/15	JAM	199.9999	1.99999	0.01998
12-17-15	JK	199.9997	1.99999	0.02003
12-18-15	MG	199.9993	2.00001	0.01999

Comments:

12/20/15	JAM	199.9998	2.00009	0.02001
12/21/15	JCM	199.9997	1.99996	0.01996

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010153

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
12/22/15	JAM	199.9998	1.99999	0.02001 JAM 12/22/15
12/23/15	JAM	199.9996	1.99997	0.02001
12/24/15	JAM	199.9994	1.99999	0.01999
12/28/15	JAM	199.9997	1.99998	0.02001
12/29/15	JAM	199.9996	JAM 12/29/15 2.00000	0.02003
12/30/15	JAM	199.9995	1.99995	0.02002
12/31/15	JAM	199.9996	1.99997	0.02001
1/1/16	JAM	199.9994	1.99999	0.02001
1/4/16	KE	199.9996	1.99993	0.02003
1/5/16	MG	199.9996	1.99999	0.02002
1/6/16	KE	199.9994	1.99995 KE 1-6-16 (WE)	~~0.01997~~ 0.01999
1-7-16	JF	199.9999	1.99999	0.01998
1-8-16	JF	200.0006	1.99998	0.02001
1/9/16	JR	200.0001	1.99996	0.01999
1/11/16	JAM	199.9996	1.99998	0.01996
1/12/16	JAM	199.9992	1.99996	0.01999
1/13/16	JAM	199.9994	1.99995 JAM 1/13/16	0.02002
1/14/16	JAM	199.9997	1.99994	0.02002
1/15/16	JAM	200.0002 *	1.99999	0.01998
1/18/16	KE	199.9992 *	1.99999	0.01996
1/19/16	JAM	200.0000 *	1.99999	0.02002
1/20/16	JAM	200.0000 *	1.99997	0.02000

Comments: * 200g out for calibration JAM 1/14/16
Useing 200g ID 015HZ

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

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Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
11/16/15	JW	1999.95	2.0004 JW 11/16/15
11-17-15	JK	1999.95	2.000
11-18-15	JK	1999.95	2.000
11-19-15	JK	1999.95	1.999
11-20-15	JK	1999.97	1.999
11-23-15	KE	1999.93	2.003
11-24-15	JK	1999.94	2.000
11-25-15	JK	1999.96	1.999
12-1-15	JK	1999.95	1.999
12-2-15	JK	1999.94	2.001
12-3-15	JK	1999.93	2.000
12-4-15	JK	1999.93	2.000
12-7-15	KE	1999.94	2.000
12-8-15	JK	1999.94	1.999
12-9-15	KE	1999.95	2.001
12-10-15	JK	1999.96	2.000
12-11-15	JK	1999.97	2.001
12-14-15	JK	1999.94	2.000
12-15-15	JK	1999.96	2.000
12/16/15	KE	1999.94	2.000
12-17-15	JK	1999.93	2.000
12/18/15	KE	1999.92	1.999

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010155

Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
12-21-15.	JK	1999,95	1.999
12-22-15.	JK	1999.95	1.999
12-23-15.	JK	1999.96	2.000
12-28-15.	JK	1999.93	2.001
12-29-15.	JK	1999,93	1.999
12-30-15	JK	1999.94	2,000
12-31-15	KE	1999.94	1.999
1-4-16	KE	1999.92	2.00
1-5-16.	JK	1999,92	2,000
1-6-16	KE	1999.94	2.000
1-7-16	KE	1999.95	2.000
1-8-16.	JK	1999,95	2,000
1/11/16	MG	1999.92	2.000
1-12-16.	JK	1999.92	2,000
1-13-16	KE	1999.92	2.000
1-14-16.	JK	1999,94	2,000
1-15-16.	JK	1999,94	1,999
1-18-16	KE	1999.92	2.000
1-19-16	KE	1999.93	2.000
1-20-16	KE	1999.94	2.000

Comments:

010156

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Certificates of Calibration

010157

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	37141
Asset Number:	007251	Calibrated:	8/21/2015
Description:	ANEMOMETER, HOTWIRE	Calibration Due:	8/21/2016
Manufacturer:	ALNOR	Data Type:	FOUND / LEFT
Model Number:	8570	Temp./RH:	72.1°F / 52 %
Serial Number:	99017063	Work Order #	403133835
Calibration Procedure:	AIR VELOCITY		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
011558	VAISALA	HMP77B	HUMIDITY/TEMPERATURE PROB	3/7/2016
014484	TSI	8390/8495	WIND TUNNEL CALIBRATION SYS	11/28/2021
014485	TSI	8495	TRANSDUCER DISPLAY & MONIT	9/2/2015
014486	MKS	220D	PRESSURE TRANSDUCER	2/19/2016
021448	FLUKE	PPC4	Pressure Controller	11/3/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133835	Mfr:	Alnor	Tech:	Mark Romero
Asset No:	007251	Model:	8570	Type Data:	Found-left
Serial No:	99017063	Type:	Anemometer	Cal Date:	21-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Linearity	ft/min	ft/min	ft/min	ft/min	ft/min		
2000	2028	2020	-8	61	37	Pass	13%
4000	3965	4035	70	119	71	Pass	59%
6000	6019	6040	21	181	108	Pass	12%
8000	8010	7940	-70	240	144	Pass	29%
10000	9585	9555	-30	288	173	Pass	10%
Temperature	°F	°F	°F	°F	°F		
Ambient	73.0	73.0	0.0	0.5	0.33	Pass	0%

END OF REPORT

010159

Southwest Research Institute

Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	24071
Asset Number:	018344	Calibrated:	2/3/2015
Description:	OVEN	Calibration Due:	2/3/2016
Manufacturer:	THERMO SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	HERATHERM OMS60	Temp./RH:	70 °F / 15 %
Serial Number:	41241291	Work Order #	403129130
Calibration Procedure:	OVENS, CHAMBERS, INCUBA		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
015454	HART SCIENTIFIC	5627A	THERMOMETER PRT	2/17/2015
018495	FLUKE	1523	TEMPERATURE METER	2/17/2015

Approved By

Calibrated By: RRV
Metrology Technician

010160

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403129130	Mfr:	Thermo Scientific	Technician:	RRV
Asset No:	018344	Model:	Heratherm OMS60	Type Data:	Found-left
Serial No:	41241291	Type:	Oven Chamber	Cal Date:	2-Feb-15

Remarks: Calibration limits per customer request. Chamber exceeds 70% of limit at the 200 °C test point. Customer to determine if the result found meets their requirements. Temperature uniformity not calibrated

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
50 °C	50.3	50.0	-0.3	2.0	0.18	Pass	15%
100 °C	100.9	100.0	-0.9				45%
200 °C	201.6	200.0	-1.6				80%

END OF REPORT

010161

Southwest Research Institute

Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36974
Asset Number:	022396	Calibrated:	8/19/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/19/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	73.6°F / 58 %
Serial Number:	22396	Work Order #	403133757
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

010162

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-found
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	2.2	0.5	Fail	159%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	3.0	1.3	Fail?	100%
	699.3	702.6	3.3	5.2	1.3	Pass	63%
	1002.6	1002.4	-0.2	7.5	1.3	Pass	3%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-left
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	19-Aug-15

Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	4.0	0.5	Pass	88%
	-44.4	-42.8	1.6	2.2	0.5	Pass	73%
	-0.1	0.3	0.4	2.2	0.5	Pass	18%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	20.0	1.3	Pass	15%
	699.3	702.6	3.3	35.0	1.3	Pass	9%
	1002.6	1002.4	-0.2	50.0	1.3	Pass	0%

END OF REPORT

010164

Southwest Research Institute

Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38121
Asset Number:	022476	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22476	Work Order #	403134199
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

010165

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134199	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022476	Model	08516-96	Type Data:	Found-left
Serial No.	22476	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.0	-0.7	2.2	0.5	Pass	33%
	498.0	497.7	-0.3	3.7	1.3	Pass	7%
	750.3	749.6	-0.7	5.6	1.3	Pass	12%
	1002.9	999.9	-3.0	7.5	1.3	Pass	40%

END OF REPORT

010166

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38186
Asset Number:	022490	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22490	Work Order #	403134278
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134278	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022490	Model	08516-96	Type Data:	Found-left
Serial No.	22490	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.1	1.7	2.2	0.5	Pass	77%
	99.7	99.1	-0.6	2.2	0.5	Pass	28%
	498.0	497.2	-0.8	3.7	1.3	Pass	20%
	750.3	751.9	1.6	5.6	1.3	Pass	28%
	1002.9	1000.2	-2.7	7.5	1.3	Pass	36%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38184
Asset Number:	022488	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22488	Work Order #	403134274
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

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Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134274	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022488	Model	08516-96	Type Data:	Found-left
Serial No.	22488	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.3	0.4	3.7	1.3	Pass	9%
	750.3	749.9	-0.4	5.6	1.3	Pass	7%
	1002.9	1000.5	-2.4	7.5	1.3	Pass	32%

END OF REPORT

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Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38183
Asset Number:	022487	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22487	Work Order #	403134273
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

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Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134273	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022487	Model	08516-96	Type Data:	Found-left
Serial No.	22487	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	98.7	-1.0	2.2	0.5	Pass	46%
	498.0	499.0	1.0	3.7	1.3	Pass	27%
	750.3	751.7	1.4	5.6	1.3	Pass	25%
	1002.9	1002.2	-0.7	7.5	1.3	Pass	9%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38185
Asset Number:	022489	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22489	Work Order #	403134275
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134275	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022489	Model	08516-96	Type Data:	Found-left
Serial No.	22489	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.1	-0.6	2.2	0.5	Pass	28%
	498.0	499.5	1.6	3.7	1.3	Pass	42%
	750.3	752.8	2.5	5.6	1.3	Pass	44%
	1002.9	1003.7	0.8	7.5	1.3	Pass	11%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36921
Asset Number:	020543	Calibrated:	8/18/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/18/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	77.4°F / 42 %
Serial Number:	20543	Work Order #	403133753
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133753	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	020543	Model	93631-11	Type Data:	As-found
Serial No.	20543	Type.	Thermocouple, Type K	Cal Date:	17-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.0	3.6	2.2	0.5	Fail	165%
	99.7	98.9	-0.8	2.2	0.5	Pass	38%
	398.4	402.8	4.4	3.0	1.3	Fail	147%
	699.3	704.2	4.9	5.2	1.3	Pass?	93%
	1002.6	1003.5	0.9	7.5	1.3	Pass	12%

END OF REPORT

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Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133753	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	020543	Model	93631-11	Type Data:	As-left
Serial No.	20543	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15

Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.0	3.6	4.0	0.5	Pass	90%
	-44.4	-43.0	1.4	2.2	0.5	Pass	63%
	-0.1	0.0	0.1	2.2	0.5	Pass	5%
	99.7	98.9	-0.8	2.2	0.5	Pass	36%
	398.4	402.8	4.4	20.0	1.3	Pass	22%
	699.3	704.2	4.9	35.0	1.3	Pass	14%
	1002.6	1003.5	0.9	50.0	1.3	Pass	2%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38118
Asset Number:	022473	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22473	Work Order #	403134196
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134196	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022473	Model	08516-96	Type Data:	Found-left
Serial No.	22473	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.7	0.8	3.7	1.3	Pass	20%
	750.3	750.9	0.6	5.6	1.3	Pass	11%
	1002.9	1001.5	-1.4	7.5	1.3	Pass	19%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	44162
Asset Number:	012017	Calibrated:	12/29/2015
Description:	CALIBRATOR, TEMPERATURE	Calibration Due:	12/29/2016
Manufacturer:	FLUKE	Data Type:	FOUND / LEFT
Model Number:	724	Temp./RH:	73.5°F / 41 %
Serial Number:	8776066	Work Order #	403136422
Calibration Procedure:	FLUKE 724, 725, 726		

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
Ohm source not calibrated below 240 Ohms per customer.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001505	AGILENT-HP	3458A OPT 002	MULTIMETER	5/1/2016
021436	FLUKE	5522A	MULTI-PRODUCT CALIBRATOR	11/5/2016

Approved By

Calibrated By: CER
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report.

Work Order:	403136422	Mfr:	Fluke	Technician:	CER
Asset No:	012017	Model:	724	Type Data:	Found-left
Serial No:	8776066	Type:	Calibrator	Cal Date:	29-Dec-15

Remarks: Ohm source not calibrated below 240 Ohms per customer.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
V DC Measure	V	V	V	V	V		
Upper Display	0	0.000	0.000	0.002	0.0012	Pass	0%
	15	15.001	0.001	0.005	0.0013	Pass	20%
	30	30.002	0.002	0.008	0.0013	Pass	25%
mV DC Measure	mV	mV	mV	mV	mV		
Lower Display	0	0.00	0.00	0.02	0.012	Pass	0%
	50	49.99	-0.01	0.03	0.013	Pass	33%
	89	88.99	-0.01	0.04	0.013	Pass	25%
V DC Measure	V	V	V	V	V		
Lower Display	0	0.000	0.000	0.002	0.0012	Pass	0%
	10	9.999	-0.001	0.004	0.0013	Pass	25%
	20	19.999	-0.001	0.006	0.0013	Pass	17%
mA DC Measure	mA	mA	mA	mA	mA		
Upper Display	4	4.000	0.000	0.003	0.0014	Pass	0%
	12	12.002	0.002	0.005	0.0020	Pass	40%
	24	24.004	0.004	0.007	0.0033	Pass	57%
Resistance	Ω	Ω	Ω	Ω	Ω		
4-Wire Measure	15	14.97	-0.03	0.10	0.01	Pass	30%
Lower Display	350	350.01	0.01	0.10	0.036	Pass	10%
	500	500.0	0.0	0.5	0.10	Pass	0%
	1500	1500.1	0.1	0.5	0.12	Pass	20%
	3200	3200.3	0.3	1.0	0.20	Pass	30%
3-Wire RTD	Ω	Ω	Ω	Ω	Ω		
Lower Display	350	349.99	-0.01	0.20	0.036	Pass	5%
Type J TC Measure	°C	°C	°C	°C	°C		
Lower Display	0	0.0	0.0	0.7	0.22	Pass	0%
Type J TC Source	°C	°C	°C	°C	°C		
Lower Display	0	0.00	0.00	0.70	0.17	Pass	0%
mV DC Source	mV	mV	mV	mV	mV		
Lower Display	0	-0.001	-0.001	0.020	0.0004	Pass	5%
	45	44.999	-0.001	0.030	0.002	Pass	4%
	100	99.998	-0.002	0.040	0.002	Pass	5%

Southwest Research Institute
Calibration Laboratory
Measurement Report.

Work Order:	403136422	Mfr:	Fluke	Technician:	CER
Asset No:	012017	Model:	724	Type Data:	Found-left
Serial No:	8776066	Type:	Calibrator	Cal Date:	29-Dec-15

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
V DC Source	V	V	V	V	V		
Lower Display	0	0.0000	0.0000	0.0020	0.00001	Pass	1%
	5	5.0000	0.0000	0.0030	0.00006	Pass	0%
	10	10.0000	0.0000	0.0040	0.00006	Pass	0%
Resistance Source	Ω	Ω	Ω	Ω	Ω		
Lower Display	15	n/a	#VALUE!	0.100	0.006	######	######
	360	360.037	0.037	0.100	0.006	Pass	37%
	500	500.11	0.11	0.50	0.04	Pass	22%
	1500	1500.12	0.12	0.50	0.04	Pass	24%
	3200	3200.20	0.20	1.00	0.07	Pass	20%

END OF REPORT

010182

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39984
Asset Number:	020014	Calibrated:	10/7/2015
Description:	BALANCE	Calibration Due:	10/7/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	72 °F / 49 %
Serial Number:	B338797310	Work Order #	403134943
Calibration Procedure:	BALANCES & SCALES		

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0002	0.0002	0.0006	Pass	33%
Left Rear		100.0003	0.0003		Pass	50%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0002	0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	80.00001				
2		80.00002				
3		80.00001				
4		80.00002				
5		80.00001				
6		80.00002				
7		80.00002				
8		80.00002				
9		80.00002				
10		80.00002				
Std Deviation		0.000005		0.00008	Pass	6%
< 220 g Range						
1	200	200.0001				
2		200.0000				
3		200.0002				
4		200.0001				
5		200.0002				
6		200.0001				
7		200.0002				
8		200.0002				
9		200.0002				
10		200.0002				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.06	Pass	0%
	8.00001	8.00002	0.01			Pass	3%
	15.99996	15.99995	-0.01			Pass	3%
	24.00005	24.00010	0.05			Pass	13%
	32.00000	32.00006	0.06			Pass	15%
	40.00002	40.00007	0.05			Pass	13%
	48.00003	48.00006	0.03			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99998	56.00006	0.08	0.40	0.06	Pass	20%
	63.99999	64.00014	0.15			Pass	38%
	72.00002	72.00018	0.16			Pass	40%
	79.99998	80.00009	0.11			Pass	28%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.18	Pass	0%
< 220 g Range	20.0000	20.0001	0.1			Pass	25%
	40.0000	40.0000	0.0			Pass	0%
	60.0000	60.0001	0.1			Pass	25%
	80.0000	80.0001	0.1			Pass	25%
	100.0001	100.0000	-0.1			Pass	25%
	120.0001	120.0001	0.0			Pass	0%
	140.0001	140.0002	0.1			Pass	25%
	160.0001	160.0002	0.1			Pass	25%
	180.0001	180.0002	0.1			Pass	25%
	199.9999	200.0002	0.3			Pass	75%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	33590
Asset Number:	009065	Calibrated:	6/24/2015
Description:	BALANCE	Calibration Due:	6/24/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	PR2003DR	Temp./RH:	72 °F / 52 %
Serial Number:	1120351000	Work Order #	403132563
Calibration Procedure:	BALANCES & SCALES		

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001711	TROEMNER	50 G	WEIGHT CLASS 1	7/1/2015
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2015
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/12/2016
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/9/2015
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/7/2016
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

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Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132563	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	24-Jun-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit		Result	% Limit
Corner Load	grams	grams	grams	grams			
Left Front	1000	1000.000	0.000	0.006		Pass	0%
Left Rear		1000.000	0.000			Pass	0%
Right Rear		1000.000	0.000			Pass	0%
Right Front		1000.000	0.000			Pass	0%
Repeatability							
500 gram Range							
1	200	200.000					
2		200.000					
3		199.999					
4		200.001					
5		200.000					
6		200.000					
7		199.999					
8		200.000					
9		199.999					
10		200.000					
Std Deviation		0.0006		0.0020		Pass	30%
2000 gram Range							
1	1000	1000.00					
2		1000.00					
3		1000.00					
4		1000.00					
5		1000.00					
6		1000.00					
7		1000.00					
8		1000.00					
9		1000.00					
10		1000.00					
Std Deviation		0.000		0.006		Pass	0%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
500 gram Range	0.000	0.000	0.000	0.004	0.0014	Pass	0%
	50.000	50.000	0.000			Pass	0%
	100.000	100.001	0.001			Pass	25%
	150.000	150.002	0.002			Pass	50%
	200.000	200.000	0.000			Pass	0%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132563	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	24-Jun-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing *(cont.)*	grams	grams	grams	grams	grams		
500 gram Range	250.000	250.001	0.001	0.004	0.0014	Pass	25%
	300.000	300.001	0.001			Pass	25%
	350.000	349.999	-0.001			Pass	25%
	400.000	400.000	0.000			Pass	0%
	450.000	449.998	-0.002			Pass	50%
	500.000	500.000	0.000			Pass	0%
Direct Weighing	0.00	0.00	0.00	0.01	0.006	Pass	0%
2000 gram Range	200.00	200.00	0.00			Pass	0%
	400.00	400.00	0.00			Pass	0%
	600.00	600.00	0.00			Pass	0%
	800.00	800.00	0.00			Pass	0%
	1000.00	1000.00	0.00			Pass	0%
	1200.00	1200.00	0.00			Pass	0%
	1400.00	1400.00	0.00			Pass	0%
	1600.00	1600.00	0.00			Pass	0%
	1800.00	1800.00	0.00			Pass	0%
	2000.00	2000.00	0.00			Pass	0%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39315
Asset Number:	014981	Calibrated:	9/25/2015
Description:	BALANCE	Calibration Due:	9/25/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	73 °F / 48 %
Serial Number:	1129242107	Work Order #	403134657
Calibration Procedure:	BALANCES & SCALES		

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134657	Mfr:	Mettler	Technician:	RRV
Asset No.:	014981	Model:	XS205DU	Type Data:	Found-left
Serial No.:	1129242107	Type:	Balance	Cal Date:	25-Sep-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		99.9998	-0.0002	0.0006	Pass	33%
Left Rear		100.0000	0.0000		Pass	0%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0000	0.0000		Pass	0%
Repeatability						
< 81 g Range						
1	80	79.99998				
2		79.99998				
3		79.99999				
4		79.99998				
5		79.99997				
6		80.00001				
7		79.99999				
8		79.99998				
9		79.99999				
10		80.00000				
Std Deviation		0.000012		0.00008	Pass	15%
< 220 g Range						
1	200	200.0000				
2		199.9999				
3		199.9999				
4		199.9998				
5		199.9997				
6		200.0000				
7		199.9999				
8		199.9998				
9		199.9999				
10		199.9999				
Std Deviation		0.00009		0.00020	Pass	45%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.07	Pass	0%
	8.00001	8.00000	-0.01			Pass	3%
	15.99996	15.99999	0.03			Pass	8%
	24.00005	24.00000	-0.05			Pass	13%
	32.00000	31.99999	-0.01			Pass	3%
	40.00002	40.00005	0.03			Pass	8%
	48.00003	48.00006	0.03			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134657	Mfr:	Mettler	Technician:	RRV
Asset No.:	014981	Model:	XS205DU	Type Data:	Found-left
Serial No.:	1129242107	Type:	Balance	Cal Date:	25-Sep-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99998	56.00000	0.02	0.40	0.07	Pass	5%
	63.99999	64.00005	0.06			Pass	15%
	72.00002	72.00004	0.02			Pass	5%
	79.99998	80.00003	0.05			Pass	13%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.22	Pass	0%
< 220 g Range	20.0000	19.9999	-0.1			Pass	25%
	40.0000	39.9999	-0.1			Pass	25%
	60.0000	59.9998	-0.2			Pass	50%
	80.0000	79.9998	-0.2			Pass	50%
	100.0001	99.9999	-0.2			Pass	50%
	120.0001	120.0001	0.0			Pass	0%
	140.0001	140.0000	-0.1			Pass	25%
	160.0001	160.0000	-0.1			Pass	25%
	180.0001	180.0000	-0.1			Pass	25%
	199.9999	200.0001	0.2			Pass	50%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	34998
Asset Number:	020917	Calibrated:	7/20/2015
Description:	DATA LOGGER	Calibration Due:	7/20/2016
Manufacturer:	OMEGA	Data Type:	FOUND / LEFT
Model Number:	OM-CP-PRHTEMP2000	Temp./RH:	69 °F / 43 %
Serial Number:	P28381	Work Order #	403132811
Calibration Procedure:	TEMPERATURE, HUMIDITY-D		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
006404	THUNDER SCIENTIFIC	2500	HUMIDITY GENERATOR	5/28/2016
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016
021448	FLUKE	PPC4	Pressure Controller	11/3/2015

Approved By

Calibrated By: RLC
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132811	Mfr.:	Omega	Technician:	MAR / RLC
Asset No.:	020917	Model:	OM-CP-PRHTEMP2000	Type Data:	Found-left
Serial No.:	P28381	Type:	Data Logger	Cal Date:	20-Jul-15

Remarks: pressure test points established per customer range request. Reading at 65% RH is 70% of the allowed limit.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Humidity	% RH	% RH	% RH	% RH	% RH		
	35.0	36.5	1.5	3.0	0.68	Pass	50%
	50.0	50.9	0.9		0.68	Pass	30%
	65.0	62.9	-2.1		0.68	Pass	70%
Temperature	°C	°C	°C	°C	°C		
	20.4	20.4	0.0	0.5	0.18	Pass	0%
	25.0	24.9	-0.1		0.18	Pass	20%
	29.8	29.8	0.0		0.18	Pass	0%
Pressure	psia	psia	psi	psi	psi		
	12	11.986	-0.014	0.060	0.01	Pass	23%
	18	18.020	0.020		0.02	Pass	33%
	24	24.010	0.010			Pass	17%
	30	29.966	-0.034			Pass	57%

END OF REPORT

010195

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 151222-14
SwRI SRR: 56087
SDG: 589620
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Chemicals Certificates of Analysis

010196

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**S318**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**152074**		
Description	**SODIUM HYDROXIDE, A.C.S.**		
Country of Origin	**United States**	*** Suggested Retest Date**	**Mar-2020**
Chemical Origin	**Inorganic**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	White pellets
ASSAY	%	>= 97.0	99.1
CALCIUM	%	<= 0.005	<0.0050
CHLORIDE	%	<= 0.005	<0.005
HEAVY METALS (as Ag)	%	<= 0.002	<0.0020
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
IRON (Fe)	%	<= 0.001	<0.0010
MAGNESIUM	%	<= 0.002	<0.0020
MERCURY (Hg)	ppm	<= 0.1	<0.10
NICKEL (Ni)	%	<= 0.001	<0.0010
NITROGEN COMPOUNDS	%	<= 0.001	<0.0010
PHOSPHATE (PO4)	%	<= 0.001	<0.0010
POTASSIUM (K)	%	<= 0.02	<0.020
SODIUM CARBONATE	%	<= 1.0	0.3
SULFATE (SO4)	%	<= 0.003	<0.0030



Edgar E. Hans

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 61580

SwRI Chem ID: 62882

010197

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Website: www.sigmaaldrich.com
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Certificate of Analysis

Product Name:
Potassium nitrate – ReagentPlus®, ≥99.0%

Product Number:	**P8394**
Batch Number:	**MKBT3182V**
Brand:	SIAL
CAS Number:	7757-79-1
MDL Number:	MFCD00011409
Formula:	KNO3
Formula Weight:	101.10 g/mol
Quality Release Date:	20 NOV 2014
Recommended Retest Date:	NOV 2018

KNO_3

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form)	Powder or Crystals	Powder
Titration	≥ 99.0 %	99.5 %
Solubility (Turbidity) 20 g per 150 ml of water	Clear	Clear
Solubility (Color)	Colorless	Colorless
Recommended Retest Period 4 Years		

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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SwRI Chem ID: 62882
SwRI Chem ID: 62882

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Certificate of Analysis

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBN0101V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	02 MAY 2014
Recommended Retest Date:	APR 2020

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	99.4 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	MEETS REQUIREMENTS OF ACS 10TH ED
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	PASSED
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

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SwRI Chem ID: 54983
SwRI Chem ID: 54983
SwRI Chem ID: 54983

SwRI Chem ID: 65583

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Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate – ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

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SwRI Chem ID: 65583

SwRI Chem ID: 65583

010200

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SwRI Chem ID: 65583

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 65583

SwRI Chem ID: 65583

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010201

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm

SwRI Chem ID: 61751
SwRI Chem ID: 61751
SwRI Chem ID: 61751

Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 4 September 2015

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Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 61751
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010203

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Outside USA: eurtechserv@sial.com

SwRI Chem ID: 63604

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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SwRI Chem ID: 63604
SwRI Chem ID: 63604

010204

Certificate of Analysis

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Product Name	Sodium nitrate, ACS reagent, ≥99.0%
Product Number	221341
Product Brand	Sigma-Aldrich
CAS Number	7631-99-4
Molecular Formula	$NaNO_3$
Molecular Weight	84.99

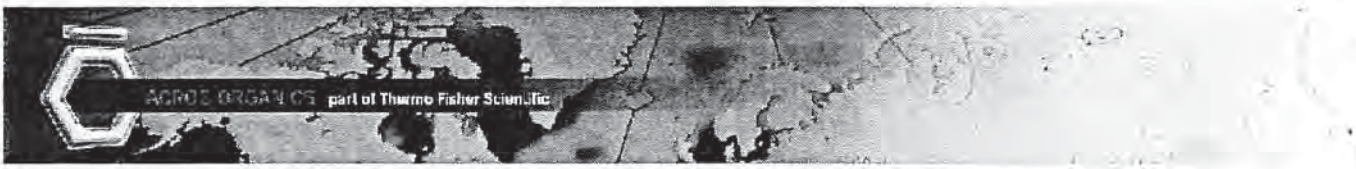
INORGANIC LABS/RADCHEM LABS
DATE RECEIVED: 10/24/08
DATE EXPIRED: 10/24/2018
DATE OPENED: 11/7/08
INORG: 7246/7247 PO: N/A from 07.V.16

TEST	LOT 07030MH RESULTS
APPEARANCE	WHITE CRYSTALLINE POWDER
TITRATION	99.7% (WITH NAOH) *
ICP ASSAY	CONFIRMS SODIUM COMPONENT
INSOLUBLE MATTER	0.003% (20%, H2O) *
CALCIUM	0.003% *
CHLORIDE	0.0002% *
IRON	1 PPM *
HEAVY METALS	3 PPM (AS PB) *
IODATE	2 PPM *
MAGNESIUM	0.001% *
NITRITE	0.0005% *
PH	6.0 @ 25 DEG C (5% H2O) *
PHOSPHATE	2 PPM *
SULFATE	0.001% *
	* SUPPLIER DATA
	MEETS REQUIREMENTS OF ACS 10TH ED
QC RELEASE DATE	NOVEMBER 2007

Barbara Rajzer

Barbara Rajzer, Supervisor
Quality Control
Milwaukee, Wisconsin USA

SwRI Chem ID: 33384
SwRI Chem ID: 33384
SwRI Chem ID: 33384



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

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Catalog Number	42385	**Quality Test / Release Date**	7 August 2014
Lot Number	A0350156	**Suggested Retest Date**	August 2019
Description	Lead(II) nitrate,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystalline powder
Titration Complexometric	>=99.0 %	99.5 %
Insoluble matter	=<0.005 %	0.002 %
Trace analysis	Type: Cl measure =< 10 ppm	Type: Cl measure =< 10 ppm
Trace analysis	Type: Cu measure =< 20 ppm	Type: Cu measure =< 10 ppm
Trace analysis	Type: Fe measure =< 10 ppm	Type: Fe measure =< 5 ppm
Trace analysis	Type: Ca measure =< 50 ppm	Type: Ca measure =< 10 ppm
Trace analysis	Type: K measure =< 50 ppm	Type: K measure =< 10 ppm
Trace analysis	Type: Na measure =< 200 ppm	Type: Na measure =< 10 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 4 November 2015

Acros Organics
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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 64108
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SwRI Chem ID: 64108

SwRI Chem ID: 63608

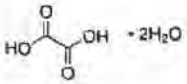
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Certificate of Analysis

Product Name:
Oxalic acid dihydrate - ACS reagent, ≥99%



Product Number:	**247537**
Batch Number:	**MKBS8637V**
Brand:	SIAL
CAS Number:	6153-56-6
MDL Number:	MFCD00149102
Formula:	C2H2O4 · 2H2O
Formula Weight:	126.07 g/mol
Quality Release Date:	18 SEP 2014
Recommended Retest Date:	SEP 2019

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Crystals, Powder, Crystalline or Granular Powder	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by KMNO4	99.5 - 102.5 %	99.9 %
Residue on ignition (Ash)	≤ 0.01 %	< 0.01 %
Insoluble Matter C=8%, H2O	≤ 0.005 %	< 0.001 %
Calcium (Ca)	≤ 0.001 %	< 0.001 %
Chloride Content	≤ 0.002 %	< 0.002 %
Substances Darkened (by H2SO4)	Pass	Pass
Iron (Fe)	≤ 2 ppm	< 2 ppm
Heavy Metals	≤ 5 ppm	< 3 ppm
Nitrogen Compounds	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %
Meets ACS Requirements	Current ACS Specification	Conforms
Recommended Retest Period 5 years	----------	----------

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SwRI Chem ID: 63608
SwRI Chem ID: 63608

010207

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SwRI Chem ID: 63608

Certificate of Analysis

Product Number: 247537
Batch Number: MKBS8637V

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 63608

SwRI Chem ID: 63608

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SwRI Chem ID: 63914

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Certificate of Analysis

Product Name:
Potassium carbonate – ACS reagent, ≥99.0%

Product Number:	**209619**
Batch Number:	**SLBM3461V**
Brand:	SIAL
CAS Number:	584-08-7
MDL Number:	MFCD00011382
Formula:	CK2O3
Formula Weight:	138.21 g/mol
Quality Release Date:	28 JAN 2015
Recommended Retest Date:	JAN 2018

K_2CO_3

Test	Specification	Result
Assay	≥ 99.0 %	99.8 %
Insoluble Matter < or = 0.01%	Pass	Pass
Chloride (Cl) < or = 0.003%	Pass	Pass
Phosphate (PO4) < or = 0.001%	Pass	Pass
Silica < or = 0.005%	Pass	Pass
Sulfur coumpounds < or = 0.004%	Pass	Pass
Calcium < or = 0.005%	Pass	Pass
Magnesium < or = 0.002%	Pass	Pass
Sodium < or = 0.02%	Pass	Pass
Iron (Fe) < or = 5 ppm	Pass	Pass
Heavy Metals (as Lead)	< = 5 ppm	< 5 ppm

SwRI Chem ID: 63914

SwRI Chem ID: 63914

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SwRI Chem ID: 63914

Certificate of Analysis

Product Number: 209619
Batch Number: SLBM3461V

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

SwRI Chem ID: 63914

SwRI Chem ID: 63914

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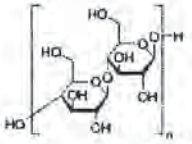
3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 61128

Certificate of Analysis

Product Name:
Cellulose - fibers, (medium)

Product Number:	**C6288**
Batch Number:	**SLBL2989V**
Brand:	SIGMA
CAS Number:	9004-34-6
MDL Number:	MFCD00081512
Quality Release Date:	25 AUG 2014



Test	Specification	Result
Appearance (Color)	White to Off White	White
Appearance (Form)	Powder or Solid	Powder
Moisture Content	≤ 10 %	4 %

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

SwRI Chem ID: 61128

SwRI Chem ID: 61128

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

010211

SIGMA-ALDRICH

sigma-aldrich.com

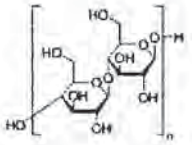
3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 65519

Certificate of Analysis

Product Name:
Cellulose - fibers, (medium)

Product Number:	**C6288**
Batch Number:	**SLBL2989V**
Brand:	SIGMA
CAS Number:	9004-34-6
MDL Number:	MFCD00081512
Quality Release Date:	25 AUG 2014



Test	Specification	Result
Appearance (Color)	White to Off White	White
Appearance (Form)	Powder or Solid	Powder
Moisture Content	≤ 10 %	4 %

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65519
SwRI Chem ID: 65519

Appendix H
SwRI Test Report, February 3, 2016

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

February 03, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Ashley Pryor

Subject:

Case:	Zeolite
SwRI Project Number:	21592.01.00X
SDG:	581291
SwRI Task Order Number:	160105-8
SwRI Sample Receipt Number:	56087
Samples Received:	09.03.2015
Analysis:	Various Wetchem

Dear Ms. Pryor,

Please find the enclosed results for the overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or via email at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Group Leader-R&D

APPROVED:

Michael J. Dammann
Director

RS: mg
Encl

010001

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160105-8
SwRI SRR: 56087
SDG: 581291
CASE: Zeolite
VTSR: 09.03.2015

SAMPLE RECEIPT PAPERWORK

Total Page Count:
Fraction: Data Report Pages: 010001-010141

Southwest Research Institute

Laboratory Task Order

TO #: 160105-8 Revision: 2

010002

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 01/13/16

SDG: 581291

SRR #'s: 56087
Client(s): Los Alamos National Laboratory

Instructions

Subcontract No. 355836 SOW Exhibit D

Documents Related to this task order: 185604[COC for SRR 56087], 185605[SRR Paperwork for SRR 56087], 191181[New Sample IDs], 191404[]

Deliverables --> Hard Copy: no EDD: no PDF: -YES-

Test: COMB_1050
Section: WETCHEM

Holding: 180 days from CED

SW846 1050 Test A & C Spontaneous Combustion

Cnt: 14

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581292		1	Solid	UNS Blend 2	NO DATA	NO DATA
581293		1	Solid	UNS Blend 3	NO DATA	NO DATA
581294		1	Solid	UNS Blend 4	NO DATA	NO DATA
581295		1	Liquid	UNS Blend 5	NO DATA	NO DATA
581296		1	Liquid	UNS Blend 6	NO DATA	NO DATA
581297		1	Liquid	UNS Blend 7	NO DATA	NO DATA
581298		1	Solid	UNS Blend 8	NO DATA	NO DATA
581300		1	Solid	UNS Blend 9	NO DATA	NO DATA
581301		1	Solid	UNS Blend 10	NO DATA	NO DATA
581302		1	Solid	UNS Blend 11	NO DATA	NO DATA
581303		1	Solid	UNS Blend 12	NO DATA	NO DATA
589629		1	Surrogate	UNS Blend 13	NO DATA	NO DATA
589632		1	Surrogate	UNS Blend 16	NO DATA	NO DATA
589634		1	Surrogate	UNS Blend 18	NO DATA	NO DATA

Test: IGNIT_1030
Section: WETCHEM

Holding: 180 days from CED

SW 846 Method 1030 Ignitability of solids

Cnt: 14

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581292		1	Solid	UNS Blend 2	NO DATA	NO DATA
581293		1	Solid	UNS Blend 3	NO DATA	NO DATA
581294		1	Solid	UNS Blend 4	NO DATA	NO DATA
581295		1	Liquid	UNS Blend 5	NO DATA	NO DATA
581296		1	Liquid	UNS Blend 6	NO DATA	NO DATA
581297		1	Liquid	UNS Blend 7	NO DATA	NO DATA
581298		1	Solid	UNS Blend 8	NO DATA	NO DATA
581300		1	Solid	UNS Blend 9	NO DATA	NO DATA
581301		1	Solid	UNS Blend 10	NO DATA	NO DATA
581302		1	Solid	UNS Blend 11	NO DATA	NO DATA
581303		1	Solid	UNS Blend 12	NO DATA	NO DATA
589629		1	Surrogate	UNS Blend 13	NO DATA	NO DATA
589632		1	Surrogate	UNS Blend 16	NO DATA	NO DATA
589634		1	Surrogate	UNS Blend 18	NO DATA	NO DATA

Test: Oxidizer_UN
Section: WETCHEM

Holding: 180 days from CED

United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.

Cnt: 14

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581292		1	Solid	UNS Blend 2	NO DATA	NO DATA

Southwest Research Institute

Laboratory Task Order

TO #: 160105-8 Revision: 2

010003

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 01/13/16

SDG: 581291

SRR #'s: 56087
Client(s): Los Alamos National Laboratory

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581293		1	Solid	UNS Blend 3	NO DATA	NO DATA
581294		1	Solid	UNS Blend 4	NO DATA	NO DATA
581295		1	Liquid	UNS Blend 5	NO DATA	NO DATA
581296		1	Liquid	UNS Blend 6	NO DATA	NO DATA
581297		1	Liquid	UNS Blend 7	NO DATA	NO DATA
581298		1	Solid	UNS Blend 8	NO DATA	NO DATA
581300		1	Solid	UNS Blend 9	NO DATA	NO DATA
581301		1	Solid	UNS Blend 10	NO DATA	NO DATA
581302		1	Solid	UNS Blend 11	NO DATA	NO DATA
581303		1	Solid	UNS Blend 12	NO DATA	NO DATA
589629		1	Surrogate	UNS Blend 13	NO DATA	NO DATA
589632		1	Surrogate	UNS Blend 16	NO DATA	NO DATA
589634		1	Surrogate	UNS Blend 18	NO DATA	NO DATA

Test: Oxidizing Liq_UN
Section: WETCHEM

Holding: 180 days from CED

Test for Oxidizing Liquids - UN Manual of Tests and Criteria Part 3

Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581291		1	Liquid	UNS Blend 1	NO DATA	NO DATA
589630		1	Surrogate	UNS Blend 14	NO DATA	NO DATA

Test: PAINT_9095
Section: WETCHEM

Holding: 180 days from CED

SW846 9095 Paint Filter Liquids Test

Cnt: 14

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581292		1	Solid	UNS Blend 2	NO DATA	NO DATA
581293		1	Solid	UNS Blend 3	NO DATA	NO DATA
581294		1	Solid	UNS Blend 4	NO DATA	NO DATA
581295		1	Liquid	UNS Blend 5	NO DATA	NO DATA
581296		1	Liquid	UNS Blend 6	NO DATA	NO DATA
581297		1	Liquid	UNS Blend 7	NO DATA	NO DATA
581298		1	Solid	UNS Blend 8	NO DATA	NO DATA
581300		1	Solid	UNS Blend 9	NO DATA	NO DATA
581301		1	Solid	UNS Blend 10	NO DATA	NO DATA
581302		1	Solid	UNS Blend 11	NO DATA	NO DATA
581303		1	Solid	UNS Blend 12	NO DATA	NO DATA
589629		1	Surrogate	UNS Blend 13	NO DATA	NO DATA
589632		1	Surrogate	UNS Blend 16	NO DATA	NO DATA
589634		1	Surrogate	UNS Blend 18	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15

Time: 08:30:00
Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

Notes

Sample was delivered intact. (no ice).

Fed Ex #(s):
590817794105 - 21.2 °C

See Task Order for full requirements.

See chain of custody as part of the SRR system for more information.

The Product along with the Section 4.0 of the paperwork provided by the client will be used to create the ADDITIONAL Solid and Liquid Surrogates identified in the Client ID section.

Due to character limitations, the following
1 (UNS LQ+SWheat 1:1):1 Spillfyter :3 zeolite or cemented
was abbreviated to:
1(UNSLQ+SWht 1:1):1 Spillfyter:3 zeolite or cmtd

1 (UNS LQ+SWheat 1:1):1 Spillfyter :1citric acid :3 zeolite or cemented
was abbreviated to:
1(UNSLQ+SWht 1:1):1 Spillfyter:1 citric acid :3

Phases:
001 - admin
002 - extraction
005 - 8082
006 - metals/radchem
007 - drg

Rev. 1
Corrected project number.
REVISION 2, DRmz 12/15/15: New Sample IDs added to the SRR, along with revisions done to previously created IDs, per email from Radonna Spies.

Rev. 3
Added samples and revised sample ID's. See attached email.

Backaround CPM: <100 cpm
Container Wipe CPM: <100 cpm
Total CPM: <100

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
581326	Blend 1		Surrogate	1	
581325	Blend 10		Surrogate	1	
581319	Blend 11		Surrogate	1	
581321	Blend 12		Surrogate	1	
581323	Blend 13		Surrogate	1	
589460	Blend 14		Surrogate	1	
589461	Blend 15		Surrogate	1	
589462	Blend 16		Surrogate	1	
589620	Blend 17		Surrogate	1	

56087 Los Alamos National Laborato

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15

Time: 08:30:00

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
589621	Blend 18		Surrogate	1	
589622	Blend 19		Surrogate	1	
581327	Blend 2		Surrogate	1	
589623	Blend 20		Surrogate	1	
589624	Blend 21		Surrogate	1	
589625	Blend 22		Surrogate	1	
589626	Blend 23		Surrogate	1	
589627	Blend 24		Surrogate	1	
589628	Blend 25		Surrogate	1	
581328	Blend 3		Surrogate	1	
581329	Blend 4		Surrogate	1	
581331	Blend 5		Surrogate	1	
581332	Blend 6		Surrogate	1	
581333	Blend 7		Surrogate	1	
581334	Blend 8		Surrogate	1	
581324	Blend 9		Surrogate	1	
581330	Cement 1		Surrogate	1	
589463	Cement 10		Surrogate	1	
589464	Cement 11		Surrogate	1	
589465	Cement 12		Surrogate	1	
589466	Cement 13		Surrogate	1	
589467	Cement 14		Surrogate	1	
589468	Cement 15		Surrogate	1	
581335	Cement 2		Surrogate	1	
581318	Cement 3		Surrogate	1	
581320	Cement 4		Surrogate	1	
581322	Cement 5		Surrogate	1	
589469	Cement 6		Surrogate	1	
589470	Cement 7		Surrogate	1	
589471	Cement 8		Surrogate	1	
589472	Cement 9		Surrogate	1	
581291	UNS Blend 1		Liquid	1	
581301	UNS Blend 10		Solid	1	
581302	UNS Blend 11		Solid	1	
581303	UNS Blend 12		Solid	1	
589629	UNS Blend 13		Surrogate	1	
589630	UNS Blend 14		Surrogate	1	
589631	UNS Blend 15		Surrogate	1	
589632	UNS Blend 16		Surrogate	1	
589633	UNS Blend 17		Surrogate	1	
589634	UNS Blend 18		Surrogate	1	

56087 Los Alamos National Laborato

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15

Time: 08:30:00

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged In by: SDOUGLAS
Creation Date: 09/03/15

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
589635	UNS Blend 19		Surrogate	1	
581292	UNS Blend 2		Solid	1	
581293	UNS Blend 3		Solid	1	
581294	UNS Blend 4		Solid	1	
581295	UNS Blend 5		Liquid	1	
581296	UNS Blend 6		Liquid	1	
581297	UNS Blend 7		Liquid	1	
581298	UNS Blend 8		Solid	1	
581300	UNS Blend 9		Solid	1	
581299	Zeolite		Solid	1	

Containers: 60 **Samples: 60**

These documents are associated with this receipt: 185604[COC for SRR 56087], 185605[SRR Paperwork for SRR 56087], 191181[New Sample IDs], 191404[]

Thermometer: 021056
Temperature: 21.2

56087 Los Alamos National Laborato

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160105-8
SwRI SRR: 56087
SDG: 581291
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of UNS Blends 1 through 14, 16, and 18. UNS blends 15, 17, and 19 were initially proposed but as testing began it was determined that these three blends would not be needed. Table 1 contains the sample ID's, UNS solution used, and the methods requested on each of the blends. A UNS surrogate solution was initially prepared following the scope of work provided by Los Alamos. The salts were combined and dissolved until about only 2% of salt remained undissolved. One of the portions was neutralized with Splifyter® Kolorsafe® liquid acid neutralizer to a pH of 5. It took approximately 2 parts Splifyter to 1 part UNS solution. The two solutions were labeled: "unadjusted" and "pH adjusted", and they were used to make up all of the UNS surrogate blends.

To make blends UNS Blends 2 though 1, large batches of 1:1 and 1:3 UNS (unadjusted)/Swheat and 1:1 and 1:3 UNS (pH adjusted)/Swheat were prepared. These four mixtures were allowed to set for one day at room temperature. Portion of each of the four mixtures was removed at this point and set aside for analysis as Blends 2 though 5. The other portion of the four mixtures were combined with water and mixed for two minutes at a volume ratio of 1 part water to 2 parts waste. These slurries were then split and mixed with zeolite at either a 3:1 and 2:1 zeolite to waste ratio. UNS Blends 6 though 9 were the 3:1 zeolite to waste and UNS Blends 10 through 13 were the 2:1 zeolite to waste mixtures. Once added to the zeolite, the blends were allowed to set for 24 hours at room temperature before proceeding with analysis.

UNS blends 14, 16, and 18 were first mixed at a volume ratio of 50mL UNS solution to 3.12mL of wastelock. This mixture was allowed to set for 24 hours before proceeding to the next step. During preliminary formulations of these blends it was found that the wastelock did not absorb the waste at all. It was found that the wastelock was better suited on neutralized solutions with low amounts of cations. Since the UNS blend was very acidic and high in cations the wastelock did little more than float about in the waste (Image 1).

Table 1. Surrogate creation and analysis table

Surrogate ID	Times made	UNS Sol	Methods				
			1030	1050	UN Ox solid	Paint filter	UN OX liquid
UNS Blend 1	1	unadjusted	*	*	*	*	1++
UNS Blend 2	1	unadjusted	1	1	1	1	*
UNS Blend 3	1	unadjusted	1	1	1	1	*
UNS Blend 4	1	pH adjusted	1	1	1	1	*
UNS Blend 5	1	pH adjusted	1	1	1	1	*
UNS Blend 6	1	unadjusted	1	1	1	1	*
UNS Blend 7	1	unadjusted	1	1	1	1	*
UNS Blend 8	1	pH adjusted	1	1	1	1	*
UNS Blend 9	1	pH adjusted	1	1	1	1	*

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8

Table 1. (continued)

Surrogate ID	Times made	UNS Sol	Methods				
			1030	1050	UN Ox solid	Paint Filter	UN OX liquid
UNS Blend 10	1	unadjusted	1	1	1	1	*
UNS Blend 11	1	unadjusted	1	1	1	1	*
UNS Blend 12	1	pH adjusted	1	1	1	1	*
UNS Blend 13	1	pH adjusted	1	1	1	1	*
UNS Blend 14	1	unadjusted	*	*	*	*	1++
UNS Blend 16	1	unadjusted	1	1	1	1	*
UNS Blend 18	1	unadjusted	1	1	1	1	*

*Testing not required for these methods.
++ UN Ox liquid results will follow in a separate report. They are not complete at this time.

SW-846 9095B: Paint Filter

For this method 100g of each blend was placed into a Gerson 260um paint filter (PN010714R, Lot# B5140428JF8) that was suspended over a 100 mL graduated cylinder for 5 minutes to collect any free liquids. During this 5-min period if any of the sample material drips into the cylinder, the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314. Under the laboratory conditions above all of the UNS blends tested for paint filter were not deemed to contain free liquids.

SW-846 1030: Ignitability of Solids

The surrogate material was formed into an unbroken powder train, 250 mm in length. An ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within 2 minutes. If the material combustion propogated, the burning time was measured over a distance of 100 mm and the rate of burning would be determined. The samples were then placed onto a ceramic tile with marks at the 80 and 180 mm in from the end of the train. The ceramic tile was placed about 8 inches in a hood with the sash lowered to give an airflow of about 0.7 m/sec. One end of the train was exposed to the end of a acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes and if the sample began to burn down the train the time taken to get from the 80 to 180 mm mark was measure to determine the burn rate.

UNS Blends 6 though 13, 16, and 18 had charring of the zeolite around the point of flame application but no flames or propagation occurred past the burn point (Image 2). Occasionally, a popping sound would be heard and a spark would fly off the sample most likely from the nitrates present.UNS Blend 2 charred and hardened at the point of flame application but remained moist and mushy in the middle (Image 3). UNS Blend 3 burned slightly and maintained a flame several seconds after removal of the acetylene torch (Image 4). Little propagation occurred but did not reach the 100mm zone. UNS Blend 4 had very little burn even at the point of application most likely due to the high amount of moisture present in the sample (Image 5). UNS Blend 5 maintained a flame several second after removal of the acetylene torch and a majority of the material at the application

point was consumed (Image 6). Since none of the blends even burned into the 100mm zone all of them are considered non-flammable under the test conditions and criteria outlined in Method 1030.

Fine Excelsior (natural hardwood shavings) were used as a positive control each day testing was performed.

SW-846 1050: Spontaneous combustion and self heating

The surrogates for this analysis were first sprinkled several times onto a ceramic tile to observe if they smoked or flamed and could be considered pyrophoric solids by test Method A. This was a little difficult to do with UNS Blends #2 and #4 due to the moisture content of the sample it was more plopping of segments of the sample then a nice sprinkle. Since none of the samples exhibited these characteristics, they were tested by Method C. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200C within the 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 2.

Table 2. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cube was placed into an oven with two thermocouples measuring the oven temp and up to four thermocouples inserted into each sample to measure its temperature during the analysis. Lids were placed onto the top of the test cubes and tungsten weights were placed on top of those sample believed to have event in order to keep the thermocouples and lids from coming off the sample. Also up to two thermocouples were placed in a tray below the sample in case any sample pushed out of the cube and onto the tray. Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for 24-48 hours depending on when the sample reached temperature. Although the method states testing to be conducted for 24 hours, many of the samples did not reach 140°C ± 2°C during the initial 24 hour period, therefore the testing was extended to a minimum of 12 hours after the sample had reached temperature. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C during the time of testing. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample. The oven and sample temperature graphs are located in Attachment A.

UNS blends 6 though 13, 16, and 18 were analyzed two at a time, using the 100mm cube, since past samples having similar combinations of waste and zeolite were innocuous. These blends were allowed to run for at least 38 hours before ending the analysis due to the moisture present in each of them. Although the method states testing to be conducted for 24 hours, many of the samples not reaching 140°C ± 2°C during the initial 24 hour period, therefore the testing was extended to a minimum of 12 hours after the sample had reached temperature. After the analysis the cubes were removed and had just a slight reduction in volume and the zeolite was now a lighter color and the

swheat was a darker brown. UNS Blend 3 was tested individually in the 100 mm cube. After analysis the sample was removed to reveal that it had hardened into a dark brown cube that slide right out of the inner cage (Image 7). Since none of these blends exceeded 200°C during the analysis all of them are classified as "Not a Self-Heating Waste" as defined by Method 1050.

UNS Blend 2 was initially run using a 100mm cube. It was noted that the sample began to heat up very quickly and appeared to be self heating since this heating rate was not seen in any of the previous samples, but then the temperature slowed and stabilized at approximately 90 ^{o}C (Figure 1 Att A). The sample run was stopped at 24 hours. and the sample did not exceed 200°C anytime during the analysis period (Figure 2 in Att A). However, when the oven was opened, the sample had expanded to about ten times its initial volume (Image 8 and 9). The sample had the appearance and texture of brittle foam insulation. When exposed to a flame, the material charred but did not combust. Upon removing the sample from the oven, it was noted that in the interior of the cube was charred showing that events had possibly occurred (Image 10) and in charring was noted in some of the sample that expanded outside of the cube (Image 11). It was also noted that the sample did not bubble upwards out of the sample cage but instead permeated though the bottom and sides of the inner and outer cage. With these observations and after discussing the situation with LANL, and decided to call this a "positive" event and proceed with the 25mm cube. During the 25mm cube analysis, the sample once again expanded out of the cubes even with lids placed on top of them (Image 12). However, when breaking up the sample for disposal no darkened or blackened areas were noticed in this analysis. The temperature in the 25 mm cube test remained below 200°C throughout the analysis. With the 25-mm cube as a "negative", UNS Blend 2 was classified as a DOT Packing group of III under the performed laboratory conditions.

UNS Blend 4 was initially run using a 100mm cube. The sample steadily increased to 140°C over the course of 20 hours. The temperature continued to steadily increase until approximately 23 hours into the analysis when the sample temperature spiked to around 450°C at which time the oven was turned off. From 23 hours into the analysis until 30 hours the sample continued to self until up to a maximum temperature of approximately 750°C when it rapidly began to cool (Figure 6 of Att A). This was most likely due to lack of sample remaining to fuel the event. When the oven was opened, a black tarlike substance coated the entire inside of the oven (Image 13 through 15). The sample cube was removed and the remaining sample residue that remained was black and grey ash (Image 16). The sample was then analyzed using the 25mm cube, and did not exceed 200°C during the test (Figure 7 of Att A). When the sample was removed from the oven it had become small hardened black cubes that encased the thermocouples (Image 17). UNS Blend 4 would be classified as a DOT Packing group III under the performed laboratory conditions.

UNS Blend 5 acted very similarly to UNS Blend 4. In the 100mm cube analysis the sample steadily heated to temperature before spiking quickly up to about 400°C. The sample continued to rise in temperature for about 5 hours before peaking at around 690°C then slowly cooled down to the oven temperature of 140°C (the event occurred overnight; therefore the oven was not turned off immediately) (Figure 8 of Att A). When the oven was opened, it was once again coated in a black tarlike substance and all that remained in of the sample was a small pile of ash in the cube (Image 18). The sample was analyzed in the 25mm cube, and did not exceed 200°C (Figure 9 of Att A). Upon removing the sample it was just a dried darkened brown pile filling the cube. UNS Blend 5

was classified as a DOT Packing group III under the performed laboratory conditions.

DOT UN Oxidation testing

The UNS blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the samples mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. If the burning time is less than the standard mixture, the burning times should be compared with those from packing group I or II or category I or II oxidizer, reference standards 3:2 and 2:3, by mass, of potassium bromated to cellulose, respectively. See Table 3 for classification. Table 4 presents the results for the reference standards. Tables 5 and 6 lists the comments the analyst noted for each of the two sample to cellulose ratio burns.

All UNS Blends were classified as "Not Division 5.1".

Table 3. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	UN Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

Table 4. Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
113.57	54.09	19.44

Table 5. Comments for Sample to Cellulose ratio of 4:1

Sample ID	Comment 4:1

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8

UNS Blend 2	no flame, light smoke, charring near ignition source.
UNS Blend 3	low flames at wire, sporadic flame flash over samp. Flames extinguished soon after power was turned off
UNS Blend 4	Reps 1 & 3 had small flame, Reps 2,4 &5 had no flame, light smoke, charring near ignition source.
UNS Blend 5	flame, smoke and charring near ignition source. Sporadic flame flash across the sample.
UNS Blend 6	no flame, light smoke, charring near ignition source.
UNS Blend 7	no flame, light smoke, charring, and smoldering near ignition source.
UNS Blend 8	no flame, light smoke, smoldering, and charring near ignition source.
UNS Blend 9	only rep 2 had a sporadic flame near ignition source, reps 1,3-5 did not. Light smoke and charring.
UNS Blend 10	no flame, light smoke, charring near ignition source.
UNS Blend 11	no flame, light smoke, charring near ignition source.
UNS Blend 12	no flame, light smoke, charring and smoldering near ignition source.
UNS Blend 13	no flame, light smoke, charring and smoldering near ignition source.
UNS Blend 16	no flame, light smoke, charring and smoldering near ignition source.
UNS Blend 18	no flame, light smoke, charring and smoldering near ignition source.

Table 6 Comments for Sample to Cellulose ratio of 1:1

Sample ID	Comment 1:1
UNS Blend 2	sporadic flame flash across the top of the sample, smoke and charring around the wire.
UNS Blend 3	Flames started near ignition source and propagated. Sporadic flame flash over top of the smpl. Power was turned off at 180sec and smpl. continued to burn
UNS Blend 4	flame, smoke, and charring near ignition source. Flames extinguished soon after power was turned off at 180sec
UNS Blend 5	flame, smoke, and charring near ignition source. Flames extinguished soon after power was turned off at 180sec
UNS Blend 6	Flames present on reps 3-5, no flame on rep 1&2. Charring and smoke near ignition source, and smoldering.
UNS Blend 7	no flame, light smoke, charring, and smoldering near ignition source.
UNS Blend 8	Only rep 2 had a flame observed. Reps 1, 3-5 did not have flames. Charring near ignition source, some smoke, smoldering.
UNS Blend 9	low flame and charring near ignition source and some smoke. Flame didn't propagate and extinguished soon after power was turned off at 180sec
UNS Blend 10	low flame and charring near ignition source and some smoke. Flames extinguished soon after power was turned off at 180sec
UNS Blend 11	flames and charring near ignition source, and smoke. Reps 1 & 5 continued to burn beyond 240 secs. (power turned off at 180sec)
UNS Blend 12	small plume, smoke charring and smoldering near ignition scource.
UNS Blend 13	no flame, more smoke then 4:1, charring and smoldering near ignition source.
UNS Blend 16	Low plume flame, smoke, charring and smoldering
UNS Blend 18	Low plume flame near wires, smoke, charring and smoldering

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8



Image 1: UNS solutions with wastelock. Left was 50ml of water that was absorbed by the wastelock. The pH 5 and 7 UNS solutions had different volumes absorbed by the wastelock but free flowing liquid was still present in them. The <2 pH UNS solution had little to no absorption and the wastelock floated on the top surface.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8



Image 2: (UNS Blend #13) Example of UNS Blends 6 though 13, 14, and 18. 14 and 18 appeared a little more moist then this due to the lack of swheat.



Image 3: (UNS Blend #2) Burn region and the mushy sample beyond that.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8



Image 4: (UNS Blend #3) Burn point and then the slight propagation of the flame past the point.



Image 5: (UNS Blend #4) Slight burning on the outside of the sample but very little past that.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8



Image 6: (UNS Blend #5) Charring and consumption of the sample at the burn point.



Image 7: (UNS Blend #3) 1050 100mm cube analysis showing the sample after analysis.

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SwRI Task Order Number(s): 160105-8



Image 8: (UNS Blend #2) 1050 100mm cube analysis showing sample after analysis inside the oven.



Image 9: (UNS Blend #2) 1050 100mm cube analysis showing the volume of sample pulled from the oven after analysis.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8



Image 10: (UNS Blend #2) 1050 100mm cube analysis showing the blacked charred material remaining in the sample cage.



Image 11: (UNS Blend #2) 1050 100mm cube analysis showing the blacked charred material within the sample pulled from the inside of the oven.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8



Image 12: (UNS Blend #2) 1050 25mm cube analysis showing the expanded sample during the analysis.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8



Image 13: (UNS Blend #4) 1050 100mm cube analysis showing the inside of the oven coated in the black tarlike substance after analysis.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8



Image 14: (UNS Blend #4) 1050 100mm cube analysis showing the inside of the oven coated in the black tarlike substance after analysis.

Client: Los Alamos National Laboratory
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SwRI Task Order Number(s): 160105-8



Image 15: (UNS Blend #4) 1050 100mm cube analysis showing the inside of the oven after a full cleanup of the oven.

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SwRI Task Order Number(s): 160105-8



Image 16: (UNS Blend #4) 1050 100mm cube analysis showing the remaining sample within the cube after analysis.



Image 17: (UNS Blend #4) 1050 25mm cube analysis showing the sample encasing the thermocouples after analysis.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160105-8



Image 18: (UNS Blend #5) 1050 100mm cube analysis showing the remaining sample within the cube after analysis.

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."



Group Leader **Date** **02/02/16**

Attachment A

Method 1050 Graphs

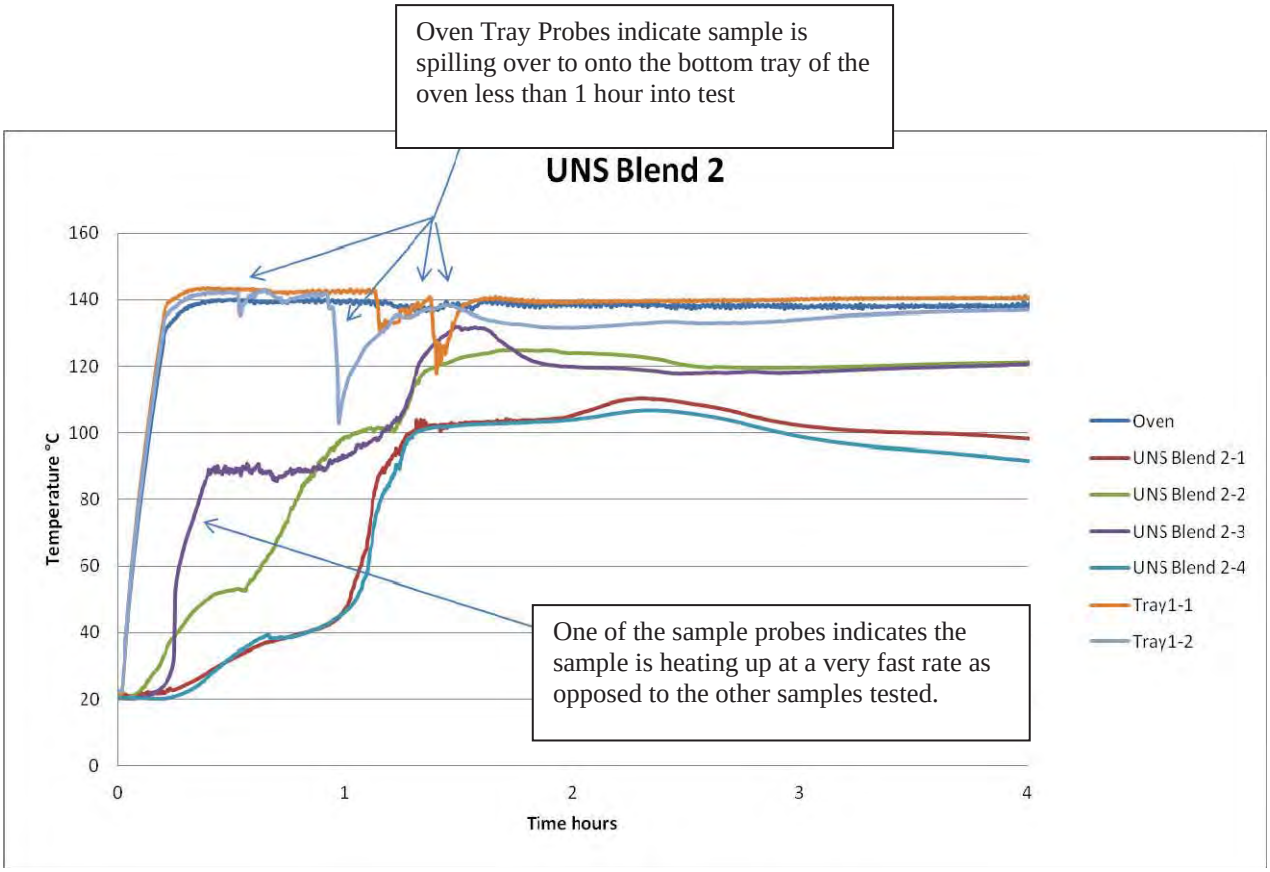


Figure 1. Method 1050 – UNS Blend 2 (100mm cube) event occuring during the first four hours of analysis.

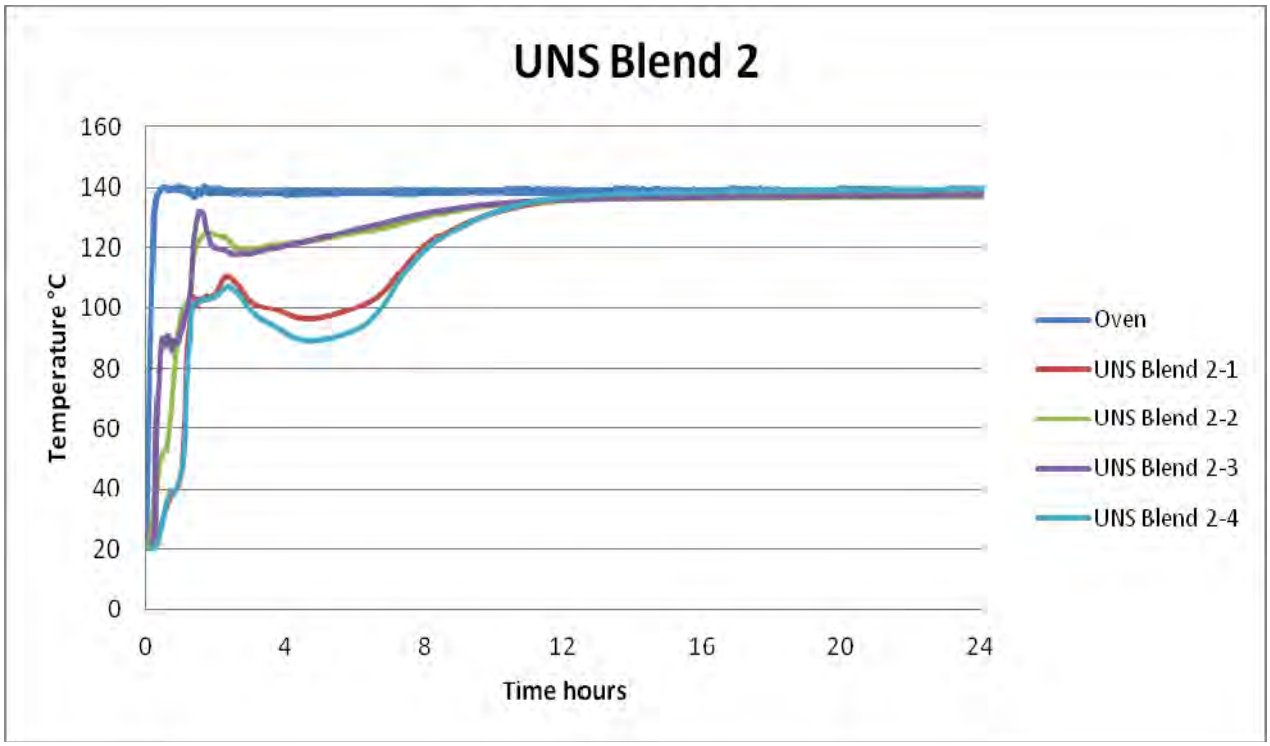


Figure 2. Method 1050 – Temperature of UNS Blend 2 (100mm cube) full run.

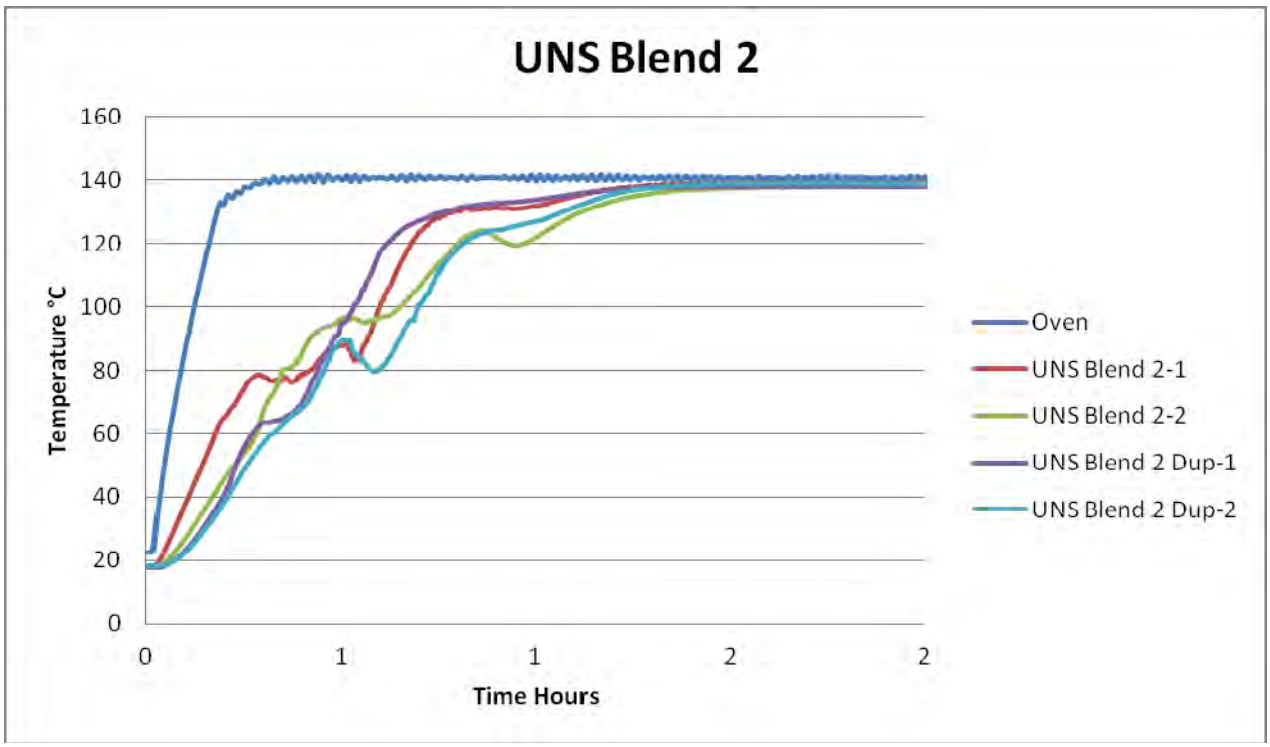


Figure 3. Method 1050 – Temperature of UNS Blend 2 (25mm cube) first two hours of the analysis show the sample heating and cooling as it expands out of the cubes.

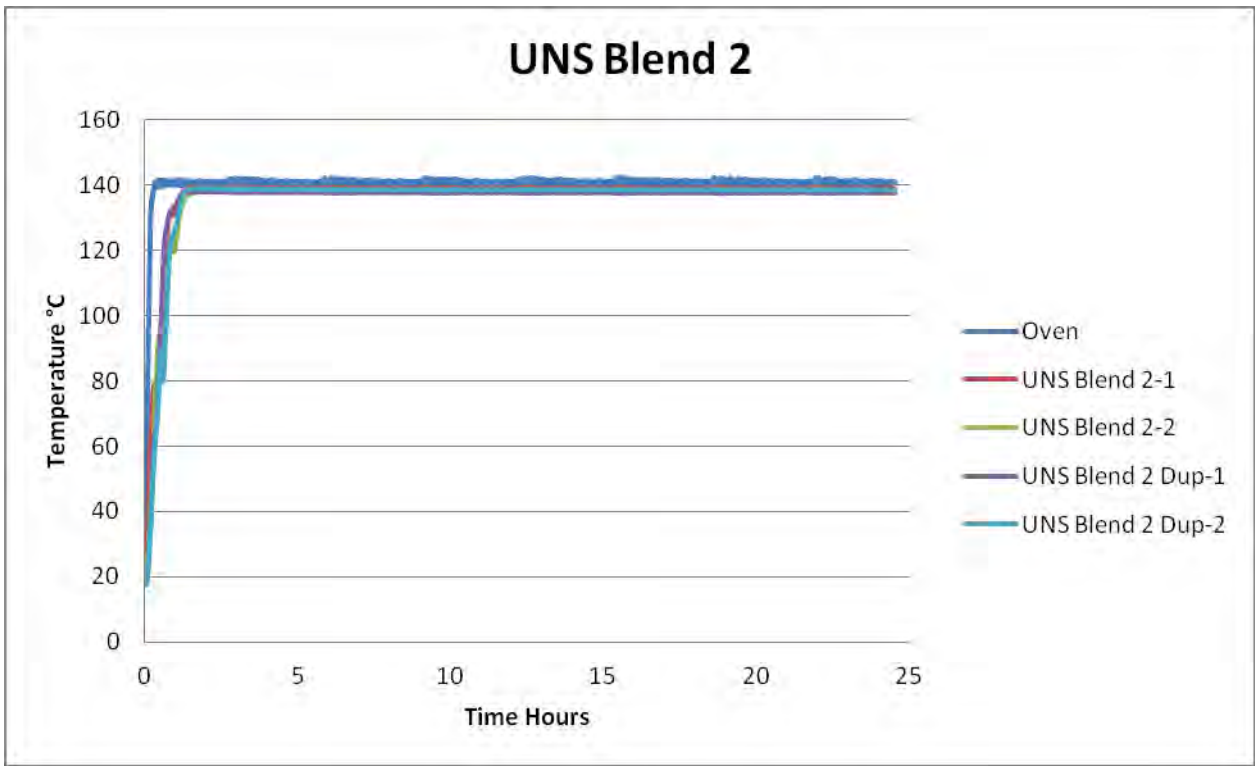


Figure 4. Method 1050 – Temperature of UNS Blend 2 (25mm cube) full run.

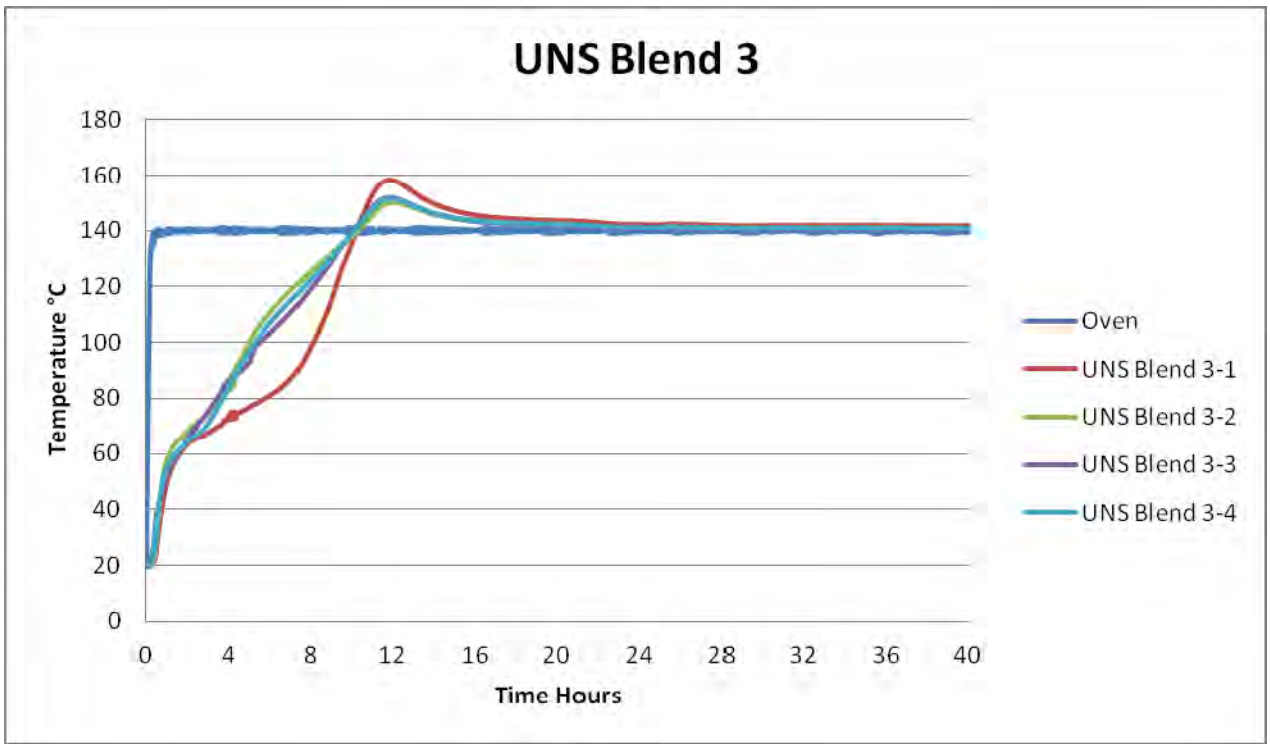


Figure 5. Method 1050 – Temperature of UNS Blend 3 (100 mm cube) slight self heating event occuring at hour 12.

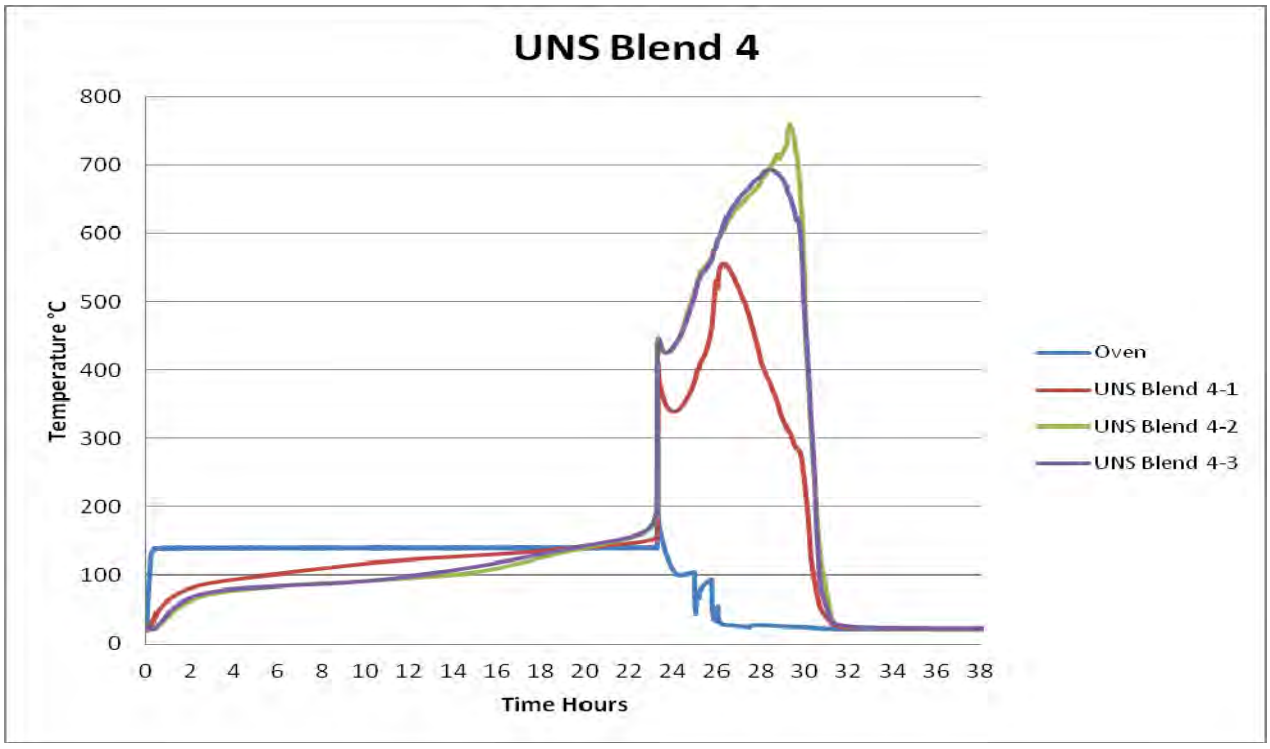


Figure 6. Method 1050 – Temperature of UNS Blend 4 (100mm cube) self heating event just before 24 hours and continuing for about 7 hours.

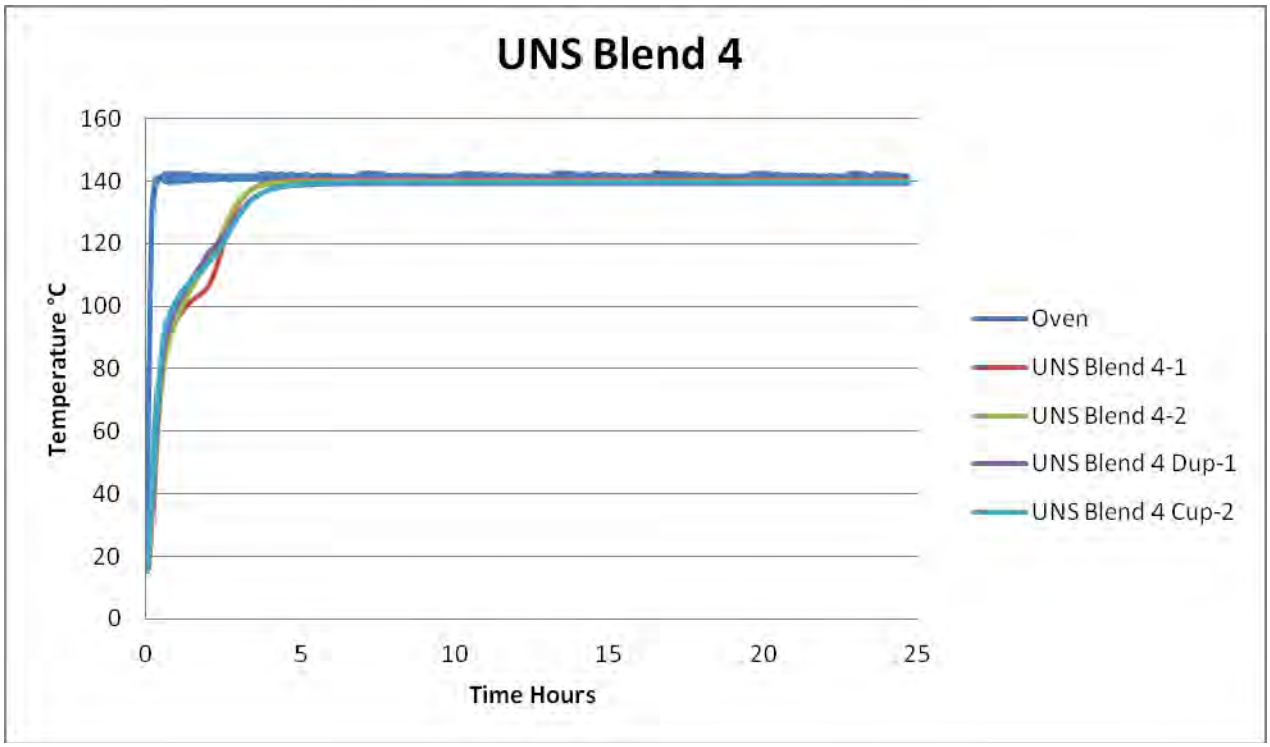


Figure 7. Method 1050 – Temperature of UNS Blend 4 (25mm cube)

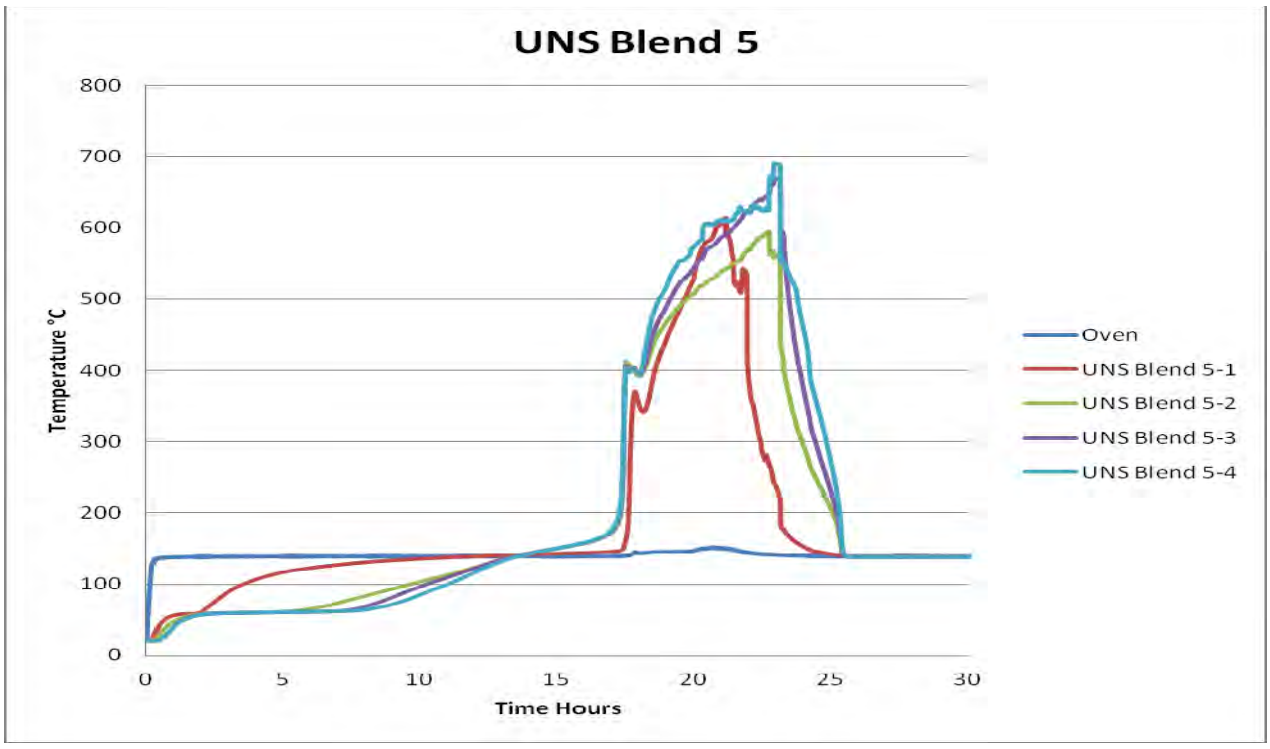


Figure 8. Method 1050 – Temperature of UNS Blend 5 (100 mm cube) with self heating event occuring at about 17 hours and continuing for another 9 hours.

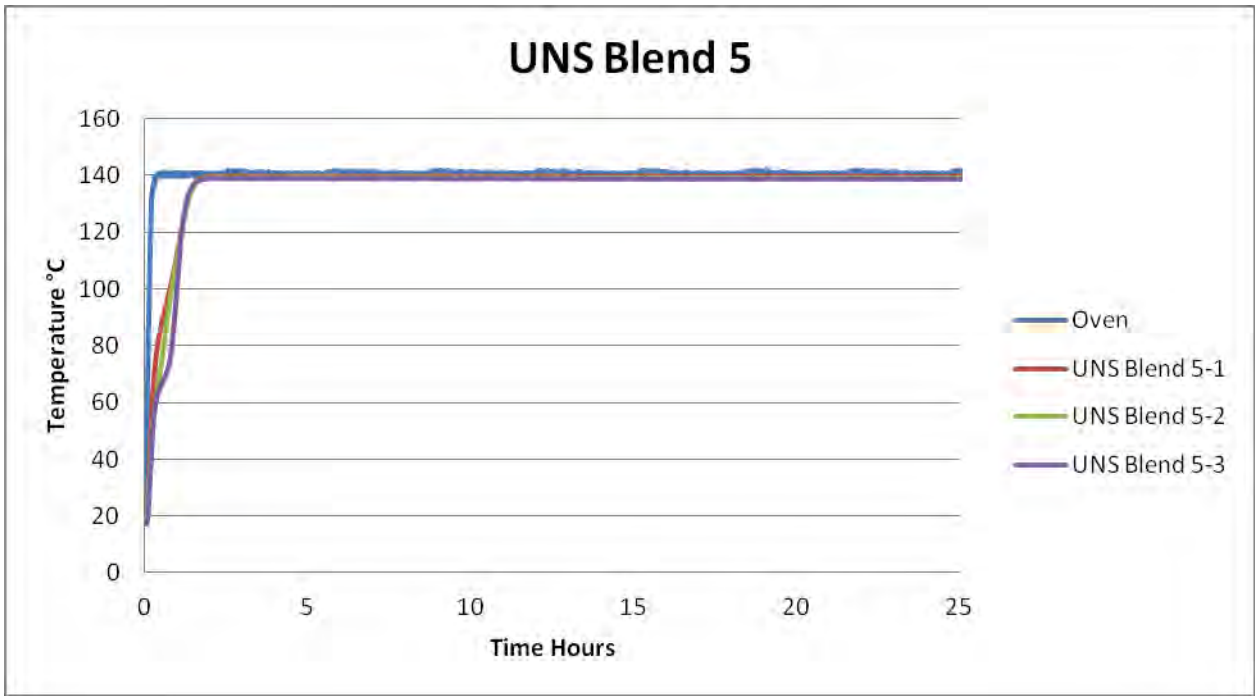


Figure 9. Method 1050 – Temperature of UNS Blend 5 (25 mm cube)

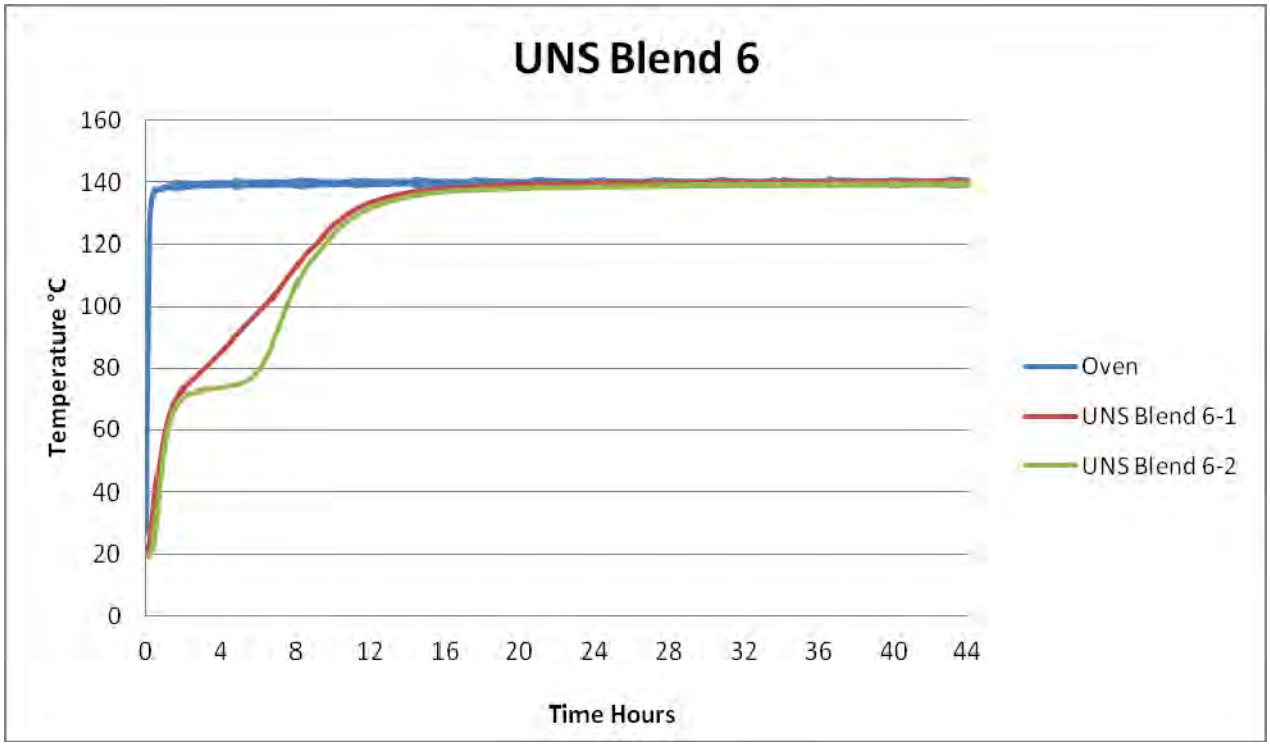


Figure 10. Method 1050 – Temperature of UNS Blend 6 (100 mm cube)

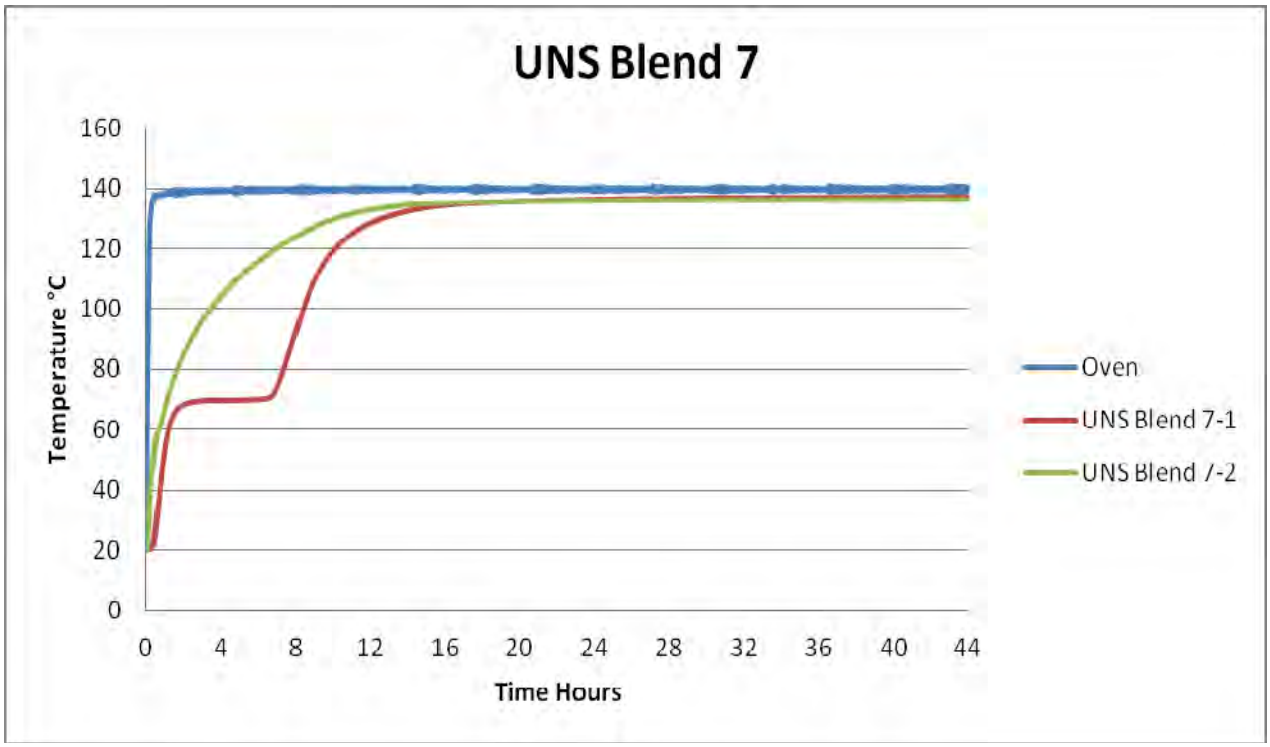


Figure 11. Method 1050 – Temperature of UNS Blend 7 (100 mm cube)

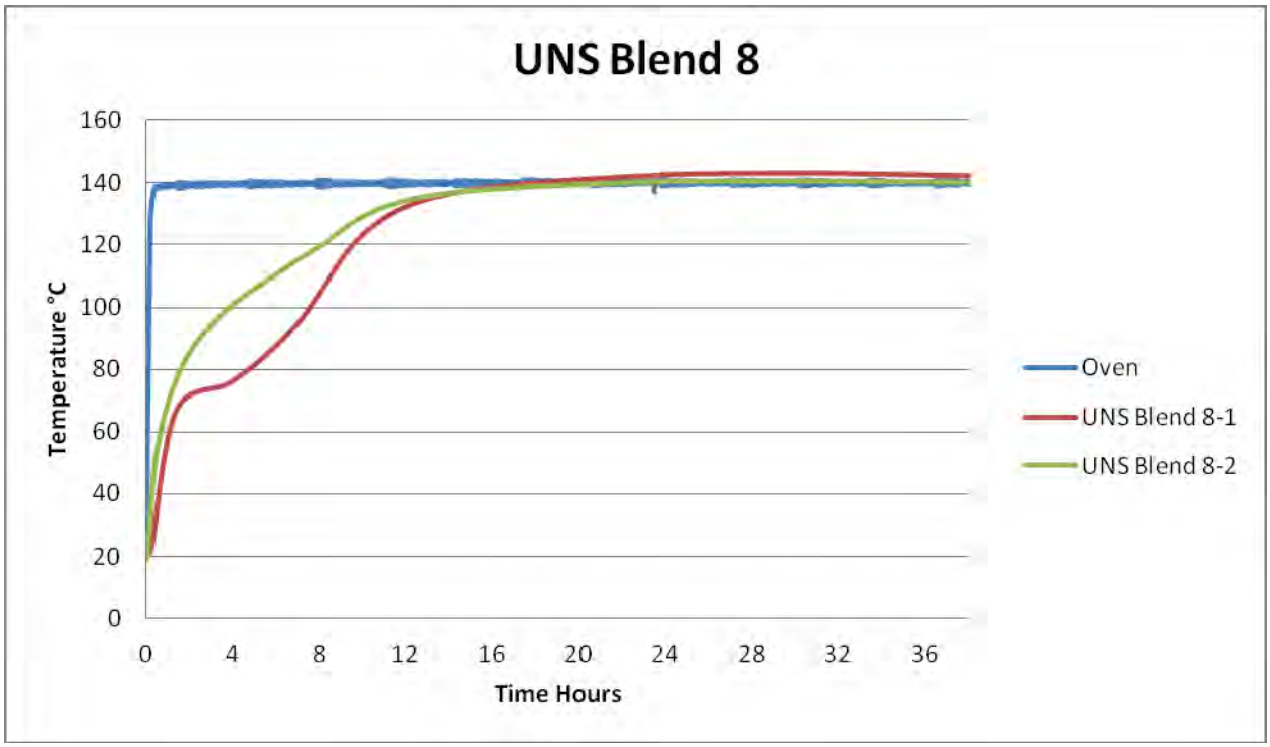


Figure 12. Method 1050 – Temperature of UNS Blend 8 (100 mm cube)

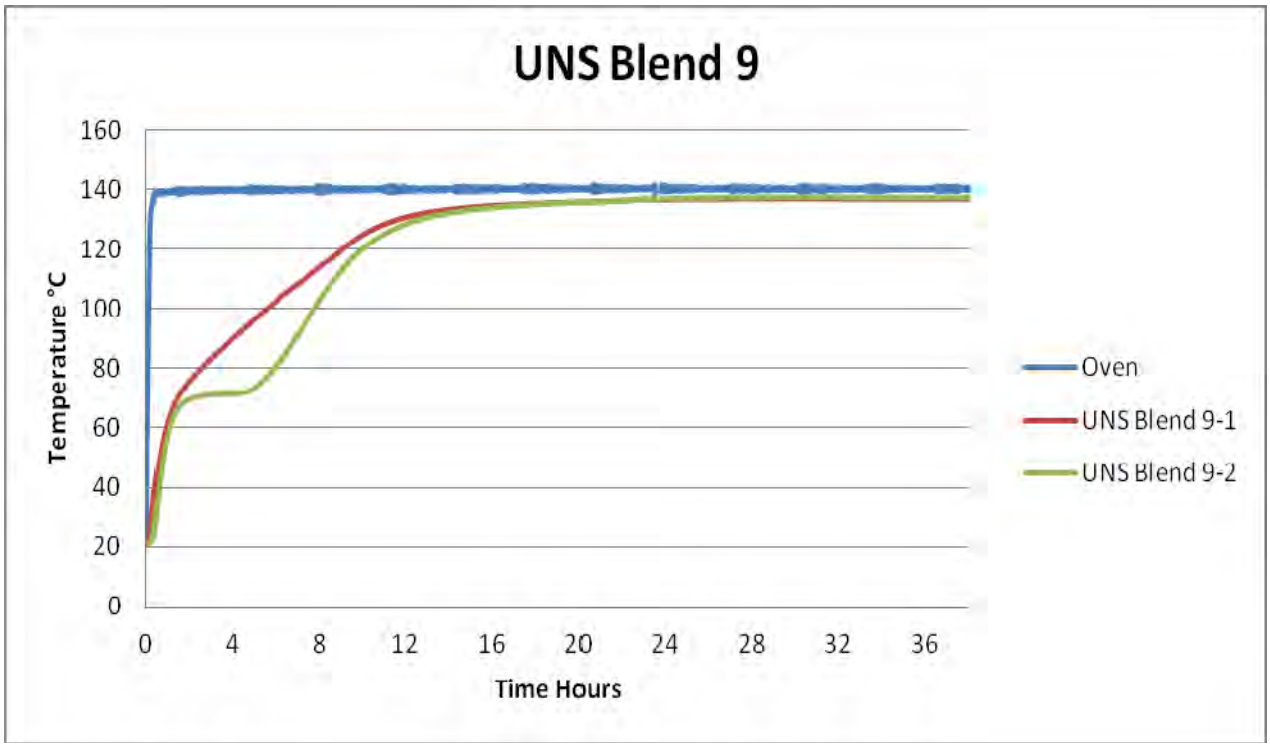


Figure 13. Method 1050 – Temperature of UNS Blend 9 (100 mm cube)

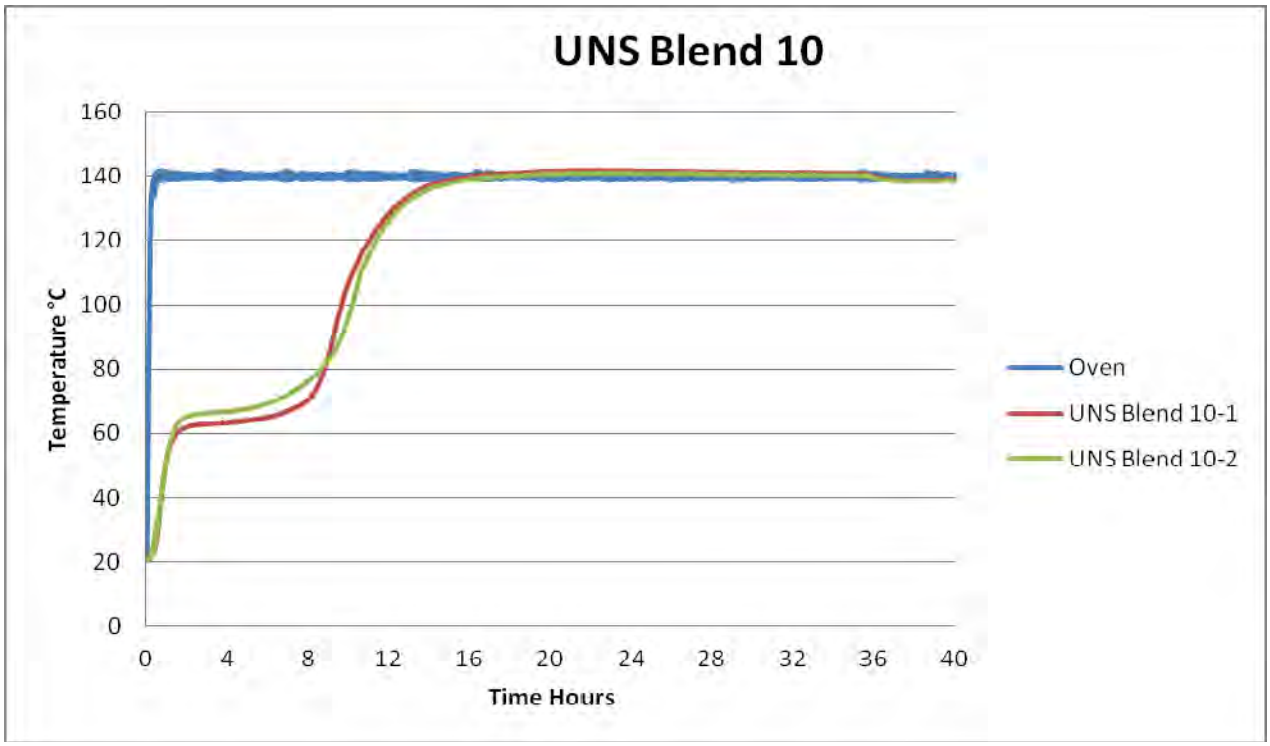


Figure 14. Method 1050 – Temperature of UNS Blend 10 (100 mm cube)

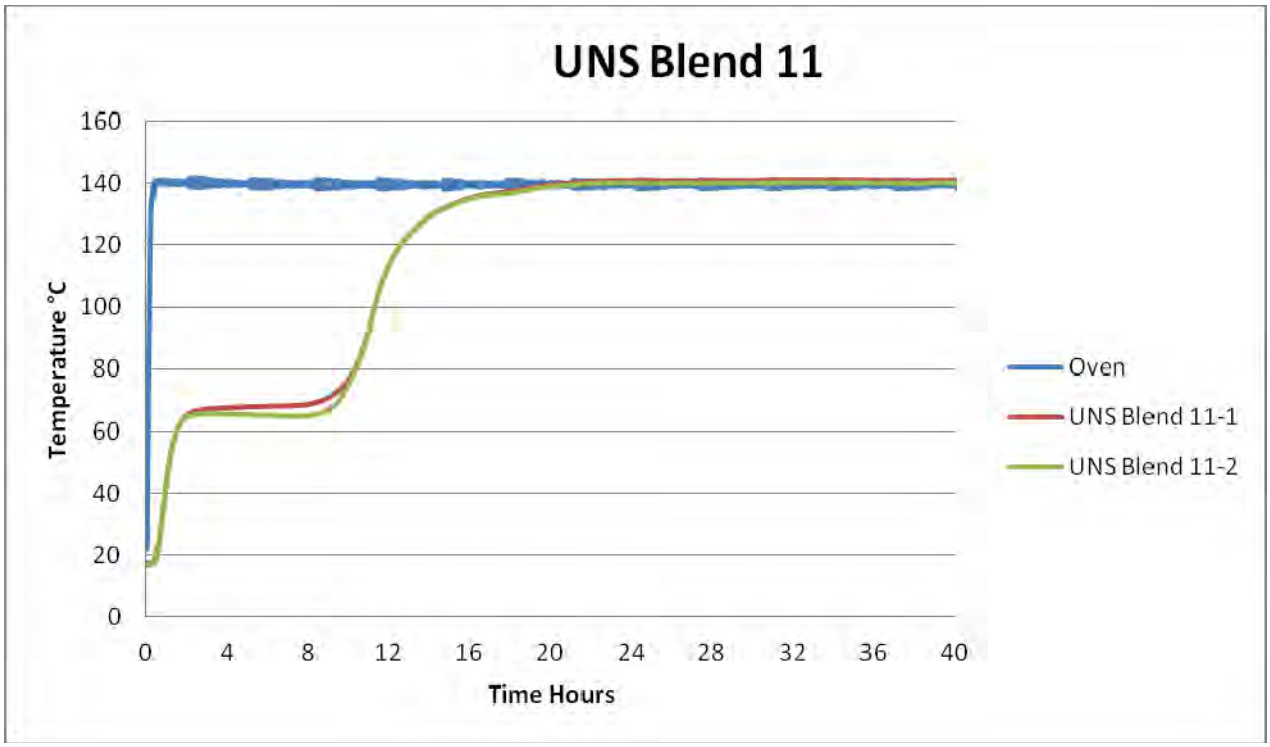


Figure 15. Method 1050 – Temperature of UNS Blend 11 (100 mm cube)

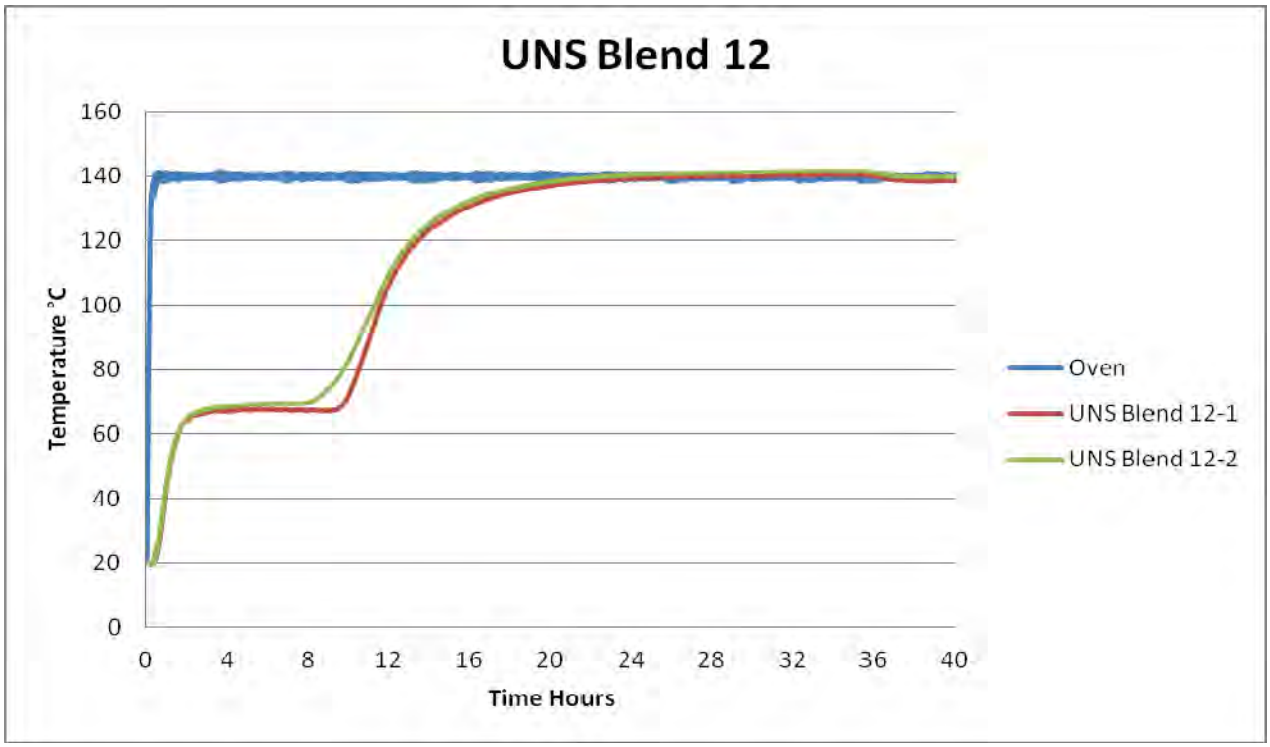


Figure 16. Method 1050 – Temperature of UNS Blend 12 (100 mm cube)

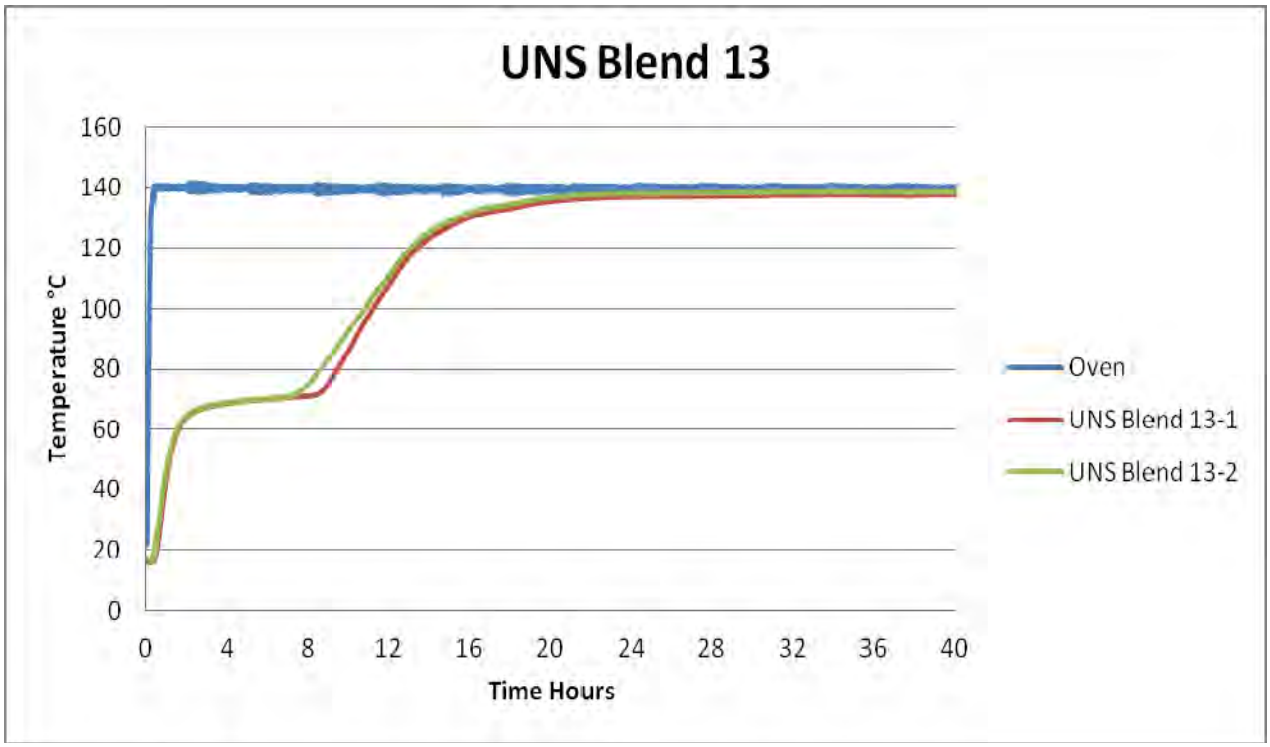


Figure 17. Method 1050 – Temperature of UNS Blend 13 (100 mm cube)

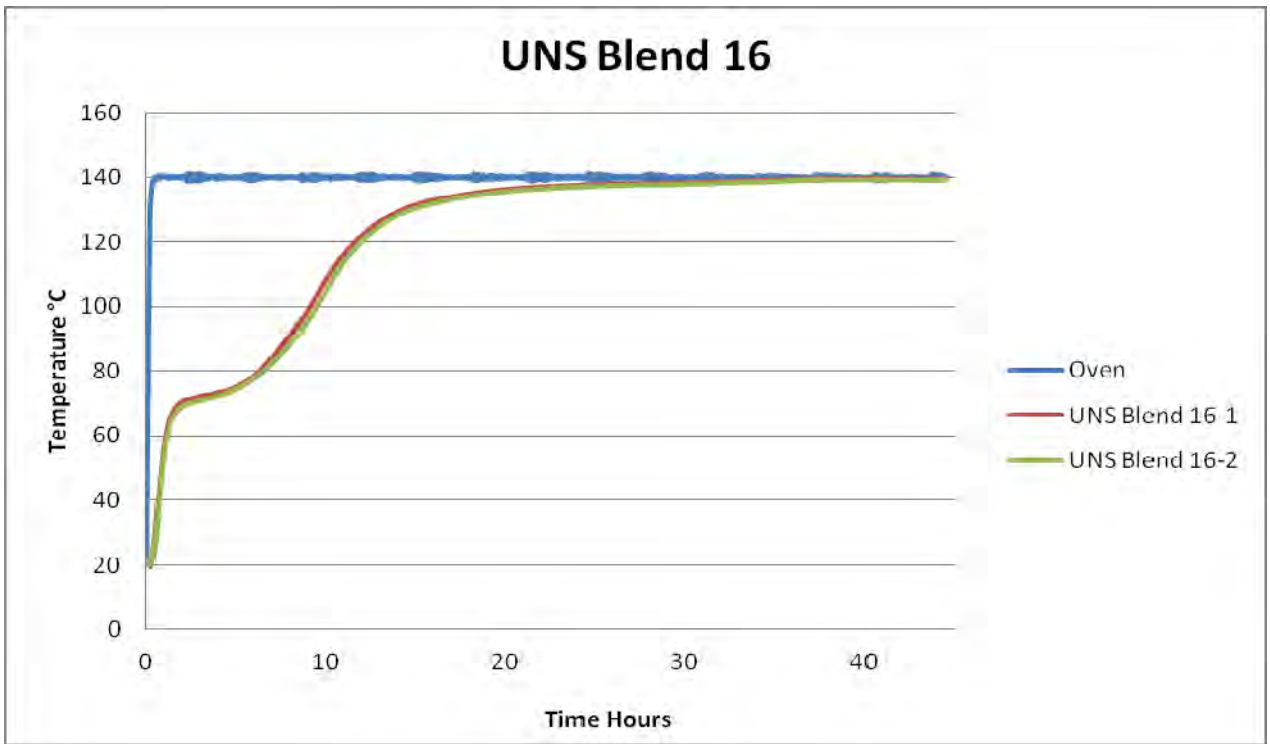


Figure 18. Method 1050 – Temperature of UNS Blend 16 (100 mm cube).

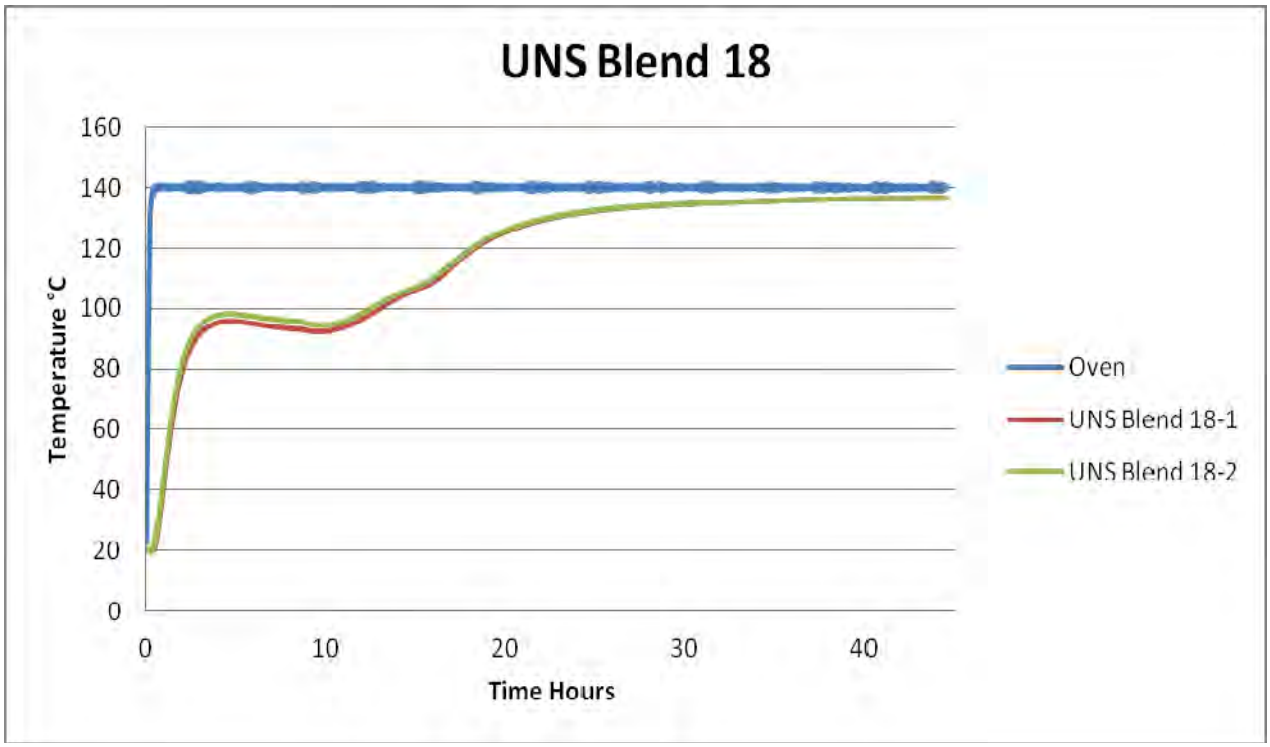


Figure 19. Method 1050 – Temperature of UNS Blend 18 (100 mm cube).

010037

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160105-8
SwRI SRR: 56087
SDG: 581291
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Sample Results

SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

SAMPLE DATA SHEET

010038

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 160105-8

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
113.57	54.09	19.44

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
UNS Blend 2	581292	no reaction	>180	Not Division 5.1	01/07/16
UNS Blend 3	581293	>180	>180	Not Division 5.1	01/07/16
UNS Blend 4	581294	>180	>180	Not Division 5.1	01/14/16
UNS Blend 5	581295	>180	>180	Not Division 5.1	01/14/16
UNS Blend 6	581296	no reaction	>180	Not Division 5.1	01/14/16
UNS Blend 7	581297	no reaction	no reaction	Not Division 5.1	01/15/16
UNS Blend 8	581298	no reaction	>180	Not Division 5.1	01/15/16
UNS Blend 9	581300	>180	>180	Not Division 5.1	01/19/16
UNS Blend 10	581301	no reaction	>180	Not Division 5.1	01/19/16
UNS Blend 11	581302	no reaction	>180	Not Division 5.1	01/19/16
UNS Blend 12	581303	no reaction	>180	Not Division 5.1	01/20/16
UNS Blend 13	589629	no reaction	no reaction	Not Division 5.1	01/20/16
UNS Blend 16	589632	no reaction	>180	Not Division 5.1	01/25/16
UNS Blend 18	589634	no reaction	>180	Not Division 5.1	01/25/16

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

LABORATORY CONTROL SAMPLE DATA SHEET 010039

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 160105-8

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
91-136 sec	43-65 sec	15-23 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	101.28	47.66	18.19	01/07/16
LCS	112.81	59.72	21.53	01/14/16
LCS	116.97	62.50	21.47	01/15/16
LCS	105.09	54.03	21.47	01/19/16
LCS	103.97	54.50	18.90	01/20/16
LCS	124.35	54.10	19.34	01/25/16

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET 010040

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 160105-8

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
UNS Blend 2	581292	Nonflammable	12/31/15
UNS Blend 3	581293	Nonflammable	12/31/15
UNS Blend 4	581294	Nonflammable	12/31/15
UNS Blend 5	581295	Nonflammable	12/31/15
UNS Blend 6	581296	Nonflammable	12/31/15
UNS Blend 7	581297	Nonflammable	12/31/15
UNS Blend 8	581298	Nonflammable	12/31/15
UNS Blend 9	581300	Nonflammable	12/31/15
UNS Blend 10	581301	Nonflammable	12/31/15
UNS Blend 11	581302	Nonflammable	12/31/15
UNS Blend 12	581303	Nonflammable	12/31/15
UNS Blend 13	589629	Nonflammable	12/31/15
UNS Blend 16	589632	Nonflammable	01/25/16
UNS Blend 18	589634	Nonflammable	01/25/16

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET

010041

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 160105-8

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
UNS Blend 2	581292	DOT Packing Group III	01/12/16 & 01/29/16
UNS Blend 3	581293	Not a self-heating waste	01/20/16
UNS Blend 4	581294	DOT Packing Group III	01/13/16 & 01/28/16
UNS Blend 5	581295	DOT Packing Group III	01/22/16 & 01/30/16
UNS Blend 6	581296	Not a self-heating waste	01/08/16
UNS Blend 7	581297	Not a self-heating waste	01/08/16
UNS Blend 8	581298	Not a self-heating waste	01/10/16
UNS Blend 9	581300	Not a self-heating waste	01/10/16
UNS Blend 10	581301	Not a self-heating waste	01/24/16
UNS Blend 11	581302	Not a self-heating waste	01/18/16
UNS Blend 12	581303	Not a self-heating waste	01/24/16
UNS Blend 13	589629	Not a self-heating waste	01/18/16
UNS Blend 16	589632	Not a self-heating waste	01/26/16
UNS Blend 18	589634	Not a self-heating waste	01/26/16

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SOUTHWEST RESEARCH INSTITUTE

SW846 9095 Paint Filter Liquids Test

SAMPLE DATA SHEET 010042

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 160105-8

Sample ID	SwRI System ID	Method 9095 *Paint Filter Results*	Date Analyzed
UNS Blend 2	581292	Not deemed to contain free liquids	12/31/15
UNS Blend 3	581293	Not deemed to contain free liquids	12/31/15
UNS Blend 4	581294	Not deemed to contain free liquids	12/31/15
UNS Blend 5	581295	Not deemed to contain free liquids	12/31/15
UNS Blend 6	581296	Not deemed to contain free liquids	12/31/15
UNS Blend 7	581297	Not deemed to contain free liquids	12/31/15
UNS Blend 8	581298	Not deemed to contain free liquids	12/31/15
UNS Blend 9	581300	Not deemed to contain free liquids	12/31/15
UNS Blend 10	581301	Not deemed to contain free liquids	12/31/15
UNS Blend 11	581302	Not deemed to contain free liquids	12/31/15
UNS Blend 12	581303	Not deemed to contain free liquids	12/31/15
UNS Blend 13	589629	Not deemed to contain free liquids	12/31/15
UNS Blend 16	589632	Not deemed to contain free liquids	01/25/16
UNS Blend 18	589634	Not deemed to contain free liquids	01/25/16

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010043

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160105-8
SwRI SRR: 56087
SDG: 581291
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Raw Data

Southwest Research Institute 010044

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14, 160105-8

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0059	21.0050	101.28	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0117	18.0021	47.128	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0060	12.0088	18.19	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 1/7/16
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/7/16
Potassium Bromate: Inorg# 63455-63457 Dried: 712 hrs @ 105°C
Cellulose: Inorg# 65519 Dried: > 4 hrs @ 105°C
Variac Setting: 150 ± 7 W

Southwest Research Institute 010045

Method: UN Oxidizer
Project #: 21592.01.0006
Client: Los Alamos
TO# 160105-8

Sample Analysis

System ID: UNS Blend 2 (Black)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0919	6.0052	180.21 *	No flames, smoke & charring around wire
4:1	2	24.0213	6.0091	180.37 *	
4:1	3	24.0050	6.0151	180.28 *	
4:1	4	24.0370	6.0432	180.34 *	
4:1	5	24.0696	6.0155	180.35 *	
4:1	Avg	Avg: 180.31		No Reaction	* Time power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0765	15.0074	⊙ > 180.72	Sporadic white flame flash, smoke & charring around wire, sample didn't ignite & burn.
1:1	2	15.0360	15.0028	⊙ > 180.68	
1:1	3	15.0621	15.0023	⊙ > 180.36	
1:1	4	15.0241	15.0085	⊙ > 180.61	
1:1	5	15.0011	15.0161	⊙ > 180.53	
1:1	Avg			180.58	⊙ Time power turned off

(WD) 1/7/16 mg

Weighted Samples: B. Villasenor Balance#: 135 Date: 1/6/16
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/7/16
Sample Dried ? (YES) NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 65519 Dried: >4hrs. @ 105°C
Variac Setting: 150 ± 7W

Classification: Not Division 5.1

Southwest Research Institute

010046

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160105-8

Sample Analysis

System ID: UNS Blend 3 (Green)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

*Time power was turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0620	6.0059	*>180.54	flame at wire leads, sporadic white flame
4:1	2	24.0148	6.0023	*>180.61	flash over sample
4:1	3	24.0609	6.0034	*>180.44	
4:1	4	24.0624	6.0108	*>180.47	+ large flame in back @ 2mins
4:1	5	24.0376	6.0025	*>180.43	↓
4:1	Avg			180.50	reaction/flames when out soon after power turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0665	15.0038	>2400	flame at wire leads tin back, started to pop after power turned off
1:1	2	15.0752	15.0120	>2400	sporadic white flame flash, charring & smo
1:1	3	15.0705	15.0048	>2400	continued to burn beyond 4mins with
1:1	4	15.0132	15.0067	>2400	power turned off @ 3mins
1:1	5	15.0081	15.0052	>2400	↓
1:1	Avg			240	

Weighted Samples: B. Villasenor Balance#: 135 Date: 1/6/16 (WD 1-11-16 MG)
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/7/16
Sample Dried ? (YES) / NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 05519 Dried: >4hrs. @ 105°C
Variac Setting: 150 ± 7W

Classification: Not Division 5.1

Southwest Research Institute

010047

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14; 160105-8

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0860	21.0365	112.81	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.1384	18.0125	59.72	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0098	12.0356	21.53	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: James Moker Balance#: 135 Date: 1-14-16
Tested Samples: James Moker Timer ID: 80494146 Date: 1-14-16
Potassium Bromate: Inorg# 63455-63457 Dried: > 12hrs 65°C
Cellulose: Inorg# 611704 Dried: > 4hrs 105°C
Variac Setting: 150 ± 7W WO 1/21/16 MG

Southwest Research Institute

010048

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14

Sample Analysis

System ID: 581294 (BLUE) UNS Blend 4

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g WD 1 wire	Burning Time, sec	Comment
4:1	1	24.0347	24.0347 6.0359	180.31	constant smoke, small flames and charing around the wire
4:1	2	24.0582	6.0578	180.19	constant smoke, charing around the wire
4:1	3	24.0508	6.0357	180.71	constant smoke, slight flame ! charing around the wire
4:1	4	24.0579	6.0783	182.43	constant smoke, charing around the wire
4:1	5	24.0374	6.6680	180.28	constant smoke, charing around the wire
4:1	Avg			180.78	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0699	15.0316	180.25	constant Smoke, constant Flame ! charing during the analysis
1:1	2	15.0937	15.0402	180.47	constant flame ! smoke throughout test, charing around wire
1:1	3	15.0011	15.0115	180.62	constant flame ! smoke throughout test, charing around wire
1:1	4	15.0837	15.0244	187.60	constant flame ! smoke throughout test, charing wire
1:1	5	15.0205	15.6405	181.06	
1:1	Avg			182.0	

Weighted Samples: Bernie Villasenor Balance#: 135 Date: 1/13/16
Tested Samples: James Mateer Timer ID: 86494446 Date: 1/14/16
Sample Dried ? (YES) NO ci 1/21/16 mg Dried: @ Room temp for 1 day
Cellulose: Inorg# 611124 Dried: 165°C 7 4hrs
Variac Setting: 150 ± 7W

Classification: Not Division 5.1

Southwest Research Institute 010049

Method: UN Oxidizer
Project #: 21592.01.006
Client: LANL
TO# 160105-8

Sample Analysis

System ID: 581295 (Green) UNS #5

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0161	6.0114	184.85	Smoke and little flame around wire throughout the analysis, charing around the wire.
4:1	2	24.0409	6.0149	189.19	Smoke and charing throughout analysis, flame would sneak off now and again, charring around wire
4:1	3	24.0233	6.0123	192.66	Smoke, flame, and charing along wire throughout analysis. Blue flames shot off sample now & again
4:1	4	24.0074	6.0116	180.85	Smoke, flame, and charing throughout the analysis
4:1	5	24.0635	6.0111	182.91	Smoke, flame, and charing throughout analysis Blue flash flame zipped across sample on & off
4:1	Avg			186.09	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0343	15.0169	187.47	Smoke and charing throughout analysis, Flame point where the wire entered the sample
1:1	2	15.0037	15.0136	190.15	Smoke, flame, and charing throughout analysis,
1:1	3	15.0894	15.0033	184.21	Smoke, flame, and charing throughout analysis
1:1	4	15.0250	15.0230	180.79	Smoke, flame, and charing throughout analysis
1:1	5	15.0331	15.0042	182.19	Smoke & charing throughout analysis, flame present on and off
1:1	Avg			184.96	

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-14-16
Tested Samples: James Moku Timer ID: 80494146 Date: 1-14-16
Sample Dried ? (YES) NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 61124 Dried: >4hrs. @ 105°C
Variac Setting: 150 ± 7 w

Classification: Not Division 5.1

Southwest Research Institute

010050

Method: UN Oxidizer
Project #: 21592.01.006
Client: LOS Alamos
TO# 160105-8

Sample Analysis

System ID: 581296 (BLACK) UNS Blend #6

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0178	6.0136	180.53	No Flame, little smoke, some charing near wire.
4:1	2	24.0051	6.0203	180.41	"
4:1	3	24.0014	6.0070	180.18	"
4:1	4	24.0156	6.0221	180.28	"
4:1	5	24.0177	6.0073	180.39	"
4:1	Avg			180.36	No Reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0271	15.0082	180.37	No Flame, smoke, charing near wire
1:1	2	15.0000	15.0339	180.09	" "
1:1	3	15.0754	15.0261	180.25	Low flame, smoke, charring continued to smolder after power off.
1:1	4	15.0088	15.0109	180.12	Low flame near wires, smoke, charring and smoldering.
1:1	5	15.0291	15.0230	180.41	"
1:1	Avg			180.25	

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-14-16
Tested Samples: B. Villasenor Timer ID: S/N 80494146 Date: 1-15-16 4 pm
Sample Dried ? (YES) NO CI 1/21/16 MG Dried: @ Room temp for 1 day
Cellulose: Inorg# 101124 Dried: Yes > 4 hrs 105 °C.
Variac Setting: 150 ± 7 W

Classification: Not Division 5.1

Southwest Research Institute 010051

Method: Oxidizer_UN
Project #: 21592.01.006
Client: LANL
TO# 160105-8

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0090	21.0097	116.97	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0183	18.0315	62.50	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0138	12.0108	21.47	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-14-16 (5 & tc)
Tested Samples: B. Villasenor Timer ID: S/N 80494196 Date: 1-15-16
Potassium Bromate: Inorg# 63455-63457 Dried: > 12 hrs 65°C.
Cellulose: Inorg# 65520 Dried: > 4 hrs @ 105°C.
Variac Setting: 150 ±7 w

Southwest Research Institute

010052

Method: Oxidizer – UN
Project #: 21592.01.006
Client: LANL
TO# 160105-8

Sample Analysis

System ID: 581297 Red (UNS Blend 7)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0102	6.0059	180.43	NO FLAME, SMOKE, SMOLDERING, CHARR
4:1	2	24.0011	6.0056	186.28	
4:1	3	24.0403	6.0156	180.35	
4:1	4	24.0172	6.0118	180.31	
4:1	5	24.0139	6.0142	180.38	
4:1	Avg			180.35	NO Reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0271	15.0121	180.41	NO FLAME, SMOKE, SMOLDERING, CHARR
1:1	2	15.0116	15.0181	180.32	
1:1	3	15.0032	15.0067	180.31	
1:1	4	15.0251	15.0172	180.35	
1:1	5	15.0095	15.0109	180.38	
1:1	Avg			180.35	NO Reaction

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-15-16
Tested Samples: B. Villasenor Timer ID: S/N 804941416 Date: 1-15-16
Sample Dried ? (YES)/NO CI 1/21/16 mb Dried: @ Room temp for 1 day
Cellulose: Inorg# 65520 Dried: Yes > 4 hrs 105°C
Variac Setting: 150 ± 7 m

Classification: Not Division 5.1

Southwest Research Institute

010053

Method: Oxidizer_UN
Project #: 21592.01.006
Client: LANL
TO# 160105-8

Sample Analysis

System ID: 581298 (Green) UNS Blend 8

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0124	6.0106	180.66	NO FLAME, little smoke, smoldering, charring
4:1	2	24.0045	6.0063	180.57	"
4:1	3	24.0021	6.0119	180.28	"
4:1	4	24.0832	6.0048	180.34	"
4:1	5	24.0318	6.0084	180.31	"
4:1	Avg			180.43	NO Reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	~~15.0313~~ 15.0313	15.0013	180.35	NO FLAME, little smoke, smoldering, char
1:1	2	15.0126	15.0026	180.28	low sputtering flame, smoke, smoldering, char
1:1	3	15.0217	15.0116	180.31	NO FLAME, smoke, smoldering, char
1:1	4	15.0164	15.0176	180.44	"
1:1	5	15.0313	15.0157	180.47	"
1:1	Avg			180.37	

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-15-16
Tested Samples: B. Villasenor Timer ID: S/N 80494146 Date: 1-15-16
Sample Dried ? (YES) NO Cl 01/21/16 MG Dried: @ room temp for 1 day
Cellulose: Inorg# 65520 Dried: yes > 4 hrs @ 105°C.
Variac Setting: 150 ± 7 watts

Classification: Not Division 5.1

Southwest Research Institute 010054

Method: UN Oxidizer
Project #: 21592.01.0006
Client: Los Alamos
TO# 160105-8

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0071	21.0007	105.09	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0029	18.0018	54.03	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0041	12.0047	21.47	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Grabaldon Balance#: 135 Date: 1/19/16
Tested Samples: Monica Grabaldon Timer ID: 80494146 Date: 1/19/16
Potassium Bromate: Inorg# 63455-63457 Dried: 72hrs @ 65°C
Cellulose: Inorg# 65520 Dried: >4 hrs @ 105°C
Variac Setting: 150 ± 7w

Method: UN-Oxidizer
Project #: 21592.01.006
Client: LANL
TO# 160105-8

Sample Analysis

System ID: 581300 (BLUE) UNS Blend 9

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

* Time power was turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0431	6.0062	180.40 *	charring, light smoke., no flames
4:1	2	24.0338	6.0168	180.37 *	↓ + lone flame sporatic @ lead, last only 1s
4:1	3	24.0035	6.0225	180.54 *	↓
4:1	4	24.0156	6.0050	180.28 *	↓
4:1	5	24.0179	6.0078	180.28 *	↓
4:1	Avg			180.37	Over all no reaction observed

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0257	15.0028	190.28 ⊙	low flame at wire leads but didn't
1:1	2	15.0045	15.0073	185.22 ⊙	propagate, charring, light smoke
1:1	3	15.0277	15.0164	186.22 ⊙	
1:1	4	15.0412	15.0134	186.53 ⊙	
1:1	5	15.0113	15.0273	190.37 ⊙	
1:1	Avg			187.72	⊙ Time flame extinguished

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-15-16
Tested Samples: Monica Gabaldon Timer ID: 80494146 Date: 1/19/16
Sample Dried ? (YES) NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 65520 Dried: >4hrs @ 105°C
Variac Setting: 150±7W

Classification: Not Division 5.1

Southwest Research Institute 010056

Method: UN Oxidizer
Project #: 21592.01.006
Client: LANL
TO# 160105-8

Sample Analysis

System ID: 581301 (Green) UNS BLEND 10

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

*Time power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0380	6.0252	182.00*	charring around wire, no flames, light smoke
4:1	2	24.0135	6.0013	180.91*	
4:1	3	24.0024	6.0256	181.19*	
4:1	4	24.0280	6.0147	180.31*	
4:1	5	24.0249	6.0097	180.28*	
4:1	Avg			Avg = 180.94	No Reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	~~15.0116~~ 15.0116	15.0053	211.65⊙	low flame at wire leads, charring, smoke
1:1	2	15.0145	15.0027	185.75⊙	
1:1	3	15.0132	15.0257	197.12⊙	
1:1	4	15.0177	15.0341	187.38⊙	
1:1	5	15.0100	15.0040	187.06⊙	
1:1	Avg			193.79	⊙Time when flame extinguished

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-18-16
Tested Samples: Monica Gabaldon Timer ID: 80494146 Date: 1/19/16
Sample Dried ? (YES) / NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 65520 Dried: >4hrs @165°C
Variac Setting: 150 ± 7N

RE 1/19/16 MG

Classification: Not Division 5.1

Method: UN Oxidizer
Project #: 21592.01.001
Client: LANL
TO# 160105-8

Sample Analysis

System ID: 581302 VNS_BLEND II RED

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

* Time power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0074	6.0002	182.09*	No flames, charring around wire,
4:1	2	24.0058	6.0321	180.28*	smoke
4:1	3	24.0124	6.0100	181.41*	
4:1	4	24.0219	6.0105	180.66*	
4:1	5	24.0506	6.0134	180.31*	
4:1	Avg		AVG = 180.95	No Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
					charring, smoke
1:1	1	15.0095	15.0203	>240	Small flames in front, one large on in back
1:1	2	15.0085	15.0112	198.31ⓞ	flame at wire lead, charring, smoke
1:1	3	15.0318	15.0110	202.57ⓞ	↓
1:1	4	15.0089	15.0329	189.12ⓞ	↓
1:1	5	15.0192	15.0095	>240	Same as #1 Rep
1:1	Avg			214.0	ⓞ Time flame extinguished

>240 = Flame continued to burn after 4min/240sec.

Weighted Samples: B. Villanueva Balance#: 135 Date: 1-18-16
Tested Samples: Monica Gabaldon Timer ID: 80494146 Date: 1/19/16
Sample Dried ? (YES) / NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 165520 Dried: >4hrs. @ 105°C
Variac Setting: 150±7 W

Classification: Not Division 5.1

Southwest Research Institute

010058

Method: UN Oxidizer
Project #: 21592.01.006
Client: LOS Alamos
TO# 160105-8

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0203	21.0161	103.97	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0196	18.0200	54.50	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0331	12.0205	18.98	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-20-16
Tested Samples: B. Villasenor Timer ID: 80494146 Date: 1-20-16
Potassium Bromate: Inorg# 63455-63457 Dried: >12hrs. @ 65°C
Cellulose: Inorg# 65520 Dried: 74hrs. @ 105°C
Variac Setting: 150±7W

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160105-8

Sample Analysis

System ID: 581303 UNS-BLEND 12 (RED)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0003	6.0014	180.58	NO FLAME, SMOKE, CHAR, SMOLDERING
4:1	2	24.0144	6.0122	180.53	
4:1	3	24.0851	6.0153	180.56	
4:1	4	24.0236	6.0161	180.69	
4:1	5	24.0092	6.0127	180.59	
4:1	Avg			180.59	NO Reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0128	15.0050	180.62	SMALL PLUME NEAR WIRE, SMOKE, CHAR SMOLDERING
1:1	2	15.0173	15.0406	180.41	
1:1	3	15.0006	15.0082	180.69	
1:1	4	15.0002	15.0265	180.50	
1:1	5	15.0163	15.0078	180.44	
1:1	Avg			180.53	

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-20-16
Tested Samples: B. Villasenor Timer ID: 804941146 Date: 1-20-16
Sample Dried ? (YES) / NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 165520 Dried: >4hrs. @ 105°C
Variac Setting: 150±7W

Classification: Not Division 5.1

Southwest Research Institute

010060

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160105-8

Sample Analysis

System ID: 589629 UNS_BLEND 13 (BLACK)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0370	6.0180	180.43	NO FLAME, SMOKE, CHAR, SMOLDERING
4:1	2	24.0208	6.0150	180.35	
4:1	3	24.0171	6.0116	180.44	
4:1	4	24.0185	6.0285	180.41	
4:1	5	24.0161	6.0183	180.41	
4:1	Avg			180.41	NO Reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0218	15.0269	180.44	NO FLAME, more smoke than 4:1 char, smoldering
1:1	2	15.0214	15.0267	180.44	
1:1	3	15.0082	15.0184	180.56	
1:1	4	15.0053	15.0305	180.59	
1:1	5	15.0178	15.0077	180.87	
1:1	Avg			180.58	NO Reaction

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-20-16
Tested Samples: B. Villasenor Timer ID: 80494146 Date: 1-20-16
Sample Dried ? (YES) / NO Dried: @ Room temp for 1 day
Cellulose: Inorg# U5520 Dried: >4hrs. @ 105°C
Variac Setting: 150 ± 7W

Classification: Not Division 5.1

Southwest Research Institute

010061

Method: UN-Oxidizer
Project #: 21592.01.006
Client: LANL
TO# 160105-8

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0651	21.0292	124.35	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1		18.0320	54.10	
2:3	2	12.0048			
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0157	12.0362	19.34	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-25-16
Tested Samples: B. Villasenor Timer ID: 80494146 Date: 1-25-16
Potassium Bromate: Inorg# 65455-63457 Dried: > 12 hrs @ 65°C.
Cellulose: Inorg# 65520 Dried: > 4 hrs @ 105°C.
Variac Setting: 150 ± 7 W

Southwest Research Institute

010062

Method: UN-oxidizer
Project #: 21592.01.006
Client: LANL
TO# 160105-8

Sample Analysis

System ID: 589632 UNS-BLEND-16 (Green)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0482	6.0039	180.56	NO FLAME, SMOKE, CHAR, SMOLDERING
4:1	2	24.0747	6.0332	180.31	
4:1	3	24.0346	6.0335	180.56	
4:1	4	24.0148	6.0311	180.47	
4:1	5	24.0459	6.0283	180.40	
4:1	Avg			180.46	NO Reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0015	15.0858	180.75	LOW PLUME FLAME, SMOKE, CHAR, SMOLDERING
1:1	2	15.0357	15.0161	180.43	
1:1	3	15.0102	15.0070	180.35	
1:1	4	15.0563	15.0214	180.31	
1:1	5	15.0196	15.0333	180.66	
1:1	Avg			180.50	

Weighted Samples: B. Villasenor Balance#: 135 Date: 1-25-16
Tested Samples: B. Villasenor Timer ID: 50494146 Date: 1-25-16
Sample Dried ? (YES) / NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 65520 Dried: > 40 hrs @ 105°C.
Variac Setting: 150 ± 7 W

Classification: Not Division 5.1

Southwest Research Institute

010063

Method: UN-oxidizer
Project #: 21592.01.006
Client: LANL
TO# 160105-8

Sample Analysis

System ID: 589634 UNS-BLEND 18 (BLUE)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0562	6.0119	180.43	NO FLAME, SMOKE, CHAR, SMOLDERING
4:1	2	24.0122	6.0132	180.31	
4:1	3	24.0524	6.0494	180.32	
4:1	4	24.0052	6.0299	180.31	
4:1	5	24.0998	6.0193	180.44	
4:1	Avg			180.36	NO Reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0043	15.0168	180.50	
1:1	2	15.0417	15.0169	180.41	LOW PLUME NEAR WIRES, SMOKE, CHAR SMOLDERING
1:1	3	15.0316	15.0153	180.44	
1:1	4	15.0466	15.0417	180.72	
1:1	5	15.0265	15.0219	180.69	
1:1	Avg			180.55	

Weighted Samples: B. VILLASENOR Balance#: 135 Date: 1-25-16
Tested Samples: B. VILLASENOR Timer ID: 80494146 Date: 1-25-16
Sample Dried ? (YES) NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 65520 Dried: > 40 hrs @ 105°C.
Variac Setting: 150 ± 7 W

Classification: Not Division 5.1

Southwest Research Institute®
Logbook: Physical Testing

010064

Analysis / Method: 1030 Project# 21592.01.006

Client: LANL TO# 151222-H
1601058

LCS Info: excelstor fine #61753 TV= positive Balance#: N18

Notes: burn rate greater than 2.2mm/sec is positive

RH= 30.2% temp 27.4°C

meter ID 020917

Sample ID	glowing past burn point	propagation past burn point	flame	time	rate
LCS	Yes	Yes	Yes	10.94	9.14mm/sec
Blend 23	NO	No	No	some popping of nitrates but only charring was sample became white at the burn point	
Blend 24	NO	NO	NO		
Blend 25	NO	No	No	sample bubbled and oozed to the back of the plate	
UNS Blend #2	No	No	No	ooze and melted endured but left inside moist	
Blend #3	NO	No	Yes	flame maintained several seconds after removal of torch	
Blend #4	NO	NO	NO	high moisture most likely prevented much burning.	
Blend #5	No	No	Yes	flame maintained briefly after removing torch burnt sample area	
Blend #6	No	No	NO		
Blend #7	No	No	No		
Blend #8	No	No	No		
Blend #9	No	No	NO	charred the zeolite with some popping of the nitrates but little ooze emerge.	
Blend #10	NO	NO	NO		
Blend #11	NO	NO	No		
Blend #12	No	NO	NO		
Blend #13	No	No	NO		

Calculation:

Analyst Signature: [signature] Date: 12/31/15

Reviewed by: J Ropes Date: 1/20/16

Southwest Research Institute®
Logbook: Physical Testing

010065

Analysis / Method: 1030 Project# 21592.01.006

Client: LANL TO# 166165-8

LCS Info: excelsior fine #61753 TV= positive Balance#: N/A

Notes: burn rate greater than 2.2 mm/sec is positive

Sample ID	glowing past burn point	propagation past burn	flame	time	rate
LCS	Yes	Yes	Yes	11.19	8.94
UNS Blend #16	NO	NO	NO	both samples just charred and whitened around burn point no flame or propagation noticed	
UNS Blend #18	NO	NO	NO		

1/25/16

DAM

Calculation:

Analyst Signature: [signature] Date: 1/25/16

Reviewed by: [signature] Date: 2/2/16

Southwest Research Institute®
Logbook: Physical Testing

010066

Analysis / Method: Paint filter Project# 21592.01.006.5.3

Client: LANL TO# 16010 12/21/15

LCS Info: DI H2O TV= passed Balance#: 05

Notes: balance #5

Sample ID	Sample Vol / wgt	Sample pass through	positive / negative		
DI H_2O	100mL	yes	positive		
WS Blend #2	100.117	No	negative		
Blend #2D	100.941	No	negative		
Blend #3	100.334	No	negative		
Blend #4	100.375	No	negative		
Blend #5	100.724 g	No	negative		
Blend #6	100.651	No	negative		
Blend #7	100.773	No	negative		
Blend #8	100.197	No	negative		
Blend #9	100.588	No	negative		
Blend #10	100.431g	No	negative		
Blend #11	100.219	No	negative		
Blend #12	100.333	No	negative		
Blend #13	100.711	No	negative		

Calculation:

Analyst Signature: Date: 12/31/15

Reviewed by: Date: 1/20/16

Book I.D. 16-0406-001 Book/ Page : 13 002

Southwest Research Institute®
Logbook: Physical Testing

010067

Analysis / Method: paint filter 9095B Project# 21542.01.006

Client: LANL TO# 166105-8

LCS Info: DI H_2O TV= positive Balance#: 05

Notes:

Sample ID	Sample vol/wgt	Sample pass through	positive or negative		
DI H_2O	100mL	Yes	positive		
LANL Blend #16	100.345	No	negative		
LANS Blend #16D	100.719	No	negative		
LANS Blend #18	100.224	No	negative		

SAM 11/25/16

Calculation:

Analyst Signature: Jana Mc Date: 11/25/16

Reviewed by: DRoth Date: 12/2/16

Book I.D. 14-0406-021 Book/ Page : 12 00198

Southwest Research Institute®
Logbook: Physical Testing

010068

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160105-8

LCS Info: N/A TV= N/A Balance#: N/A

Notes:

Sample ID					
1/8/16 UNS	Blend 6-7	Start: 18:50 1/8/16 Stop: 14:46 1/10/16			
Samples were removed from the oven after analysis. Zeolite was now a dry light color rather than the dark moist green color it began the analysis at. Both samples did not exceed 200°C during the analysis and are therefore considered not to be self-heating waste.					
1/10/16 UNS	Blend 8 & 9	Start: 16:21 1/10/16 Stop: 6:36 1/12/16			
UNS Blend 8 slightly exceeded 140°C but came back down slowly. During the analysis both samples did not exceed 200°C and therefore are considered to be non self-heating waste.					
Calculation:					

Analyst Signature: James Mark Date: 1/12/16

Reviewed by: RBMM Date: 2/2/16

Southwest Research Institute®
Logbook: Physical Testing

010069

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160105-8

LCS Info: N/A TV= N/A Balance#: N/A

Notes:

Calibration: 012017

Sample ID									
UNS Blend #2			start: 10:28 11/2/16				stop: 12:59		11/3/16
During analysis it was seen that the sample was expanding out of the cube due to the tray thermocouples adjustment in temperature. The sample expanded about 5-8 times its initial volume and filled up a good portion of the oven. Even though temperatures did not exceed 200°C the sample was still considered to have gone through an event.									
Charged computer, new calibration needed 11/3/16									
temp	0	1	2	3	4	5	6	7	
0	0.0	0.3	-0.2	-0.4	-0.4	-0.3	0.0	0.1	
50	50.0	50.4	49.9	49.7	49.6	49.8	50.1	50.2	
100	100.0	100.3	99.8	99.7	99.5	99.8	100.0	100.1	
200	200.0	200.3	199.9	199.6	199.5	199.8	200.0	200.2	
300	300.1	300.3	299.9	299.7	299.5	299.8	300.1	300.2	
Calculation:									

Analyst Signature: [signature] Date: 11/2/16

Reviewed by: [signature] Date: 12/16

Book I.D. 14-0406-021 Book/ Page : 12 00200

Southwest Research Institute®
Logbook: Physical Testing

010070

Analysis / Method: 1050 Project# 21592.06.006

Client: LANL TO# 160205-8

LCS Info: N/A TV= N/A Balance#: N/A

Notes:

Sample ID					
WNS Blend #4		Start: 15:23 1/13/16		Stop: 6:33 1/15/16	
Sample slowly came to temperature over a 22 hour period and kept slowly climbing until an event occured at around 23 hours. Samples exceeded 400°C and proceeded to climb to 700°C and over during a coarse of 6 hours. Oven was turned off during this time. A 25mm cube will be needed for further analysis.					
WNS Blend 11 : B		start: 14:39 1/18/16		Stop: 9:09 1/20/16	
Samples came out of the oven dry. During the analysis the samples did not exceede 200°C therefore they are not considered to be self heating waste.					
Calculation:					

Analyst Signature: Date: 1/13/16

Reviewed by: Date: 2/2/16

Southwest Research Institute®
Logbook: Physical Testing

010071

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160105-8

LCS Info: N/A TV= N/A Balance#: N/A

Notes:

Sample ID					
UNS Blend #3		Start: 13:01	1/20/16	Stop: 6:35	1/22/16
When the sample was removed it was a darkened brown cube that had hardened into that shape. During the analysis the sample went up to almost 160°C but came back down to 140°C. The sample did not exceed 200°C during the analysis and is therefor considered to not be a self-heating waste.					
UNS Blend #5		Start: 8:07	1/22/16	Stop: 8:18	1/24/16
Similar characteristic and event as UNS Blend #4. Sample self heated to almost 200°C. Sample will need to be reanalyzed in a 25mm cube to make an accurate classification.					
Calculation:					

Analyst Signature: Jana Mah Date: 1/20/16

Reviewed by: RPorus Date: 2/2/16

Book I.D. 16-0406-001 Book/ Page : 13 004

Southwest Research Institute®
Logbook: Physical Testing

010072

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160105-8

LCS Info: N/A TV= N/A Balance#: N/A

Notes:

Sample ID					
UNs Blend #10	# 12	start: 12:18	11/24/16	stop: 7:31	11/26/16
Samples took some time to come to temperature, so they were allowed to run for 40 hours. Sample did not exceed 200°c during the analysis and are considered to be not self heating.					
UNS Blend 16	# 18	start: 10:11	11/26/16	stop: 6:41	11/28/16
Due to elevated moisture level of the samples it took some time for the samples to reach a steady temperature. Samples ran for 45 hours. Slight reduced volume when removed from the oven. Samples did not exceed 200°c and did not appear to undergo and events. Therefore, the samples are considered to not be self heating.					
Calculation:					

Analyst Signature: Date: 11/24/16

Reviewed by: Date: 12/2/16

Southwest Research Institute®
Logbook: Physical Testing

010073

Analysis / Method: 1556 Project# 21592.01.006

Client: LANL TO# 160105-8

LCS Info: N/A TV= N/A Balance#: N/A

Notes: 25mm cube runs

Sample ID					
UNS Blend #4	25mm	Start: 8:33	1/28/16	stop: 9:14	1/29/16
Sample came to temperature in about 4 hours and remained at temp for the remainder of the test. When removing the sample from the oven it had formed hard solid cubes around the thermocouples. Sample is considered not self heating in the 25mm cube.					
UNS Blend #7	25mm	Start: 11:01	1/29/16	stop 11:32	1/30/16
When coming to temperature several thermocouples had rising and falling temperatures showing that the sample was possibly expanding out of the cubes. Upon opening the oven it was noted that the sample had expanded out of the cubes. No areas of burning or charring were present in the expanded foam like sample material. Sample is considered to be not self heating in the 25mm cube.					
UNS Blend #5	25mm	Start: 12:46	1/30/16	stop: 6:37	2/1/16
When removing the sample from the oven it had a dark brown color to it but still remained quite cubed and did not harden into a cube during analysis. Sample is considered to be non self heating in the 25 mm cube.					

Calculation:

Analyst Signature: Date: 1/28/16

Reviewed by: Date: 2/2/16

010074

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160105-8
SwRI SRR: 56087
SDG: 581291
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Surrogate Preparation

Work continued from Page

SWRI

010075

10-01-WCS12 UNS solution balance # 05

aluminum nitrate (#63012, 63610, 63609) 1387.111 g +
calcium nitrate (#63613) 140.196 g +
chromium nitrate (#63857) 10.308 g +
iron nitrate (#63604) 99.256 g +
sodium nitrate (#33383) 82.302 +
Magnesium nitrate (#63605) 668.125
Nickle nitrate (#65543) 0.417 g
lead nitrate (#64108) 94.419 g
oxalic acid (#63607) 395.608 g
H_2O 106.921 g
HNO_3 (#62998) 10.619 g

added 1050mL DI H_2O then split into two portions.

(A) - used as is ~ 2% solid remaining
(B) - added 2,300mL liquid neutralized to make ~ pH 5.10 <1% solids left

approximately 1300mL UNS.
UNS sulfeat
10-12-WCS12 50:150

800mL UNS (10-01-WCS12 A) + 2400mL sulfeat #12
let sit 24 hr 13:50
UNS sulfeat
10-3-WCS12 50:150

700*
800mL* UNS (10-01-WCS12 A* (B)) + 700* 2400mL sulfeat #15
let sit 24 hr 13:58

*TC ran out of sulfeat charged up blend

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Work continued to Page

SIGNATURE James Nash DATE 12/28/15

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SWRI 12-01-WCS12 UNS-heat solvent 50:150 010076

800mL UNS (10-01-WCS12 B) to 2400mL solvent
let sit 24hrs 9:45 #11 tray

12-02-WCS12 UNS B solvent 50:50

1000mL UNS (10-01-WCS12 B) to 1000mL solvent
let sit 24hrs 10:00 #13 tray

12-03-WCS12 UNS solution balance #5

aluminum nitrate	(#65580)	1387.106
calcium nitrate	(#63614)	140.107g
chromium nitrate	(#61751)	10.311
iron nitrate	(#63604)	99.201g
Sodium nitrate	(#33383)	82.303g
magnesium nitrate	(#636055)	668.109
nickle nitrate	(#63593)	0.402
Lead nitrate	(#64108)	99.418g
Oxalic acid	(#636058)	395.612
H_2O		106.918
HNO_3	(#62998)	10.617

added 1100mL DI H_2O

SPM 1/11/16

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SIGNATURE James Pen DATE 12/29/15

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SWRI 010077

141-01-WCS12 Blend #7

500mL (10-02-WCS12) + 250mL DI H_2O mix and take 460 mL of this and add it to 1380 mL zeolite #8 15:00

141-02-WCS12 Blend #11

600mL (10-02-WCS12) + ~~250~~ 300 mL DI H_2O mix and take 600 mL of this and add it to 1200 mL zeolite #12 16:20

141-03-WCS12 Blend # 6

500mL (10-03-WCS12) + 250mL DI H_2O mix and take 560 mL of this and add it to 1680 mL zeolite #15 17:50

141-01-WCS12 Blend # 10

500mL (10-03-WCS12) + 250mL DI H_2O mix and take 600 mL of this and add it to 1200 mL zeolite #9

12/30/15

141-05-WCS12 UNS Blend #9

500mL (12-01-WCS12) + 250mL DI H_2O and take 500 mL of this and add it to 1500 mL zeolite #8 11:10

141-06-WCS12 UNS Blend #13

600mL (12-01-WCS12) + 300mL DI H_2O and take 600 mL of this and add it to 1200 mL zeolite #12

141-07-WCS12 UNS Blend # ~~8~~ 12

500mL (12-02-WCS12) + 250 mL DI H_2O take 730 mL of this and add to 1460 mL zeolite #11

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SWRI 16-01-WG12 UNS Blend # 8

010078

400mL (12-02-WG12) + 200mL DI H_2O mix and take 600 mL of this and add it to 1800 mL zeolite #15

SAM 11/1/16

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SIGNATURE James Mc

DATE 12/30/15

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DATE

WITNESS

DATE 11/15/16

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010079

SWRI

34-01-WCS12 UNS Blend #14

1200 mL (12-03-WCS12) + 75mL Waste lock let sit for 24 hr.
17:15 1/20/16 start

34-02-WCS12 UNS Blend #16

500mL UNS Blend #14 (#34-01-WCS12) + 1500mL zeolite and let
sit for 24 hrs 8:30 1/22/16 tray #12

34-03-WCS12 UNS Blend #18

600mL (UNS Blend #14 (#34-01-WCS12) + 1200mL zeolite and let
sit for 24 hrs 8:35 1/22/16 tray #15

SAM 2/2/16

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SIGNATURE James Rue DATE 1/28/16

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SWRI

010080

for 25mm cube

UNS Blend #2 36-01-WCS12

75mL UNS Blend #1 (10-01-WCS12) + 75mL softheat let sit for 24 hr
8:50 1/28/16

JAM 2/2/16

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SIGNATURE [signature] DATE 1/28/16

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010081

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160105-8
SwRI SRR: 56087
SDG: 581291
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Chemicals Certificates of Analysis

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3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBQ6140V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	19 AUG 2015

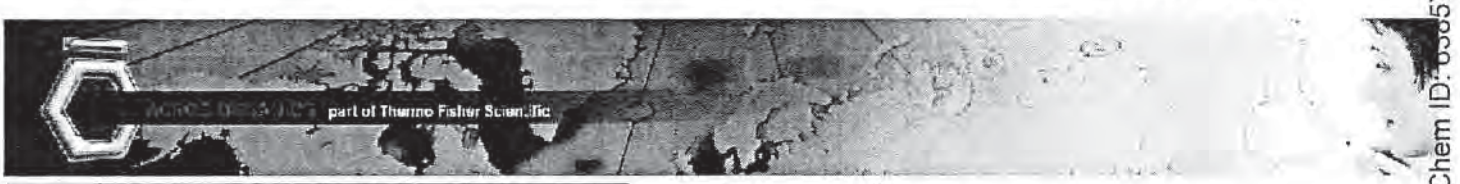
TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	100.0 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	CORRESPONDS TO ACS (10TH ED.)
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	INSOLUBLE MATTER < 0.005 % HEAVY METALS (AS PB) < 0.001 %
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 20 MG/KG	< 20 MG/KG
POTASSIUM (ICP)	≤ 20 MG/KG	< 20 MG/KG
MAGNESIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

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SwRI Chem ID: 63072
SwRI Chem ID: 63072
SwRI Chem ID: 63072



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

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Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	dark purple to black crystalline chunks	black crystalline chunks
Titration Iodometric	>=98.5 %	101.9 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Trace analysis	Type: Ca measure =< 50 PPM	Type: Ca measure 5 PPM
Trace analysis	Type: Cd measure =< 10 PPM	Type: Cd measure 3 PPM
Trace analysis	Type: Co measure =< 10 PPM	Type: Co measure 5 PPM
Trace analysis	Type: Cu measure =< 10 PPM	Type: Cu measure 7 PPM
Trace analysis	Type: Fe measure =< 200 PPM	Type: Fe measure 178 PPM
Trace analysis	Type: Mg measure =< 50 PPM	Type: Mg measure 6 PPM
Trace analysis	Type: Mn measure =< 10 PPM	Type: Mn measure 7 PPM
Trace analysis	Type: Na measure =< 50 PPM	Type: Na measure 17 PPM
Trace analysis	Type: Ni measure =< 50 PPM	Type: Ni measure 8 PPM
Trace analysis	Type: Pb measure =< 20 PPM	Type: Pb measure 4 PPM
Trace analysis	Type: Sr measure =< 50 PPM	Type: Sr measure 11 PPM
Trace analysis	Type: Zn measure =< 10 PPM	Type: Zn measure 4 PPM
Trace analysis	Type: Cl measure =< 20 PPM	Type: Cl measure =< 20 PPM
Trace analysis	Type: SO4 measure =< 50 PPM	Type: SO4 measure =< 50 PPM
Trace analysis	Type: NH4 measure =< 10 PPM	Type: NH4 measure =< 10 PPM
Subst not pptd by NH4OH	=<0.2 % (as SO4)	=<0.0077 % (as SO4)

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857

010084



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 28 October 2015

Acros Organics
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Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857

SwRI Chem ID: 63604

010085

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3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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SwRI Chem ID: 63604
SwRI Chem ID: 63604

010086

Certificate of Analysis

SIGMA-ALDRICH

Product Name	Sodium nitrate, ACS reagent, ≥99.0%
Product Number	221341
Product Brand	Sigma-Aldrich
CAS Number	7631-99-4
Molecular Formula	$NaNO_3$
Molecular Weight	84.99

INORGANIC LABS/RADCHEM LABS
DATE RECEIVED: 10/24/08
DATE EXPIRED: 10/24/2018
DATE OPENED: 11/7/08
INORG: 7246/7247 PO: N/A from 01.V.16

TEST	LOT 07030MH RESULTS
APPEARANCE	WHITE CRYSTALLINE POWDER
TITRATION	99.7% (WITH NAOH) *
ICP ASSAY	CONFIRMS SODIUM COMPONENT
INSOLUBLE MATTER	0.003% (20%, H2O) *
CALCIUM	0.003% *
CHLORIDE	0.0002% *
IRON	1 PPM *
HEAVY METALS	3 PPM (AS PB) *
IODATE	2 PPM *
MAGNESIUM	0.001% *
NITRITE	0.0005% *
PH	6.0 @ 25 DEG C (5% H2O) *
PHOSPHATE	2 PPM *
SULFATE	0.001% *
	* SUPPLIER DATA
	MEETS REQUIREMENTS OF ACS 10TH ED
QC RELEASE DATE	NOVEMBER 2007

Barbara Rajzer

Barbara Rajzer, Supervisor
Quality Control
Milwaukee, Wisconsin USA

SwRI Chem ID: 33383
SwRI Chem ID: 33383
SwRI Chem ID: 33383

SIGMA-ALDRICH®

3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:	NICKEL(II) NITRATE HEXAHYDRATE purum p.a., crystallized, >= 97.0 % KT
Product Number:	72253
Batch Number:	BCBP4160V
Brand:	Sigma-Aldrich
CAS Number:	13478-00-7
Formula:	$Ni(NO_3)_2 \bullet 6H_2O$
Formula Weight:	290.79
Quality Release Date:	26 JAN 2015

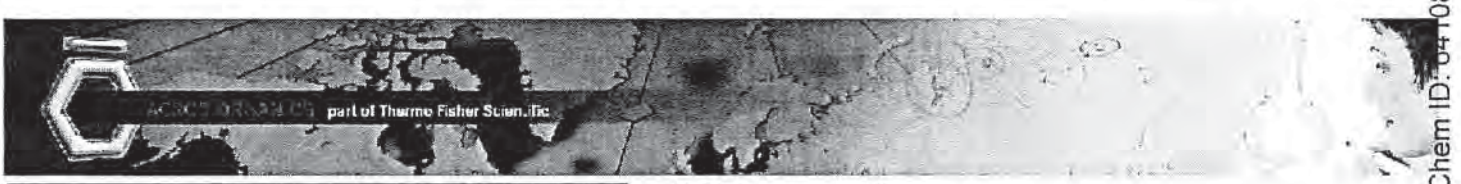
TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	BLUE-GREEN TO DEEP BLUE-GREEN	BLUE-GREEN
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	97.0 - 103.0 %	97.0 %
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
CADMIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
COBALT (ICP)	≤ 500 MG/KG	< 500 MG/KG
COPPER (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 50 MG/KG	< 50 MG/KG
POTASSIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
SODIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
LEAD (ICP)	≤ 50 MG/KG	< 50 MG/KG
ZINC (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 50 MG/KG	< 50 MG/KG

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

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SwRI Chem ID: 65593
SwRI Chem ID: 65593
SwRI Chem ID: 65593



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

Certificate of Analysis

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Catalog Number	42385	**Quality Test / Release Date**	7 August 2014
Lot Number	A0350156	**Suggested Retest Date**	August 2019
Description	Lead(II) nitrate,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystalline powder
Titration Complexometric	>=99.0 %	99.5 %
Insoluble matter	=<0.005 %	0.002 %
Trace analysis	Type: Cl measure =< 10 ppm	Type: Cl measure =< 10 ppm
Trace analysis	Type: Cu measure =< 20 ppm	Type: Cu measure =< 10 ppm
Trace analysis	Type: Fe measure =< 10 ppm	Type: Fe measure =< 5 ppm
Trace analysis	Type: Ca measure =< 50 ppm	Type: Ca measure =< 10 ppm
Trace analysis	Type: K measure =< 50 ppm	Type: K measure =< 10 ppm
Trace analysis	Type: Na measure =< 200 ppm	Type: Na measure =< 10 ppm



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 4 November 2015

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 64108
SwRI Chem ID: 64108
SwRI Chem ID: 64108

SwRI Chem ID: 63607

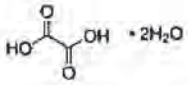
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Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Oxalic acid dihydrate - ACS reagent, ≥99%



Product Number:	**247537**
Batch Number:	**MKBS8637V**
Brand:	SIAL
CAS Number:	6153-56-6
MDL Number:	MFCD00149102
Formula:	$C_2H_2O_4 \cdot 2H_2O$
Formula Weight:	126.07 g/mol
Quality Release Date:	18 SEP 2014
Recommended Retest Date:	SEP 2019

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Crystals, Powder, Crystalline or Granular Powder	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by KMNO4	99.5 - 102.5 %	99.9 %
Residue on ignition (Ash)	≤ 0.01 %	< 0.01 %
Insoluble Matter C=8%, H2O	≤ 0.005 %	< 0.001 %
Calcium (Ca)	≤ 0.001 %	< 0.001 %
Chloride Content	≤ 0.002 %	< 0.002 %
Substances Darkened (by H2SO4)	Pass	Pass
Iron (Fe)	≤ 2 ppm	< 2 ppm
Heavy Metals	≤ 5 ppm	< 3 ppm
Nitrogen Compounds	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %
Meets ACS Requirements	Current ACS Specification	Conforms
Recommended Retest Period 5 years	----------	----------

SwRI Chem ID: 63607

SwRI Chem ID: 63607

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SwRI Chem ID: 63607

Certificate of Analysis

Product Number: 247537
Batch Number: MKBS8637V

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 63607

SwRI Chem ID: 63607

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SwRI Chem ID: 63607

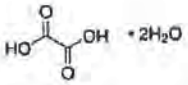
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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Oxalic acid dihydrate - ACS reagent, ≥99%



Product Number:	**247537**
Batch Number:	**MKBS8637V**
Brand:	SIAL
CAS Number:	6153-56-6
MDL Number:	MFCD00149102
Formula:	$C_2H_2O_4 \cdot 2H_2O$
Formula Weight:	126.07 g/mol
Quality Release Date:	18 SEP 2014
Recommended Retest Date:	SEP 2019

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Crystals, Powder, Crystalline or Granular Powder	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by KMNO4	99.5 - 102.5 %	99.9 %
Residue on ignition (Ash)	≤ 0.01 %	< 0.01 %
Insoluble Matter C=8%, H2O	≤ 0.005 %	< 0.001 %
Calcium (Ca)	≤ 0.001 %	< 0.001 %
Chloride Content	≤ 0.002 %	< 0.002 %
Substances Darkened (by H2SO4)	Pass	Pass
Iron (Fe)	≤ 2 ppm	< 2 ppm
Heavy Metals	≤ 5 ppm	< 3 ppm
Nitrogen Compounds	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %
Meets ACS Requirements	Current ACS Specification	Conforms
Recommended Retest Period 5 years	----------	----------

SwRI Chem ID: 63607

SwRI Chem ID: 63607

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SwRI Chem ID: 63607

Certificate of Analysis

Product Number: 247537
Batch Number: MKBS8637V

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 63607

SwRI Chem ID: 63607

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Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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Catalog Number	**A509**	**Mfg. Date**	7/3/2015
Lot Number	**1115060**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	07/03/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

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Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

CERTIFIED BY

Edgar E Hess
Lab Manager Fair Lawn

Joel Boland
Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1.800.227.6701.

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Certificate of Analysis

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBQ1780V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	10 JUN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	99.6 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	CORRESPONDS TO ACS (10TH ED.)
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	INSOLUBLE MATTER < 0.005 % HEAVY METALS (AS PB) < 0.001 %
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 20 MG/KG	< 20 MG/KG
POTASSIUM (ICP)	≤ 20 MG/KG	< 20 MG/KG
MAGNESIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

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010096

ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for use in manufacturing, consumption or application of drugs, cosmetics, dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm

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Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 4 September 2015

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 61751
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SwRI Chem ID: 63613

Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate – ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

SwRI Chem ID: 63613

SwRI Chem ID: 63613

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SwRI Chem ID: 63613

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	———	———

Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 63613

SwRI Chem ID: 63613

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Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate – ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

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Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 63614

SwRI Chem ID: 63614

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Certificate of Analysis

Product Name:
Magnesium nitrate hexahydrate – ACS reagent, 99%

Product Number:	**237175**
Batch Number:	**MKBW3613V**
Brand:	SIAL
CAS Number:	13446-18-9
MDL Number:	MFCD00149779
Formula:	MgN2O6 · 6H2O
Formula Weight:	256.41 g/mol
Quality Release Date:	24 AUG 2015

$Mg(NO_3)_2 \cdot 6H_2O$

SwRI Chem ID: 63605

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Chips or Crystals	Conforms to Requirements	Crystals
X-Ray Diffraction	Conforms to Structure	Conforms
Complexometric EDTA	98.0 - 102.0 %	100.4 %
Insoluble Matter C= 10%, H2O	≤ 0.005 %	0.002 %
Barium	≤ 0.005 %	< 0.001 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Chloride Content	≤ 0.001 %	< 0.001 %
Iron (Fe)	≤ 5 ppm	< 1 ppm
Heavy Metals as Pb	≤ 5 ppm	< 4 ppm
Potassium (K)	≤ 0.005 %	< 0.001 %
Manganese (Mn)	≤ 5 ppm	< 4 ppm
Sodium (Na)	≤ 0.005 %	< 0.001 %
Ammonia (NH4)	≤ 0.003 %	< 0.003 %
pH C= 5%, H2O @ 25 Deg C	5.0 - 8.2	5.4
Phosphate (PO4)	≤ 5 ppm	< 5 ppm
Strontium (Sr)	≤ 0.005 %	< 0.001 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %

SwRI Chem ID: 63605

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Certificate of Analysis

Product Number: 237175
Batch Number: MKBW3613V

Test	Specification	Result
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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Certificate of Analysis

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBQ6140V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	19 AUG 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	100.0 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	CORRESPONDS TO ACS (10TH ED.)
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	INSOLUBLE MATTER < 0.005 % HEAVY METALS (AS PB) < 0.001 %
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 20 MG/KG	< 20 MG/KG
POTASSIUM (ICP)	≤ 20 MG/KG	< 20 MG/KG
MAGNESIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

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SwRI Chem ID: 63609
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SwRI Chem ID: 63609

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Certificate of Analysis

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBQ6140V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \cdot 9H_2O$
Formula Weight:	375.13
Quality Release Date:	19 AUG 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	100.0 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	CORRESPONDS TO ACS (10TH ED.)
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	INSOLUBLE MATTER < 0.005 % HEAVY METALS (AS PB) < 0.001 %
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 20 MG/KG	< 20 MG/KG
POTASSIUM (ICP)	≤ 20 MG/KG	< 20 MG/KG
MAGNESIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

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SwRI Chem ID: 65519

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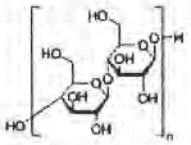
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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Cellulose - fibers, (medium)

Product Number:	**C6288**
Batch Number:	**SLBL2989V**
Brand:	SIGMA
CAS Number:	9004-34-6
MDL Number:	MFCD00081512
Quality Release Date:	25 AUG 2014



Test	Specification	Result
Appearance (Color)	White to Off White	White
Appearance (Form)	Powder or Solid	Powder
Moisture Content	≤ 10 %	4 %

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65519

SwRI Chem ID: 65519

GFS Chemicals, Inc.
Columbus, Ohio 43223

010107

LOT ANALYSIS

ITEM: 555 POTASSIUM BROMATE, REAGENT (ACS)

LOT#:C469259

Test	PASS/FAIL	NUMERICAL RESULT
Assay (dried basis) 99.8% min.	PASS	100.3%
pH of 5% solution 5.0-9.0	PASS	6.1
Insoluble 0.005%	PASS	<0.005%
Bromide Pass test	PASS	pass test
Sulfate 0.005%	PASS	<0.005%
Heavy metals 0.0005%	PASS	<0.0005%
Iron 0.002%	PASS	<0.002%
Sodium 0.01%	PASS	<0.01%

TRACEABLE TO N.I.S.T. (Y/N)? Y
Comment:
Reported by: Nicholas E. Dangler
QC Supervisor: Charles Fontaine
Quality Assured to Retest Point: 60 months from shipment
C/A Print Date: 10/22/2015

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SwRI Chem ID: 63455
SwRI Chem ID: 63455
SwRI Chem ID: 63455

010108

GFS Chemicals, Inc.
Columbus, Ohio 43223

LOT ANALYSIS

ITEM: 555 POTASSIUM BROMATE, REAGENT (ACS)

LOT#:C577499

Test	PASS/FAIL	NUMERICAL RESULT
Assay (dried basis) 99.8% min.	PASS	100.9%
pH of 5% solution 5.0-9.0	PASS	6.5
Insoluble 0.005%	PASS	<0.005%
Bromide Pass test	PASS	pass test
Sulfate 0.005%	PASS	<0.005%
Heavy metals 0.0005%	PASS	<0.0005%
Iron 0.002%	PASS	<0.002%
Sodium 0.01%	PASS	<0.01%

TRACEABLE TO N.I.S.T. (Y/N)? Y
Comment:
Reported by: Nicholas E. Dangler
QC Supervisor: Charles Fontaine
Quality Assured to Retest Point: 60 months from shipment
C/A Print Date: 10/22/2015

Not for direct use in food, cosmetics, finished pharmaceuticals or drug products. Supplier is not responsible for compliance with FDA Current Good Manufacturing Practice (CGMP) requirements, including without limitation those for finished drug products in 21 C.F.R Parts 210 and 211. Consult warranty limitations at www.gfschemicals.com/statics/documents/aboutus/termsandconditions.html For resale by GFS authorized distributors only.

SwRI Chem ID: 63456
SwRI Chem ID: 63456
SwRI Chem ID: 63456

010109

GFS Chemicals, Inc.
Columbus, Ohio 43223

LOT ANALYSIS

ITEM: 555 POTASSIUM BROMATE, REAGENT (ACS)

LOT#:C577499

Test	PASS/FAIL	NUMERICAL RESULT
Assay (dried basis) 99.8% min.	PASS	100.9%
pH of 5% solution 5.0-9.0	PASS	6.5
Insoluble 0.005%	PASS	<0.005%
Bromide Pass test	PASS	pass test
Sulfate 0.005%	PASS	<0.005%
Heavy metals 0.0005%	PASS	<0.0005%
Iron 0.002%	PASS	<0.002%
Sodium 0.01%	PASS	<0.01%

TRACEABLE TO N.I.S.T. (Y/N)? Y
Comment:
Reported by: Nicholas E. Dangler
QC Supervisor: Charles Fontaine
Quality Assured to Retest Point: 60 months from shipment
C/A Print Date: 10/22/2015

Not for direct use in food, cosmetics, finished pharmaceuticals or drug products. Supplier is not responsible for compliance with FDA Current Good Manufacturing Practice (CGMP) requirements, including without limitation those for finished drug products in 21 C.F.R Parts 210 and 211. Consult warranty limitations at www.gfschemicals.com/statics/documents/aboutus/termsandconditions.html For resale by GFS authorized distributors only.

GFS Chemicals, Inc. P.O. Box 245 Powell, OH 43065 * Signed Orig. Doc. on File
800-858-9682 (U.S. and Canada) 740-881-5501(International) 740-881-5989 (Fax)

SwRI Chem ID: 63457
SwRI Chem ID: 63457
SwRI Chem ID: 63457

SwRI Chem ID: 61124

SIGMA-ALDRICH®

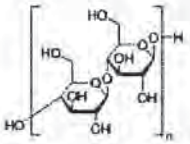
sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Cellulose - fibers, (medium)

Product Number:	**C6288**
Batch Number:	**SLBL2989V**
Brand:	SIGMA
CAS Number:	9004-34-6
MDL Number:	MFCD00081512
Quality Release Date:	25 AUG 2014



Test	Specification	Result
Appearance (Color)	White to Off White	White
Appearance (Form)	Powder or Solid	Powder
Moisture Content	≤ 10 %	4 %

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 61124

SwRI Chem ID: 61124

SwRI Chem ID: 65520

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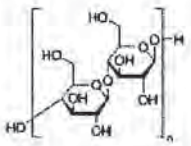
sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Cellulose - fibers, (medium)

Product Number:	**C6288**
Batch Number:	**SLBL2989V**
Brand:	SIGMA
CAS Number:	9004-34-6
MDL Number:	MFCD00081512
Quality Release Date:	25 AUG 2014



Test	Specification	Result
Appearance (Color)	White to Off White	White
Appearance (Form)	Powder or Solid	Powder
Moisture Content	≤ 10 %	4 %

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65520

SwRI Chem ID: 65520

010112

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160105-8
SwRI SRR: 56087
SDG: 581291
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES

D.I. Water & Balance Verification Logs

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

010113

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
11/25/15 1315	DRmZ	17.91	✓	✓	—	n/A	—
11/30/15 1731	DRmZ	11.91	✓	✓	—	n/A	—
12/1/15 1810	DRmZ	17.91	✓	—	—	n/A	—
12/2/15 1854	DRmZ	17.95	✓	X	—	n/A	✓ verify.
12/3/15 1901	DRmZ	17.91	✓	X	✓	n/A	X-change needed
12/4/15 1747	DRmZ	17.91	✓	X	—	n/A	same as above.
12/7/15 1500	DRmZ	17.90	✓	X	✓	n/A	pending service
12/8/15 1830	DRmZ	17.91	✓	X	—	n/A	pending service
12/9/15 1810	DRmZ	17.90	—	X	—	n/A	same
12/10/15 1751	DRmZ	17.90	✓	X	—	n/A	pending exchange
12/11/15 1649	DRmZ	17.96	✓	X	✓	n/A	same
12/14/15 1801	DRmZ	17.90	—	X	—	n/A	same
12/15/15 1835	DRmZ	17.90	✓	X	—	n/A	pending
12/16/15 1831	DRmZ	17.95	✓	✓	✓	n/A	V-Tank replaced. ✓
12/17/15 1811	DRmZ	17.96	—	✓	✓	n/A	✓
12/18/15 1650	DRmZ	17.96	—	X	✓	n/A	X-change?? needed??

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
11/25/15 1317	DRmZ	✓	✓ 17.5	36925.3	—
11/30/15 1733	DRmZ	✓	✓ 18.0	36926.7	—
12/1/15 1811	DRmZ	✓	✓ 18.0	36930.8	—
12/2/15 1855	DRmZ	✓	✓ 18.0	36939.5	—
12/3/15 1902	DRmZ	✓	✓ 18.0	36941.3	—
12/4/15 1748	DRmZ	✓	✓ 18.0	36956.7	—
12/7/15 1501	DRmZ	✓	✓ 18.0	36958.2	—
12/8/15 1831	DRmZ	✓	✓ 18.0	36970.4	—
12/9/15 1811	DRmZ	✓	✓ 18.0	36975.3	—
12/11/15 1752	DRmZ	✓	✓ 18.0	36975.6	✓
12/11/15 1650	DRmZ	—	— 18.0	36976.7	—
12/14/15 1803	DRmZ	—	— 18.0	36979.4	—
12/15/15 1836	DRmZ	—	— 18.0	36980.3	—
12/16/15 1832	DRmZ	—	— 18.0	36989.5	—
12/17/15 1812	DRmZ	—	— 18.0	~~36~~ 37001.1	—
12/18/15 1652	DRmZ	✓	— 18.0	37001.9	—

Legend: Check = Green (OK); X = Red (call for service)

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

010114

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
12/21/15 1816	DRmZ	17.95	✓	X	✓	n/A	X-change made
12/22/15 1705	DRmZ	17.95	✓	X	✓	n/A	Pending service
12/23/15 1700	DRmZ	17.95	✓	X	✓	n/A	Pending
12/28/15 1702	DRmZ	17.96	✓	X	✓	n/A	Pending
12/29/15 1809	DRmZ	17.96	✓	X	✓	n/A	SAME
12/30/15 1813	DRmZ	17.96	✓	X	✓	n/A	Pending
12/31/15 1510	DRmZ	17.97	✓	X	✓	n/A	SAME
1/5/2016 1820	DRmZ	17.97	✓	X	✓	n/A	Incorrect tank touched/fixed.
1/6/2016 1815	DRmZ	17.97	✓	X	✓	n/A	Pending
1/7/2016 1810	DRmZ	17.97	✓	X	✓	n/A	Service call placed
1/8/2016 1801	DRmZ	17.97	✓	✓	✓	n/A	Carbon & mixed tanks exchanged
1/11/2016 1831	DRmZ	17.96	✓	✓	✓	n/A	✓
1/12/2016 1858	DRmZ	17.96	✓	✓	✓	n/A	✓
1/13/2016 1810	DRmZ	17.97	✓	✓	✓	n/A	✓
1/14/2016 1750	DRmZ	17.96	✓	✓	✓	n/A	✓
1/15/2016 1830	DRmZ	17.96	✓	✓	✓	n/A	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
12/21/15 1817	DRmZ	✓	✓ 17.5	37003.1	✓
12/22/15 1706	DRmZ	✓	✓ 17.5	37003.7	✓
12/23/15 1701	DRmZ	✓	✓ 17.5	37006.0	✓
12/28/15 1703	DRmZ	✓	✓ 17.5	37007.5	✓
12/29/15 1810	DRmZ	✓	✓ 18.0	37015.3	✓
12/30/15 1813	DRmZ	✓	✓ 18.0	37024.0	✓
12/31/15 1511	DRmZ	✓	✓ 18.0	37024.9	✓
1/5/16 1831	DRmZ	✓	✓ 17.5	37049.8	✓
1/6/16 1816	DRmZ	✓	✓ 17.5	37052.1	✓
1/7/16 1811	DRmZ	✓	✓ 17.5	37053.0	✓
1/8/16 1807	DRmZ	✓	✓ 18.0	37056.8	✓
1/11/16 1832	DRmZ	✓	✓ 18.0	37060.3	✓
1/12/16 1859	DRmZ	✓	✓ 18.0	37063.7	✓
1/13/16 1811	DRmZ	✓	✓ 18.0	37064.8	✓
1/14/16 1751	DRmZ	✓	✓ 18.0	37082.0	✓
1/15/16 1831	DRmZ	✓	✓ 18.0	37083.1	✓

Legend: Check = Green (OK); X = Red (call for service)

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

010115

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
1/18/16 1820	DRmz	17.96	✓	✓	✓	n/a	✓
1/19/16 1831	DRmz	17.95	✓	✓	✓	n/a	✓
1/20/16 2001	DRmz	17.96	✓	✓	✓	n/a	✓
1/21/16 1840	DRmz	17.96	✓	✓	✓	n/a	✓
1/22/16 1710	DRmz	17.96	✓	✓	✓	n/a	✓
1/25/16 1520	DRmz	17.94	✓	✓	✓	n/a	✓
1/26/16 1801	DRmz	17.95	✓	✓	✓	n/a	✓
1/27/16 1805	DRmz	17.94	✓	✓	✓	n/a	✓
1/28/16 1810	DRmz	17.94	✓	✓	✓	n/a	✓
1/29/16 1540	NS	17.94	✓	✓	✓	n/a	✓
2/1/16 1709	DRmz	17.92	✓	✓	✓	n/a	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
1/18/16 1821	DRmz	✓	✓ 18.0	37086.3	✓
1/19/16 1833	DRmz	✓	✓ 18.0	37087.6	✓
1/20/16 2003	DRmz	✓	✓ 18.0	37096.1	✓
1/21/16 1841	DRmz	✓	✓ 18.0	37099.5	✓
1/22/16 1711	DRmz	✓	✓ 16.0	37103.4	✓
1/25/16 1521	DRmz	✓	✓ 18.0	37106.1	✓
1/26/16 1803	DRmz	✓	✓ 16.0	37107.0	✓
1/27/16 1806	DRmz	✓	✓ 18.0	37107.4	✓
1/28/16 1811	DRmz	✓	✓ 17.5	37111.5	✓
1/29/16 1540	NS	✓	✓ 18	37110	✓
2/1/16 1711	DRmz	✓	✓ 18.0	37124.9	✓

Legend: Check = Green (OK); X = Red (call for service)

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010116

Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
12-21-15.	JK	1999,95	1,999
12-22-15.	JK	1999,95	1,999
12-23-15.	JK	1999,96	2,000
12-28-15.	JK	1999,93	2,001
12-29-15.	JK	1999,93	1,999
12-30-15	JK	1999,94	2,000
12-31-15	KE	1999.94	1.999
1-4-16	KE	1999.92	2.00
1-5-16.	JK	1999,92	2,000
1-6-16	KE	1999.94	2.000
1-7-16	KE	1999.95	2.000
1-8-16.	JK	1999,95	2,000
1/11/16	MG	1999.92	2.000
1-12-16.	JK	1999,92	2,000
1-13-16	KE	1999.92	2.000
1-14-16.	JK	1999,94	2,000
1-15-16.	JK	1999,97	1,999
1-18-16	KE	1999.92	2.000
1-19-16	KE	1999.93	2.000
1-20-16	KE	1999.94	2.000
1-21-16.	JK	1999,95	1,999
1-22-16	KE	1999.92	2.000

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010117

Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
1-25-16	KE	1999.95	2.000
1-26-16	KE	1999.93	2.000
1-27-16	KE	1999.92	2.000
1-28-16.	JT	1999.92	2.000
1-29-16.	JT	1999.91	2.000
1-30-16.	JT	1999.92	1.999
1-31-16,	JT	1999.95	1.999
KE 2-1-16 ~~2-1-16~~ (KE)	KE	1999.94	2.001
2-2-16.	JT	1999.93	1.999

Comments:

010118

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160105-8
SwRI SRR: 56087
SDG: 581291
CASE: Zeolite
VTSR: 09.03.2015

WETCHEM ANALYSES
Equipment Certificates of Calibration

010119

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	34998
Asset Number:	020917	Calibrated:	7/20/2015
Description:	DATA LOGGER	Calibration Due:	7/20/2016
Manufacturer:	OMEGA	Data Type:	FOUND / LEFT
Model Number:	OM-CP-PRHTEMP2000	Temp./RH:	69 °F / 43 %
Serial Number:	P28381	Work Order #	403132811
Calibration Procedure:	TEMPERATURE, HUMIDITY-D		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
006404	THUNDER SCIENTIFIC	2500	HUMIDITY GENERATOR	5/28/2016
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016
021448	FLUKE	PPC4	Pressure Controller	11/3/2015

Approved By

Calibrated By: RLC
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132811	Mfr.:	Omega	Technician:	MAR / RLC
Asset No.:	020917	Model:	OM-CP-PRHTEMP2000	Type Data:	Found-left
Serial No.:	P28381	Type:	Data Logger	Cal Date:	20-Jul-15

Remarks: pressure test points established per customer range request. Reading at 65% RH is 70% of the allowed limit.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Humidity	% RH	% RH	% RH	% RH	% RH		
	35.0	36.5	1.5	3.0	0.68	Pass	50%
	50.0	50.9	0.9		0.68	Pass	30%
	65.0	62.9	-2.1		0.68	Pass	70%
Temperature	°C	°C	°C	°C	°C		
	20.4	20.4	0.0	0.5	0.18	Pass	0%
	25.0	24.9	-0.1		0.18	Pass	20%
	29.8	29.8	0.0		0.18	Pass	0%
Pressure	psia	psia	psi	psi	psi		
	12	11.986	-0.014	0.060	0.01	Pass	23%
	18	18.020	0.020		0.02	Pass	33%
	24	24.010	0.010			Pass	17%
	30	29.966	-0.034			Pass	57%

END OF REPORT

010121

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	44162
Asset Number:	012017	Calibrated:	12/29/2015
Description:	CALIBRATOR, TEMPERATURE	Calibration Due:	12/29/2016
Manufacturer:	FLUKE	Data Type:	FOUND / LEFT
Model Number:	724	Temp./RH:	73.5°F / 41 %
Serial Number:	8776066	Work Order #	403136422
Calibration Procedure:	FLUKE 724, 725, 726		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
Ohm source not calibrated below 240 Ohms per customer.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001505	AGILENT-HP	3458A OPT 002	MULTIMETER	5/1/2016
021436	FLUKE	5522A	MULTI-PRODUCT CALIBRATOR	11/5/2016

Approved By

Calibrated By: CER
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report.

Work Order:	403136422	Mfr:	Fluke	Technician:	CER
Asset No:	012017	Model:	724	Type Data:	Found-left
Serial No:	8776066	Type:	Calibrator	Cal Date:	29-Dec-15
Remarks: Ohm source not calibrated below 240 Ohms per customer.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
V DC Measure	V	V	V	V	V		
Upper Display	0	0.000	0.000	0.002	0.0012	Pass	0%
	15	15.001	0.001	0.005	0.0013	Pass	20%
	30	30.002	0.002	0.008	0.0013	Pass	25%
mV DC Measure	mV	mV	mV	mV	mV		
Lower Display	0	0.00	0.00	0.02	0.012	Pass	0%
	50	49.99	-0.01	0.03	0.013	Pass	33%
	89	88.99	-0.01	0.04	0.013	Pass	25%
V DC Measure	V	V	V	V	V		
Lower Display	0	0.000	0.000	0.002	0.0012	Pass	0%
	10	9.999	-0.001	0.004	0.0013	Pass	25%
	20	19.999	-0.001	0.006	0.0013	Pass	17%
mA DC Measure	mA	mA	mA	mA	mA		
Upper Display	4	4.000	0.000	0.003	0.0014	Pass	0%
	12	12.002	0.002	0.005	0.0020	Pass	40%
	24	24.004	0.004	0.007	0.0033	Pass	57%
Resistance	Ω	Ω	Ω	Ω	Ω		
4-Wire Measure	15	14.97	-0.03	0.10	0.01	Pass	30%
Lower Display	350	350.01	0.01	0.10	0.036	Pass	10%
	500	500.0	0.0	0.5	0.10	Pass	0%
	1500	1500.1	0.1	0.5	0.12	Pass	20%
	3200	3200.3	0.3	1.0	0.20	Pass	30%
3-Wire RTD	Ω	Ω	Ω	Ω	Ω		
Lower Display	350	349.99	-0.01	0.20	0.036	Pass	5%
Type J TC Measure	°C	°C	°C	°C	°C		
Lower Display	0	0.0	0.0	0.7	0.22	Pass	0%
Type J TC Source	°C	°C	°C	°C	°C		
Lower Display	0	0.00	0.00	0.70	0.17	Pass	0%
mV DC Source	mV	mV	mV	mV	mV		
Lower Display	0	-0.001	-0.001	0.020	0.0004	Pass	5%
	45	44.999	-0.001	0.030	0.002	Pass	4%
	100	99.998	-0.002	0.040	0.002	Pass	5%

Southwest Research Institute
Calibration Laboratory
Measurement Report.

Work Order:	403136422	Mfr:	Fluke	Technician:	CER
Asset No:	012017	Model:	724	Type Data:	Found-left
Serial No:	8776066	Type:	Calibrator	Cal Date:	29-Dec-15

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
V DC Source	V	V	V	V	V		
Lower Display	0	0.0000	0.0000	0.0020	0.00001	Pass	1%
	5	5.0000	0.0000	0.0030	0.00006	Pass	0%
	10	10.0000	0.0000	0.0040	0.00006	Pass	0%
Resistance Source	Ω	Ω	Ω	Ω	Ω		
Lower Display	15	n/a	#VALUE!	0.100	0.006	#######	#######
	360	360.037	0.037	0.100	0.006	Pass	37%
	500	500.11	0.11	0.50	0.04	Pass	22%
	1500	1500.12	0.12	0.50	0.04	Pass	24%
	3200	3200.20	0.20	1.00	0.07	Pass	20%

END OF REPORT

010124

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38185
Asset Number:	022489	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22489	Work Order #	403134275
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

010125

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134275	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022489	Model	08516-96	Type Data:	Found-left
Serial No.	22489	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.1	-0.6	2.2	0.5	Pass	28%
	498.0	499.5	1.6	3.7	1.3	Pass	42%
	750.3	752.8	2.5	5.6	1.3	Pass	44%
	1002.9	1003.7	0.8	7.5	1.3	Pass	11%

END OF REPORT

010126

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36974
Asset Number:	022396	Calibrated:	8/19/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/19/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	73.6°F / 58 %
Serial Number:	22396	Work Order #	403133757
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

010127

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-found
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	2.2	0.5	Fail	159%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	3.0	1.3	Fail?	100%
	699.3	702.6	3.3	5.2	1.3	Pass	63%
	1002.6	1002.4	-0.2	7.5	1.3	Pass	3%

END OF REPORT

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Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-left
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	19-Aug-15

Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	4.0	0.5	Pass	88%
	-44.4	-42.8	1.6	2.2	0.5	Pass	73%
	-0.1	0.3	0.4	2.2	0.5	Pass	18%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	20.0	1.3	Pass	15%
	699.3	702.6	3.3	35.0	1.3	Pass	9%
	1002.6	1002.4	-0.2	50.0	1.3	Pass	0%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36921
Asset Number:	020543	Calibrated:	8/18/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/18/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	77.4°F / 42 %
Serial Number:	20543	Work Order #	403133753
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

010130

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133753	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	020543	Model	93631-11	Type Data:	As-found
Serial No.	20543	Type.	Thermocouple, Type K	Cal Date:	17-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.0	3.6	2.2	0.5	Fail	165%
	99.7	98.9	-0.8	2.2	0.5	Pass	38%
	398.4	402.8	4.4	3.0	1.3	Fail	147%
	699.3	704.2	4.9	5.2	1.3	Pass?	93%
	1002.6	1003.5	0.9	7.5	1.3	Pass	12%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133753	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	020543	Model	93631-11	Type Data:	As-left
Serial No.	20543	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15

Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.0	3.6	4.0	0.5	Pass	90%
	-44.4	-43.0	1.4	2.2	0.5	Pass	63%
	-0.1	0.0	0.1	2.2	0.5	Pass	5%
	99.7	98.9	-0.8	2.2	0.5	Pass	36%
	398.4	402.8	4.4	20.0	1.3	Pass	22%
	699.3	704.2	4.9	35.0	1.3	Pass	14%
	1002.6	1003.5	0.9	50.0	1.3	Pass	2%

END OF REPORT

010132

Southwest Research Institute

Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38186
Asset Number:	022490	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22490	Work Order #	403134278
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134278	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022490	Model	08516-96	Type Data:	Found-left
Serial No.	22490	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.1	1.7	2.2	0.5	Pass	77%
	99.7	99.1	-0.6	2.2	0.5	Pass	28%
	498.0	497.2	-0.8	3.7	1.3	Pass	20%
	750.3	751.9	1.6	5.6	1.3	Pass	28%
	1002.9	1000.2	-2.7	7.5	1.3	Pass	36%

END OF REPORT

010134

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38184
Asset Number:	022488	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22488	Work Order #	403134274
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

010136

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38183
Asset Number:	022487	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22487	Work Order #	403134273
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134273	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022487	Model	08516-96	Type Data:	Found-left
Serial No.	22487	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	98.7	-1.0	2.2	0.5	Pass	46%
	498.0	499.0	1.0	3.7	1.3	Pass	27%
	750.3	751.7	1.4	5.6	1.3	Pass	25%
	1002.9	1002.2	-0.7	7.5	1.3	Pass	9%

END OF REPORT

010138

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38118
Asset Number:	022473	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22473	Work Order #	403134196
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016

Approved By

Calibrated By: MAR
Metrology Technician

010139

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134196	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022473	Model	08516-96	Type Data:	Found-left
Serial No.	22473	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.7	0.8	3.7	1.3	Pass	20%
	750.3	750.9	0.6	5.6	1.3	Pass	11%
	1002.9	1001.5	-1.4	7.5	1.3	Pass	19%

END OF REPORT

010140

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	24071
Asset Number:	018344	Calibrated:	2/3/2015
Description:	OVEN	Calibration Due:	2/3/2016
Manufacturer:	THERMO SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	HERATHERM OMS60	Temp./RH:	70 °F / 15 %
Serial Number:	41241291	Work Order #	403129130
Calibration Procedure:	OVENS, CHAMBERS, INCUBA		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
015454	HART SCIENTIFIC	5627A	THERMOMETER PRT	2/17/2015
018495	FLUKE	1523	TEMPERATURE METER	2/17/2015

Approved By

Calibrated By: RRV
Metrology Technician

010141

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403129130	Mfr:	Thermo Scientific	Technician:	RRV
Asset No:	018344	Model:	Heratherm OMS60	Type Data:	Found-left
Serial No:	41241291	Type:	Oven Chamber	Cal Date:	2-Feb-15

Remarks: Calibration limits per customer request. Chamber exceeds 70% of limit at the 200 °C test point. Customer to determine if the result found meets their requirements. Temperature uniformity not calibrated

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
50 °C	50.3	50.0	-0.3	2.0	0.18	Pass	15%
100 °C	100.9	100.0	-0.9				45%
200 °C	201.6	200.0	-1.6				80%

END OF REPORT

Appendix I
SwRI Test Report, March 3, 2016

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

March 3, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Ashley Pryor

Subject:		
	Case:	Zeolite
	SwRI Project Number:	21592.01.00X
	SDG:	581318
	SwRI Task Order Number:	150904-4
	SwRI Sample Receipt Number:	56087
	Samples Received:	09.03.2015
	Analysis:	Addendum for Blend 9 in accordance with the United Nations Oxidation Testing

Dear Ms. Pryor,

Please find the enclosed results for Sample ID Blend 9, our Lab System ID 581324, as an addendum to the original submitted data package. Should you have any questions, please feel free to contact me at 210-522-3242, or via email at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Group Leader

APPROVED:

Michael J. Dammann
Director

RPS: jz
Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
VTSR: 09.03.2015
CASE: Zeolite

BLEND 9
Case Narrative

Total Page Count: 020001-
Fraction: Addendum Pages: 020010
for Blend 9

REANALYSIS

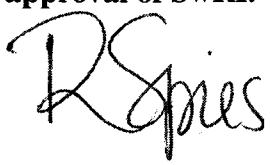
DOT UN Oxidation Testing

The initial classification for Blend 9 was a Packing Group III, which was inconsistent with previous testing according to LANL; therefore, the sample was reprepared, and the oxidizer tested was repeated. Blend 9 was retested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the sample mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. The reference mixtures and the sample mixtures were tested five times at each cellulose mixing ratio. .

Both ratios sparked, flamed, charred and smoked; however, this reaction was slow and steady and continued throughout the 3 min (180 sec) duration that power was applied; therefore, the Blend 9 classification is Not Division 5.1.

The only explanations for the initial reporting of Packing Group III was that either the sample could have been prepared incorrectly or that the salt in the potassium nitrate/ Swheat mixture partitioned out due to density or particle size,

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."



Group Leader — **Date** 2/17/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
VTSR: 09.03.2015
CASE: Zeolite

BLEND 9
Sample Results

020004

SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 150904-4

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
113.57	54.09	19.44

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
Blend 9- Rerun	581324	>180	>180	Not Division 5.1	01/19/16

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE 020005

UN OXIDIZER TEST

LABORATORY CONTROL SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 150904-4

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
91-136 sec	43-65 sec	15-23 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	105.09	54.03	21.47	01/19/16

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SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI TASK ORDER: 150904-4
SwRI SRR: 56087
SDG: 581318
VTSR: 09.03.2015
CASE: Zeolite

BLEND 9
Raw Data

Southwest Research Institute

020007

Method: Oxidizer UN
Project #: 21592.01.006
Client: Los Alamos
TO# 151222-14, 150904-4

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0044	21.0025	109.59	
3:7	2	9.0118	21.0086	101.03	
3:7	3	9.0059	21.0047	124.84	
3:7	4	9.0099	21.0058	117.81	
3:7	5	9.0060	21.0047	114.59	
3:7	**Avg**			113.57	90.86 - 136.28
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0037	18.0056	55.75	
2:3	2	12.0048	18.0039	51.60	
2:3	3	12.0084	18.0064	49.28	
2:3	4	12.0060	18.0071	53.72	
2:3	5	12.0076	18.0061	60.10	
2:3	**Avg**			54.09	43.27 - 64.908
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0085	12.0039	18.81	
3:2	2	18.0022	12.0045	19.59	
3:2	3	18.0088	12.0047	17.56	
3:2	4	18.0070	12.0039	20.25	
3:2	5	18.0049	12.0020	21.00	
3:2	**Avg**			19.44	15.55 - 23.328

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 12/11/15
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 12/11/15
Potassium Bromate: Inorg# 63455-63457 Dried: 12 hrs. @ 65°C
Cellulose: Inorg# 61128 Dried: 105°C ; >4 hrs.
Variac Setting: 150 I 7 W

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 150904-4

Sample Analysis

System ID: Blend #9 (30-61-WCS12) Black

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

*Time power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0044	6.0028	206.93 *	sparking, charring, smoke, formed a solid
4:1	2	24.0108	6.0062	184.36*	around wire, small sporadic flames at
4:1	3	24.0014	6.0034	181.62*	wire leads, smoldering
4:1	4	24.0021	6.0131	180.65*	↓
4:1	5	24.0053	6.0014	180.37*	↓
4:1	Avg			186.79	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0069	15.0024	185.66⊙	~1:44 sample caught fire, sparks, flames, smo
1:1	2	15.0116	15.0041	183.25⊙	flames, smoke, sparks, smoldering
1:1	3	15.0019	15.0011	188.18⊙	flames, smoke, sparks, smoldering
1:1	4	15.0046	15.0039	173.22	↓ + flames stopped before 3min power off
1:1	5	15.0053	15.0018	180.84⊙	↓
1:1	Avg			182.23	All @ ~1:30 full sample on fire

⊙flames stopped soon after power off.

Weighted Samples: Monica Grabaldon Balance#: 135 Date: 1/19/16
Tested Samples: Monica Grabaldon Timer ID: 80494146 Date: 1/19/16
Sample Dried ? YES (NO) Dried:
Cellulose: Inorg# 65520 Dried: >4hrs.@105C
Variac Setting: 150±7W

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160105-8, 150904-4 CISAM 2129116

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0071	21.0007	105.09	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	Avg				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0029	18.0018	54.03	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	Avg				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0041	12.0047	21.47	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	Avg				

Weighted Samples: Monica Grabaldon Balance#: 135 Date: 1/19/16
Tested Samples: Monica Grabaldon Timer ID: 8 02 19 44 14 6 Date: 1/19/16
Potassium Bromate: Inorg# 63455-63457 Dried: 72hrs @ 65°C
Cellulose: Inorg# 65520 Dried: >4 hrs @ 105°C
Variac Setting: 150 ± 7w

Work continued from Page

SWRI

30-01-WCS12 Blend #9

200mL of KNO_3 (#62882) + 600mL zeolite and let sit for 24hr

JAM 11/9/16

www.scientificbindery88yrs.com

Work continued to Page

SIGNATURE

DATE 11/14/16

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE 2/2/16

Appendix J
SwRI Test Report, March 11, 2016

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

March 11, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Ashley Pryor

Subject:		
	Case:	Zeolite
	SwRI Project Number:	21592.01.00X
	SDG:	591439
	SwRI Task Order Number:	160307-2
	SwRI Sample Receipt Number:	56087, 56933, 56955
	Samples Received:	09.03.15, 01.27.16, 01.29.16
	Analysis:	Various Wetchem

Dear Ms. Pryor,

Please find the enclosed results for the overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or via email at radonna.spies@swri.org.

Sincerely,

for Radonna Spies
Group Leader-R&D

APPROVED:

Michael J. Dammann
Director

RS: mg
Encl

010001

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

CHAIN-OF-CUSTODY & SAMPLE RECEIPT PAPERWORK

Total Page Count:
Fraction: Date Report Pages: 010001 010178

General Sample Chain of Custody

Ver (8/25/2011)

010002

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

SRR #:	56087	Thermometer:	021056
Project	19869.01.00X	Temperature:	21.2
CASE:	Zeolite	Airbill #:	590817794105
Customer:	Los Alamos National Laboratory	Logged in by:	SDOUGLAS
Samples Received:	Sep 3 2015 8:30AM	Logged in:	Sep 3 2015 9:03AM
Manager:	DAMMANN, MIKE		
Disposal Instructions:	Contact project manager for disposal authority.		

System ID	Customer ID	CED	Matrix	# Cont	Special Requirements	Sample Condition
581291	(UNS Liquid+SWheat 1:1):3 zeolite or cemented		Liquid	1		Intact
581292	(UNS+SWheat 1:1):3 zeolite or cemented		Solid	1		Intact
581293	(UNS+SWheat 1:3):3 zeolite or cemented		Solid	1		Intact
581294	(UNS+SWheat 1:4):3 zeolite or cemented		Solid	1		Intact
581295	1(UNSLQ+SWht 1:1):1 Spillfyter:1 citric acid :3		Liquid	1		Intact
581296	1(UNSLQ+SWht 1:1):1 Spillfyter:3 zeolite or cmtd		Liquid	1		Intact
581297	1 (UNS LQ+Wastelock 16:1):3 zeolite or cemented		Liquid	1		Intact
581298	1 UNS: 3 zeolite or cemented		Solid	1		Intact
581299	Zeolite		Solid	1		Intact
581300	UNS		Solid	1		Intact
581301	UNS+SWheat 1:1		Solid	1		Intact
581302	UNS+SWheat 1:3		Solid	1		Intact
581303	UNS+SWheat 1:4		Solid	1		Intact
581318	(WB8 + SWheat 1:1) cemented		Surrogate	1		Intact
581319	(WB8 + SWheat 1:1):3 zeolite		Surrogate	1		Intact
581320	(WB8 + SWheat 1:3) cemented		Surrogate	1		Intact
581321	(WB8 + SWheat 1:3):3 zeolite		Surrogate	1		Intact
581322	(WB8 + SWheat 1:4) cemented		Surrogate	1		Intact
581323	(WB8 + SWheat 1:4):3 zeolite		Surrogate	1		Intact
581324	1 Potassium Nitrate: 3 zeolite		Surrogate	1		Intact
581325	1 WB8: 3 zeolite		Surrogate	1		Intact
581326	Potassium Nitrate		Surrogate	1		Intact
581327	Potassium Nitrate + SWheat 1:1		Surrogate	1		Intact
581328	Potassium Nitrate + SWheat 1:3		Surrogate	1		Intact
581329	Potassium Nitrate + SWheat 1:4		Surrogate	1		Intact
581330	Potassium Nitrate cemented		Surrogate	1		Intact
581331	WB8		Surrogate	1		Intact
581332	WB8 + SWheat 1:1		Surrogate	1		Intact
581333	WB8 + SWheat 1:3		Surrogate	1		Intact
581334	WB8 + SWheat 1:4		Surrogate	1		Intact
581335	WB8 cemented		Surrogate	1		Intact

Reliquished by (Print/Signature): [signature] Date 9/3/15 Time 0830

010003

	Date	Time
Received by (Print/Signature): Steven Lo/GS	9/3/15	0830
Reliquished by (Print/Signature):	Date	Time
Received by (Print/Signature):	Date	Time
Reliquished by (Print/Signature):	Date	Time

General Sample Chain of Custody

Ver (8/25/2011)

010004

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

SRR #:	56933	Thermometer:	021056
Project	21592.01.00X	Temperature:	17.6
CASE:	Cardboard	Airbill #:	590817800468, 590817800479
Customer:	Los Alamos National Laboratory	Logged in by:	SDOUGLAS
Samples Received:	Jan 27 2016 8:30AM	Logged in:	Jan 27 2016 2:39PM
Manager:	SPIES, RADONNA		
Disposal Instructions:	Contact project manager for disposal authority.		

System ID	Customer ID	CED	Matrix	# Cont	Special Requirements	Sample Condition
591438	10cm x 10cm (Count 150) Gloves		Solid	1		Intact
591439	10cm x 10cm (Count 156) Cardboard		Solid	1		Intact
591440	10cm x 10cm (Count 314) Black Plastic Gloves		Solid	1		Intact
591441	2.5cm x 2.5cm (Count 150) Black Plastic Gloves		Solid	1		Intact
591442	2.5cm^2 (Count 75) Black Plastic Gloves		Solid	1		Intact
591443	25cm x 2cm (Count 105) Black Plastic Gloves		Solid	1		Intact
591444	25cm x 2cm (Count 40) Black Plastic Gloves		Solid	1		Intact
591445	25cm x 2cm Cardboard		Solid	1		Intact
591446	Wipe All		Solid	1		Intact

	Date	Time
Reliquished by (Print/Signature) FedEx	1/27/16	0836
Received by (Print/Signature)	1/27/16	0830
Reliquished by (Print/Signature)	Date	Time
Received by (Print/Signature):	Date	Time
Reliquished by (Print/Signature)	Date	Time

General Sample Chain of Custody

010005

Ver (8/25/2011)

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

SRR #:	56955	Thermometer:	021056
Project	21592.01.00X	Temperature:	17.5
CASE:	LANS	Airbill #:	5908 1780 0538
Customer:	Los Alamos National Laboratory	Logged in by:	DRAMIREZ
Samples Received:	Jan 29 2016 8:30AM	Logged in:	Jan 29 2016 9:18AM
Manager:	SPIES, RADONNA		
Disposal Instructions:	Contact Project Manager for instructions.		

System ID	Customer ID	CED	Matrix	# Cont	Special Requirements	Sample Condition
591577	Black Full Length - 8N15		Gloves	17		Intact
591578	Purple _ LANL-BAG-3-SPVC DOM.01-14		Plastic	2		Intact
591579	Purple _ LANL-BAG-3-SPVC DOM.07-13		Plastic	2		Intact
591580	Wypall		Cloth	2		Intact

Reliquished by (Print/Signature): FED EX	Date 1/29/16	Time 0830
Received by (Print/Signature): Swift / DRamirez	Date 1/29/16	Time 0830
Reliquished by (Print/Signature):	Date	Time
Received by (Print/Signature):	Date	Time
Reliquished by (Print/Signature):	Date	Time

Southwest Research Institute

Laboratory Task Order

TO #: 160307-2 Revision: 0

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 03/09/16

SDG: 591439

SRR #'s: 56087, 56933, 56955
Client(s): Los Alamos National Laboratory

010006

Instructions
Subcontract No. 355836 SOW Exhibit D

Documents Related to this task order: 185604[COC for SRR 56087], 185605[SRR Paperwork for SRR 56087], 191181[New Sample IDs], 191404[], 193489[COC for SRR 56955], 193490[SRR Paperwork for SRR 56955], 194211[COC for SRR 56933], 194212[SRR Paperwork for SRR 56933]

Deliverables --> Hard Copy: no EDD: no PDF: -YES-

Test: COMB_1050 Holding: 180 days from CED
Section: WETCHEM **SW846 1050 Test A & C Spontaneous Combustion** Cnt: 4

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
591439		1	Solid	10cm x 10cm (Count 156) Cardboard	NO DATA	NO DATA
591577		14-DA1013	Gloves	Black Full Length - 8N15	NO DATA	NO DATA
591578		1	Plastic	Purple _ LANL-BAG-3-SPVC DOM.01-14	NO DATA	NO DATA
591580		1	Cloth	Wypall	NO DATA	NO DATA

Test: IGNIT_1030 Holding: 180 days from CED
Section: WETCHEM **SW 846 Method 1030 Ignitability of solids** Cnt: 4

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
591439		1	Solid	10cm x 10cm (Count 156) Cardboard	NO DATA	NO DATA
591577		14-DA1013	Gloves	Black Full Length - 8N15	NO DATA	NO DATA
591578		1	Plastic	Purple _ LANL-BAG-3-SPVC DOM.01-14	NO DATA	NO DATA
591580		1	Cloth	Wypall	NO DATA	NO DATA

Test: PAINT_9095 Holding: 180 days from CED
Section: WETCHEM **SW846 9095 Paint Filter Liquids Test** Cnt: 11

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
589460		1	Surrogate	Blend 14	NO DATA	NO DATA
589461		1	Surrogate	Blend 15	NO DATA	NO DATA
589462		1	Surrogate	Blend 16	NO DATA	NO DATA
589620		1	Surrogate	Blend 17	NO DATA	NO DATA
589621		1	Surrogate	Blend 18	NO DATA	NO DATA
589622		1	Surrogate	Blend 19	NO DATA	NO DATA
589623		1	Surrogate	Blend 20	NO DATA	NO DATA
589624		1	Surrogate	Blend 21	NO DATA	NO DATA
589625		1	Surrogate	Blend 22	NO DATA	NO DATA
589626		1	Surrogate	Blend 23	NO DATA	NO DATA
589627		1	Surrogate	Blend 24	NO DATA	NO DATA

010007

Sample Receipt

Southwest Research Institute

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15 Time: 08:30:00

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

Notes

Sample was delivered intact. (no ice).

Fed Ex #(s):
590817794105 - 21.2 °C

See Task Order for full requirements.

See chain of custody as part of the SRR system for more information.

The Product along with the Section 4.0 of the paperwork provided by the client will be used to create the ADDITIONAL Solid and Liquid Surrogates identified in the Client ID section.

Due to character limitations, the following
1 (UNS LQ+SWheat 1:1):1 Spillfyter :3 zeolite or cemented
was abbreviated to:
1(UNSLQ+SWht 1:1):1 Spillfyter:3 zeolite or cmtd

1 (UNS LQ+SWheat 1:1):1 Spillfyter :1citric acid :3 zeolite or cemented
was abbreviated to:
1(UNSLQ+SWht 1:1):1 Spillfyter:1 citric acid :3

Phases:
001 - admin
002 - extraction
005 - 8082
006 - metals/radchem
007 - drg

Rev. 1
Corrected project number.
REVISION 2, DRmz 12/15/15: New Sample IDs added to the SRR, along with revisions done to previously created IDs, per email from Radonna Spies.

Rev. 3
Added samples and revised sample ID's. See attached email.

Background CPM: <100 cpm
Container Wipe CPM: <100 cpm
Total CPM: <100

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
581326	Blend 1		Surrogate	1	
581325	Blend 10		Surrogate	1	
581319	Blend 11		Surrogate	1	
581321	Blend 12		Surrogate	1	
581323	Blend 13		Surrogate	1	
589460	Blend 14		Surrogate	1	
589461	Blend 15		Surrogate	1	
589462	Blend 16		Surrogate	1	
589620	Blend 17		Surrogate	1	

Page Printed: 03/11/2016 13:08
ver: (7/18/2014)

56087 Los Alamos National Laborato

Southwest Research Institute

Sample Receipt

010008

VTSR: 09/03/15 Time: 08:30:00

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
589621	Blend 18		Surrogate	1	
589622	Blend 19		Surrogate	1	
581327	Blend 2		Surrogate	1	
589623	Blend 20		Surrogate	1	
589624	Blend 21		Surrogate	1	
589625	Blend 22		Surrogate	1	
589626	Blend 23		Surrogate	1	
589627	Blend 24		Surrogate	1	
589628	Blend 2S		Surrogate	1	
581328	Blend 3		Surrogate	1	
581329	Blend 4		Surrogate	1	
581331	Blend S		Surrogate	1	
581332	Blend 6		Surrogate	1	
581333	Blend 7		Surrogate	1	
581334	Blend 8		Surrogate	1	
581324	Blend 9		Surrogate	1	
581330	Cement 1		Surrogate	1	
589463	Cement 10		Surrogate	1	
589464	Cement 11		Surrogate	1	
589465	Cement 12		Surrogate	1	
589466	Cement 13		Surrogate	1	
589467	Cement 14		Surrogate	1	
589468	Cement 1S		Surrogate	1	
581335	Cement 2		Surrogate	1	
581318	Cement 3		Surrogate	1	
581320	Cement 4		Surrogate	1	
581322	Cement 5		Surrogate	1	
589469	Cement 6		Surrogate	1	
589470	Cement 7		Surrogate	1	
589471	Cement 8		Surrogate	1	
589472	Cement 9		Surrogate	1	
581291	UNS Blend 1		Liquid	1	
581301	UNS Blend 10		Solid	1	
581302	UNS Blend 11		Solid	1	
581303	UNS Blend 12		Solid	1	
589629	UNS Blend 13		Surrogate	1	
589630	UNS Blend 14		Surrogate	1	
589631	UNS Blend 15		Surrogate	1	
589632	UNS Blend 16		Surrogate	1	
589633	UNS Blend 17		Surrogate	1	
589634	UNS Blend 18		Surrogate	1	

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ver: (7/18/2014)

56087 Los Alamos National Laborato

Sample Receipt

010009

Southwest Research Institute

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15 Time: 08:30:00

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged In by: SDOUGLAS
Creation Date: 09/03/15

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
S8963S	UNS Blend 19		Surrogate	1	
581292	UNS Blend 2		Solid	1	
581293	UNS Blend 3		Solid	1	
581294	UNS Blend 4		Solid	1	
581295	UNS Blend 5		Liquid	1	
581296	UNS Blend 6		Liquid	1	
581297	UNS Blend 7		Liquid	1	
581298	UNS Blend 8		Solid	1	
581300	UNS Blend 9		Solid	1	
581299	Zeolite		Solid	1	

Containers: 60 **Samples: 60**

These documents are associated with this receipt: 185604[COC for SRR S6087], 185605[SRR Paperwork for SRR 56087], 191181[New Sample IDs], 191404[]

Thermometer: 021056
Temperature: 21.2

56087 Los Alamos National Laborato

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ver: (7/18/2014)

Southwest Research Institute
Traffic Report

010010

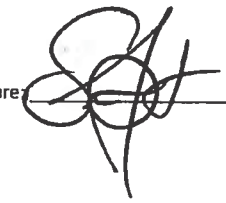
Sample Custodian Signature: _____

1. Custody Seal — Present
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Case: Zeolite / SDG: _____
Sample Receipt: 56087
Airbill: 590817794105

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
09/03/15	08:30:00	Email	(UNS Liquid+SWheat 1:1):3 zeolite or cemented	N/A	581291	YES	Intact
09/03/15	08:30:00	Email	(UNS+SWheat 1:1):3 zeolite or cemented	N/A	581292	YES	Intact
09/03/15	08:30:00	Email	(UNS+SWheat 1:3):3 zeolite or cemented	N/A	581293	YES	Intact
09/03/15	08:30:00	Email	(UNS+SWheat 1:4):3 zeolite or cemented	N/A	581294	YES	Intact
09/03/15	08:30:00	Email	1(UNSLQ+SWht 1:1):1 Spillfyter:1 citric acid :3	N/A	581295	YES	Intact
09/03/15	08:30:00	Email	1(UNSLQ+SWht 1:1):1 Spillfyter:3 zeolite or cmtd	N/A	581296	YES	Intact
09/03/15	08:30:00	Email	1 (UNS LQ+Wastelock 16:1):3 zeolite or cemented	N/A	581297	YES	Intact
09/03/15	08:30:00	Email	1 UNS: 3 zeolite or cemented	N/A	581298	YES	Intact
09/03/15	08:30:00	Email	Zeolite	N/A	581299	YES	Intact
09/03/15	08:30:00	Email	UNS	N/A	581300	YES	Intact
09/03/15	08:30:00	Email	UNS+SWheat 1:1	N/A	581301	YES	Intact
09/03/15	08:30:00	Email	UNS+SWheat 1:3	N/A	581302	YES	Intact
09/03/15	08:30:00	Email	UNS+SWheat 1:4	N/A	581303	YES	Intact
09/03/15	08:30:00	4.0	(WB8 + SWheat 1:1) cemented	N/A	581318	YES	Intact
09/03/15	08:30:00	4.0	(WB8 + SWheat 1:1):3 zeolite	N/A	581319	YES	Intact
09/03/15	08:30:00	4.0	(WB8 + SWheat 1:3) cemented	N/A	581320	YES	Intact
09/03/15	08:30:00	4.0	(WB8 + SWheat 1:3):3 zeolite	N/A	581321	YES	Intact
09/03/15	08:30:00	4.0	(WB8 + SWheat 1:4) cemented	N/A	581322	YES	Intact
09/03/15	08:30:00	4.0	(WB8 + SWheat 1:4):3 zeolite	N/A	581323	YES	Intact
09/03/15	08:30:00	4.0	1 Potasslum Nitrate: 3 zeolite	N/A	581324	YES	Intact
09/03/15	08:30:00	4.0	1 WB8: 3 zeolite	N/A	581325	YES	Intact
09/03/15	08:30:00	4.0	Potassium Nitrate	N/A	581326	YES	Intact
09/03/15	08:30:00	4.0	Potassium Nitrate + SWheat 1:1	N/A	581327	YES	Intact
09/03/15	08:30:00	4.0	Potasslum Nitrate + SWheat 1:3	N/A	581328	YES	Intact
09/03/15	08:30:00	4.0	Potassium Nitrate + SWheat 1:4	N/A	581329	YES	Intact
09/03/15	08:30:00	4.0	Potassium Nitrate cemented	N/A	581330	YES	Intact
09/03/15	08:30:00	4.0	WB8	N/A	581331	YES	Intact
09/03/15	08:30:00	4.0	WB8 + SWheat 1:1	N/A	581332	YES	Intact
09/03/15	08:30:00	4.0	WB8 + SWheat 1:3	N/A	581333	YES	Intact

Sample Custodian Signature: 

Southwest Research Institute
Traffic Report

010011

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Case: Zeolite / SDG: _____
Sample Receipt: 56087
Airbill: 590817794105

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	Custody Seal # SwRI # N/A		
09/03/15	08:30:00	4.0	WB8 + SWheat 1:4	N/A	581334	YES	Intact
09/03/15	08:30:00	4.0	WB8 cemented	N/A	581335	YES	Intact

SAMPLE LOG-IN SHEET

010012

Lab Name: Southwest Research Institute	Page 1 of 2
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 09/03/2015
Received By (Signature)	

Case Number: Zeolite	Sample Delivery Group No: NA	SAS Number: NA
Remarks: 19869.01.00X		

1. Custody Seal(s)	Present/Absent* Intact/Broken		
2. Custody Seal Nos.	N/A		
3. Chain-of Custody Records	Present/Absent*		
4. Traffic Reports or Packing Lists	Present/Absent		
5. Airbill	Airbill/Sticker Present/Absent*		
6. Airbill No.	590817794105		
7. Sample Tags	Present/Absent		
Sample Tag Numbers	Listed/Not listed on Chain of Custody		
8. Sample Condition	Intact/Broken*/ Leaking		
9. Cooler Temperature	21.2C		
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*		
11. Date Received at Lab	09/03/2015		
12. Time Received	08:30:00		

Sample Transfer		
Fraction: ORG	Fraction	
Area #: CABINET	Area #	
By: STEVEN DOUGLAS	By	
On: 09/03/2015	On	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks Condition of Sample Shipment, etc
(UNS Liquid+SW heat 1:1):3 zeolite or cemented	N/A	581291	Intact
(UNS+SWheat 1: 1):3 zeolite or cemented	N/A	581292	Intact
(UNS+SWheat 1: 3):3 zeolite or cemented	N/A	581293	Intact
(UNS+SWheat 1: 4):3 zeolite or cemented	N/A	581294	Intact
1(UNSLQ+SWht 1 :1):1 Spillfyter:1 citric acid :3	N/A	581295	Intact
1(UNSLQ+SWht 1 :1):1 Spillfyter:1 zeolite or cmtd	N/A	581296	Intact
1 (UNS LQ+Wast block 16:1):3 zeolite or cemented	N/A	581297	Intact
1 UNS: 3 zeoli te or cemented	N/A	581298	Intact
Zeolite	N/A	581299	Intact
UNS	N/A	581300	Intact
UNS+SWheat 1:1	N/A	581301	Intact
UNS+SWheat 1:3	N/A	581302	Intact
UNS+SWheat 1:4	N/A	581303	Intact
(WB8 + SWheat 1:1) cemented	N/A	581318	Intact
(WB8 + SWheat 1:1):3 zeolite	N/A	581319	Intact
(WB8 + SWheat 1:3) cemented	N/A	581320	Intact
(WB8 + SWheat 1:3):3 zeolite	N/A	581321	Intact
(WB8 + SWheat 1:4) cemented	N/A	581322	Intact
(WB8 + SWheat 1:4):3 zeolite	N/A	581323	Intact
1 Potassium Ni trate: 3 zeolite	N/A	581324	Intact
1 WB8: 3 zeoli te	N/A	581325	Intact
Potassium Nitr ate	N/A	581326	Intact
Potassium Nitr ate + SWheat 1:1	N/A	581327	Intact

* Contact SMO and attach record of resolution

Reviewed By	Logbook No: Sample Receipt (56087)
Date: 9.8.15	Logbook Page No: 9201 SEC 1, 2 OF 4

FORM DC-1

OLMO4.2

SAMPLE LOG-IN SHEET

010013

Lab Name: Southwest Research Institute	Page 2 of 2
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 09/03/2015
Received By (Signature):	
Case Number: Zeolite	Sample Delivery Group No: N/A
Remarks: 19869.01.00X	SAS Number: N/A

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3 Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present Absent	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	590817794105	
7 Sample Tags	Present Absent	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/ Leaking	
9. Cooler Temperature	21.2C	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	09/03/2015	
12. Time Received	08:30:00	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Potassium Nitrate + SWheat 1:3	N/A	581328	Intact
Potassium Nitrate + SWheat 1:4	N/A	581329	Intact
Potassium Nitrate cemented	N/A	581330	Intact
WB8	N/A	581331	Intact
WB8 + SWheat 1 :1	N/A	581332	Intact
WB8 + SWheat 1 :3	N/A	581333	Intact
WB8 + SWheat 1 :4	N/A	581334	Intact
WB8 cemented	N/A	581335	Intact

Sample Transfer

Fraction	Fraction
ORG	
Area # CABINET	Area #
By STEVEN	By
On DOUGLAS 09/03/2015	On

* Contact SMO and attach record of resolution

Reviewed By	Logbook No: Sample Receipt (56087)
Date: 9.8.15	Logbook Page No: 9201 SR 1, 2 of 4

FORM DC-1

OLMO4.2

010014

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 56933

VTSR: 01/27/16

Time: 08:30:00

Project: 21592.01.00X
Case #: Cardboard
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 01/27/16

Notes

Sample was delivered intact. (blue ice).

Fed Ex #(s):
590817800468 - 17.6 °C
590817800479 - 17.6 °C

See Task Order for full requirements.

See chain of custody as part of the SRR system for more information.

Phases:
001 - admin
002 - extraction
005 - 8082
006 - metals/radchem
007 - drg

Sample Note:
Samples were received with no COC all ID's were taken off of the containers.

Backaround CPM: <100 cpm
Container Wipe CPM: <100 cpm
Total CPM: <100

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
S91438	10cm x 10cm (Count 150) Gloves		Solid	1	
S91439	10cm x 10cm (Count 156) Cardboard		Solid	1	
591440	10cm x 10cm (Count 314) Black Plastic Gloves		Solid	1	
591441	2.5cm x 2.5cm (Count 150) Black Plastic Gloves		Solid	1	
591442	2.5cm^2 (Count 75) Black Plastic Gloves		Solid	1	
591443	25cm x 2cm (Count 105) Black Plastic Gloves		Solid	1	
591444	25cm x 2cm (Count 40) Black Plastic Gloves		Solid	1	
591445	25cm x 2cm Cardboard		Solid	1	
S91446	Wipe All		Solid	1	

Containers: 9 **Samples: 9**

These documents are associated with this receipt: 194211[COC for SRR 56933], 194212[SRR Paperwork for SRR 56933]

Thermometer: 021056
Temperature: 17.6

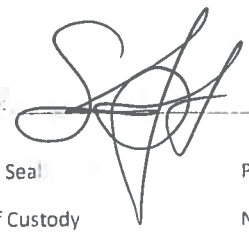
Page Printed: 03/11/2016 13:09
ver: (7/18/2014)

56933 Los Alamos National Laborato

Southwest Research Institute

Traffic Report

010015

Sample Custodian Signature: 

1. Custody Seal — Present
2. Chain of Custody — Not Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: Cardboard / SDG: _____

Sample Receipt: 56933

Airbill: 590817800468, 590817800479

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
01/27/16	08:30:00	SwRI COC	10cm x 10cm (Count 150) Gloves	N/A	591438	YES	Intact
01/27/16	08:30:00	SwRI COC	10cm x 10cm (Count 156) Cardboard	N/A	591439	YES	Intact
01/27/16	08:30:00	SwRI COC	10cm x 10cm (Count 314) Black Plastic Gloves	N/A	591440	YES	Intact
01/27/16	08:30:00	SwRI COC	2.5cm x 2.5cm (Count 150) Black Plastic Gloves	N/A	591441	YES	Intact
01/27/16	08:30:00	SwRI COC	2.5cm^2 (Count 75) Black Plastic Gloves	N/A	591442	YES	Intact
01/27/16	08:30:00	SwRI COC	25cm x 2cm (Count 105) Black Plastic Gloves	N/A	591443	YES	Intact
01/27/16	08:30:00	SwRI COC	25cm x 2cm (Count 40) Black Plastic Gloves	N/A	591444	YES	Intact
01/27/16	08:30:00	SwRI COC	25cm x 2cm Cardboard	N/A	591445	YES	Intact
01/27/16	08:30:00	SwRI COC	Wipe All	N/A	591446	YES	Intact

SAMPLE LOG-IN SHEET

010016

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 01/27/2016
Received By (Signature):	
Case Number: Cardboard	Sample Delivery Group No.: N/A
Remarks: 21592.01.00X	SAS Number: N/A

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	Present/Absent	
4. Traffic Reports or Packing Lists	Present/Absent	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	590817800468, 590817800479	
7. Sample Tags	Present/Absent	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/ Leaking	
9 Cooler Temperature	17.6C	
10 Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11 Date Received at Lab	01/27/2016	
12 Time Received	08:30:00	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
10cm x 10cm (Count 150) Gloves	N/A	591438	Intact
10cm x 10cm (Count 156) Cardboard	N/A	591439	Intact
10cm x 10cm (Count 314) Black Plastic Gloves	N/A	591440	Intact
2.5cm x 2.5cm (Count 150) Black Plastic Gloves	N/A	591441	Intact
2.5cm^2 (Count 75) Black Plastic Gloves	N/A	591442	Intact
25cm x 2cm (Count 105) Black Plastic Gloves	N/A	591443	Intact
25cm x 2cm (Count 40) Black Plastic Gloves	N/A	591444	Intact
25cm x 2cm Cardboard	N/A	591445	Intact
Wipe All	N/A	591446	Intact

Sample Transfer		
Fraction	ORG	Fraction
Area #	CABINET	Area #
By	STEVEN	By
On	DOUGLAS 01/27/2016	On

* Contact SMO and attach record of resolution

Reviewed By	Logbook No.: Sample Receipt (56933)
Date: 2.10.16	Logbook Page No.: 4347 SEC 4 of 4

010017

Sample Receipt

Southwest Research Institute

Sample Receipt Number: S6955

VTSR: 01/29/16 Time: 08:30:00

Project: 21S92.01.00X
Case #: LANS
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged In by: DRAMIREZ
Creation Date: 01/29/16

Notes

Samples were delivered intact. (no ice)

FED EX(x):
5908 1780 0538

See Task Order for full requirements.

No chain-of-custody or COC-like form received with the items.

See Project Manager for full Scope of Work specifications.

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
S91577	Black Full Length - 8N15		Gloves	17	
591578	Purple _ LANL-BAG-3-SPVC DOM.01-14		Plastic	2	
591579	Purple _ LANL-BAG-3-SPVC DOM.07-13		Plastic	2	
591580	Wypall		Cloth	2	

Containers: 23 **Samples: 4**

These documents are associated with this receipt: 193489[COC for SRR 56955], 193490[SRR Paperwork for SRR S6955]

Thermometer: 0210S6
Temperature: 17.S

56955 Los Alamos National Laborato

Page Printed: 03/11/2016 13:10
ver: (7/18/2014)

Southwest Research Institute

Traffic Report

Sample Custodian Signature: _____

010018

1. Custody Seal — Present
2. Chain of Custody — Not Present n/a
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC n/a
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: LANS / SDG: See TO

Sample Receipt: 56955

Airbill: 5908 1780 0538

Custody Seal #(s):

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
01/29/16	08:30:00	SwRI	Black Full Length - 8N15	Intact	591577	YES	Intact
01/29/16	08:30:00	SwRI	Purple _ LANL-BAG-3-SPVC DOM.01-14	Intact	591578	YES	Intact
01/29/16	08:30:00	SwRI	Purple _ LANL-BAG-3-SPVC DOM.07-13	Intact	591579	YES	Intact
01/29/16	08:30:00	SwRI	Wypall	Intact	591580	YES	Intact

SAMPLE LOG-IN SHEET

010019

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): DANNY RAMIREZ	Log-in Date: 01/29/2016
Received By (Signature): DRmz	
Case Number: LANS	Sample Delivery Group No.: SEE T.O.
	SAS Number: N/A

Remarks: 21592.01.00X

			EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
1.	Custody Seal(s)	Present/Absent* Intact/Broken	Black Full Length - 8N15	Intact	591577	Intact
2.	Custody Seal Nos.	N/A	Purple _ LANL- BAG-3-SPVC DOM.01-14	Intact	591578	Intact
			Purple _ LANL- BAG-3-SPVC DOM.07-13	Intact	591579	Intact
3.	Chain-of Custody Records	Present/Absent*	Wypall	Intact	591580	Intact
4.	Traffic Reports or Packing Lists	Present/Absent*				
5.	Airbill	Airbill/Sticker Present/Absent*				
6.	Airbill No.	5908 1780 0538				
7.	Sample Tags	Present/Absent* N/A				
	Sample Tag Numbers	Listed/Not listed on Chain of Custody				
8.	Sample Condition	Intact/Broken*/ Leaking				
9.	Cooler Temperature	17.5C				
10.	Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*				
11.	Date Received at Lab	01/29/2016				
12.	Time Received	08:30:00				

Sample Transfer					
Fraction: North	Fraction				
Area #: Cab	Area #				
By: DANNY	By				
On: RAMIREZ 01/29/2016	On				

* Contact SMO and attach record of resolution

Reviewed By: [signature]	Logbook No.: Sample Receipt (56955)
Date: 1.29.16	Logbook Page No.: V9349 SEC. 3 OF 4

010020

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

WETCHEM ANALYSES
Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of UNS and RNS debris blends as well as the reevaluation of RNS Blend 14 through 24 for paint filter (Method 9095B). Table 1 contains the sample ID's, solution used, and the methods requested on each of the blends. Both the UNS and RNS waste surrogates were prepared following the scope of work provided by Los Alamos.

RNS waste surrogate Blends 14 through 24 were prepared by using dried 1:1, 1:3, 1:4, and 2:1 WB8 to Swheat ratios made during the previous analysis of these blends. The salt mixtures were then added to water at either a 1:1 or 2:1 water to salt ratios. These mixtures were mixed and allowed to sit for several minutes before being added to zeolite at either a 2:1 or 3:1 zeolite to salt ratio. After adding in the zeolite the blends were allowed to sit for 24 hours prior to analysis.

The dry debris material used in the RNS and UNS debris testing was sent to Southwest Research Institute (SwRI) by Los Alamos in two shipments. The first shipment was precut samples to be used form Methods 1050 and 1030 analysis and the second shipment contained additional uncut sample if needed. The debris included: cardboard, plastic drum liner, black rubber gloves, and Kimberly-Clark L40 white Wypall towels. For the UNS testing, samples were first weighed and soaked in a 2L beaker containing the UNS solution. After soaking, the samples were placed onto a rack above a catch pan to drain for one hour. When draining was complete, the sample was submitted for analysis. The only exception to this process was for the towels. The towels were soaked for two hours, squeezed to remove excess solution, and then analyzed. Images of this soaking and drying process can be seen in Images 1 through 4.

For the RNS testing, a 1:1 Swheat to WB8 salt mixture was made and then applied to the debris using a rolling pin. After the RNS mixture was applied to one side of the debris, it was flipped over and applied to the other side as well. The coated debris samples were then shaken and tapped to remove any loose material from the surface of the debris prior to the 1050 and 1030 analysis. Sample weights were taken prior to impregnating the samples and after removing excess debris. Images of the impregnation process can be seen in images 5 through 9. All of the initial and tested weights for the RNS and UNS Methods 1030 and 1050 analysis can be found in Tables 2 and 3.

SW-846 9095B: Paint Filter

For this method, 100g of each blend was placed into a Gerson 260um paint filter (PN010714R, Lot# B5140428JF8) that was suspended over a 100 mL graduated cylinder for 5 minutes to collect any free liquids. During this 5-min period, if any of the sample material drips into the cylinder, the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314. Under the laboratory conditions, all RNS waste surrogate blends were deemed to contain no free liquids

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2

Table 1. Surrogate creation and analysis table

Surrogate ID	Times made	Solution	Methods		
			1030	1050	Paint filter
Blend 14	1	RNS Surrogate	*	*	1
Blend 15	1	RNS Surrogate	*	*	1
Blend 16	1	RNS Surrogate	*	*	1
Blend 17	1	RNS Surrogate	*	*	1
Blend 18	1	RNS Surrogate	*	*	1
Blend 19	1	RNS Surrogate	*	*	1
Blend 20	1	RNS Surrogate	*	*	1
Blend 21	1	RNS Surrogate	*	*	1
Blend 22	1	RNS Surrogate	*	*	1
Blend 23	1	RNS Surrogate	*	*	1
Blend 24	1	RNS Surrogate	*	*	1
Cardboard baseline	1	NA	1	1	*
Towel baseline	1	NA	1	1	*
Plastic baseline	1	NA	1	1	*
Gloves baseline	1	NA	1	1	*
UNS Cardboard	2	UNS Surrogate	2	2	*
UNS Towel	2	UNS Surrogate	2	2	*
UNS Plastic	2	UNS Surrogate	2	2	*
UNS Gloves	2	UNS Surrogate	2	2	*
RNS Cardboard	2	RNS Surrogate	2	2	*
RNS Towel	2	RNS Surrogate	2	2	*
RNS Plastic	2	RNS Surrogate	2	2	*
RNS Gloves	2	RNS Surrogate	2	2	*

*Testing not required for these methods.

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Table 2. Weights of the debris samples for 1050 analysis

Sample	Cube (mm)	Initial wt (g)	Soaked wt used (g)	Wt soaked sample not used (g)	Wt UNS/RNS on sample (g)	After analysis wt (g)
Cardboard Baseline	100	542.10	NA	NA	NA	525.79
Plastic Baseline	100	413.51	NA	NA	NA	409.48
Gloves Baseline	100	523.93	NA	NA	NA	522.29
Towel Baseline	100	92.742	NA	NA	NA	88.659
UNS-Cardboard	100	567.77	738.71	157.36	328.30	482.51
UNS-Cardboard Dup	100	583.69	802.93	129.21	348.45	533.38
UNS-Towel	100	97.12	669.19	NA	572.07	86.40
UNS-Towel Dup	25	4.134	26.313	NA	22.179	2.902
UNS-Gloves	100	582.02	619.94	NA	37.92	581.73
UNS-Gloves Dup	100	571.95	619.24	NA	47.29	570.65
UNS-Gloves Trip	100	547.26	579.85	NA	32.59	546.85
UNS-Plastic	100	406.85	458.22	NA	51.38	413.73
UNS-Plastic Dup	100	533.90	600.85	NA	66.95	543.16
RNS-Cardboard	100	421.69	606.47	NA	184.78	502.80
RNS-Cardboard Dup	100	392.38	561.29	NA	168.91	456.55
RNS-Plastic	100	358.67	589.34	NA	230.67	467.91
RNS-Plastic Dup	100	329.21	584.94	NA	255.73	443.50
RNS-Towel	100	62.45	654.75	NA	592.30	356.19
RNS-Towel Dup	100	60.41	605.11	NA	544.70	322.95
RNS-Gloves	100	351.39	601.88	NA	250.49	462.30
RNS-Gloves Dup	100	340.95	552.88	NA	211.93	426.32

SW-846 1030: Ignitability of Solids

The debris material was cut into strips and layered on top of each other to be 250 mm in length x 20mm wide x 10mm in height. An ignition source was applied to one end of the test material to determine whether combustion would propagate along 200 mm of the strip within 2 minutes. If the material combustion propagated, the burning time was measured over a distance of 100 mm and the rate of burning would be determined. The samples were then placed onto a ceramic tile with marks at the 80 and 180 mm in from the end of the train. The ceramic tile was placed about 8 inches in a hood with the sash lowered to give an airflow of about 0.7 m/sec. One end of the train was exposed to the end of an acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes. If the sample began to burn down the train, the time taken to get from the 80 to 180 mm mark was measure to determine the burn rate. Wastes that have a rate of burning of more than 2.2 mm/sec (or burn time of less than 45 sec for 100 mm) are considered to have a positive result for ignitability according to DOT regulations.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2

Table 3. Weights of the debris samples for 1030 analysis.

Sample	Initial wt(g)	Soaked wt (g)	Wt UNS/RNS on sample (g)
Cardboard Baseline	40.177	NA	NA
Plastic Baseline	47.876	NA	NA
Gloves Baseline	60.157	NA	NA
Towel Baseline	6.726	NA	NA
UNS-Cardboard	41.926	66.048	24.122
UNS-Cardboard Dup	39.919	63.495	23.576
UNS-Plastic	44.471	51.853	7.382
UNS-Plastic Dup	50.384	59.985	9.601
UNS-Rubber gloves	65.51	76.766	11.256
UNS-Rubber gloves Dup	48.134	56.899	8.765
UNS-Towel	7.177	63.418	56.241
UNS-Towel Dup	7.498	64.245	56.747
RNS-Cardboard	39.658	56.190	16.532
RNS-Cardboard Dup	43.715	64.251	20.536
RNS-Plastic	23.341	39.504	16.163
RNS-Plastic Dup	25.76	41.616	15.856
RNS-Rubber gloves	38.292	57.059	18.767
RNS-Rubber gloves Dup	37.155	53.874	16.719
RNS-Towel	4.165	88.569	84.404
RNS-Towel Dup	4.752	90.415	85.663

A baseline was performed on all of the untreated debris to determine their where the material itself was considered ignitable. All of the debris samples maintained a flame after the torch was removed at 2 minutes but only the cardboard and towel had any propagation. The Cardboard propagated to the 80mm mark and slowly propagated approximately 20 mm before extinguished itself at after 4½ minutes (Image 10). The rubber gloves and Plastic only burned and melted at the flame initiation point (Image 11 & 12). The Towel burned the entire length of the sample and had a burn rate of 3.52mm/sec (Image 13). Out of the four baseline debris samples, only the towel is considered to be flammable under the test conditions and criteria outlined in Method 1030.

The analysis of the UNS debris was performed in duplicate. None of the UNS debris samples propagated to the 80mm mark. This is likely attributed to the amount of moisture absorbed by the debris during the soaking process. The UNS-Cardboard charred and burned during the analysis but did not have any propagation past the point of flame application (Image 14). The UNS-Rubber gloves initially exhibit a large flame when the torch was first applied and dark smoke billowed from the sample throughout the analysis but did not propagate (Image 15). The UNS-Plastic maintained a flame for up to 30 seconds after removing the torch at 2 minutes but did not propagate to the 80mm mark. During the analysis the sample burned and charred causing the burn area to turn into a

blackened brown melted mass (Image 16). The towel shriveled up and formed a white granular layer around the sample but no flame or propagation was observed (Image 17). Since none of the UNS debris samples propagated to the 80mm mark, they were all considered non-flammable under the test conditions and criteria outlined in Method 1030.

The analysis of the RNS debris analysis was performed in duplicate. None of the RNS debris samples propagated to the 80mm mark. The RNS-Cardboard burned for approximately 7 seconds after removal of the ignition source (Image 18). The RNS-Rubber had a small amount of billowing smoke and only burned at the point of the flame application but had no propagation (Image 19). The RNS-Plastic burned for up to 15 seconds after the flame was removed and only burned at the point of flame application with no propagation (Image 20). The RNS-Towel formed granular crust on the outside and browned slightly but no flame or propagation was observed (Image 21). Since none of the RNS debris samples propagated to the 80mm mark, they were all considered non-flammable under the test conditions and criteria outlined in Method 1030.

Fine Excelsior (natural hardwood shavings) was used as a positive control each day testing was performed.

SW-846 1050: Spontaneous combustion and self heating

Due to the nature of the samples, the preliminary (Method A) which looks for spontaneous combustion, was not performs. Instead, testing proceeded directly to Method C -Self Heating. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200 ^{o}C within the 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 4.

Table 4. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cube was placed into an oven with two thermocouples measuring the oven temp and up to four thermocouples inserted into each sample to measure its temperature during the analysis. Lids were placed onto the top of the test cubes and tungsten weights were placed on top of those sample believed to have event in order to keep the thermocouples and lids from coming out of the sample. Also up to two thermocouples were placed in a tray below the sample in case any sample pushed out of the cube and onto the tray. Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for 24-48 hours depending on when the sample reached temperature. Although the method states testing to be conducted for 24 hours, a few of the samples did not reach 140°C ± 2°C until midway or close to the initial 24 hour period, therefore the testing was extended to a minimum of 12 hours after the sample had reached temperature. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C

during the time of testing. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample. The oven and sample temperature graphs are located in Attachment A.

An initial baseline analysis was performed on each of the debris samples. For the Cardboard analysis, the sample was layered together in the cube and four holes were drilled so the thermocouples could be placed in the center of the cardboard mass. The Cardboard sample got to temperature within approximately 6 hours and remained there for the duration of the test (Image 22). The Plastic reached temperature with 5 hours and remained for the duration of the test (Image 23). The Rubber gloves reached temperature within 4 hours and remained at an elevated temperature of 144°C throughout testing (Image 24). The Towel came to temperature fairly quickly and remained at temperature for the entirety of the test. The temperature charts for the baseline samples can be found in Figures 1-4 of Attachment A. Since none of the baseline debris samples exceeded 200°C during the analysis, all are classified as "Not a Self-Heating Waste" as defined by Method 1050 under the laboratory testing conditions.

The UNS debris samples were prepared the day of analysis and were run in duplicate using the 100mm cube. The UNS-Cardboard reached the test temperature within 5 hours and exceeded temperature by as much as 7°C before eventually coming back down to 140°C (Image 25 & 26) The UNS-Plastic samples reached temperature within 6 hours and slightly rose above 140°C but remained at temperature for the entirety of the testing. The UNS-plastic appeared black and brown after analysis but no event appears to have taken place within the sample (Image 27 & 28). The UNS-Rubber gloves reached temperature within 6-7 hours and remained at temperature for the entirety of the analysis (Image 29 & 30 – the data file for the initial test was corrupt; therefore, duplicate and triplicate were reported. Since UNS-Cardboard, UNS-Plastic and UNS-Rubber gloves did not exceeded 200°C during the analysis, all were are classified as "Not a Self-Heating Waste" as defined by Method 1050 under the laboratory testing conditions. As the UNS-Towel sample approached the test temperature 11 hours into testing, an event occurred and caused the temperature to rise above 600°C. Once the sample was removed from the oven, it did appear to be charred, brittle, and discolored (Image 31). The UNS-Towel was retested in duplicate using the 25mm cubes. A little over 1½ hours into the test, an event occurred causing the samples to exceed 500°C. Once removed from the oven, the sample had a similar appearance to the 100mm cube (Image 32). Since the UNS-Towel sample exceeded 200°C on both the 100mm and 25mm cubes, it is considered to be a DOT Packing Group II. All temperature charts for the UNS debris samples are found in Figure 5-12 in Attachment A.

The RNS samples were prepped the day of analysis and were run in duplicate using the 100mm cube. When impregnating the cardboard with the RNS mixture, it mainly soaked up the free liquid fraction of the RNS and only retained small amounts of kitty litter after tapping the loose material off. The RNS-Cardboard attained test temperature within 10 hours and remained at temperature for the entirety of the test (Image 33 and 34). When pressing the RNS waste into the plastic, the plastic became a little moist and maintained only a small amount of solid material from the RNS. The RNS-Plastic samples reached temperature within approximately 9 hours and slightly rose above 140°C before returning to the test temperature. After testing, it was noted that the RNS-Plastic darkened but no event seem to have occurred within the sample (Image 35). The RNS-Rubber gloves had the same moisture and solid content as the RNS-Plastic had. The RNS-Rubber gloves reached test temperature

between 8-12 hours and remained at temperature for the remainder of the test (Image 36). The towel was the most difficult debris to impregnate due to the fact that it would absorb all the moisture out of the 1:1 WB8 to Swheat in the matter of just a few pieces. In order to have the same sample consistency throughout the cube several small batches of 400mL WB8 to 400mL Swheat were made for each RNS-Towel test. The RNS-Towel samples took 15 to 22 hours to reach the test temperature and remained at temperature for the remainder of the analysis (Image 37 & 38). It was noted that at all the RNS debris samples expanded in volume during testing. Since none of the RNS debris samples exceeded 200°C during the analysis, all of them are classified as "Not a Self-Heating Waste" as defined by Method 1050 under the laboratory testing conditions. All of the temperature charts for the RNS debris samples can be found in figure 13-20 in Attachment A.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 1: Soaking of the cardboard sample in UNS solution for 1050 analysis.



Image 2: Draining of the Cardboard sample for the UNS 1050 analysis.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 3: Soaking of the Plastic, Rubber gloves, and Towel samples for UNS 1030 analysis.



Image 4: Draining of the Cardboard, Plastic, and Rubber gloves for UNS 1030 analysis.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 5: Overview show how samples were impregnated with the RNS surrogate.



Image 6: RNS impregnation of the Cardboard for 1050 analysis.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 7: RNS-Plastic as it was being stuffed into the 100mm cube for 1050 analysis.



Image 8: RNS-Towel for 1050 analysis.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 9: RNS-Rubber gloves for 1050 analysis.



Image 10: Cardboard 1030 baseline analysis showing the sample reaching the 80mm but slowing down and just smoldering slightly after the mark.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 11: Rubber end that was under the torch during the baseline 1030 analysis.

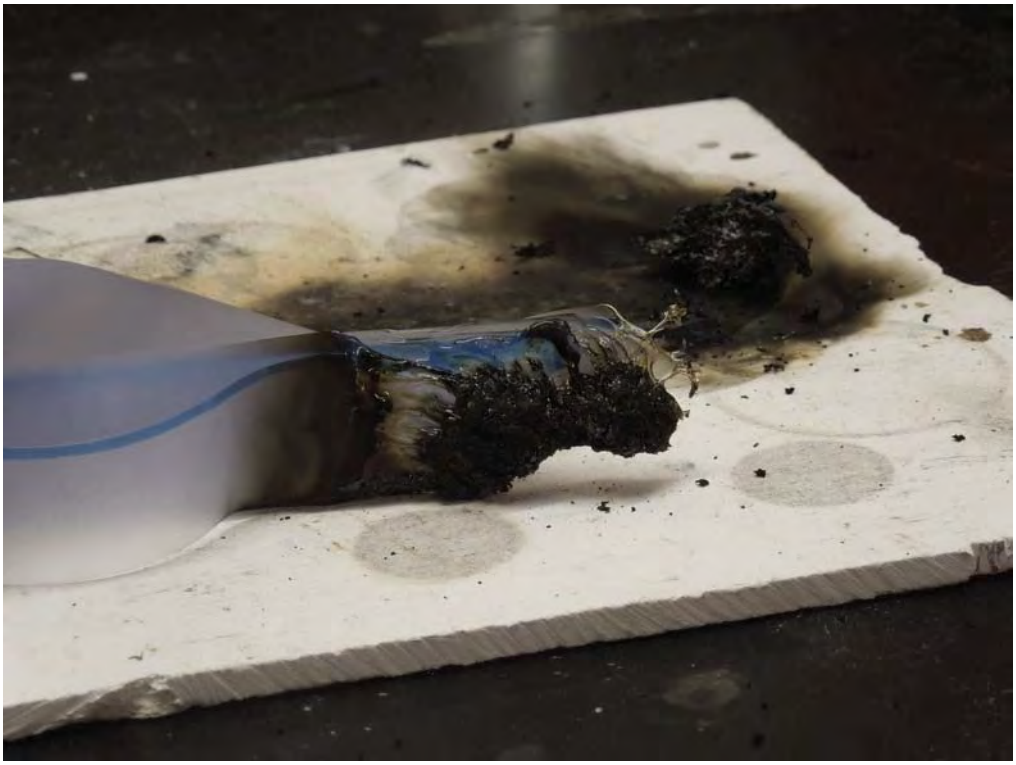


Image 12: Melted and charred end of the plastic during the baseline 1030 analysis.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 13: Smoldering remains of the baseline 1030 Towel analysis.



Image 14: UNS-Cardboard for 1030 analysis showing the white nitrate formations farther away from the burn point and the charring at the burn point.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 15: UNS-Rubber glove for 1030 analysis showing the burn region that was brittle to the touch and some of the white nitrate layer on the outside of the sample.



Image 16: UNS-Plastic for 1030 analysis showing the charred melted mass formed at the burn point of the sample.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 17: UNS-Towel for 1030 analysis showing the white granular formation in the burn point.



Image 18: RNS-Cardboard for 1030 analysis showing the crumbling of the sample and the burning that took place at the burn point.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 19: RNS-Rubber gloves for 1030 analysis showing the slight burning that took place during the analysis.



Image 20: RNS-Plastic for 1030 analysis showing the external granular formation and the melting at the burn point.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 21: RNS-Towel for 1030 analysis showing the granular crust on the outside of the sample and the slight browning that took place.

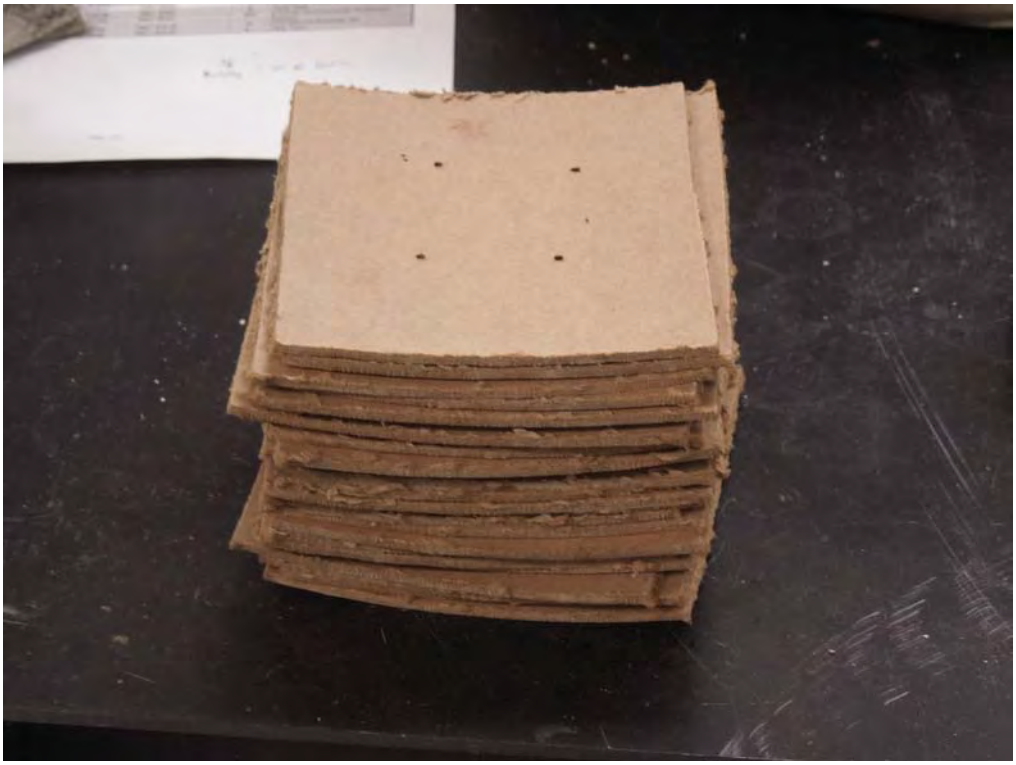


Image 22: Baseline Cardboard for 1050 analysis showing little change after the analysis was performed.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 23: Baseline Plastic for 1050 analysis showing the slight discoloration and shrinkage of the sample during testing.



Image 24: Baseline Rubber gloves for 1050 analysis showing the stiffening of the sample into the cube shape.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2

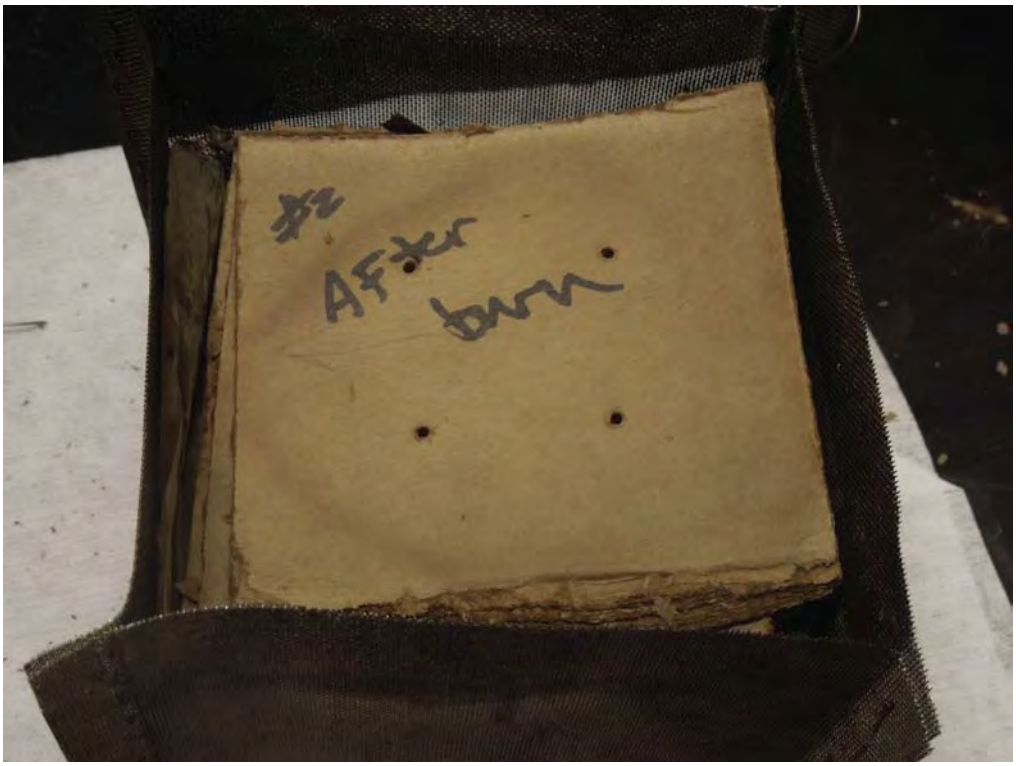


Image 25: UNS-Cardboard for 1050 analysis showing the streaks and different shades of brown after analysis.



Image 26: UNS Cardboard after 1050 analysis showing the sandy particles coming of the sample when rubbing ones hand across it.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 27: UNS-Plastic while stuffing the 100mm cube prior to analysis.



Image 28: UNS-Plastic after 1050 analysis showing the darkened color and the cube form the sample took on.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 29: UNS-Rubber gloves after 1050 analysis showing slight stiffness and coating of salt material.



Image 30: UNS-Rubber gloves after 1050 analysis showing the accumulation of salt lower down in the base region of the cube.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 31: UNS-Towel (100mm cube) 1050 analysis showing the remaining sample after event being charred and burnt.



Image 32: UNS-Towel after 1050 analysis showing sample that was removed from the two 25mm cubes used in the analysis.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 33: RNS-Cardboard after 1050 analysis showing the covering of the sample in the RNS waste.



Image 34: RNS-Cardboard after 1050 analysis showing some darkened areas within the central region of the 100mm cube.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2

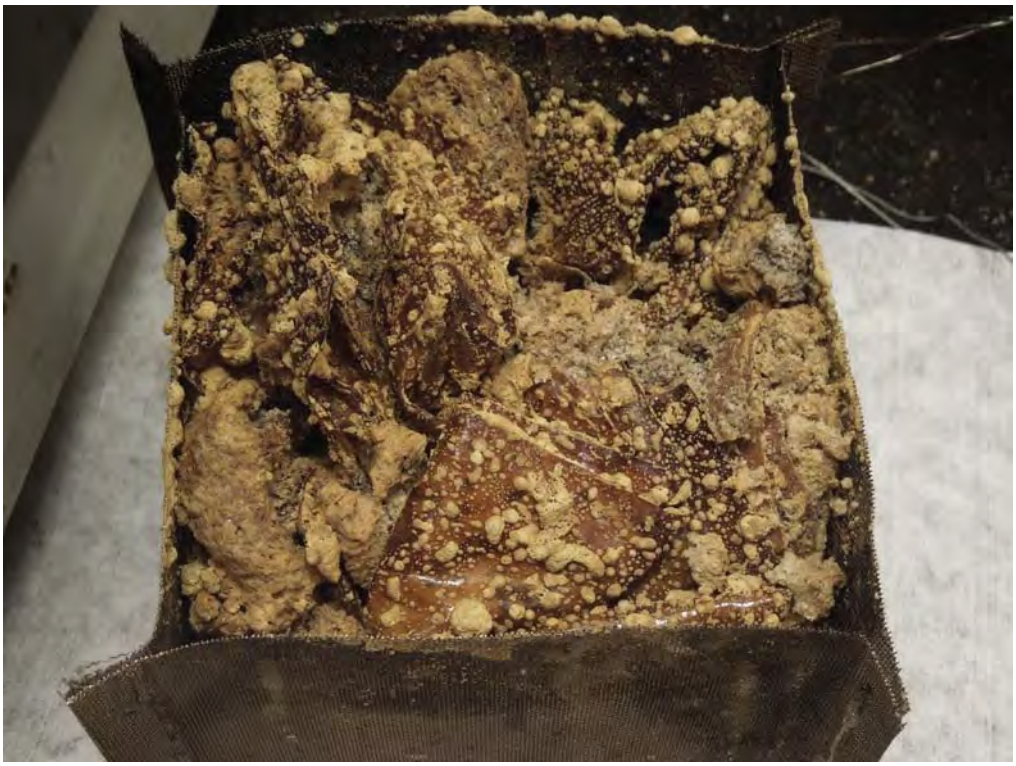


Image 35: RNS-Plastic after 1050 analysis showing the darkening of the sample and the NS waste expanding within the 100mm cube.



Image 36: RNS-Rubber gloves after 1050 analysis showing the expansion of the sample due to the RNS waste.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 37: RNS-Towel after 1050 analysis showing the discoloration of the towel and the lack of expanse seen in the other RNS waste debris samples.



Image 38: RNS-Towel after 1050 analysis showing how it became a hardened cube during the analysis.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."



Group Leader **3-10-16**
Date

Attachment A

Method 1050 Graphs

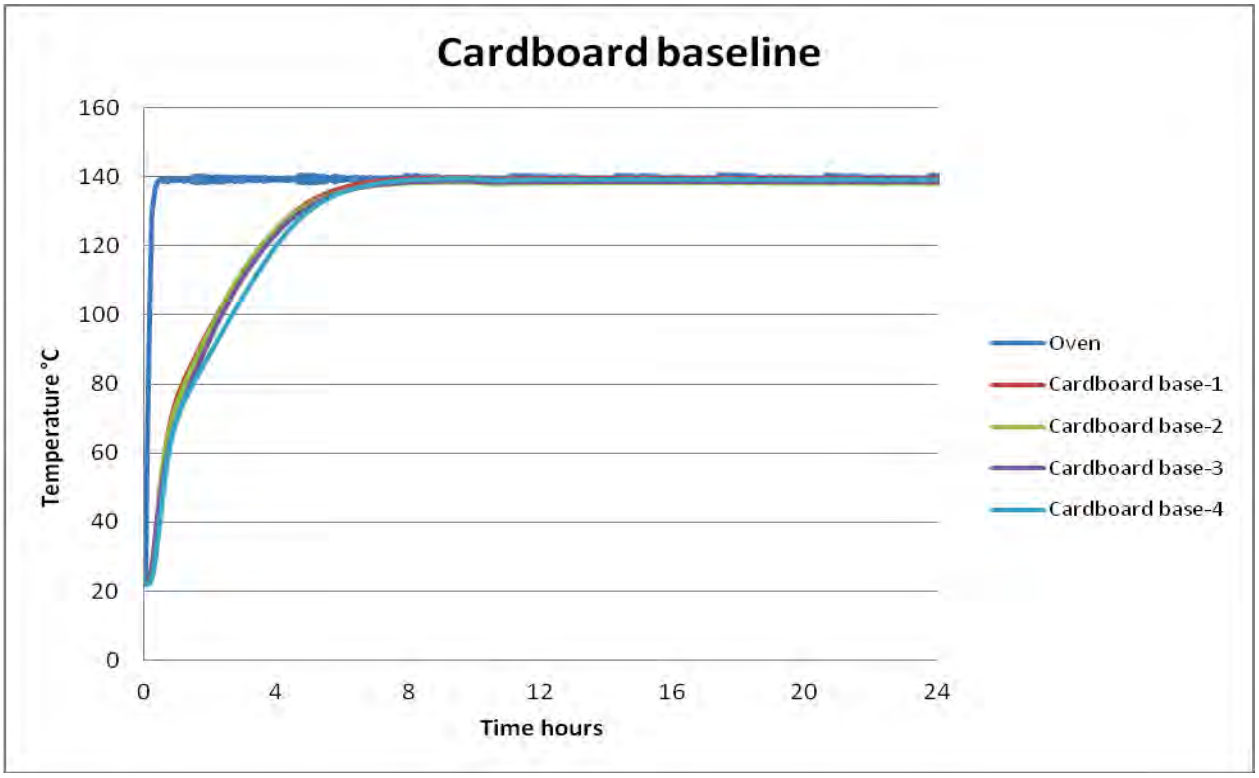


Figure 1. Method 1050 – Cardboard Baseline (100mm cube) full run.

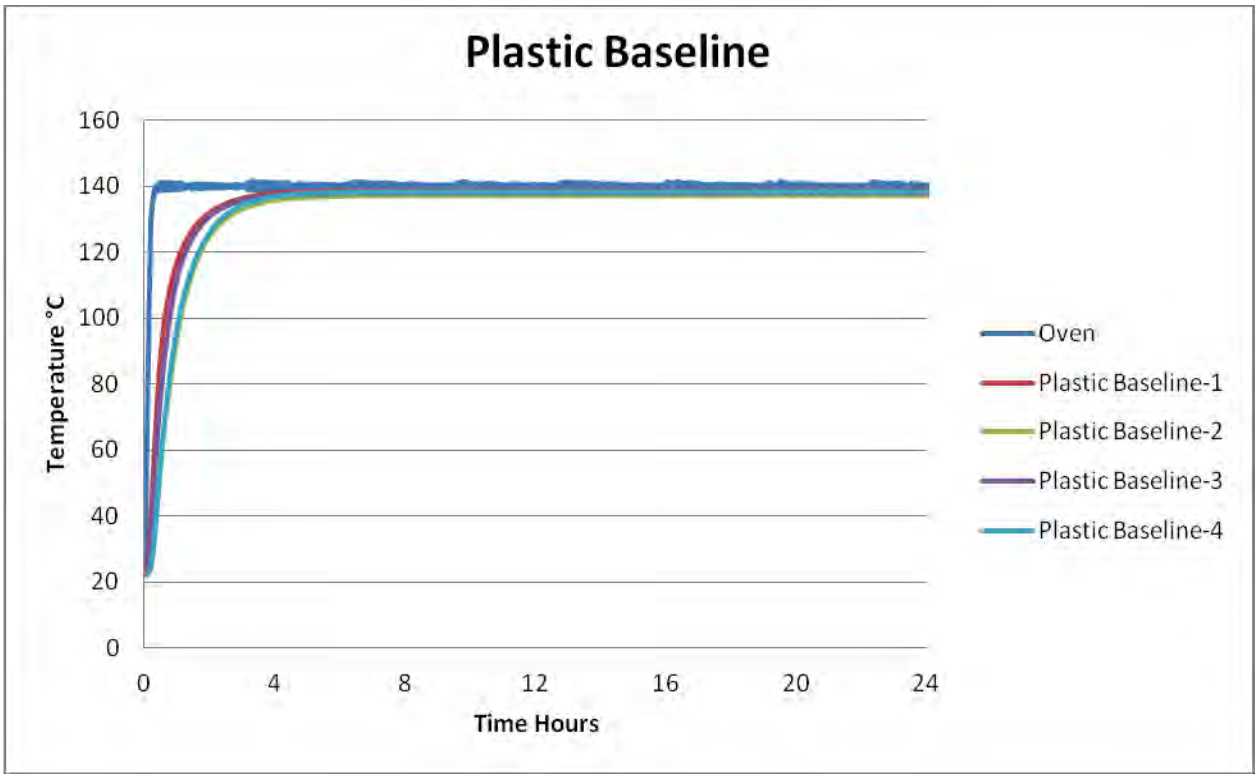


Figure 2. Method 1050 – Plastic Baseline (100mm cube) full run.

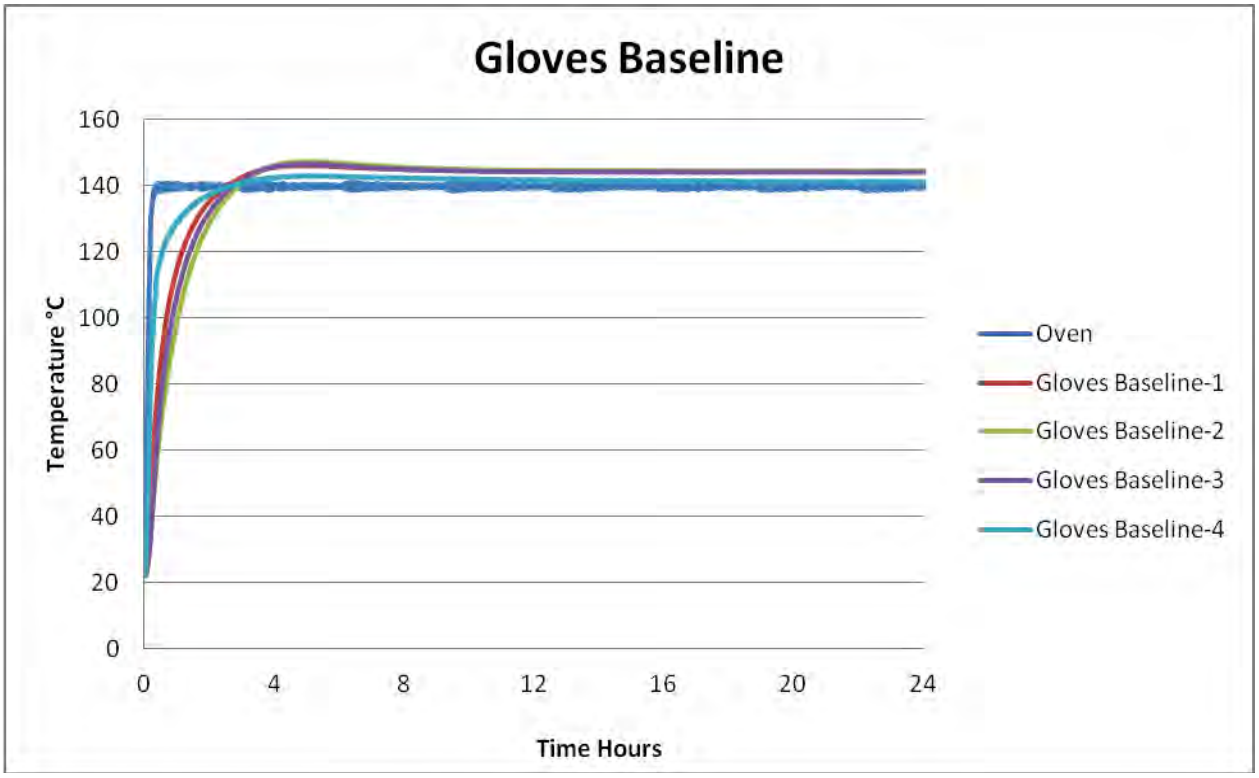


Figure 3. Method 1050 – Rubber Gloves Baseline (100mm cube) full run showing the slightly elevated temperature above 140°C.

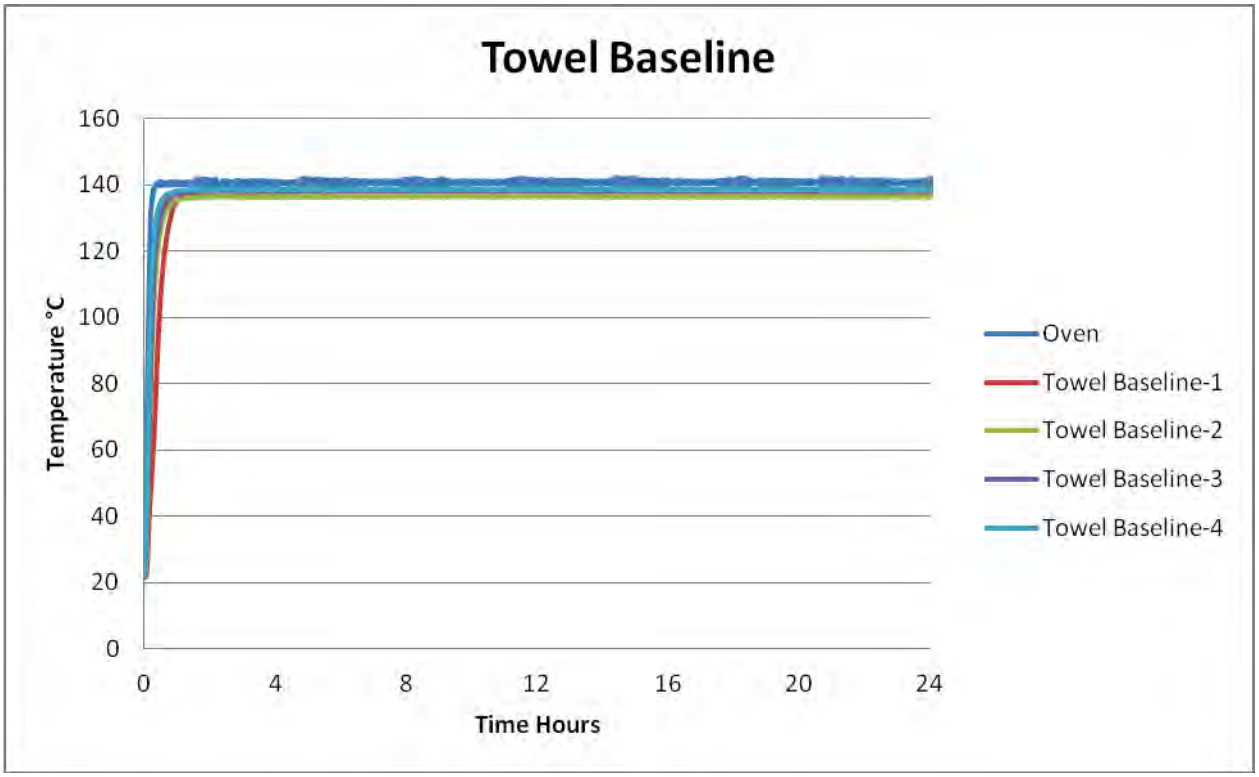


Figure 4. Method 1050 – Towel Baseline (100mm cube) full run.

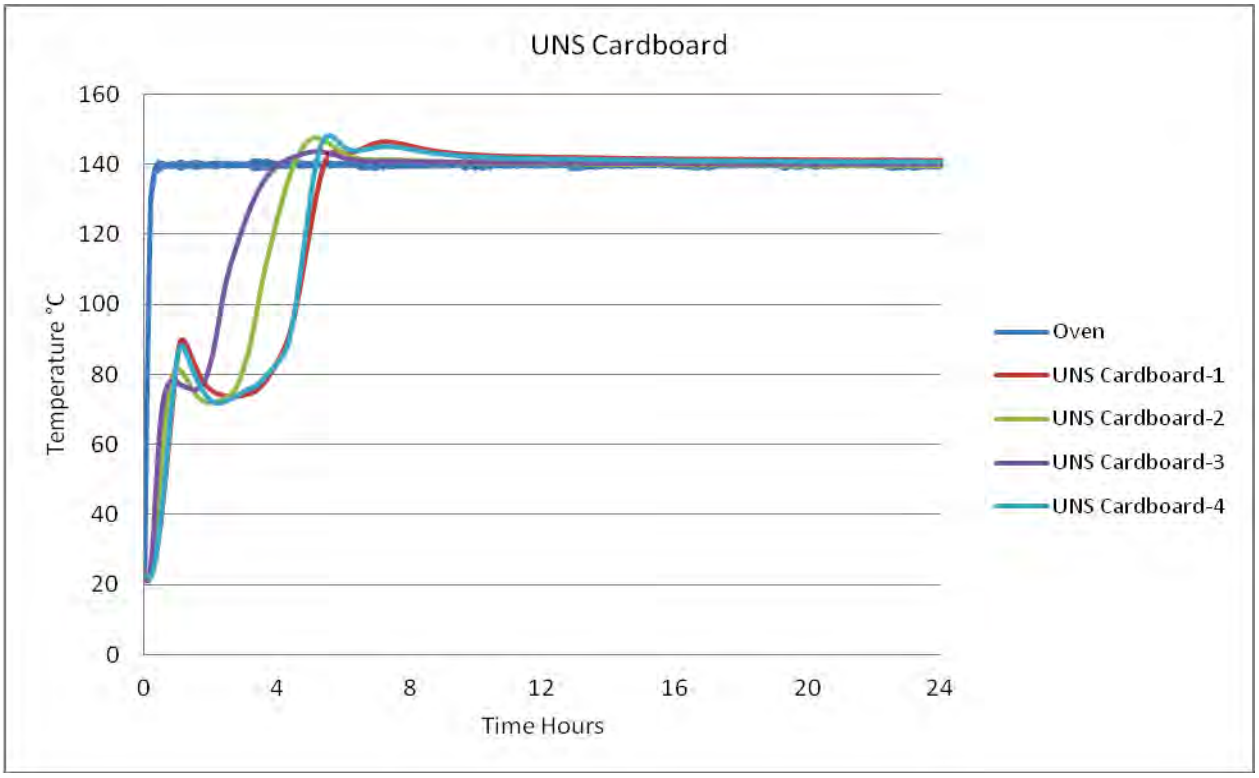


Figure 5. Method 1050 – UNS Cardboard (100mm cube) full run.

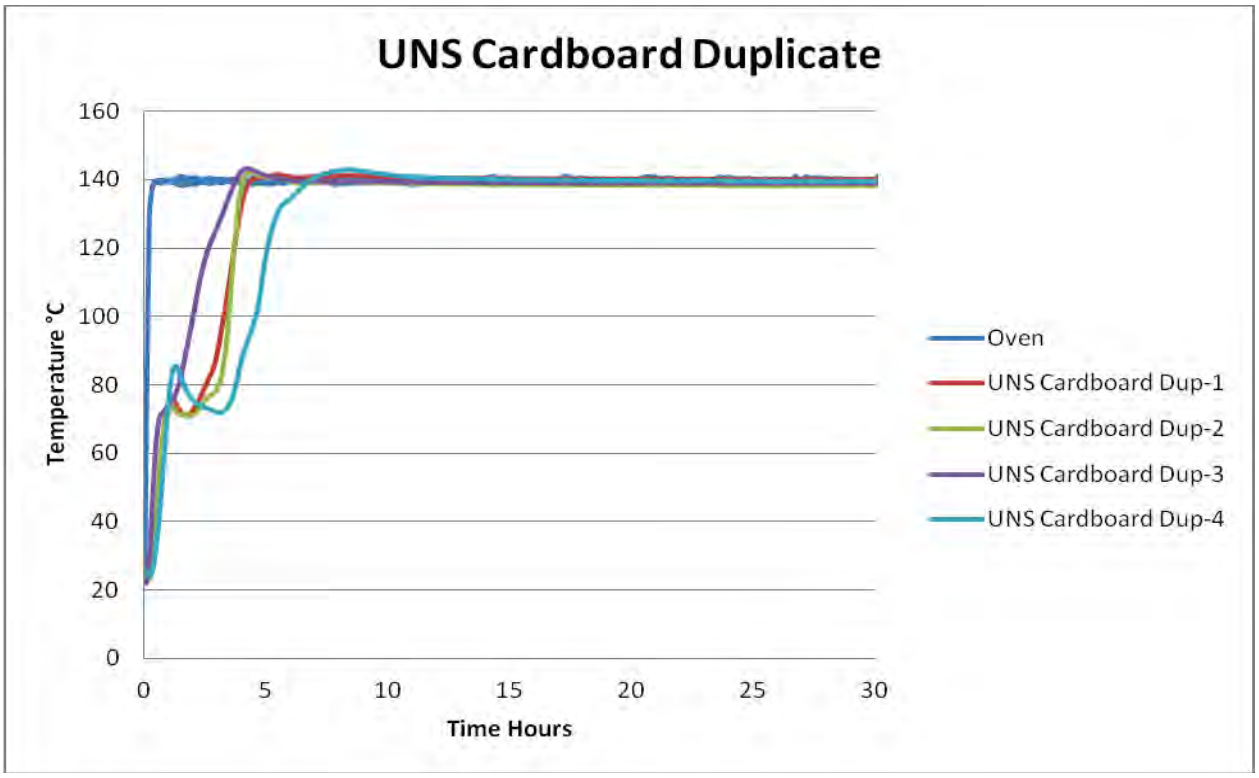


Figure 6. Method 1050 – UNS Cardboard Duplicate (100mm cube) full run.

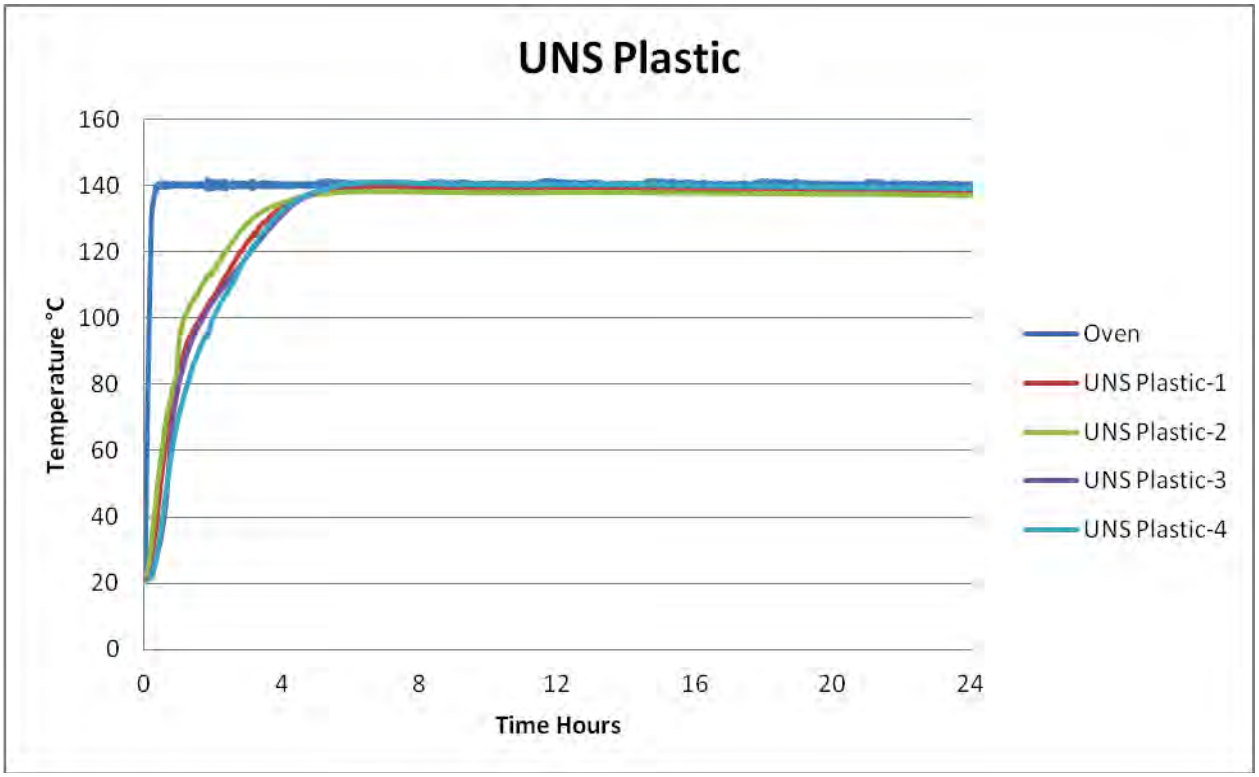


Figure 7. Method 1050 – UNS Plastic liner (100mm cube) full run

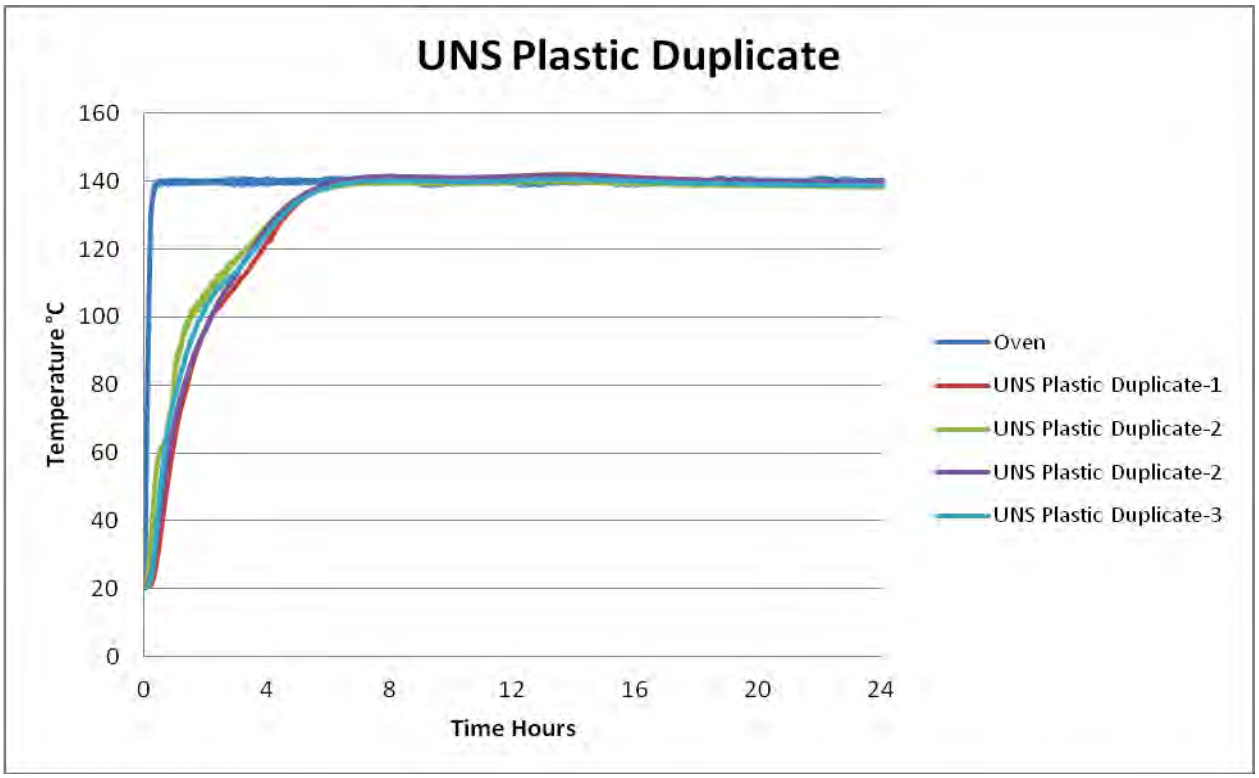


Figure 8. Method 1050 – UNS Plastic liner Duplicate (100mm cube) full run.

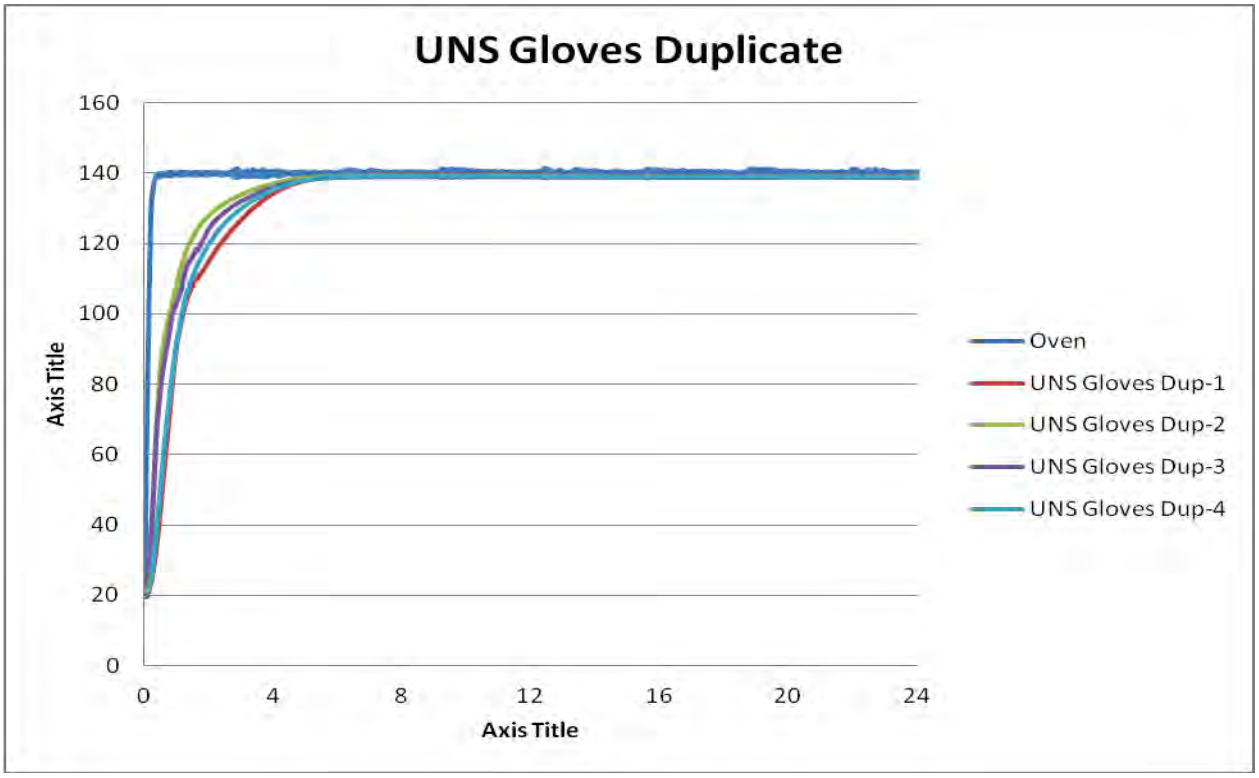


Figure 9. Method 1050 – UNS Rubber Gloves Duplicate (100mm cube) full run.

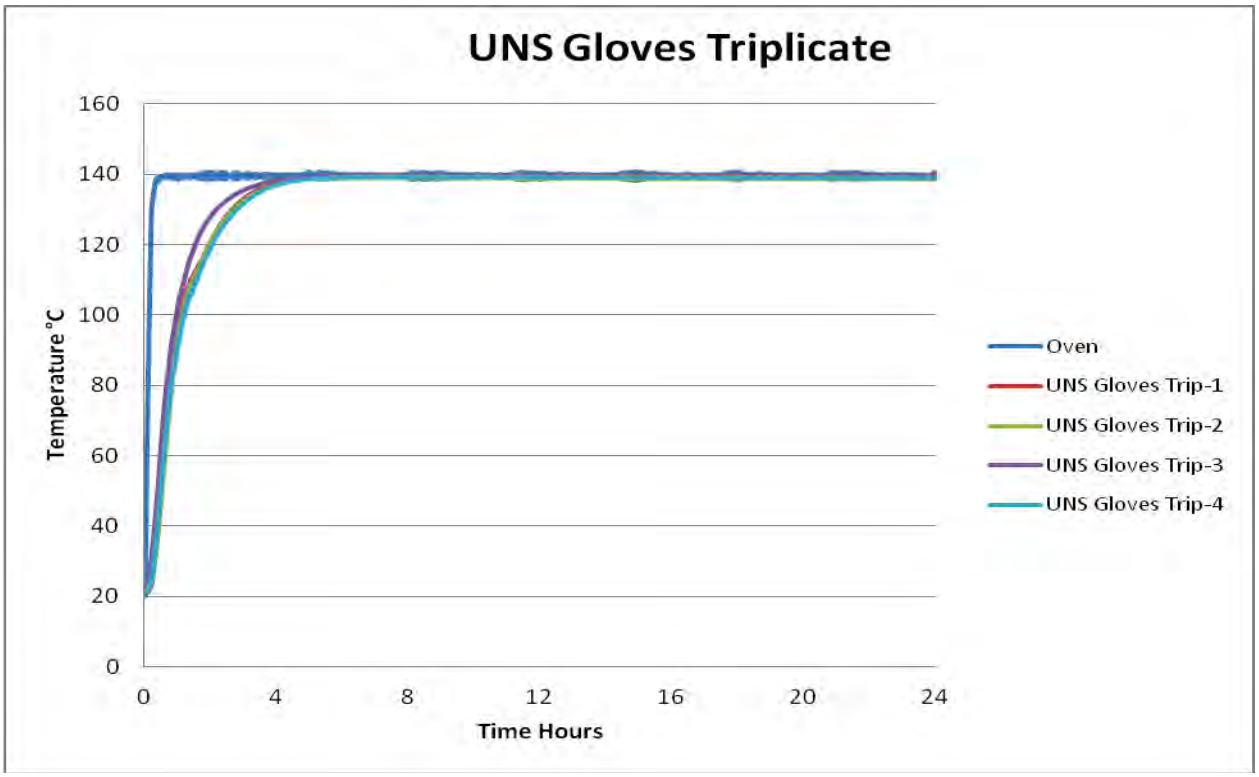


Figure 10. Method 1050 – UNS Rubber Gloves Triplicate (100mm cube) full run

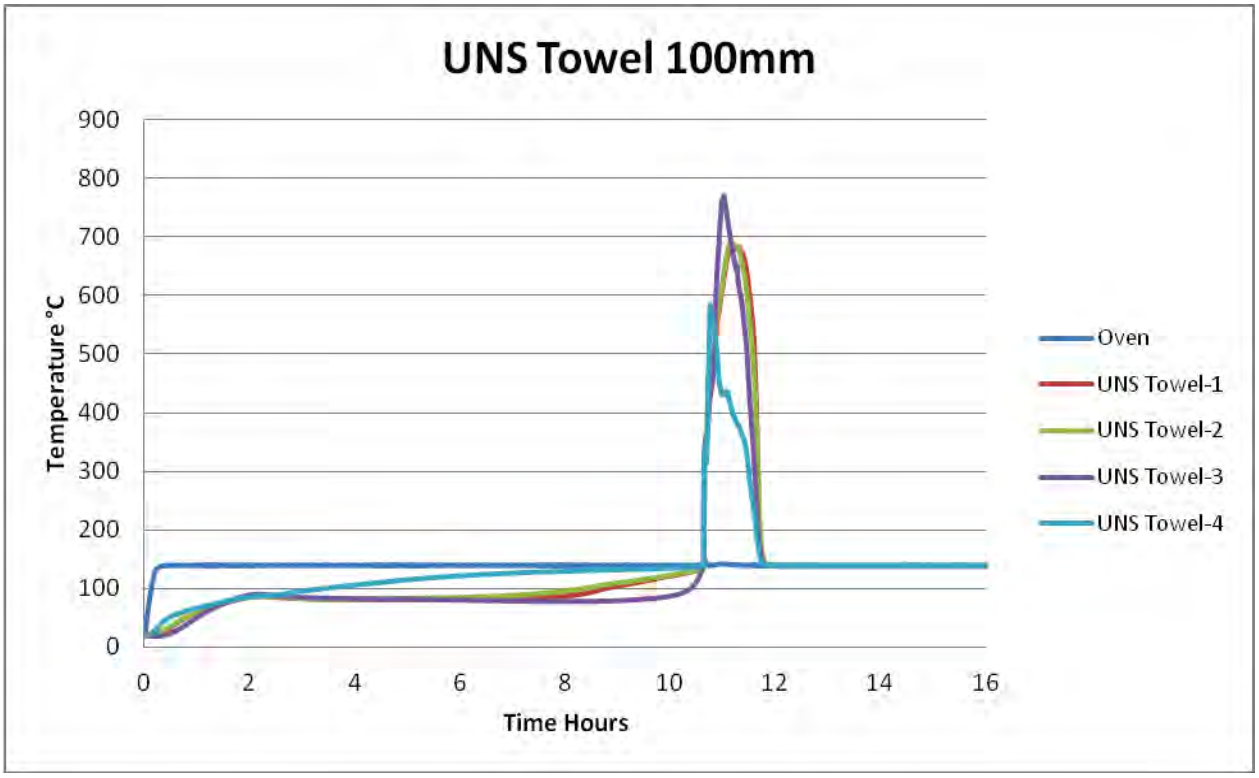


Figure 11. Method 1050 – UNS Towel (100 mm cube) showing an event occuring around ll hours into the analysis.

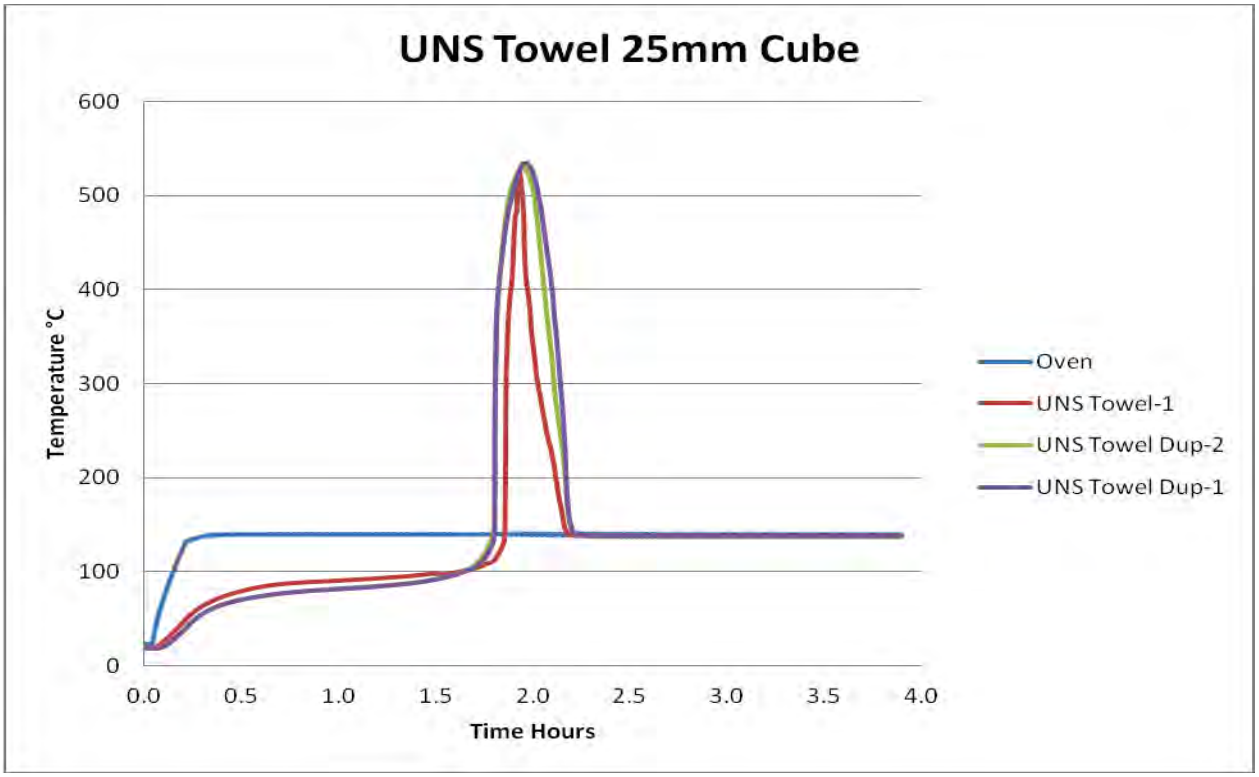


Figure 12. Method 1050 – UNS Towel (25 mm cube) showing an event occuring a little over 1½ hours into analysis.

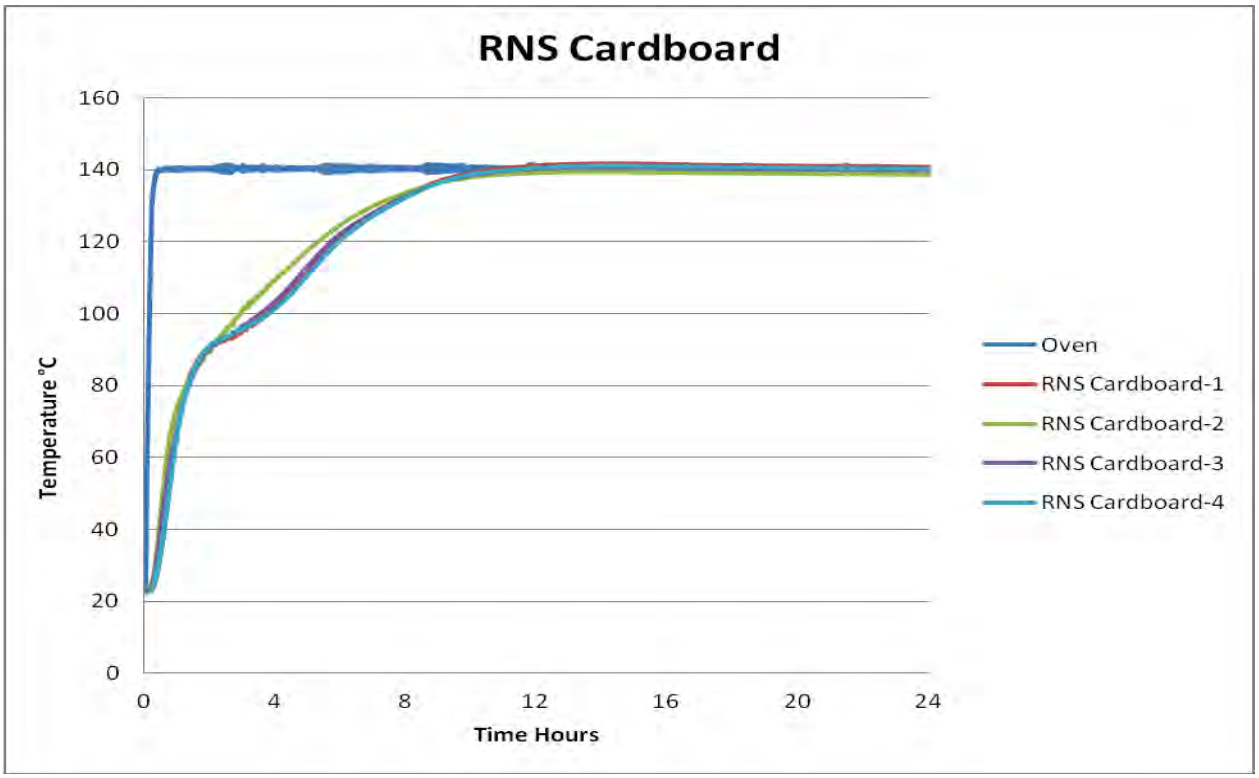


Figure 13. Method 1050 – RNS Cardboard (100mm cube) full run

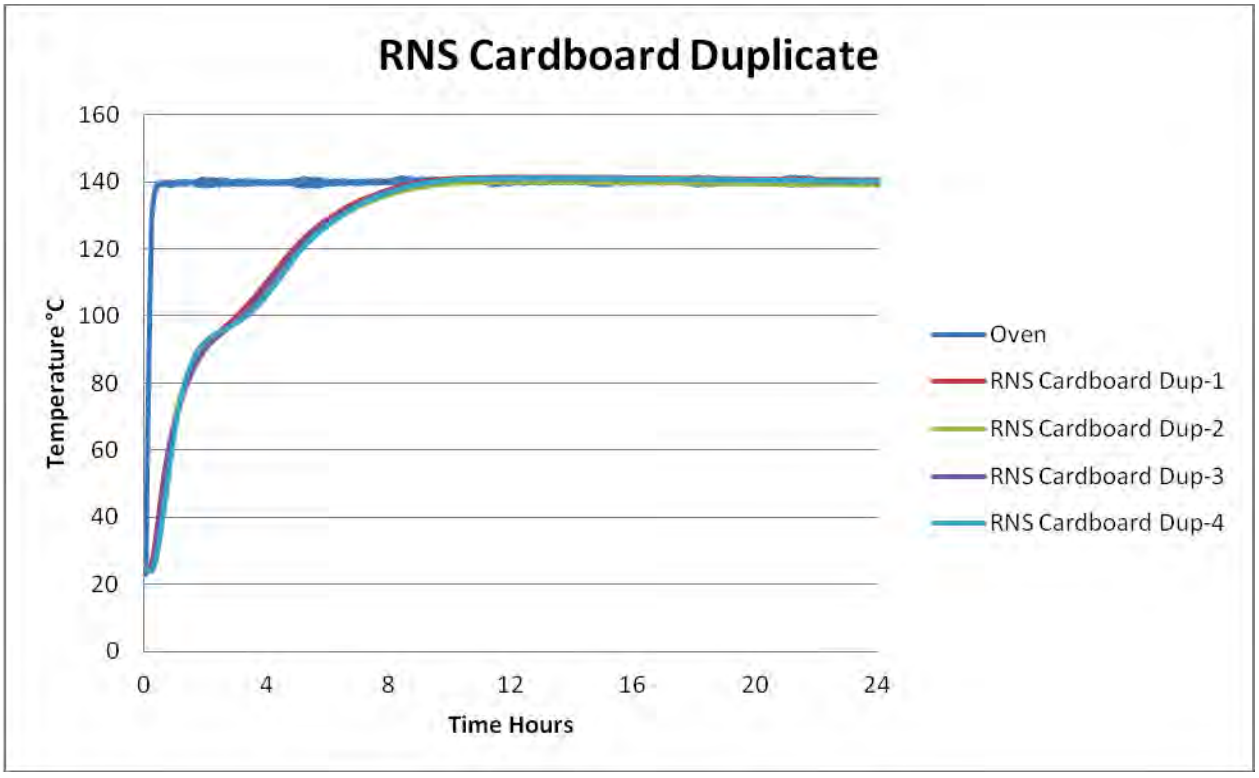


Figure 14. Method 1050 – RNS Cardboard Duplicate (100mm cube) full run

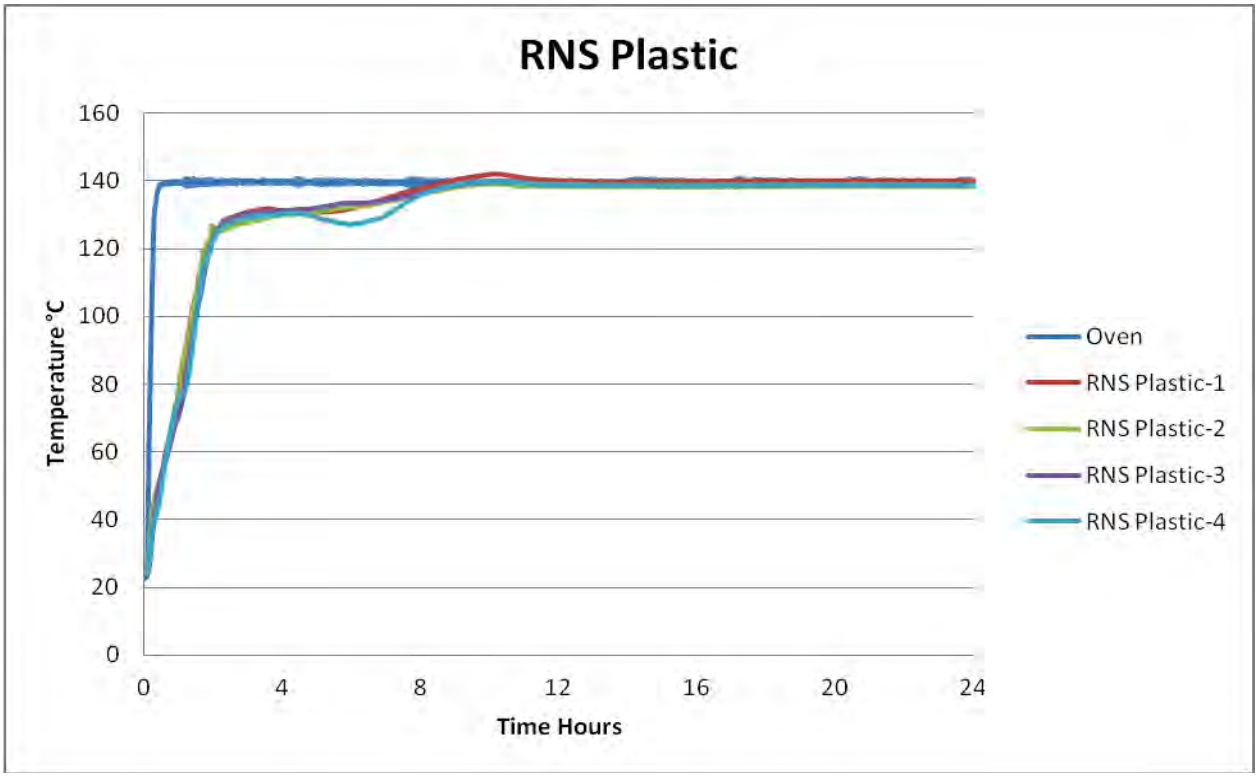


Figure 15. Method 1050 – RNS Plastic liner (100mm cube) full run.

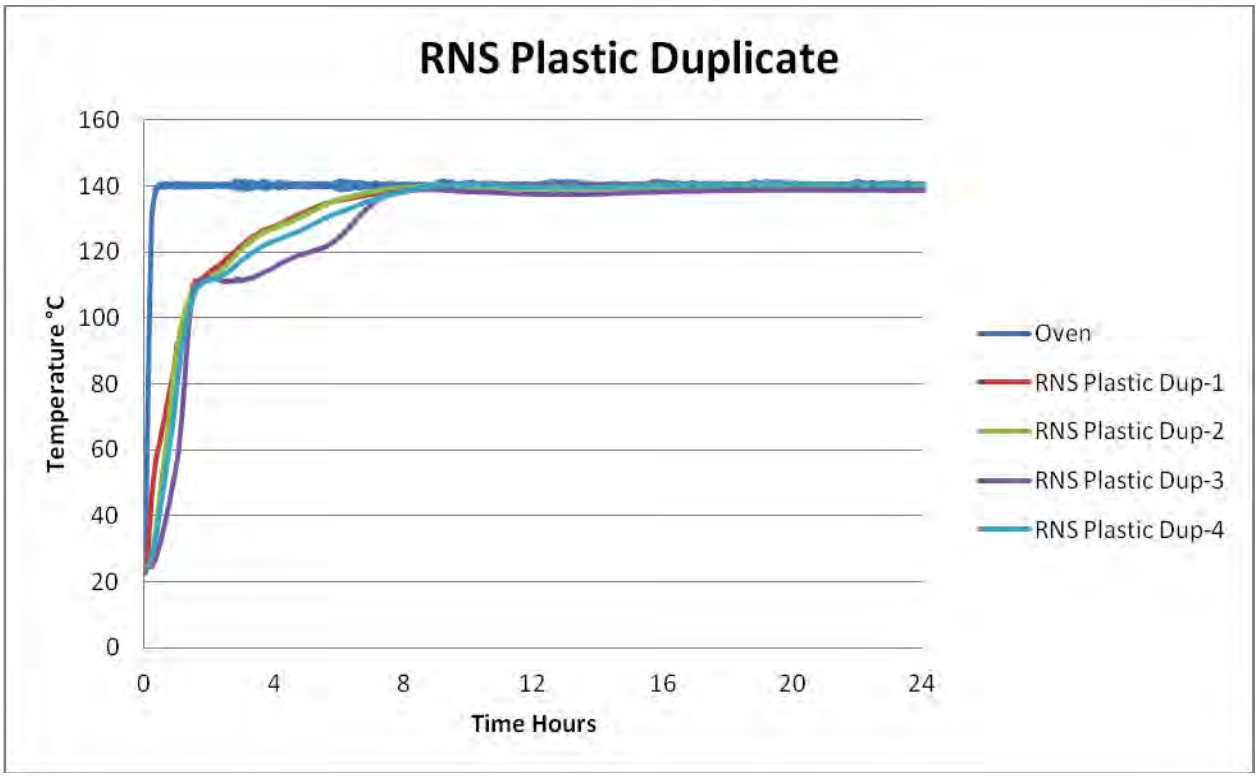


Figure 16. Method 1050 – RNS Plastic liner Duplicate (100mm cube) full run

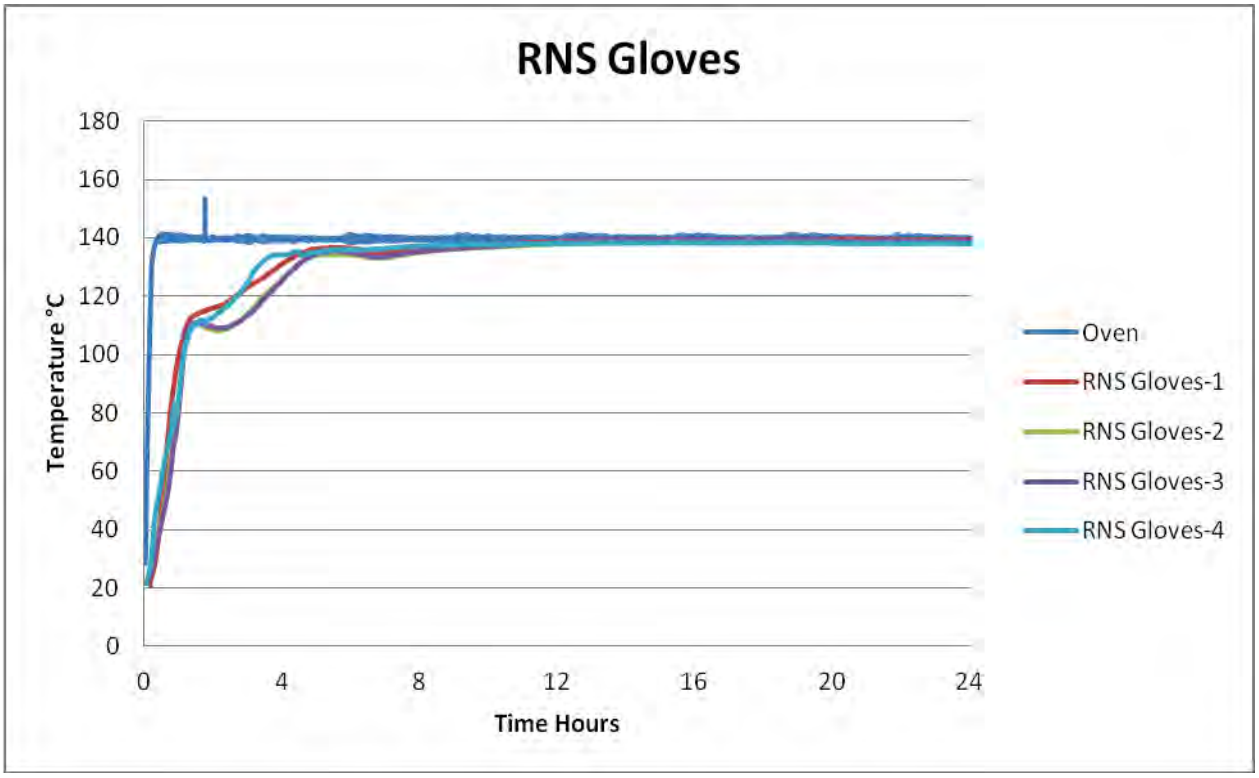


Figure 17. Method 1050 – RNS Rubber gloves (100mm cube) full run.

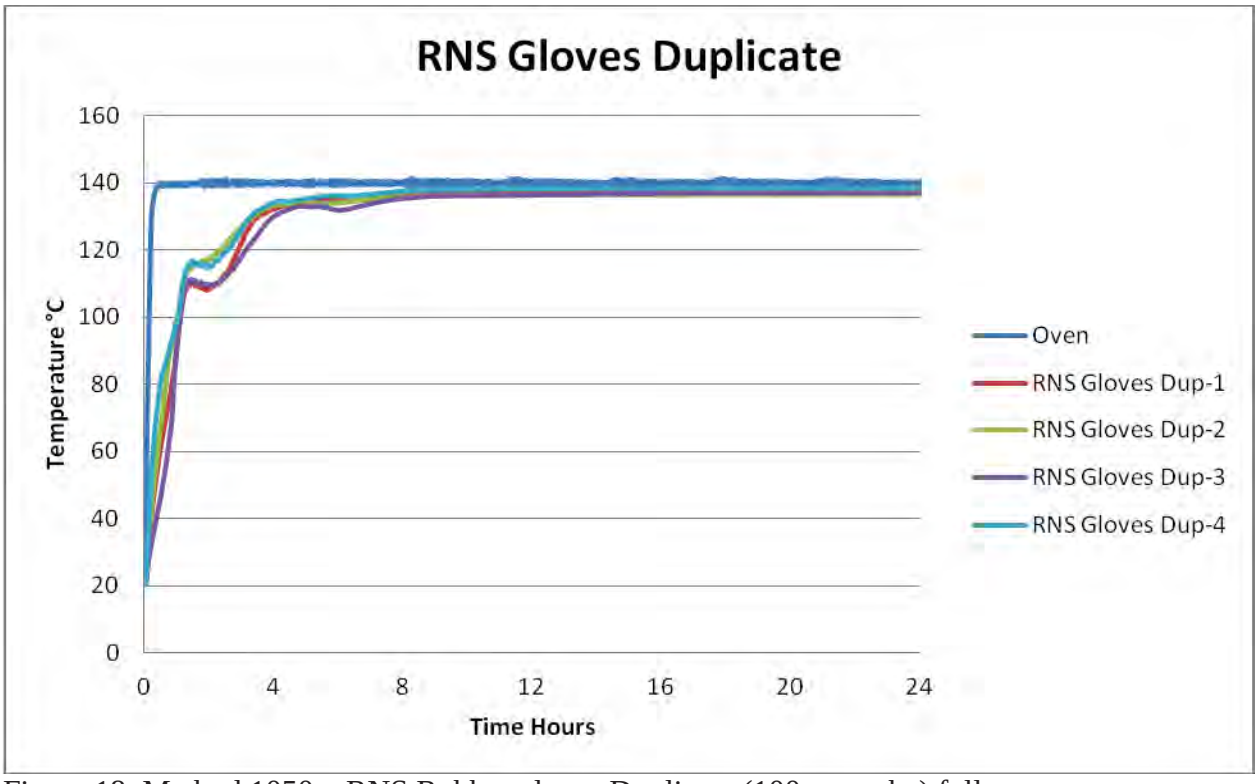


Figure 18. Method 1050 – RNS Rubber gloves Duplicate (100mm cube) full run.

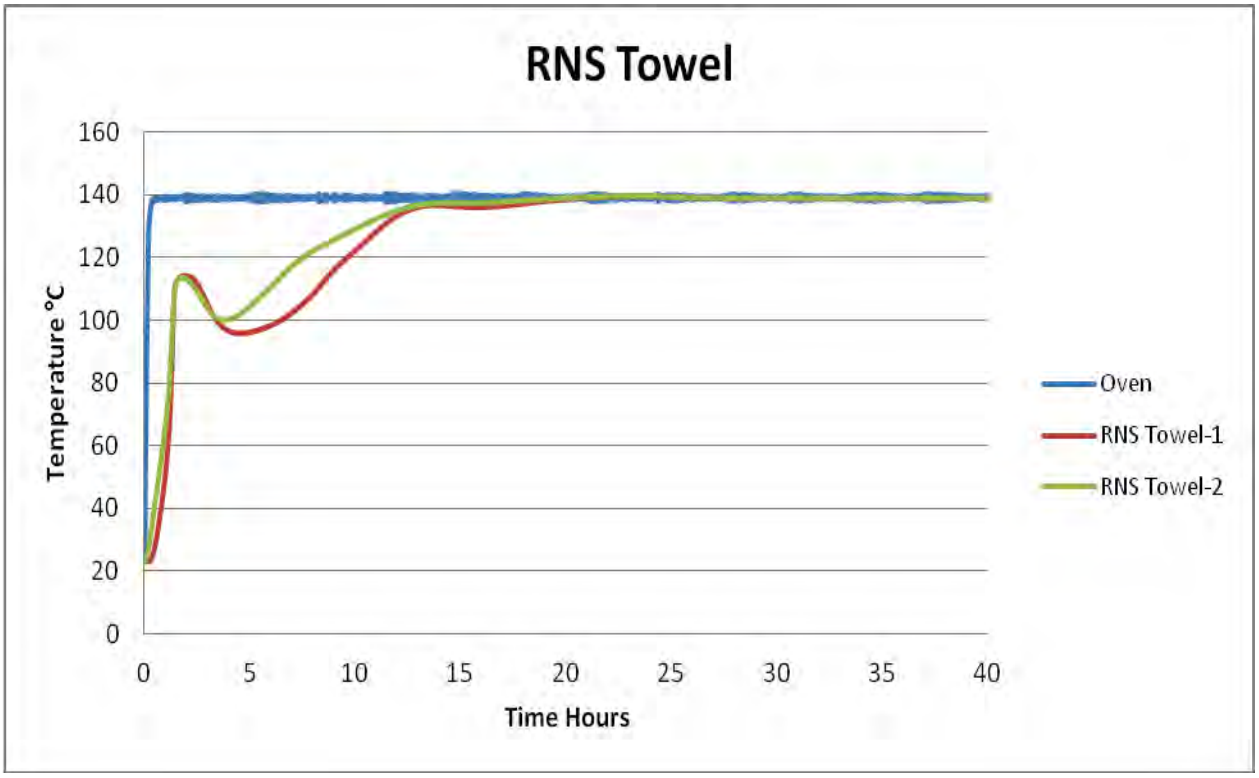


Figure 19. Method 1050 – RNS Towel (100mm cube) two thermocouples malfunctioned during this analysis which is why there are only two in the sample instead of the usual four.

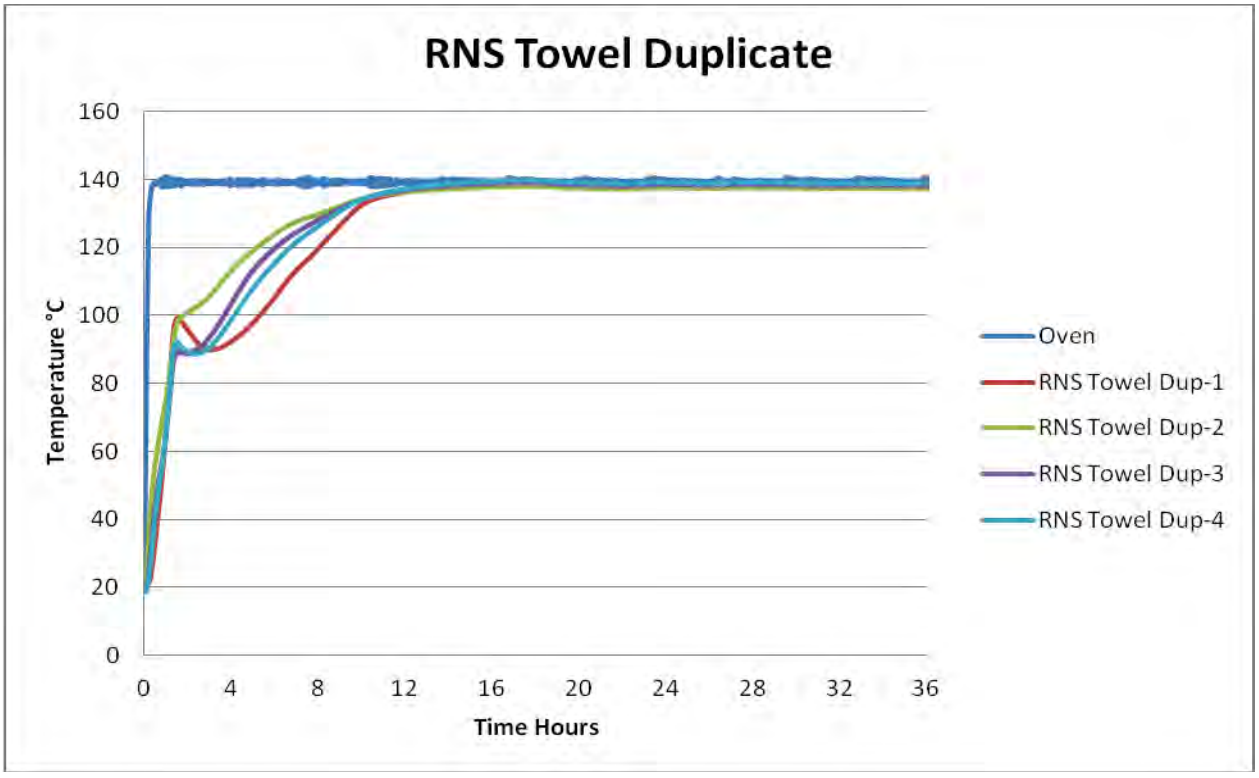


Figure 20. Method 1050 – RNS Towel Duplicate (100mm cube) full run.

010059

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

WETCHEM ANALYSES

010060

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

WETCHEM ANALYSES
Sample Results

SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET 010061

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 01/27/2016

SRR #: 56933, 56955

Task Order #: 160307-2

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
Cardboard Baseline	591439	Nonflammable	02/04/16
Plastic liner Baseline	591578	Nonflammable	02/04/16
Rubber Gloves Baseline	591577	Nonflammable	02/04/16
Towel Baseline	591580	Flammable with rate of 3.52mm/sec	02/04/16
UNS Cardboard	591439	Nonflammable	02/04/16
UNS Cardboard Dup	591439	Nonflammable	02/07/16
UNS Plastic Liner	591578	Nonflammable	02/04/16
UNS Plastic Liner Dup	591578	Nonflammable	02/07/16
UNS Rubber Gloves	591577	Nonflammable	02/04/16
UNS Rubber Gloves Dup	591577	Nonflammable	02/07/16
UNS Towel	591580	Nonflammable	02/04/16
UNS Towel Dup	591580	Nonflammable	02/07/16
RNS Cardboard	591439	Nonflammable	02/22/16
RNS Cardboard Dup	591439	Nonflammable	02/22/16
RNS Plastic Liner	591578	Nonflammable	02/22/16
RNS Plastic Liner Dup	591578	Nonflammable	02/22/16
RNS Rubber Glove	591577	Nonflammable	02/22/16
RNS Rubber Glove Dup	591577	Nonflammable	02/22/16
RNS Towel	591580	Nonflammable	02/22/16
RNS Towel Dup	591580	Nonflammable	02/22/16

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET 010062

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 01/27/2016

SRR #: 56933, 56955

Task Order #: 160307-2

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
Cardboard Baseline	591439	Not a self-heating waste	02/01/16
Plastic liner Baseline	591578	Not a self-heating waste	02/06/16
Rubber Gloves Baseline	591577	Not a self-heating waste	02/07/16
Towel Baseline	591580	Not a self-heating waste	02/08/16
UNS Cardboard	591439	Not a self-heating waste	02/03/16
UNS Cardboard Dup	591439	Not a self-heating waste	02/04/16
UNS Plastic Liner	591578	Not a self-heating waste	02/14/16
UNS Plastic Liner Dup	591578	Not a self-heating waste	02/15/16
UNS Rubber Gloves	591577	Not a self-heating waste	02/11/16
UNS Rubber Gloves Dup	591577	Not a self-heating waste	02/12/16
UNS Towel	591580	DOT Packing Group II	02/09/16, 02/10/16
RNS Cardboard	591439	Not a self-heating waste	02/16/16
RNS Cardboard Dup	591439	Not a self-heating waste	02/18/16
RNS Plastic Liner	591578	Not a self-heating waste	02/19/16
RNS Plastic Liner Dup	591578	Not a self-heating waste	02/20/16
RNS Rubber Glove	591577	Not a self-heating waste	02/24/16
RNS Rubber Glove Dup	591577	Not a self-heating waste	02/25/16
RNS Rubber Glove Trip	591577	Not a self-heating waste	02/28/16
RNS Towel	591580	Not a self-heating waste	02/22/16
RNS Towel Dup	591580	Not a self-heating waste	02/26/16

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SOUTHWEST RESEARCH INSTITUTE

SW846 9095 Paint Filter Liquids Test

SAMPLE DATA SHEET

010063

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 160307-2

Sample ID	SwRI System ID	Method 9095 *Paint Filter Results*	Date Analyzed
Blend 14	589460	No free liquids	02/09/16
Blend 15	589461	No free liquids	02/09/16
Blend 16	589462	No free liquids	02/09/16
Blend 17	589620	No free liquids	02/09/16
Blend 18	589621	No free liquids	02/09/16
Blend 19	589622	No free liquids	02/09/16
Blend 20	589623	No free liquids	02/09/16
Blend 21	589624	No free liquids	02/09/16
Blend 22	589625	No free liquids	02/09/16
Blend 23	589626	No free liquids	02/09/16
Blend 24	589627	No free liquids	02/09/16

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010064

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

WETCHEM ANALYSES

Method 1030

Logbook Pages

Book I.D. 16-0406-001 Book/ Page : 13 007

Southwest Research Institute®
Logbook: Physical Testing

010065

Analysis / Method: 1030 Project# 21592.01.006

Client: LANL TO# 160307-2

LCS Info: excelsior wood TV= positive Balance#: 5

Notes: 22.6°C RH= 14.3%

meter # 020417

Sample ID	glowing past beam point	propagated flame	flame	time	rate
LCS	Yes	Yes	Yes	8.94 sec	11.19 mm/sec
40.147g Cardboard both*	Yes	yes	yes	> 4 min 27 sec	
cardboard 1 piece	Yes ESAM 214116	No	Yes	- did not take to start point + seemed to just smolder & char.	
66.157g rubber gloves	~~Yes~~ No	NO	Yes	- flame maintained for several seconds after removal of torch **	
47.876g plastic	No	NO	Yes	- burnt for 3 sec after removing the torch. Charred and burnt around end of torch	
6.726g towel	Yes	Yes	Yes	28.40 sec	3.52 mm/sec
UNS cardboard	No	NO	slight	- sample mainly formed white substance on the outside after burning and cooling	
UNS towel	No	NO	No	- would shrivel and form white granules on the outside of the sample	
UNS plastic	NO	NO	yes	- maintained a flame 40 sec after removing the torch, blackening & charring	
UNS rubber	NO	NO	Yes	- flame was big when torch initially applied but flame went out when torch removed. Sample charred on test area	
* burned after flame was removed and burned faster when top piece lifted and allowed more oxygen in the system					
** burned quickly at the point of flame torch but not much further beyond that					

Calculation:

	dry	wet
UNS towel	7.177g	63.418
UNS cardboard	41.426	66.048
UNS rubber	65.710	76.766
UNS plastic	44.471g	51.853

Analyst Signature: Date: 2/4/16

Reviewed by: Date: 3/1/16

Book I.D. 16-0406-001 Book/ Page : 13 0010

Southwest Research Institute®
Logbook: Physical Testing

010066

Analysis / Method: 1030 Project# 21542.01.002

Client: LANL TO# 160307-2

LCS Info: excelsior wood TV= positive Balance#: 5

Notes:

22.9°C RH= 23.4%

meter ID: 020917

Sample ID	glowing past burn point	propagation of flame	flame	time	rate
LCS	Yes	Yes	Yes	10.45	9.57 mm/sec
UNS towel D	No	NO	No	- turned a white crust at the burn point no flame or burning. - sample smoldered after torch removed	
UNS gloves D	NO	NO	No	- black smoke released during entirety of only 5	
UNS cardboard D	No	No	Yes	- flame burst for 7 sec after torch removed - charred at burn area	
UNS plastic D	No	NO	Yes	- flame maintained 15 sec after removing torch. Sample chared and burned only at flame administered point	
	wgt dry	wgt soaked			
towel	7.498	64.245			
gloves	48.134	56.899			
cardboard	39.919	63.495			
plastic	50.384	59.985			

Calculation:

Analyst Signature: [signature] Date: 2/7/16

Reviewed by: [signature] Date: 3/1/16

Book I.D. 16-0406-001 Book/ Page : 13 0019

Southwest Research Institute®
Logbook: Physical Testing

010067

Analysis / Method: 1030 Project# 21592.01.006

Client: LANL TO# 160307-2

LCS Info: excelsior wood TV= positive Balance#: 5

Notes:

Sample ID	glowing post burn point	propagation of flame	flame	time	rate
LCS	Yes	Yes	Yes	11.91 sec	8.40 mm/sec
RNs plastic	No	No	Yes	Burned up to tip after removing flame.	
RNs plastic D	No	No	Yes	Bubbled up from nitrates but no propagation.	
RNs Rubber	No	No	No	could hear sample crackling during analysis. Did not flame after removing torch.	
RNs Rubber D	No	No	No		
RNs towel	No	No	No	the moisture of the towel most likely prevented burning. Sample browned and charred. No propagation.	
RNs towel D	No	No	No		
RNs cardboard	No	No	Yes	Burned up to 7 seconds after removing the torch. Bubbled up and heard popping during analysis. No propagation.	
RNs cardboard D	No	No	Yes		

		initial wgt	wet wgt
	RNs plastic	23.341	39.504
	RNs plastic D	25.760	41.616
	RNs Rubber	38.292	57.059
	RNs Rubber D	37.155	53.874
	RNs towel	4.165	88.569
	RNs towel D	4.752	90.415
	RNs cardboard	39.658	56.190
	RNs cardboard D	43.715	64.251

Calculation:

Analyst Signature: Date: 2/22/16

Reviewed by: Date: 3/8/16

010068

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

WETCHEM ANALYSES

Method 1050

Logbook Pages

Southwest Research Institute®
Logbook: Physical Testing

010069

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 166307-2

LCS Info: TV= Balance#: 5

Notes:

Sample ID					
cardboard baseline		Start: 14:16	2/1/16	stop: 14:50	2/2/16
balance #5	start wgt: 542.10g		final wgt: 525.79		
Sample heated up to temperature in 6 hours and then remained @ 140°C for the remainder of the test. The sample lost 16grams during the test. Sample is considered not to be self heating.					
LANS cardboard	soak start: 5:50		2/3/16	drain start: 7:55	2/3/16
	Soak stop: 7:54 2/3/16			drain stop: 8:55 2/3/16	
	test start: 4:07 2/3/16			stop time: 10:52 2/4/16	
initial wgt dry all trials: 567.77g					
initial wgt soaked trials in cube: 738.74g					
trials not used wgt: 157.35.7g					
final wgt dry of test trials 482.50g					
Sample came to temperature in about 5 hours. all thermocouples exceeded 140oc by as much as 7°C but eventually came back down to 140°C. Sample appeared to be a little more brittle and flakier than the baseline cardboard. Sample is considered to not be self heating. Duplicate needs to be run.					

Calculation:

Analyst Signature: Date: 2/1/16

Reviewed by: Date: 3/1/16

Southwest Research Institute®
Logbook: Physical Testing

010070

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160307-2

LCS Info: TV= Balance#: 5

Notes:

Sample ID					
UNS cardboard duplicate		soak start: 9:20 2/4/16		drain start: 11:25 2/4/16	
		soak stop: 11:20 2/4/16		drain stop: 12:25 2/4/16	
balance #5		test start: 12:39 2/4/16		stop: 6:30am 2/6/16	
initial wgt dry: 583.69 g					
initial wgt soaked tials in cube: 802.93 g					
tials soaked not used wgt: 129.207 g					
final wgt tials used after analysis: 533.379 g					
Sample ran pretty similarly to the initial run. reaching temperature in about 5 hours. Sample initially exceeded 140°C by as much as 3°C before retuning to 140°C and remaining there throughout analysis. Sample is considered to be not self heating.					
plastic liner baseline		start: 7:22 2/16/16		stop: 8:08 2/4/16	
Balance #5 initial wgt: 415.059 TESAM 2/4/16					
final wgt: 409.475					
Sample shrunk in size during analysis and gained a slight yellow/tan brown discoloration. also slight melting. Sample came to temperature and held there throughout the analysis. Not considered to be self heating.					
Calculation:					

Analyst Signature: Date: 2/4/16

Reviewed by: Date: 3/1/16

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Southwest Research Institute®
Logbook: Physical Testing

010071

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160307-2

LCS Info: TV= Balance#: 5

Notes:

Sample ID					
Gloves baseline		start: 9:03 2/7/16	stop: 16:54 2/8/16		
initial wgt: 523.93		balance #5			
final wgt: 522.29					
Sample came to temperature in about 4 hours and then remained at an elevated temperature of 144°C throughout the analysis. Sample stirred just slightly but little charge was noted. Sample is considered to be not self heating.					
towel baseline		start: 17:06 2/8/16	stop: 17:21 2/9/16		
initial wgt: 92.742g (2 TEW 2/8/16)		balance #5			
final wgt: 88.659g					
Sample came to temperature fairly quickly and held there throughout the analysis. Sample came out slightly discolored and not as thingy as when it went in. Sample is considered to be not self heating.					
Calculation:					

Analyst Signature: Date: 2/7/16

Reviewed by: Date: 3/1/16

Southwest Research Institute®
Logbook: Physical Testing

010072

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160307-2

LCS Info: TV= Balance#: 5

Notes:

Sample ID					
LLNS towel	100mm	soak start:	11:40 2/9/16	start:	13:55 2/9/16
balance #5		soak stop:	13:45 2/9/16	stop:	6:39 2/10/16
initial wgt dry:	97.122				
initial wgt soaked:	669.19				
final wgt:	869.399				
Sample took	some time to	increase in temperature	due to the large	amount	
of liquid present. About		11 hours into the analysis	the sample had an event		
that caused temps to spike well above 600°C. Once removed from the oven some					
of the towel was ejected from an event and some of it appeared to be sealed.					
The sample was brittle and crumbled easily. Perform analysis using					25mm cubes.
LLNS towel	25mm	Soak start:	9:30 2/10/16	start:	11:57 2/10/16
balance #5		Soak stop:	11:30 2/10/16	stop:	15:51 2/10/16
initial wgt dry:	4.134				
initial wgt soaked:	26.313	As sample was coming to temperature an			
final wgt:	2.902	event occured at around 100°C. At this point			
the sample went up to		about 540°C. Since the sample exceeded 200°C			
on both the 100mm and		25mm cubes	the sample is considered to be a		
DOT Packing Group II					
Calculation:					

Analyst Signature: Date: 2/9/16

Reviewed by: Date: 3/8/16

Book I.D. 16-0406-001 Book/ Page : 13 0014

Southwest Research Institute®
Logbook: Physical Testing

010073

Analysis / Method: 1050 Project# 21542.01.0010

Client: LANL TO# 160307-2

LCS Info: TV= Balance#: 5

Notes:

Sample ID					
UNS Gloves 100mm		soak start: 9:20 2/11/16	drain start: 11:25 2/11/16		
Initial wgt: 582.02		soak stop: 11:20 2/11/16	drain stop: 12:25 2/11/16		
Soaked wgt: 619.94			start time: 12:49 2/11/16		
after test wgt: 581.737			stop time: 13:04 2/12/16		
Sample did not seem to increase in temperature after reaching 140°C. Data was lost between 18 hr & 23 hours Because sample after all other samples analyzed, became a hardened mass with solidified packets of nitrate.					
UNS Gloves dup		soak start: 10:40 2/12/16	drain start: 12:47 2/12/16		
initial wgt: 571.95		soak stop: 12:40 2/12/16	drain stop: 13:47 2/12/16		
Soaked wgt: 619.24			start time: 14:04 2/12/16		
after test wgt: 570.65			stop time: 8:12 2/14/16		
Sample came up to temperature in about 7 hours and remained at temperature for the remainder of the analysis. The sample formed a hardened mass and the nitrate was not as runny as it initially began. Sample is considered to be not self heating.					
Calculation:					

Analyst Signature: Date: 2/11/16

Reviewed by: Date: 3/8/16

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Southwest Research Institute®
Logbook: Physical Testing

010074

Analysis / Method: 1050 Project# 21542.01.006

Client: LANL TO# 160307-2

LCS Info: TV= Balance#: 5

Notes:

Sample ID					
UNS Plastic		Soak start:	8:15 2/14/16	drain start:	10:23 2/14/16
initial wgt: 406.346		Soak stop:	10:15 2/14/16	drain stop:	11:23 2/14/16
Soaked wgt: 458.221			start: 11:41	2/14/16	
after test wgt: 413.73			stop: 12:10	2/15/16	
Sample came to temperature in around 6 hours and remained at temperature throughout the analysis. Sample went from a clear plastic bottle to a darkened charred plastic sheet with a little bit of the texture. Sample is considered to be not self heating.					
UNS plastic duplicate					
initial wgt: 533.901		Soak start:	12:10	drain start:	14:20
soaked wgt: 600.850		Soak stop:	14:10	drain stop:	15:20
after test wgt: 543.155			start: 15:35	2/15/16	
			stop: 15:35	2/16/16	
Sample came to temperature in about 6 hours. Sample slightly rose above 140°C but came back down to temperature several hours later. As with the initial run the duplicate came out of the analysis as a blackened solid plastic mass. Since temperature did not exceed 200°C and no event appeared to occur, the Sample is considered to be not self heating.					
Calculation:					

Analyst Signature: Date: 2/14/16

Reviewed by: Date: 3/8/16

Southwest Research Institute®
Logbook: Physical Testing

010075

Analysis / Method: 1050 Project# 21542.01.006

Client: LANL TO# 160307-2

LCS Info: TV= Balance#: 5

Notes:

James Mah 2/17/16

RNS Cardboard

Start:	02/16/16 17:32	Initial wgt:	421.69
Stop:	02/17/16 17:37	Wet wgt:	606.47
		After test wgt:	502.80

Sample seemed to mainly soak up the WB8 mixture out of the kitty litter. Small portions of the kitty litter remained on the sample after tapping the loose material off. Sample came up to temperature in about 10 hours. After removing the sample from the oven it was seen that the WB8/kitty litter mixture had expanded on and between the carboard pieces. At no time during the test did the sample exceed 200°C therefore, the sample is considered to be not self heating.

James Mah 2/19/16

RNS Cardboard Duplicate

Start:	02/18/16 8:11	Initial wgt:	392.38
Stop:	02/19/16 8:25	Wet wgt:	561.29
		After test wgt:	456.55

Sample seemed to mainly soak up the WB8 mixture out of the kitty litter. Small portions of the kitty litter remained on the sample after tapping the loose material off. Sample came up to temperature in about 10 hours. After removing the sample from the oven it was seen that the WB8/kitty litter mixture had expanded on and between the carboard pieces. At no time during the test did the sample exceed 200°C therefore, the sample is considered to be not self heating.

Calculation:

Analyst Signature: James Mah Date: 2/17/16 17 WD SAM 2/17/16

Reviewed by: J Rapp Date: 3/8/16

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Southwest Research Institute®
Logbook: Physical Testing

010076

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160307-2

LCS Info: TV= Balance#: 5

Notes:

James Mohr 2/20/16

RNS Plastic

Start: 02/19/16 10:18
Stop: 02/20/16 11:04

Initial wgt: 358.67
Wet wgt: 589.34
After test wgt: 467.91

When intially pressing the waste into the sample it became moist and portions of the WB8/kitty litter mixture stuck to the surface after gently wiping off. Sample came to temperature in about 9 hours, slightly exceeded 140°C and then returned to temperature for the remainder of the test. After testing the sample felt slightly moist and flimsy. SInce the sample did not exceed 200°C during the analysis it is considered to be not self heating.

James Mohr 2/22/16

RNS Plastic Duplicate CISAM 2/22/16

Start: 02/20/16 13:27
Stop: 02/22/16 6:43

Initial wgt: 329.21
Wet wgt: 584.94
After test wgt: 443.50

When intially pressing the waste into the sample it became moist and portions of the WB8/kitty litter mixture stuck to the surface after gently wiping off. Sample came to temperature in about 9 hours, slightly exceeded 140°C and then returned to temperature for the remainder of the test. After testing the sample felt slightly moist and flimsy. SInce the sample did not exceed 200°C during the analysis it is considered to be not self heating.

Calculation:

Analyst Signature: James Mohr Date: 2/20/16

Reviewed by: [signature] Date: 3/8/16

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Southwest Research Institute®
Logbook: Physical Testing

010077

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160367-2

LCS Info: TV= Balance#: 5

Notes: James Mark 2/24/16

RNS Towel

Start: 02/22/16 10:55
Stop: 02/24/16 6:35

Initial wgt: 62.452
Wet wgt: 654.75
After test wgt: 356.19

When initial impregnating the sample with the waste the sample primarily obsorbed the WB8 and some residual kitty litter remained on the towels. In order to keep a consitant sample mixture several small batches of 400mL WB8 to 400mL of swheat were made. During the analysis the sample took about 22 hours to get to temperature. Once at temperature it remained there for the remainder of the analysis. After testing the sample had formed a hardened cube and did not expand much unlike some of the other RNS waste. Since the sample did not exceed 200°C during the analysis and did not appear to have had an event the sample is considered to be not self heating.

James Mark 2/25/16

RNS Gloves

Start: 02/24/16 12:14
Stop: 02/25/16 13:17

Initial wgt: 351.39
Wet wgt: 601.88
After test wgt: 462.30

When initially impregnated the sample had a moist surface with small amounts of kitty litter holding onto the surface. The sample came to temperature in about 12 hours and remained at temperature for the remainder of the test. After testing the sample had expanded through the top lid and formed the foam like material seen in prior moist WB8/swheat mixtures. The sample did not exceed 200°C during the testing and did not appear to have any significant event occur. The sample is considered to be not self heating.

Calculation:

Analyst Signature: James Mark Date: 2/24/16

Reviewed by: RDM Date: 3/8/16

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Southwest Research Institute®
Logbook: Physical Testing

010078

Analysis / Method: 1050 Project# 21542.01.006

Client: LANL TO# 160307-2

LCS Info: TV= Balance#: 5

Notes:

James Grau 2/26/16

RNS Gloves Duplicate

Start: 02/25/16 14:41

Stop: 02/26/16 15:28

Initial wgt: 340.95

Wet wgt: 552.88

After test wgt: 426.32

When initially impregnated the sample had a moist surface with small amounts of kitty litter holding onto the surface. The sample came to temperature in about 8 hours and remained at temperature for the remainder of the test. After testing the sample had expanded through the top lid and formed the foam like material seen in prior moist WB8/swheat mixtures. The sample did not exceed 200°C during the testing and did not appear to have any significant event occur. The sample is considered to be not self heating.

James Grau 2/28/16

RNS Towel Dulicate

Start: 02/26/16 17:10

Stop: 02/28/16 7:54

Initial wgt: 60.41

Wet wgt: 605.11

After test wgt: 322.95

When initial impregnating the sample with the waste the sample primarily obsorbed the WB8 and some residual kitty litter remained on the towels. In order to keep a consitant sample mixture several small batches of 400mL WB8 to 400mL of swheat were made. During the analysis the sample took about 15 hours to get to temperature. Once at temperature it remained there for the remainder of the analysis. After testing the sample had formed a hardened cube and did not expand much unlike some of the other RNS waste. Since the sample did not exceed 200°C during the analysis and did not appear to have had an event the sample is considered to be not self heating.

Analyst Signature: James Grau Date: 2/26/16

Reviewed by: RDJ Date: 3/8/16

Book I.D. 16-0406-001 Book/ Page : 13 0022

Southwest Research Institute®
Logbook: Physical Testing

010079

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160307-2

LCS Info: TV= Balance#: 5

Notes:

3/11/16

UNS Glove Triplicate

Soak Start:	02/28/16 9:20
Soak Stop:	02/28/16 11:20
Drain Start:	02/28/16 11:35
Drain Stop:	02/28/16 12:35
Start:	02/28/16 12:52
Stop:	03/01/16 11:09

Initial wgt:	547.26
Wet wgt:	579.85
After test wgt:	546.85

Sample came to temperature in about 6 hours and remained at temperature for the remainder of the analysis. After analysis the sample had formed a hardened mass that was not nearly as flimsy as when the test was initiated. Since the sample did not exceed 200°C during the analysis and did not seem to have any events occur the sample is deemed to be not self heating.

JAM 3/11/16

Calculation:

Analyst Signature: Date: 3/11/16

Reviewed by: Date: 3/8/16

010080

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

WETCHEM ANALYSES

Method 9095B

Logbook Pages

Book I.D. 16-0406-001 Book/ Page : 13 0012

Southwest Research Institute®
Logbook: Physical Testing

010081

Analysis / Method: Paint filter Project# 21592.01.006

Client: LANL TO# 160307-2

LCS Info: DI H2O TV=positive Balance#: ~~135~~ TESAM 2/9/16 135

Notes:

Sample ID	Sample Vol / wgt	pass through	positive or negative		
LCS	100ml	Yes	positive		
Blend #14	100.4005g	No	negative		
Blend #15	100.7147g	No	negative		
Blend #16	100.2151	No	negative		
Blend #17	100.3722	No	negative		
Blend #18	100.1123	No	negative		
Blend #18D	100.2711	No	negative		
Blend #19	100.6191	No	negative		
Blend #20	100.4271	No	negative		
Blend #21	100.3177	No	negative		
Blend #22	100.1776	No	negative		
Blend #23	100.7177	No	negative		
Blend #24	100.3714	No	negative		
Calculation:					

Analyst Signature: Date: 2/9/16

Reviewed by: Date: 3/8/16

010082

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

WETCHEM ANALYSES
Preparation Logbook

154 TITLE WB8

PROJECT NO. —

BOOK NO. 15-0406-021

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SWRI

010083

154-01-WCS11 TI WB8

✓ 110.7773 g $AlNO_3$ (#54983) +
✓ 440.541 g $CaNO_3$ (#36657) +
✓ 5.422 g $CrNO_3$ (#61751) +
✓ 168.273 g $FeNO_3$ (# 61136) +
✓ 1236.380 g $MgNO_3$ (# 63069) +
✓ 274.090 g $NaNO_3$ (# 33384) +
✓ 97.304 g $PbNO_3$ (# 61750)

all mixed on 10/20/15 by bernie.

52.16 g potassium carbonate (#61752) +
✓ 149.05 g water +
✓ 99.99 g oxalic acid (#47355)

154-02-WCS11 1:1 WB8 : SWheat

750mL WB8 to 750mL SWheat

154-03-WCS11 1:3 WB8 : SWheat

400mL WB8 to 1200mL SWheat

154-04-WCS11 1:4 WB8 : SWheat

300mL WB8 to 1200mL SWheat

all WB8 used is from above. Placed into pans and covered with Saranwrap with holes punch in it. Placed onto hotblock @ 60°C at 18:00 on 10/22/15 The 1:3 & 1:4 were taken off the hotplate after 20 hours of being on, this was done because at 16 hours they were not entirely crispy. The 1:1 was still moist after 48 hours after being placed on the hotplate. It was placed into oven #31 @ 60°C on 10/25/15 @ 9:45am.

Work continued to Page

SIGNATURE James Mor **DATE** 10/22/15

DISCLOSED TO AND UNDERSTOOD BY Carolyn Klemer **DATE** **WITNESS** **DATE** 10/26/15

40-01-WC512 - TISAB3

37.0315 g KCl (# 60103) +
68.0469 g sodium acetate (# 57005) +
36.0085 g CDTA (# 63100)
to F.V. 1000mL with DI H_2O Adjust pH to 5.5±0.2 with NaOH
balance #34 exp 2/2/17

40-02-WC512 URNS Liquid

$Al(NO_3)$	1387.10	g (# 65580) +
$Ca(NO_3)$	140.1092	g (# 60383) +
$Cr(NO_3)$	10.3012	g (# 61751) +
$Fe(NO_3)$	99.2068	g (# 65581) +
$Mg(NO_3)$	668.10	g (# 65590) +
$NaNO_3$	82.3075	g (# 33383) +
$Ni(NO_3)$	0.4031	g (# 65593) +
$Pb(NO_3)$	99.4642	g (# 66142) +
Oxalic acid	395.604	g (# 65591) +
water	106.904	g +
HNO_3	10.6	g (# 62992)

add 1100 mL DI H_2O

SAM 2/2/16

SIGNATURE James Mack DATE 2/2/16

DISCLOSED TO AND UNDERSTOOD BY R Dyer DATE WITNESS DATE 3/8/16

Work continued from Page

010085

SWRI

42-01-WCS12 1:1 salt solvent to water

mix 1 part volume to 1 part volume increments of 1:1 salt solvent (15H-02-WCS11) to water and mix for 5 minutes

42-02-WCS12 Blend #14

40mL of 42-01-WCS12 to 120mL zeolite let sit for 24hr

42-03-WCS12 Blend #17

50mL of 42-01-WCS12 to 100mL zeolite let sit for 24 hours

42-04-WCS12 1:3 salt solvent to water

mix 1 part volume to 1 part volume of 1:3 salt to solvent (#206-01-WCS11) to water and mix for 5 minutes

42-05-WCS12 Blend #15

40mL of 42-04-WCS11 to 120 mL zeolite let sit for 24 hr

42-06-WCS12 Blend #18

50mL of 42-04-WCS11 to 100mL zeolite and let sit for 24hr

42-07-WCS12 Blend #20

make a 2:1 water to salt 1:1 solvent (15H-01-WCS11). take 50mL of this mixture and add it to 100 mL zeolite let sit for 24hr

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SIGNATURE DATE 2/18/16

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 3/8/16

SWRI

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010086

43-01-WCS12 1:4 salt subset to water

mix 1part volume to 1part volume of 1:1 salt subset (206-02-WCS11) to water and mix for 5 minutes

43-02-WCS12 Blend # 16

40mL of 43-01-WCS12 to 120mL zeolite let sit for 24 hours

43-03-WCS12 Blend #19

50mL of 43-01-WCS12 to 100mL zeolite let sit for 24 hour

43-04-WCS12 2:1 salt subset to water

mix 1part volume to 2part volume of 2:1 salt subset (4-02-WCS12) to water and mix for 5 minutes

43-05-WCS12 Blend # 23

40mL of 43-04-WCS12 to 120mL zeolite let sit for 24hours

43-06-WCS12 Blend #24

50mL of 43-04-WCS12 to 100mL zeolite let sit for 24hours

43-07-WCS12 Blend # 21

make a 2:1 water to 1:3 salt subset (206-01-WCS11) mixture & mix for 5 min. Take 50mL of this & add it to 100mL zeolite. let sit for 24 hr

43-08-WCS12 Blend #22

make a 2:1 water to 1:4 salt subset (206-02-WCS11) mixture & mix for 5 min. Take 50mL of this & add it to 100mL zeolite let sit for 24 hr

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SIGNATURE [signature] DATE 2/8/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 3/8/16

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010087 SWRI

51-01-WCS12 1:1 WB8 : Sulfuric

800mL WB8 (29-02-WCS12) to 800mL Sulfuric

51-02-WCS12 0.25N NaOH

20.0847 g NaOH (#62694) to F.V. 2L with DI H_2O
balance # 135 exp 2/16/17 WD JAM 2/16/16

51-03-WCS12 1% Nitric

10mL Nitric acid (#62341) to F.V. 1L with DI H_2O
exp 2/16/17

JAM 2/17/16

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SIGNATURE

DATE 2/16/16

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE 3/8/16

Work continued from Page

010088 SWRI

53-01-WCS12 WD8

A	aluminum nitrate	(# 65580)	84.1155	g +
	calcium nitrate	(# 63613)	334.5127	g +
	chromium nitrate	(# 63857)	4.1154	g +
	Iron nitrate	(# 63604)	127.7624	g +
	Magnesium nitrate	(# 65590)	938.782	g +
	Sodium nitrate	(# 33383)	208.1237	g +
	Lead nitrate	(# 66142)	73.8851	g

bal #34

B	oxalic acid	(# 65591)	75.9231	g +
	potassium carbonate	(# 63914)	39.6052	g +
	water		113.1871	g

add A + B

JAM 2/18/16

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SIGNATURE DATE 2/18/16

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 2/18/16

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010089 SWRI

57-01-WC512 WB8

A	aluminum nitrate (# 65579)	84.1197	g	+
	calcium nitrate (# 65736)	334.5174	g	+
	chromium nitrate (# 63857)	4.1159	g	+
	iron nitrate (# 63604)	127.7654	g	+
	magnesium nitrate (# 65737)	938.781	g	+
	sodium nitrate (# 33383)	208.1217	g	+
	lead nitrate (# 66142)	73.8882	g	

bwl #34

B	oxalic acid (# 65591)	75.92 ~~92~~ TESAM 2/22/16	g	+
	potassium carbonate (# 63914)	39.6017	g	+
	water	113.18	g	

mix A & B together

JAM 2/22/14

SIGNATURE [signature] DATE 2/22/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 3/18/16

010090

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

WETCHEM ANALYSES

D.I. Water

&

Balance Verification Logs

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

010091

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
1/18/16 1820	DRm2	17.96	✓	✓	✓	n/a	✓
1/19/16 1831	DRm2	17.95	✓	✓	✓	n/a	✓
1/20/16 2001	DRm2	17.96	✓	✓	✓	n/a	✓
1/21/16 1840	DRm2	17.96	✓	✓	✓	n/a	✓
1/22/16 1710	DRm2	17.96	✓	✓	✓	n/a	✓
1/25/16 1520	DRm2	17.94	✓	✓	✓	n/a	✓
1/26/16 1801	DRm2	17.95	✓	✓	✓	n/a	✓
1/27/16 1805	DRm2	17.94	✓	✓	✓	n/a	✓
1/28/16 1810	DRm2	17.94	✓	✓	✓	n/a	✓
1/29/16 1540	NS	17.94	✓	✓	✓	n/a	✓
2/1/16 1709	DRm2	17.92	✓	✓	✓	n/a	✓
2/2/16 1559	DRm2	17.92	✓	✓	✓	n/a	✓
2/3/16 1821	DRm2	17.91	✓	✓	✓	n/a	✓
2/4/16 1850	DRm2	17.92	✓	✓	✓	n/a	✓
2/5/16 2030	DRm2	17.90	✓	✓	✓	n/a	✓
2/8/16 1857	DRm2	17.90	✓	✓	✓	n/a	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
1/18/16 1821	DRm2	✓	✓ 18.0	37086.3	✓
1/19/16 1832	DRm2	✓	✓ 18.0	37087.6	✓
1/20/16 2003	DRm2	✓	✓ 18.0	37096.1	✓
1/21/16 1841	DRm2	✓	✓ 18.0	37099.5	✓
1/28/16 1711	DRm2	✓	✓ 16.0	37103.4	✓
1/25/16 1521	DRm2	✓	✓ 18.0	37106.1	✓
1/26/16 1803	DRm2	✓	✓ 16.0	37107.0	✓
1/27/16 1806	DRm2	✓	✓ 18.0	37107.4	✓
1/28/16 1811	DRm2	✓	✓ 17.5	37111.5	✓
1/29/16 1540	NS	✓	✓ 18	37110	✓
2/1/16 1711	DRm2	✓	✓ 18.0	37124.9	✓
2/2/16 1600	DRm2	✓	✓ 18.0	37126.8	✓
2/3/16 1821	DRm2	✓	✓ 18.0	37128.0	✓
2/4/16 1851	DRm2	✓	✓ 18.0	37145.1	✓
2/5/16 2031	DRm2	✓	✓ 18.0	37148.7	✓
2/8/16 1858	DRm2	✓	✓ 18.0	37153.7	✓

Legend: Check = Green (OK); X = Red (call for service)

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

010092

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS	
2/9/16 1820	DRmZ	17.90	✓	✓	✓	N/A	✓	
2/10/16 1840	DRmZ	17.90	✓	✓	✓	N/A	✓	
2/11/16 1650	DRmZ	17.90	✓	✓	✓	N/A	✓	
2/12/16 1758	DRmZ	17.90	✓	✓	✓	N/A	✓	
2/15/16 1820	DRmZ	17.89	✓	✓	✓	N/A	✓	DQA RL
2/16/16 1801	DRmZ	17.89	✓	✓	✓	N/A	✓	
2/17/16 1830	DRmZ	17.89	✓	✓	✓	N/A	✓	
2/18/16 1800	DRmZ	17.89	✓	✓	✓	N/A	✓	
2/19/16 1701	DRmZ	17.89	✓	✓	✓	N/A	✓	
2/22/16 1710	DRmZ	17.89	✓	✓	✓	N/A	✓	
2/23/16 1800	DRmZ	17.89	✓	✓	✓	N/A	✓	
2/24/16 1702	DRmZ	17.89	✓	✓	✓	N/A	✓	
2/25/16 1750	DRmZ	17.89	✓	✓	✓	N/A	✓	
2/26/16 1920	DRmZ	17.88	✓	X	✓	N/A	exchange needed???	
2/29/16 1800	DRmZ	17.88	✓	X	✓	N/A	exchange needed	
3/1/16 1805	DRmZ	17.89	✓	X	✓	N/A	call placed.	

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS	
2/9/16 1821	DRmZ	✓	✓ 18.0	37160.8	✓	
2/10/16 1841	DRmZ	✓	✓ 18.0	3716 2.9	✓	
2/11/16 1651	DRmZ	✓	✓ 18.0	3716 4.1	✓	DQA RL
2/12/16 1757	DRmZ	✓	✓ 18.0	3716 5.0	✓	
2/15/16 1821	DRmZ	✓	✓ 18.0	3717 4.6	✓	
2/16/16 1802	DRmZ	✓	✓ 18.0	3717 6.0	✓	
2/17/16 1831	DRmZ	✓	✓ 18.0	3718 6.5	✓	
2/18/16 1801	DRmZ	✓	✓ 18.0	3719 2.2	✓	
2/19/16 1702	DRmZ	✓	✓ 18.0	3719 7.4	CARBON TANK exchanged	
2/22/16 1711	DRmZ	✓	✓ 18.0	3719 3.6	✓	
2/23/16 1801	DRmZ	✓	✓ 18.0	3720 0.3	✓	
2/24/16 1703	DRmZ	✓	✓ 18.0	3720 1.8	✓	
2/25/16 1751	DRmZ	✓	✓ 18.0	3720 2.4	✓	
2/26/16 1921	DRmZ	✓	✓ 18.0	3720 5.7	✓	
2/29/16 1801	DRmZ	✓	✓ 18.0	3721 2.4	✓	
3/1/16 1806	DRmZ	✓	✓ 18.0	3721 4.2	✓	

Legend: Check = Green (OK); X = Red (call for service)

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

010093

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
3/2/16 1840	DRm2	17.88	✓	X	✓	n/a	Pending service
3/3/16 1940	DRm2	17.89	✓	X	✓	n/a	Pending
3/4/16 1605	DRm2	17.89	✓	X	✓	n/a	Pending
3/7/16 2010	DRm2	17.89	✓	✓	✓	n/a	MIXED TANK exchanged
3/8/16 1702	DRm2	17.90	✓	✓	✓	n/a	✓
3/9/16 1813	DRm2	17.91	✓	✓	✓	n/a	✓
3/10/16 1815	DRm2	17.91	✓	✓	✓	n/a	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2		USAGE (GALS)	COMMENTS
3/2/16 1841	DRm2	✓	✓	18.0	37215.0	✓
3/3/16 1941	DRm2	✓	✓	18.0	37219.0	✓
3/4/16 1607	DRm2	✓	✓	18.0	37222.3	✓
3/7/16 2011	DRm2	✓	✓	18.0	37243.1	✓
3/8/16 1703	DRm2	✓	✓	18.0	37246.5	✓
3/9/16 1814	DRm2	✓	✓	18.0	37248.8	✓
3/10/16 1816	DRm2	✓	✓	18.0	37251.4	✓

Legend: Check = Green (OK); X = Red (call for service)

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010094

Book ID #: 11-0406-064

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
34	005420	Mettler	AG 245	Lab 42	4th 5th	210 g 41 g

Date	Operator	Asset# 015142 Std Wt. 200 g Tolerance: 199.9800-200.02000 g Recorded Wt. (g)	Asset# 015144 Std Wt. 2 g Tolerance: 1.99980-2.00020 g Recorded Wt. (g)	Asset# 015143 Std Wt. 0.02 g Tolerance: 0.01995-0.02005 g Recorded Wt. (g)
02/06/15	JW	199.9914	1.99991	0.02004
2/9/15	AM	199.9928	1.99991	0.02003
2/10/15	JCLL	199.9933	1.99990	0.01998
2/11/15	AM	199.9932	1.99993	0.01997
2/12/15	AM	199.9953	1.99996	0.02005
2-13-15	JT	199.9923	1.99986	0.02001
2-14-15	JT	199.9939	1.99986	0.01996
2/24/15	PW	199.9933	2.00000	0.02001
4/2/15 KE (IK)	KE	199.9978	1.99985	0.01999
4-3-15	MM	199.9971	2.00005	0.01996
4-20-15	KE	200.0000	1.99994	0.01995
6-9-15	KE	200.0016	1.99999	0.01996 WC 7/27/15 JCLL
7/27/15	JCLL	200.0024	1.99999	~~0.01999~~ 0.02001
10/27/15	KE	199.9995	1.99998	0.01997
11/2/15	JCLL	199.9994	1.99995	0.01999
11-16-15	KE	* 199.9980	* 2.00000	* 0.02001
1/28/16	MG	199.9994	2.00008	0.02004
2/2/16	SAM	199.9934	1.99993	0.02003
2/4/16	SAM	199.9941	1.99998	0.02003
2/18/16	SAM	199.9927	1.99995	0.02003
2/22/16	SAM	199.9942	1.99990	0.02002

Comments: * out for cal - used ANR 011998, 020641, and 012685 11/16/15 KE

DQA RL

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Division 01, Building 70
Inorganic's Balance Verification Log

010095

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
1/21/16	JAM	200.0000 *	1.99993	0.01997
1/22/16	JAM	199.9997 *	1.99997	0.01997
1/25/16	JAM	199.9997 *	1.99998	0.01996
1/26/16	JAM	199.9999 *	2.00001	0.02001
1/27/16	JAM	199.9994 *	1.99997	0.01999
1/28/16	JAM	199.9999 *	1.99994	0.01996
1/29/16	JAM	199.9998 *	1.99998	0.01997
1/30/16	JAM	199.9997 *	1.99999	0.02002
2/1/16	JAM	200.0000 *	2.00001	0.02000
2/2/16	JAM	199.9998 *	2.00000	0.02001
2/3/16	JAM	199.9994 *	1.99995	0.02000
2/4/16	JAM	199.9992 *	2.00000	0.02000
2/5/16	JAM	200.0001 *	1.99997	0.02001
2/6/16	JAM	199.9995 *	1.99998	0.01998
2/7/16	JAM	199.9998 *	1.99998	0.02004
2/8/16	JAM	199.9994 *	2.00000	0.01998
2/9/16	JAM	199.9997 *	2.00000	0.02001
2/10/16	JAM	199.9996 *	1.99998	0.02001
2/11/16	JAM	199.9999 *	1.99996	0.01997
2/12/16	JAM	199.9998 *	1.99996	0.02001
2/15/16	JAM	199.9997 *	2.00003	0.02004
2/16/16	JAM	199.9997	1.99999	0.02004

DQA-RAL

Comments: * 200g out for calibration using ID 015142 JAM 1/21/16

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010096

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
2/17/16	JAM	199.9993	1.99998	0.02001
2/18/16	JAM	199.9997	1.99998	0.02001
2/19/16	JAM	199.9998	2.00003	0.01999
2/20/16	JAM	199.9996	1.99999	0.01998
2/22/16	JAM	199.9995	1.99999	TESTM 2/22/16 ~~0.019~~ 0.02001
2/23/16	JAM	199.9995	1.99997	0.02000
2/24/16	JAM	199.9992	2.00002	0.02000
2/25/16	JAM	199.9995	2.00001	0.02002
2/26/16	JAM	199.9992	2.00004	0.02002
2/28/16	JAM	199.9994	1.99997	0.02003
2/29/16	JAM	199.9996	2.00003	0.02001
3/1/16	JAM	199.9996	2.00002	0.02000
3/2/16	JAM	200.0000	1.99998	0.01999
3/3/16	JAM	199.9995	1.99998	0.01997
3/4/16	JAM	199.9995	2.00001	0.01998
3/7/16	JAM	199.9999	2.00001	0.02002
3/8/16	JAM	199.9996	1.99998	0.02002

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010097

Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
1-25-16	KE	1999.95	2.000
1-26-16	KE	1999.93	2.000
1-27-16	KE	1999.92	2.000
1-28-16.	JK	1999.92	2.000
1-29-16.	JK	1999.91	2.000
1-30-16.	JK	1999.92	1.999
1-31-16.	JK	1999.95	1.999
KE 2-1-16 2-1-16 (RE)	KE	1999.94	2.001
2-2-16.	JK	1999.93	1.999
2-3-16.	JK	1999.90	1.999
2-4-16.	JK	1999.89	2.001
2-5-16.	JK	1999.89	2.000
2-6-16	SAM	1999.90	2.000
2-7-16	SAM	1999.89	2.000
2-8-16	SAM	1999.89	2.000
2-9-16.	JK	1999.87	1.999
2-10-16.	JK	1999.85	2.000
2-11-16.	JK	1999.89	1.999
2-12-16.	JK	1999.90	2.000
2/14/16	SAM	1999.93	2.000
2-15-16	KE	1999.94	2.000
2-16-16.	JK	1999.91	1.999

DQA RL

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010098

Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
2-17-16	JT	1999.90	1.999
2-18-16	JT	1999.92	1.999
2-19-16	JT	1999.94	1.999
2-20-16	JAM	1999.94	2.003
2-21-16	JT	1999.94	1.999
2-22-16	JAM	1999.94	1.999
2-23-16	JT	1999.96	1.999
2-24-16	KE	1999.93	1.999
2-25-16	JT	1999.92	2.001
2-26-16	JT	1999.91	1.999
2-28-16	KE	1999.95	1.998
2-29-16	KE	1999.95	2.000
3-1-16	JT	1999.95	1.999
3-2-16	JT	1999.93	2.000
3/3/16	JT JT	1999.96	2.004
3/4/16	JT JT	1999.93	2.002
3/7/16	JT JT	1999.96	2.000
3/8/16	JT	1999.96	1.999

Comments:

010099

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

WETCHEM ANALYSES
Equipment Certificates of Calibration

010100

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39984
Asset Number:	020014	Calibrated:	10/7/2015
Description:	BALANCE	Calibration Due:	10/7/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	72 °F / 49 %
Serial Number:	B338797310	Work Order #	403134943
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute

Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010102

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0002	0.0002	0.0006	Pass	33%
Left Rear		100.0003	0.0003		Pass	50%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0002	0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	80.00001				
2		80.00002				
3		80.00001				
4		80.00002				
5		80.00001				
6		80.00002				
7		80.00002				
8		80.00002				
9		80.00002				
10		80.00002				
Std Deviation		0.000005		0.00008	Pass	6%
< 220 g Range						
1	200	200.0001				
2		200.0000				
3		200.0002				
4		200.0001				
5		200.0002				
6		200.0001				
7		200.0002				
8		200.0002				
9		200.0002				
10		200.0002				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.06	Pass	0%
	8.00001	8.00002	0.01			Pass	3%
	15.99996	15.99995	-0.01			Pass	3%
	24.00005	24.00010	0.05			Pass	13%
	32.00000	32.00006	0.06			Pass	15%
	40.00002	40.00007	0.05			Pass	13%
	48.00003	48.00006	0.03			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

010103

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99998	56.00006	0.08	0.40	0.06	Pass	20%
	63.99999	64.00014	0.15			Pass	38%
	72.00002	72.00018	0.16			Pass	40%
	79.99998	80.00009	0.11			Pass	28%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.18	Pass	0%
< 220 g Range	20.0000	20.0001	0.1			Pass	25%
	40.0000	40.0000	0.0			Pass	0%
	60.0000	60.0001	0.1			Pass	25%
	80.0000	80.0001	0.1			Pass	25%
	100.0001	100.0000	-0.1			Pass	25%
	120.0001	120.0001	0.0			Pass	0%
	140.0001	140.0002	0.1			Pass	25%
	160.0001	160.0002	0.1			Pass	25%
	180.0001	180.0002	0.1			Pass	25%
	199.9999	200.0002	0.3			Pass	75%

END OF REPORT

010104

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	33590
Asset Number:	009065	Calibrated:	6/24/2015
Description:	BALANCE	Calibration Due:	6/24/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	PR2003DR	Temp./RH:	72 °F / 52 %
Serial Number:	1120351000	Work Order #	403132563
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001711	TROEMNER	50 G	WEIGHT CLASS 1	7/1/2015
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2015
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/12/2016
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/9/2015
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/7/2016
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010105

Work Order:	403132563	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	24-Jun-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit		Result	% Limit
Corner Load	grams	grams	grams	grams			
Left Front	1000	1000.000	0.000	0.006		Pass	0%
Left Rear		1000.000	0.000			Pass	0%
Right Rear		1000.000	0.000			Pass	0%
Right Front		1000.000	0.000			Pass	0%
Repeatability							
500 gram Range							
1	200	200.000					
2		200.000					
3		199.999					
4		200.001					
5		200.000					
6		200.000					
7		199.999					
8		200.000					
9		199.999					
10		200.000					
Std Deviation		0.0006		0.0020		Pass	30%
2000 gram Range							
1	1000	1000.00					
2		1000.00					
3		1000.00					
4		1000.00					
5		1000.00					
6		1000.00					
7		1000.00					
8		1000.00					
9		1000.00					
10		1000.00					
Std Deviation		0.000		0.006		Pass	0%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
500 gram Range	0.000	0.000	0.000	0.004	0.0014	Pass	0%
	50.000	50.000	0.000			Pass	0%
	100.000	100.001	0.001			Pass	25%
	150.000	150.002	0.002			Pass	50%
	200.000	200.000	0.000			Pass	0%

Southwest Research Institute
Calibration Laboratory
Measurement Report

010106

Work Order:	403132563	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	24-Jun-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing *(cont.)*	grams	grams	grams	grams	grams		
500 gram Range	250.000	250.001	0.001	0.004	0.0014	Pass	25%
	300.000	300.001	0.001			Pass	25%
	350.000	349.999	-0.001			Pass	25%
	400.000	400.000	0.000			Pass	0%
	450.000	449.998	-0.002			Pass	50%
	500.000	500.000	0.000			Pass	0%
Direct Weighing	0.00	0.00	0.00	0.01	0.006	Pass	0%
2000 gram Range	200.00	200.00	0.00			Pass	0%
	400.00	400.00	0.00			Pass	0%
	600.00	600.00	0.00			Pass	0%
	800.00	800.00	0.00			Pass	0%
	1000.00	1000.00	0.00			Pass	0%
	1200.00	1200.00	0.00			Pass	0%
	1400.00	1400.00	0.00			Pass	0%
	1600.00	1600.00	0.00			Pass	0%
	1800.00	1800.00	0.00			Pass	0%
	2000.00	2000.00	0.00			Pass	0%

END OF REPORT

010107

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	33589
Asset Number:	005420	Calibrated:	6/24/2015
Description:	BALANCE	Calibration Due:	6/24/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	AG245	Temp./RH:	72 °F / 52 %
Serial Number:	1116031935	Work Order #	403132562
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/1/2015
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/9/2015
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/21/2015
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/1/2015
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/6/2015
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/6/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/1/2015
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2015
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010109

Work Order:	403132562	Mfr:	Mettler	Technician:	RRV
Asset No:	005420	Model:	AG245	Type Data:	Found-left
Serial No:	1116031935	Type:	Balance	Cal Date:	24-Jun-15

Remarks: The balance has resulted in a <Pass?> at multiple test points. An external calibration was performed but it did not improve the results. Customer to determine if the results found meet their requirements

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Front		99.9997	-0.0003	0.0006	Pass	50%
Rear		99.9999	-0.0001		Pass	17%
Left		100.0004	0.0004		Pass	67%
Right		100.0002	0.0002		Pass	33%
Repeatability						
< 41 g Range						
1	20	20.00000				
2		20.00001				
3		20.00000				
4		19.99999				
5		20.00000				
6		20.00000				
7		19.99999				
8		19.99999				
9		20.00000				
10		20.00001				
Std Deviation		0.000007		0.000040	Pass	18%
Repeatability						
< 205 g Range						
1	100	100.0000				
2		100.0000				
3		100.0001				
4		99.9999				
5		99.9999				
6		100.0000				
7		100.0000				
8		100.0000				
9		99.9999				
10		99.9999				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
< 41 g Range	0.00000	0.00000	0.00000	0.00006	0.000057	Pass	0%
	4.00003	4.00000	-0.00003			Pass	50%
	8.00001	7.99999	-0.00002			Pass	33%
	12.00000	11.99999	-0.00001			Pass	17%
	15.99998	15.99998	0.00000			Pass	0%

Southwest Research Institute
Calibration Laboratory
Measurement Report

010110

Work Order:	403132562	Mfr:	Mettler	Technician:	RRV
Asset No:	005420	Model:	AG245	Type Data:	Found-left
Serial No:	1116031935	Type:	Balance	Cal Date:	24-Jun-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
< 41 g Range *(Cont)*	20.00002	19.99999	-0.00003			Pass	50%
	24.00005	24.00002	-0.00003	0.00006	0.000057	Pass	50%
	28.00003	27.99998	-0.00005			Pass?	83%
	32.00002	31.99998	-0.00004			Pass?	67%
	36.00000	35.99997	-0.00003			Pass	50%
	40.00002	40.00000	-0.00002			Pass	33%
< 205 g Range	0.0000	0.0000	0.0000	0.0004	0.00020	Pass	0%
	20.0000	19.9999	-0.0001			Pass	25%
	40.0000	40.0000	0.0000			Pass	0%
	59.9999	60.0000	0.0001			Pass	25%
	80.0000	79.9999	-0.0001			Pass	25%
	100.0001	100.0000	-0.0001			Pass	25%
	120.0001	120.0001	0.0000			Pass	0%
	140.0001	140.0001	0.0000			Pass	0%
	160.0000	159.9998	-0.0002			Pass	50%
	180.0001	179.9998	-0.0003			Pass	75%
	199.9999	199.9998	-0.0001			Pass	25%

END OF REPORT

010111

Southwest Research Institute

Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	46011
Asset Number:	018344	Calibrated:	2/1/2016
Description:	OVEN	Calibration Due:	2/1/2017
Manufacturer:	THERMO SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	HERATHERM OMS60	Temp./RH:	70 °F / 42 %
Serial Number:	41241291	Work Order #	403137157
Calibration Procedure:	OVENS, CHAMBERS, INCUBA		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
015454	HART SCIENTIFIC	5627A	THERMOMETER PRT	2/18/2016
018495	FLUKE	1523	TEMPERATURE METER	2/18/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010112

Work Order:	403137157	Mfr:	Thermo Scientific	Technician:	RRV
Asset No:	018344	Model:	Heratherm OMS60	Type Data:	Found-left
Serial No:	41241291	Type:	Oven Chamber	Cal Date:	1-Feb-16

Remarks: Calibration limits per customer request. Chamber exceeds 70% of limit at the 200 °C test point. Customer to determine if the result found meets their requirements. Temperature uniformity not calibrated

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
50 °C	50.4	50.0	-0.4	2.0	0.18	Pass	20%
100 °C	101.0	100.0	-1.0			Pass	50%
150 °C	152.1	150.0	-2.1	3.0		Pass	70%
200 °C	203.2	200.0	-3.2	4.0		Pass	80%

END OF REPORT

010113

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36974
Asset Number:	022396	Calibrated:	8/19/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/19/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	73.6°F / 58 %
Serial Number:	22396	Work Order #	403133757
Calibration Procedure:	TEMPERATURE PROBES		

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010114

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-found
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	2.2	0.5	Fail	159%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	3.0	1.3	Fail?	100%
	699.3	702.6	3.3	5.2	1.3	Pass	63%
	1002.6	1002.4	-0.2	7.5	1.3	Pass	3%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

010115

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-left
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	19-Aug-15

Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	4.0	0.5	Pass	88%
	-44.4	-42.8	1.6	2.2	0.5	Pass	73%
	-0.1	0.3	0.4	2.2	0.5	Pass	18%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	20.0	1.3	Pass	15%
	699.3	702.6	3.3	35.0	1.3	Pass	9%
	1002.6	1002.4	-0.2	50.0	1.3	Pass	0%

END OF REPORT

010116

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38121
Asset Number:	022476	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22476	Work Order #	403134199
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010117

Work Order:	403134199	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022476	Model	08516-96	Type Data:	Found-left
Serial No.	22476	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.0	-0.7	2.2	0.5	Pass	33%
	498.0	497.7	-0.3	3.7	1.3	Pass	7%
	750.3	749.6	-0.7	5.6	1.3	Pass	12%
	1002.9	999.9	-3.0	7.5	1.3	Pass	40%

END OF REPORT

010118

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38120
Asset Number:	022475	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22475	Work Order #	403134198
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Institute Calibration Laboratory, Bldg. 64, San Antonio, TX 78227, ext. 5215 Page 1 of 1

Southwest Research Institute
Calibration Laboratory
Measurement Report

010119

Work Order:	403134198	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022475	Model	08516-96	Type Data:	Found-left
Serial No.	22475	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	98.6	-1.1	2.2	0.5	Pass	51%
	498.0	497.9	-0.1	3.7	1.3	Pass	1%
	750.3	749.8	-0.5	5.6	1.3	Pass	9%
	1002.9	999.4	-3.5	7.5	1.3	Pass	47%

END OF REPORT

C10120

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36921
Asset Number:	020543	Calibrated:	8/18/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/18/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	77.4°F / 42 %
Serial Number:	20543	Work Order #	403133753
Calibration Procedure:	TEMPERATURE PROBES		

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010121

Work Order:	403133753	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	020543	Model	93631-11	Type Data:	As-found
Serial No.	20543	Type.	Thermocouple, Type K	Cal Date:	17-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.0	3.6	2.2	0.5	Fail	165%
	99.7	98.9	-0.8	2.2	0.5	Pass	38%
	398.4	402.8	4.4	3.0	1.3	Fail	147%
	699.3	704.2	4.9	5.2	1.3	Pass?	93%
	1002.6	1003.5	0.9	7.5	1.3	Pass	12%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

010122

Work Order:	403133753	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	020543	Model	93631-11	Type Data:	As-left
Serial No.	20543	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15

Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.0	3.6	4.0	0.5	Pass	90%
	-44.4	-43.0	1.4	2.2	0.5	Pass	63%
	-0.1	0.0	0.1	2.2	0.5	Pass	5%
	99.7	98.9	-0.8	2.2	0.5	Pass	36%
	398.4	402.8	4.4	20.0	1.3	Pass	22%
	699.3	704.2	4.9	35.0	1.3	Pass	14%
	1002.6	1003.5	0.9	50.0	1.3	Pass	2%

END OF REPORT

010123

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47207
Asset Number:	022925	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22925	Work Order #	403137433
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010124

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-found
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-75.9	3.2	2.2	0.5	Fail	145%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

010125

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-left
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-42.5	2.4	3.0	0.5	Pass	80%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

010126

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38184
Asset Number:	022488	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22488	Work Order #	403134274
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010127

Work Order:	403134274	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022488	Model	08516-96	Type Data:	Found-left
Serial No.	22488	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.3	0.4	3.7	1.3	Pass	9%
	750.3	749.9	-0.4	5.6	1.3	Pass	7%
	1002.9	1000.5	-2.4	7.5	1.3	Pass	32%

END OF REPORT

010128

Southwest Research Institute

Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47204
Asset Number:	022922	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22922	Work Order #	403137430
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010129

Work Order:	403137430	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022922	Model:	08516-96	Type Data:	As-found
Serial No.:	22922	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-76.0	3.1	2.2	0.5	Fail	141%
	0.2	0.3	0.1	2.2	0.5	Pass	5%
	396.7	396.6	-0.1	3.0	1.3	Pass	3%
	698.9	698.6	-0.3	5.2	1.3	Pass	6%
	1101.6	1095.3	-6.3	8.3	1.3	Pass	76%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

010130

Work Order:	403137430	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022922	Model:	08516-96	Type Data:	As-left
Serial No.:	22922	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A couple readings exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-42.5	2.4	3.0	0.5	Pass	80%
	0.2	0.3	0.1	2.2	0.5	Pass	5%
	396.7	396.6	-0.1	3.0	1.3	Pass	3%
	698.9	698.6	-0.3	5.2	1.3	Pass	6%
	1101.6	1095.3	-6.3	8.3	1.3	Pass	76%

END OF REPORT

010131

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38118
Asset Number:	022473	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22473	Work Order #	403134196
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010132

Work Order:	403134196	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022473	Model	08516-96	Type Data:	Found-left
Serial No.	22473	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.7	0.8	3.7	1.3	Pass	20%
	750.3	750.9	0.6	5.6	1.3	Pass	11%
	1002.9	1001.5	-1.4	7.5	1.3	Pass	19%

END OF REPORT

010133

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38183
Asset Number:	022487	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22487	Work Order #	403134273
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

010135

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	34998
Asset Number:	020917	Calibrated:	7/20/2015
Description:	DATA LOGGER	Calibration Due:	7/20/2016
Manufacturer:	OMEGA	Data Type:	FOUND / LEFT
Model Number:	OM-CP-PRHTEMP2000	Temp./RH:	69 °F / 43 %
Serial Number:	P28381	Work Order #	403132811
Calibration Procedure:	TEMPERATURE, HUMIDITY-D		

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Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
006404	THUNDER SCIENTIFIC	2500	HUMIDITY GENERATOR	5/28/2016
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016
021448	FLUKE	PPC4	Pressure Controller	11/3/2015

Approved By

Calibrated By: RLC
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010136

Work Order:	403132811	Mfr.:	Omega	Technician:	MAR / RLC
Asset No.:	020917	Model:	OM-CP-PRHTEMP2000	Type Data:	Found-left
Serial No.:	P28381	Type:	Data Logger	Cal Date:	20-Jul-15

Remarks: pressure test points established per customer range request. Reading at 65% RH is 70% of the allowed limit.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Humidity	% RH	% RH	% RH	% RH	% RH		
	35.0	36.5	1.5	3.0	0.68	Pass	50%
	50.0	50.9	0.9		0.68	Pass	30%
	65.0	62.9	-2.1		0.68	Pass	70%
Temperature	°C	°C	°C	°C	°C		
	20.4	20.4	0.0	0.5	0.18	Pass	0%
	25.0	24.9	-0.1		0.18	Pass	20%
	29.8	29.8	0.0		0.18	Pass	0%
Pressure	psia	psia	psi	psi	psi		
	12	11.986	-0.014	0.060	0.01	Pass	23%
	18	18.020	0.020		0.02	Pass	33%
	24	24.010	0.010			Pass	17%
	30	29.966	-0.034			Pass	57%

END OF REPORT

010137

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160307-2
SwRI SRR: 56087, 56933, 56955
SDG: 591439
CASE: Zeolite
VTSR: 09.03.15, 01.27.16, 01.29.16

WETCHEM ANALYSES
Chemicals Certificates of Analysis

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Certificate of Analysis

010138

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBQ1780V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	10 JUN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	99.6 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	CORRESPONDS TO ACS (10TH ED.)
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	INSOLUBLE MATTER < 0.005 % HEAVY METALS (AS PB) < 0.001 %
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 20 MG/KG	< 20 MG/KG
POTASSIUM (ICP)	≤ 20 MG/KG	< 20 MG/KG
MAGNESIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65580
SwRI Chem ID: 65580
SwRI Chem ID: 65580

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SwRI Chem ID: 63613

Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate – ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

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SwRI Chem ID: 63613
SwRI Chem ID: 63613

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SwRI Chem ID: 63613

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

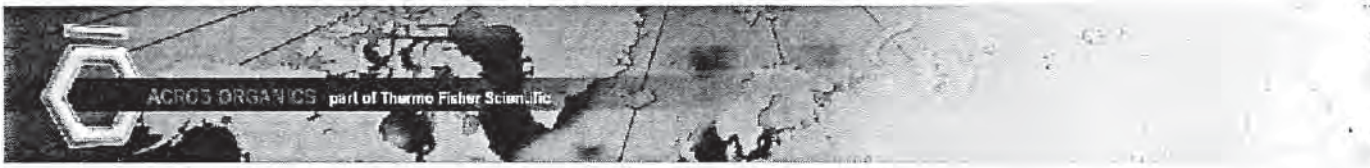
Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 63613

SwRI Chem ID: 63613

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ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

010141

SwRI Chem ID: 63857

Certificate of Analysis

This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	dark purpie to black crystalline chunks	black crystalline chunks
Titration iodometric	>=98.5 %	101.9 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Trace analysis	Type: Ca measure =< 50 PPM	Type: Ca measure 5 PPM
Trace analysis	Type: Cd measure =< 10 PPM	Type: Cd measure 3 PPM
Trace analysis	Type: Co measure =< 10 PPM	Type: Co measure 5 PPM
Trace analysis	Type: Cu measure =< 10 PPM	Type: Cu measure 7 PPM
Trace analysis	Type: Fe measure =< 200 PPM	Type: Fe measure 178 PPM
Trace analysis	Type: Mg measure =< 50 PPM	Type: Mg measure 6 PPM
Trace analysis	Type: Mn measure =< 10 PPM	Type: Mn measure 7 PPM
Trace analysis	Type: Na measure =< 50 PPM	Type: Na measure 17 PPM
Trace analysis	Type: Ni measure =< 50 PPM	Type: Ni measure 8 PPM
Trace analysis	Type: Pb measure =< 20 PPM	Type: Pb measure 4 PPM
Trace analysis	Type: Sr measure =< 50 PPM	Type: Sr measure 11 PPM
Trace analysis	Type: Zn measure =< 10 PPM	Type: Zn measure 4 PPM
Trace analysis	Type: Cl measure =< 20 PPM	Type: Cl measure =< 20 PPM
Trace analysis	Type: SO4 measure =< 50 PPM	Type: SO4 measure =< 50 PPM
Trace analysis	Type: NH4 measure =< 10 PPM	Type: NH4 measure =< 10 PPM
Subst not pptd by NH4OH	=<0.2 % (as SO4)	=<0.0077 % (as SO4)

SwRI Chem ID: 63857

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CERTIFIED BY

010142

L. Van den Broek, QA Manager Issued: 28 October 2015

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857

010143

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Outside USA: eurtechserv@sial.com

SwRI Chem ID: 63604

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate - ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

SwRI Chem ID: 63604

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

SwRI Chem ID: 63604

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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SwRI Chem ID: 63604

SwRI Chem ID: 65590

010144

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Certificate of Analysis

Product Name:
Magnesium nitrate hexahydrate - ACS reagent, 99%

$Mg(NO_3)_2 \cdot 6H_2O$

Product Number:	**237175**
Batch Number:	**MKBX1623V**
Brand:	SIAL
CAS Number:	13446-18-9
MDL Number:	MFCD00149779
Formula:	MgN2O6 · 6H2O
Formula Weight:	256.41 g/mol
Quality Release Date:	10 DEC 2015

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Chips or Crystals	Conforms to Requirements	Crystals
X-Ray Diffraction	Conforms to Structure	Conforms
Complexometric EDTA	98.0 - 102.0 %	99.8 %
Insolubie Matter C= 10%, H2O	≤ 0.005 %	< 0.005 %
Barium	≤ 0.005 %	< 0.005 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Chioride Content	≤ 0.001 %	< 0.001 %
Iron (Fe)	≤ 5 ppm	< 5 ppm
Heavy Metals as Pb	≤ 5 ppm	< 1 ppm
Potassium (K)	≤ 0.005 %	< 0.005 %
Manganese (Mn)	≤ 5 ppm	< 5 ppm
Sodium (Na)	≤ 0.005 %	< 0.005 %
Ammonia (NH4)	≤ 0.003 %	< 0.003 %
pH C= 5%, H2O @ 25 Deg C	5.0 - 8.2	5.0
Phosphate (PO4)	≤ 5 ppm	< 5 ppm
Strontium (Sr)	≤ 0.005 %	< 0.005 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %

SwRI Chem ID: 65590

SwRI Chem ID: 65590

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Version Number: 1

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SwRI Chem ID: 65590

Certificate of Analysis

Product Number: 237175
Batch Number: MKBX1623V

Test	Specification	Result
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Michael Grady, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 65590

SwRI Chem ID: 65590

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Certificate of Analysis

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Product Name	Sodium nitrate, ACS reagent, ≥99.0%
Product Number	221341
Product Brand	Sigma-Aldrich
CAS Number	7631-99-4
Molecular Formula	$NaNO_3$
Molecular Weight	84.99

INORGANIC LABS/RADCHEM LABS
DATE RECEIVED: 10/24/08
DATE EXPIRED: 10/24/2018
DATE OPENED: 11/7/08
INORG: 7246/7247 PO: NIA from D.V. 16

TEST	LOT 07030MH RESULTS
APPEARANCE	WHITE CRYSTALLINE POWDER
TITRATION	99.7% (WITH NAOH) *
ICP ASSAY	CONFIRMS SODIUM COMPONENT
INSOLUBLE MATTER	0.003% (20%, H2O) *
CALCIUM	0.003% *
CHLORIDE	0.0002% *
IRON	1 PPM *
HEAVY METALS	3 PPM (AS PB) *
IODATE	2 PPM *
MAGNESIUM	0.001% *
NITRITE	0.0005% *
PH	6.0 @ 25 DEG C (5% H2O) *
PHOSPHATE	2 PPM *
SULFATE	0.001% *
	* SUPPLIER DATA
	MEETS REQUIREMENTS OF ACS 10TH ED
QC RELEASE DATE	NOVEMBER 2007

Barbara Rajzer

Barbara Rajzer, Supervisor
Quality Control
Milwaukee, Wisconsin USA

SwRI Chem ID: 33383
SwRI Chem ID: 33383
SwRI Chem ID: 33383

SwRI Chem ID: 65583

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Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate – ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

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SwRI Chem ID: 65583
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SwRI Chem ID: 65583

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SwRI Chem ID: 65583

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 65583

SwRI Chem ID: 65583

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010149

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Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm

SwRI Chem ID: 61751
SwRI Chem ID: 61751
SwRI Chem ID: 61751

Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 4 September 2015

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 61751
SwRI Chem ID: 61751
SwRI Chem ID: 61751

SIGMA-ALDRICH

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 65581

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBW6908V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	16 OCT 2015

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Michael Grady, Manager
Quality Control
Milwaukee, WI US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65581
SwRI Chem ID: 65581

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Certificate of Analysis

Product Name:	NICKEL(II) NITRATE HEXAHYDRATE purum p.a., crystallized, >= 97.0 % KT
Product Number:	72253
Batch Number:	BCBP4160V
Brand:	Sigma-Aldrich
CAS Number:	13478-00-7
Formula:	$Ni(NO_3)_2 \bullet 6H_2O$
Formula Weight:	290.79
Quality Release Date:	26 JAN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	BLUE-GREEN TO DEEP BLUE-GREEN	BLUE-GREEN
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	97.0 - 103.0 %	97.0 %
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
CADMIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
COBALT (ICP)	≤ 500 MG/KG	< 500 MG/KG
COPPER (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 50 MG/KG	< 50 MG/KG
POTASSIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
SODIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
LEAD (ICP)	≤ 50 MG/KG	< 50 MG/KG
ZINC (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 50 MG/KG	< 50 MG/KG

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

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SwRI Chem ID: 65593
SwRI Chem ID: 65593
SwRI Chem ID: 65593

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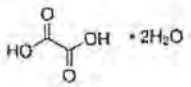
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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 65591

Certificate of Analysis

Product Name:
Oxalic acid dihydrate - ACS reagent, ≥99%



Product Number:	**247537**
Batch Number:	**MKBV8626V**
Brand:	SIAL
CAS Number:	6153-56-6
MDL Number:	MFCD00149102
Formula:	C2H2O4 · 2H2O
Formula Weight:	126.07 g/mol
Quality Release Date:	02 JUL 2015
Recommended Retest Date:	JUN 2020

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form)	Conforms to Requirements	Granules
Infrared Spectrum	Conforms to Structure	Conforms
Titration by KMNO4	99.5 - 102.5 %	101.3 %
Residue on ignition (Ash)	≤ 0.01 %	< 0.01 %
Insoluble Matter C= 8%, H2O	≤ 0.005 %	0.001 %
Calcium (Ca)	≤ 0.001 %	< 0.001 %
Chloride Content	≤ 0.002 %	< 0.002 %
Substances Darkened (by H2SO4)	Pass	Pass
Iron (Fe)	≤ 2 ppm	< 1 ppm
Heavy Metals	≤ 5 ppm	< 1 ppm
Nitrogen Compounds	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %
Meets ACS Requirements	Current ACS Specification	Conforms
Recommended Retest Period 5 years	----------	----------

Ali Ataei, Manager
Quality Control

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65591
SwRI Chem ID: 65591

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Website: www.sigmaaldrich.com
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Outside USA: eurtechserv@sial.com

SwRI Chem ID: 65591

Certificate of Analysis

Product Number: 247537
Batch Number: MKBV8626V

Milwaukee, WI US

SwRI Chem ID: 65591

SwRI Chem ID: 65591

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

010155

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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Catalog Number	**A509**	**Mfg. Date**	7/3/2015
Lot Number	**1115060**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	07/03/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

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Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

CERTIFIED BY

Edgar E Hess
Lab Manager Fair Lawn

Joel Boland
Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1.800.227.6701.

SwRI Chem ID: 62999
SwRI Chem ID: 62999
SwRI Chem ID: 62999

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SwRI Chem ID: 61750

ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	9 July 2015
Lot Number	A0349449	**Suggested Retest Date**	July 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystalline powder
Titration Complexometric	>=99 %	99.2 %
Trace analysis	Type: Cl measure =< 10 ppm	Type: Cl measure =< 10 ppm
Trace analysis	Type: Fe measure =< 5 ppm	Type: Fe measure =< 5 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 4 September 2015

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 61750

SwRI Chem ID: 61750

Certificate of Analysis

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SIGMA-ALDRICH

Product Name	Sodium nitrate, ACS reagent, ≥99.0%
Product Number	221341
Product Brand	Sigma-Aldrich
CAS Number	7631-99-4
Molecular Formula	$NaNO_3$
Molecular Weight	84.99

INORGANIC LABS/RADCHEM LABS
DATE RECEIVED: 10/24/08
DATE EXPIRED: 10/24/2018
DATE OPENED: 11/7/08
INORG: 7246/7247 PO: NIA from 10.V.16

TEST	LOT 07030MH RESULTS
APPEARANCE	WHITE CRYSTALLINE POWDER
TITRATION	99.7% (WITH NAOH) *
ICP ASSAY	CONFIRMS SODIUM COMPONENT
INSOLUBLE MATTER	0.003% (20%, H2O) *
CALCIUM	0.003% *
CHLORIDE	0.0002% *
IRON	1 PPM *
HEAVY METALS	3 PPM (AS PB) *
IODATE	2 PPM *
MAGNESIUM	0.001% *
NITRITE	0.0005% *
PH	6.0 @ 25 DEG C (5% H2O) *
PHOSPHATE	2 PPM *
SULFATE	0.001% *
	* SUPPLIER DATA
	MEETS REQUIREMENTS OF ACS 10TH ED
QC RELEASE DATE	NOVEMBER 2007

Barbara Rajzer

Barbara Rajzer, Supervisor
Quality Control
Milwaukee, Wisconsin USA

SwRI Chem ID: 33384
SwRI Chem ID: 33384
SwRI Chem ID: 33384

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Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 63069

Certificate of Analysis

Product Name:
Magnesium nitrate hexahydrate - ACS reagent, 99%

$Mg(NO_3)_2 \cdot 6H_2O$

Product Number:	**237175**
Batch Number:	**MKBW3613V**
Brand:	SIAL
CAS Number:	13446-18-9
MDL Number:	MFCD00149779
Formula:	MgN2O6 · 6H2O
Formula Weight:	256.41 g/mol
Quality Release Date:	24 AUG 2015

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Chips or Crystals	Conforms to Requirements	Crystals
X-Ray Diffraction	Conforms to Structure	Conforms
Complexometric EDTA	98.0 - 102.0 %	100.4 %
Insoluble Matter C= 10%, H2O	≤ 0.005 %	0.002 %
Barium	≤ 0.005 %	< 0.001 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Chloride Content	≤ 0.001 %	< 0.001 %
Iron (Fe)	≤ 5 ppm	< 1 ppm
Heavy Metals as Pb	≤ 5 ppm	< 4 ppm
Potassium (K)	≤ 0.005 %	< 0.001 %
Manganese (Mn)	≤ 5 ppm	< 4 ppm
Sodium (Na)	≤ 0.005 %	< 0.001 %
Ammonia (NH4)	≤ 0.003 %	< 0.003 %
pH C= 5%, H2O @ 25 Deg C	5.0 - 8.2	5.4
Phosphate (PO4)	≤ 5 ppm	< 5 ppm
Strontium (Sr)	≤ 0.005 %	< 0.001 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %

SwRI Chem ID: 63069

SwRI Chem ID: 63069

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SwRI Chem ID: 63069

Certificate of Analysis

Product Number: 237175
Batch Number: MKBW3613V

Test	Specification	Result
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 63069

SwRI Chem ID: 63069

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SwRI Chem ID: 61136

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Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate - ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBV6056V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	27 MAY 2015

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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Version Number: 1

SwRI Chem ID: 61136

SwRI Chem ID: 61136



Certificate of Analysis

Product 42353
Calcium nitrate tetrahydrate,99+%,ACS reagent

General Product Data

Version	0
CAS No	13477-34-4
Country of origin	SPAIN
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
Linear formula	Ca(NO3)2.4H2O

Product Specifications

Appearance	white crystals
Assay Complexometry	99.0 to 103.0 %
Heavy metals (as Pb)	=<5 ppm
pH	5.0 to 7.0 (5% soln. at 25°C)
Insoluble matter	=<0.005 %
Trace analysis	Type: Cl measure =< 50 ppm
	Type: SO4 measure =< 20 ppm
	Type: Ba measure =< 50 ppm
	Type: Fe measure =< 5 ppm
	Type: NO2 measure =< 10 ppm
	Type: Mg measure =< 500 ppm
	Type: K measure =< 50 ppm
	Type: Na measure =< 100 ppm
	Type: Sr measure =< 500 ppm

Lot Specific Data : A0303920

Appearance	white crystals
Assay Complexometry	99.9 %
Heavy metals (as Pb)	=<2 ppm
pH	5.9 (5% soln. at 25°C)
Insoluble matter	=<0.005 %
Trace analysis	Type: Cl measure =< 2 ppm
	Type: SO4 measure =< 20 ppm
	Type: Ba measure =< 10 ppm
	Type: Fe measure =< 2 ppm
	Type: NO2 measure =< 10 ppm
	Type: Mg measure 1 ppm
	Type: K measure 3 ppm
	Type: Na measure 6 ppm
	Type: Sr measure =< 1 ppm

Issued: 21-09-12
L. Van den Broek, QA Manager

SwRI Chem ID: 36657
SwRI Chem ID: 36657
SwRI Chem ID: 36657

010163

Acros Organics

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1 Reagent Lane, Fair Lawn, NJ 07410,USA
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SwRI Chem ID: 36657
SwRI Chem ID: 36657
SwRI Chem ID: 36657

3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBN0101V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	02 MAY 2014
Recommended Retest Date:	APR 2020

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	99.4 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	MEETS REQUIREMENTS OF ACS 10TH ED
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	PASSED
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 54983
SwRI Chem ID: 54983
SwRI Chem ID: 54983

Fisher Scientific

010165

Certificate of Analysis

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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SwRI Chem ID: 61752

Catalog Number	**P208**	**Mfg. Date**	**9/8/2011**
Lot Number	**114872**		
Description	**POTASSIUM CARBONATE, ANHYDROUS, A.C.S.**		
Country of Origin	**United States**	**Recommended Retest Date**	**Sep-2016**
Chemical Origin	**Inorganic-non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	FINE WHITE GRANULAR POWDER
ASSAY	%	>= 99.0	100.0
CALCIUM	%	<= 0.005	0.001
CHLORIDE	%	<= 0.003	<0.0030
HEAVY METALS (as Pb)	ppm	<= 5	<5.0
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.01	0.002
IRON (Fe)	ppm	<= 5	<5.0
MAGNESIUM	%	<= 0.002	0.0002
PHOSPHATE (PO4)	%	<= 0.001	<0.0010
SILICA (SiO2)	%	<= 0.005	<0.005
SODIUM (Na)	%	<= 0.02	0.004
SULFUR COMPOUNDS	%	<= 0.004	<0.0040

SwRI Chem ID: 61752



Edgar E. Hess

Lab Manager Fair Lawn

SwRI Chem ID: 61752

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.

Fisher Scientific

010166

Certificate of Analysis

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

SwRI Chem ID: 47355

This is to certify that units of the above mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	**A219**	**Mfg. Date**	**6/26/2013**
Lot Number	**134700**		
Description	**OXALIC ACID, A.C.S**		
Country of Origin	**India**	**Recommended Retest Date**	**Jun-2018**
Chemical Origin	**Organic - non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 99.5 - 102.5	100.8
CALCIUM	%	<= 0.001	<0.0010
CHLORIDE	%	<= 0.002	<0.0020
HEAVY METALS (as Pb)	ppm	<= 5	<5
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
IGNITION RESIDUE	%	<= 0.01	0.008
INSOLUBLE MATTER	%	<= 0.005	0.004
IRON (Fe)	ppm	<= 2	<2
NITROGEN COMPOUNDS	%	<= 0.001	<0.0010
SUBSTANCES DARKENED BY H2SO4	PASS/FAIL	= PASS TEST	PASS TEST
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hau

Lab Manager Fair Lawn

SwRI Chem ID: 47355

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.

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Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBQ1780V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	10 JUN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	99.6 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	CORRESPONDS TO ACS (10TH ED.)
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	INSOLUBLE MATTER < 0.005 % HEAVY METALS (AS PB) < 0.001 %
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 20 MG/KG	< 20 MG/KG
POTASSIUM (ICP)	≤ 20 MG/KG	< 20 MG/KG
MAGNESIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65579
SwRI Chem ID: 65579
SwRI Chem ID: 65579

SwRI Chem ID: 65736

010168

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Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate - ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

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SwRI Chem ID: 65736
SwRI Chem ID: 65736
SwRI Chem ID: 65736

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Outside USA: eurtechserv@sial.com

SwRI Chem ID: 65736

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

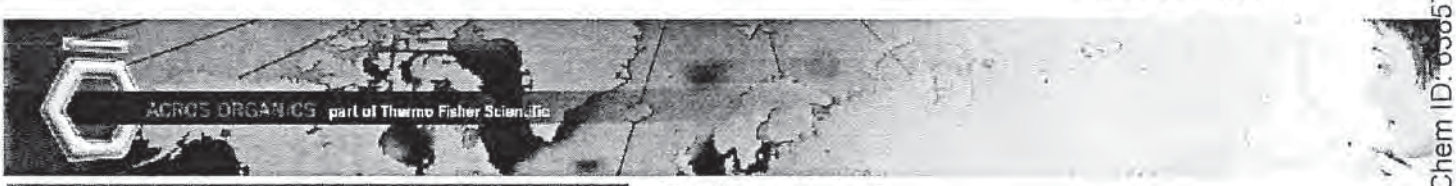
Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 65736

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010170



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	dark purple to black crystalline chunks	black crystalline chunks
Titration Iodometric	>=98.5 %	101.9 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Trace analysis	Type: Ca measure =< 50 PPM	Type: Ca measure 5 PPM
Trace analysis	Type: Cd measure =< 10 PPM	Type: Cd measure 3 PPM
Trace analysis	Type: Co measure =< 10 PPM	Type: Co measure 5 PPM
Trace analysis	Type: Cu measure =< 10 PPM	Type: Cu measure 7 PPM
Trace analysis	Type: Fe measure =< 200 PPM	Type: Fe measure 178 PPM
Trace analysis	Type: Mg measure =< 50 PPM	Type: Mg measure 6 PPM
Trace analysis	Type: Mn measure =< 10 PPM	Type: Mn measure 7 PPM
Trace analysis	Type: Na measure =< 50 PPM	Type: Na measure 17 PPM
Trace analysis	Type: Ni measure =< 50 PPM	Type: Ni measure 8 PPM
Trace analysis	Type: Pb measure =< 20 PPM	Type: Pb measure 4 PPM
Trace analysis	Type: Sr measure =< 50 PPM	Type: Sr measure 11 PPM
Trace analysis	Type: Zn measure =< 10 PPM	Type: Zn measure 4 PPM
Trace analysis	Type: Cl measure =< 20 PPM	Type: Cl measure =< 20 PPM
Trace analysis	Type: SO4 measure =< 50 PPM	Type: SO4 measure =< 50 PPM
Trace analysis	Type: NH4 measure =< 10 PPM	Type: NH4 measure =< 10 PPM
Subst not pptd by NH4OH	=<0.2 % (as SO4)	=<0.0077 % (as SO4)

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 28 October 2015

010171

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857

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Website: www.sigmaaldrich.com
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Outside USA: eurtechserv@sial.com

SwRI Chem ID: 65737

Certificate of Analysis

Product Name:
Magnesium nitrate hexahydrate - ACS reagent, 99%

$Mg(NO_3)_2 \cdot 6H_2O$

Product Number:	**237175**
Batch Number:	**MKBX1623V**
Brand:	SIAL
CAS Number:	13446-18-9
MDL Number:	MFCD00149779
Formula:	MgN2O6 · 6H2O
Formula Weight:	256.41 g/mol
Quality Release Date:	10 DEC 2015

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Chips or Crystals	Conforms to Requirements	Crystals
X-Ray Diffraction	Conforms to Structure	Conforms
Complexometric EDTA	98.0 - 102.0 %	99.8 %
Insoluble Matter C= 10%, H2O	≤ 0.005 %	< 0.005 %
Barium	≤ 0.005 %	< 0.005 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Chloride Content	≤ 0.001 %	< 0.001 %
Iron (Fe)	≤ 5 ppm	< 5 ppm
Heavy Metals as Pb	≤ 5 ppm	< 1 ppm
Potassium (K)	≤ 0.005 %	< 0.005 %
Manganese (Mn)	≤ 5 ppm	< 5 ppm
Sodium (Na)	≤ 0.005 %	< 0.005 %
Ammonia (NH4)	≤ 0.003 %	< 0.003 %
pH C= 5%, H2O @ 25 Deg C	5.0 - 8.2	5.0
Phosphate (PO4)	≤ 5 ppm	< 5 ppm
Strontium (Sr)	≤ 0.005 %	< 0.005 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %

SwRI Chem ID: 65737

SwRI Chem ID: 65737

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Outside USA: eurtechserv@sial.com

SwRI Chem ID: 65737

Certificate of Analysis

Product Number: 237175
Batch Number: MKBX1623V

Test	Specification	Result
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Michael Grady, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 65737

SwRI Chem ID: 65737

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SwRI Chem ID: 63914

Certificate of Analysis

Product Name:
Potassium carbonate - ACS reagent, ≥99.0%

K_2CO_3

Product Number:	**209619**
Batch Number:	**SLBM3461V**
Brand:	SIAL
CAS Number:	584-08-7
MDL Number:	MFCD00011382
Formula:	CK2O3
Formula Weight:	138.21 g/mol
Quality Release Date:	28 JAN 2015
Recommended Retest Date:	JAN 2018

SwRI Chem ID: 63914

Test	Specification	Result
Assay	≥ 99.0 %	99.8 %
Insoluble Matter < or = 0.01%	Pass	Pass
Chloride (Cl) < or = 0.003%	Pass	Pass
Phosphate (PO4) < or = 0.001%	Pass	Pass
Silica < or = 0.005%	Pass	Pass
Sulfur coumpounds < or = 0.004%	Pass	Pass
Calcium < or = 0.005%	Pass	Pass
Magnesium < or = 0.002%	Pass	Pass
Sodium < or = 0.02%	Pass	Pass
Iron (Fe) < or = 5 ppm	Pass	Pass
Heavy Metals (as Lead)	< = 5 ppm	< 5 ppm

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SwRI Chem ID: 63914

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Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 209619
Batch Number: SLBM3461V

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

SwRI Chem ID: 63914

SwRI Chem ID: 63914

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Certificate of Analysis

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBQ1780V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	10 JUN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	99.6 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	CORRESPONDS TO ACS (10TH ED.)
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	INSOLUBLE MATTER < 0.005 % HEAVY METALS (AS PB) < 0.001 %
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 20 MG/KG	< 20 MG/KG
POTASSIUM (ICP)	≤ 20 MG/KG	< 20 MG/KG
MAGNESIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65580
SwRI Chem ID: 65580
SwRI Chem ID: 65580

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Website: www.sigmaaldrich.com
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Outside USA: eurtechserv@sial.com

SwRI Chem ID: 63613

Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate – ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 63613
SwRI Chem ID: 63613
SwRI Chem ID: 63613

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SwRI Chem ID: 63613

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 63613

SwRI Chem ID: 63613

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Appendix K
SwRI Test Report, March 29, 2016

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

March 29, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Ashley Pryor

Subject:		
	Case:	Zeolite
	SwRI Project Number:	21592.01.00X
	SDG:	581291
	SwRI Task Order Number:	160328-2
	SwRI Sample Receipt Number:	56087
	Samples Received:	09.03.2015
	Analysis:	Test for Oxidizing Liquids

Dear Ms. Pryor,

Please find the enclosed results for the two overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Group Leader – R&D

APPROVED:

Michael J. Dammann
Director

RPS: jz

Cc: Nita Patel, Los Alamos National Laboratory

Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI TASK ORDER: 160328-2
SwRI SRR: 56087
SDG: 581291
VTSR: 09.03.2015
CASE: Zeolite

CHAIN-OF-CUSTODY
&
SAMPLE RECEIPT PAPERWORK

Total Page Count: 010001
Fraction: UN Pages: 00030
Liquid Oxidizer Test

010002

General Sample Chain of Custody

Ver (8/25/2011)

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

SRR #:	56087	Thermometer:	021056
Project	19869.01.00X	Temperature:	21.2
CASE:	Zeolite	Airbill #:	590817794105
Customer:	Los Alamos National Laboratory	Logged in by:	SDOUGLAS
Samples Received:	Sep 3 2015 8:30AM	Logged in:	Sep 3 2015 9:03AM
Manager:	DAMMANN, MIKE		
Disposal Instructions:	Contact project manager for disposal authority.		

System ID	Customer ID	CED	Matrix	# Cont	Special Requirements	Sample Condition
581291	(UNS Liquid+SWheat 1:1):3 zeolite or cemented		Liquid	1		Intact
581292	(UNS+SWheat 1:1):3 zeolite or cemented		Solid	1		Intact
581293	(UNS+SWheat 1:3):3 zeolite or cemented		Solid	1		Intact
581294	(UNS+SWheat 1:4):3 zeolite or cemented		Solid	1		Intact
581295	1(UNSLQ+SWht 1:1):1 Spillfyter:1 citric acid :3		Liquid	1		Intact
581296	1(UNSLQ+SWht 1:1):1 Spillfyter:3 zeolite or cmtd		Liquid	1		Intact
581297	1 (UNS LQ+Wastelock 16:1):3 zeolite or cemented		Liquid	1		Intact
581298	1 UNS: 3 zeolite or cemented		Solid	1		Intact
581299	Zeolite		Solid	1		Intact
581300	UNS		Solid	1		Intact
581301	UNS+SWheat 1:1		Solid	1		Intact
581302	UNS+SWheat 1:3		Solid	1		Intact
581303	UNS+SWheat 1:4		Solid	1		Intact
581318	(WB8 + SWheat 1:1) cemented		Surrogate	1		Intact
581319	(WB8 + SWheat 1:1):3 zeolite		Surrogate	1		Intact
581320	(WB8 + SWheat 1:3) cemented		Surrogate	1		Intact
581321	(WB8 + SWheat 1:3):3 zeolite		Surrogate	1		Intact
581322	(WB8 + SWheat 1:4) cemented		Surrogate	1		Intact
581323	(WB8 + SWheat 1:4):3 zeolite		Surrogate	1		Intact
581324	1 Potassium Nitrate: 3 zeolite		Surrogate	1		Intact
581325	1 WB8: 3 zeolite		Surrogate	1		Intact
581326	Potassium Nitrate		Surrogate	1		Intact
581327	Potassium Nitrate + SWheat 1:1		Surrogate	1		Intact
581328	Potassium Nitrate + SWheat 1:3		Surrogate	1		Intact
581329	Potassium Nitrate + SWheat 1:4		Surrogate	1		Intact
581330	Potassium Nitrate cemented		Surrogate	1		Intact
581331	WB8		Surrogate	1		Intact
581332	WB8 + SWheat 1:1		Surrogate	1		Intact
581333	WB8 + SWheat 1:3		Surrogate	1		Intact
581334	WB8 + SWheat 1:4		Surrogate	1		Intact
581335	WB8 cemented		Surrogate	1		Intact

Relinquished by (Print/Signature):	Date	Time
[illegible]	9/3/15	0820

010003

Received by (Print/Signature):	Date	Time
Reliquished by (Print/Signature):	9/3/15	0830
Received by (Print/Signature):	Date	Time
Reliquished by (Print/Signature):	Date	Time
	Date	Time

Douglas, Steven M.

From: Spies, Radonna S.
Sent: Friday, December 18, 2015 2:22 PM
To: Spies, Radonna S.; Douglas, Steven M.
Cc: Ramirez, Daniel
Subject: RE: SRR 56087 PLease add these sample IDs to SRR. Thx

Please rename the following system IDs with these names

581291	UNS Blend 1
581292	UNS Blend 2
581293	UNS Blend 3
581294	UNS Blend 4
581295	UNS Blend 5
581296	UNS Blend 6
581297	UNS Blend 7
581298	UNS Blend 8
581300	UNS Blend 9
581301	UNS Blend 10
581302	UNS Blend 11
581303	UNS Blend 12

And ADD these to the SRR

Blend 17
Blend 18
Blend 19
Blend 20
Blend 21
Blend 22
Blend 23
Blend 24
Blend 25
UNS Blend 13
UNS Blend 14
UNS Blend 15
UNS Blend 16
UNS Blend 17
UNS Blend 18
UNS Blend 19

Thanks!

Radonna Spies

010005

Group Leader
Southwest Research Institute
Analytical & Environmental Chemistry Department
Chemistry & Chemical Engineering, Division 01
6220 Culebra Road
P.O. Drawer 28510
San Antonio, Texas 78228
email: rspies@swri.org
210.522.3242: office
210.522.3649: fax

Southwest Research Institute

Laboratory Task Order

TO #: 160328-2 Revision: 0

SDG: 581291

SRR #'s: 56087

Client(s): Los Alamos National Laboratory

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 03/28/16

Instructions
UN Liquid Oxidizer Test

Documents Related to this task order: 185604[COC for SRR 56087], 185605[SRR Paperwork for SRR 56087], 191181[New Sample IDs], 191404[]

Deliverables --> Hard Copy: no EDD: no PDF: -YES-

Test: Oxidizing Liq_UN
Section: WETCHEM

Holding: 180 days from CED

Test for Oxidizing Liquids - UN Manual of Tests and Criteria Part 3

Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
581291		1	Liquid	UNS Blend 1	NO DATA	NO DATA
589630		1	Surrogate	UNS Blend 14	NO DATA	NO DATA

010007

Sample Receipt

Southwest Research Institute

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15

Time: 08:30:00
Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

Notes

Sample was delivered intact. (no ice).

Fed Ex #(s):
590817794105 - 21.2 °C

See Task Order for full requirements.

See chain of custody as part of the SRR system for more information.

The Product along with the Section 4.0 of the paperwork provided by the client will be used to create the ADDITIONAL Solid and Liquid Surrogates identified in the Client ID section.

Due to character limitations, the following
1 (UNS LQ+SWheat 1:1):1 Spillfyter :3 zeolite or cemented
was abbreviated to:
1(UNSLQ+SWht 1:1):1 Spillfyter:3 zeolite or cmtd

1 (UNS LQ+SWheat 1:1):1 Spillfyter :1citric acid :3 zeolite or cemented
was abbreviated to:
1(UNSLQ+SWht 1:1):1 Spillfyter:1 citric acid :3

Phases:
001 - admin
002 - extraction
005 - 8082
006 - metals/radchem
007 - drg

Rev. 1
Corrected project number.
REVISION 2, DRmz 12/15/15: New Sample IDs added to the SRR, along with revisions done to previously created IDs, per email from Radonna Spies.

Rev. 3
Added samples and revised sample ID's. See attached email.

Background CPM: <100 cpm
Container Wipe CPM: <100 cpm
Total CPM: <100

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
581326	Blend 1		Surrogate	1	
581325	Blend 10		Surrogate	1	
581319	Blend 11		Surrogate	1	
581321	Blend 12		Surrogate	1	
581323	Blend 13		Surrogate	1	
589460	Blend 14		Surrogate	1	
589461	Blend 15		Surrogate	1	
589462	Blend 16		Surrogate	1	
589620	Blend 17		Surrogate	1	

56087 Los Alamos National Laborato

Sample Receipt

Southwest Research Institute

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Sample Receipt Number: 56087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15

Time: 08:30:00
Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

System ID	Customer ID	CED	Matrix	Containe	Special Reqs.
589621	Blend 18		Surrogate	1	
589622	Blend 19		Surrogate	1	
581327	Blend 2		Surrogate	1	
589623	Blend 20		Surrogate	1	
589624	Blend 21		Surrogate	1	
589625	Blend 22		Surrogate	1	
589626	Blend 23		Surrogate	1	
589627	Blend 24		Surrogate	1	
589628	Blend 25		Surrogate	1	
581328	Blend 3		Surrogate	1	
581329	Blend 4		Surrogate	1	
581331	Blend 5		Surrogate	1	
581332	Blend 6		Surrogate	1	
581333	Blend 7		Surrogate	1	
581334	Blend 8		Surrogate	1	
581324	Blend 9		Surrogate	1	
581330	Cement 1		Surrogate	1	
589463	Cement 10		Surrogate	1	
589464	Cement 11		Surrogate	1	
589465	Cement 12		Surrogate	1	
589466	Cement 13		Surrogate	1	
589467	Cement 14		Surrogate	1	
589468	Cement 15		Surrogate	1	
581335	Cement 2		Surrogate	1	
581318	Cement 3		Surrogate	1	
581320	Cement 4		Surrogate	1	
581322	Cement 5		Surrogate	1	
589469	Cement 6		Surrogate	1	
589470	Cement 7		Surrogate	1	
589471	Cement 8		Surrogate	1	
589472	Cement 9		Surrogate	1	
581291	UNS Blend 1		Liquid	1	
581301	UNS Blend 10		Solid	1	
581302	UNS Blend 11		Solid	1	
581303	UNS Blend 12		Solid	1	
589629	UNS Blend 13		Surrogate	1	
589630	UNS Blend 14		Surrogate	1	
589631	UNS Blend 15		Surrogate	1	
589632	UNS Blend 16		Surrogate	1	
589633	UNS Blend 17		Surrogate	1	
589634	UNS Blend 18		Surrogate	1	

Page Printed: 03/29/2016 08:40
ver: (7/18/2014)

56087 Los Alamos National Laborato

010009

Sample Receipt

Southwest Research Institute

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Sample Receipt Number: S6087
Revision: 3

This Receipt was Revised 12/18/2015

VTSR: 09/03/15

Time: 08:30:00
Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 09/03/15

System ID	Customer ID	CED	Matrix	Containers	Special Reqs
589635	UNS Blend 19		Surrogate	1	
581292	UNS Blend 2		Solid	1	
581293	UNS Blend 3		Solid	1	
581294	UNS Blend 4		Solid	1	
581295	UNS Blend 5		Liquid	1	
581296	UNS Blend 6		Liquid	1	
581297	UNS Blend 7		Liquid	1	
581298	UNS Blend 8		Solid	1	
581300	UNS Blend 9		Solid	1	
581299	Zeolite		Solid	1	

Containers: 60 Samples: 60

These documents are associated with this receipt: 185604[COC for SRR 56087], 185605[SRR Paperwork for SRR S6087[, 191181[New Sample IDs], 191404[]

Thermometer: 021056
Temperature: 21.2

Page Printed: 03/29/2016 08:40
ver: (7/18/2014)

56087 Los Alamos National Laborato

Southwest Research Institute
Traffic Report

010010

Sample Custodian Signature: _____

1. Custody Seal — Present
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory
Project: 21592.01.00X
Case: Zeolite / SDG: _____
Sample Receipt: 56087
Airbill: 590817794105

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
09/03/15	08:30:00	Email	UNS Blend 1	N/A	581291	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 2	N/A	581292	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 3	N/A	581293	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 4	N/A	581294	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 5	N/A	581295	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 6	N/A	581296	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 7	N/A	581297	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 8	N/A	581298	YES	Intact
09/03/15	08:30:00	Email	Zeolite	N/A	581299	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 9	N/A	581300	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 10	N/A	581301	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 11	N/A	581302	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 12	N/A	581303	YES	Intact
09/03/15	08:30:00	4.0	Cement 3	N/A	581318	YES	Intact
09/03/15	08:30:00	4.0	Blend 11	N/A	581319	YES	Intact
09/03/15	08:30:00	4.0	Cement 4	N/A	581320	YES	Intact
09/03/15	08:30:00	4.0	Blend 12	N/A	581321	YES	Intact
09/03/15	08:30:00	4.0	Cement 5	N/A	581322	YES	Intact
09/03/15	08:30:00	4.0	Blend 13	N/A	581323	YES	Intact
09/03/15	08:30:00	4.0	Blend 9	N/A	581324	YES	Intact
09/03/15	08:30:00	4.0	Blend 10	N/A	581325	YES	Intact
09/03/15	08:30:00	4.0	Blend 1	N/A	581326	YES	Intact
09/03/15	08:30:00	4.0	Blend 2	N/A	581327	YES	Intact
09/03/15	08:30:00	4.0	Blend 3	N/A	581328	YES	Intact
09/03/15	08:30:00	4.0	Blend 4	N/A	581329	YES	Intact
09/03/15	08:30:00	4.0	Cement 1	N/A	581330	YES	Intact
09/03/15	08:30:00	4.0	Blend 5	N/A	581331	YES	Intact
09/03/15	08:30:00	4.0	Blend 6	N/A	581332	YES	Intact
09/03/15	08:30:00	4.0	Blend 7	N/A	581333	YES	Intact
09/03/15	08:30:00	4.0	Blend 8	N/A	581334	YES	Intact
09/03/15	08:30:00	4.0	Cement 2	N/A	581335	YES	Intact
09/03/15	08:30:00	4.0	Blend 14	N/A	589460	YES	Intact
09/03/15	08:30:00	4.0	Blend 15	N/A	589461	YES	Intact
09/03/15	08:30:00	4.0	Blend 16	N/A	589462	YES	Intact
09/03/15	08:30:00	4.0	Cement 10	N/A	589463	YES	Intact

Southwest Research Institute

Traffic Report

010011

Sample Custodian Signature: _____

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: Zeolite / SDG: _____

Sample Receipt: 56087

Airbill: 590817794105

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
				Custody Seal #'s: N/A			
09/03/15	08:30:00	4.0	Cement 11	N/A	589464	YES	Intact
09/03/15	08:30:00	4.0	Cement 12	N/A	589465	YES	Intact
09/03/15	08:30:00	4.0	Cement 13	N/A	589466	YES	Intact
09/03/15	08:30:00	4.0	Cement 14	N/A	589467	YES	Intact
09/03/15	08:30:00	4.0	Cement 15	N/A	589468	YES	Intact
09/03/15	08:30:00	4.0	Cement 6	N/A	589469	YES	Intact
09/03/15	08:30:00	4.0	Cement 7	N/A	589470	YES	Intact
09/03/15	08:30:00	4.0	Cement 8	N/A	589471	YES	Intact
09/03/15	08:30:00	4.0	Cement 9	N/A	589472	YES	Intact
09/03/15	08:30:00	Email	Blend 17	N/A	589620	YES	Intact
09/03/15	08:30:00	Email	Blend 18	N/A	589621	YES	Intact
09/03/15	08:30:00	Email	Blend 19	N/A	589622	YES	Intact
09/03/15	08:30:00	Email	Blend 20	N/A	589623	YES	Intact
09/03/15	08:30:00	Email	Blend 21	N/A	589624	YES	Intact
09/03/15	08:30:00	Email	Blend 22	N/A	589625	YES	Intact
09/03/15	08:30:00	Email	Blend 23	N/A	589626	YES	Intact
09/03/15	08:30:00	Email	Blend 24	N/A	589627	YES	Intact
09/03/15	08:30:00	Email	Blend 25	N/A	589628	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 13	N/A	589629	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 14	N/A	589630	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 15	N/A	589631	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 16	N/A	589632	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 17	N/A	589633	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 18	N/A	589634	YES	Intact
09/03/15	08:30:00	Email	UNS Blend 19	N/A	589635	YES	Intact

SAMPLE LOG-IN SHEET

010012

Lab Name: Southwest Research Institute	Page 1 of 3
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 09/03/2015
Received By (Signature):	
Case Number: Zeolite	Sample Delivery Group No.: NA
Remarks: 21592.01.00X	SAS Number: N/A

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present Absent	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	590817794105	
7. Sample Tags	Present Absent	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/ Leaking	
9. Cooler Temperature	21.2C	
10. Does information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	09/03/2015	
12. Time Received	08:30:00	

Sample Transfer		
Fraction: INORG	Fraction:	
Area #: R. Spres	Area #:	
By: STEVEN DOUGLAS	By:	
On: 09/03/2015	On:	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
UNS Blend 1	N/A	581291	Intact
UNS Blend 2	N/A	581292	Intact
UNS Blend 3	N/A	581293	Intact
UNS Blend 4	N/A	581294	Intact
UNS Blend 5	N/A	581295	Intact
UNS Blend 6	N/A	581296	Intact
UNS Blend 7	N/A	581297	Intact
UNS Blend 8	N/A	581298	Intact
Zeolite	N/A	581299	Intact
UNS Blend 9	N/A	581300	Intact
UNS Blend 10	N/A	581301	Intact
UNS Blend 11	N/A	581302	Intact
UNS Blend 12	N/A	581303	Intact
Cement 3	N/A	581318	Intact
Blend 11	N/A	581319	Intact
Cement 4	N/A	581320	Intact
Blend 12	N/A	581321	Intact
Cement 5	N/A	581322	Intact
Blend 13	N/A	581323	Intact
Blend 9	N/A	581324	Intact
Blend 10	N/A	581325	Intact
Blend 1	N/A	581326	Intact
Blend 2	N/A	581327	Intact

* Contact SMO and attach record of resolution

Reviewed By:	Logbook No.: Sample Receipt (56087)
Date: 12.21.15	Logbook Page No.: 9201 SEC 23 of 4

FORM DC-1

OLMO4.2

SAMPLE LOG-IN SHEET

010013

Lab Name: Southwest Research Institute	Page 2 of 3
Received By (Print Name): STEVEN DOUGLAS	Log-In Date: 09/03/2015
Received By (Signature): [signature]	
Case Number: Zeolite	Sample Delivery Group No.: NA
Remarks: 21592.01.00X	SAA Number: NA

1. Custody Seal(s)	(Present) / Absent* (Intact) / Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	(Present) / Absent*	
4. Traffic Reports or Packing Lists	Present (Absent)	
5. Airbill	Airbill/Sticker (Present) / Absent*	
6. Airbill No.	590817794105	
7. Sample Tags	Present (Absent)	
Sample Tag Numbers	Listed / (Not listed on Chain of Custody)	
8. Sample Condition	Intact / Broken*/ Leaking	
9. Cooler Temperature	21.2C	
10. Does information on custody records, traffic reports, and sample tags agree?	(Yes) / No*	
11. Date Received at Lab	09/03/2015	
12. Time Received	08:30:00	

Sample Transfer		
Fraction	Fraction	
Area # L. Spies	Area #	
By STEVEN DOUGLAS	By	
On 09/03/2015	On	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Blend 3	N/A	581328	Intact
Blend 4	N/A	581329	Intact
Cement 1	N/A	581330	Intact
Blend 5	N/A	581331	Intact
Blend 6	N/A	581332	Intact
Blend 7	N/A	581333	Intact
Blend 8	N/A	581334	Intact
Cement 2	N/A	581335	Intact
Blend 14	N/A	589460	Intact
Blend 15	N/A	589461	Intact
Blend 16	N/A	589462	Intact
Cement 10	N/A	589463	Intact
Cement 11	N/A	589464	Intact
Cement 12	N/A	589465	Intact
Cement 13	N/A	589466	Intact
Cement 14	N/A	589467	Intact
Cement 15	N/A	589468	Intact
Cement 6	N/A	589469	Intact
Cement 7	N/A	589470	Intact
Cement 8	N/A	589471	Intact
Cement 9	N/A	589472	Intact
Blend 17	N/A	589620	Intact
Blend 18	N/A	589621	Intact

* Contact SMO and attach record of resolution

Reviewed By [signature]	Logbook No. Sample Receipt (56087)
Date 12.21.15	Logbook Page No. 92015 2, 3 OF 4

SAMPLE LOG-IN SHEET

010014

Lab Name: Southwest Research Institute	Page 3 of 3
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 09/03/2015
Received By (Signature): Steven Douglas	
Case Number: Zeolite	Sample Delivery Group No.: NA
Remarks: 21592.01.00X	SAS Number: NA

1. Custody Seal(s)	(Present)/Absent* (Intact)/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	(Present)/Absent*	
4. Traffic Reports or Packing Lists	Present (Absent)	
5. Airbill	Airbill/Sticker (Present)/Absent*	
6. Airbill No.	590817794105	
7. Sample Tags	Present (Absent)	
Sample Tag Numbers	Listed/(Not listed on Chain of Custody	
8. Sample Condition	(Intact)/Broken*/ Leaking	
9. Cooler Temperature	21.2C	
10. Does Information on custody records, traffic reports, and sample tags agree?	(Yes)/No*	
11. Date Received at Lab	09/03/2015	
12. Time Received	08:30:00	

Sample Transfer		
Fraction: 1 Bag	Fraction:	
Area #: 10 Spots	Area #:	
By: STEVEN DOUGLAS	By:	
On: 09/03/2015	On:	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Blend 19	N/A	589622	Intact
Blend 20	N/A	589623	Intact
Blend 21	N/A	589624	Intact
Blend 22	N/A	589625	Intact
Blend 23	N/A	589626	Intact
Blend 24	N/A	589627	Intact
Blend 25	N/A	589628	Intact
ONS Blend 13	N/A	589629	Intact
ONS Blend 14	N/A	589630	Intact
ONS Blend 15	N/A	589631	Intact
ONS Blend 16	N/A	589632	Intact
ONS Blend 17	N/A	589633	Intact
ONS Blend 18	N/A	589634	Intact
ONS Blend 19	N/A	589635	Intact

* Contact SMO and attach record of resolution

Reviewed By: [signature]	Logbook No.: ~~Sample Receipt~~ (56087)
Date: 12415	Logbook Page No.: 9201 SBC 2,3 of 4

FORM DC-1 OLMO4.2

010015

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI TASK ORDER: 160328-2
SwRI SRR: 56087
SDG: 581291
VTSR: 09.03.2015
CASE: Zeolite

CASE NARRATIVE

Client: Los Alamos National Laboratory
SDG: 581291
SwRI Project Number: 21592.01.00x
SwRI Task Order Number: 160328-2

010016

WETCHEM ANALYSIS

DOT UN Liquid Oxidizer test

The two UNS liquid blends (#1 and #14) were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1 Test O.2 Test for oxidizing liquid.* The test method measures the potential for a liquid substance to increase the burn rate or intensity mixed at a 1:1 ratio with fibrous cellulose. The mixture is heated in a pressure vessel and the rate of pressure rise is determined and pressure rise time is compared to three reference materials (50% perchloric acid, 40% sodium chlorate and 65% nitric acid) when also mixed at a 1:1 ratio with the cellulose. The mean pressure rise of the reference substances are listed in Table 1 and the classifications are listed in the Table 2.

UNS Blends #1 and #14 had a mean pressure rise time of 36.468 and 34.156 msec; therefore, they are Not Division 5.1.

Table 1. Reference Substances

Mean pressure rise time, msec		
(1:1) 50 % perchloric acid and cellulose	(1:1) 40% aqueous sodium chlorate and cellulose	(1:1) 65% nitric acid and cellulose
0.131	0.645	6.784

Table 1. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in a 1:1 mixture, by mass, of substance and cellulose tested, spontaneously ignites; or the mean pressure rise time of a 1:1 mixture, by mass, of substance and cellulose is less than that of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose.	Packing group I
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chloreate solution and cellulose; and the criteria for Packing group I are not met	Packing group II
Any substance which, in the 1:1 mixtuer, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose; and the criteria for Packing groups I and II are not met.	Packing group III
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a pressure rise of less than 2070 kPa gauge; or exhibits a mean pressure rise time greater than the mean pressure rise time of a 1:1 mixture, by mass, of a 65% aqueous nitric acid and cellulose.	Not Division 5.1

Client: Los Alamos National Laboratory
SDG: 581291
SwRI Project Number: 21592.01.00x
SwRI Task Order Number: 160328-2

010017

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."



Group Leader

3/28/16
Date

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI TASK ORDER: 160328-2
SwRI SRR: 56087
SDG: 581291
VTSR: 09.03.2015
CASE: Zeolite

WETCHEM ANALYSIS

Sample Results

SOUTHWEST RESEARCH INSTITUTE

010019

UN LIQUID OXIDIZER TEST O.2

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Received: 09/03/2015

SRR #: 56087

Task Order #: 160328-2

Reference Substances

Mean pressure rise time, msec		
(1:1) 50 % perchloric acid and cellulose	(1:1) 40% aqueous sodium chlorate and cellulose	(1:1) 65% nitric acid and cellulose
0.131	0.645	6.784

Test Substance

Sample ID	SwRI System ID	Mean pressure rise time, msec 1:01 Sample:Cellulose Ratio	Classification	Date Analyzed
UNS Blend 1	581291	36.468	Not Division 5.1	03/25/16
UNS Blend 14	589630	34.156	Not Division 5.1	03/25/16

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in a 1:1 mixture, by mass, of substance and cellulose tested, spontaneously ignites; or the mean pressure rise time of a 1:1 mixture, by mass, of substance and cellulose is less than that of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose.	Packing group I
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chloreate solution and cellulose; and the criteria for Packing group I are not met	Packing group II
Any substance which, in the 1:1 mixtuer, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose; and the criteria for Packing groups I and II are not met.	Packing group III
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a pressure rise of less than 2070 kPa gauge; or exhibits a mean pressure rise time greater than the mean pressure rise time of a 1:1 mixture, by mass, of a 65% aqueous nitric acid and cellulose.	Not Division 5.1

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010020

Southwest Research Institute

UN Test O.2: Test for Oxidizing liquids

Client	LANL
Project #	21592.01.006
TO#	160328-2

RSpicer . 3/28/16

v/Jam 3/28/16

Standardization	
50% (w/w) HCLO4	Time, msec
1	0.108
2	0.133
3	0.117
4	0.163
5	0.134
avg	0.131
40% (w/w) NaCLO3	Time, msec
1	0.747
2	0.772
3	0.480
4	0.776
5	0.451
avg	0.645
65% (w/w) HNO3	Time, msec
1	6.845
2	7.765
3	6.749
4	5.951
5	6.611
avg	6.784

Sample Results

UNS #1	Time, msec	Classification
1	15.507	
2	51.045	
3	27.196	
4	47.143	
5	41.448	
avg	36.468	Not Div 5.1
UNS #14	Time, msec	
1	24.970	
2	54.180	
3	25.630	
4	18.399	
5	47.599	
avg	34.156	Not Div 5.1

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI TASK ORDER: 160328-2
SwRI SRR: 56087
SDG: 581291
VTSR: 09.03.2015
CASE: Zeolite

Logbook Pages

Work continued from Page

SWRI
010022

STD		Cellulose Wt. g	Chem. Wt. g
$HClO_4$, 50%	-1	2.5006	2.5016
	2	2.5014	2.5136
	3	2.5043	2.5087
	4	2.5015	2.5120
	5	2.5035	2.5036

		Cellulose Wt. g	Chem Wt. g
$NaClO_3$, 40%	-1	2.5015	2.5065
RSS 3/17	2	2.5045	2.5102
	3	2.5125	2.5025
	4	2.5075	2.5163
	5	2.5125	2.5107

HNO_3, 65%		Cellulose Wt. g	Chem Wt. g
	1	2.5126	2.5175
	2	2.5106	2.5065
	3	2.5009	2.5100
	4	2.5075	2.5175
	5	2.5057	2.5181

Balance # 135 (ID 020014)
$HClO_4$, 50% 79-03-WCS12
$NaClO_3$, 40% 79-01-WCS12
HNO_3, 65% 79-02-WCS12

Cellulose: Inv # 65520.

Pressure Transducers ~~#12~~ ID# 022492

12SS 3/23/16

www.scientificbindery88yrs.com

Work continued to Page 3/24/16

SIGNATURE [signature] DATE 3/22/16 thru 3/28/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE

NaClO, test

	Cellulose Wt g	Chem Wt. g. 100 psi	300 psi
	2.5102	2.5021	

UNS #1	Cellulose Wt. g	Chem Wt. g
1	2.5125	2.5104
2	2.5065	2.5063
3	2.5091	25167
4	2.5197	2.5097
5	2.5129	2.5164
	2.5104	2.5215

UNS #14	Cellulose Wt.	Chem Wt. g
1	2.5025	2.5126
2	2.5109	2.5200
3	2.5016	2.5110
4	2.5197	2.5065
5	2.5088	2.5126

UNS #1 (40-02-WCS12)

Prepared UNS #14 To 50 mL UNS #1 (40-02-WCS12) added 3.12 mL Waste Lock Allowed to Set Overnight prior to analysis.

Balance #135.

Pressure Transducer: ID# 022992.

SIGNATURE

DISCLOSED TO AND UNDERSTOOD BY

DATE 3/28/16.

DATE WITNESS

DATE 3/28/16 RSS 3/28/16.

Work continued from Page

010024

SWRI

40-01-WC012 - TISAB3

37.0315 g KCl (# 60103) +
68.0469 g sodium acetate (# 57005) +
36.0085 g CDTA (# 63100)
to F.V. 1000mL with DI H_2O Adjust pH to 5.5±0.2 with NaOH
balance #34 exp 2/2/17

40-02-WC012 HNO3 liquid

$Al(NO_3)_3$	1387.10	g (# 60580) +
$Ga(NO_3)_3$	140.1092	g (# 60583) +
$Cr(NO_3)_3$	10.3012	g (# 61751) +
$Fe(NO_3)_3$	99.2668	g (# 60581) +
$Mg(NO_3)_3$	668.10	g (# 60540) +
$NaNO_3$	82.3075	g (# 33383) +
$Ni(NO_3)_2$	0.4031	g (# 65593) +
$Pb(NO_3)_2$	99.4642	g (# 66142) +
Oxalic acid	395.604	g (# 65591) +
water	196.904	g +
HNO_3	10.6	g (# 62599)

add 100mL DI H_2O

SAM 2/2/16

SIGNATURE James Mack DATE 2/2/16

DISCLOSED TO AND UNDERSTOOD BY R Dyer DATE WITNESS DATE 3/8/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI TASK ORDER: 160328-2
SwRI SRR: 56087
SDG: 581291
VTSR: 09.03.2015
CASE: Zeolite

Certificates of Calibration

010026

Southwest Research Institute

Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	48788
Asset Number:	022992	Calibrated:	3/18/2016
Description:	PRESSURE TRANSDUCER	Calibration Due:	3/18/2017
Manufacturer:	OMEGA	Data Type:	FOUND / LEFT
Model Number:	PX309-500GI	Temp./RH:	68 °F / 40 %
Serial Number:	122010D089	Work Order #	403138243
Calibration Procedure:	PRESSURE GAUGES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? Indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
007001	AGILENT-HP	3458A OPT 002	MULTIMETER	4/29/2016
021448	FLUKE	PPC4	Pressure Controller	11/18/2016

Approved By

Calibrated By: RLC
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010027

Work Order:	403138243	Mfr:	Omega	Technician:	RLC
Asset No.:	022992	Model:	PX309-500GI	Type Data:	Found-left
Serial No.:	122010D089	Type:	Pressure Transducer	Cal Date:	18-Mar-16

Remarks: Data is referenced to a Best Fit Straight Line.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Output for psi applied	mA	mA	mA	mA	mA		
0	3.993	3.981	-0.012	0.040	0.019	Pass	30%
100	7.185	7.188	0.003			Pass	8%
200	10.378	10.382	0.004			Pass	10%
300	13.570	13.580	0.010			Pass	25%
400	16.763	16.755	-0.008			Pass	20%
500	19.955	19.943	-0.012			Pass	30%
400	16.763	16.764	0.001			Pass	2%
300	13.570	13.577	0.007			Pass	17%
200	10.378	10.386	0.008			Pass	20%
100	7.185	7.190	0.005			Pass	13%
0	3.993	3.985	-0.008			Pass	20%
Zero Balance	4.000	3.981	-0.019	0.400	0.019	Pass	5%

END OF REPORT

010028

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39984
Asset Number:	020014	Calibrated:	10/7/2015
Description:	BALANCE	Calibration Due:	10/7/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	72 °F / 49 %
Serial Number:	B338797310	Work Order #	403134943
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? Indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute

Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

010030

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0002	0.0002	0.0006	Pass	33%
Left Rear		100.0003	0.0003		Pass	50%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0002	0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	80.00001				
2		80.00002				
3		80.00001				
4		80.00002				
5		80.00001				
6		80.00002				
7		80.00002				
8		80.00002				
9		80.00002				
10		80.00002				
Std Deviation		0.000005		0.00008	Pass	6%
< 220 g Range						
1	200	200.0001				
2		200.0000				
3		200.0002				
4		200.0001				
5		200.0002				
6		200.0001				
7		200.0002				
8		200.0002				
9		200.0002				
10		200.0002				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.06	Pass	0%
	8.00001	8.00002	0.01			Pass	3%
	15.99996	15.99995	-0.01			Pass	3%
	24.00005	24.00010	0.05			Pass	13%
	32.00000	32.00006	0.06			Pass	15%
	40.00002	40.00007	0.05			Pass	13%
	48.00003	48.00006	0.03			Pass	8%

Appendix L
SwRI Test Report 598477, June 27, 2016

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

June 27, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Victor Garde

Subject:		
	Case:	Zeolite
	SwRI Project Number:	21592.01.00X
	SDG:	598447
	SwRI Task Order Number:	160605-2
	SwRI Sample Receipt Number:	57710
	Samples Received:	05.31.2016
	Analysis:	Solid Sodium Nitrate Solutions

Dear Mr. Garde,

Please find the enclosed results for the eighteen overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

FOR Radonna Spies
Group Leader – R&D

APPROVED:

Michael J. Dammann
Director

RPS: jz

Cc: Anya Gonzales, Los Alamos National Laboratory

Encl

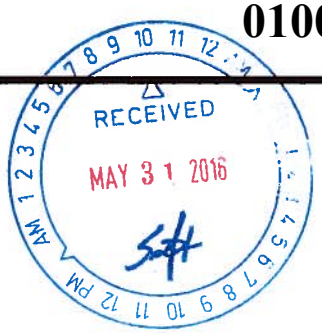
SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Chain-of-Custody
&
Sample Receipt Paperwork

Total Page Count: 010001
Fraction: Sodium Nitrate Solutions Pages: 010134

010002

Douglas, Steven M.



From: Moken, James A.
Sent: Tuesday, May 31, 2016 9:27 AM
To: Douglas, Steven M.
Subject: Sample ID's

Steven,

Can I get you to make sample ID's and SDG's for the following samples. Table 1 will need to be on one SDG and Table 2 will be on a separate SDG since we will be adding samples to it later this month. If you have any questions let me know. Thanks.

Table 1

Requested Analysis					
Sample ID	**SW-846 Test Method 1030**	**SW-846 Test Method 1050**	**DOT O.1 Test**	**DOT O.2 Test**	**Test Method 9095B (Paint Filter)**
Sod Nit A				X	
Sod Nit Sol – Zeo 1			X		X
Sod Nit Sol – Zeo 2			X		X
Sod Nit B				X	
Sod Nit B – Zeo 1			X		X
Sod Nit B – Zeo 2			X		X
Sod Nit A pH – Zeo 1			X		X
Sod Nit A pH – Zeo 2			X		X
Sod Nit A Blend 1	X	X	X		X
Sod Nit A Blend 2	X	X	X		X
Sod Nit A Blend 3	X	X	X		X
Sod Nit A Blend 4	X	X	X		X
Sod Nit B Blend 1	X	X	X		X
Sod Nit B Blend 2	X	X	X		X
Sod Nit B Blend 3	X	X	X		X
Sod Nit B Blend 4	X	X	X		X
Sod Nit A pH Blend 1	X	X	X		X
Sod Nit A pH Blend 2	X	X	X		X
Sod Nit A pH Blend 3	X	X	X		X
Sod Nit A pH Blend 4	X	X	X		X

Table 2

Wypall Blend ID (Wypall mix: zeolite)	Wypall Mixture (ml)	Zeolite (ml)

Client: Los Alamos National Laboratory
SRR # 57710
Project # 21592.01.00X
Case: Zeolite
VTSR: 05/31/2016
Sample(s) Received: Intact
Temperature: N/A °C/ SN #: N/A

WB1(1:3)	1233	3700
WB2(1:4)	925	3700
WB3(1:5)	740	3700

Jamie

Southwest Research Institute

Laboratory Task Order

010004

TO #: 160605-2 Revision: 2

SDG: 598447

SRR #'s: 57710

Client(s): Los Alamos National Laboratory

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 06/19/16

Instructions

Documents Related to this task order: 200812[COC for SRR 57710], 200814[SRR Paperwork for SRR 57710]

Deliverables --> Hard Copy: -YES- EDD: no PDF: no

Test: COMB_1050
Section: WETCHEM

Holding: 180 days from CED

SW846 1050 Test A & C Spontaneous Combustion

Cnt: 12

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
598447		1	Solid	Sod Nit A Blend 1	NO DATA	NO DATA
598448		1	Solid	Sod Nit A Blend 2	NO DATA	NO DATA
598449		1	Solid	Sod Nit A Blend 3	NO DATA	NO DATA
598450		1	Solid	Sod Nit A Blend 4	NO DATA	NO DATA
598453		1	Solid	Sod Nit A pH Blend - 1	NO DATA	NO DATA
598454		1	Solid	Sod Nit A pH Blend - 2	NO DATA	NO DATA
598455		1	Solid	Sod Nit A pH Blend - 3	NO DATA	NO DATA
598456		1	Solid	Sod Nit A pH Blend - 4	NO DATA	NO DATA
598460		1	Solid	Sod Nit B Blend 1	NO DATA	NO DATA
598461		1	Solid	Sod Nit B Blend 2	NO DATA	NO DATA
598462		1	Solid	Sod Nit B Blend 3	NO DATA	NO DATA
598463		1	Solid	Sod Nit B Blend 4	NO DATA	NO DATA

Test: IGNIT_1030
Section: WETCHEM

Holding: 180 days from CED

SW 846 Method 1030 Ignitability of solids

Cnt: 12

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
598447		1	Solid	Sod Nit A Blend 1	NO DATA	NO DATA
598448		1	Solid	Sod Nit A Blend 2	NO DATA	NO DATA
598449		1	Solid	Sod Nit A Blend 3	NO DATA	NO DATA
598450		1	Solid	Sod Nit A Blend 4	NO DATA	NO DATA
598453		1	Solid	Sod Nit A pH Blend - 1	NO DATA	NO DATA
598454		1	Solid	Sod Nit A pH Blend - 2	NO DATA	NO DATA
598455		1	Solid	Sod Nit A pH Blend - 3	NO DATA	NO DATA
598456		1	Solid	Sod Nit A pH Blend - 4	NO DATA	NO DATA
598460		1	Solid	Sod Nit B Blend 1	NO DATA	NO DATA
598461		1	Solid	Sod Nit B Blend 2	NO DATA	NO DATA
598462		1	Solid	Sod Nit B Blend 3	NO DATA	NO DATA
598463		1	Solid	Sod Nit B Blend 4	NO DATA	NO DATA

Test: Oxidizer_UN
Section: WETCHEM

Holding: 180 days from CED

United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.

Cnt: 18

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
598447		1	Solid	Sod Nit A Blend 1	NO DATA	NO DATA
598448		1	Solid	Sod Nit A Blend 2	NO DATA	NO DATA
598449		1	Solid	Sod Nit A Blend 3	NO DATA	NO DATA
598450		1	Solid	Sod Nit A Blend 4	NO DATA	NO DATA

Southwest Research Institute

Laboratory Task Order

010005

TO #: 160605-2 Revision: 2

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 06/19/16

SDG: 598447

SRR #'s: 57710
Client(s): Los Alamos National Laboratory

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
598451		1	Solid	Sod Nit A pH - Zeo 1	NO DATA	NO DATA
598452		1	Solid	Sod Nit A pH - Zeo 2	NO DATA	NO DATA
598453		1	Solid	Sod Nit A pH Blend - 1	NO DATA	NO DATA
598454		1	Solid	Sod Nit A pH Blend - 2	NO DATA	NO DATA
598455		1	Solid	Sod Nit A pH Blend - 3	NO DATA	NO DATA
598456		1	Solid	Sod Nit A pH Blend - 4	NO DATA	NO DATA
598458		1	Solid	Sod Nit B - Zeo 1	NO DATA	NO DATA
598459		1	Solid	Sod Nit B - Zeo 2	NO DATA	NO DATA
598460		1	Solid	Sod Nit B Blend 1	NO DATA	NO DATA
598461		1	Solid	Sod Nit B Blend 2	NO DATA	NO DATA
598462		1	Solid	Sod Nit B Blend 3	NO DATA	NO DATA
598463		1	Solid	Sod Nit B Blend 4	NO DATA	NO DATA
598464		1	Solid	Sod Nit Sol - Zeo 1	NO DATA	NO DATA
598465		1	Solid	Sod Nit Sol - Zeo 2	NO DATA	NO DATA

Test: PAINT_9095
Section: WETCHEM

Holding: 180 days from CED

SW846 9095 Paint Filter Liquids Test

Cnt: 18

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
598447		1	Solid	Sod Nit A Blend 1	NO DATA	NO DATA
598448		1	Solid	Sod Nit A Blend 2	NO DATA	NO DATA
598449		1	Solid	Sod Nit A Blend 3	NO DATA	NO DATA
598450		1	Solid	Sod Nit A Blend 4	NO DATA	NO DATA
598451		1	Solid	Sod Nit A pH - Zeo 1	NO DATA	NO DATA
598452		1	Solid	Sod Nit A pH - Zeo 2	NO DATA	NO DATA
598453		1	Solid	Sod Nit A pH Blend - 1	NO DATA	NO DATA
598454		1	Solid	Sod Nit A pH Blend - 2	NO DATA	NO DATA
598455		1	Solid	Sod Nit A pH Blend - 3	NO DATA	NO DATA
598456		1	Solid	Sod Nit A pH Blend - 4	NO DATA	NO DATA
598458		1	Solid	Sod Nit B - Zeo 1	NO DATA	NO DATA
598459		1	Solid	Sod Nit B - Zeo 2	NO DATA	NO DATA
598460		1	Solid	Sod Nit B Blend 1	NO DATA	NO DATA
598461		1	Solid	Sod Nit B Blend 2	NO DATA	NO DATA
598462		1	Solid	Sod Nit B Blend 3	NO DATA	NO DATA
598463		1	Solid	Sod Nit B Blend 4	NO DATA	NO DATA
598464		1	Solid	Sod Nit Sol - Zeo 1	NO DATA	NO DATA
598465		1	Solid	Sod Nit Sol - Zeo 2	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 57710

VTSR: 05/31/16 Time: 10:00:00

Project: 21S92.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 05/31/16

Notes

Email was received to create an SRR for the following.

Parameters: Requirements located on the applicable Task Order.

See chain of custody as part of the LIMS system for more information.

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
598446	Sod Nit A		Liquid	1	
598447	Sod Nit A Blend 1		Solid	1	
598448	Sod Nit A Blend 2		Solid	1	
598449	Sod Nit A Blend 3		Solid	1	
598450	Sod Nit A Blend 4		Solid	1	
598451	Sod Nit A pH - Zeo 1		Solid	1	
598452	Sod Nit A pH - Zeo 2		Solid	1	
598453	Sod Nit A pH Blend - 1		Solid	1	
598454	Sod Nit A pH Blend - 2		Solid	1	
598455	Sod Nit A pH Blend - 3		Solid	1	
598456	Sod Nit A pH Blend - 4		Solid	1	
598457	Sod Nit B		Liquid	1	
598458	Sod Nit B - Zeo 1		Solid	1	
598459	Sod Nit B - Zeo 2		Solid	1	
598460	Sod Nit B Blend 1		Solid	1	
598461	Sod Nit B Blend 2		Solid	1	
598462	Sod Nit B Blend 3		Solid	1	
598463	Sod Nit B Blend 4		Solid	1	
598464	Sod Nit Sol - Zeo 1		Solid	1	
598465	Sod Nit Sol - Zeo 2		Solid	1	

Containers: 20 **Samples: 20**

These documents are associated with this receipt: 200812[COC for SRR 57710], 200814[SRR Paperwork for SRR 57710]

Thermometer: N/A
Temperature: N/A

Page Printed: 06/27/2016 14:29
ver: (7/18/2014)

57710 Los Alamos National Laborato

Southwest Research Institute

Traffic Report

010007

Sample Custodian Signature: _____

1. Custody Seal — Not Present or Damaged
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: Zeolite / SDG: _____

Sample Receipt: 57710

Airbill: Email

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
05/31/16	10:00:00	Email	Sod Nit A	N/A	598446	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A Blend 1	N/A	598447	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A Blend 2	N/A	598448	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A Blend 3	N/A	598449	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A Blend 4	N/A	598450	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH - Zeo 1	N/A	598451	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH - Zeo 2	N/A	598452	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH Blend - 1	N/A	598453	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH Blend - 2	N/A	598454	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH Blend - 3	N/A	598455	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH Blend - 4	N/A	598456	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B	N/A	598457	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B - Zeo 1	N/A	598458	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B - Zeo 2	N/A	598459	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B Blend 1	N/A	598460	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B Blend 2	N/A	598461	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B Blend 3	N/A	598462	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B Blend 4	N/A	598463	YES	Intact
05/31/16	10:00:00	Email	Sod Nit Sol - Zeo 1	N/A	598464	YES	Intact
05/31/16	10:00:00	Email	Sod Nit Sol - Zeo 2	N/A	598465	YES	Intact

SAMPLE LOG-IN SHEET **010008**

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 05/31/2016
Received By (Signature): SD	
Case Number: Zeolite	Sample Delivery Group No.: NA
	SAS Number: NA

Remarks: 21592.01.00X

1.	Custody Seal(s)	Present/Absent* Intact/Broken
2.	Custody Seal Nos.	N/A
3.	Chain-of Custody Records	Present/Absent*
4.	Traffic Reports or Packing Lists	Present/Absent
5.	Airbill	Airbill/Sticker Present/Absent*
6.	Airbill No.	Email
7.	Sample Tags	Present/Absent
	Sample Tag Numbers	Listed/Not listed on Chain of Custody
8.	Sample Condition	Intact/Broken*/ Leaking
9.	Cooler Temperature	N/AC
10.	Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*
11.	Date Received at Lab	05/31/2016
12.	Time Received	10:00:00

Sample Transfer	
Fraction: INORG	Fraction
Area #: J. MOKE	Area #
By: STEVEN DOUGLAS	By
On: 05/31/2016	On

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Sod Nit A	N/A	598446	Intact
Sod Nit A Blend 1	N/A	598447	Intact
Sod Nit A Blend 2	N/A	598448	Intact
Sod Nit A Blend 3	N/A	598449	Intact
Sod Nit A Blend 4	N/A	598450	Intact
Sod Nit A pH - Zeo 1	N/A	598451	Intact
Sod Nit A pH - Zeo 2	N/A	598452	Intact
Sod Nit A pH Blend - 1	N/A	598453	Intact
Sod Nit A pH Blend - 2	N/A	598454	Intact
Sod Nit A pH Blend - 3	N/A	598455	Intact
Sod Nit A pH Blend - 4	N/A	598456	Intact
Sod Nit B	N/A	598457	Intact
Sod Nit B - Zeo 1	N/A	598458	Intact
Sod Nit B - Zeo 2	N/A	598459	Intact
Sod Nit B Blend 1	N/A	598460	Intact
Sod Nit B Blend 2	N/A	598461	Intact
Sod Nit B Blend 3	N/A	598462	Intact
Sod Nit B Blend 4	N/A	598463	Intact
Sod Nit Sol - Zeo 1	N/A	598464	Intact
Sod Nit Sol - Zeo 2	N/A	598465	Intact

* Contact SMO and attach record of resolution

Reviewed By:	Logbook No.: Sample Receipt (57710)
Date: 6.1.16	Logbook Page No.: 9472 SOC 1 of 2

010009

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Case Narrative

Client: Los Alamos National Laboratory **010010**
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160605-2

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of the solid Sodium Nitrate solution blends presented in Table 1 which contains the sample ID's and the methods requested on each of the blends. Three different sodium nitrate solutions were prepared in accordance with the scope of work provided by Los Alamos. The three solutions include; 1 molar nitric acid (Sod Nit A) and 1 molar sodium hydroxide (Sod Nit B) solutions saturated with sodium nitrate, and a 1 molar nitric acid solution that was first saturated with sodium nitrate and then pH adjusted between 4-9 with Spilfyter® Kolorsafe® liquid acid neutralizer (Sod Nit A pH).

To make the blends, each solution was mixed with Swheat in the designated ratios and then allowed to set for 24 hours. After the 24 hours water was added if required and then zeolite was added in the designated ratios. Once the zeolite was added the samples were allowed to set for an additional 24 hours prior to submittal for analysis (Image 1).

Table 1. Surrogate creation and analysis table

Surrogate ID	Times made	Methods			
		1030	1050	UN Ox solid (DOT 0.1)	Paint filter
Sod Nit A – Zeo 1	2	*	*	1	1
Sod Nit A – Zeo 2	1	*	*	1	1
Sod Nit B – Zeo 1	2	*	*	1	1
Sod Nit B - Zeo 2	1	*	*	1	1
Sod Nit A pH – Zeo 1	1	*	*	1	1
Sod Nit A pH – Zeo 2	1	*	*	1	1
Sod Nit A Blend 1	1	1	1	1	1
Sod Nit A Blend 2	1	1	1	1	1
Sod Nit A Blend 3	1	1	1	1	1
Sod Nit A Blend 4	1	1	1	1	1
Sod Nit B Blend 1	1	1	1	1	1
Sod Nit B Blend 2	1	1	1	1	1
Sod Nit B Blend 3	1	1	1	1	1
Sod Nit B Blend 4	1	1	1	1	1
Sod Nit A pH Blend 1	1	1	1	1	1
Sod Nit A pH Blend 2	1	1	1	1	1
Sod Nit A pH Blend 3	1	1	1	1	1
Sod Nit A pH Blend 4	1	1	1	1	1

*Testing not required for these methods.

(Note: Sod Nit A and Sod Nit B – UN Ox Liquid (DOT 0.2) testing will be submitted separately.)

SW-846 9095B: Paint Filter

For this method 100g of each blend was placed into a Gerson 260um paint filter (PN010714R, Lot# B5140428JF8) that was suspended over a 250 mL beaker for 5 minutes to collect any free liquids. During this 5-min period if any of the sample material drips into the cylinder, the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314. Initially, Sod Nit A – Zeo 1 and Sod Nit B – Zeo 1 were made at the requested 2:1 Zeolite to waste ratio. When these two samples were analyzed they both began dripping liquid after about 3 minutes in the paint filter (Image 2). When this information was presented to the Los Alamos, they decided to raise the ratio from 2:1 to 4:1. Under the laboratory conditions all other sodium nitrate blends tested for paint filter were not deemed to contain free liquids.

SW-846 1030: Ignitability of Solids

An ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within 2 minutes. If the material combustion propogates, the burning time was measured over a distance of 100 mm and the rate of burning would be determined. The surrogate material was formed into an unbroken powder train, 250 mm in length atop a ceramic tile with marks at the 80 and 180 mm in from the end of the train. The ceramic tile was placed about 8 inches in a hood with the sash lowered to give airflow of about 0.7 m/sec. One end of the train was exposed to the end of an acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes and if the sample began to burn down the train the time taken to get from the 80 to 180 mm mark was measure to determine the burn rate.

All of the sodium nitrate samples followed the same series of events during the analysis. The surrogate sample would go from a moistened, green color to a dry white, faint green color as the heat dried the sample; the samples would then proceed to char (Image 3). The only notable difference was all the Sod Nit A Blends 1 through 4, Sod Nit A pH Blend 1, and Sod Nit B Blend 3 had a cracking sound to them most likely from the nitrate salts being heated. Since none of the blends burned into the 100mm zone, all are considered non-flammable under the test conditions and criteria outlined in Method 1030.

Fine Excelsior (natural hardwood shavings) were used as a positive control each day testing was performed.

SW-846 1050: Spontaneous combustion and self heating

The surrogates for this analysis were first sprinkled several times onto a ceramic tile to observe if they smoked or flamed and could be considered pyrophoric solids by test Method A. Since none of the samples exhibited these characteristics, they were tested by Method C. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200C within the 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 2.

Table 2. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cube was placed into an oven with two thermocouples measuring the oven temp and up to four thermocouples inserted into each sample to measure its temperature during the analysis. Lids were placed onto the top of the test cubes and tungsten weights were placed on top of those sample believed to have event in order to keep the thermocouples and lids from coming off the sample. Also up to two thermocouples were placed in a tray below the sample in case any sample pushed out of the cube and onto the tray. Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for 24-48 hours depending on when the sample reached a stable temperature. Although the method states testing to be conducted for 24 hours, many of the samples did not reach 140°C ± 2°C during the initial 24 hour period, therefore the testing was extended to a minimum of 12 hours after the sample had reached a stable temperature. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C during the time of testing. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample. The oven and sample temperature graphs are located in Attachment A.

Two sodium nitrate samples were analyzed simultaneously, using the 100mm cube, since past samples having similar combinations of waste and zeolite did not self heat. These blends were allowed to run for at least 38 hours before ending the analysis due to their moisture content. Although the method states testing to be conducted for 24 hours, many of the samples not reaching 140°C ± 2°C during the initial 24 hour period, therefore the testing was extended to a minimum of 12 hours after the sample had reached a stable temperature. After the analysis the cubes were removed and all had a dried zeolite appearance to them and most of them came readily out of the cube. Sod Nit A pH Blend 1 formed hardened chunks of zeolite but no odd coloring or event took place (Image 4). Since none of these blends exceeded 200°C during the analysis all of them are classified as "Not a Self-Heating Waste" as defined by Method 1050.

DOT UN Oxidation testing

The sodium nitrate solid blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the samples mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. If the burning time is less than the standard mixture, the burning times should be compared with those from packing group I or II or category I or II oxidizer, reference standards 3:2 and 2:3, by mass, of potassium bromated to cellulose, respectively. See Table 3 for classification. Table 4 presents the results for the reference standards. Tables 5 and 6 lists the comments the analyst noted for each of the two sample-to- cellulose ratio burns.

All sodium nitrate solid blends were classified as "Not Division 5.1".

Table 3. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	UN Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

Table 4. Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
135.32	52.44	19.54

Table 5. Comments for Sample to Cellulose ratio of 4:1

Sample ID	Comment 4:1
Sod Nit A – Zeo 1	Spontaneous flames at wire leads, charring, smoke
Sod Nit A – Zeo 2	Charring around wire leads, smoke, no flame
Sod Nit B – Zeo 1	Charring at wire leads, smoke.
Sod Nit B - Zeo 2	Charring around wire leads & smoking
Sod Nit A pH – Zeo 1	Charring around wire, smoke, no flames
Sod Nit A pH – Zeo 2	Charring around wire, smoke, no flames
Sod Nit A Blend 1	Charring around wire, smoke, no flames
Sod Nit A Blend 2	Charring at wire leads, slight smoke, no flames
Sod Nit A Blend 3	Charring around wire, smoke
Sod Nit A Blend 4	Charring around wire, smoke, no flames
Sod Nit B Blend 1	Charring around wire, smoke, no flames
Sod Nit B Blend 2	Charring around wire, smoke, no flames
Sod Nit B Blend 3	Charring at wire leads, smoke & random flames at wire leads
Sod Nit B Blend 4	Charring around wire leads & smoke, no flames
Sod Nit A pH Blend 1	Charring around wire leads, spontaneous flame at front wire lead. Smoke
Sod Nit A pH Blend 2	Charring around wire and smoke
Sod Nit A pH Blend 3	Charring around wire, smoke, no flames
Sod Nit A pH Blend 4	Charring around wire leads, smoke, no flames

Table 6 Comments for Sample to Cellulose ratio of 1:1

Sample ID	Comment 1:1
Sod Nit A – Zeo 1	low flames at wire leads, charring and smoke.
Sod Nit A – Zeo 2	low flames at the wire leads, charring and smoke
Sod Nit B – Zeo 1	flames at wire leads, smoke + charring. One rep had slight propagation of the flame.
Sod Nit B - Zeo 2	charring at wire leads and smoking
Sod Nit A pH – Zeo 1	small flames at wire leads, charring and smoke
Sod Nit A pH – Zeo 2	small flames at wire leads, smoke and charring
Sod Nit A Blend 1	small flames at wire leads, smoke + charring
Sod Nit A Blend 2	small flames at wire leads, smoke
Sod Nit A Blend 3	small flames at wire leades, charring and smoke. Flame propagated slightly on one rep.
Sod Nit A Blend 4	low flames ta wire leads, charring and smoke. Flames propagated slightly around the sides of the mound.
Sod Nit B Blend 1	small flames at wire leads, smoke and charring
Sod Nit B Blend 2	small flames at wire leads, charring and smoke
Sod Nit B Blend 3	low flames at wire leads, charring & smoke
Sod Nit B Blend 4	small flame at wire leads, smoke & charring.
Sod Nit A pH Blend 1	flames at wire leads + slight propagation, charring and smoke
Sod Nit A pH Blend 2	small flames at wire leads, charring & smoke
Sod Nit A pH Blend 3	small flames at wire leads, charring and smoke
Sod Nit A pH Blend 4	low flames at wire leads, charring and smoke



Image 1: Appearance of the sodium nitrate solution blends setting for 24 hours after the addition of the zeolite.

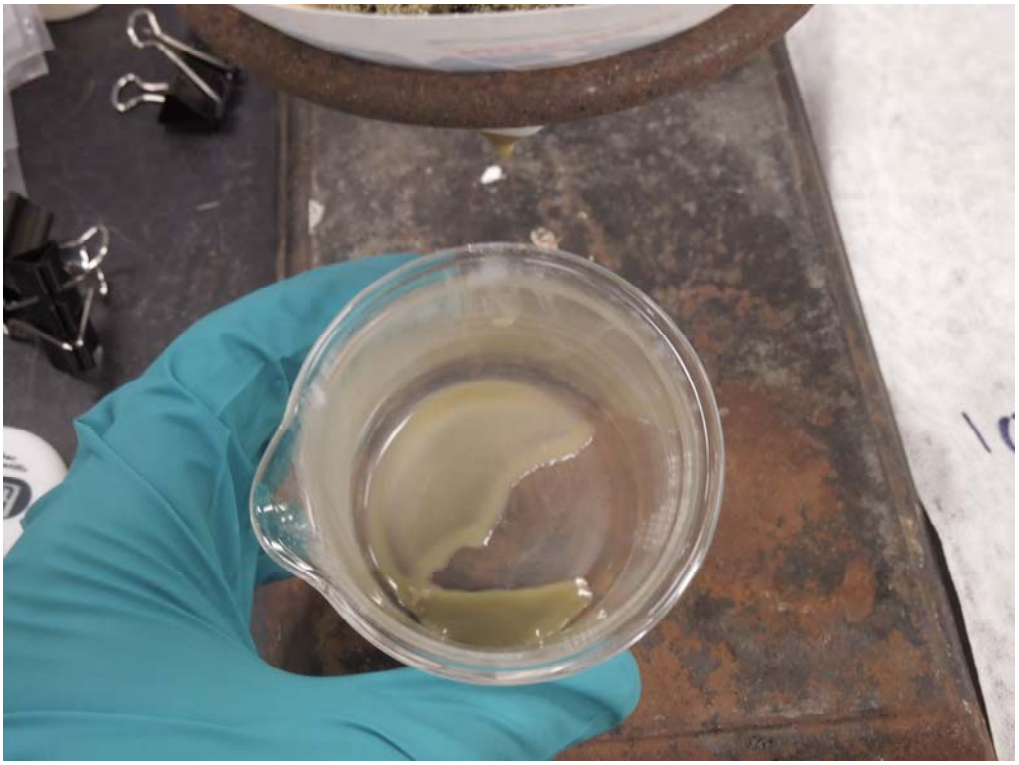


Image 2: Showing the liquid draining out of the paint filter after 5 minutes from Sod Nit A – Zeo 1 at a 2:1 zeolite to waste ratio.



Image 3: Appearance of the Sodium nitrate blends after flame application for 2 minutes during 1030 analysis.



Image 4: Solid chunk formed during 1050 analysis from Sod Nit A pH 1.

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."

RSpies

Group Leader **Date** **06/24/16**

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Attachment A

Method 1050 Graphs

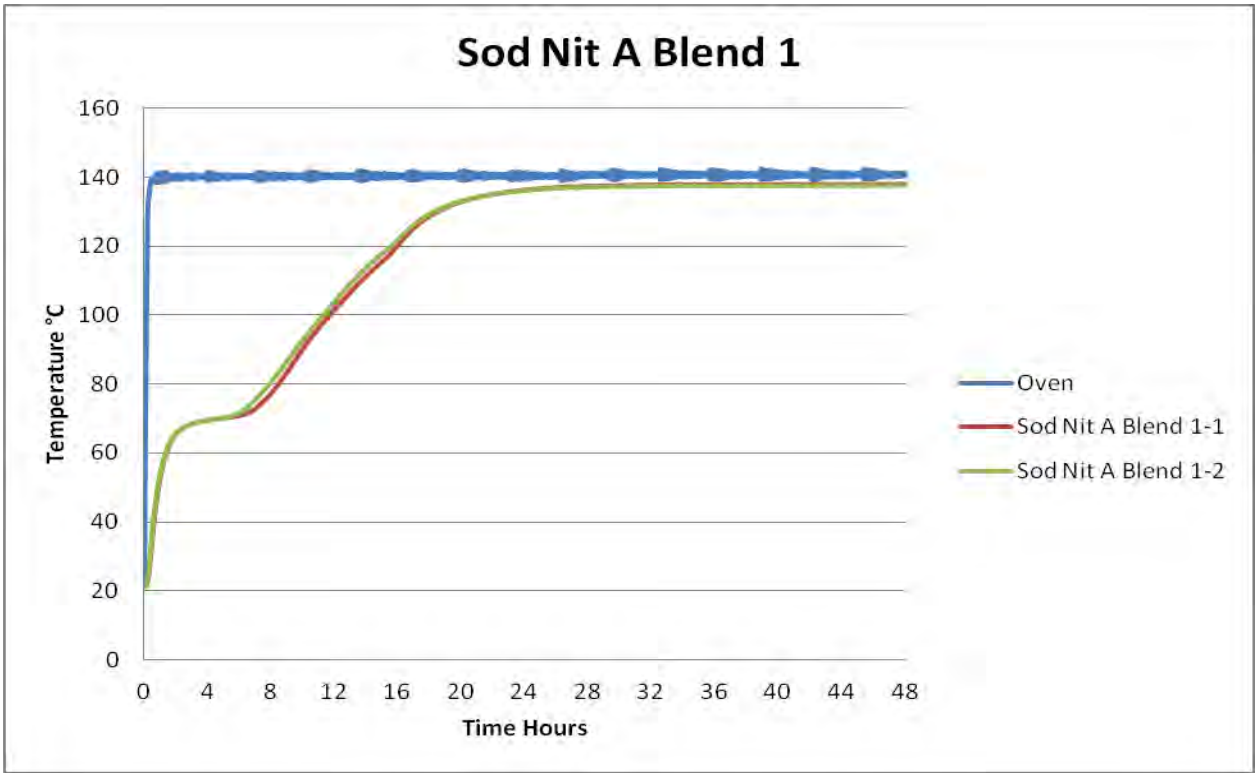


Figure 1. Method 1050 – Sod Nit A Blend 1 (100mm cube) full run.

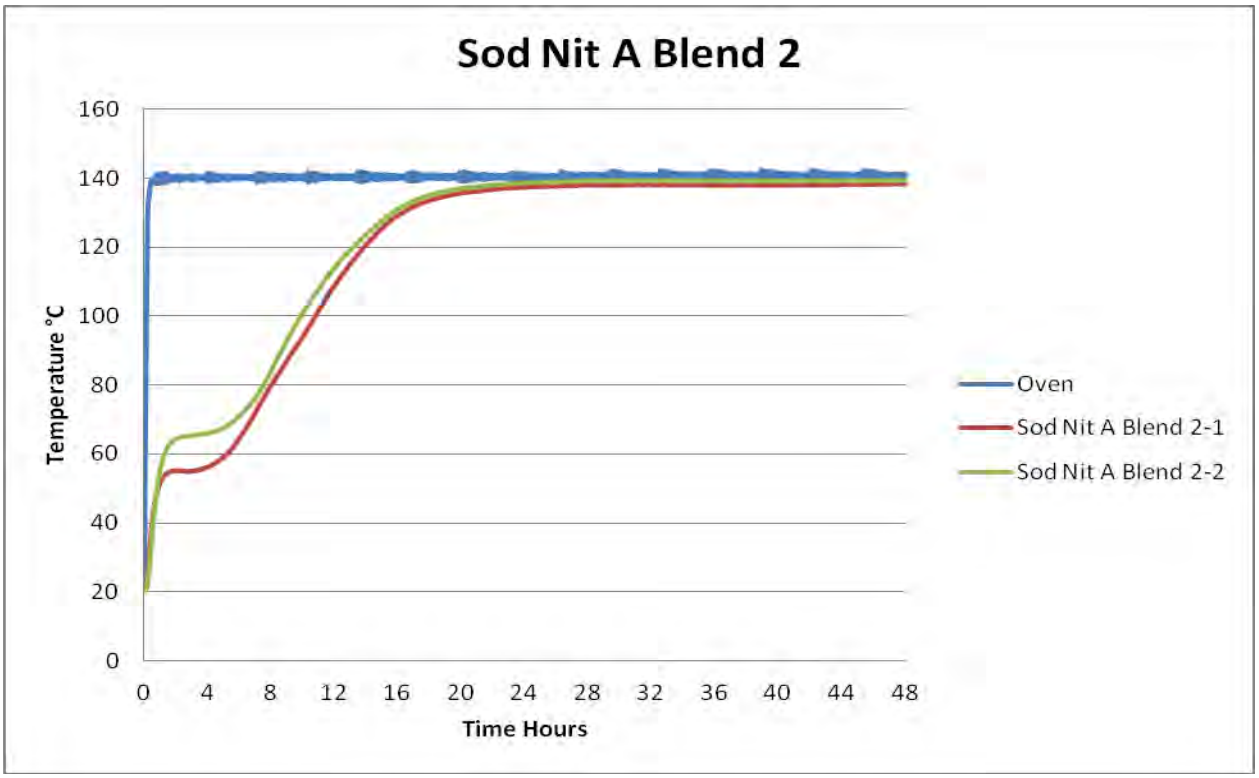


Figure 2. Method 1050 – Sod Nit A Blend 2 (100mm cube) full run.

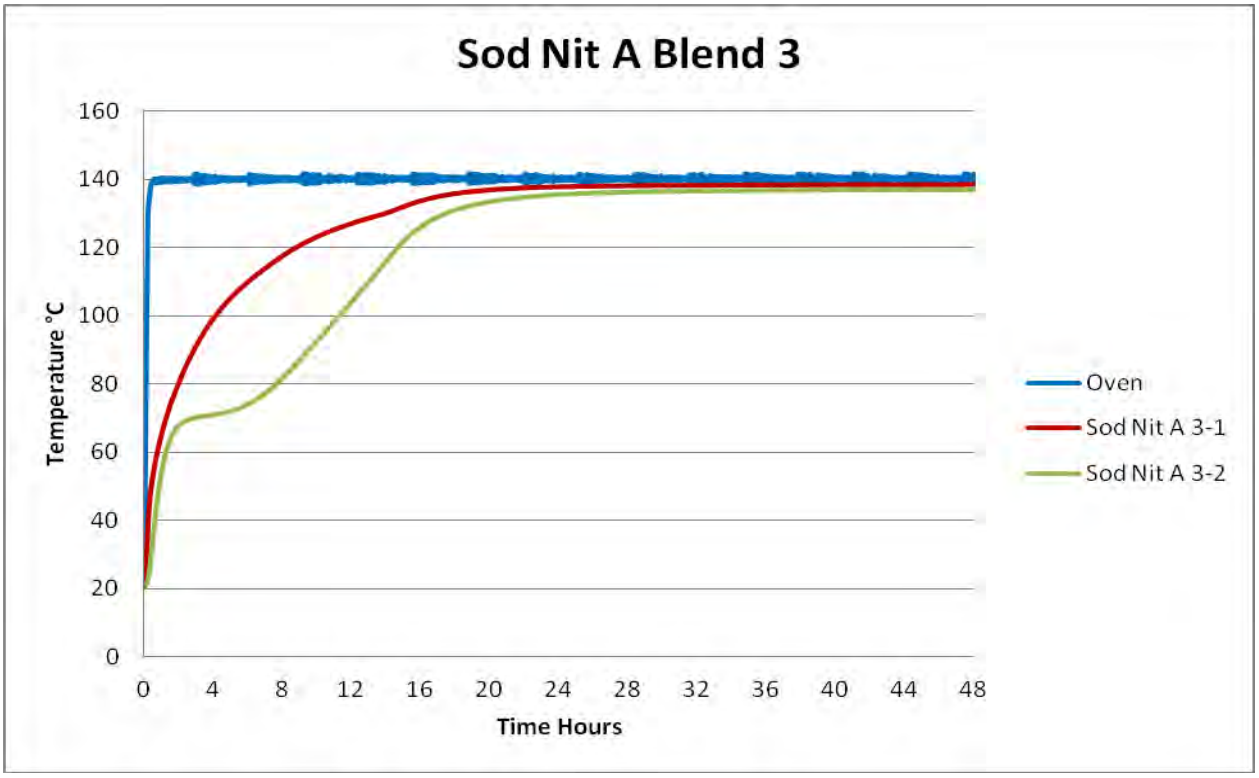


Figure 3. Method 1050 – Sod Nit A Blend 3 (100mm cube) full run.

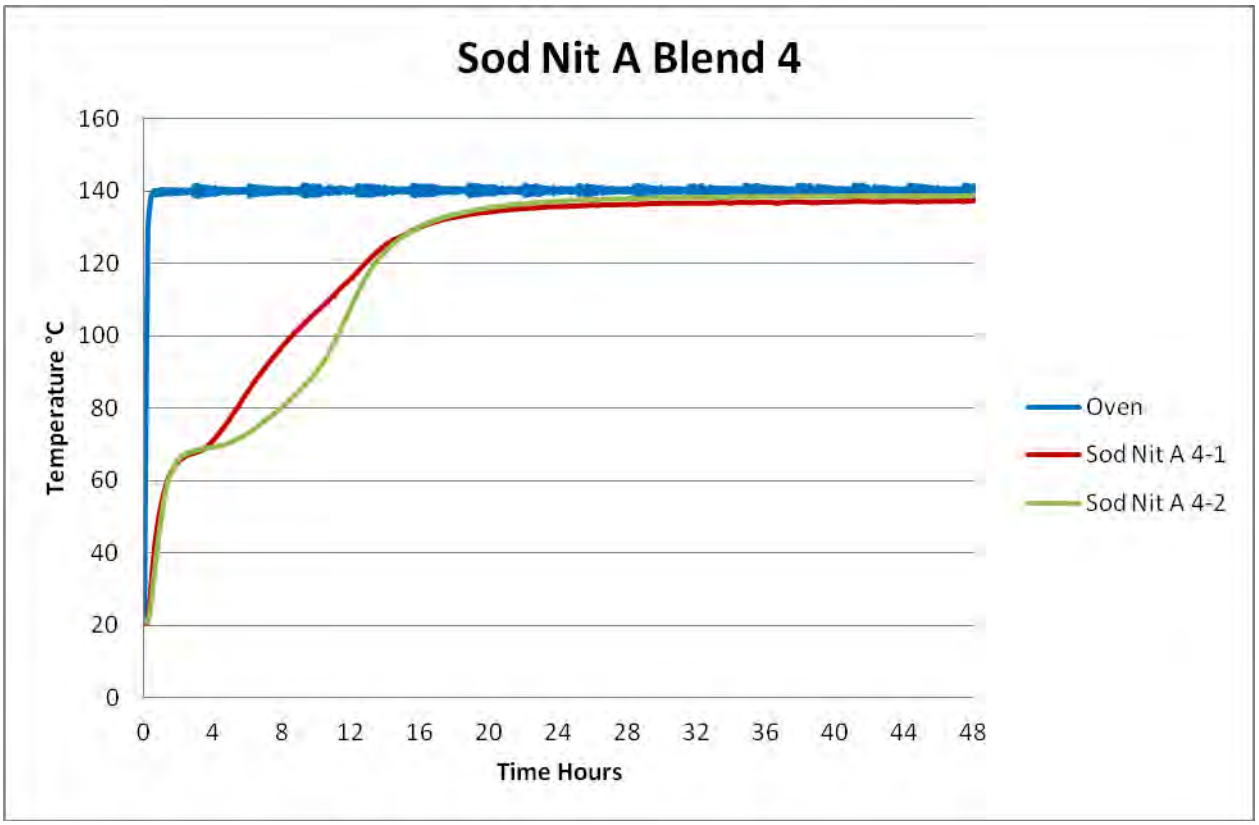


Figure 4. Method 1050 – Sod Nit A Blend 4 (100mm cube) full run.

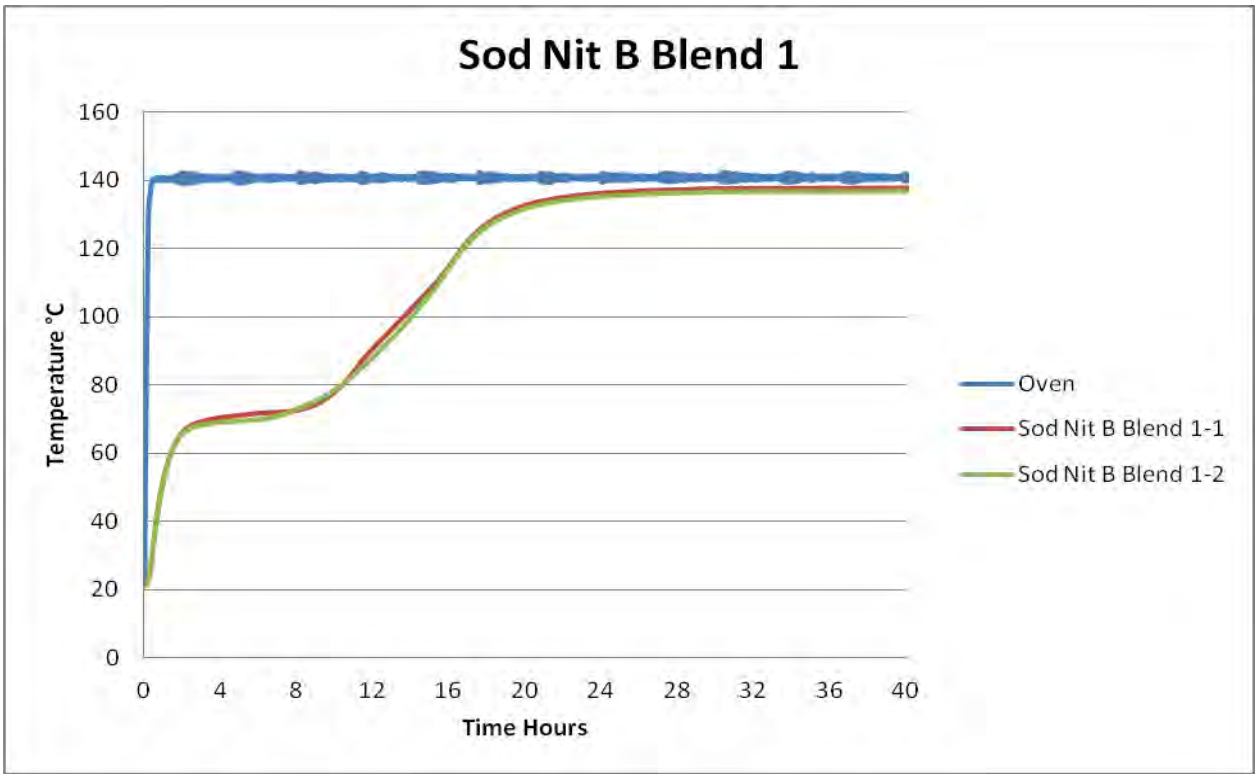


Figure 5. Method 1050 – Sod Nit B Blend 1 (100mm cube) full run.

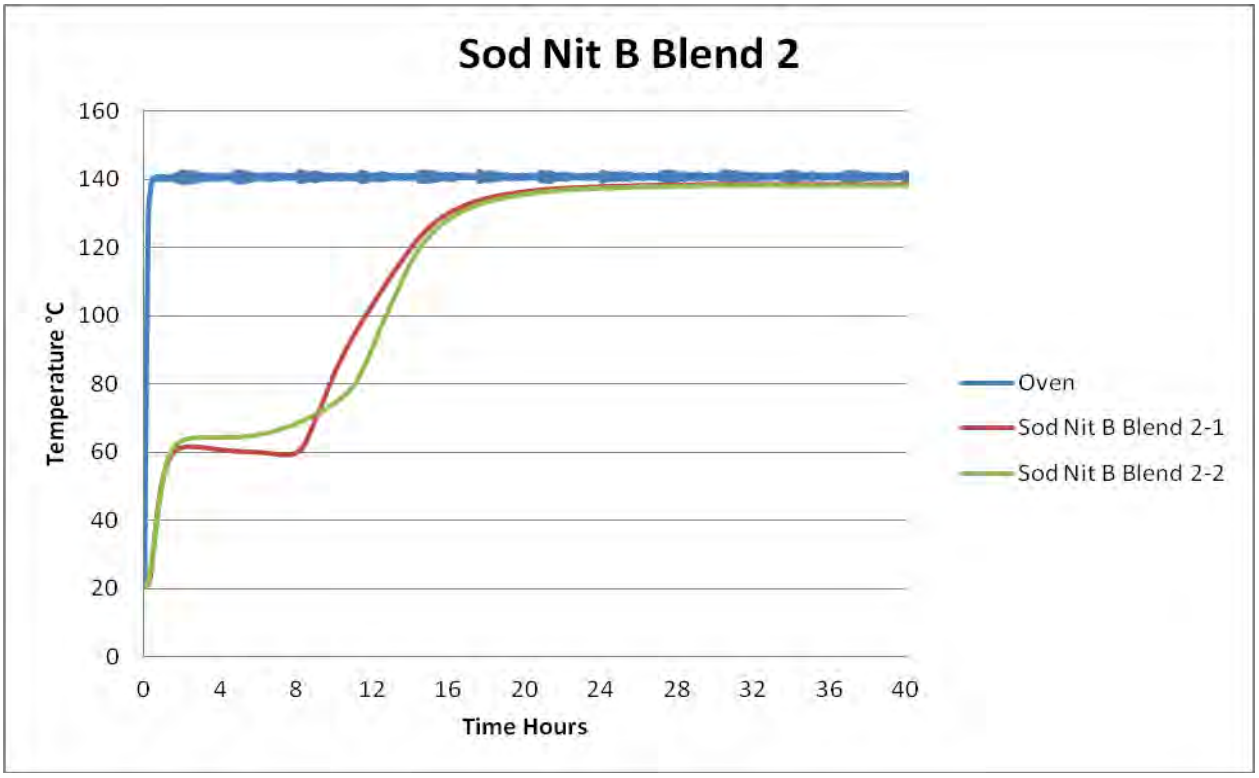


Figure 6. Method 1050 – Sod Nit B Blend 2 (100mm cube) full run.

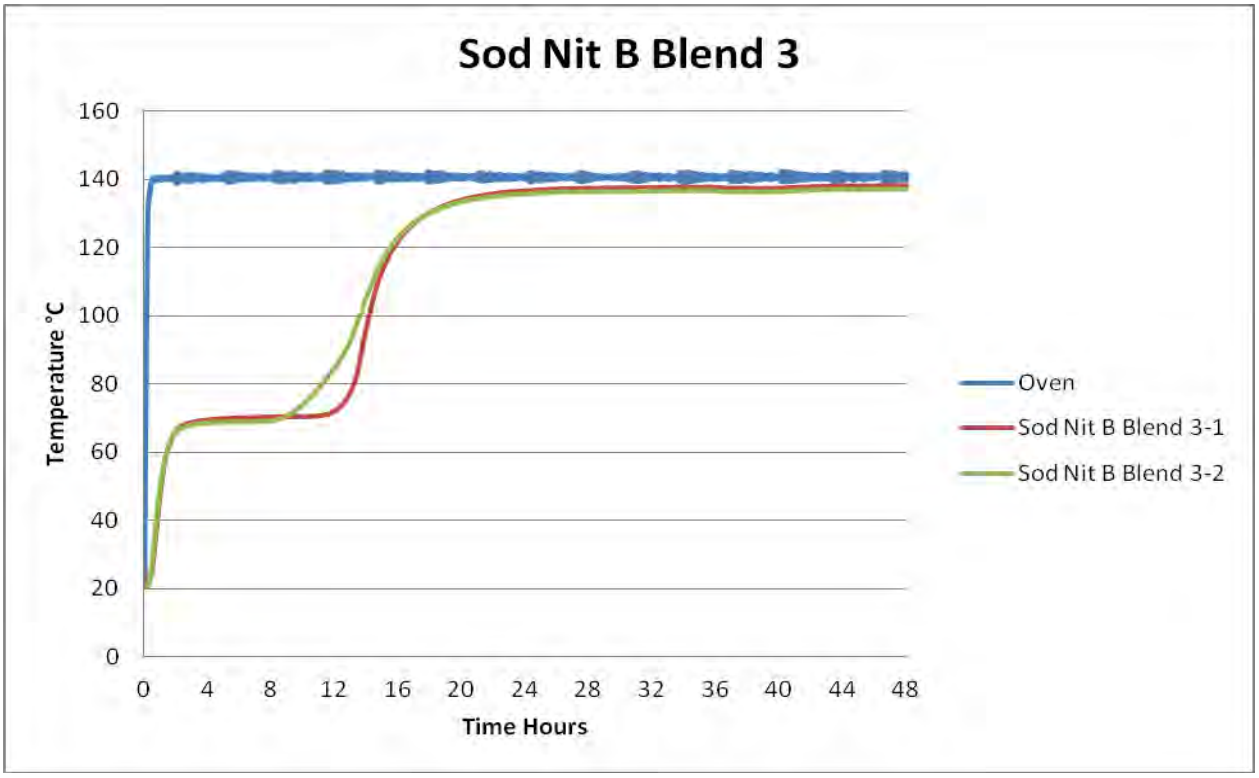


Figure 7. Method 1050 – Sod Nit B Blend 3 (100mm cube) full run

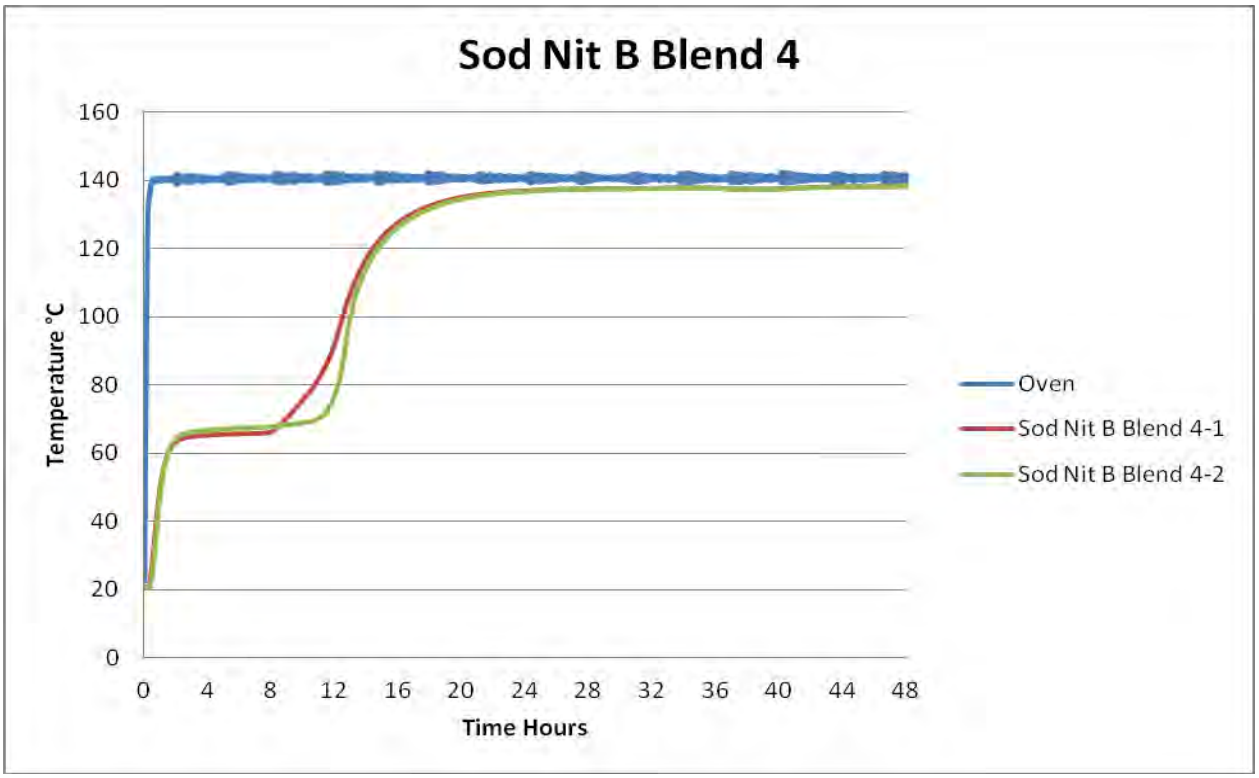


Figure 8. Method 1050 – Sod Nit B Blend 4 (100mm cube) full run.

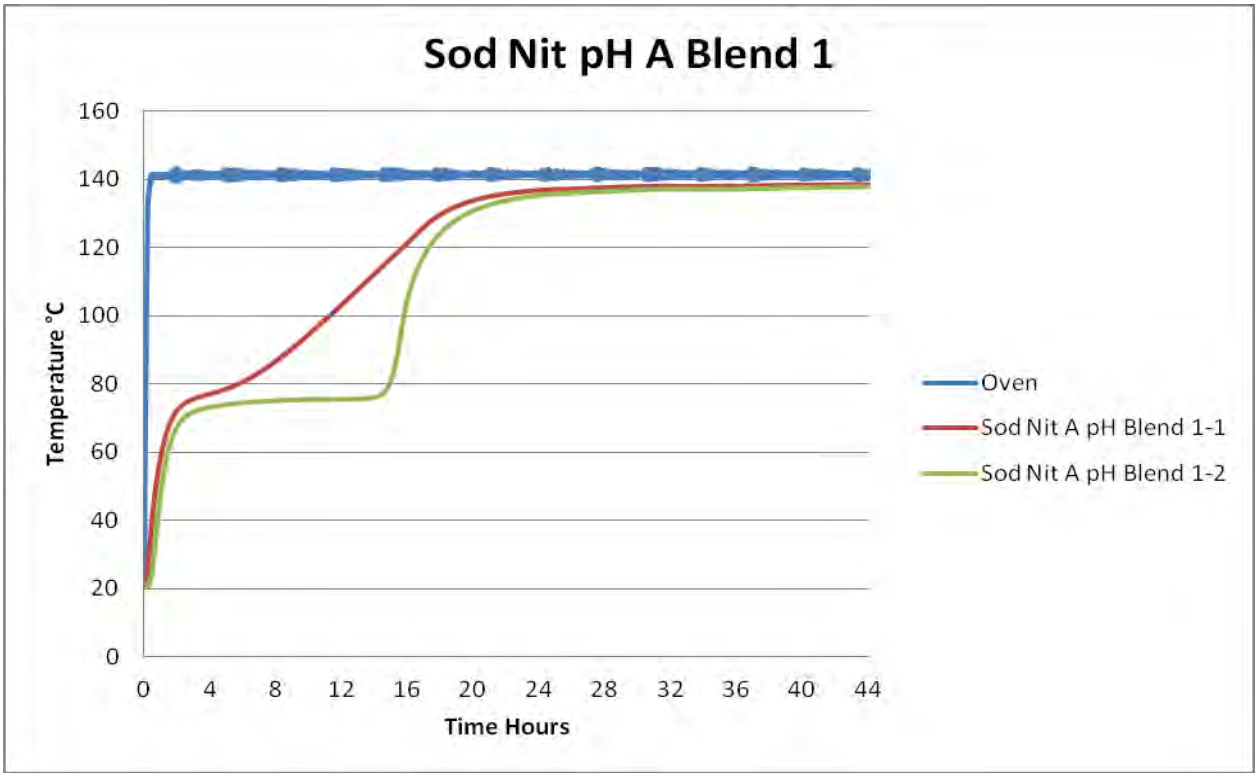


Figure 9. Method 1050 – Sod Nit pH A Blend 1 (100mm cube) full run.

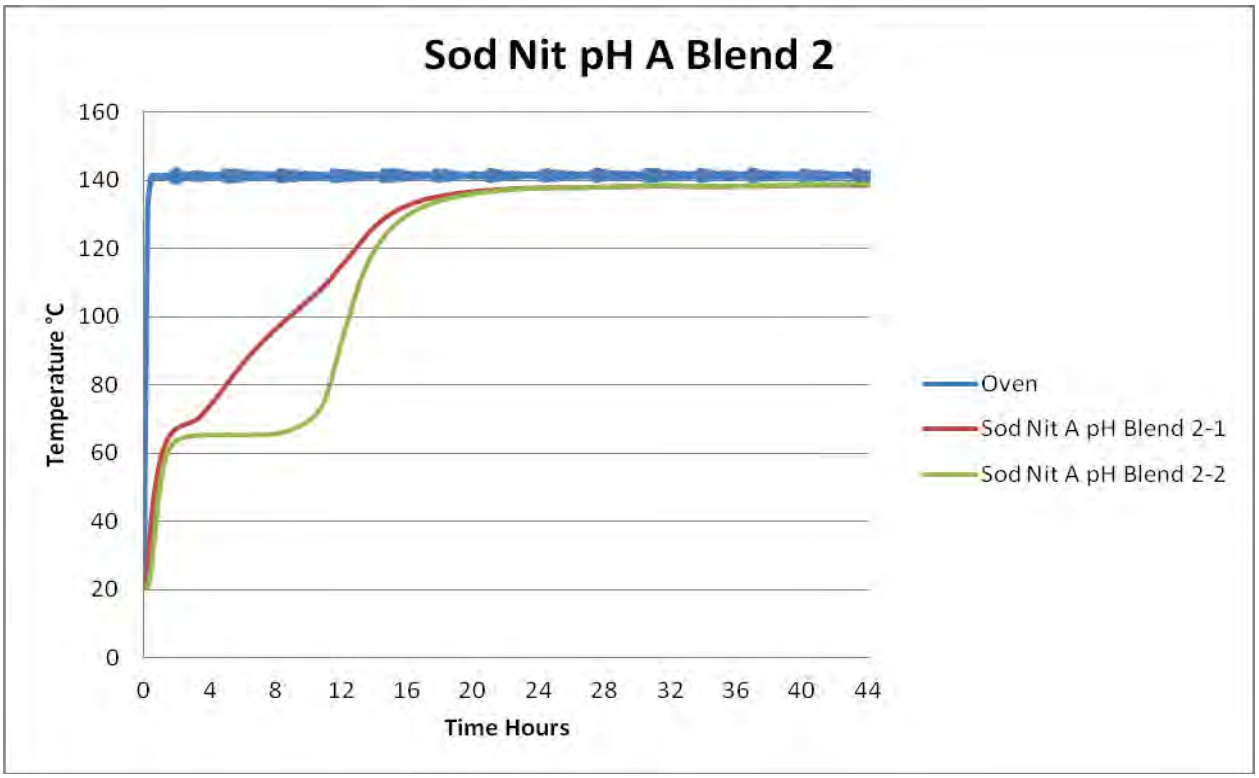


Figure 10. Method 1050 – Sod Nit pH A Blend 2 (100mm cube) full run

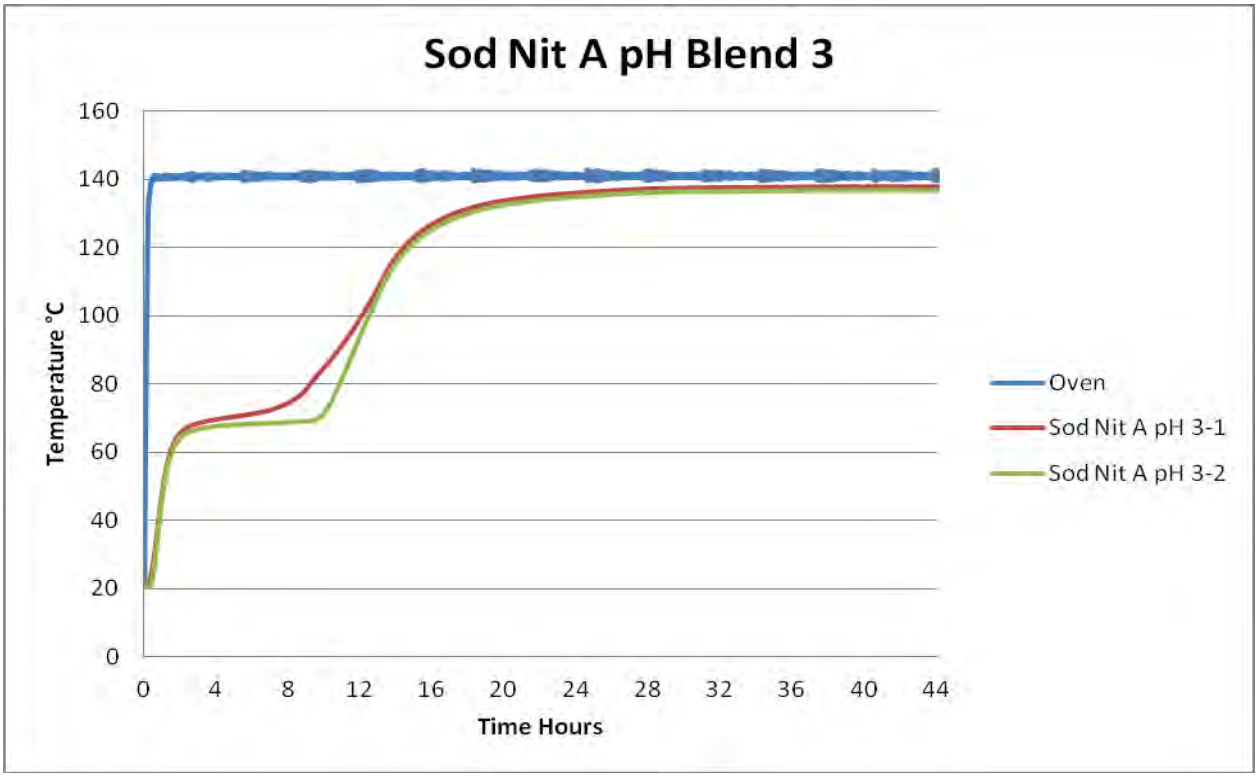


Figure 11. Method 1050 – Sod Nit pH A Blend 3 (100 mm cube) full run.

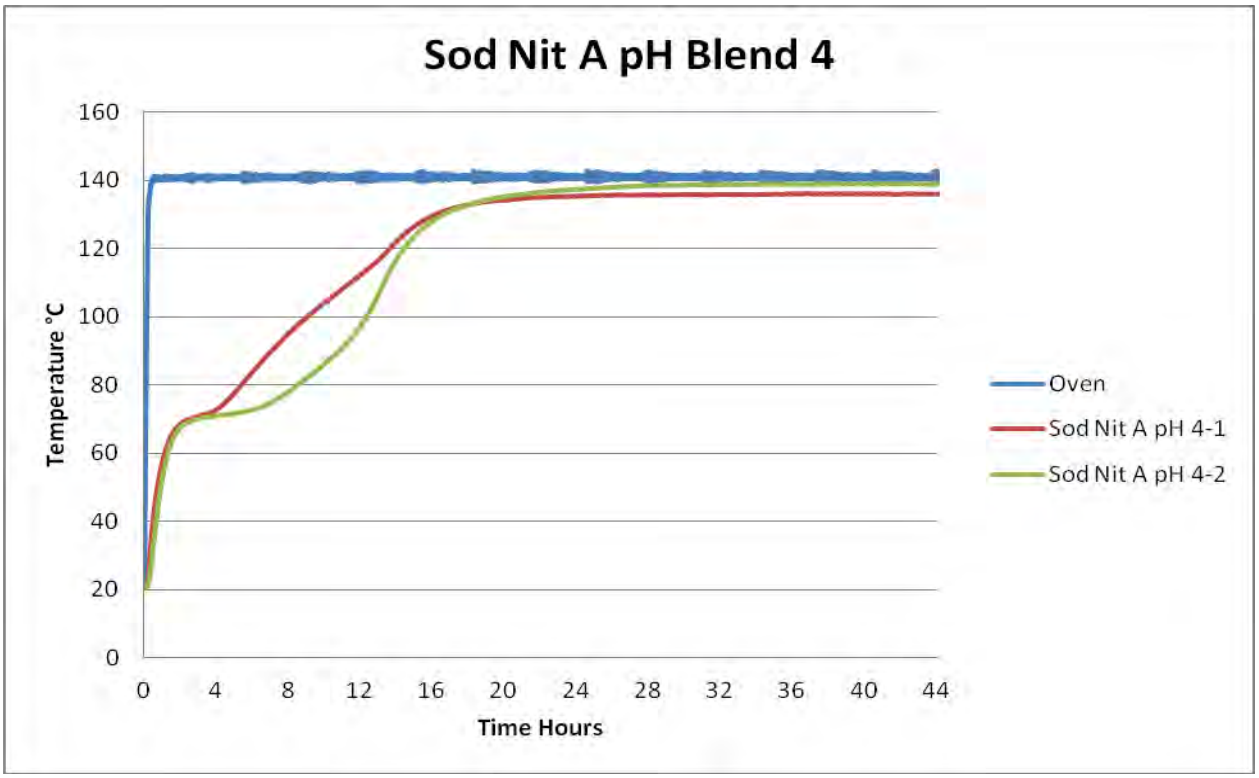


Figure 12. Method 1050 – Sod Nit pH A Blend 4 (25 mm cube) full run.

010025

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Wetchem Analyses

Sample Results

SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/13/16

SRR #: 57710

Task Order #: 160605-2

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
Sod Nit A Blend 1	598447	Nonflammable	06/12/16
Sod Nit A Blend 1 Dup	598447	Nonflammable	06/12/16
Sod Nit A Blend 2	598448	Nonflammable	06/12/16
Sod Nit A Blend 3	598449	Nonflammable	06/12/16
Sod Nit A Blend 4	598450	Nonflammable	06/12/16
Sod Nit A pH Blend -1	598453	Nonflammable	06/12/16
Sod Nit A pH Blend -2	598454	Nonflammable	06/12/16
Sod Nit A pH Blend -3	598455	Nonflammable	06/12/16
Sod Nit A pH Blend -4	598456	Nonflammable	06/12/16
Sod Nit B Blend 1	598460	Nonflammable	06/12/16
Sod Nit B Blend 2	598461	Nonflammable	06/12/16
Sod Nit B Blend 3	598462	Nonflammable	06/12/16
Sod Nit B Blend 4	598463	Nonflammable	06/12/16

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/13/16

SRR #: 57710

Task Order #: 160605-2

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
Sod Nit A Blend 1	598447	Not a self-heating waste	06/08/16
Sod Nit A Blend 2	598448	Not a self-heating waste	06/08/16
Sod Nit A Blend 3	598449	Not a self-heating waste	06/05/16
Sod Nit A Blend 4	598450	Not a self-heating waste	06/05/16
Sod Nit A pH Blend -1	598453	Not a self-heating waste	05/31/16
Sod Nit A pH Blend -2	598454	Not a self-heating waste	05/31/16
Sod Nit A pH Blend -3	598455	Not a self-heating waste	06/03/16
Sod Nit A pH Blend -4	598456	Not a self-heating waste	06/03/16
Sod Nit B Blend 1	598460	Not a self-heating waste	05/29/16
Sod Nit B Blend 2	598461	Not a self-heating waste	05/29/16
Sod Nit B Blend 3	598462	Not a self-heating waste	05/27/16
Sod Nit B Blend 4	598463	Not a self-heating waste	05/27/16

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SOUTHWEST RESEARCH INSTITUTE

SW846 9095 Paint Filter Liquids Test

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/13/16

SRR #: 57710

Task Order #: 160605-2

Sample ID	SwRI System ID	Method 9095 *Paint Filter Results*	Date Analyzed
Sod Nit A Blend 1	598447	No free liquids	06/12/16
Sod Nit A Blend 1 Dup	598447	No free liquids	06/12/16
Sod Nit A Blend 2	598448	No free liquids	06/12/16
Sod Nit A Blend 3	598449	No free liquids	06/12/16
Sod Nit A Blend 4	598450	No free liquids	06/12/16
Sod Nit A ph - Zeo 1	598451	No free liquids	06/15/16
Sod Nit A ph - Zeo 2	598452	No free liquids	06/15/16
Sod Nit A pH Blend -1	598453	No free liquids	06/12/16
Sod Nit A pH Blend -2	598454	No free liquids	06/12/16
Sod Nit A pH Blend -3	598455	No free liquids	06/12/16
Sod Nit A pH Blend -4	598456	No free liquids	06/12/16
Sod Nit B - Zeo 1	598458	No free liquids	06/15/16
Sod Nit B - Zeo 2	598459	No free liquids	06/15/16
Sod Nit B Blend 1	598460	No free liquids	06/12/16
Sod Nit B Blend 2	598461	No free liquids	06/15/16
Sod Nit B Blend 3	598462	No free liquids	06/15/16
Sod Nit B Blend 4	598463	No free liquids	06/15/16
Sod Nit A Sol - Zeo 1	598464	No free liquids	06/15/16
Sod Nit A Sol - Zeo 2	598465	No free liquids	06/15/16

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/13/16

SRR #: 57710

Task Order #: 160605-2

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
135.32	52.44	19.45

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
Sod Nit A Blend 1	598447	>180	>180	Not Division 5.1	06/09/16
Sod Nit A Blend 2	598448	no reaction	>180	Not Division 5.1	06/09/16
Sod Nit A Blend 3	598449	no reaction	>180	Not Division 5.1	06/06/16
Sod Nit A Blend 4	598450	no reaction	no reaction	Not Division 5.1	06/06/16
Sod Nit A ph - Zeo 1	598451	no reaction	>180	Not Division 5.1	06/15/16
Sod Nit A ph - Zeo 2	598452	no reaction	> 180	Not Division 5.1	06/20/16
Sod Nit A pH Blend -1	598453	no reaction	>180	Not Division 5.1	06/02/16
Sod Nit A pH Blend -2	598454	no reaction	>180	Not Division 5.1	06/01/16
Sod Nit A pH Blend -3	598455	no reaction	>180	Not Division 5.1	06/07/16
Sod Nit A pH Blend -4	598456	no reaction	>180	Not Division 5.1	06/09/16
Sod Nit B - Zeo 1	598458	no reaction	>180	Not Division 5.1	06/15/16
Sod Nit B - Zeo 2	598459	no reaction	>180	Not Division 5.1	06/15/16
Sod Nit B Blend 1	598460	>180	>180	Not Division 5.1	06/01/16
Sod Nit B Blend 2	598461	no reaction	>180	Not Division 5.1	06/02/16
Sod Nit B Blend 3	598462	>180	>180	Not Division 5.1	06/07/16
Sod Nit B Blend 4	598463	no reaction	>180	Not Division 5.1	06/07/16
Sod Nit A Sol - Zeo 1	598464	no reaction	>180	Not Division 5.1	06/15/16
Sod Nit A Sol - Zeo 2	598465	no reaction	>180	Not Division 5.1	06/09/16

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

LABORATORY CONTROL SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/13/16

SRR #: 57710

Task Order #: 160605-2

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
108-162 sec	42-63 sec	15-23 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	127.10	55.28	18.94	06/01/16
LCS	127.03	48.35	18.56	06/02/16
LCS	132.09	55.56	19.90	06/06/16
LCS	135.25	55.75	21.25	06/07/16
LCS	136.91	56.52	20.65	06/09/16
LCS	123.90	49.19	19.63	06/15/16
LCS	122.50	58.41	17.69	06/20/16

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010031

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

UN Oxidizer Test

Raw Data

010032

Southwest Research Institute

Method: UN_Oxidizer
Project #: 21592.01.0026
Client: Los Alamos (LANL)
TO# 160605-2 ; 160605-1

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0190	21.0143	135.53	
3:7	2	9.0181	21.0485	134.46	
3:7	3	9.0300	21.0156	132.35	
3:7	4	9.0481	21.0075	138.56	
3:7	5	9.0349	21.0035	135.69	
3:7	**Avg**			135.32	
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0035	18.0057	55.66	
2:3	2	12.0134	18.0086	52.05	
2:3	3	12.0146	18.0108	52.79	
2:3	4	12.0106	18.0083	51.37	
2:3	5	12.0056	18.0110	50.35	
2:3	**Avg**			52.44	
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0148	12.0069	19.15	
3:2	2	18.0104	12.0079	18.09	
3:2	3	18.0084	12.0153	18.93	
3:2	4	18.0147	12.0094	20.25	
3:2	5	18.0207	12.0032	20.81	
3:2	**Avg**			19.45	

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 5/31/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 5/31/16
Potassium Bromate: Inorg# 69450-69453 Dried: 65°C for >12hrs.
Cellulose: Inorg# 69668-69663 Dried: 105°C for >4hrs.
Variac Setting: 150±7W RE 6/1/16 MG

010033

Southwest Research Institute

Method: UN - Oxidizer
Project #: 21592.01.0006
Client: Los Alamos (LANL)
TO# 160605-2

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0051	21.0063	127.10	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0195	18.0180	55.28	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0053	12.0083	18.94	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/1/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/1/16
Potassium Bromate: Inorg# 69450-69453 Dried: 65°C for >12 hrs.
Cellulose: Inorg# 69662-69663 Dried: 105°C for >4 hrs.
Variac Setting: 150 ± 7 watts ee u/ llu mG

Southwest Research Institute

010034

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 166605-2

Sample Analysis

System ID: Sod Nit B Blend #1 (Blue) 137-01-WC512
598460

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0100	6.0059	181.97 ②	charring at wire leads, smoke & random flames
4:1	2	24.0161	6.0120	182.03 ②	at wire leads
4:1	3	24.0027	6.0040	185.62 ②	↓
4:1	4	24.0084	6.0079	183.06 ②	↓
4:1	5	24.0120	6.0350	180.41 ②	↓
4:1	Avg			>180	② time stopped when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0065	15.0070	184.75 ①	low flames at wire leads, charring & smoke
1:1	2	15.0152	15.0126	185.44 ①	↓
1:1	3	15.0253	15.0176	188.37 ①	↓
1:1	4	15.0081	15.0094	187.90 ①	↓
1:1	5	15.0048	15.0042	182.02 ①	↓
1:1	Avg			>180	① time stopped when flames extinguished

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/1/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/1/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 69662-69663 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts RE 6/1/16 mG

Classification: Not Division 5.1

Southwest Research Institute 010035

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A pH Blend #2 (Black) 142-02-WX512
598454

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0082	6.0126	180.16 ①	charring around wire leads, slight smoke,
4:1	2	24.0032	6.0036	180.93 ①	NO flames
4:1	3	24.0014	6.0058	180.31 ①	
4:1	4	24.0098	6.0070	180.78 ①	
4:1	5	24.0007	6.0099	180.31 ①	
4:1	Avg			>180	① time when power turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0079	15.0092	185.88 ②	Small flames at wire leads, smoke
1:1	2	15.0097	15.0019	185.22 ②	
1:1	3	15.0168	15.0138	189.84 ②	
1:1	4	15.0091	15.0056	187.34 ②	
1:1	5	15.0128	15.0130	185.22 ②	
1:1	Avg			>180	② time when flames ext

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/1/16 RE 6/1/16 MG
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/1/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 696661-696643 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN-Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 160605-2

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0048	21.0022	127.03	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0129	18.0125	48.35	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0169	12.0050	18.56	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/2/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/2/16
Potassium Bromate: Inorg# 69450-69453 Dried: 105°C for > 12hrs.
Cellulose: Inorg# 69668-69663 Dried: 105°C for > 4hrs.
Variac Setting: 150±7 Watts EE 6/2/16 mh

Southwest Research Institute

010037

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit B Blend #2 137-02-WCS12 (Red)
RE 160523/10 MG 4 598461

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0036	6.0119	180.81 ①	Charring around wire leads + smoke, no flames
4:1	2	24.0092	6.0065	180.35 ①	
4:1	3	24.0042	6.0189	180.44 ①	
4:1	4	24.0114	6.0069	180.31 ①	
4:1	5	24.0181	6.0053	180.34 ①	↓
4:1	Avg			7180	① time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0048	15.0239	184.78 ②	Small flame at wire leads, smoke + charring
1:1	2	15.0052	15.0024	185.59 ②	
1:1	3	15.0143	15.0041	188.63 ②	
1:1	4	15.0021	15.0165	184.50 ②	
1:1	5	15.0134	15.0028	184.00 ②	
1:1	Avg			7180	② time when flame extinguished

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/1/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/2/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 469661-469663 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute 010038

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A pH Blend #1 192-01-WCS12 (Green)
598453

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0134	6.0158	180.84 ①	charring around wire, smoke, no flames
4:1	2	24.0238	6.0032	180.81 ①	
4:1	3	24.0194	6.0124	180.22 ①	
4:1	4	24.0160	6.0151	180.47 ①	
4:1	5	24.0167	6.0063	180.28 ①	
4:1	Avg			>180	① time when power

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0206	15.0245	182.47 ②	small flames at wire leads, smoke + charring
1:1	2	15.0140	15.0064	181.50 ②	
1:1	3	15.0153	15.0033	183.56 ②	
1:1	4	15.0139	15.0087	184.28 ②	
1:1	5	15.0080	15.0153	181.79 ②	
1:1	Avg			>180	② time when flames extinguished

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/1/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/2/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 160161-160163 Dried: >4hrs. @ 105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010039

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 160605-2

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0142	21.0122	132.09	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0099	18.0107	55.56	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0081	12.00165	19.90	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 10/10/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 10/6/16
Potassium Bromate: Inorg# 69450-69453 Dried:65°C for >12hrs.
Cellulose: Inorg# 69461-69463 Dried: 105°C for >4 hrs.
Variac Setting: 150 ± 7W

Southwest Research Institute 010040

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A Blend #3 (133-03-WCS12) [Black]
598449

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0109	6.0101	180.32 ①	Charring at wire leads, smoke
4:1	2	24.0179	6.0068	180.98 ①	
4:1	3	24.0186	6.0139	180.34 ①	
4:1	4	24.0084	6.0082	180.100 ①	
4:1	5	24.0075	6.0054	180.41 ①	↓
4:1	Avg			7/80	① time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0185	15.0124	185.06 ②	flames at wire leads, smoke + charring
1:1	2	15.0155	15.0136	227.06 ②	same as rep #1 but flames propagated
1:1	3	15.0164	15.0171	229.09 ②	↓
1:1	4	15.0134	15.0091	188.22 ②	flames at wire leads, smoke + charring
1:1	5	15.0108	15.0103	188.66 ②	↓
1:1	Avg			7/80	② time when flame extinguished

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/6/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/6/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 69661-69663 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute 010041

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A Blend #4 (133-04-WCS12) [Blue]
598450

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0140	6.0136	180.41 ①	charring around wire leads, smoke
4:1	2	24.0171	6.0163	180.28 ①	
4:1	3	24.0047	6.0054	180.28 ①	
4:1	4	24.0067	6.0044	180.87 ①	
4:1	5	24.0069	6.0072	180.40 ①	↓
4:1	Avg			7180	① time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0084	15.0067	187.47 ②	
1:1	2	15.0179	15.0138	188.31 ②	
1:1	3	15.0189	15.0208	193.25 ②	
1:1	4	15.0083	15.0094	201.04 ②	
1:1	5	15.0129	15.0105	188.81 ②	
1:1	Avg			7180	② time when flames extinguished

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/6/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/6/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 69661-69663 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010042

Method: IAN - Oxidizer
Project #: 21592.01.0006
Client: Los Alamos (LANL)
TO# 160605-2

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0110	21.0107	135.25	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0020	18.0077	55.75	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0081	12.0027	21.25	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/7/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/7/16
Potassium Bromate: Inorg# 69450 - 69453 Dried: >12hrs. @ 65°C
Cellulose: Inorg# 69661 - 69663 Dried: >4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts

Southwest Research Institute 010043

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit B Blend #3 (137-023-WCS12) [Red]
5984662 RE 6/6/16 MG

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0071	6.0043	180.28 ①	charring around wire, spontanious flame at front wire lead, smoke
4:1	2	24.0074	6.0083	180.88 ①	
4:1	3	24.0106	6.0118	180.29 ①	
4:1	4	24.0098	6.0056	180.41 ①	
4:1	5	24.0162	6.0088	180.31 ①	
4:1	Avg			>180	① time when power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0148	15.0139	208.41 ②	flames at wire leads + propigated a little bit, charring + smoke
1:1	2	15.0064	15.0114	197.50 ①	
1:1	3	15.0074	15.0080	186.60 ②	
1:1	4	15.0168	15.0162	204.00 ①	
1:1	5	15.0097	15.0092	207.65 ②	
1:1	Avg			>180	② time when flames extinguished; power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/6/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/7/16
Sample Dried ? YES (NO) Dried: N/A
Cellulose: Inorg# 696161-696163 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute 010044

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit B Blend #4 (137-04-WCS12) [Green]
598463

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0060	6.0170	180.38 ①	charring around wire + smoke
4:1	2	24.0047	6.0072	180.29 ①	
4:1	3	24.0025	6.0070	180.35 ①	
4:1	4	24.0078	6.0103	180.22 ①	
4:1	5	24.00198	6.0127	180.25 ①	
4:1	Avg			>180	① time when power was turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0139	15.0176	180.97 ②	small flames at wire leads, charring + smoke
1:1	2	15.0130	15.0087	185.12 ②	
1:1	3	15.0048	15.0064	184.84 ②	
1:1	4	15.0006	15.0026	187.94 ②	
1:1	5	15.0042	15.0142	184.53 ②	
1:1	Avg			>180	② time flame extinguished, power turned off at 180 sec

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/6/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/7/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 149661-49663 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010045

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A pH Blend #3 (142-03-WCS12) [Blue]
598455

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0082	6.0152	180.28 ①	Charring around wire + smoke
4:1	2	24.0099	6.0162	180.34 ①	↓
4:1	3	24.0034	6.0085	180.31 ①	
4:1	4	24.0141	6.0104	180.163 ①	
4:1	5	24.0092	6.0084	180.37 ①	↓
4:1	Avg			>180	①time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0183	15.0078	181.28 ②	small flames at wire leads, charring +
1:1	2	15.0097	15.0032	185.47 ②	smoke
1:1	3	15.0025	15.0078	208.69 ②	flame propagated a little bit + Above disc
1:1	4	15.0098	15.0098	182.71 ②	small flame at wire leads, charring + smoke
1:1	5	15.0089	15.0112	182.71 ②	↓
1:1	Avg			>180	②time when flame extinguished; power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/7/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/7/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 69641 - 69663 Dried: >4hrs. @ 105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

010046

Southwest Research Institute

Method: UN - Oxidizer
Project #: 21592.01.0006
Client: Los Alamos (LANL)
TO# 160605-2

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0696	21.0070	136.91	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0060	18.0018	50.52	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0040	12.0058	20.65	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/9/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/9/16
Potassium Bromate: Inorg# 69450-59453 Dried: >12hrs. @ 65°C
Cellulose: Inorg# 69461-69663 Dried: >4hrs. @ 105°C
Variac Setting: 150±7 Watts

Southwest Research Institute

010047

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A pH Blend #4 (142-04-WC512) [Black]
598456

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0045	6.0109	180.35 ①	charring around wire, smoke, + no flames
4:1	2	24.0160	6.0045	180.44 ①	
4:1	3	24.0099	6.0099	180.47 ①	
4:1	4	24.0095	6.0108	180.31 ①	
4:1	5	24.0049	6.0068	180.37 ①	
4:1	Avg			>180	① time power turned off, no reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0064	15.0056	196.31 ②	low flames at wire leads, charring + smoke
1:1	2	15.0124	15.0108	191.68 ②	↓
1:1	3	15.0112	15.0067	212.41 ②	↓
1:1	4	15.0165	15.0104	7240 ③	low flames propagated around side of mound
1:1	5	15.0130	15.0080	196.62 ②	low flames at wire leads, charring + smoke
1:1	Avg			>180	② time when flame extinguished, power turned off at 180 sec

③ flame continued after 4 min/240 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/8/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/9/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 96661-96663 Dried: >4hrs. @ 105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010048

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A Blend #1 (133-01-WCS12) [Green]
598447

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0167	6.0037	180.56 ①	spontaneous flames at wire leads, charring + smoke
4:1	2	24.0174	6.0139	180.81 ①	
4:1	3	24.0051	6.0026	180.16 ①	
4:1	4	24.0184	6.0145	180.59 ①	
4:1	5	24.0104	6.0077	180.50 ①	
4:1	Avg			>180	① time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0026	15.0059	184.25 ②	low flames at wire leads, charring + smoke
1:1	2	15.0029	15.0056	199.91 ②	
1:1	3	15.0023	15.0046	183.12 ②	
1:1	4	15.0135	15.0058	183.41 ②	
1:1	5	15.0065	15.0126	186.54 ②	
1:1	Avg			>180	② time when flames extinguished

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/8/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/9/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 169161 - 169163 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010049

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A Blend #2 (133-02-WCS12) [Blue]
598448

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0156	6.0092	180.28 ①	charring around wire leads, smoke, NO flames
4:1	2	24.0052	6.0087	180.81 ①	
4:1	3	24.0129	6.0075	180.18 ①	
4:1	4	24.0114	6.0065	180.32 ①	
4:1	5	24.0045	6.0061	180.41 ①	
4:1	Avg			>180	① time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0187	15.0033	190.13 ②	low flames at wire leads, charring + smoke
1:1	2	15.0065	15.0058	185.37 ②	
1:1	3	15.0093	15.0101	188.28 ②	
1:1	4	15.0018	15.0079	215.13 ②	
1:1	5	15.0119	15.0179	185.96 ②	
1:1	Avg			>180	② time when flames extinguished

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/8/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/9/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 169661-169663 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute 010050

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A Zco 2 (126-02-WCS12) [Red]
598465

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0138	6.0220	180.34 ①	charring around wire leads, smoke, no flames
4:1	2	24.0083	6.0040	180.28 ①	
4:1	3	24.0192	6.0159	180.41 ①	
4:1	4	24.0011	6.0089	180.43 ①	
4:1	5	24.0194	6.0188	180.34 ①	
4:1	Avg			>180	① time when power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0197	15.0127	181.31 ②	low flames at wire leads, charring + smoke
1:1	2	15.0105	15.0122	181.01 ②	
1:1	3	15.0024	15.0067	182.03 ②	
1:1	4	15.0010	15.0056	181.91 ②	
1:1	5	15.0072	15.0053	181.59 ②	
1:1	Avg			>180	② Time when flames extinguished, power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/8/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/9/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 69661-69663 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

010051

Southwest Research Institute

Method: HN- Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 160005-2

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0152	21.0033	123.90	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0154	18.0024	49.19	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0046	12.0035	19.63	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/15/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/15/16
Potassium Bromate: Inorg# 69450 - 69453 Dried: 7 12hrs. @ 65°C
Cellulose: Inorg# 69661 - 69663 Dried: 7 4hrs. @ 105°C
Variac Setting: 150 ± 7 W

Southwest Research Institute

010052

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit B-2e02 (128-02-WCS12) [Blue]
598459

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0091	6.0093	180.28 ①	charring around wire, smoke, no flame
4:1	2	24.0069	6.0024	180.38 ①	↓
4:1	3	24.0155	6.0099	180.75 ①	
4:1	4	24.0099	6.0146	180.31 ①	
4:1	5	24.0064	6.0130	180.34 ①	↓
4:1	Avg			7180	①time power turned off; no reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0043	15.0127	183.09 ②	small flames at wire leads, charring + smoke
1:1	2	15.0129	15.0108	181.91 ②	↓
1:1	3	15.0028	15.0076	183.03 ②	
1:1	4	15.0086	15.0109	181.60 ②	
1:1	5	15.0044	15.0026	183.06 ②	↓
1:1	Avg			7180	②time when flames extinguished - Power turned off at 180sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/13/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/15/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 69661-69663 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010053

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A pH Zeo 1 (150-04-WCS12) [Red]
598451

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0098	6.0059	180.31 ①	charring around wire, smoke, no flames
4:1	2	24.0144	6.0107	180.85 ①	
4:1	3	24.0067	6.0016	180.34 ①	
4:1	4	24.0119	6.0114	180.25 ①	
4:1	5	24.0120	6.0081	180.49 ①	WD 6/15/16 MA
4:1	Avg			>180	①time when power ~~timer~~ was turned off. No reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0089	15.0087	180.34 ②	Small flames at wire leads, charring + smoke
1:1	2	15.0041	15.0069	182.16 ②	
1:1	3	15.0144	15.0092	182.56 ②	
1:1	4	15.0036	15.0077	182.44 ②	
1:1	5	15.0063	15.0066	182.97 ②	
1:1	Avg			>180	②time when flames extinguished. Power turned off at 180 sec

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/13/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/15/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 69661-69663 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010054

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A-Zeol (150-01-WCS12) [Black]
598464

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0125	6.0058	180.75 ①	charring around wire, smoke, no flames
4:1	2	24.0139	6.0132	180.38 ①	
4:1	3	24.0128	6.0004	180.33 ①	
4:1	4	24.0051	6.0112	180.28 ①	
4:1	5	24.0029	6.0135	180.31 ①	
4:1	Avg			>180	①time when power was turned off. NO reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0035	15.0148	183.75 ②	small flames at wire leads, smoke + charring
1:1	2	15.0032	15.0114	182.13 ②	
1:1	3	15.0040	15.0097	182.72 ②	
1:1	4	15.0081	15.0101	182.47 ②	
1:1	5	15.0109	15.0108	182.53 ②	
1:1	Avg			>180	②Time when flames extinguished - Power turned off at 180sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/13/16
Tested Samples: Monica Gabaldon Timer ID: D22921 Date: 6/15/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 69661-691663 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010055

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit B-Zeol (150-02-WCS12) [Green]
598458

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0009	6.0042	180.41 ①	charring around wire, smoke, no flames
4:1	2	24.0042	6.0153	180.32 ①	
4:1	3	24.0036	6.0076	180.38 ①	
4:1	4	24.0156	6.0137	180.31 ①	
4:1	5	24.0037	6.0164	180.31 ①	↓
4:1	Avg			>180	① time power turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0042	15.0183	181.35 ②	small flames at wire leads, smoke + charring
1:1	2	15.0115	15.0149	181.81 ②	
1:1	3	15.0048	15.0108	181.68 ②	
1:1	4	15.0039	15.0083	181.72 ②	
1:1	5	15.0091	15.0066	181.75 ②	↓
1:1	Avg			>180	② time flames extinguished. Power turned off at 180sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/13/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/15/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 696161-696163 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

010056

Southwest Research Institute

Method: LLN - Oxidizer
Project #: 21592.01.0006
Client: Los Alamos (LANL)
TO# 160605-1, 160505-2
6 RE 6/20/16 MG

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0291	21.0211	124.50	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0117	18.0044	58.41	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0039	12.0049	17.109	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Grabaldon Balance#: 88 Date: 6/20/16
Tested Samples: Monica Grabaldon Timer ID: 022921 Date: 6/20/16
Potassium Bromate: Inorg# 69450 - 69453 Dried: 7 1/2 hrs. @ 65°C
Cellulose: Inorg# 69461 - 69663 Dried: > 4 hrs. @ 105°C
Variac Setting: 150 ± 7 W

Southwest Research Institute

010057

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A pH 2e02 (150-05-wcs12) [Blue]
598452

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0090	6.0162	180.62 ①	charring around wire, smoke, NO flames
4:1	2	24.0018	6.0040	180.37 ①	
4:1	3	24.0075	6.0067	180.38 ①	
4:1	4	24.0139	6.0076	180.56 ①	
4:1	5	24.0046	6.0064	180.28 ①	↓
4:1	Avg			7180	①Time power turned off. NO reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0074	15.0070	181.34 ②	Small flames at wire leads, smoke + charring
1:1	2	15.0080	15.0128	183.50 ②	
1:1	3	15.0067	15.0053	181.91 ②	
1:1	4	15.0171	15.0057	182.50 ②	
1:1	5	15.0032	15.0154	181.85 ②	↓
1:1	Avg			7180	②Time flames extinguished. Power turned off at 180 sec

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/16/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/20/16
Sample Dried ? YES / (NO) . oz w/cellulose mix Dried: NA
Cellulose: Inorg# 691961 - 691663 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010058

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160665-1

Sample Analysis

System ID: 598466 WB1 (1:3) [red]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0127	6.0152	180.35 ①	charring around wire, smoke, no flames
4:1	2	24.0086	6.0151	180.31 ①	
4:1	3	24.0148	6.0086	180.66 ①	
4:1	4	24.0100	6.0067	180.28 ①	
4:1	5	24.0010	6.0049	180.44 ①	
4:1	Avg			>180	①Time power turned off. No reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0049	15.0070	181.31 ②	small flames at wire leads, smoke & charring
1:1	2	15.0250	15.0113	183.19 ②	
1:1	3	15.0150	15.0041	192.94 ②	
1:1	4	15.0238	15.0103	182.75 ②	
1:1	5	15.0063	15.0090	183.38 ②	
1:1	Avg			>180	②Time when flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/17/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/20/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 696681 - 696683 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

010059

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160105-1

Sample Analysis

System ID: 598467 WB2(1:4) [Black]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0217	6.0090	180.28 ①	Charring around wire, smoke & charring, NO flames
4:1	2	24.0015	6.0055	180.53 ①	
4:1	3	24.0095	6.0136	180.57 ①	
4:1	4	24.0195	6.0132	180.63 ①	
4:1	5	24.0159	6.0092	180.34 ①	
4:1	Avg			>180	① Time power was turned off. No reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0273	15.0108	183.28 ②	Small flames at wire leads, smoke & charring
1:1	2	15.0140	15.0154	183.85 ②	
1:1	3	15.0255	15.0210	184.28 ②	
1:1	4	15.0246	15.0198	185.04 ②	
1:1	5	15.0085	15.0098	184.84 ②	
1:1	Avg			>180	② time when flame extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 88 Date: 6/20/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/20/16
Sample Dried ? YES (NO) Dried: N/A
Cellulose: Inorg# 691621-696463 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

010060

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-1

Sample Analysis

System ID: 598408 WB3 (1:5) [Green]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0160	6.0092	180.31 ①	charring around wire, smoke, no flames
4:1	2	24.0047	6.0097	180.39 ①	
4:1	3	24.0118	6.0056	180.28 ①	
4:1	4	24.0136	6.0116	180.41 ①	
4:1	5	24.0109	6.0065	180.75 ①	
4:1	Avg			>180	① time when power turned off. No reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0173	15.0103	184.22 ②	charring + smoke, sparking + smoldering
1:1	2	15.0059	15.0151	184.75 ②	after power was turned off
1:1	3	15.0233	15.0242	185.87 ②	
1:1	4	15.0047	15.0063	183.22 ②	
1:1	5	15.0072	15.0086	185.12 ②	
1:1	Avg			>180	② Time sparking/smoldering stopped. Power turned off at 180sec.

Weighted Samples: Monica Gabaldon Balance#: 88 Date: 6/20/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/20/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 691661-691663 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

010061

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Method 1050
Logbook Pages

010062

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. #__15-0406-048_

Analysis / Method: 1050 Project# 21592.01.006

TAP# (if applicable):

Client: Los Alamos TO# 160605-2

Balance #

LCS Info: TV:

Notes: Sod Nit B Blend #4, #3 poured out easily
start 5/27/16 16:13 pm TE Sam 6/7/16
~~6/15/16 4:44 pm~~
Stop 5/29/16 18:09 pm TE Sam 6/7/16
~~6/17/16 11:44 AM~~

Sample ID					
Sod Nit B Blend #3					
One thermocouple was closer to the edge and did not have the water lost slow ramp that thermocouple 2 had. Sample @ temp and stable around 28 to 32 hours. Sample was removed from the oven and appeared loose and dry. Since no excess temperature was noted the sample is not self heating					
Sod nit B Blend #4					
Both thermocouples saw a slow rise in temperature due to the moisture of the sample. They came to temperature around 28-32 hours into testing. Sample was removed after analysis and appeared loose and dry. Since no event was noticed and temperature did not exceed 200°C it is considered to be not self heating.					
Calculation:					

Analyst Signature: Date: 5/27/16

Reviewed by: M. Gradalski Date: 5/31/16

Logbook #/ Page #___017___ 0046_____

Southwest Research Institute®
Logbook: Miscellaneous

010063

Book I.D. #__15-0406-048_

Analysis / Method: 1050 Project# 21592.01.006

TAP# (if applicable): _____

Client: Los Alamos TO# 160605-2

Balance # _____

LCS Info: _____ TV: _____

Notes: Sod Nit B Blend #1, #2

Start 5/29/16 19:27

Stop 5/31/16 12:24

Sample ID					
Sod Nit B blend #1					
Both thermocouples had a slow rise in temperature due to moisture in the sample. Came to a stable temperature around 28 hrs. Once removed after analysis the sample was both cool and dry, since sample did not exceed 200°C and no visual event occured the sample is considered to be not self heating.					
Sod Nit B Blend #2					
Similar observations as blend #1 sample is considered to be not self heating.					
Calculation:					

Analyst Signature: _____ Date: 5/29/16

Reviewed by: _____ Date: 5/31/16

Logbook #/ Page #___017___ 0047_____

010064

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. #__15-0406-048_

Analysis / Method: 1050 Project# 21592.01.006

TAP# (if applicable):

Client: Los Alamos TO# 160605-2

Balance #

LCS Info: TV:

Notes: ~~sodNIT~~ A pH #1 and #2

#1 hardened mass extracted

Start: 5/31/16 19:13

Stop 6/2/16 16:44

Sample ID					
sod NIT A pH #1					
Sample thermocouples took some time to get to temperature due to the moisture in the sample. The sample came to temperature in 28-32 hours. Upon removal of the sample it was noticed that it formed a hardened mass in the cube that was chipped out. Since sample did not exceed 200°C it is not self heating.					
sod NIT A pH #2					
Similer to #1 except upon removal from oven sample was loose and dry. Since sample did not exceed 200°C it is not self heating.					
Calculation:					

Analyst Signature: Date: 5/31/16

Reviewed by: M. Crabtree Date: 5/31/16

Logbook #/ Page #___017___ 0048_____

Southwest Research Institute®
Logbook: Miscellaneous

010065

Book I.D. #__15-0406-048_

Analysis / Method: 1050 Project# 21592.01.006

TAP# (if applicable): _____

Client: Los Alamos TO# 1606005-2

Balance # _____

LCS Info: _____ TV: _____

Notes: Sed Nist A pH 3 & 4

Start 6/3/16 7:11 am

Stop 6/5/16 7:21 am

Sample ID					
Sed Nist A pH 3					
Sample took some time to come to temperature due to the moisture in the sample. Sample came to temp in about 28 hours. Upon removing of the sample after analysis it was noted to be loose & dry. Since sample did not exceed 200°C it is not considered to be a of heating.					
Sed Nist A pH 4					
Same as sample #3.					
DAM 6/3/16					
Calculation:					

Analyst Signature: _____ Date: 6/3/16

Reviewed by: M. Galaloa Date: 6/24/16

Logbook #/ Page #___017___ 0051_____

FRM-292 (Rev 4/Mar 10)

Southwest Research Institute®
Logbook: Miscellaneous

010066

Book I.D. #__15-0406-048_

Analysis / Method: 1050 Project# 21592.01.006

TAP# (if applicable): _____

Client: Los Alamos TO# 160605-2

Balance # _____

LCS Info: _____ TV: _____

Notes: Sod Nit A Blend 3 & 4
#3 some darkened areas of filter both loose
start: 6/15/16 9:41
Stop: 6/17/16 11:41

Sample ID					

Sod Nit A Blend 3

Sample took some time to come to temperature due to the moisture in the sample. Sample reach temperature around 28 hours. After removal of sample once analysis was completed, the sample was loose and dry. Since sample did not exceed 200°C it is considered to be not self heating.

Sod Nit A Blend 4

Same observations and results as #3

SAM 06/15/16

Calculation:

Analyst Signature: _____ Date: 6/15/16

Reviewed by: M. Gabaldon Date: 6/24/16

Logbook #/ Page #___017___ 0052_____

FRM-292 (Rev 4/Mar 10)

Southwest Research Institute®
Logbook: Miscellaneous

010067

Book I.D. #__15-0406-048_

Analysis / Method: 1050 Project# 21592101.006

TAP# (if applicable): _____ _____

Client: Los Alamos TO# 160605-2

Balance # _____

LCS Info: _____ TV: _____

Notes: SOC Nit A 1 & 2

start: 6/8/16 9:57

Stop: 6/10/16 11:33

Sample ID					
Soc Nit A	Blend #1				
Sample took some time to get to temperature due to moisture in the sample. Sample came to temperature in about 24 hours. After sample was removed once analysis was completed it was found to be loose and dry. Since sample did not exceed 200°C it is considered to be not self heating.					
Soc Nit A	Blend #2				
Same observations as #1.					

JAM 6/10/16

Calculation:

Analyst Signature: _____ Date: 6/8/16

Reviewed by: _____ Date: 6/24/16

Logbook #/ Page #___017___ 0053_____

010068

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Method 1030
Logbook Pages

010069

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. #__15-0406-048_

Analysis / Method: 1030 Project# 21592.01.006

TAP# (if applicable):

Client: LANL TO# 166052 166066

Balance # acelstar wood balance #: 34

LCS Info: S #61753 TV: positive

Notes: burn rate greater than 2.2mm/sec is positive

Sample ID	burn time across 100mm	burn rate mm/sec			
LCS	10.94 sec	9.14			
598447	did not burn	—	whitened at flame application region, some crackling heard but no flame or burning. Only smoke.		
598447D	did not burn	—			
598448	did not burn	—	charring and whitening of zeolite, some crackling but no burning took place.		
598449	did not burn	—	charring and whitening of zeolite, some crackling of sample.		
598450	did not burn	—	charring and drying of zeolite		
598453	did not burn	—	charring and drying of zeolite, cracking.		
598454	did not burn	—	charring and whitening at burn area no flame present.		
598455	did not burn	—	charring and drying of zeolite		
598456	did not burn	—	charring and drying of zeolite		
598460	did not burn	—	charring and drying of zeolite		
598461	did not burn	—	charring and drying of zeolite		
598462	did not burn	—	charring and drying of zeolite, some crackling		
598463	did not burn	—	charring and drying of zeolite		
LCS II	8.35 sec	11.98	charred zeolite blackened ungrall areas	wrong line used for LCS II	
598466	did not burn	—	dried zeolite, blackened ungrall areas		
598466D	did not burn	—	dried zeolite, blackened ungrall areas		
598467	did not burn	—	dried zeolite, blackened ungrall areas		
598468	did not burn	8.90	charred and dried zeolite blackened areas with ungrall		
Calculation: LCS II	11.24 sec				

Analyst Signature: [signature] Date: 6/12/16 / 6/15/16

Reviewed by: [signature] Date: 6/24/16

Logbook #/ Page #___017___ 0054_____

010070

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Method 9095
Paint Filter
Logbook Pages

010071

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. #__15-0406-048_

Analysis / Method: paint filter 9095 Project# 21592.01.006

TAP# (if applicable): _____

Client: LANL TO# K6W05-2

Balance # 34

LCS Info: water TV: fail

Notes: _____

Sample ID	sample wgt	Pass / fail			
LCS	100.0124g	fail			
Sod Ni-Zeo 1 2:1 A	100.2174	fail	Did not drip immediately but began to drip and then run after 2:30min passed		
Sod Ni-Zeo 1 2:1 Dup A	109.3418	fail			
Sod Ni-Zeo B 2:1	104.2716	fail			

5/16/16

SAM

Calculation:

Analyst Signature: _____ Date: 5/15/16

Reviewed by: M. Gabaldon Date: 5/31/16

Logbook #/ Page #___017___ 0040_____

FRM-292 (Rev 4/Mar 10)

Southwest Research Institute®
Logbook: Miscellaneous

010072

Book I.D. #__15-0406-048_

Analysis / Method: Paint Filter 9095 Project# 21592.01.006

TAP# (if applicable): _____

Client: LANL TO# 160605-2
160605-1

Balance # 34

LCS Info: water TV: fail

Notes: _____

Sample ID	sample weight (g)	pass / fail			
LCS	101.2271	fail			
598447	100.6282	pass	Soil	Nit A Blend 1	
598447D	102.8179	pass			
598448	104.2198	pass	Soil	Nit A Blend 2	
598449	103.7724	pass			
598450	106.3029	pass			
598453	101.0121	pass			
598454	100.9715	pass	Soil	Nit A pH Blend 2	
598455	101.0279	pass			
598456	103.2149	pass			
598460	104.5137	pass			
598461	101.4509	pass	Sample ID	Sample wt (g)	pass / fail
598462	101.0100	Pass			
598463	101.2436	Pass	LCS III KEC 14116 (RD)	100.5403	Fail
598451	104.3260	Pass	598466	104.1483	Pass
598452	100.9383	Pass	598466D	103.4290	Pass
598458	100.5220	pass	598467	115.8450	Pass
598459	100.9887	Pass	598468	109.6482	Pass
598464	100.2055	Pass	LCS IV	100.1001	Fail
Calculation: 598465	100.7298	Pass			
LCS II	100.9985	Fail			

Analyst Signature: _____ Date: 6/12/16 / 6/15/16

Reviewed by: _____ Date: 6/24/16

Logbook #/ Page #___017___ 0055_____

010073

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Preparation
Logbook Pages

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SWRI

124-01-WCS12 1M NaOH

40.01441 TGAM 5/12/16 g NaOH (# 62694) to FV 1L with DI H_2O
balance #135 exp 5/12/17

124-02-WCS12 1M HNO_3 WO 5AM 5/17/16

63.3mL HNO_3 (# 67843) to FV 1L with DI H_2O
SOCC-R exp 5/12/17

124-03-WCS12 saturated HNO_3

1L 124-02-WCS12 + 1000.27g sodium nitrate (# 69610)
balance # 135

124-04-WCS12 saturated 1M NaOH

1L 124-01-WCS12 + 1000.29g sodium nitrate (# 69610)

5 AM 5/17/16

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Work continued to Page

SIGNATURE [signature] DATE 5/12/16

DISCLOSED TO AND UNDERSTOOD BY M. Bradley DATE WITNESS DATE 5/13/16

Work continued from Page

SWRI

Sod Nit A-200 126-01-WCS12 (2:1)

600mL (124-03-WCS12) to 1200mL zealite (mud cracking ruins when setting)

126-02-WCS12 Sod Nit A-200 2 (3:1) Wet zealite set for 24hr

600mL (124-03-WCS12) to 1800mL zealite

126-03-WCS12 WB8

743.801	g	Aluminum nitrate (#65579) +	
2957.067	g	calcium nitrate (#65736) + (#63614) + (65735) + (#69600)	
36.405	g	chromium nitrate (#63857) +	A
1129.441	g	iron nitrate (#65821) + (63604)	
8298.857	g	magnesium nitrate (#65737) + 69602	
1839.762	g	sodium nitrate (#69610, 69611) +	
653.127	g	lead nitrate (#66142, 65951) +	
oxalic acid	671.146	g (#69684) +	
potassium carbonate	350.133	g (#65514, 69460) +	B
water	1000.148	g	

balance #89

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Work continued to Page

SIGNATURE [signature] DATE 5/13/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon DATE WITNESS DATE 5/25/14

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SWRI

128-01-WCS12 Nit B 200-1

600mL (124-04-WCS12) to 1200mL zeolite

let sit for 24hr prior to analysis 5/15/16 10:10

128-02-WCS12 Nit B 200-2

600mL (124-04-WCS12) to 1800mL zeolite

128-03-WCS12 LLNS solution

8322.851 g aluminum nitrate nonahydrate (# 69597-69592, 69593-69571, 69591-69586)+
840.695 g calcium nitrate (# 69606, 69607)+
61.562 g chromium nitrate (# 66141, 63857)+
595.084 g Iron(III) nitrate (# 63601, 65582)+
40008.600 g magnesium nitrate (# 69603, 69609) +
~~Sodium~~ TBJ Am 5/16/16 ~~nitrite~~ Sodium Nitrite
493.5682 g Sodium nitrate (# 69611)+
596.525 g lead nitrate (# 65951, 69629, 69623)+
2373.849 g oxalic acid (# 69684)+
2.340 g nickle nitrate (# 65593)+

63.727 g nitric acid (# 67843)
6500.17 g DI H_2O

balance #89

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Work continued to Page

SIGNATURE [signature] DATE 5/15/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon DATE WITNESS DATE 5/25/16

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SWRI

131-01-WCS12 - UVT5 (1:3)

500mL UVT5 solution (# 128-03-WCS12) + 1500mL solvent
tray #3 test sit for 48 hours start: 5/16/16 15:00

131-02-WCS12 1M HNO_3

63.3mL HNO_3 (# 67843) to FV 1L with DI H_2O
5000-2 exp 5/16/17

131-03-WCS13 Saturated 1M HNO_3

1L 1M HNO_3 (# 131-02-WCS12) to unsaturated salts from (124-03-WCS12)
then added 600.217g sodium nitrate (#6960)
balance #135

SAM 5/17/16

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Work continued to Page

SIGNATURE James Mohr DATE 5/16/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon DATE WITNESS DATE 5/25/16

SWRI

Work continued from Page

133-01-WCS12 Soil Nit A Blend 1 tray #11

400mL saturate 1M NHO_3 (# 131-03-WCS12) + 400mL solvent let sit for 24 Hours. 800mL of this to 400mL DI H_2O and mix for 2min take 975 mL of this to 1950 mL zeolite

133-02-WCS12 Soil Nit A Blend 2 tray #3

200mL saturate 1M HNO_3 (# 131-03-WCS12) + 600mL solvent let sit for 24 hours. 800mL of this to 400mL DI H_2O and mix for 2min. 750 mL of this to 1500mL zeolite

13

133-03-WCS12 Soil Nit A Blend 3 tray # 12

400mL saturate 1M HNO_3 (131-03-WCS12) + 400mL solvent let sit for 24 hours 6800 mL (Tasm 5/20/16) of this and mix for 2min with 3400 mL (Tasm 5/20/16) DI H_2O.
Take 750mL of this to 2250mL zeolite

133-04-WCS12 Soil Nit A Blend #4 # 15

200mL saturated 1M HNO_3 (# 131-03-WCS12) + 600mL solvent let sit for 24 hours. 700 mL of this to 350mL DI H_2O mix for 2 min.
Take 700 mL of this to 2100mL zeolite

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SWRI

135-01-WCS12 1M NaOH

40.0814 g NaOH (#62693) to FV. 1L with DI H_2O
balance #135 exp 5/23/17

135-02-WCS12 1M HNO_3

63.3mL HNO_3 (#69790) to FV. 1L with DI H_2O
exp 52317

135-03-WCS12 saturated HNO_3

1L 1M HNO_3 (135-01-WCS12) to undissolved salts from (131-03-WCS12) then added 683.21 g $NaNO_3$ (#69610).
balance #135

135-04-WCS12 saturated NaOH

1L 1M NaOH (~~124-01~~ 135-02-WCS12) to undissolved salts from (124-04-WCS12) TESAMS 5/23/16
then added 721.82g $NaNO_3$ (#69610, 70359)
balance #135

JAM 5/24/16

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SIGNATURE		DATE
		5/23/16
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M. Graboski		DATE 5/25/16

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SWRI

137-01-WCS12 Sod Nit B Blend #1 tray #11

400mL saturate 1M NaOH (#135-04-WCS12) + 400mL sweat mix and let sit for 24 hr.
600mL of this was added to 300mL DI H_2O mixed and then 700mL was added to 1400mL zeolite.

137-02-WCS12 Sod Nit B Blend #2 tray #8

200mL saturate 1M NaOH (135-04-WCS12) + 600mL sweat mix and let sit for 24 hours
800mL of this was added to 400mL water mixed and then 750mL was added to 1500 mL zeolite

137-03-WCS12 Sod Nit B Blend #3 tray #12

400mL saturated 1M NaOH (135-04-WCS12) to 400mL sweat mix and let sit for 24 hr.
600mL of this was added to 300mL DI H_2O mixed and then 700mL was added to 2100 mL zeolite.

137-04-WCS12 Sod Nit B Blend #4 tray # 15

200mL saturated 1M NaOH (135-04-WCS12) to 600mL sweat mix and let sit for 24 hours.
780 TRIAM 5/16/16 mL of this was added to 350mL of DI H_2O, and mixed and then 700mL added to 2100mL zeolite.

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SIGNATURE [signature] DATE 5/24/16

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SWRI

141-01-WCS12 calcium hypochlorite

2.5104 g calcium hypochlorite (# 263041) to FV. 50mL with DI H_2O
balance #135 exp 5/26/17

141-02-WCS12 0.25N NaOH

10.0572 g NaOH (# 62643) to FV. 1L with DI H_2O
balance #135 exp 5/26/17

141-03-WCS12 neutralize 1M HNO_3 saturated with $NaNO_3$ 2x

500mL saturated 1M HNO_3 with $NaNO_3$ (# 135-02-WCS12) added 125 mL of spiltger to pH ~7.

JAM 6/16/16

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Work continued to Page

SIGNATURE			DATE
	James Mer		5/26/16
DISCLOSED TO AND UNDERSTOOD BY	DATE	WITNESS	DATE
M. Grabaldon			6/10/16

Work continued from Page

142-01-WCS12 Sod Nit A pH Blend #1

400mL of neutralized HNO_3 (#141-03-WCS12) to 400mL sulfuric and let sit for 24 hours.
600mL of this added to 300mL of water and mixed for 2 min.
700mL of the solution was then added to 1400mL zeolite.

142-02-WCS12 Sod Nit A pH Blend #2

200mL of neutralized HNO_3 (#141-03-WCS12) to 600 mL sulfuric and let sit for 24 hr.
800mL of this added to 400mL water and mixed for two minutes before using 750mL to 1500mL zeolite.

142-03-WCS12 Sod Nit ~~A~~ (Tosdan 5737 IV) pH Blend #3

400mL of neutralized HNO_3 (#141-03-WCS12) to 400mL sulfuric and let sit for 24 hr.
600mL of this was added to 300mL water and mixed for two minutes before using 700mL of the mixture in 2100mL zeolite

142-04-WCS12 Sod Nit ~~A~~ (Tosdan 5737 IV) pH Blend #4

200mL of neutralized HNO_3 (#141-03-WCS12) to 600mL sulfuric and let sit for 24 hours.
700mL of this to 350mL water and mix for 2 minutes, take 700mL of this to 2100mL zeolite.

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SIGNATURE [signature] DATE 5/25/16

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150 TITLE LANL

PROJECT NO. 21592.01.06 **010083**

BOOK NO. 15-0406-052

Work continued from Page

SWRI

150-01-WCS12 Sod Nit A zeo 1 (4:1) smallest tray

100mL saturated HNO_3 (# 135-03-WCS12) + 400mL zeolite

150-02-WCS12 Sod Nit B zeo 1 (4:1) tray #14

100mL saturate NaOH (#135-04-WCS12) + 400mL zeolite

150-03-WCS12 neutralize saturate HNO_3

300mL saturated HNO_3 (# 135-03-WCS12) + mL spillfor (# 65913)

150-04-WCS12 Sod Nit A pH zeo 1 4:1 tray #10

100mL neutralized saturated HNO_3 (# 150-03-WCS12) + 400mL zeolite

150-05-WCS12 Sod Nit A pH zeo 2 3:1 tray #15

200mL neutralized saturated HNO_3 (# 150-03-WCS12) + 600mL zeolite

150-06-WCS12 TISAB

Combined 131-01-WCS12 + 118-02-WCS12

exp 6/30/16

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SIGNATURE		DATE 6/16/16
DISCLOSED TO AND UNDERSTOOD BY M. Goodwin	DATE	WITNESS DATE 6/23/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Certificates of Calibration

010085

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36974
Asset Number:	022396	Calibrated:	8/19/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/19/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	73.6°F / 58 %
Serial Number:	22396	Work Order #	403133757
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? Indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-found
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	2.2	0.5	Fail	159%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	3.0	1.3	Fail?	100%
	699.3	702.6	3.3	5.2	1.3	Pass	63%
	1002.6	1002.4	-0.2	7.5	1.3	Pass	3%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-left
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	19-Aug-15

Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	4.0	0.5	Pass	88%
	-44.4	-42.8	1.6	2.2	0.5	Pass	73%
	-0.1	0.3	0.4	2.2	0.5	Pass	18%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	20.0	1.3	Pass	15%
	699.3	702.6	3.3	35.0	1.3	Pass	9%
	1002.6	1002.4	-0.2	50.0	1.3	Pass	0%

END OF REPORT

010088

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47205
Asset Number:	022923	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22923	Work Order #	403137431
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137431	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022923	Model:	08516-96	Type Data:	As-found
Serial No.:	22923	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-76.3	2.8	2.2	0.5	Fail	127%
	0.2	0.0	-0.2	2.2	0.5	Pass	9%
	396.7	396.0	-0.7	3.0	1.3	Pass	24%
	698.9	698.0	-0.9	5.2	1.3	Pass	17%
	1101.6	1094.9	-6.7	8.3	1.3	Pass	81%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137431	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022923	Model:	08516-96	Type Data:	As-left
Serial No.:	22923	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	3.0	0.5	Pass	63%
	0.2	0.0	-0.2	2.2	0.5	Pass	9%
	396.7	396.5	-0.2	3.0	1.3	Pass	7%
	698.9	698.0	-0.9	5.2	1.3	Pass	17%
	1101.6	1094.9	-6.7	8.3	1.3	Pass	81%

END OF REPORT

010091

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	53401
Asset Number:	023174	Calibrated:	5/25/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	5/25/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	75.4°F / 57 %
Serial Number:	23174	Work Order #	403139870
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 200 °C.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403139870	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023174	Model:	08516-96	Type Data:	Found-left
Serial No.:	23174	Type:	Thermocouple Type K	Cal Date:	25-May-16

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if reading meets their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	2.2	0.5	Pass	86%
	0.0	0.3	0.3	2.2	0.5	Pass	14%
	99.7	99.4	-0.3	2.2	0.5	Pass	14%
	200.5	200.8	0.3	2.2	0.5	Pass	14%

END OF REPORT

010093

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38118
Asset Number:	022473	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22473	Work Order #	403134196
Calibration Procedure:	TEMPERATURE PROBES		

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134196	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022473	Model	08516-96	Type Data:	Found-left
Serial No.	22473	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.7	0.8	3.7	1.3	Pass	20%
	750.3	750.9	0.6	5.6	1.3	Pass	11%
	1002.9	1001.5	-1.4	7.5	1.3	Pass	19%

END OF REPORT

010095

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47207
Asset Number:	022925	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22925	Work Order #	403137433
Calibration Procedure:	TEMPERATURE PROBES		

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-found
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-75.9	3.2	2.2	0.5	Fail	145%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-left
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-42.5	2.4	3.0	0.5	Pass	80%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

010098

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38121
Asset Number:	022476	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22476	Work Order #	403134199
Calibration Procedure:	TEMPERATURE PROBES		

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Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134199	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022476	Model	08516-96	Type Data:	Found-left
Serial No.	22476	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.0	-0.7	2.2	0.5	Pass	33%
	498.0	497.7	-0.3	3.7	1.3	Pass	7%
	750.3	749.6	-0.7	5.6	1.3	Pass	12%
	1002.9	999.9	-3.0	7.5	1.3	Pass	40%

END OF REPORT

010100

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38184
Asset Number:	022488	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22488	Work Order #	403134274
Calibration Procedure:	TEMPERATURE PROBES		

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Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134274	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022488	Model	08516-96	Type Data:	Found-left
Serial No.	22488	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.3	0.4	3.7	1.3	Pass	9%
	750.3	749.9	-0.4	5.6	1.3	Pass	7%
	1002.9	1000.5	-2.4	7.5	1.3	Pass	32%

END OF REPORT

010102

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39984
Asset Number:	020014	Calibrated:	10/7/2015
Description:	BALANCE	Calibration Due:	10/7/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	72 °F / 49 %
Serial Number:	B338797310	Work Order #	403134943
Calibration Procedure:	BALANCES & SCALES		

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0002	0.0002	0.0006	Pass	33%
Left Rear		100.0003	0.0003		Pass	50%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0002	0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	80.00001				
2		80.00002				
3		80.00001				
4		80.00002				
5		80.00001				
6		80.00002				
7		80.00002				
8		80.00002				
9		80.00002				
10		80.00002				
Std Deviation		0.000005		0.00008	Pass	6%
< 220 g Range						
1	200	200.0001				
2		200.0000				
3		200.0002				
4		200.0001				
5		200.0002				
6		200.0001				
7		200.0002				
8		200.0002				
9		200.0002				
10		200.0002				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.06	Pass	0%
	8.00001	8.00002	0.01			Pass	3%
	15.99996	15.99995	-0.01			Pass	3%
	24.00005	24.00010	0.05			Pass	13%
	32.00000	32.00006	0.06			Pass	15%
	40.00002	40.00007	0.05			Pass	13%
	48.00003	48.00006	0.03			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99998	56.00006	0.08	0.40	0.06	Pass	20%
	63.99999	64.00014	0.15			Pass	38%
	72.00002	72.00018	0.16			Pass	40%
	79.99998	80.00009	0.11			Pass	28%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.18	Pass	0%
< 220 g Range	20.0000	20.0001	0.1			Pass	25%
	40.0000	40.0000	0.0			Pass	0%
	60.0000	60.0001	0.1			Pass	25%
	80.0000	80.0001	0.1			Pass	25%
	100.0001	100.0000	-0.1			Pass	25%
	120.0001	120.0001	0.0			Pass	0%
	140.0001	140.0002	0.1			Pass	25%
	160.0001	160.0002	0.1			Pass	25%
	180.0001	180.0002	0.1			Pass	25%
	199.9999	200.0002	0.3			Pass	75%

END OF REPORT

010106

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39315
Asset Number:	014981	Calibrated:	9/25/2015
Description:	BALANCE	Calibration Due:	9/25/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	73 °F / 48 %
Serial Number:	1129242107	Work Order #	403134657
Calibration Procedure:	BALANCES & SCALES		

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134657	Mfr:	Mettler	Technician:	RRV
Asset No.:	014981	Model:	XS205DU	Type Data:	Found-left
Serial No.:	1129242107	Type:	Balance	Cal Date:	25-Sep-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		99.9998	-0.0002	0.0006	Pass	33%
Left Rear		100.0000	0.0000		Pass	0%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0000	0.0000		Pass	0%
Repeatability						
< 81 g Range						
1	80	79.99998				
2		79.99998				
3		79.99999				
4		79.99998				
5		79.99997				
6		80.00001				
7		79.99999				
8		79.99998				
9		79.99999				
10		80.00000				
Std Deviation		0.000012		0.00008	Pass	15%
< 220 g Range						
1	200	200.0000				
2		199.9999				
3		199.9999				
4		199.9998				
5		199.9997				
6		200.0000				
7		199.9999				
8		199.9998				
9		199.9999				
10		199.9999				
Std Deviation		0.00009		0.00020	Pass	45%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.07	Pass	0%
	8.00001	8.00000	-0.01			Pass	3%
	15.99996	15.99999	0.03			Pass	8%
	24.00005	24.00000	-0.05			Pass	13%
	32.00000	31.99999	-0.01			Pass	3%
	40.00002	40.00005	0.03			Pass	8%
	48.00003	48.00006	0.03			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134657	Mfr:	Mettler	Technician:	RRV
Asset No.:	014981	Model:	XS205DU	Type Data:	Found-left
Serial No.:	1129242107	Type:	Balance	Cal Date:	25-Sep-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99998	56.00000	0.02	0.40	0.07	Pass	5%
	63.99999	64.00005	0.06			Pass	15%
	72.00002	72.00004	0.02			Pass	5%
	79.99998	80.00003	0.05			Pass	13%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.22	Pass	0%
< 220 g Range	20.0000	19.9999	-0.1			Pass	25%
	40.0000	39.9999	-0.1			Pass	25%
	60.0000	59.9998	-0.2			Pass	50%
	80.0000	79.9998	-0.2			Pass	50%
	100.0001	99.9999	-0.2			Pass	50%
	120.0001	120.0001	0.0			Pass	0%
	140.0001	140.0000	-0.1			Pass	25%
	160.0001	160.0000	-0.1			Pass	25%
	180.0001	180.0000	-0.1			Pass	25%
	199.9999	200.0001	0.2			Pass	50%

END OF REPORT

010110

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	46011
Asset Number:	018344	Calibrated:	2/1/2016
Description:	OVEN	Calibration Due:	2/1/2017
Manufacturer:	THERMO SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	HERATHERM OMS60	Temp./RH:	70 °F / 42 %
Serial Number:	41241291	Work Order #	403137157
Calibration Procedure:	OVENS, CHAMBERS, INCUBA		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
015454	HART SCIENTIFIC	5627A	THERMOMETER PRT	2/18/2016
018495	FLUKE	1523	TEMPERATURE METER	2/18/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137157	Mfr:	Thermo Scientific	Technician:	RRV
Asset No:	018344	Model:	Heratherm OMS60	Type Data:	Found-left
Serial No:	41241291	Type:	Oven Chamber	Cal Date:	1-Feb-16

Remarks: Calibration limits per customer request. Chamber exceeds 70% of limit at the 200 °C test point. Customer to determine if the result found meets their requirements. Temperature uniformity not calibrated

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
50 °C	50.4	50.0	-0.4	2.0	0.18	Pass	20%
100 °C	101.0	100.0	-1.0			Pass	50%
150 °C	152.1	150.0	-2.1	3.0		Pass	70%
200 °C	203.2	200.0	-3.2	4.0		Pass	80%

END OF REPORT

010112

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	33589
Asset Number:	005420	Calibrated:	6/24/2015
Description:	BALANCE	Calibration Due:	6/24/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	AG245	Temp./RH:	72 °F / 52 %
Serial Number:	1116031935	Work Order #	403132562
Calibration Procedure:	BALANCES & SCALES		

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/1/2015
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/9/2015
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/21/2015
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/1/2015
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/6/2015
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/6/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute

Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/1/2015
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2015
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132562	Mfr:	Mettler	Technician:	RRV
Asset No:	005420	Model:	AG245	Type Data:	Found-left
Serial No:	1116031935	Type:	Balance	Cal Date:	24-Jun-15

Remarks: The balance has resulted in a <Pass?> at multiple test points. An external calibration was performed but it did not improve the results. Customer to determine if the results found meet their requirements

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Front		99.9997	-0.0003	0.0006	Pass	50%
Rear		99.9999	-0.0001		Pass	17%
Left		100.0004	0.0004		Pass	67%
Right		100.0002	0.0002		Pass	33%
Repeatability						
< 41 g Range						
1	20	20.00000				
2		20.00001				
3		20.00000				
4		19.99999				
5		20.00000				
6		20.00000				
7		19.99999				
8		19.99999				
9		20.00000				
10		20.00001				
Std Deviation		0.000007		0.000040	Pass	18%
Repeatability						
< 205 g Range						
1	100	100.0000				
2		100.0000				
3		100.0001				
4		99.9999				
5		99.9999				
6		100.0000				
7		100.0000				
8		100.0000				
9		99.9999				
10		99.9999				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
< 41 g Range	0.00000	0.00000	0.00000	0.00006	0.000057	Pass	0%
	4.00003	4.00000	-0.00003			Pass	50%
	8.00001	7.99999	-0.00002			Pass	33%
	12.00000	11.99999	-0.00001			Pass	17%
	15.99998	15.99998	0.00000			Pass	0%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132562	Mfr:	Mettler	Technician:	RRV
Asset No:	005420	Model:	AG245	Type Data:	Found-left
Serial No:	1116031935	Type:	Balance	Cal Date:	24-Jun-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
< 41 g Range *(Cont)*	20.00002	19.99999	-0.00003			Pass	50%
	24.00005	24.00002	-0.00003	0.00006	0.000057	Pass	50%
	28.00003	27.99998	-0.00005			Pass?	83%
	32.00002	31.99998	-0.00004			Pass?	67%
	36.00000	35.99997	-0.00003			Pass	50%
	40.00002	40.00000	-0.00002			Pass	33%
< 205 g Range	0.0000	0.0000	0.0000	0.0004	0.00020	Pass	0%
	20.0000	19.9999	-0.0001			Pass	25%
	40.0000	40.0000	0.0000			Pass	0%
	59.9999	60.0000	0.0001			Pass	25%
	80.0000	79.9999	-0.0001			Pass	25%
	100.0001	100.0000	-0.0001			Pass	25%
	120.0001	120.0001	0.0000			Pass	0%
	140.0001	140.0001	0.0000			Pass	0%
	160.0000	159.9998	-0.0002			Pass	50%
	180.0001	179.9998	-0.0003			Pass	75%
	199.9999	199.9998	-0.0001			Pass	25%

END OF REPORT

010116

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Certificates of Analysis for Chemicals

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

This is to certify that units of the above mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	**A509**	**Mfg. Date**	11/4/2015
Lot Number	**1115100**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	11/04/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

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Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

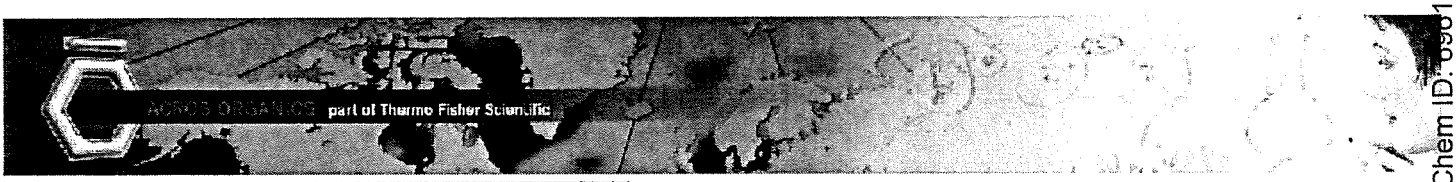
CERTIFIED BY

Edgar E Hess — Lab Manager Fair Lawn

Joel Boland — Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1.800.227.6701.

SwRI Chem ID: 67843
SwRI Chem ID: 67843
SwRI Chem ID: 67843



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

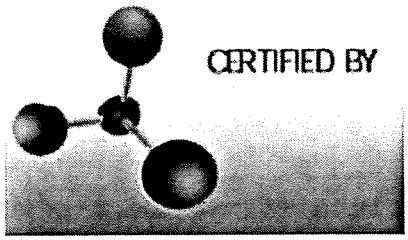
This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69610
SwRI Chem ID: 69610
SwRI Chem ID: 69610



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69610
SwRI Chem ID: 69610
SwRI Chem ID: 69610

SwRI Chem ID: 62694

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3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Sodium hydroxide - ACS reagent, ≥97.0%, pellets

Product Number:	**221465**
Batch Number:	**MKBV3988V**
Brand:	SIAL
CAS Number:	1310-73-2
MDL Number:	MFCD00003548
Formula:	HNaO
Formula Weight:	40.00 g/mol
Quality Release Date:	22 APR 2015
Recommended Retest Date:	APR 2017

NaOH

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form)	Pellets	Pellets
X-Ray Diffraction	Conforms to Structure	Conforms
Titration by HCL	≥ 97.0 %	99.0 %
Impurity % Na2CO3 by HCl Titration	≤ 1.0 %	0.3 %
Sulfate (SO4)	≤ 0.003 %	0.003 %
Chloride Content	≤ 0.005 %	0.005 %
Nitrogen Compounds (as N)	≤ 0.001 %	0.001 %
Phosphate (PO4)	≤ 0.001 %	0.001 %
Heavy Metals (as Ag)	≤ 0.002 %	0.002 %
Iron (Fe)	≤ 0.001 %	0.001 %
Nickel (Ni)	≤ 0.001 %	0.001 %
Mercury (Hg)	≤ 0.1 ppm	0.1 ppm
Calcium (Ca)	≤ 0.005 %	0.005 %
Magnesium (Mg)	≤ 0.002 %	0.002 %
Potassium (K)	≤ 0.02 %	0.02 %
Meets ACS Requirements 10th Edition	Current ACS Specification	Conforms

SwRI Chem ID: 62694

SwRI Chem ID: 62694

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 62694

SIGMA-ALDRICH®

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 221465
Batch Number: MKBV3988V

Test	Specification	Result
Recommended Retest Period 2 Years	----------	----------

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 62694

SwRI Chem ID: 62694

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 62693

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3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Sodium hydroxide – ACS reagent, ≥97.0%, pellets

Product Number:	**221465**
Batch Number:	**MKBV3988V**
Brand:	SIAL
CAS Number:	1310-73-2
MDL Number:	MFCD00003548
Formula:	HNaO
Formula Weight:	40.00 g/mol
Quality Release Date:	22 APR 2015
Recommended Retest Date:	APR 2017

NaOH

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form)	Pellets	Pellets
X-Ray Diffraction	Conforms to Structure	Conforms
Titration by HCL	≥ 97.0 %	99.0 %
Impurity	≤ 1.0 %	0.3 %
% Na2CO3 by HCl Titration		
Sulfate (SO4)	≤ 0.003 %	0.003 %
Chloride Content	≤ 0.005 %	0.005 %
Nitrogen Compounds	≤ 0.001 %	0.001 %
(as N)		
Phosphate (PO4)	≤ 0.001 %	0.001 %
Heavy Metals	≤ 0.002 %	0.002 %
(as Ag)		
Iron (Fe)	≤ 0.001 %	0.001 %
Nickel (Ni)	≤ 0.001 %	0.001 %
Mercury (Hg)	≤ 0.1 ppm	0.1 ppm
Calcium (Ca)	≤ 0.005 %	0.005 %
Magnesium (Mg)	≤ 0.002 %	0.002 %
Potassium (K)	≤ 0.02 %	0.02 %
Meets ACS Requirements	Current ACS Specification	Conforms
10th Edition		

SwRI Chem ID: 62693

SwRI Chem ID: 62693

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SwRI Chem ID: 62693

SIGMA-ALDRICH®

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3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 221465
Batch Number: MKBV3988V

Test	Specification	Result
Recommended Retest Period 2 Years	----------	----------

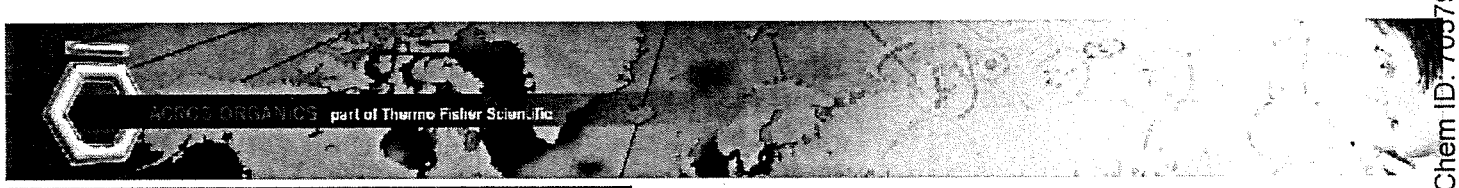
ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 62693

SwRI Chem ID: 62693

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

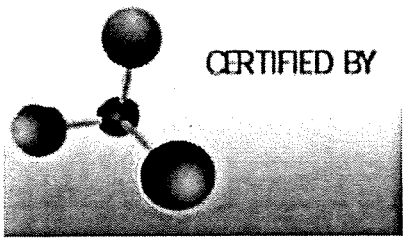
This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantabllity and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	42434	**Quality Test / Release Date**	23 December 2015
Lot Number	A0367952	**Suggested Retest Date**	December 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5 % at 25°C)	5.7 (5 % at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 70579
SwRI Chem ID: 70579
SwRI Chem ID: 70579



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 20 May 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceutlcalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 70579

SwRI Chem ID: 70579

SwRI Chem ID: 70579

010127

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-2
SwRI SRR: 57710
SDG: 598447
VTSR: 05.31.2016

Balance and DI Water Verification Logs

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010128

Book I.D.: 15-0406-042

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
88	014981	Mettler Toledo	XS205	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
5/4/16	JCU	200.0001	1.99999	0.01999
5-5-16	JK	200.0000	② 2.00016	0.02001
5-6-16	JK	199.9996	② 2.00002	0.02001
5-8-16	JK	199.9999	② 2.00002	0.02004
5-9-16	KE	199.9999	① 1.99997	0.02001
5-10-16	JK	199.9998	① 2.00008	0.02003
5-11-16	JK	199.9997	② 2.00002	0.02000
5-12-16	KE	199.9998	1.99999	0.02002
5-13-16	KE	199.9999	1.99999	0.01998
5-14-16	DM	199.9998	1.99996	0.02000
5-15-16	KE	199.9997	1.99991	0.01999
5-16-16	KE	199.9998	1.99998	0.01998
5-17-16	KE	199.9998	1.99996	0.01999
5-18-16	KE	199.9997	1.99998	0.02000
5-19-16	KE	199.9998	1.99991	0.02002
5-20-16	JK	199.9999	2.00002	0.02003
5-21-16	JK	199.9998	1.99999	0.02004
5-22-16	JK	199.9998	2.00004	0.02004
5-23-16	JK	200.0003	1.99999	0.02001
5/24/16	JCU	199.9998 KE 5/25/16	2.00000	0.02003
5/25/16	KE	199.99999	1.99999	0.20000
5/26/16	JCU	200.0001	1.99997	0.02001

Comments: ① KE 5-9-16 (TE) K USED 2g WEIGHT SN 1022033133 ID 011999
② 020641 is back. 5-11-16 KE

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010129

Book I.D.: 15-0406-042

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
88	014981	Mettler Toledo	XS205	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
5/27/16	SAM	199.9999	1.99999	0.02001
~~5-28~~		~~JK 5-27-16~~		
5-29-16	JK	200.0020	2.00002 KE 5/31/16	① 0.02003
5/31/16	L-P	200.0001	1.99997 5/31/16	TE ① 0.02004
6-1-16	JK	199.9998	2.00001	① 0.02003
6-2-16	JK	199.9995	2.00000	① 0.01999
6-3-16	KE	199.9997	1.99998	② 0.02002
6-4-16	JK	200.0000	2.00002	② 0.02000
6-5-16	JK	200.0001	2.00003	② 0.02000
6-6-16	JK	199.9999	1.99998	② 0.01999
6/7/16	JGH	200.0000	1.99999	0.02002
6-8-16	JK	199.9996	1.99996	② 0.01999
6-9-16	JK	199.9998	2.00006	② 0.02002
6-10-16	KE	199.9998	1.99999	② 0.02001
6-13-16 KE 6/14/16	KE	199.9998	2.00002	② 0.01998
6-14-16	KE	199.9998	2.00001	② 0.01999
6-15-16	JK	199.9995	2.00001	② 0.01997
6-16-16	JK	199.9996	1.99999	② 0.02001
6-17-16	JK	199.9995	2.00001	② 0.02000
6-20-16	KE	199.9997	2.00000	② 0.02001
6-21-16	KE	200.0000	1.99997 ②	~~0.02002~~ KE 6/21/16 0.02002
6-22-16	KE	200.0004	1.99999	② 0.01997

⑤ 5/31/16 TE

Comments: ⚠ : USED WT. I.D. 013790 (20mg) JK
② wt. is back # 12685.

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010130

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
5/14/16	JT	199.9998	1.99997	0.01998
5/16/16	VF	199.9999	1.99997	0.01997
5/17/16	JAM	199.9994	1.99997	0.02002
5/18/16	MG	200.0002	1.99999	0.02001
5/19/16	MG	199.9998	2.00001	0.01999
5/20/16	JAM	200.0000	2.00001	0.02000
5/22/16	JCM	199.9993	1.99999	0.02000
5/23/16	MG	200.0000	1.99999	0.01999
5/24/16	JAM	199.9994	2.00000	0.02001
5/25/16	JAM	199.9996	2.00001	0.01999
5/26/16	JAM	200.0000	1.99999	0.02002
5/27/16	JAM	199.9996	2.00002	0.01999
5/28/16	JAM	199.9998	2.00000	① 0.02003
5/29/16	JAM	199.9996	1.99999	① 0.01999
5/31/16	JCM	199.9996	1.99999	① 0.01999
6/1/16	JAM	199.9995	1.99994	① 0.01999
6/2/16	JCM	200.0000	2.00005	0.01999
6/3/16	JAM	199.9998	1.99999	0.02000
6/6/16	MG	199.9999	1.99996	0.01999
6/7/16	JAM	199.9998	1.99999	0.01998
6/8/16	JCM	199.9993	1.99997	0.01997
6/9/16	JCM	199.9991	1.99996	0.01999

Comments: ① wgt out for calibration use ID# 013790 20mg wgt

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010131

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
6/10/16	JCM	199.9998	2.00003	0.01995
6/13/16	SAM	199.9996	1.99996	0.02001
6/14/16	SAM	199.9998	1.99999	0.02003
6/15/16	SAM	199.9996	1.99997	0.01999
6/16/16	[illegible]	199.9998	2.00013	0.02002
6-17-16	KE	199.9998	2.00000	0.02001
6-19-16	SAM	199.9997	1.99998	0.02000
6-20-16	KE	199.9994	2.00005	0.01998
6/21/16	SAM	199.9997	1.99998	0.01997
6-22-16	KE	199.9997	1.99996	0.01996
6-23-16	KE	199.9996	1.99995	0.01998
6-24-16	KE	199.9996	1.99996	0.01997

Comments:

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Division 01, Building 70
Inorganic's Balance Verification Log

010132

Book ID #: 16-0406-010

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
34	005260	Mettler	AG 245	Lab 26	4th 5th	210 g 41 g

Date	Operator	Asset# 015142 Std Wt. 200 g Tolerance: 199.9800-200.02000 g Recorded Wt. (g)	Asset# 015144 Std Wt. 2 g Tolerance: 1.99980-2.00020 g Recorded Wt. (g)	Asset# 015143 Std Wt. 0.02 g Tolerance: 0.01995-0.02005 g Recorded Wt. (g)
3/8/16	MG	199.9963	1.99997	0.01995
3/15/16	JCM	199.9988	1.999991	0.01999
4/21/16	MG	200.0003	1.99997	0.01998
4/25/16	SAM	199.9999	1.999993	0.02001
4/26/16	SAM	199.9994	1.999995	0.01998
4/27/16	SAM	199.9996	1.99996	0.01998
5/11/16	SAM	200.0022	1.99984	0.02001
6/9/16	JCM	200.0046	1.99999	0.01997
6/12/16	SAM	200.0037	2.00007	0.02002
6/15/16	SAM	200.0044	2.00006	0.02001
12/23/16	MG	200.0054	2.00006	0.01999

Comments:

D.I. WATER SYSTEM NOTEBOOK 010133
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
5/9/16 1735	DRmz	17.93	✓	✓	✓	n/a	✓
5/10/16 1801	DRmz	17.94	✓	✓	✓	n/a	✓
5/13/16 1810	DRmz	17.94	✓	✓	✓	n/a	✓
5/16/16 1715	DRmz	17.93	✓	✓	✓	n/a	✓
5/17/16 1930	DRmz	17.94	✓	✓	✓	n/a	✓
5/18/16 1801	DRmz	17.94	✓	✓	✓	n/a	✓
5/19/16 1805	DRmz	17.94	✓	✓	✓	n/a	✓
5/20/16 1650	DRmz	17.94	✓	✓	✓	n/a	✓
5/23/16 1807	DRmz	17.93	✓	✓	✓	n/a	✓
5/24/16 1811	DRmz	17.93	✓	✓	✓	n/a	✓
5/25/16 1747	DRmz	17.93	✓	✓	✓	n/a	✓
5/26/16 1800	DRmz	17.93	✓	✓	✓	n/a	✓
5/27/16 1547	DRmz	17.93	✓	✓	✓	n/a	✓
5/31/16 1657	DRmz	17.94	✓	✓	✓	n/a	✓
6/1/16 1801	DRmz	17.93	✓	X	✓	n/a	X-change needed ??
6/2/16 1710	DRmz	17.93	✓	X	✓	n/a	tank xchange needed

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
5/9/16 1736	DRmz	✓	✓ 18.0	37407.4	✓
5/10/16 1802	DRmz	✓	✓ 18.0	37408.1	✓
5/13/16 1812	DRmz	✓	✓ 18.0	37411.8	✓
5/16/16 1716	DRmz	✓	✓ 18.0	37426.5	✓
5/17/16 1931	DRmz	✓	✓ 18.0	37427.6	✓
5/18/16 1803	DRmz	✓	✓ 18.0	37435.3	✓
5/19/16 1806	DRmz	✓	✓ 18.0	37446.7	✓
5/20/16 1451	DRmz	✓	✓ 18.0	37448.4	✓
5/23/16 1808	DRmz	✓	✓ 18.0	37462.1	✓
5/24/16 1812	DRmz	✓	✓ 18.0	37463.5	✓
5/25/16 1748	DRmz	✓	✓ 18.0	37464.6	✓
5/26/16 1821	DRmz	✓	✓ 18.0	37471.5	✓
5/27/16 1548	DRmz	✓	✓ 18.0	37473.0	✓
5/31/16 1657	DRmz	✓	✓ 18.0	37473.9	✓
6/1/16 1802	DRmz	✓	✓ 18.0	37476.7	✓
6/2/16 1711	DRmz	✓	✓ 18.0	37480.1	✓

Legend: Check = Green (OK); X = Red (call for service)

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

010134

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/3/16 1757	DRmz	17.94	✓	X	✓	n/a	TAIL PLATED
6/6/16 1806	DRmz	17.94	✓	X	✓	n/a	pending
6/7/16 1700	DRmz	17.93	✓	X	✓	n/a	pending
6/8/16 1702	DRmz	17.93	✓	X	✓	n/a	still pending
6/9/16 1728	DRmz	17.93	✓	X	✓	n/a	pending
6/10/16 1630	DRmz	17.93	✓	X	✓	n/a	PENDING EXCHANGE
6/13/16 1655	DRmz	17.93	—	✓	✓	n/a	MIXED BED TANK V-1 HANGS. ALL OK
6/14/16 1815	DRmz	17.93	✓	✓	—	n/a	✓
6/15/16 1817	DRmz	17.93	✓	✓	—	n/a	✓
6/16/16 1750	DRmz	17.93	✓	✓	✓	n/a	✓
6/17/16 1950	DRmz	17.93	—	—	✓	n/a	✓
6/20/16 1755	DRmz	17.94	✓	✓	—	n/a	✓
6/21/16 1735	DRmz	17.92	✓	✓	—	n/a	✓
6/22/16 1800	DRmz	17.93	✓	✓	—	n/a	✓
6/23/16 1751	DRmz	17.92	✓	—	—	n/a	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/3/16 1758	DRmz	✓	✓ 18.0	37482.2	—
6/6/16 1857	DRmz	✓	— 18.0	37484.3	—
6/7/16 1701	DRmz	✓	— 18.0	37489.2	✓
6/8/16 1703	DRmz	✓	— 18.0	37491.8	✓
6/9/16 1729	DRmz	✓	✓ 18.0	37492.6	✓
6/10/16 1631	DRmz	✓	✓ 18.0	37499.3	✓
6/13/16 1656	DRmz	✓	✓ 18.0	37501.4	✓
6/14/16 1816	DRmz	✓	✓ 18.0	37520.5	✓
6/15/16 1818	DRmz	✓	✓ 18.0	37521.3	✓
6/16/16 1751	DRmz	✓	✓ 18.0	37522.6	—
6/17/16 1951	DRmz	✓	✓ 18.0	37527.3	✓
6/20/16 1757	DRmz	✓	✓ 18.0	37530.8	—
6/21/16 1736	DRmz	✓	✓ 18.0	37538.4	✓
6/22/16 1801	DRmz	✓	✓ 18.0	37540.1	✓
6/23/16 1752	DRmz	✓	✓ 18.0	37541.4	✓

Legend: Check = Green (OK); X = Red (call for service)

Appendix M
SwRI Test Report 598466, June 27, 2016

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

June 27, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Victor Garde

Subject:		
	Case:	Zeolite
	SwRI Project Number:	21592.01.00X
	SDG:	598466
	SwRI Task Order Number:	160605-1
	SwRI Sample Receipt Number:	57711
	Samples Received:	05.31.2016
	Analysis:	Wypall and UNS Liquid Testing

Dear Mr. Garde,

Please find the enclosed results for the three overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

for Radonna Spies
Group Leader – R&D

APPROVED:

Michael J. Dammann
Director

RPS: jz

Cc: Anya Gonzales, Los Alamos National Laboratory

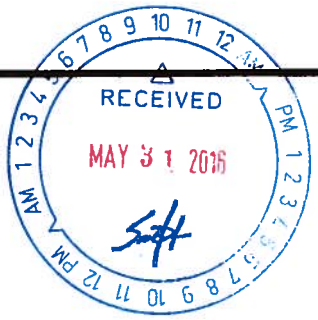
Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Chain-of-Custody
&
Sample Receipt Paperwork

Total Page Count: 010001+
Fraction: Wipes & Pages: 010120
UNS Liquid Testing

Douglas, Steven M.



From: Moken, James A.
Sent: Tuesday, May 31, 2016 9:27 AM
To: Douglas, Steven M.
Subject: Sample ID's

Steven,

Can I get you to make sample ID's and SDG's for the following samples. Table 1 will need to be on one SDG and Table 2 will be on a separate SDG since we will be adding samples to it later this month. If you have any questions let me know. Thanks.

Table 1

Requested Analysis					
Sample ID	**SW-846 Test Method 1030**	**SW-846 Test Method 1050**	**DOT O.1 Test**	**DOT O.2 Test**	**Test Method 9095B (Paint Filter)**
Sod Nit A				X	
Sod Nit Sol – Zeo 1			X		X
Sod Nit Sol – Zeo 2			X		X
Sod Nit B				X	
Sod Nit B – Zeo 1			X		X
Sod Nit B – Zeo 2			X		X
Sod Nit A pH – Zeo 1			X		X
Sod Nit A pH – Zeo 2			X		X
Sod Nit A Blend 1	X	X	X		X
Sod Nit A Blend 2	X	X	X		X
Sod Nit A Blend 3	X	X	X		X
Sod Nit A Blend 4	X	X	X		X
Sod Nit B Blend 1	X	X	X		X
Sod Nit B Blend 2	X	X	X		X
Sod Nit B Blend 3	X	X	X		X
Sod Nit B Blend 4	X	X	X		X
Sod Nit A pH Blend 1	X	X	X		X
Sod Nit A pH Blend 2	X	X	X		X
Sod Nit A pH Blend 3	X	X	X		X
Sod Nit A pH Blend 4	X	X	X		X

Table 2

Wypall Blend ID (Wypall mix: zeolite)	Wypall Mixture (ml)	Zeolite (ml)

Client: Los Alamos National Laboratory
SRR # 57711
Project # 21592.01.00X
Case: Zeolite
VTSR: 05/31/2016
Sample(s) Received: Intact
Temperature: N/A °C/ SN #: N/A

WB1(1:3)	1233	3700
WB2(1:4)	925	3700
WB3(1:5)	740	3700

Jamie

Southwest Research Institute

Laboratory Task Order

TO #: 160605-1 Revision: 0

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 06/19/16

SDG: 598466

SRR #'s: 57711
Client(s): Los Alamos National Laboratory

Instructions

Documents Related to this task order: 200815[COC for SRR 57711], 200816[SRR Paperwork for SRR 57711]

Deliverables --> Hard Copy: -YES- EDD: no PDF: no

Test: COMB_1050
Section: WETCHEM

Holding: 180 days from CED

SW846 1050 Test A & C Spontaneous Combustion

Cnt: 3

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
598466		1	Solid	WB1(1:3)	NO DATA	NO DATA
598467		1	Solid	WB2(1:4)	NO DATA	NO DATA
598468		1	Solid	WB3(1:5)	NO DATA	NO DATA

Test: IGNIT_1030
Section: WETCHEM

Holding: 180 days from CED

SW 846 Method 1030 Ignitability of solids

Cnt: 3

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
598466		1	Solid	WB1(1:3)	NO DATA	NO DATA
598467		1	Solid	WB2(1:4)	NO DATA	NO DATA
598468		1	Solid	WB3(1:5)	NO DATA	NO DATA

Test: Oxidizer_UN
Section: WETCHEM

Holding: 180 days from CED

United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.

Cnt: 3

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
598466		1	Solid	WB1(1:3)	NO DATA	NO DATA
598467		1	Solid	WB2(1:4)	NO DATA	NO DATA
598468		1	Solid	WB3(1:5)	NO DATA	NO DATA

Test: PAINT_9095
Section: WETCHEM

Holding: 180 days from CED

SW846 9095 Paint Filter Liquids Test

Cnt: 3

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
598466		1	Solid	WB1(1:3)	NO DATA	NO DATA
598467		1	Solid	WB2(1:4)	NO DATA	NO DATA
598468		1	Solid	WB3(1:5)	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 57711

VTSR: 05/31/16

Time: 10:00:00

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 05/31/16

Notes

Email was received to create an SRR for the following.

Parameters: Requirements located on the applicable Task Order.

See chain of custody as part of the LIMS system for more information.

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
598466	WB1(1:3)		Solid	1	
598467	WB2(1:4)		Solid	1	
598468	WB3(1:5)		Solid	1	

Containers: 3 **Samples: 3**

These documents are associated with this receipt: 200815[COC for SRR 57711], 200816[SRR Paperwork for SRR 57711]

Thermometer: N/A
Temperature: N/A

Page Printed: 06/27/2016 09:41
ver: (7/18/2014)

57711 Los Alamos National Laborato

Southwest Research Institute

Traffic Report

Sample Custodian Signature: _____

1. Custody Seal	Not Present or Damaged
2. Chain of Custody	Not Present
3. Sample Tags	Not Present
Sample Tag Numbers	Not on COC
4. SMO Forms	Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: Zeolite / SDG: _____

Sample Receipt: 57711

Airbill: Email

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
05/31/16	10:00:00	Email	WB1(1:3)	N/A	598466	YES	Intact
05/31/16	10:00:00	Email	WB2(1:4)	N/A	598467	YES	Intact
05/31/16	10:00:00	Email	WB3(1:5)	N/A	598468	YES	Intact

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 05/31/2016
Received By (Signature): Steven Douglas	
Case Number: Zeolite	Sample Delivery Group No.: NA
	SAS Number: NA

Remarks: 21592.01.00X

1.	Custody Seal(s)	Present/Absent* Intact/Broken
2.	Custody Seal Nos.	N/A
3.	Chain-of Custody Records	Present/Absent*
4.	Traffic Reports or Packing Lists	Present/Absent*
5.	Airbill	Airbill/Sticker Present/Absent*
6.	Airbill No.	Email
7.	Sample Tags	Present/Absent*
	Sample Tag Numbers	Listed/Not listed on Chain of Custody
8.	Sample Condition	Intact/Broken*/ Leaking
9.	Cooler Temperature	N/AC
10.	Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*
11.	Date Received at Lab	05/31/2016
12.	Time Received	10:00:00

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
WB1(1:3)	N/A	598466	Intact
WB2(1:4)	N/A	598467	Intact
WB3(1:5)	N/A	598468	Intact

Sample Transfer	
Fraction: INORG	Fraction
Area #: J. Mokem	Area #
By: STEVEN DOUGLAS	By
On: 05/31/2016	On

* Contact SMO and attach record of resolution

Reviewed By: Andrea Mel	Logbook No.: Sample Receipt (57711)
Date: 6.1.16	Logbook Page No.: 9472 SEC 2 of 2

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160605-1

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of the three Wypall rag and UNS liquid testing samples presented in Table 1 which contains the sample ID's and the methods requested on each of the blends. The Wypall rags were first soaked in a prepared UNS liquid solution for two hours before being removed and pressed to remove excess solution. The soaked rags where then added one at a time to a Waring Model blender (Model MX1500XTX) with a quart of water and blended for the designated period of time. This slurry was then added to a Kitchen aid mixer (Model KSMC895ER) where zeolite was then added in the designated ratios (Image 1). Once combined with the zeolite the samples were then submitted for analysis.

Table 1. Surrogate creation and analysis table

Surrogate ID	Times made	Methods			
		1030	1050	UN Ox solid (DOT 0.1)	Paint filter
WB1 (1:3)	1	1	1	1	1
WB2 (1:4)	1	1	1	1	1
WB3 (1:5)	1	1	1	1	1

*Testing not required for these methods.

SW-846 9095B: Paint Filter

For this method 100g of each blend was placed into a Gerson 260um paint filter (PN010714R, Lot# B5140428JF8) that was suspended over a 250 mL beaker for 5 minutes to collect any free liquids. During this 5-min period if any of the sample material drips into the cylinder, the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314. Under the laboratory conditions all other Wypall rag and UNS liquid testing samples tested for paint filter were not deemed to contain free liquids.

SW-846 1030: Ignitability of Solids

An ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within 2 minutes. If the material combustion propogates, the burning time was measured over a distance of 100 mm and the rate of burning would be determined. The surrogate material was formed into an unbroken powder train, 250 mm in length atop a ceramic tile with marks at the 80 and 180 mm in from the end of the train. The ceramic tile was placed about 8 inches in a hood with the sash lowered to give airflow of about 0.7 m/sec. One end of the train was exposed to the end of an acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes and if the sample began to burn down the train the time taken to get from the 80 to 180 mm mark was measure to determine the burn rate.

All three of the Wypall samples acted in a similar fashion during the 1030 analysis. The sample would dry at the burn region and begin to char after a little time had passed (Image 2). It could be

seen that the Wypall portion of the sample did burn and give off a flame here and there but no propagation took place. Since none of the blends even burned into the 100mm zone, all of them are considered non-flammable under the test conditions and criteria outlined in Method 1030.

Fine Excelsior (natural hardwood shavings) were used as a positive control each day testing was performed.

SW-846 1050: Spontaneous combustion and self heating

The surrogates for this analysis were first sprinkled several times onto a ceramic tile to observe if they smoked or flamed and could be considered pyrophoric solids by test Method A. Since none of the samples exhibited these characteristics, they were tested by Method C. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200C within the 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 2.

Table 2. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cube was placed into an oven with two thermocouples measuring the oven temp and up to four thermocouples inserted into each sample to measure its temperature during the analysis. Lids were placed onto the top of the test cubes and tungsten weights were placed on top of those sample believed to have event in order to keep the thermocouples and lids from coming off the sample. Also up to two thermocouples were placed in a tray below the sample in case any sample pushed out of the cube and onto the tray. Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for 24-48 hours depending on when the sample reached a stable temperature. Although the method states testing to be conducted for 24 hours, many of the samples did not reach 140°C ± 2°C during the initial 24 hour period, therefore the testing was extended to a minimum of 12 hours after the sample had reached a stable temperature. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C during the time of testing. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample. The oven and sample temperature graphs are located in Attachment A.

Wypall WB1 (1:3) and (1:4) were analyzed together and WB3 (1:5) was analyzed in duplicate, using the 100mm cube, since past samples having similar combinations of waste and zeolite were not self heating in the previous testing. These blends were allowed to run for at least 38 hours before ending the analysis due to the moisture present in each of them. After the analysis the cubes were removed and all Wypall samples had a dried zeolite appearance to them and all three blends came right out of the cube with very little clumping. Since none of these blends exceeded 200°C during the analysis all of them are classified as “Not a Self-Heating Waste” as defined by Method 1050 under laboratory conditions.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160605-1

DOT UN Oxidation testing

The Wypall blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the samples mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. If the burning time is less than the standard mixture, the burning times should be compared with those from packing group I or II or category I or II oxidizer, reference standards 3:2 and 2:3, by mass, of potassium bromated to cellulose, respectively. See Table 3 for classification. Table 4 presents the results for the reference standards. Tables 5 and 6 lists the comments the analyst noted for each of the two sample to cellulose ratio burns. All Wypall blends were classified as "Not Division 5.1" under laboratory conditions.

Table 3. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	UN Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

Table 4. Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
135.32	52.44	19.54

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160605-1

Table 5. Comments for Sample to Cellulose ratio of 4:1

Sample ID	Comment 4:1
WB1 (1:3)	Charring around wire, smoke, no flames
WB2 (1:4)	Charring around wire, smoke, no flames
WB3 (1:5)	Charring around wire, smoke, no flames

Table 6 Comments for Sample to Cellulose ratio of 1:1

Sample ID	Comment 1:1
WB1 (1:3)	small flames at wire leads, smoke and charring
WB2 (1:4)	small flames at wire leads, smoke and charring
WB3 (1:5)	Charring and smoke, sparking and smoldering after power was turned off.



Image 1: Appearance of the Wypall rags after being blended in the Waring Model MX1500XTX blender and prior to the addition of zeolite.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160605-1



Image 2: Showing the drying and charring after application of the flame for 2 minutes during 1030 analysis.

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."

RSpies

Group Leader **Date** **6/24/16**

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Attachment A

Method 1050 Graphs

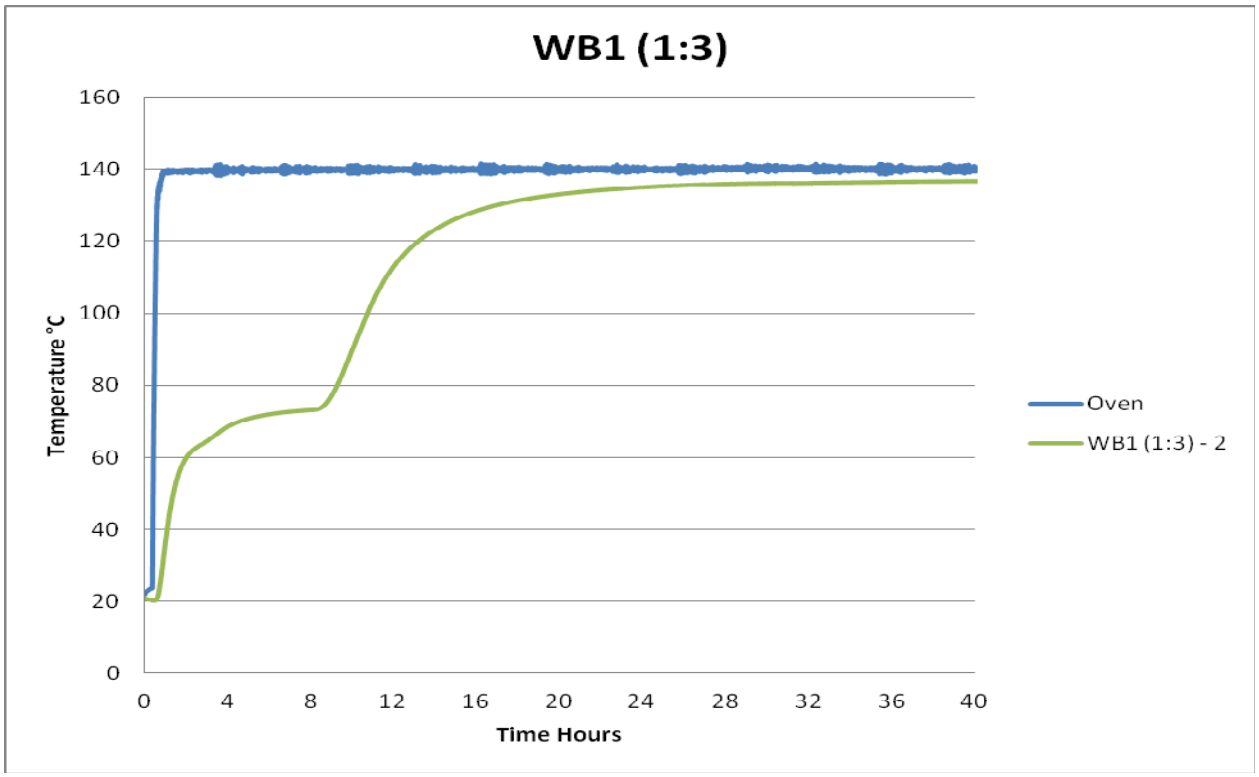


Figure 1. Method 1050 – WB1 (1:3) (100mm cube) full run. Thermocouple 1 died during the analysis and is not shown on the graph.

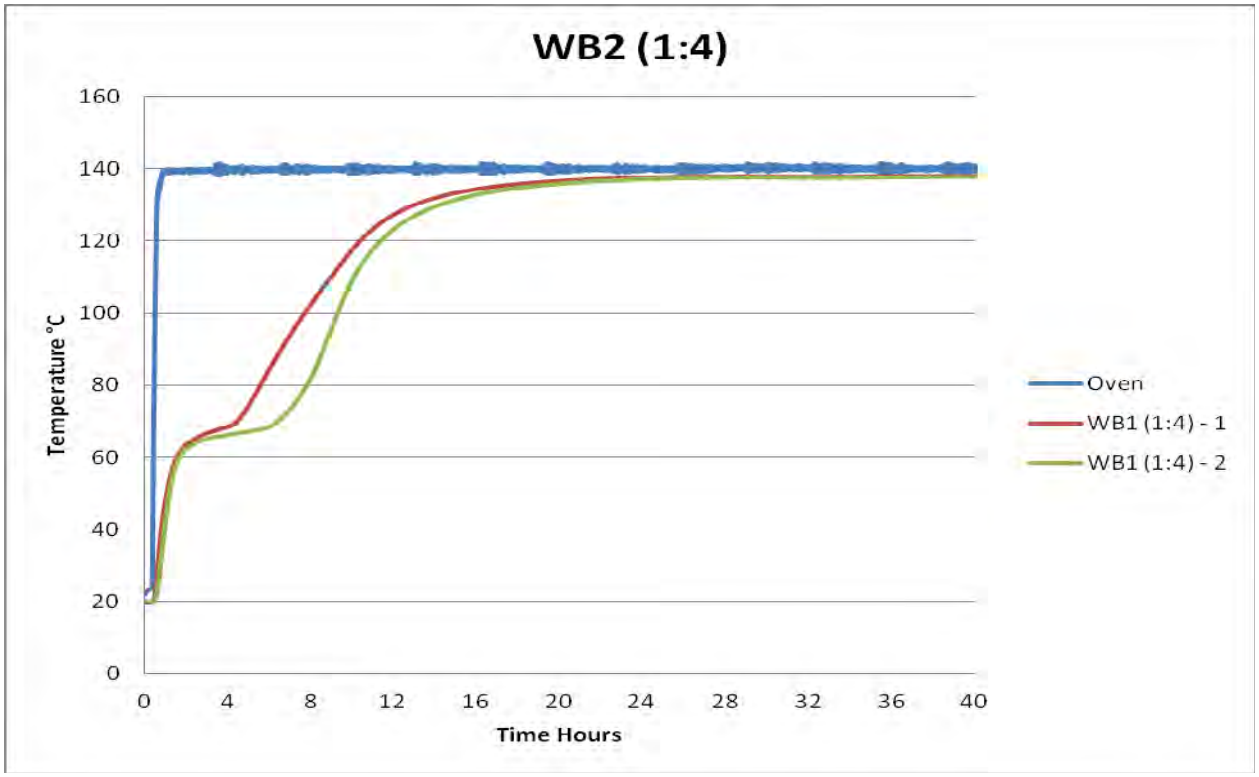


Figure 2. Method 1050 – WB2 (1:4) (100mm cube) full run.

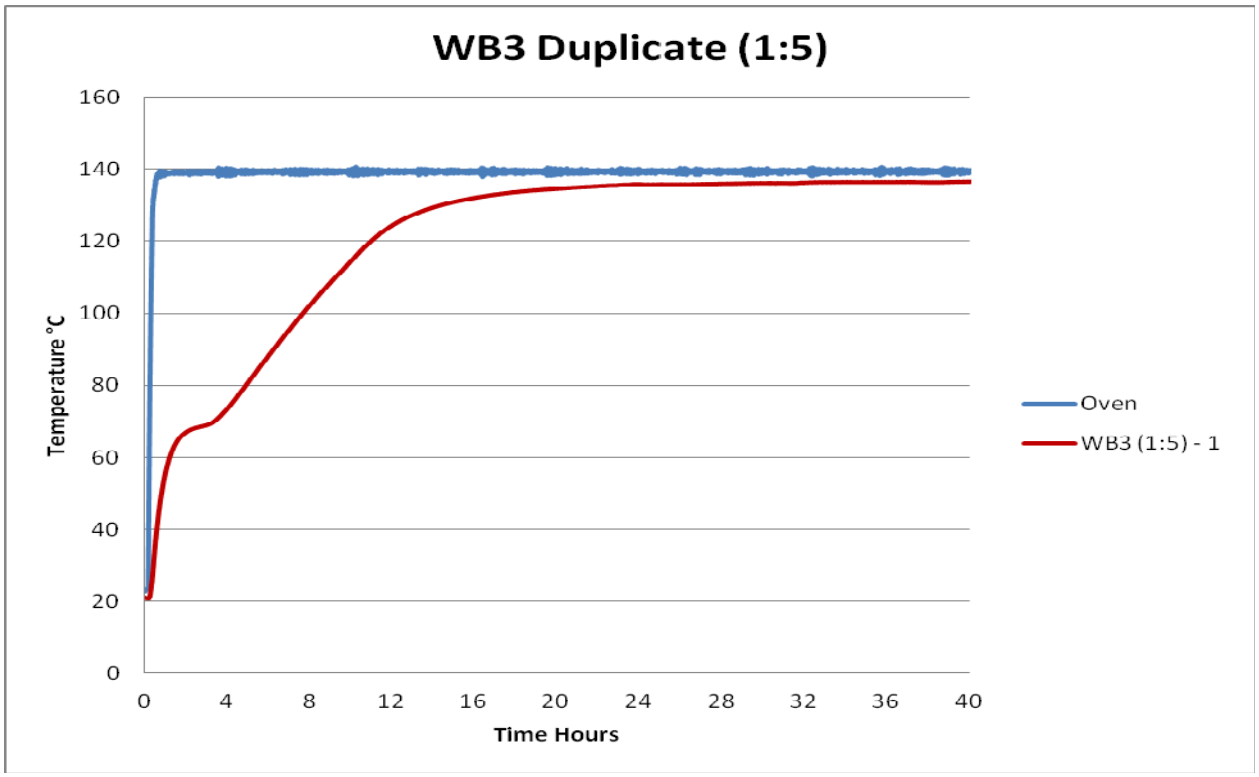


Figure 3. Method 1050 – WB3 (1:5) (100mm cube) full run. Only one thermocouple used for this sample.

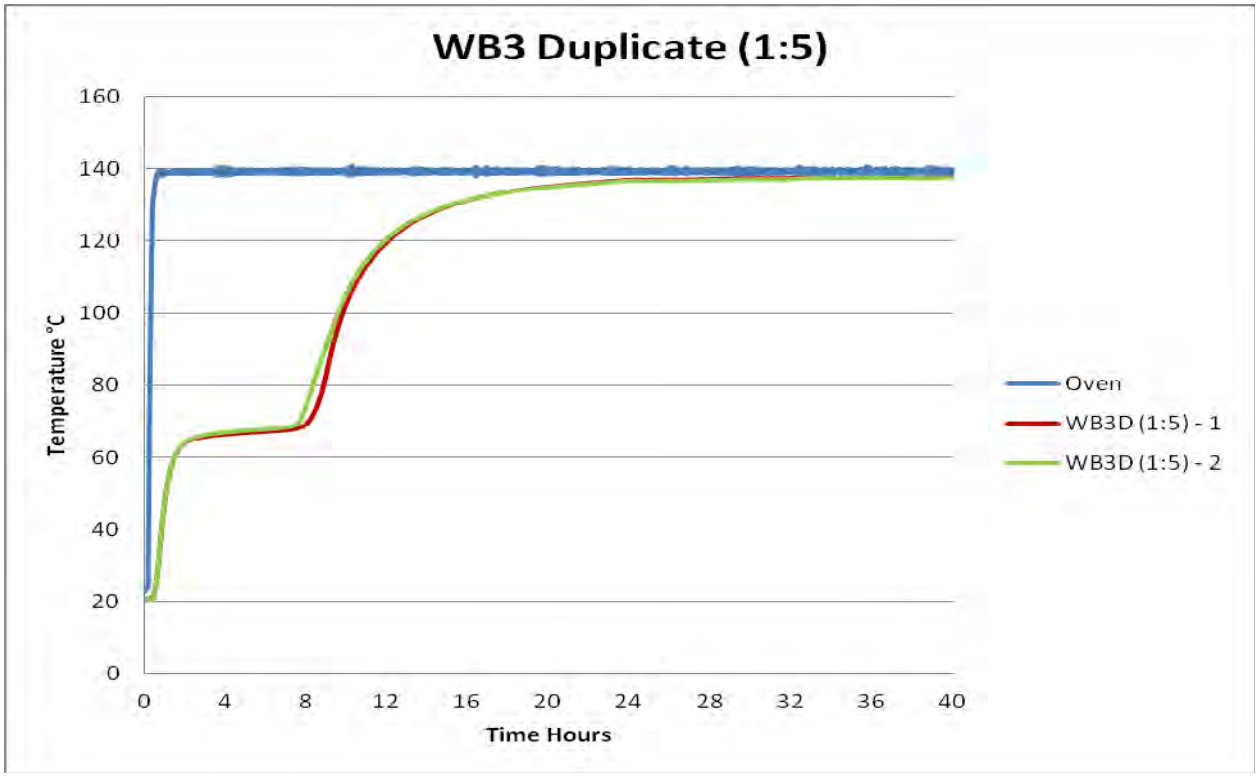


Figure 4. Method 1050 WB3 (1:5) duplicate (100mm cube) full run.

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Wetchem Analyses

Sample Results

SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/18/16

SRR #: 57711

Task Order #: 160605-1

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
WB1 (1:3)	598466	Nonflammable	06/15/16
WB1 (1:3) Dup	598466	Nonflammable	06/15/16
WB2 (1:4)	598467	Nonflammable	06/15/16
WB3 (1:5)	598468	Nonflammable	06/15/16

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/18/16

SRR #: 57711

Task Order #: 160605-1

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
WB1 (1:3)	598466	Not a self-heating waste	05/23/16
WB2 (1:4)	598467	Not a self-heating waste	05/23/16
WB3 (1:5)	598468	Not a self-heating waste	05/25/16
WB3 (1:5) Dup	598468	Not a self-heating waste	05/25/16

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SOUTHWEST RESEARCH INSTITUTE

SW846 9095 Paint Filter Liquids Test

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/18/16

SRR #: 57711

Task Order #: 160605-1

Sample ID	SwRI System ID	Method 9095 *Paint Filter Results*	Date Analyzed
WB1 (1:3)	598466	No free liquids	06/15/16
WB1 (1:3) Dup	598466	No free liquids	06/15/16
WB2 (1:4)	598467	No free liquids	06/15/16
WB3 (1:5)	598468	No free liquids	06/15/16

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/18/16

SRR #: 57711

Task Order #: 160605-1

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
135.32	52.44	19.45

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
WB1 (1:3)	598466	no reaction	>180	Not Division 5.1	06/20/16
WB2 (1:4)	598467	no reaction	>180	Not Division 5.1	06/20/16
WB3 (1:5)	598468	no reaction	>180	Not Division 5.1	06/06/16

The test criteria for determining oxidizing properties of the substance are:	**Classification**
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

LABORATORY CONTROL SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/13/16

SRR #: 57711

Task Order #: 160605-1

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
108-162 sec	42-63 sec	15-23 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	122.50	58.41	17.69	06/20/16

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SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

UN Oxidizer Test

Raw Data

Southwest Research Institute

Method: UN_Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 160605-2 ; 160605-1

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0190	21.0143	135.53	
3:7	2	9.0181	21.0485	134.46	
3:7	3	9.0300	21.0156	132.35	
3:7	4	9.0481	21.0075	138.56	
3:7	5	9.0349	21.0035	135.69	
3:7	**Avg**			135.32	

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0035	18.0057	55.66	
2:3	2	12.0134	18.0086	52.05	
2:3	3	12.0146	18.0108	52.79	
2:3	4	12.0106	18.0083	51.37	
2:3	5	12.0056	18.0110	50.35	
2:3	**Avg**			52.44	

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0148	12.0069	19.15	
3:2	2	18.0104	12.0079	18.09	
3:2	3	18.0084	12.0153	18.93	
3:2	4	18.0147	12.0094	20.25	
3:2	5	18.0207	12.0032	20.81	
3:2	**Avg**			19.45	

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 5/31/14
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 5/31/14
Potassium Bromate: Inorg# 69450-69453 Dried: 65°C for >12hrs.
Cellulose: Inorg# 69668-69663 Dried: 105°C for >4hrs.
Variac Setting: 150±7W RE 6/1/14 MG

Southwest Research Institute

Method: UN - Oxidizer
Project #: 21592.01.0006
Client: Los Alamos (LANL)
TO# 160605-1, 160505-2
U RE 6/20/16 MG

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0291	21.0711	122.50	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0117	18.0044	58.41	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0039	12.0049	17.169	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 88 Date: 6/20/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/20/16
Potassium Bromate: Inorg# 69450 - 69453 Dried: 7 12hrs. @ 65°C
Cellulose: Inorg# 69461 - 69663 Dried: > 4hrs @ 105°C
Variac Setting: 150 ± 7 W

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160605-2

Sample Analysis

System ID: Sod Nit A pH 2e02 (150-05-wcs12) [Blue]
598452

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0090	6.0162	180.62 ①	charring around wire, smoke, no flames
4:1	2	24.0018	6.0040	181.37 ①	
4:1	3	24.0075	6.0067	180.38 ①	
4:1	4	24.0139	6.0076	180.56 ①	
4:1	5	24.0046	6.0064	180.28 ①	
4:1	Avg			7180	① Time power turned off. NO reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0074	15.0070	181.34 ②	small flames at wire leads, smoke + charring
1:1	2	15.0080	15.0128	183.50 ②	
1:1	3	15.0067	15.0053	181.91 ②	
1:1	4	15.0171	15.0157	182.50 ②	
1:1	5	15.0032	15.0154	181.85 ②	
1:1	Avg			7180	② Time flames extinguished. Power turned off at 180 sec

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/16/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/20/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 698161 - 698163 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160665-1

Sample Analysis

System ID: 598466 WB1 (1:3) [red]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0127	6.0152	180.35 ①	Charring around wire, smoke, no flames
4:1	2	24.0086	6.0151	180.31 ①	
4:1	3	24.0148	6.0086	180.66 ①	
4:1	4	24.0100	6.0067	180.28 ①	
4:1	5	24.0010	6.0049	180.44 ①	
4:1	Avg			>180	①Time power turned off. No reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0049	15.0070	181.31 ②	Small flames at wire leads, smoke & charring
1:1	2	15.0250	15.0113	183.19 ②	
1:1	3	15.0150	15.0041	192.94 ②	
1:1	4	15.0238	15.0103	182.75 ②	
1:1	5	15.0063	15.0090	183.38 ②	
1:1	Avg			>180	②Time when flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/17/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/20/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 69661 - 69663 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160106 05-1

Sample Analysis

System ID: 598467 WB2(1:4) [Black]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0217	6.0090	180.28 ①	Charring around wire, smoke & charring. No flames
4:1	2	24.0015	6.0055	180.53 ①	
4:1	3	24.0095	6.0136	180.57 ①	
4:1	4	24.0195	6.0132	180.63 ①	
4:1	5	24.0159	6.0092	180.34 ①	
4:1	Avg			7/80	① Time power was turned off. No reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0273	15.0108	183.28 ②	Small flames at wire leads, smoke & charring
1:1	2	15.0140	15.0154	183.85 ②	
1:1	3	15.0255	15.0210	184.28 ②	
1:1	4	15.0246	15.0198	185.04 ②	
1:1	5	15.0085	15.0098	184.84 ②	
1:1	Avg			7/80	② time when flame extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 88 Date: 6/20/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/20/16
Sample Dried ? YES (NO) Dried: N/A
Cellulose: Inorg# 691691-69663 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160665-1

Sample Analysis

System ID: 598408 WB3 (1:5) [Green]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0160	6.0092	180.31 ①	charring around wire, smoke, no flames
4:1	2	24.0047	6.0097	180.39 ①	
4:1	3	24.0118	6.0056	180.28 ①	
4:1	4	24.0136	6.0116	180.41 ①	
4:1	5	24.0109	6.0065	180.75 ①	
4:1	Avg			>180	① time when power turned off. No reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0173	15.0103	184.22 ②	charring + smoke, sparking + smoldering
1:1	2	15.0059	15.0151	184.75 ②	after power was turned off
1:1	3	15.0233	15.0242	185.87 ②	
1:1	4	15.0047	15.0063	183.22 ②	
1:1	5	15.0072	15.0086	185.02 ②	
1:1	Avg			>180	② Time sparking/smoldering stopped. Power turned off at 180sec.

Weighted Samples: Monica Gabaldon Balance#: 88 Date: 6/20/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/20/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 691661-691663 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Method 1050
Logbook Pages

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. #__15-0406-048_

Analysis / Method: 1050 Project# 21592.01.006

TAP# (if applicable):

Client: Los Alamos TO# 160005-1

Balance #

LCS Info: TV:

Notes: Wypall blends formed hardened portions in the cubs
start: 5/23/16 15:00
Stop: 5/25/16 7:50

Sample ID							
temp °C	0	1	2	3	4	5	6
0	-0.0	0.2	-0.1	-0.5	-0.5	-0.5	-0.3
50	49.9	50.2	49.7	49.5	49.2	49.6	49.9
100	99.9	100.2	99.6	99.5	99.2	99.5	99.8
200	200.0	200.2	199.6	199.5	199.2	199.5	199.8
300	300.0	300.1	299.7	299.5	299.3	299.5	299.9
WB1 (1:3)							
sample took some time to come to temperature due to the amount of moisture. Sample came to temp in around 28 hours. Thermocouple 1 in the sample died during the analysis. When sample was removed it formed hardened portions within the cube. Since the sample did not exceed 200°C it is not considered to be self heating.							
WB2 (1:4)							
Similar observations as WB1 except this sample came to a stable temp around 24 hours. Since sample did not exceed 200°C it is not considered to be self heating.							
Calculation:							

Analyst Signature: [signature] Date: 5/23/16

Reviewed by: M. Galindo Date: 5/31/16

Logbook #/ Page #___017___ 0044_____

010032

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. #__15-0406-048_

Analysis / Method: 1050 Project# 21552.01.006

TAP# (if applicable): _____

Client: Los Alamos TO# 160605~1

Balance # _____

LCS Info: _____ TV: _____

Notes: WB3 & D did not clump up much dry loose zeolite and typical.
start: 5/25/16 14:41
stop: 5/27/16 10:57

Sample ID					
WB3 sample & duplicate. Sample came to temperature slowly due to the moisture content. Sample came to temperature around 24-28 hours into testing. Upon removing the sample after analysis it was noticed to be loose dry zeolite with little to no clumping. Since sample did not exceed 200°C during the analysis it is not considered to be self heating.					

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Method 1030
Logbook Pages

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. # 15-0406-048

Analysis / Method: 1030 Project# 21592.02.006

TAP# (if applicable):

Client: LANL TO# 16[illegible]605-2
1606665-1

Balance # acelsior wood balance#: 34

LCS Info: § #61753 TV: positive

Notes: burn rate greater than 2.2mm/sec is positive

Sample ID	burn time across 100mm	burn rate mm/sec			
LCS	10.94 sec	9.14			
598447	did not burn	—	whitened at flame application region, some crackling heard but no flame		
598447D	did not burn	—	or burning. only smoke,		
598448	did not burn	—	charring and whitening of zeolite, some crackling but no burning took place.		
598449	did not burn	—	charring and whitening of zeolite, some crackling of sample.		
598450	did not burn	—	charring and drying of zeolite		
598453	did not burn	—	charring and drying of zeolite, cracking		
598454	did not burn	—	charring and whitening at burn area no flame present.		
598455	did not burn	—	charring and drying of zeolite		
598456	did not burn	—	charring and drying of zeolite		
598460	did not burn	—	charring and drying of zeolite		
598461	did not burn	—	charring and drying of zeolite		
598462	did not burn	—	charring and drying of zeolite, some crackling		
598463	did not burn	—	charring and drying of zeolite		
LCS II	8.35 sec	11.98	charred zeolite blocked mypall creen		wrong line was crossed
598466	did not burn	—	dried zeolite, blocked mypall mesh		
598466D	did not burn	—	dried zeolite, blocked mypall mesh		
598467	did not burn	—	dried zeolite, blocked mypall mesh		
598468	did not burn	8.90	charred and dried zeolite blocked mesh with mypall		
Calculation: LCS II	11.24 sec				

Analyst Signature: [signature] Date: 6/12/16 / 6/15/16

Reviewed by: [signature] Date: 6/24/16

Logbook #/ Page # 017 0054

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Method 9095
Paint Filter
Logbook Pages

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. # 15-0406-048

Analysis / Method: Paint Filter 9095 Project# 21592.01.006

TAP# (if applicable):

Client: LANL TO# 160605-2
160605-1

Balance # 34

LCS Info: water TV: fail

Notes:

Sample ID	sample weight (g)	pass / fail			
LCS	101.2271	fail			
598447	100.6282	pass	Soil	Mix A Blend 1	
598447D	102.3179	pass			
598448	104.2198	pass	Soil	Mix A Blend 2	
598449	103.7724	pass			
598450	104.3029	pass			
598453	101.0121	pass			
598454	100.9715	pass	Soil	Mix A pH Blend 2	
598455	101.0229	pass			
598456	103.2149	pass			
598460	104.5137	pass			
598461	101.4509	pass	Sample ID	Sample (g)	pass / fail
598462	101.0100	Pass			
598463	101.2436	Pass	LCS III Rec 4/16 (60)	100.5403	Fail
598451	104.3260	Pass	598466	104.1483	Pass
598452	100.9383	Pass	598466D	103.4290	Pass
598458	100.5220	pass	598467	115-8450	Pass
598459	100.9887	Pass	598468	109.6482	Pass
598464	100.2055	Pass	LCS IV	100.1001	Fail
Calculation: 598463 =	100.7298	Pass			
LCS II	100.9985	fail			

Analyst Signature: Date: 6/12/16 / 6/15/16

Reviewed by: Date: 6/24/16

Logbook #/ Page # 017 0055

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Preparation Logbook Pages

128 TITLE Los Alamos

PROJECT NO. 21592.01.006

BOOK NO. 75-0406-052

Work continued from Page

SWRI

128-01-WCS12 Nit B 200-1

600mL (124-04-WCS12) to 1200mL zeolite

let sit for 24hr prior to analysis 5/15/16 10:10

128-02-WCS12 Nit B 200-2

600mL (124-04-WCS12) to 1800mL zeolite

128-04-WCS12 LLNS solution

8322.851 g aluminum nitrate nonahydrate (# 69597-69592, 69593-69571, 69591-69586) +

840.695 g calcium nitrate (# 69606, 69607) +

61.562 g chromium nitrate (# 66141, 63857) +

595.084 g Iron(III) nitrate (# 63601, 65582) +

40008.600 g magnesium nitrate (# 69603, 69604) +

~~Sodium~~ TBJAM 5/16/16 Sodium STE 5/16/16

493.5682 g sodium nitrate (# 69611) +

596.525 g lead nitrate (# 65951, 69629, 69623) +

2373.849 g oxalic acid (# 69684) +

2.340 g nickle nitrate (# 65593) +

63.727 g nitric acid (# 67843)

6500.17 g DI H_2O

balance #89

www.scientificbindery88yrs.com

Work continued to Page

SIGNATURE [signature] DATE 5/15/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon DATE WITNESS DATE 5/25/16

132 TITLE LANL

PROJECT NO. 21592.01.006

BOOK NO. 15-0406-052

Work continued from Page

SWRI

towels dry 160.066 g
747.00 wet

wypall rags were soaked in UNS solution (128-03-WCS12) for 2 hours and the squeezed to remove excess liquid.

132-01-WCS12 WB1 (1:3)

1 quart of warm water added to blender. Then seven rags were added to blender 1 at a time and blended @ 75% speed for 30 seconds. They were then blended at 75% speed for additional 30 seconds @ end. 1233 mL of this solution was added to the mixer and 1850mL zeolite was slowly added while blending on speed 8 and then speed 3. The remaining 1850mL of zeolite was added while mixing on speed 3 until thoroughly mixed.

132-02-WCS12 WB2 (1:4)

Same procedure as 132-01-WCS12 except only 925mL of wypall solution was added.

132-03-WCS12 WB3 (1:5)

Same procedure as 132-01-WCS12 except only 740mL of wypall solution was added.

132-04-WCS12 UVT 3 (3:1)

1330 mL of UNS solution (128-03-WCS12) added to the mixing bowl. ~~1000mL of warm water was added to the~~ (wrong client) 2000mL of zeolite slowly added at speed 8 and then lowered to speed 3. The remaining 2000mL of zeolite slowly added at speed 3 until thoroughly mixed. (AM 5/18/16)

132-05-WCS12 UVT5 (1:3))

1000mL of warm water and 1500mL of UNS/Sweat (131-01-WCS12) added and mixed at speed 4 for 3min. Temp/pH recorded. Then 1850mL zeolite at speed 3 then 8. Remaining 1850mL zeolite added until thoroughly mixed.

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Work continued to Page

SIGNATURE [signature] DATE 5/18/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 5/25/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Certificates of Calibration

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36974
Asset Number:	022396	Calibrated:	8/19/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/19/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	73.6°F / 58 %
Serial Number:	22396	Work Order #	403133757
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-found
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	2.2	0.5	Fail	159%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	3.0	1.3	Fail?	100%
	699.3	702.6	3.3	5.2	1.3	Pass	63%
	1002.6	1002.4	-0.2	7.5	1.3	Pass	3%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-left
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	19-Aug-15
Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	4.0	0.5	Pass	88%
	-44.4	-42.8	1.6	2.2	0.5	Pass	73%
	-0.1	0.3	0.4	2.2	0.5	Pass	18%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	20.0	1.3	Pass	15%
	699.3	702.6	3.3	35.0	1.3	Pass	9%
	1002.6	1002.4	-0.2	50.0	1.3	Pass	0%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47205
Asset Number:	022923	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22923	Work Order #	403137431
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137431	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022923	Model:	08516-96	Type Data:	As-found
Serial No.:	22923	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-76.3	2.8	2.2	0.5	Fail	127%
	0.2	0.0	-0.2	2.2	0.5	Pass	9%
	396.7	396.0	-0.7	3.0	1.3	Pass	24%
	698.9	698.0	-0.9	5.2	1.3	Pass	17%
	1101.6	1094.9	-6.7	8.3	1.3	Pass	81%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137431	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022923	Model:	08516-96	Type Data:	As-left
Serial No.:	22923	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	3.0	0.5	Pass	63%
	0.2	0.0	-0.2	2.2	0.5	Pass	9%
	396.7	396.5	-0.2	3.0	1.3	Pass	7%
	698.9	698.0	-0.9	5.2	1.3	Pass	17%
	1101.6	1094.9	-6.7	8.3	1.3	Pass	81%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	53401
Asset Number:	023174	Calibrated:	5/25/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	5/25/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	75.4°F / 57 %
Serial Number:	23174	Work Order #	403139870
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 200 °C.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403139870	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023174	Model:	08516-96	Type Data:	Found-left
Serial No.:	23174	Type:	Thermocouple Type K	Cal Date:	25-May-16

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if reading meets their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	2.2	0.5	Pass	86%
	0.0	0.3	0.3	2.2	0.5	Pass	14%
	99.7	99.4	-0.3	2.2	0.5	Pass	14%
	200.5	200.8	0.3	2.2	0.5	Pass	14%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38118
Asset Number:	022473	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22473	Work Order #	403134196
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134196	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022473	Model	08516-96	Type Data:	Found-left
Serial No.	22473	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.7	0.8	3.7	1.3	Pass	20%
	750.3	750.9	0.6	5.6	1.3	Pass	11%
	1002.9	1001.5	-1.4	7.5	1.3	Pass	19%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47207
Asset Number:	022925	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22925	Work Order #	403137433
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-found
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-75.9	3.2	2.2	0.5	Fail	145%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-left
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-42.5	2.4	3.0	0.5	Pass	80%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38121
Asset Number:	022476	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22476	Work Order #	403134199
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty In Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134199	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022476	Model	08516-96	Type Data:	Found-left
Serial No.	22476	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.0	-0.7	2.2	0.5	Pass	33%
	498.0	497.7	-0.3	3.7	1.3	Pass	7%
	750.3	749.6	-0.7	5.6	1.3	Pass	12%
	1002.9	999.9	-3.0	7.5	1.3	Pass	40%

END OF REPORT

010056

Southwest Research Institute
Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38184
Asset Number:	022488	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22488	Work Order #	403134274
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134274	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022488	Model	08516-96	Type Data:	Found-left
Serial No.	22488	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.3	0.4	3.7	1.3	Pass	9%
	750.3	749.9	-0.4	5.6	1.3	Pass	7%
	1002.9	1000.5	-2.4	7.5	1.3	Pass	32%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39984
Asset Number:	020014	Calibrated:	10/7/2015
Description:	BALANCE	Calibration Due:	10/7/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	72 °F / 49 %
Serial Number:	B338797310	Work Order #	403134943
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the Instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty In Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0002	0.0002	0.0006	Pass	33%
Left Rear		100.0003	0.0003		Pass	50%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0002	0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	80.00001				
2		80.00002				
3		80.00001				
4		80.00002				
5		80.00001				
6		80.00002				
7		80.00002				
8		80.00002				
9		80.00002				
10		80.00002				
Std Deviation		0.000005		0.00008	Pass	6%
< 220 g Range						
1	200	200.0001				
2		200.0000				
3		200.0002				
4		200.0001				
5		200.0002				
6		200.0001				
7		200.0002				
8		200.0002				
9		200.0002				
10		200.0002				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.06	Pass	0%
	8.00001	8.00002	0.01			Pass	3%
	15.99996	15.99995	-0.01			Pass	3%
	24.00005	24.00010	0.05			Pass	13%
	32.00000	32.00006	0.06			Pass	15%
	40.00002	40.00007	0.05			Pass	13%
	48.00003	48.00006	0.03			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99998	56.00006	0.08	0.40	0.06	Pass	20%
	63.99999	64.00014	0.15			Pass	38%
	72.00002	72.00018	0.16			Pass	40%
	79.99998	80.00009	0.11			Pass	28%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.18	Pass	0%
< 220 g Range	20.0000	20.0001	0.1			Pass	25%
	40.0000	40.0000	0.0			Pass	0%
	60.0000	60.0001	0.1			Pass	25%
	80.0000	80.0001	0.1			Pass	25%
	100.0001	100.0000	-0.1			Pass	25%
	120.0001	120.0001	0.0			Pass	0%
	140.0001	140.0002	0.1			Pass	25%
	160.0001	160.0002	0.1			Pass	25%
	180.0001	180.0002	0.1			Pass	25%
	199.9999	200.0002	0.3			Pass	75%

END OF REPORT

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Calibration Certificate

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Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39315
Asset Number:	014981	Calibrated:	9/25/2015
Description:	BALANCE	Calibration Due:	9/25/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	73 °F / 48 %
Serial Number:	1129242107	Work Order #	403134657
Calibration Procedure:	BALANCES & SCALES		

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134657	Mfr:	Mettler	Technician:	RRV
Asset No.:	014981	Model:	XS205DU	Type Data:	Found-left
Serial No.:	1129242107	Type:	Balance	Cal Date:	25-Sep-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		99.9998	-0.0002	0.0006	Pass	33%
Left Rear		100.0000	0.0000		Pass	0%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0000	0.0000		Pass	0%
Repeatability						
< 81 g Range						
1	80	79.99998				
2		79.99998				
3		79.99999				
4		79.99998				
5		79.99997				
6		80.00001				
7		79.99999				
8		79.99998				
9		79.99999				
10		80.00000				
Std Deviation		0.000012		0.00008	Pass	15%
< 220 g Range						
1	200	200.0000				
2		199.9999				
3		199.9999				
4		199.9998				
5		199.9997				
6		200.0000				
7		199.9999				
8		199.9998				
9		199.9999				
10		199.9999				
Std Deviation		0.00009		0.00020	Pass	45%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.07	Pass	0%
	8.00001	8.00000	-0.01			Pass	3%
	15.99996	15.99999	0.03			Pass	8%
	24.00005	24.00000	-0.05			Pass	13%
	32.00000	31.99999	-0.01			Pass	3%
	40.00002	40.00005	0.03			Pass	8%
	48.00003	48.00006	0.03			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134657	Mfr:	Mettler	Technician:	RRV
Asset No.:	014981	Model:	XS205DU	Type Data:	Found-left
Serial No.:	1129242107	Type:	Balance	Cal Date:	25-Sep-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99998	56.00000	0.02	0.40	0.07	Pass	5%
	63.99999	64.00005	0.06			Pass	15%
	72.00002	72.00004	0.02			Pass	5%
	79.99998	80.00003	0.05			Pass	13%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.22	Pass	0%
< 220 g Range	20.0000	19.9999	-0.1			Pass	25%
	40.0000	39.9999	-0.1			Pass	25%
	60.0000	59.9998	-0.2			Pass	50%
	80.0000	79.9998	-0.2			Pass	50%
	100.0001	99.9999	-0.2			Pass	50%
	120.0001	120.0001	0.0			Pass	0%
	140.0001	140.0000	-0.1			Pass	25%
	160.0001	160.0000	-0.1			Pass	25%
	180.0001	180.0000	-0.1			Pass	25%
	199.9999	200.0001	0.2			Pass	50%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39314
Asset Number:	014982	Calibrated:	9/25/2015
Description:	BALANCE	Calibration Due:	9/25/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XP5003SDR	Temp./RH:	73 °F / 48 %
Serial Number:	1129300727	Work Order #	403134658
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/12/2016
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/8/2016
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/7/2016
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016
001718	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001719 RICE LAKE 5 KG WEIGHT CLASS 1 4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134658	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	25-Sep-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit		Result	% Limit
Corner Load	grams	grams	grams	grams			
Left Front	1000	1000.000	0.000	0.010		Pass	0%
Left Rear		999.999	-0.001			Pass	10%
Right Rear		1000.000	0.000			Pass	0%
Right Front		1000.001	0.001			Pass	10%
Repeatability							
1000 g Range							
1	500	500.002					
2		500.000					
3		500.001					
4		500.002					
5		500.000					
6		500.000					
7		500.001					
8		500.001					
9		500.001					
10		500.000					
Std Deviation		0.0008		0.0020		Pass	40%
5100 g Range							
1	2000	199.99					
2		200.00					
3		199.99					
4		199.99					
5		200.00					
6		200.00					
7		199.99					
8		199.99					
9		199.99					
10		199.99					
Std Deviation		0.005		0.012		Pass	42%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
1000 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	100.000	100.001	0.001			Pass	8%
	200.000	200.001	0.001			Pass	8%
	300.000	300.001	0.001			Pass	8%
	400.000	400.001	0.001			Pass	8%
	500.000	500.002	0.002			Pass	17%
	600.000	600.003	0.003			Pass	25%
	700.000	700.002	0.002			Pass	17%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134658	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	25-Sep-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	grams	grams	grams		
1000 g Range	800.000	800.002	0.002	0.012	0.003	Pass	17%
	900.000	900.001	0.001			Pass	8%
	1000.000	1000.000	0.000			Pass	0%
5100 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	500.000	500.001	0.001			Pass	8%
	1000.000	999.999	-0.001			Pass	8%
	1500.00	1500.00	0.00	0.02	0.01	Pass	0%
	2000.00	2000.00	0.00			Pass	0%
	2500.00	2500.00	0.00			Pass	0%
	3000.00	3000.00	0.00			Pass	0%
	3500.00	3500.00	0.00			Pass	0%
	4000.00	4000.00	0.00			Pass	0%
	4500.00	4500.00	0.00			Pass	0%
	5000.00	5000.00	0.00			Pass	0%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	46011
Asset Number:	018344	Calibrated:	2/1/2016
Description:	OVEN	Calibration Due:	2/1/2017
Manufacturer:	THERMO SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	HERATHERM OMS60	Temp./RH:	70 °F / 42 %
Serial Number:	41241291	Work Order #	403137157
Calibration Procedure:	OVENS, CHAMBERS, INCUBA		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
015454	HART SCIENTIFIC	5627A	THERMOMETER PRT	2/18/2016
018495	FLUKE	1523	TEMPERATURE METER	2/18/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137157	Mfr:	Thermo Scientific	Technician:	RRV
Asset No:	018344	Model:	Heratherm OMS60	Type Data:	Found-left
Serial No:	41241291	Type:	Oven Chamber	Cal Date:	1-Feb-16

Remarks: Calibration limits per customer request. Chamber exceeds 70% of limit at the 200 °C test point. Customer to determine if the result found meets their requirements. Temperature uniformity not calibrated

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
50 °C	50.4	50.0	-0.4	2.0	0.18	Pass	20%
100 °C	101.0	100.0	-1.0			Pass	50%
150 °C	152.1	150.0	-2.1	3.0		Pass	70%
200 °C	203.2	200.0	-3.2	4.0		Pass	80%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	33589
Asset Number:	005420	Calibrated:	6/24/2015
Description:	BALANCE	Calibration Due:	6/24/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	AG245	Temp./RH:	72 °F / 52 %
Serial Number:	1116031935	Work Order #	403132562
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/iEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/1/2015
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/9/2015
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/21/2015
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/1/2015
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/6/2015
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/6/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/1/2015
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2015
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132562	Mfr:	Mettler	Technician:	RRV
Asset No:	005420	Model:	AG245	Type Data:	Found-left
Serial No:	1116031935	Type:	Balance	Cal Date:	24-Jun-15

Remarks: The balance has resulted in a <Pass?> at multiple test points. An external calibration was performed but it did not improve the results. Customer to determine if the results found meet their requirements

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Front		99.9997	-0.0003	0.0006	Pass	50%
Rear		99.9999	-0.0001		Pass	17%
Left		100.0004	0.0004		Pass	67%
Right		100.0002	0.0002		Pass	33%
Repeatability						
< 41 g Range						
1	20	20.00000				
2		20.00001				
3		20.00000				
4		19.99999				
5		20.00000				
6		20.00000				
7		19.99999				
8		19.99999				
9		20.00000				
10		20.00001				
Std Deviation		0.000007		0.000040	Pass	18%
Repeatability						
< 205 g Range						
1	100	100.0000				
2		100.0000				
3		100.0001				
4		99.9999				
5		99.9999				
6		100.0000				
7		100.0000				
8		100.0000				
9		99.9999				
10		99.9999				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
< 41 g Range	0.00000	0.00000	0.00000	0.00006	0.000057	Pass	0%
	4.00003	4.00000	-0.00003			Pass	50%
	8.00001	7.99999	-0.00002			Pass	33%
	12.00000	11.99999	-0.00001			Pass	17%
	15.99998	15.99998	0.00000			Pass	0%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403132562	Mfr:	Mettler	Technician:	RRV
Asset No:	005420	Model:	AG245	Type Data:	Found-left
Serial No:	1116031935	Type:	Balance	Cal Date:	24-Jun-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
< 41 g Range *(Cont)*	20.00002	19.99999	-0.00003			Pass	50%
	24.00005	24.00002	-0.00003	0.00006	0.000057	Pass	50%
	28.00003	27.99998	-0.00005			Pass?	83%
	32.00002	31.99998	-0.00004			Pass?	67%
	36.00000	35.99997	-0.00003			Pass	50%
	40.00002	40.00000	-0.00002			Pass	33%
< 205 g Range	0.0000	0.0000	0.0000	0.0004	0.00020	Pass	0%
	20.0000	19.9999	-0.0001			Pass	25%
	40.0000	40.0000	0.0000			Pass	0%
	59.9999	60.0000	0.0001			Pass	25%
	80.0000	79.9999	-0.0001			Pass	25%
	100.0001	100.0000	-0.0001			Pass	25%
	120.0001	120.0001	0.0000			Pass	0%
	140.0001	140.0001	0.0000			Pass	0%
	160.0000	159.9998	-0.0002			Pass	50%
	180.0001	179.9998	-0.0003			Pass	75%
	199.9999	199.9998	-0.0001			Pass	25%

END OF REPORT

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Certificates of Analysis for Chemicals

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

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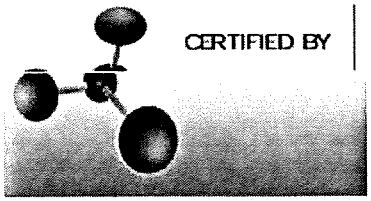
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SwRI Chem ID: 69597

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69597



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69597

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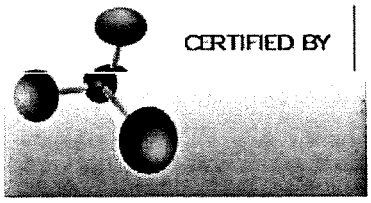
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SwRI Chem ID: 69592

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69592



Edgar E. Hans

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69592

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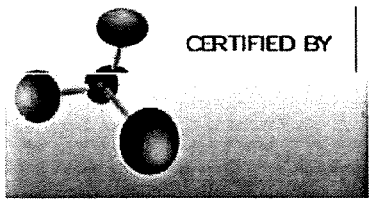
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69573
SwRI Chem ID: 69573
SwRI Chem ID: 69573

Fisher Scientific

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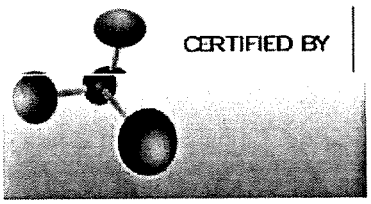
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SwRI Chem ID: 69571

Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69571



Edgar E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69571

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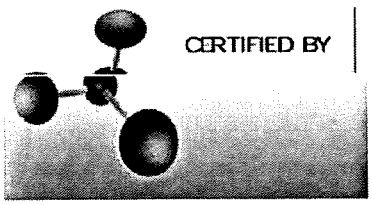
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69591
SwRI Chem ID: 69591
SwRI Chem ID: 69591

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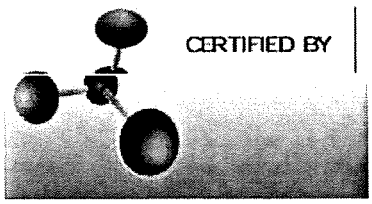
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hess

Lab Manager Fair Lawn

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SwRI Chem ID: 69590
SwRI Chem ID: 69590
SwRI Chem ID: 69590

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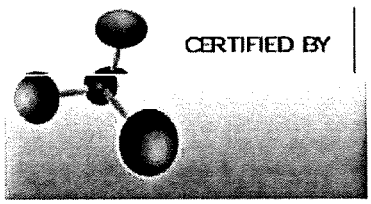
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SwRI Chem ID: 69589

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69589



Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69589

Fisher Scientific

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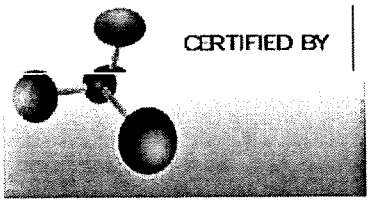
SwRI Chem ID: 69588

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69588



Edgar E. Hess

Lab Manager Fair Lawn

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SwRI Chem ID: 69588

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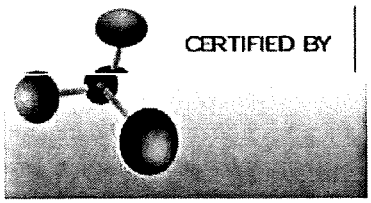
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Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69587
SwRI Chem ID: 69587
SwRI Chem ID: 69587

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

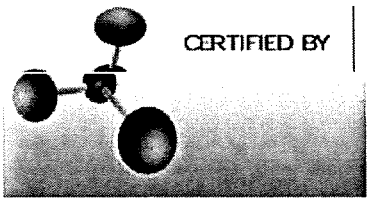
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SwRI Chem ID: 69586

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69586

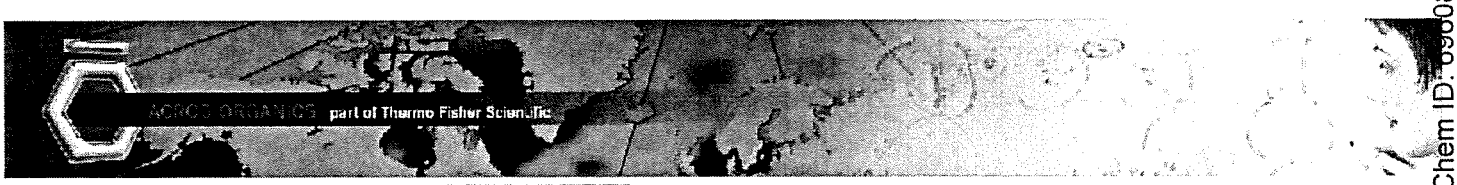


Edgar E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69586



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

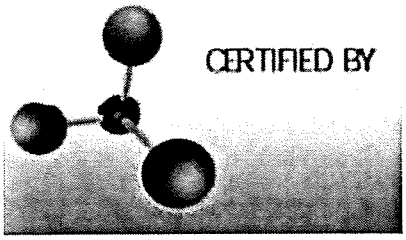
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Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608

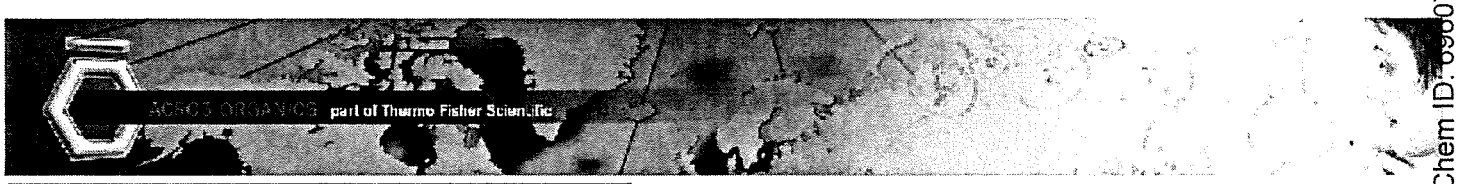


CERTIFIED BY

L. Van den Broek, QA Manager Issued: 25 April 2016

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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

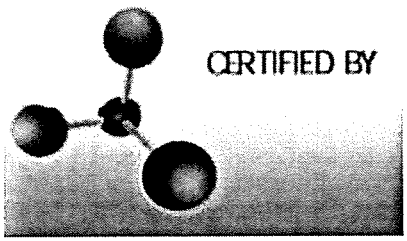
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Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69607
SwRI Chem ID: 69607
SwRI Chem ID: 69607

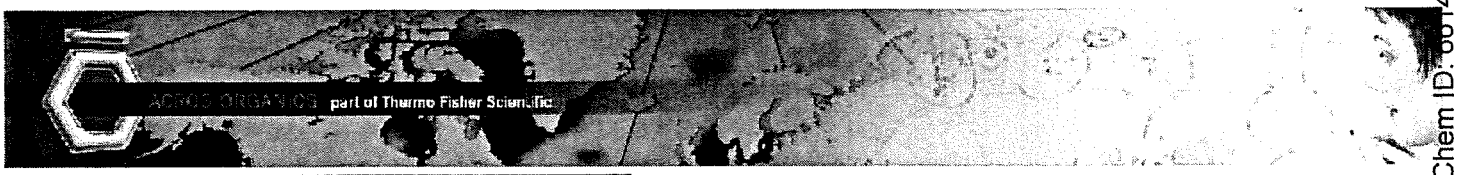


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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69607
SwRI Chem ID: 69607
SwRI Chem ID: 69607



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

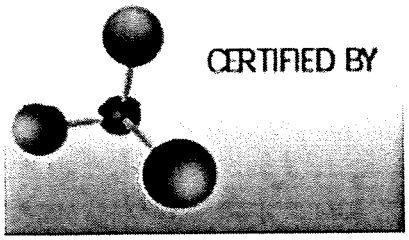
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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm
Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)

SwRI Chem ID: 66141
SwRI Chem ID: 66141
SwRI Chem ID: 66141



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L. Van den Broek, QA Manager

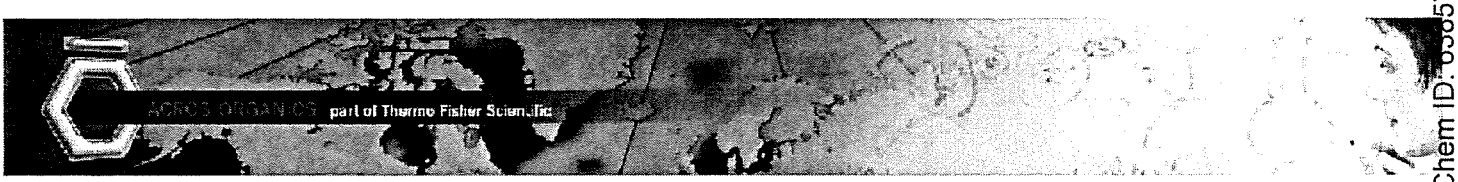
Issued: 14 January 2016

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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 66141

SwRI Chem ID: 66141

SwRI Chem ID: 66141



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

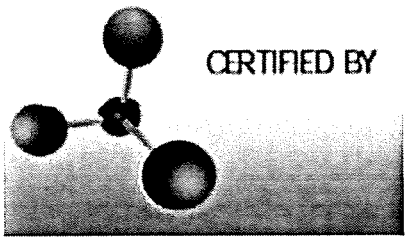
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Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	dark purple to black crystalline chunks	black crystalline chunks
Titration Iodometric	>=98.5 %	101.9 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Trace analysis	Type: Ca measure =< 50 PPM	Type: Ca measure 5 PPM
Trace analysis	Type: Cd measure =< 10 PPM	Type: Cd measure 3 PPM
Trace analysis	Type: Co measure =< 10 PPM	Type: Co measure 5 PPM
Trace analysis	Type: Cu measure =< 10 PPM	Type: Cu measure 7 PPM
Trace analysis	Type: Fe measure =< 200 PPM	Type: Fe measure 178 PPM
Trace analysis	Type: Mg measure =< 50 PPM	Type: Mg measure 6 PPM
Trace analysis	Type: Mn measure =< 10 PPM	Type: Mn measure 7 PPM
Trace analysis	Type: Na measure =< 50 PPM	Type: Na measure 17 PPM
Trace analysis	Type: Ni measure =< 50 PPM	Type: Ni measure 8 PPM
Trace analysis	Type: Pb measure =< 20 PPM	Type: Pb measure 4 PPM
Trace analysis	Type: Sr measure =< 50 PPM	Type: Sr measure 11 PPM
Trace analysis	Type: Zn measure =< 10 PPM	Type: Zn measure 4 PPM
Trace analysis	Type: Cl measure =< 20 PPM	Type: Cl measure =< 20 PPM
Trace analysis	Type: SO4 measure =< 50 PPM	Type: SO4 measure =< 50 PPM
Trace analysis	Type: NH4 measure =< 10 PPM	Type: NH4 measure =< 10 PPM
Subst not pptd by NH4OH	=<0.2 % (as SO4)	=<0.0077 % (as SO4)

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857



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L. Van den Broek, QA Manager Issued: 28 October 2015

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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857

SwRI Chem ID: 63604

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sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 63604

SwRI Chem ID: 63604

SwRI Chem ID: 65582

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate - ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBW6908V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	16 OCT 2015

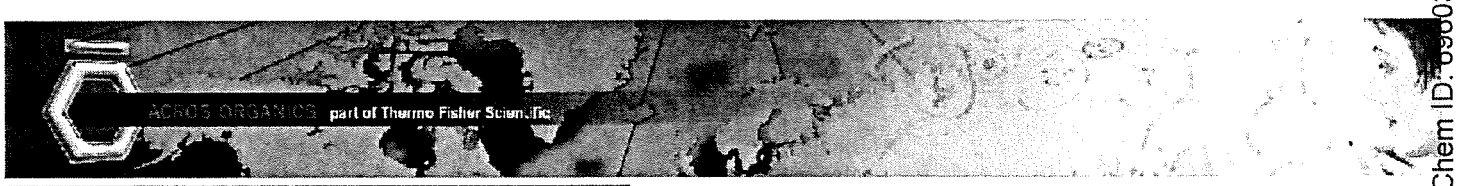
SwRI Chem ID: 65582

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Michael Grady, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 65582

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.



SwRI Chem ID: 69603

ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

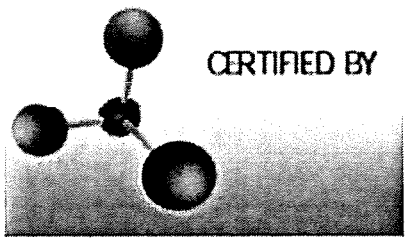
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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



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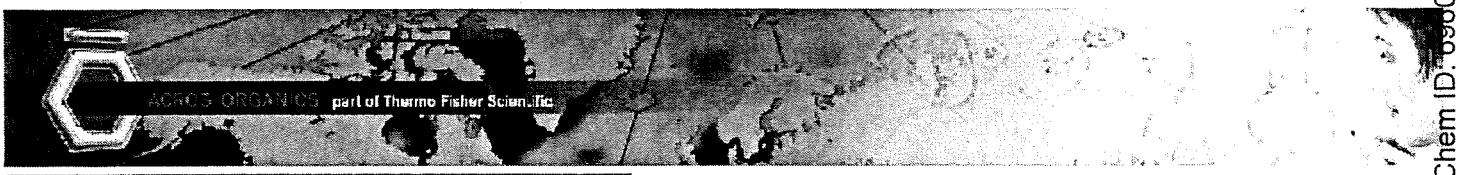
L. Van den Broek, QA Manager

Issued: 25 April 2016

Acros Organics
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Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Intemet: http://www.acros.com
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SwRI Chem ID: 69603

SwRI Chem ID: 69603



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

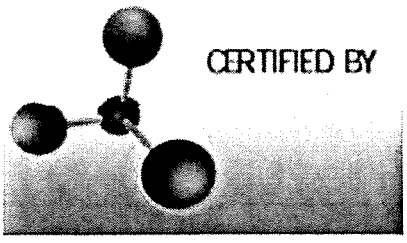
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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



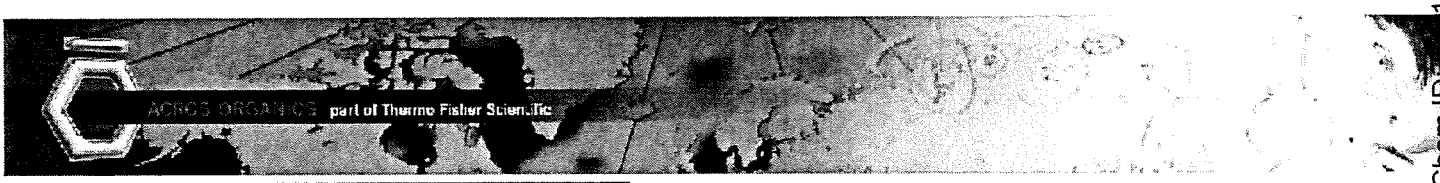
CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69604
SwRI Chem ID: 69604
SwRI Chem ID: 69604



SwRI Chem ID: 69611

ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

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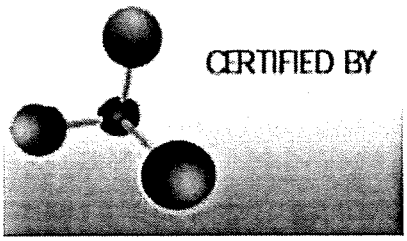
Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69611

SwRI Chem ID: 69611



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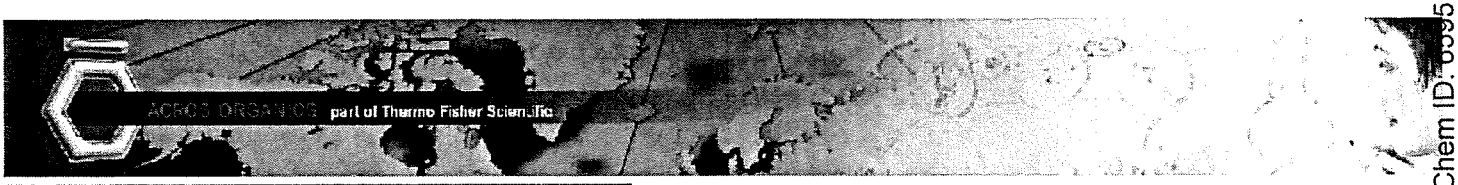
L. Van den Broek, QA Manager Issued: 25 April 2016

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SwRI Chem ID: 69611

SwRI Chem ID: 69611

SwRI Chem ID: 69611



SwRI Chem ID: 65951

ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

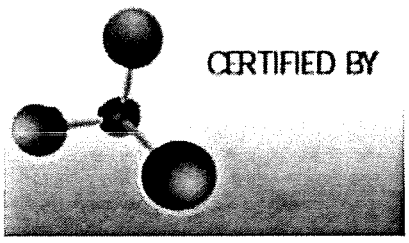
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



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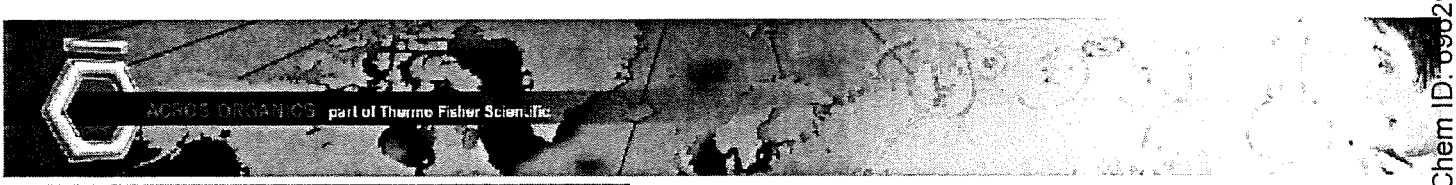
L. Van den Broek, QA Manager

Issued: 7 January 2016

Acros Organics
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Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
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SwRI Chem ID: 65951

SwRI Chem ID: 65951



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

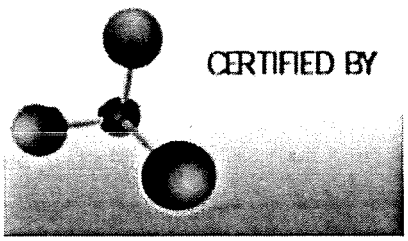
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



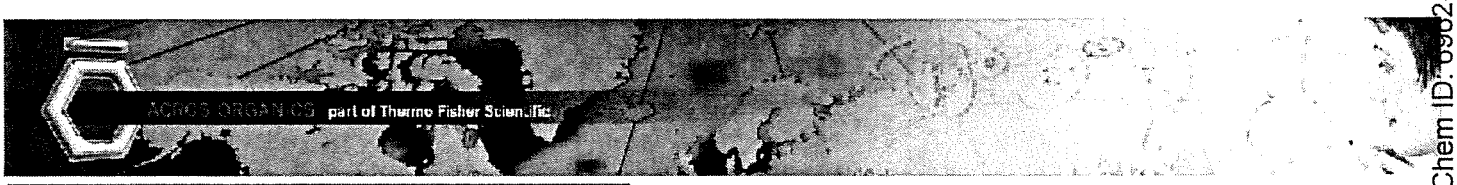
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L. Van den Broek, QA Manager

Issued: 26 April 2016

Acros Organics
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SwRI Chem ID: 69629
SwRI Chem ID: 69629
SwRI Chem ID: 69629



SwRI Chem ID: 69628

ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

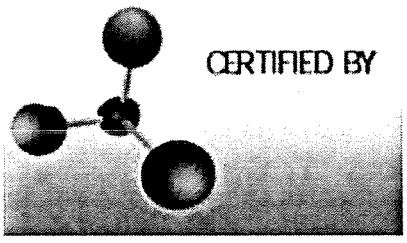
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



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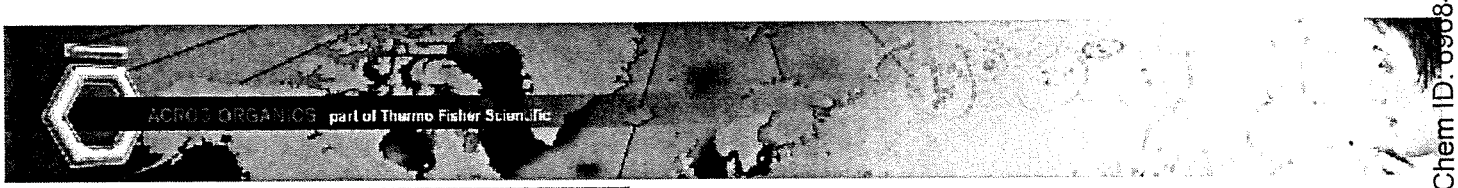
L. Van den Broek, QA Manager

Issued: 26 April 2016

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SwRI Chem ID: 69628

SwRI Chem ID: 69628



SwRI Chem ID: 69684

ACROS ORGANICS

Version	0
Molecular weight	126.04
Molecular formula	C2 H2 O4 . 2 H2 O
CAS No	6153-56-6
Linear formula	HO2CCO2H.2H2O
Flash point (°C)	

Certificate of Analysis

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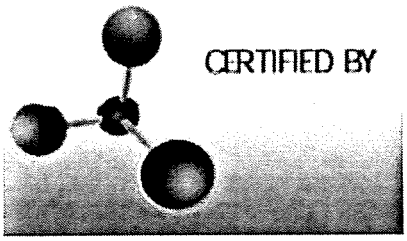
Catalog Number	42315	**Quality Test / Release Date**	10 December 2014
Lot Number	A0354614	**Suggested Retest Date**	December 2019
Description	Oxalic acid dihydrate,99.5+%,ACS reagent		
Country of Origin	SPAIN		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystals
Infrared spectrometry	authentic	authentic
Assay Titrimetry	99.5 to 102.5 %	99.9 %
Heavy metals (as Pb)	=<5 ppm	=<2.5 ppm
Residue after ignition	=<0.01 %	0.004 %
Nitrogen compounds (as N)	=<0.001 %	=<0.001 %
Trace analysis	Type: Cl measure =< 20 ppm	Type: Cl measure < 5 ppm
Trace analysis	Type: SO4 measure =< 50 ppm	Type: SO4 measure < 20 ppm
Trace analysis	Type: Ca measure =< 10 ppm	Type: Ca measure < 1 ppm
Trace analysis	Type: Fe measure =< 2 ppm	Type: Fe measure < 2 ppm
Insoluble matter	=<0.005 %	=<0.005 %
Substance darkened by H2SO4	passes test	passes test

SwRI Chem ID: 69684

SwRI Chem ID: 69684



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L. Van den Broek, QA Manager Issued: 27 April 2016

Acros Organics
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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69684
SwRI Chem ID: 69684
SwRI Chem ID: 69684

SIGMA-ALDRICH®

3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

SwRI Chem ID: 65593

Product Name:	NICKEL(II) NITRATE HEXAHYDRATE purum p.a., crystallized, >= 97.0 % KT
Product Number:	72253
Batch Number:	BCBP4160V
Brand:	Sigma-Aldrich
CAS Number:	13478-00-7
Formula:	$Ni(NO_3)_2 \bullet 6H_2O$
Formula Weight:	290.79
Quality Release Date:	26 JAN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	BLUE-GREEN TO DEEP BLUE-GREEN	BLUE-GREEN
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	97.0 - 103.0 %	97.0 %
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
CADMIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
COBALT (ICP)	≤ 500 MG/KG	< 500 MG/KG
COPPER (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 50 MG/KG	< 50 MG/KG
POTASSIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
SODIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
LEAD (ICP)	≤ 50 MG/KG	< 50 MG/KG
ZINC (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 50 MG/KG	< 50 MG/KG

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

SwRI Chem ID: 65593

SwRI Chem ID: 65593

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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Catalog Number	**A509**	**Mfg. Date**	11/4/2015
Lot Number	**1115100**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	11/04/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

SwRI Chem ID: 67843
SwRI Chem ID: 67843
SwRI Chem ID: 67843

Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

CERTIFIED BY

Edgar E Hess
Lab Manager Fair Lawn

Joel Boland
Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1.800.227.6701.

SwRI Chem ID: 67843
SwRI Chem ID: 67843
SwRI Chem ID: 67843

Fisher Scientific

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Certificate of Analysis

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Catalog Number	**A509**	**Mfg. Date**	11/4/2015
Lot Number	**1115100**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	11/04/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

SwRI Chem ID: 67843
SwRI Chem ID: 67843
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Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

CERTIFIED BY

Edgar E Hess
Lab Manager Fair Lawn

Joel Boland
Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1.800.227.6701.

SwRI Chem ID: 67843
SwRI Chem ID: 67843
SwRI Chem ID: 67843

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160605-1
SwRI SRR: 57711
SDG: 598466
VTSR: 05.31.2016

Balance and DI Water Verification Logs

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.#_11-0406-062_

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
89	014982	Mettler Toledo	XP5003S	Lab 24	2nd 3rd	5100 g 1000 g

Date	Operator	Asset# 015583 Std Wt. 5000 g Tolerance: 4999.50-5000.50 g Recorded Wt. (mg)	Asset# 015580 Std Wt. 100 g Tolerance: 99.990-100.010 g Recorded Wt. (mg)	Asset# 015584 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (mg)
2/26/15	JAM	5000.00	99.998	1.999
3/3/15	JAM	4999.98	99.999	2.000
6/8/15	JAM	4999.97	99.997	1.999
6/12/15	JAM	4999.97	100.002	1.999
6/13/15	JAM	4999.98	99.997	1.999
6/15/15	JAM	4999.97	99.999	1.999
8-5-15	BV	4999.96	99.999	1.999
8/6/15	JAM	4999.97	100.000	2.000
8/10/15	JAM	4999.96	100.001	2.000
9/1/15	JAM	4999.98	99.999	1.999
9/4/15	JAM	4999.97	100.000	2.000
9/5/15	JAM	4999.97	99.998	2.000
9/6/15	JAM	4999.99	99.999	1.999
9/7/15	JAM	4999.96	99.999	2.000
9/8/15	JAM	4999.97	99.997	1.998
9/24/15	JAM	4999.97	99.999	2.000
12/2/15	JAM	4999.97	99.997	2.000
12/7/15	JAM	4999.98	99.998	1.999
3-2-16	KE	4999.99	99.999	1.999
3-4-16	KE	4999.99	99.999	1.999
5/12/16	JAM	4999.98	99.999	2.001
5/13/16	JAM	4999.97	99.998	1.998

DQA RL

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.#_11-0406-062_

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
89	014982	Mettler Toledo	XP5003S	Lab 24	2nd 3rd	5100 g 1000 g

Date	Operator	Asset# 015583 Std Wt. 5000 g Tolerance: 4999.50-5000.50 g Recorded Wt. (mg)	Asset# 015580 Std Wt. 100 g Tolerance: 99.990-100.010 g Recorded Wt. (mg)	Asset# 015584 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (mg)
5/15/16	SAM	4999.97	99.998	1.998
5/18/16	SAM	4999.97	99.998	2.000
6/1/16	SAM	4999.97	99.998	1.999
6/3/16	SAM	4999.97	99.998	2.001
6/17/16	SAM	4999.98	99.998	2.001
6/20/16	SAM	4999.97	99.998	2.000

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.: 15-0406-042

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
88	014981	Mettler Toledo	XS205	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
5/4/16	JCW	200.0001	1.99999	0.01999
5-5-16	JK	200.0000	① 2.00016	0.02001
5-6-16	JK	199.9996	① 2.00002	0.02001
5-8-16	JK	199.9999	① 2.00002	0.02004
5-9-16	KE	199.9999	① 1.99997	0.02001
5-10-16	JK	199.9998	① 2.00008	0.02003
5-11-16	JK	199.9997	② 2.00002	0.02000
5-12-16	KE	199.9998	1.99999	0.02002
5-13-16	KE	199.9999	1.99999	0.01998
5-14-16	JM	199.9998	1.99996	0.02000
5-15-16	KE	199.9997	1.99991	0.01999
5-16-16	KE	199.9998	1.99998	0.01998
5-17-16	KE	199.9998	1.99996	0.01999
5-18-16	KE	199.9997	1.99998	0.02000
5-19-16	KE	199.9998	1.99991	0.02002
5-20-16	JK	199.9999	2.00002	0.02003
5-21-16	JK	199.9998	1.99999	0.02004
5-22-16	JK	199.9998	2.00004	0.02004
5-23-16	JK	200.0003	1.99999	0.02001
5/24/16	JCW	199.9998 KE 5/25/16	2.00000	0.02003
5/25/16	KE	199.99999	1.99999	0.20000
5/26/16	JCW	200.0001	1.99997	0.02001

KE 5-9-16 (TE)

Comments: ① ~~JK~~ USED 2g WEIGHT SN 1022033133 ID 011999
② 020641 is back. 5-11-16 KE

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010115

Book I.D.: 15-0406-042

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
88	014981	Mettler Toledo	XS205	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
5/27/16	SAM	199.9999	1.99999	0.02001
~~5-28~~		~~JK 5-27-16~~		
5-29-16	JK	200.0000	2.00002 KE 5/31/16	① 0.02003
5/31/16	[illegible]	200.0001	1.99997 5/31/16	TE ① 0.02004
6-1-16	JK	199.9998	2.00001	① 0.02003
6-2-16	JK	199.9995	2.00000	① 0.01999
6-3-16	KE	199.9997	1.999998	② 0.02002
6-4-16	JK	200.0000	2.00002	② 0.02000
6-5-16	JK	200.0001	2.00003	② 0.02000
6-6-16	JK	199.9999	1.99998	② 0.01999
6/7/16	JSH	200.0000	1.99999	0.02002
6-8-16	JK	199.9996	1.99996	② 0.01999
6-9-16	JK	199.9998	2.00006	② 0.02002
6-10-16	KE	199.9998	1.99999	② 0.02001
6-13-16 KE 6/14/16	KE	199.9998	2.00002	② 0.01998
6-14-16	KE	199.9998	2.00001	② 0.01999
6-15-16	JK	199.9995	2.00001	② 0.01997
6-16-16	JK	199.9996	1.99999	② 0.02001
6-17-16	JK	199.9995	2.00001	② 0.02000
6-20-16	KE	199.9997	2.00000	② 0.02001 KE 6/21/16
6-21-16	KE	200.0000	1.99997 ②	~~0.02002~~ KE 6/21/16 0.02002
6-22-16	KE	200.0004	1.99999	② 0.01997

① 5/31/16 TE

Comments: ① ; USED WT. I.D. 013790 (20mg) JK
② wt. is back # 12685.

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010116

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
5/14/16	JT	199.9998	1.99997	0.01998
5/16/16	VF	199.9999	1.99997	0.01997
5/17/16	JAM	199.9994	1.99997	0.02002
5/18/16	MG	200.0002	1.99999	0.02001
5/19/16	MG	199.9998	2.00001	0.01999
5/20/16	JAM	200.0000	2.00001	0.02000
5/22/16	JCM	199.9993	1.99999	0.02000
5/23/16	MG	200.0000	1.99999	0.01999
5/24/16	JAM	199.9994	2.00000	0.02001
5/25/16	JAM	199.9996	2.00001	0.01999
5/26/16	JAM	200.0000	1.99999	0.02002
5/27/16	JAM	199.9996	2.00002	0.01999
5/28/16	JAM	199.9998	2.00000	① 0.02003
5/29/16	JAM	199.9996	1.99999	① 0.01999
5/31/16	JCM	199.9996	1.99999	① 0.01999
6/1/16	JAM	199.9995	1.99994	① 0.01999
6/2/16	JCM	200.0000	2.00005	0.01999
6/3/16	JAM	199.9998	1.99999	0.02000
6/6/16	MG	199.9999	1.99996	0.01999
6/7/16	JAM	199.9998	1.99999	0.01998
6/8/16	JCM	199.9993	1.99997	0.01997
6/9/16	JCM	199.9991	1.99996	0.01999

Comments: ① wgt out for calibration use ID# 013790 20mg wgt

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
6/10/16	JCM	199.9998	2.00003	0.01995
6/13/16	SAM	199.9996	1.99996	0.02001
6/14/16	SAM	199.9998	1.99999	0.02003
6/15/16	SAM	199.9996	1.99997	0.01999
6/16/16	VS	199.9998	2.00013	0.02002
6-17-16	KE	199.9998	2.00000	0.02001
6-19-16	SAM	199.9997	1.99998	0.02000
6-20-16	KE	199.9994	2.00005	0.01998
6/21/16	SAM	199.9997	1.99998	0.01997
6-22-16	KE	199.9997	1.99996	0.01996
6-23-16	KE	199.9996	1.99995	0.01998
6-24-16	KE	199.9996	1.99996	0.01997

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book ID #: 16-0406-010

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
34	005260	Mettler	AG 245	Lab 26	4th 5th	210 g 41 g

Date	Operator	Asset# 015142 Std Wt. 200 g Tolerance: 199.9800-200.02000 g Recorded Wt. (g)	Asset# 015144 Std Wt. 2 g Tolerance: 1.99980-2.00020 g Recorded Wt. (g)	Asset# 015143 Std Wt. 0.02 g Tolerance: 0.01995-0.02005 g Recorded Wt. (g)
3/8/16	MG	199.9963	1.99997	0.01995
3/15/16	JCM	199.9988	1.999991	0.01999
4/21/16	MG	200.0003	1.99997	0.01998
4/25/16	SAM	199.9999	1.999993	0.02001
4/26/16	SAM	199.9994	1.99995	0.01998
4/27/16	SAM	199.9996	1.99996	0.01998
5/11/16	SAM	200.0022	1.99984	0.02001
6/9/16	JCM	200.0046	1.99999	0.01997
6/12/16	SAM	200.0037	2.00007	0.02002
6/15/16	SAM	200.0044	2.00006	0.02001
12/23/16	MG	200.0054	2.00006	0.01999

Comments:

D.I. WATER SYSTEM NOTEBOOK 010119

SOUTHWEST RESEARCH INSTITUTE

BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
5/9/16 1735	DRmz	17.93	✓	✓	✓	n/a	✓
5/10/16 1801	DRmz	17.94	✓	✓	✓	n/a	✓
5/13/16 1810	DRmz	17.94	✓	✓	✓	n/a	✓
5/16/16 1715	DRmz	17.93	✓	✓	✓	n/a	✓
5/17/16 1930	DRmz	17.94	✓	✓	✓	n/a	✓
5/18/16 1801	DRmz	17.94	✓	✓	✓	n/a	✓
5/19/16 1805	DRmz	17.94	✓	✓	✓	n/a	✓
5/20/16 1650	DRmz	17.94	✓	✓	✓	n/a	✓
5/23/16 1807	DRmz	17.93	✓	✓	✓	n/a	✓
5/24/16 1811	DRmz	17.93	✓	✓	✓	n/a	✓
5/25/16 1747	DRmz	17.93	✓	✓	✓	n/a	✓
5/26/16 1800	DRmz	17.93	✓	✓	✓	n/a	✓
5/27/16 1547	DRmz	17.93	✓	✓	✓	n/a	✓
5/31/16 1657	DRmz	17.94	✓	✓	✓	n/a	✓
6/1/16 1801	DRmz	17.93	✓	X	✓	n/a	X-change needed ??
6/2/16 1710	DRmz	17.93	✓	X	✓	n/a	tank X change needed.

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
5/9/16 1736	DRmz	✓	✓ 18.0	37407.4	✓
5/10/16 1802	DRmz	✓	✓ 18.0	37408.1	✓
5/13/16 1812	DRmz	✓	✓ 18.0	37411.8	✓
5/16/16 1716	DRmz	✓	✓ 18.0	37426.5	✓
5/17/16 1931	DRmz	✓	✓ 18.0	37427.6	✓
5/18/16 1803	DRmz	✓	✓ 18.0	37435.3	✓
5/19/16 1806	DRmz	✓	✓ 18.0	37446.7	✓
5/20/16 1451	DRmz	✓	✓ 18.0	37448.4	✓
5/23/16 1808	DRmz	✓	✓ 18.0	37462.1	✓
5/24/16 1812	DRmz	✓	✓ 18.0	37463.5	✓
5/25/16 1748	DRmz	✓	✓ 18.0	37464.6	✓
5/26/16 1821	DRmz	✓	✓ 18.0	37477.5	✓
5/27/16 1548	DRmz	✓	✓ 18.0	37473.0	✓
5/31/16 1657	DRmz	✓	✓ 18.0	37473.9	✓
6/1/16 1802	DRmz	✓	✓ 18.0	37476.7	✓
6/2/16 1711	DRmz	✓	✓ 18.0	37480.1	✓

Legend: Check = Green (OK); X = Red (call for service)

Book ID#:__14-0406-024___

D.I. WATER SYSTEM NOTEBOOK 010120
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/3/16 1757	DRmz	17.94	✓	X	✓	n/a	FAILED
6/6/16 1806	DRmz	17.94	✓	X	✓	n/a	pending
6/7/16 1700	DRmz	17.93	✓	X	✓	n/a	pending
6/8/16 1702	DRmz	17.93	✓	X	✓	n/a	still pending
6/9/16 1728	DRmz	17.93	✓	X	✓	n/a	pending
6/10/16 1630	DRmz	17.93	✓	X	✓	n/a	PENDING EXCHANGE
6/13/16 1655	DRmz	17.93	✓	✓	✓	n/a	MIXED BED TANK CHANGED. ALL OK
6/14/16 1815	DRmz	17.93	✓	✓	✓	n/a	✓
6/15/16 1817	DRmz	17.93	✓	✓	✓	n/a	✓
6/16/16 1750	DRmz	17.93	✓	✓	✓	n/a	✓
6/17/16 1950	DRmz	17.93	✓	✓	✓	n/a	✓
6/20/16 1755	DRmz	17.94	✓	✓	✓	n/a	✓
6/21/16 1735	DRmz	17.92	✓	✓	✓	n/a	✓
6/22/16 1800	DRmz	17.93	✓	✓	✓	n/a	✓
6/23/16 1751	DRmz	17.92	✓	✓	✓	n/a	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/3/16 1758	DRmz	✓	✓ 18.0	37482.2	✓
6/6/16 1857	DRmz	✓	✓ 18.0	37484.3	✓
6/7/16 1701	DRmz	✓	✓ 18.0	37489.2	✓
6/8/16 1703	DRmz	✓	✓ 18.0	37491.8	✓
6/9/16 1729	DRmz	✓	✓ 18.0	37492.6	✓
6/10/16 1631	DRmz	✓	✓ 18.0	37499.3	✓
6/13/16 1656	DRmz	✓	✓ 18.0	37501.4	✓
6/14/16 1816	DRmz	✓	✓ 18.0	37520.5	✓
6/15/16 1818	DRmz	✓	✓ 18.0	37521.3	✓
6/16/16 1751	DRmz	✓	✓ 18.0	37522.6	✓
6/17/16 1951	DRmz	✓	✓ 18.0	37527.3	✓
6/20/16 1757	DRmz	✓	✓ 18.0	31530.8	✓
6/21/16 1736	DRmz	✓	✓ 18.0	37538.4	✓
6/22/16 1801	DRmz	✓	✓ 18.0	37540.1	✓
6/23/16 1752	DRmz	✓	✓ 18.0	37541.4	✓

Legend: Check = Green (OK); X = Red (call for service)

Appendix N
SwRI Test Report, June 29, 2016

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

June 29, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Victor Garde

Subject:		
	SwRI Project Number:	21592.01.00X
	SDG:	599959
	SwRI Task Order Number:	160627-5
	SwRI Sample Receipt Number:	57871
	Samples Received:	06.24.2016
	Analysis:	UNS Blends 19 and 20

Dear Mr. Garde,

Please find the enclosed results for the two overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Group Leader – R&D

APPROVED:

Michael J. Dammann
Director

RPS: jz

Cc: Anya Gonzales, Los Alamos National Laboratory

Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Chain-of-Custody
&
Sample Receipt Paperwork

Total Page Count: 010001-
Fraction: WNS Pages: 010110
BLANKS 19 & 20

Douglas, Steven M.

From: Moken, James A.
Sent: Friday, June 24, 2016 10:08 AM
To: Douglas, Steven M.
Subject: Two more sample ID's and SRR

Steven,

I have two more sample ID's that will go under the Los Alamos project # 21592.01.006.

Client ID	Matrix
UNS Blend 19	Solid
UNS Blend 20	Solid

If you have any questions let me know. Thanks.

Jamie



Client: Los Alamos National Laboratory
SRR # 57871
Project # 21592.01.00X
Case: J. Moken
VTSR: 06/24/2016
Sample(s) Received: Intact
Temperature: N/A °C/ SN #: N/A

Southwest Research Institute

Laboratory Task Order

TO #: 160627-5 Revision: 0

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 06/28/16

SDG: 599959

SRR #'s: 57871
Client(s): Los Alamos National Laboratory

Instructions

Documents Related to this task order: 202308[COC for SRR 57871], 202309[SRR Paperwork for SRR 57871]

Deliverables --> Hard Copy: -YES- EDD: no PDF: no

Test: COMB_1050
Section: WETCHEM

Holding: 180 days from CED

SW846 1050 Test A & C Spontaneous Combustion

Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
599959		1	Solid	UNS Blend 19	NO DATA	NO DATA
599960		1	Solid	UNS Blend 20	NO DATA	NO DATA

Test: IGNIT_1030
Section: WETCHEM

Holding: 180 days from CED

SW 846 Method 1030 Ignitability of solids

Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
599959		1	Solid	UNS Blend 19	NO DATA	NO DATA
599960		1	Solid	UNS Blend 20	NO DATA	NO DATA

Test: Oxidizer_UN
Section: WETCHEM

Holding: 180 days from CED

United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.

Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
599959		1	Solid	UNS Blend 19	NO DATA	NO DATA
599960		1	Solid	UNS Blend 20	NO DATA	NO DATA

Test: PAINT_9095
Section: WETCHEM

Holding: 180 days from CED

SW846 9095 Paint Filter Liquids Test

Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
599959		1	Solid	UNS Blend 19	NO DATA	NO DATA
599960		1	Solid	UNS Blend 20	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 57871

VTSR: 06/24/16

Time: 11:40:00

Project: 21592.01.00X
Case #: J. Moken
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 06/24/16

Notes

Email was received to create an SRR for the following.

Parameters: Analysis/located on Task Order

FRM-070 (J. Moken)

See chain of custody as part of the work order system for more information.

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
599959	UNS Blend 19		Solid	1	
599960	UNS Blend 20		Solid	1	

Containers: 2 **Samples: 2**

These documents are associated with this receipt: 202308[COC for SRR 57871], 202309[SRR Paperwork for SRR 57871]

Thermometer: N/A
Temperature: N/A

Page Printed: 06/29/2016 10:36
ver: (7/18/2014)

57871 Los Alamos National Laborato

Southwest Research Institute

Traffic Report

Sample Custodian Signature: _____

1. Custody Seal	Not Present or Damaged
2. Chain of Custody	Present
3. Sample Tags	Not Present
Sample Tag Numbers	Not on COC
4. SMO Forms	Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: J. Moken / SDG: _____

Sample Receipt: 57871

Airbill: Email

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
06/24/16	11:40:00	Email	UNS Blend 19	N/A	599959	YES	Intact
06/24/16	11:40:00	Email	UNS Blend 20	N/A	599960	YES	Intact

010006

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 06/24/2016
Received By (Signature):	
Case Number: J. Moken	Sample Delivery Group No.: NA
Remarks: 21592.01.00X	SAS Number: NA

1. Custody Seal(s)	Present/(Absent)* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	(Present)/Absent*	
4. Traffic Reports or Packing Lists	Present/(Absent)	
5. Airbill	Airbill/Sticker (Present)/Absent*	
6. Airbill No.	Email	
7. Sample Tags	Present/(Absent)	
Sample Tag Numbers	Listed/(Not) listed on Chain of Custody	
8. Sample Condition	(Intact)/Broken*/ Leaking	
9. Cooler Temperature	N/AC	
10. Does Information on custody records, traffic reports, and sample tags agree?	(Yes)/No*	
11. Date Received at Lab	06/24/2016	
12. Time Received	11:40:00	

Sample Transfer	
Fraction: INORG	Fraction
Area #: J. Moken	Area #
By: STEVEN DOUGLAS	By
On: 06/24/2016	On

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
UNS Blend 19	N/A	599959	Intact
UNS Blend 20	N/A	599960	Intact

* Contact SMO and attach record of resolution

Reviewed By: 6.24.16	Logbook No.: Sample Receipt (57871)
Date	Logbook Page No.: 9496 SOC 4 of 5

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160627-5

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of UNS blends 19 and 20 which are the citric acid and PIG base neutralized UNS blends. Samples are presented in Table 1 which contains the sample ID's and the methods requested on each of the blends. To prep the samples, the UNS solution was first neutralized to pH of around 5 using a 1:1.5 ratio of UNS to Splifyter® Kolorsafe® liquid acid neutralizer. PIG base neutralizer or Citric acid was then added at the same volume as the Splifyter® Kolorsafe® liquid acid neutralizer. This mixture was then added to swheat and allowed to set for 24 hours before adding it to water and finally to zeolite in the designated ratios. The zeolite concoction was allowed to set for an additional 24 hours prior to analysis.

Table 1. Surrogate creation and analysis table

Surrogate ID	Times made	Methods			
		1030	1050	UN Ox solid (DOT 0.1)	Paint filter
UNS Blend 19	1	1	1	1	1
UNS Blend 20	1	1	1	1	1

SW-846 9095B: Paint Filter

For this method 100g of each blend was placed into a Gerson 260um paint filter (PN010714R, Lot# B5140428JF8) that was suspended over a 250 mL beaker for 5 minutes to collect any free liquids. During this 5-min period if any of the sample material drips into the cylinder, the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314. Under the laboratory conditions both UNS blends were not deemed to contain free liquids.

SW-846 1030: Ignitability of Solids

An ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within 2 minutes. If the material combustion propagates, the burning time was measured over a distance of 100 mm and the rate of burning would be determined. The surrogate material was formed into an unbroken powder train, 250 mm in length atop a ceramic tile with marks at the 80 and 180 mm in from the end of the train. The ceramic tile was placed about 8 inches in a hood with the sash lowered to give airflow of about 0.7 m/sec. One end of the train was exposed to the end of an acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes and if the sample began to burn down the train the time taken to get from the 80 to 180 mm mark was measured to determine the burn rate.

All two UNS samples acted in a similar fashion during the 1030 analysis. The sample would dry at the burn region and begin to char after a little time had passed (Image 1). The only major difference was that UNS Blend 20 crackled and popped kicking little portions of zeolite out of the burn zone (Image 2). Since none of the blends even burned into the 100mm zone, all of them are considered non-flammable under the test conditions and criteria outlined in Method 1030.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160627-5

Fine Excelsior (natural hardwood shavings) were used as a positive control each day testing was performed.

SW-846 1050: Spontaneous combustion and self heating

The surrogates for this analysis were first sprinkled several times onto a ceramic tile to observe if they smoked or flamed and could be considered pyrophoric solids by test Method A. Since none of the samples exhibited these characteristics, they were tested by Method C. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200C within the 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 2.

Table 2. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cube was placed into an oven with two thermocouples measuring the oven temp and up to four thermocouples inserted into each sample to measure its temperature during the analysis. Lids were placed onto the top of the test cubes and tungsten weights were placed on top of those sample believed to have event in order to keep the thermocouples and lids from coming off the sample. Also up to two thermocouples were placed in a tray below the sample in case any sample pushed out of the cube and onto the tray. Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for 24-48 hours depending on when the sample reached a stable temperature. Although the method states testing to be conducted for 24 hours, many of the samples did not reach 140°C ± 2°C during the initial 24 hour period, therefore the testing was extended to a minimum of 12 hours after the sample had reached a stable temperature. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C during the time of testing. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample. The oven and sample temperature graphs are located in Attachment A.

UNS Blend 19 was removed from the oven and found that the outer lower portion of the sample had become brown and formed large clumps (Image 3). UNS Blend 20 had one of the thermocouples record several dips in temperature in the 5-8 hour region and several once temperature had been reached. The early dips may be attributed to sample moisture or possibly a small endothermic reaction in the region. It may also be attributed to issues with the thermocouple since it has been used in numerous 1050 testing's and thermocouple 1 did not show any of these dips. Blend 20 had a faint brown tint to it on the extremities of the sample but very few clumps were seen within the cube. Since none of these blends exceeded 200°C during the analysis all of them are classified as "Not a Self-Heating Waste" as defined by Method 1050 under laboratory conditions.

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SwRI Project Number: 21592.01.00X
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DOT UN Oxidation testing

The UNS blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the samples mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. If the burning time is less than the standard mixture, the burning times should be compared with those from packing group I or II or category I or II oxidizer, reference standards 3:2 and 2:3, by mass, of potassium bromated to cellulose, respectively. See Table 3 for classification. Table 4 presents the results for the reference standards. Tables 5 and 6 lists the comments the analyst noted for each of the two sample to cellulose ratio burns. All UNS blends were classified as "Not Division 5.1" under laboratory conditions.

Table 3. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	UN Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

Table 4. Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
135.32	52.44	19.54

Table 5. Comments for Sample to Cellulose ratio of 4:1

Sample ID	Comment 4:1
UNS Blend 19	Charring around wire, smoke, no flames
UNS Blend 20	Charring around wire, smoke, no flames

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Table 6 Comments for Sample to Cellulose ratio of 1:1

Sample ID	Comment 1:1
UNS Blend 19	Small flames at wire leads, charring and smoke.
UNS Blend 20	small flames at wire leads, smoke and charring



Image 1: Appearance of UNS Blend 19 after two minute burn during 1030 analysis.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160627-5



Image 2: Appearance of UNS Blend 20 after the 2 minute burn period after 1030 analysis. Portions of the zeolite where thrown a little distance away from the main sample train.



Image 3: Browning and clumping formed in the lower portion of the cube of UNS Blend 19 during the 1050 analysis.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160627-5

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."



Group Leader

6/28/16
Date

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Attachment A
Method 1050 Graphs

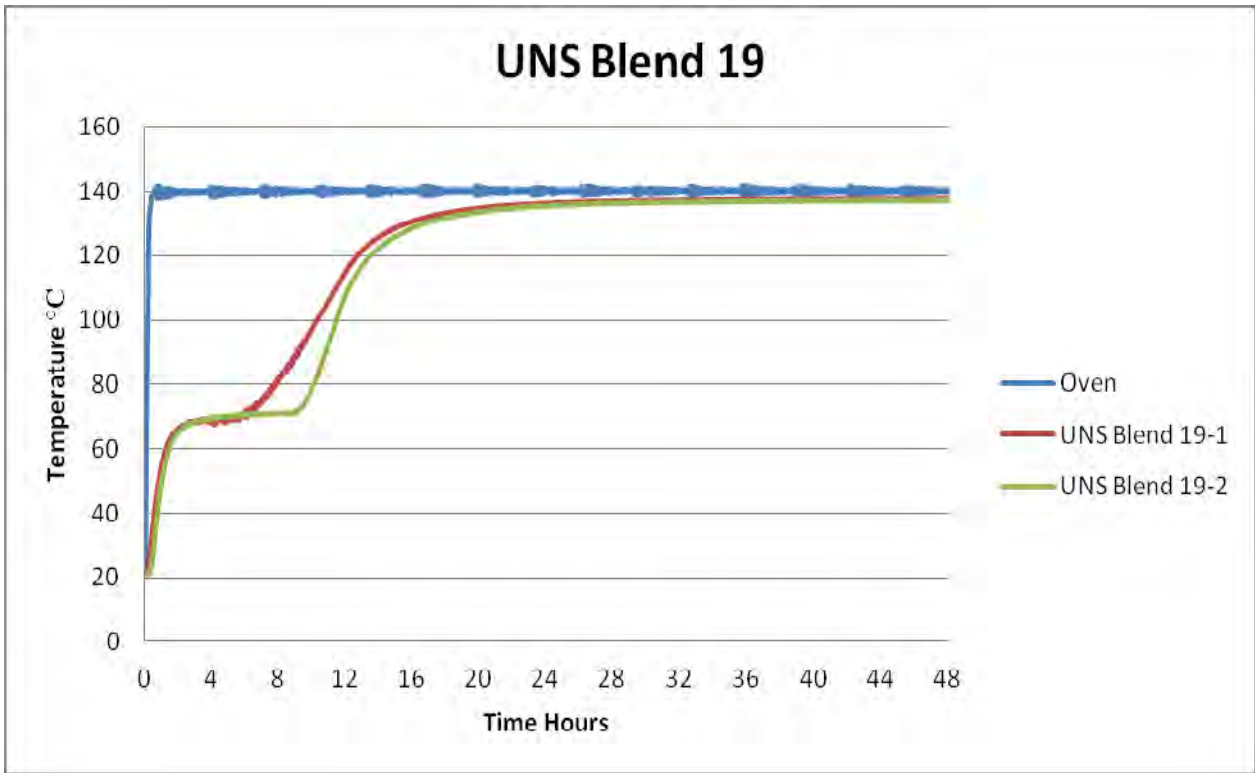


Figure 1. Method 1050 – UNS Blend 19 (100mm cube) full run.

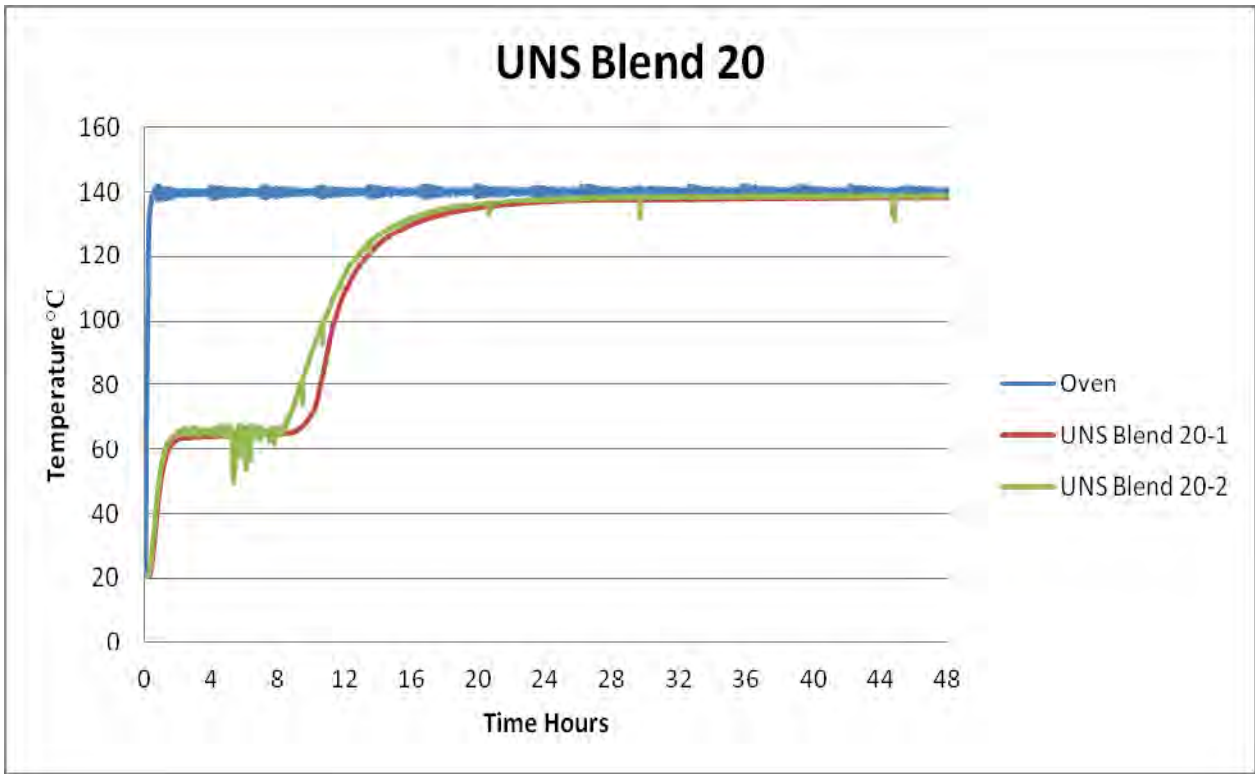


Figure 2. Method 1050 – UNS Blend 20 (100mm cube) full run. Thermocouple 2 had several dips throughout the analysis. These may either be attributed to moisture, small endothermic reactions, or the thermocouple issues.

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CLIENT: Los Alamos National Laboratory
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SDG: 599959
VTSR: 06.24.2016

Wetchem Analyses

Sample Results

SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 6/22/16

SRR #: 57871

Task Order #: 160627-5

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
135.32	52.44	19.45

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
UNS Blend 19	599959	no reaction	> 180	Not Division 5.1	06/27/16
UNS Blend 20	599960	no reaction	> 180	Not Division 5.1	06/27/16

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

LABORATORY CONTROL SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 6/22/16

SRR #: 57871

Task Order #: 160627-5

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
108-162 sec	42-63 sec	15-23 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	119.97	52.87	19.65	06/27/16

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 6/22/16

SRR #: 57871

Task Order #: 160627-5

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
UNS Blend 19	599959	Nonflammable	06/24/16
UNS Blend 19 Dup	599959	Nonflammable	06/24/16
UNS Blend 20	599960	Nonflammable	06/24/16

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 6/22/16

SRR #: 57871

Task Order #: 160627-5

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
UNS Blend 19	599959	Not a self-heating waste	06/24/16
UNS Blend 20	599960	Not a self-heating waste	06/24/16

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SOUTHWEST RESEARCH INSTITUTE

SW846 9095 Paint Filter Liquids Test

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 6/22/16

SRR #: 57871

Task Order #: 160627-5

Sample ID	SwRI System ID	Method 9095 *Paint Filter Results*	Date Analyzed
UNS Blend 19	599959	No free liquids	06/24/16
UNS Blend 19 Dup	599959	No free liquids	06/24/16
UNS Blend 20	599960	No free liquids	06/24/16

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SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

UN Oxidizer

Raw Data

010023

Southwest Research Institute

Method: UN- Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 1100627-5

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0215	21.0060	119.97	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0135	18.0002	52.87	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0053	12.0621	19.65	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/27/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/27/16
Potassium Bromate: Inorg# Dried: >12hrs @ 65°C
Cellulose: Inorg# 71755-71759 Dried: 74hrs. @ 105°C
Variac Setting: 150 ± 7 W

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160627-5

Sample Analysis

System ID: UNS Blend #20 [Red]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0222	6.0168	180.78 ①	charring around wire, smoke, no flames
4:1	2	24.0061	6.0040	180.19 ①	
4:1	3	24.0078	6.0124	180.40 ①	
4:1	4	24.0045	6.0071	180.37 ①	
4:1	5	24.0143	6.0274	180.29 ①	
4:1	Avg			>180	① ② time power turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
				RE 6/27/16 MG	
1:1	1	15.0161	15.0102	183.03 ②	Small flames at wire leads, charring & smoke
1:1	2	15.0233	15.0054	183.50 ②	
1:1	3	15.0089	15.0050	184.40 ②	
1:1	4	15.0054	15.0157	187.07 ②	
1:1	5	15.0174	15.0084	184.76 ②	
1:1	Avg			>180	② Time when flames extinguished. Power turned off at 180sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/24/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/27/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160627-5

Sample Analysis

System ID: UNS Blend #19 [Blue]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0016	6.0032	180.31 ①	charring around wire, smoke, no flames
4:1	2	24.0140	6.0043	180.56 ①	↓
4:1	3	24.0031	6.0035	180.29 ①	↓
4:1	4	24.0076	6.0076	180.72 ①	↓
4:1	5	24.0084	6.0013	180.31 ①	↓
4:1	Avg			7180	①Time power turned off. No reaction

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, , sec	Comment
1:1	1	15.0120	15.0285	181.31 ②	small flames at wire leads, smoke & charring
1:1	2	15.0160	15.0072	183.03 ②	↓
1:1	3	15.0079	15.0081	184.00 ②	↓
1:1	4	15.0069	15.0092	187.94 ②	↓
1:1	5	15.0282	15.0129	188.97 ②	↓
1:1	Avg			7180	②Time flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 6/24/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 6/27/16
Sample Dried ? YES (NO) Dried: N A
Cellulose: Inorg# 71755 - 71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Method 1050

Raw Data

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. #__15-0406-048_

Analysis / Method: 1050 Project# 21592.01.006

TAP# (if applicable):

Client: Los Alamos TO# 160627-5

Balance # NA

LCS Info: N/A TV: NA

Notes: UNS Blend #19 & #20

start: 6/24/16 14:57

stop: 6/26/16 16:57

Sample ID					
UNS Blend #19					
Sample took some time getting to temperature due to the moisture content. Sample reach temperature around 26 hours. Upon removal of the sample after analysis it had formed large chunks and the outer portions were browned. No reaction appeared to have caused the temperature to exceede 440°F (TEDAM 6/26/16) 200°C. The sample is considered to be not self heating.					
UNS Blend #20					
Sample took some time to get to temperature due to the moisture content. Around 5-8 hours the second thermocouple head dips in temp from 65 - 52°C. This may be attributed to moisture of possible electrical issues in the thermocouple. After analysis the sample was removed and the external portions of the sample had an burnt brown tint to it. Since no excess temperature increase of 200°C was noted the sample is considered to be not self heating					
Calculation:					

Analyst Signature: James Gill Date: 6/24/16

Reviewed by: M. Grabelda Date: 6/28/16

Logbook #/ Page #___017___ 0061_____

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Method 9095
Paint Filter
Raw Data

010029

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. #__15-0406-048_

Analysis / Method: Paint filter 9095 Project# 21592.01.006

TAP# (if applicable): _____

Client: Los Alamos TO# 160627-5

Balance # 135

LCS Info: water TV: fail

Notes: sample fails if any liquid or sample passes the filter into the beaker below.

Sample ID	sample wgt (g)	pass/fail			
LCS	101.2791	fail			
UNS Blend 19	100.3428	pass			
UNS Blend 19 D	100.9572	pass			
UNS Blend 20	103.2814	pass			

6/24/16

DAM

Calculation:

Analyst Signature: [signature] Date: 6/24/16

Reviewed by: [signature] Date: 6/28/16

Logbook #/ Page #____017___ 0063_____

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Method 1030

Raw Data

Southwest Research Institute®
Logbook: Miscellaneous

Book I.D. #__15-0406-048_

Analysis / Method: 1030 Project# 21592.01.006

TAP# (if applicable): _____

Client: Los Alamos TO# 16686275

Balance # NA

LCS Info: excelsior #61753 TV: burn rate 7.2.2 mm/sec

Notes: _____

Sample ID	burn time accept 10.0 min	burn rate mm/sec			
LCS	12.03 sec	8.31			
UNS Blend 19	did not burn	Sample dried and charred		did not burn a flame	"
UNS Blend 19P	did not burn	"			
UNS Blend 20	did not burn	Sample crackled + popped occasionally but did not burn a flame and propagate.			

JAM 6/24/16

Calculation:

Analyst Signature: _____ Date: 6/24/16

Reviewed by: M. Grabski Date: 6/28/16

Logbook #/ Page #___017___ 0062_____

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Surrogate Preparation Logbook Pages

Work continued from Page

SWRI

128-01-WCS12 Nit B Zeo-1

600mL (124-04-WCS12) to 1200mL zeolite

let sit for 24 hr prior to analysis 5/15/16 10:10

128-02-WCS12 Nit B Zeo-2

600mL (124-04-WCS12) to 1800mL zeolite

128-03-WCS12 UNS solution

8322.851 g aluminum nitrate nonahydrate (#69597-69542, 69593-69571, 69591-69586)+

840.695 g calcium nitrate (#69606, 69607)+

61.562 g chromium nitrate (#66141, 63857)+

595.084 g Iron(III) nitrate (#63607, 63582)+

40008.600 g magnesium nitrate (#69603, 69604)+

~~Sodium nitrate~~ TP 5/16/16 5/16/16

493.5682 g sodium nitrate (#69611)+

596.525 g lead nitrate (#65951, 69629, 69625)+

2373.849 g oxalic acid (#69684)+

2.340 g nickle nitrate (#65593)+

63.727 g nitric acid (#67843)

6500.17 g DI H_2O

balance #89

www.scientificbindery88yrs.com

Work continued to Page

SIGNATURE DATE 5/15/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon DATE WITNESS DATE 5/25/16

Work continued from Page

SWRI

Blend #19 172-01-WCS12

100mL UNS solution to 150mL Spilfyr neutralized pH ~5.
150mL citric acid (# 36116) added and then 400mL of this was added to 400 mL solvent and let sit for 24 hours. Take 600mL of this and add 1200mL DI H_2O. Then add 1800mL of this to 5100mL zeolite.

Blend #20 172-02-WCS12

100mL UNS solution to 150mL Spilfyr ~~(# 36~~ Re-Sam 6/22/16 + 150mL PIG Base neutralized (# 21804). 400mL of this was added to 400mL solvent, and let set for 24 hours.
took 200mL of the solvent mixture and added 400mL DI H_2O. then after mixing added this to 1800mL zeolite.

JAM 6/26/16

Work continued to Page

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SIGNATURE

DISCLOSED TO AND UNDERSTOOD BY M. Gribbin

DATE

WITNESS

DATE 6/22/16

DATE 6/28/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Balances and DI Water Verification Logs

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010036

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
6/10/16	JCW	199.9998	2.00003	0.01995
6/13/16	SAM	199.9996	1.99996	0.02001
6/14/16	SAM	199.9998	1.99999	0.02003
6/15/16	SAM	199.9996	1.99997	0.01999
6/16/16	VS	199.9998	2.00013	0.02002
6-17-16	KE	199.9998	2.00000	0.02001
6-19-16	SAM	199.9997	1.99998	0.02000
6-20-16	KE	199.9994	2.00005	0.01998
6/21/16	SAM	199.9997	1.99998	0.01997
6-22-16	KE	199.9997	1.99996	0.01996
6-23-16	KE	199.9996	1.99995	0.01998
6-24-16	KE	199.9996	1.99996	0.01997
6/27/16	SAM	199.9997	2.00004	0.02000
6-28-16	KE	199.9998	2.00000	0.02002

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.# 11-0406-062_

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
89	014982	Mettler Toledo	XP5003S	Lab 24	2nd 3rd	5100 g 1000 g

Date	Operator	Asset# 015583 Std Wt. 5000 g Tolerance: 4999.50-5000.50 g Recorded Wt. (mg)	Asset# 015580 Std Wt. 100 g Tolerance: 99.990-100.010 g Recorded Wt. (mg)	Asset# 015584 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (mg)
5/15/16	JAM	4999.97	99.998	1.998
5/18/16	JAM	4999.97	99.998	2.000
6/1/16	JAM	4999.97	99.998	1.999
6/3/16	JAM	4999.97	99.998	2.001
6/17/16	JAM	4999.98	99.998	2.001
6/20/16	JAM	4999.97	99.998	2.000

Comments:

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
5/9/16 1735	DRmz	17.93	✓	✓	✓	n/a	✓
5/10/16 1801	DRmz	17.94	✓	✓	✓	n/a	✓
5/13/16 1810	DRmz	17.94	✓	✓	✓	n/a	✓
5/16/16 1715	DRmz	17.93	✓	✓	✓	n/a	✓
5/17/16 1930	DRmz	17.94	✓	✓	✓	n/a	✓
5/18/16 1801	DRmz	17.94	✓	✓	✓	n/a	✓
5/19/16 1805	DRmz	17.94	✓	✓	✓	n/a	✓
5/20/16 1650	DRmz	17.94	✓	✓	✓	n/a	✓
5/23/16 1807	DRmz	17.93	✓	✓	✓	n/a	✓
5/24/16 1811	DRmz	17.93	✓	✓	✓	n/a	✓
5/25/16 1747	DRmz	17.93	✓	✓	✓	n/a	✓
5/26/16 1800	DRmz	17.93	✓	✓	✓	n/a	✓
5/27/16 1547	DRmz	17.93	✓	✓	✓	n/a	✓
5/31/16 1651	DRmz	17.94	✓	✓	✓	n/a	✓
6/1/16 1801	DRmz	17.93	✓	X	✓	n/a	X-change needed ??
6/2/16 1710	DRmz	17.93	✓	X	✓	n/a	tank xchange needed

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
5/9/16 1736	DRmz	✓	✓ 18.0	37402.4	✓
5/10/16 1802	DRmz	✓	✓ 18.0	37408.1	✓
5/13/16 1812	DRmz	✓	✓ 16.0	37411.8	✓
5/16/16 1716	DRmz	✓	✓ 18.0	37426.5	✓
5/17/16 1931	DRmz	✓	✓ 18.0	37427.6	✓
5/18/16 1803	DRmz	✓	✓ 18.0	37435.3	✓
5/19/16 1806	DRmz	✓	✓ 18.0	37446.7	✓
5/20/16 1451	DRmz	✓	✓ 18.0	37448.4	✓
5/23/16 1808	DRmz	✓	✓ 18.0	37462.1	✓
5/24/16 1810	DRmz	✓	✓ 18.0	37463.5	✓
5/25/16 1748	DRmz	✓	✓ 18.0	37464.6	✓
5/26/16 1821	DRmz	✓	✓ 18.0	37471.5	✓
5/27/16 1548	DRmz	✓	✓ 18.0	37473.0	✓
5/31/16 1657	DRmz	✓	✓ 18.0	37473.9	✓
6/1/16 1802	DRmz	✓	✓ 18.0	37476.7	✓
6/2/16 1711	DRmz	✓	✓ 18.0	37480.1	✓

Legend: Check = Green (OK); X = Red (call for service)

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/3/16 1757	DRmz	17.94	✓	X	✓	n/a	CAll placed
6/6/16 1806	DRmz	17.94	✓	X	✓	n/a	pending
6/7/16 1700	DRmz	17.93	✓	X	✓	n/a	pending
6/8/16 1702	DRmz	17.93	✓	X	✓	n/a	still pending
6/9/16 1728	DRmz	17.93	✓	X	✓	n/a	pending
6/10/16 1630	DRmz	17.93	✓	X	✓	n/a	PENDING EXCHANGE
6/13/16 1655	DRmz	17.93	✓	✓	✓	n/a	MIXED BED TANK CHANGE. ALL OK
6/14/16 1815	DRmz	17.93	✓	✓	✓	n/a	✓
6/15/16 1817	DRmz	17.93	✓	✓	✓	n/a	✓
6/16/16 1750	DRmz	17.93	✓	✓	✓	n/a	✓
6/17/16 1950	DRmz	17.93	✓	✓	X	n/a	✓
6/20/16 1755	DRmz	17.94	✓	✓	✓	n/a	✓
6/21/16 1735	DRmz	17.92	✓	✓	✓	n/a	✓
6/22/16 1800	DRmz	17.93	✓	✓	✓	n/a	✓
6/23/16 1751	DRmz	17.92	✓	✓	✓	n/a	✓
6/24/16 1729	DRmz	17.92	✓	✓	✓	n/a	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/3/16 1758	DRmz	✓	✓ 18.0	37482.2	✓
6/6/16 1857	DRmz	✓	✓ 18.0	37484.3	✓
6/7/16 1701	DRmz	✓	✓ 18.0	37489.2	✓
6/8/16 1703	DRmz	✓	✓ 18.0	37491.8	✓
6/9/16 1729	DRmz	✓	✓ 18.0	37492.6	✓
6/10/16 1631	DRmz	✓	✓ 18.0	37499.3	✓
6/13/16 1656	DRmz	✓	✓ 18.0	37501.4	✓
6/14/16 1816	DRmz	✓	✓ 18.0	37520.5	✓
6/15/16 1818	DRmz	✓	✓ 18.0	37521.3	✓
6/16/16 1751	DRmz	✓	✓ 18.0	37522.6	✓
6/17/16 1951	DRmz	✓	✓ 18.0	37527.3	✓
6/20/16 1757	DRmz	✓	✓ 18.0	37530.8	✓
6/21/16 1736	DRmz	✓	✓ 18.0	37538.4	✓
6/22/16 1801	DRmz	✓	✓ 18.0	37540.1	✓
6/23/16 1752	DRmz	✓	✓ 18.0	37541.4	✓
6/24/16 1730	DRmz	✓	✓ 18.0	37548.3	✓

Legend: Check = Green (OK); X = Red (call for service)

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Certificates of Calibration

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	46011
Asset Number:	018344	Calibrated:	2/1/2016
Description:	OVEN	Calibration Due:	2/1/2017
Manufacturer:	THERMO SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	HERATHERM OMS60	Temp./RH:	70 °F / 42 %
Serial Number:	41241291	Work Order #	403137157
Calibration Procedure:	OVENS, CHAMBERS, INCUBA		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
015454	HART SCIENTIFIC	5627A	THERMOMETER PRT	2/18/2016
018495	FLUKE	1523	TEMPERATURE METER	2/18/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137157	Mfr:	Thermo Scientific	Technician:	RRV
Asset No:	018344	Model:	Heratherm OMS60	Type Data:	Found-left
Serial No:	41241291	Type:	Oven Chamber	Cal Date:	1-Feb-16

Remarks: Calibration limits per customer request. Chamber exceeds 70% of limit at the 200 °C test point.
Customer to determine if the result found meets their requirements. Temperature uniformity not calibrated

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
50 °C	50.4	50.0	-0.4	2.0	0.18	Pass	20%
100 °C	101.0	100.0	-1.0			Pass	50%
150 °C	152.1	150.0	-2.1	3.0		Pass	70%
200 °C	203.2	200.0	-3.2	4.0		Pass	80%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36974
Asset Number:	022396	Calibrated:	8/19/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/19/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	73.6°F / 58 %
Serial Number:	22396	Work Order #	403133757
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-found
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	2.2	0.5	Fail	159%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	3.0	1.3	Fail?	100%
	699.3	702.6	3.3	5.2	1.3	Pass	63%
	1002.6	1002.4	-0.2	7.5	1.3	Pass	3%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-left
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	19-Aug-15
Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	4.0	0.5	Pass	88%
	-44.4	-42.8	1.6	2.2	0.5	Pass	73%
	-0.1	0.3	0.4	2.2	0.5	Pass	18%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	20.0	1.3	Pass	15%
	699.3	702.6	3.3	35.0	1.3	Pass	9%
	1002.6	1002.4	-0.2	50.0	1.3	Pass	0%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47205
Asset Number:	022923	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22923	Work Order #	403137431
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137431	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022923	Model:	08516-96	Type Data:	As-found
Serial No.:	22923	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-76.3	2.8	2.2	0.5	Fail	127%
	0.2	0.0	-0.2	2.2	0.5	Pass	9%
	396.7	396.0	-0.7	3.0	1.3	Pass	24%
	698.9	698.0	-0.9	5.2	1.3	Pass	17%
	1101.6	1094.9	-6.7	8.3	1.3	Pass	81%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137431	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022923	Model:	08516-96	Type Data:	As-left
Serial No.:	22923	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 °C be ±3 °C. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	3.0	0.5	Pass	63%
	0.2	0.0	-0.2	2.2	0.5	Pass	9%
	396.7	396.5	-0.2	3.0	1.3	Pass	7%
	698.9	698.0	-0.9	5.2	1.3	Pass	17%
	1101.6	1094.9	-6.7	8.3	1.3	Pass	81%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38184
Asset Number:	022488	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22488	Work Order #	403134274
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134274	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022488	Model	08516-96	Type Data:	Found-left
Serial No.	22488	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.3	0.4	3.7	1.3	Pass	9%
	750.3	749.9	-0.4	5.6	1.3	Pass	7%
	1002.9	1000.5	-2.4	7.5	1.3	Pass	32%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38121
Asset Number:	022476	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22476	Work Order #	403134199
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134199	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022476	Model	08516-96	Type Data:	Found-left
Serial No.	22476	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.0	-0.7	2.2	0.5	Pass	33%
	498.0	497.7	-0.3	3.7	1.3	Pass	7%
	750.3	749.6	-0.7	5.6	1.3	Pass	12%
	1002.9	999.9	-3.0	7.5	1.3	Pass	40%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	53401
Asset Number:	023174	Calibrated:	5/25/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	5/25/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	75.4°F / 57 %
Serial Number:	23174	Work Order #	403139870
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 200 °C.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403139870	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023174	Model:	08516-96	Type Data:	Found-left
Serial No.:	23174	Type:	Thermocouple Type K	Cal Date:	25-May-16
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if reading meets their requirements.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	2.2	0.5	Pass	86%
	0.0	0.3	0.3	2.2	0.5	Pass	14%
	99.7	99.4	-0.3	2.2	0.5	Pass	14%
	200.5	200.8	0.3	2.2	0.5	Pass	14%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38118
Asset Number:	022473	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22473	Work Order #	403134196
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134196	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022473	Model	08516-96	Type Data:	Found-left
Serial No.	22473	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.7	0.8	3.7	1.3	Pass	20%
	750.3	750.9	0.6	5.6	1.3	Pass	11%
	1002.9	1001.5	-1.4	7.5	1.3	Pass	19%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47207
Asset Number:	022925	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22925	Work Order #	403137433
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-found
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-75.9	3.2	2.2	0.5	Fail	145%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-left
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-42.5	2.4	3.0	0.5	Pass	80%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39984
Asset Number:	020014	Calibrated:	10/7/2015
Description:	BALANCE	Calibration Due:	10/7/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	72 °F / 49 %
Serial Number:	B338797310	Work Order #	403134943
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0002	0.0002	0.0006	Pass	33%
Left Rear		100.0003	0.0003		Pass	50%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0002	0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	80.00001				
2		80.00002				
3		80.00001				
4		80.00002				
5		80.00001				
6		80.00002				
7		80.00002				
8		80.00002				
9		80.00002				
10		80.00002				
Std Deviation		0.000005		0.00008	Pass	6%
< 220 g Range						
1	200	200.0001				
2		200.0000				
3		200.0002				
4		200.0001				
5		200.0002				
6		200.0001				
7		200.0002				
8		200.0002				
9		200.0002				
10		200.0002				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.06	Pass	0%
	8.00001	8.00002	0.01			Pass	3%
	15.99996	15.99995	-0.01			Pass	3%
	24.00005	24.00010	0.05			Pass	13%
	32.00000	32.00006	0.06			Pass	15%
	40.00002	40.00007	0.05			Pass	13%
	48.00003	48.00006	0.03			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99998	56.00006	0.08	0.40	0.06	Pass	20%
	63.99999	64.00014	0.15			Pass	38%
	72.00002	72.00018	0.16			Pass	40%
	79.99998	80.00009	0.11			Pass	28%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.18	Pass	0%
< 220 g Range	20.0000	20.0001	0.1			Pass	25%
	40.0000	40.0000	0.0			Pass	0%
	60.0000	60.0001	0.1			Pass	25%
	80.0000	80.0001	0.1			Pass	25%
	100.0001	100.0000	-0.1			Pass	25%
	120.0001	120.0001	0.0			Pass	0%
	140.0001	140.0002	0.1			Pass	25%
	160.0001	160.0002	0.1			Pass	25%
	180.0001	180.0002	0.1			Pass	25%
	199.9999	200.0002	0.3			Pass	75%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39314
Asset Number:	014982	Calibrated:	9/25/2015
Description:	BALANCE	Calibration Due:	9/25/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XP5003SDR	Temp./RH:	73 °F / 48 %
Serial Number:	1129300727	Work Order #	403134658
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/12/2016
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/8/2016
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/7/2016
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016
001718	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016

Approved By

Calibrated By RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

001719 RICE LAKE 5 KG WEIGHT CLASS 1 4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134658	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	25-Sep-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Left Front	1000	1000.000	0 000	0.010	Pass	0%
Left Rear		999.999	-0 001		Pass	10%
Right Rear		1000.000	0 000		Pass	0%
Right Front		1000.001	0 001		Pass	10%
Repeatability						
1000 g Range						
1	500	500.002				
2		500.000				
3		500.001				
4		500.002				
5		500.000				
6		500.000				
7		500.001				
8		500.001				
9		500.001				
10		500.000				
Std Deviation		0.0008		0.0020	Pass	40%
5100 g Range						
1	2000	199.99				
2		200.00				
3		199.99				
4		199.99				
5		200.00				
6		200.00				
7		199.99				
8		199.99				
9		199.99				
10		199.99				
Std Deviation		0.005		0.012	Pass	42%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
1000 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	100.000	100.001	0.001			Pass	8%
	200.000	200.001	0.001			Pass	8%
	300.000	300.001	0.001			Pass	8%
	400.000	400.001	0.001			Pass	8%
	500.000	500.002	0.002			Pass	17%
	600.000	600.003	0.003			Pass	25%
	700.000	700.002	0.002			Pass	17%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134658	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	25-Sep-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	grams	grams	grams		
1000 g Range	800.000	800.002	0.002	0.012	0.003	Pass	17%
	900.000	900.001	0.001			Pass	8%
	1000.000	1000.000	0.000			Pass	0%
5100 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	500.000	500.001	0.001			Pass	8%
	1000.000	999.999	-0.001			Pass	8%
	1500.00	1500.00	0.00	0.02	0.01	Pass	0%
	2000.00	2000.00	0.00			Pass	0%
	2500.00	2500.00	0.00			Pass	0%
	3000.00	3000.00	0.00			Pass	0%
	3500.00	3500.00	0.00			Pass	0%
	4000.00	4000.00	0.00			Pass	0%
	4500.00	4500.00	0.00			Pass	0%
	5000.00	5000.00	0.00			Pass	0%

END OF REPORT

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Certificates of Analysis for Chemicals

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Elgan E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69597

Fisher Scientific

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hernandez

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
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SwRI Chem ID: 69596

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SwRI Chem ID: 69595

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69595



Edgar E. Hernandez

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
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SwRI Chem ID: 69595

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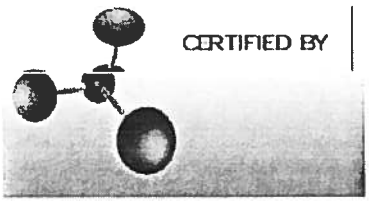
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SwRI Chem ID: 69594

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69594



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69594

Fisher Scientific

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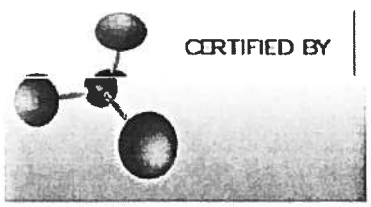
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SwRI Chem ID: 69593

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69593



Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69593

Fisher Scientific

Certificate of Analysis

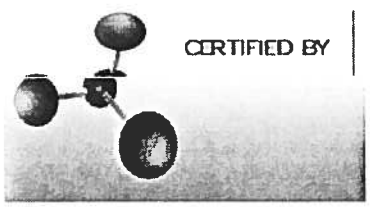
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69592
SwRI Chem ID: 69592
SwRI Chem ID: 69592

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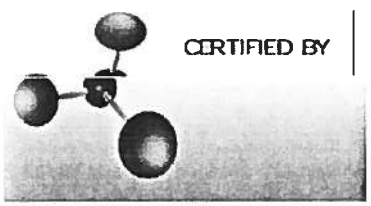
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69573
SwRI Chem ID: 69573
SwRI Chem ID: 69573

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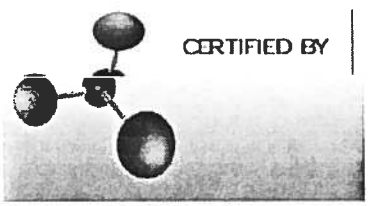
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69574
SwRI Chem ID: 69574
SwRI Chem ID: 69574

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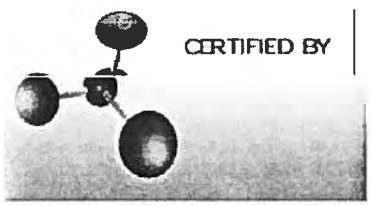
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69575
SwRI Chem ID: 69575
SwRI Chem ID: 69575

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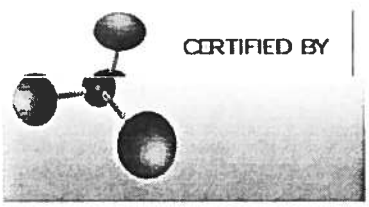
Certificate of Analysis

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Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69576
SwRI Chem ID: 69576
SwRI Chem ID: 69576

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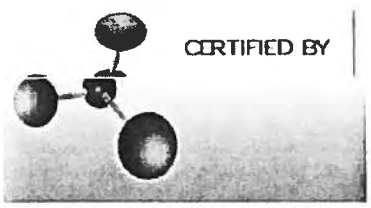
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Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

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SwRI Chem ID: 69577

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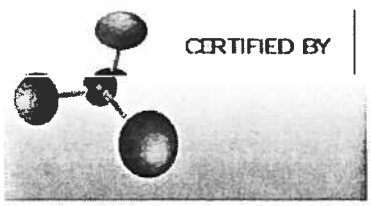
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Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

SwRI Chem ID: 69578

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69578



Lab Manager Fair Lawn

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SwRI Chem ID: 69578

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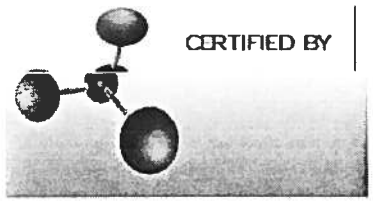
Certificate of Analysis

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Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69579
SwRI Chem ID: 69579
SwRI Chem ID: 69579

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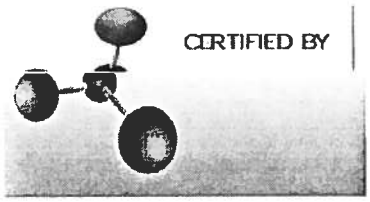
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69591
SwRI Chem ID: 69591
SwRI Chem ID: 69591

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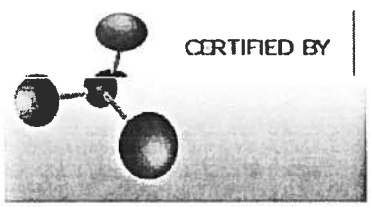
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SwRI Chem ID: 69590

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69590



Edgar E. Hernandez

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69590

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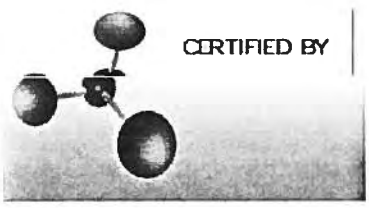
SwRI Chem ID: 69589

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69589



Lab Manager Fair Lawn

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SwRI Chem ID: 69589

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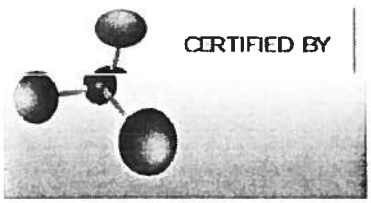
Certificate of Analysis

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Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69588
SwRI Chem ID: 69588
SwRI Chem ID: 69588

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201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

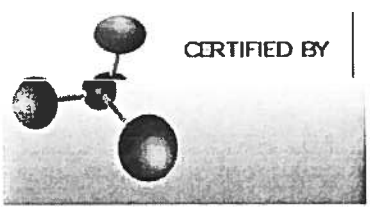
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SwRI Chem ID: 69587

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69587



Edgar E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69587

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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SwRI Chem ID: 69586

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

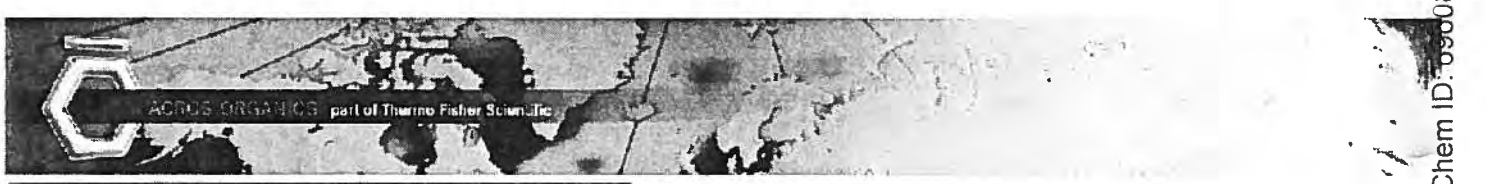
SwRI Chem ID: 69586



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69586



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

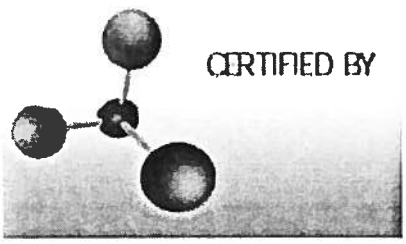
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Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608



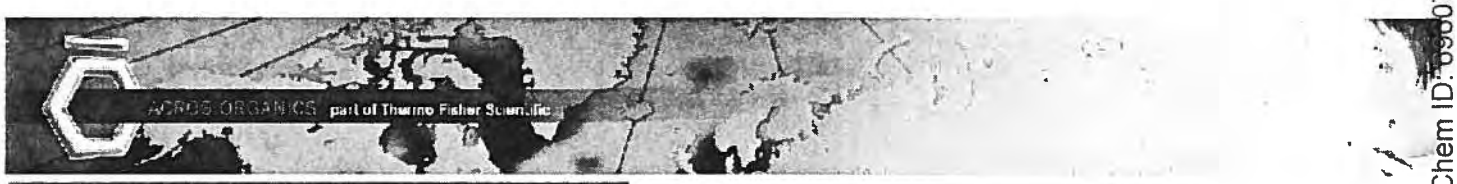
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L. Van den Broek, QA Manager Issued: 25 April 2016

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Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608

SwRI Chem ID: 69607



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

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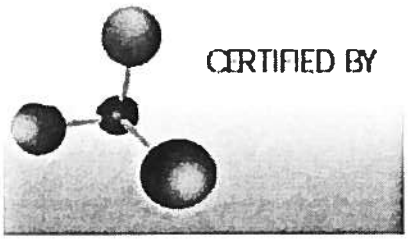
Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69607

SwRI Chem ID: 69607



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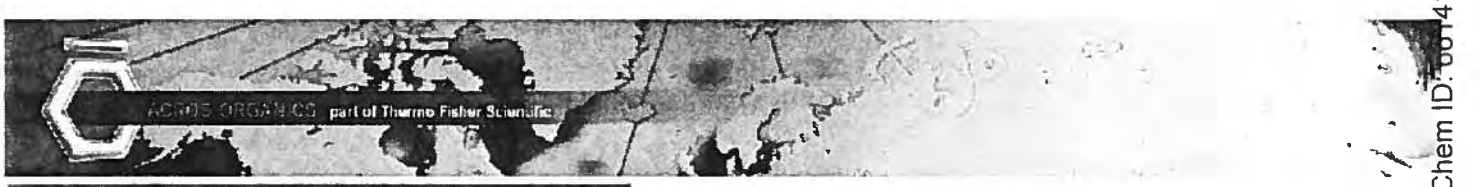
L. Van den Broek, QA Manager Issued: 25 April 2016

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SwRI Chem ID: 69607

SwRI Chem ID: 69607

SwRI Chem ID: 69607



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

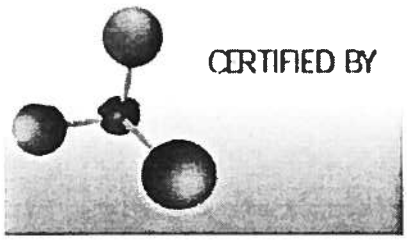
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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm
Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)

SwRI Chem ID: 66141
SwRI Chem ID: 66141
SwRI Chem ID: 66141



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 14 January 2016

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SwRI Chem ID: 66141

SwRI Chem ID: 66141

SwRI Chem ID: 66141

SwRI Chem ID: 63857



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

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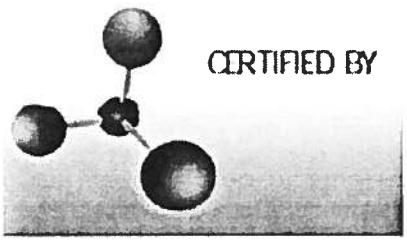
Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	dark purple to black crystalline chunks	black crystalline chunks
Titration Iodometric	>=98.5 %	101.9 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Trace analysis	Type: Ca measure =< 50 PPM	Type: Ca measure 5 PPM
Trace analysis	Type: Cd measure =< 10 PPM	Type: Cd measure 3 PPM
Trace analysis	Type: Co measure =< 10 PPM	Type: Co measure 5 PPM
Trace analysis	Type: Cu measure =< 10 PPM	Type: Cu measure 7 PPM
Trace analysis	Type: Fe measure =< 200 PPM	Type: Fe measure 178 PPM
Trace analysis	Type: Mg measure =< 50 PPM	Type: Mg measure 6 PPM
Trace analysis	Type: Mn measure =< 10 PPM	Type: Mn measure 7 PPM
Trace analysis	Type: Na measure =< 50 PPM	Type: Na measure 17 PPM
Trace analysis	Type: Ni measure =< 50 PPM	Type: Ni measure 8 PPM
Trace analysis	Type: Pb measure =< 20 PPM	Type: Pb measure 4 PPM
Trace analysis	Type: Sr measure =< 50 PPM	Type: Sr measure 11 PPM
Trace analysis	Type: Zn measure =< 10 PPM	Type: Zn measure 4 PPM
Trace analysis	Type: Cl measure =< 20 PPM	Type: Cl measure =< 20 PPM
Trace analysis	Type: SO4 measure =< 50 PPM	Type: SO4 measure =< 50 PPM
Trace analysis	Type: NH4 measure =< 10 PPM	Type: NH4 measure =< 10 PPM
Subst not pptd by NH4OH	=<0.2 % (as SO4)	=<0.0077 % (as SO4)

SwRI Chem ID: 63857

SwRI Chem ID: 63857



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 28 October 2015

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SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857

SwRI Chem ID: 63604

SIGMA-ALDRICH

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

SwRI Chem ID: 63604

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 63604

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65582

SIGMA-ALDRICH

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

Product Number:	**216828**
Batch Number:	**MKBW6908V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	16 OCT 2015

$Fe(NO_3)_3 \cdot 9H_2O$

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Michael Grady, Manager
Quality Control
Milwaukee, WI US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65582

SwRI Chem ID: 65582

SwRI Chem ID: 69603

ACROS ORGANICS part of Thermo Fisher Scientific

ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

Certificate of Analysis

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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %

CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57 52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69603

SwRI Chem ID: 69603

SwRI Chem ID: 69604



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

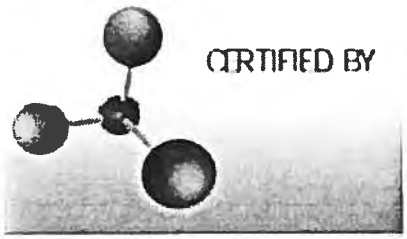
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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 25 April 2016

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SwRI Chem ID: 69604

SwRI Chem ID: 69604

SwRI Chem ID: 69611



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

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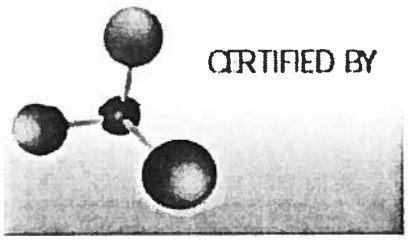
Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69611

SwRI Chem ID: 69611



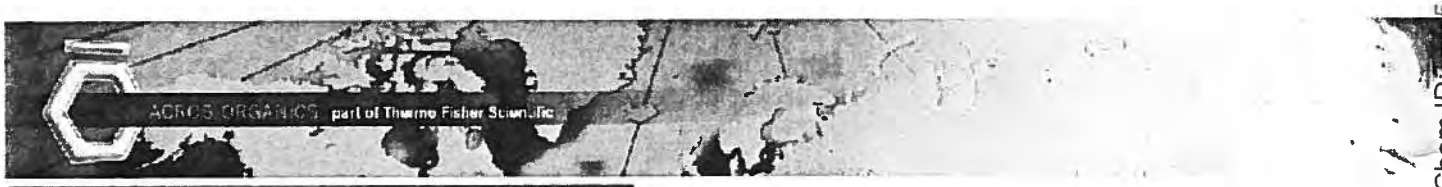
CERTIFIED BY

L. Van den Broek, QA Manager Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69611
SwRI Chem ID: 69611
SwRI Chem ID: 69611

SwRI Chem ID: 65951



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

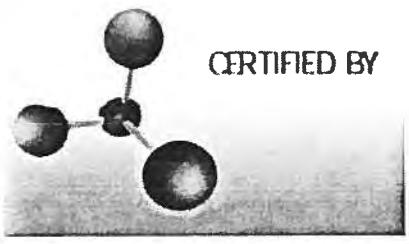
Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 7 January 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 65951

SwRI Chem ID: 65951

SwRI Chem ID: 69629



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

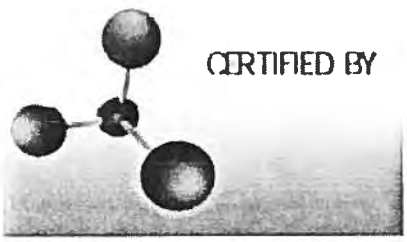
Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 26 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69629

SwRI Chem ID: 69629

SwRI Chem ID: 69628



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

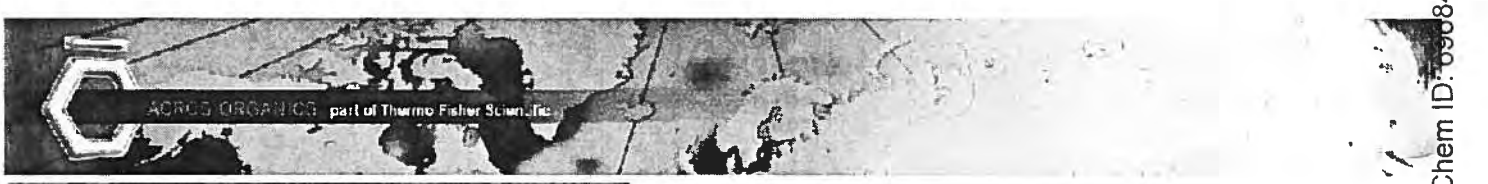
Issued: 26 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69628

SwRI Chem ID: 69628

SwRI Chem ID: 69684



ACROS ORGANICS

Version	0
Molecular weight	126.04
Molecular formula	C2 H2 O4 . 2 H2 O
CAS No	6153-56-6
Linear formula	HO2CCO2H.2H2O
Flash point (°C)	

Certificate of Analysis

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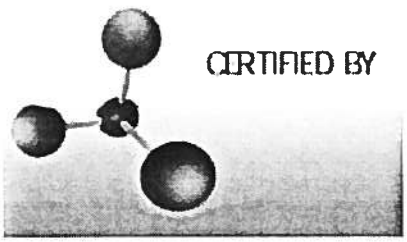
Catalog Number	42315	**Quality Test / Release Date**	10 December 2014
Lot Number	A0354614	**Suggested Retest Date**	December 2019
Description	Oxalic acid dihydrate,99.5+%,ACS reagent		
Country of Origin	SPAIN		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystals
Infrared spectrometry	authentic	authentic
Assay Titrimetry	99.5 to 102.5 %	99.9 %
Heavy metals (as Pb)	=<5 ppm	=<2.5 ppm
Residue after ignition	=<0.01 %	0.004 %
Nitrogen compounds (as N)	=<0.001 %	=<0.001 %
Trace analysis	Type: Cl measure =< 20 ppm	Type: Cl measure < 5 ppm
Trace analysis	Type: SO4 measure =< 50 ppm	Type: SO4 measure < 20 ppm
Trace analysis	Type: Ca measure =< 10 ppm	Type: Ca measure < 1 ppm
Trace analysis	Type: Fe measure =< 2 ppm	Type: Fe measure < 2 ppm
Insoluble matter	=<0.005 %	=<0.005 %
Substance darkened by H2SO4	passes test	passes test

SwRI Chem ID: 69684

SwRI Chem ID: 69684



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 27 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69684

SwRI Chem ID: 69684

SwRI Chem ID: 69684

SIGMA-ALDRICH®

3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:	NICKEL(II) NITRATE HEXAHYDRATE purum p.a., crystallized, >= 97.0 % KT
Product Number:	72253
Batch Number:	BCBP4160V
Brand:	Sigma-Aldrich
CAS Number:	13478-00-7
Formula:	$Ni(NO_3)_2 \bullet 6H_2O$
Formula Weight:	290.79
Quality Release Date:	26 JAN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	BLUE-GREEN TO DEEP BLUE-GREEN	BLUE-GREEN
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	97.0 - 103.0 %	97.0 %
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
CADMIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
COBALT (ICP)	≤ 500 MG/KG	< 500 MG/KG
COPPER (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 50 MG/KG	< 50 MG/KG
POTASSIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
SODIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
LEAD (ICP)	≤ 50 MG/KG	< 50 MG/KG
ZINC (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 50 MG/KG	< 50 MG/KG

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65593
SwRI Chem ID: 65593
SwRI Chem ID: 65593

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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Catalog Number	**A509**	**Mfg. Date**	11/4/2015
Lot Number	**1115100**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	11/04/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

SwRI Chem ID: 67843
SwRI Chem ID: 67843
SwRI Chem ID: 67843

Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

CERTIFIED BY

Edgar E Hess
Lab Manager Fair Lawn

Joel Boland
Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1.800.227.6701.

SwRI Chem ID: 67843
SwRI Chem ID: 67843
SwRI Chem ID: 67843

INORGANIC LABS/RADCHEM LABS
DATE RECEIVED: 7/10/12
DATE EXPIRED: 9/1/2016 OKnZ
DATE OPENED: 7/18/12
INORG: 9980 PO: E37845E

Certificate of Analysis

Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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Catalog Number	**A940**	**Mfg. Date**	**9/23/2011**
Lot Number	**114303**		
Description	**CITRIC ACID, ANHYDROUS, A.C.S.**		
Country of Origin	**United States**	**Recommended Retest Date**	**Sep-2016**
Chemical Origin	**Organic - Plant**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Fine, white crystals
ASSAY	%	>= 99.5	99.6
CHLORIDE	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
IGNITION RESIDUE	%	<= 0.02	<0.020
INSOLUBLE MATTER	%	<= 0.005	<0.0050
IRON (Fe)	ppm	<= 3	<3.0
LEAD (Pb)	ppm	<= 2	<2.0
OXALATE	PASS/FAIL	= P.T. (ABOUT 0.05%)	P.T. (ABOUT 0.05%)
PHOSPHATE (PO4)	%	<= 0.001	<0.0010
SUBST. CARBONIZED BY H2SO4	PASS/FAIL	= PASS TEST	PASS TEST
SULFUR COMPOUNDS	%	<= 0.002	<0.0020



Edgar E. Hernandez

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.

SwRI Chem ID: 36116
SwRI Chem ID: 36116
SwRI Chem ID: 36116

Appendix O
SwRI Test Report, July 5, 2016

SOUTHWEST RESEARCH INSTITUTE®

6220 CULEBRA ROAD 78238-5166 • P.O. DRAWER 28510 78228-0510 • SAN ANTONIO, TEXAS, USA • (210) 684-5111 • WWW.SWRI.ORG

CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

July 05, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Victor Garde

Subject:		
	SwRI Project Number:	21592.01.00X
	SDG:	598446
	SwRI Task Order Number:	160622-1
	SwRI Sample Receipt Number:	57710
	Samples Received:	06.24.2016
	Analysis:	UN Oxidation Liquid

Dear Mr. Garde,

Please find the enclosed results for the two overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

Radonna Spies for
Group Leader – R&D

APPROVED:

for Michael J. Dammann
Director

RPS: mg

Cc: Anya Gonzales, Los Alamos National Laboratory

Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160622-1
SwRI SRR: 57710
SDG: 598446
VTSR: 05.31.2016

Chain-of-Custody
&
Sample Receipt Paperwork

Total Page Count:
Fraction: JNJ Oxidation Liquid Pages: 010001 - 010042

Douglas, Steven M.



From: Moken, James A.
Sent: Tuesday, May 31, 2016 9:27 AM
To: Douglas, Steven M.
Subject: Sample ID's

Steven,

Can I get you to make sample ID's and SDG's for the following samples. Table 1 will need to be on one SDG and Table 2 will be on a separate SDG since we will be adding samples to it later this month. If you have any questions let me know. Thanks.

Table 1

Requested Analysis					
Sample ID	**SW-846 Test Method 1030**	**SW-846 Test Method 1050**	**DOT O.1 Test**	**DOT O.2 Test**	**Test Method 9095B (Paint Filter)**
Sod Nit A				X	
Sod Nit Sol – Zeo 1			X		X
Sod Nit Sol – Zeo 2			X		X
Sod Nit B				X	
Sod Nit B – Zeo 1			X		X
Sod Nit B – Zeo 2			X		X
Sod Nit A pH – Zeo 1			X		X
Sod Nit A pH – Zeo 2			X		X
Sod Nit A Blend 1	X	X	X		X
Sod Nit A Blend 2	X	X	X		X
Sod Nit A Blend 3	X	X	X		X
Sod Nit A Blend 4	X	X	X		X
Sod Nit B Blend 1	X	X	X		X
Sod Nit B Blend 2	X	X	X		X
Sod Nit B Blend 3	X	X	X		X
Sod Nit B Blend 4	X	X	X		X
Sod Nit A pH Blend 1	X	X	X		X
Sod Nit A pH Blend 2	X	X	X		X
Sod Nit A pH Blend 3	X	X	X		X
Sod Nit A pH Blend 4	X	X	X		X

Table 2

Wypall Blend ID (Wypall mix: zeolite)	Wypall Mixture (ml)	Zeolite (ml)

Client: Los Alamos National Laboratory
SRR # 57710
Project # 21592.01.00X
Case: Zeolite
VTSR: 05/31/2016
Sample(s) Received: Intact
Temperature: N/A °C/ SN #: N/A

WB1(1:3)	1233	3700
WB2(1:4)	925	3700
WB3(1:5)	740	3700

Jamie

Southwest Research Institute

Laboratory Task Order

TO #: 160622-1 Revision: 0

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 06/27/16

SDG: 598446

SRR #'s: 57710
Client(s): Los Alamos National Laboratory

Instructions

Two samples for UN oxidation liquid.

Documents Related to this task order: 200812[COC for SRR 57710], 200814[SRR Paperwork for SRR 57710]

Deliverables --> Hard Copy: -YES- EDD: no PDF: no

Test: Oxidizing Liq_UN
Section: WETCHEM

Holding: 180 days from CED

Test for Oxidizing Liquids - UN Manual of Tests and Criteria Part 3

Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
598446		1	Liquid	Sod Nit A	NO DATA	NO DATA
598457		1	Liquid	Sod Nit B	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 57710

VTSR: 05/31/16

Time: 10:00:00

Project: 21592.01.00X
Case #: Zeolite
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 05/31/16

Notes

Email was received to create an SRR for the following.

Parameters: Requirements located on the applicable Task Order.

See chain of custody as part of the LIMS system for more information.

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
598446	Sod Nit A		Liquid	1	
598447	Sod Nit A Blend 1		Solid	1	
598448	Sod Nit A Blend 2		Solid	1	
598449	Sod Nit A Blend 3		Solid	1	
598450	Sod Nit A Blend 4		Solid	1	
598451	Sod Nit A pH - Zeo 1		Solid	1	
598452	Sod Nit A pH - Zeo 2		Solid	1	
598453	Sod Nit A pH Blend - 1		Solid	1	
598454	Sod Nit A pH Blend - 2		Solid	1	
598455	Sod Nit A pH Blend - 3		Solid	1	
598456	Sod Nit A pH Blend - 4		Solid	1	
598457	Sod Nit B		Liquid	1	
598458	Sod Nit B - Zeo 1		Solid	1	
598459	Sod Nit B - Zeo 2		Solid	1	
598460	Sod Nit B Blend 1		Solid	1	
598461	Sod Nit B Blend 2		Solid	1	
598462	Sod Nit B Blend 3		Solid	1	
598463	Sod Nit B Blend 4		Solid	1	
598464	Sod Nit Sol - Zeo 1		Solid	1	
598465	Sod Nit Sol - Zeo 2		Solid	1	

Containers: 20 **Samples: 20**

These documents are associated with this receipt: 200812[COC for SRR 57710], 200814[SRR Paperwork for SRR 57710]

Thermometer: N/A
Temperature: N/A

Page Printed: 07/05/2016 14:22
ver: (7/18/2014)

57710 Los Alamos National Laborato

Southwest Research Institute

Traffic Report

Sample Custodian Signature: _____

1. Custody Seal — Not Present or Damaged
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: Zeolite / SDG: _____

Sample Receipt: 57710

Airbill: Email

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
05/31/16	10:00:00	Email	Sod Nit A	N/A	598446	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A Blend 1	N/A	598447	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A Blend 2	N/A	598448	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A Blend 3	N/A	598449	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A Blend 4	N/A	598450	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH - Zeo 1	N/A	598451	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH - Zeo 2	N/A	598452	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH Blend - 1	N/A	598453	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH Blend - 2	N/A	598454	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH Blend - 3	N/A	598455	YES	Intact
05/31/16	10:00:00	Email	Sod Nit A pH Blend - 4	N/A	598456	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B	N/A	598457	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B - Zeo 1	N/A	598458	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B - Zeo 2	N/A	598459	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B Blend 1	N/A	598460	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B Blend 2	N/A	598461	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B Blend 3	N/A	598462	YES	Intact
05/31/16	10:00:00	Email	Sod Nit B Blend 4	N/A	598463	YES	Intact
05/31/16	10:00:00	Email	Sod Nit Sol - Zeo 1	N/A	598464	YES	Intact
05/31/16	10:00:00	Email	Sod Nit Sol - Zeo 2	N/A	598465	YES	Intact

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 05/31/2016
Received By (Signature): SD	
Case Number: Zeolite	Sample Delivery Group No.: NA
Remarks: 21592.01.00X	SAS Number: NA

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present/Absent*	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	Email	
7. Sample Tags	Present/Absent*	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/ Leaking	
9. Cooler Temperature	N/AC	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	05/31/2016	
12. Time Received	10:00:00	

Sample Transfer		
Fraction: INORG	Fraction	
Area #: J. Moker	Area #	
By: STEVEN DOUGLAS	By	
On: 05/31/2016	On	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Sod Nit A	N/A	598446	Intact
Sod Nit A Blend 1	N/A	598447	Intact
Sod Nit A Blend 2	N/A	598448	Intact
Sod Nit A Blend 3	N/A	598449	Intact
Sod Nit A Blend 4	N/A	598450	Intact
Sod Nit A pH - Zeo 1	N/A	598451	Intact
Sod Nit A pH - Zeo 2	N/A	598452	Intact
Sod Nit A pH Blend - 1	N/A	598453	Intact
Sod Nit A pH Blend - 2	N/A	598454	Intact
Sod Nit A pH Blend - 3	N/A	598455	Intact
Sod Nit A pH Blend - 4	N/A	598456	Intact
Sod Nit B	N/A	598457	Intact
Sod Nit B - Zeo 1	N/A	598458	Intact
Sod Nit B - Zeo 2	N/A	598459	Intact
Sod Nit B Blend 1	N/A	598460	Intact
Sod Nit B Blend 2	N/A	598461	Intact
Sod Nit B Blend 3	N/A	598462	Intact
Sod Nit B Blend 4	N/A	598463	Intact
Sod Nit Sol - Zeo 1	N/A	598464	Intact
Sod Nit Sol - Zeo 2	N/A	598465	Intact

* Contact SMO and attach record of resolution

Reviewed By:	Logbook No: Sample Receipt (57710)
Date: 6.1.16	Logbook Page No: 9472 SDC 1, 2 of 2

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160622-1
SwRI SRR: 57710
SDG: 598446
VTSR: 05.31.2016

Case Narrative

Client: Los Alamos National Laboratory
SDG: 598446
SwRI Project Number: 21592.01.00x
SwRI Task Order Number: 160622-1

WETCHEM ANALYSIS

DOT UN Liquid Oxidizer test

The two sodium nitrate A and sodium nitrate B blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1 Test O.2 Test for oxidizing liquid.* The test method measures the potential for a liquid substance to increase the burn rate or intensity mixed at a 1:1 ratio with fibrous cellulose. The mixture is heated in a pressure vessel and the rate of pressure rise is determined and pressure rise time is compared to three reference materials (50% perchloric acid, 40% sodium chlorate and 65% nitric acid) when also mixed at a 1:1 ratio with the cellulose. The mean pressure rise of the reference substances are listed in Table 1 and the classifications are listed in the Table 2.

Sod Nit A and Sod Nit B blends had a mean pressure rise time of 8.026 and 9.067 msec respectively; therefore, they are Not Division 5.1 under the tested laboratory conditions. Only the averages of the first four reps of the Sod Nit A were reported due to the fifth rep having wire connection issues. One of the electrical posts was then broken on the apparatus when trying to reassemble it for a repeat test and was unable to repair it at the time of testing.

Table 1. Reference Substances

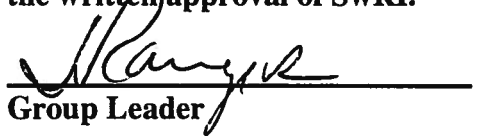
Mean pressure rise time, msec		
(1:1) 50 % perchloric acid and cellulose	(1:1) 40% aqueous sodium chlorate and cellulose	(1:1) 65% nitric acid and cellulose
0.131	0.645	6.784

Table 2. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in a 1:1 mixture, by mass, of substance and cellulose tested, spontaneously ignites; or the mean pressure rise time of a 1:1 mixture, by mass, of substance and cellulose is less than that of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose.	Packing group I
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chloreate solution and cellulose; and the criteria for Packing group I are not met	Packing group II
Any substance which, in the 1:1 mixtuer, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose; and the criteria for Packing groups I and II are not met.	Packing group III
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a pressure rise of less than 2070 kPa gauge; or exhibits a mean pressure rise time greater than the mean pressure rise time of a 1:1 mixture, by mass, of a 65% aqueous nitric acid and cellulose.	Not Division 5.1

Client: Los Alamos National Laboratory
SDG: 598446
SwRI Project Number: 21592.01.00x
SwRI Task Order Number: 160622-1

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."



Group Leader

7/5/16

Date

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160622-1
SwRI SRR: 57710
SDG: 598446
VTSR: 05.31.2016

UN Oxidizer
Sample Results

SOUTHWEST RESEARCH INSTITUTE

UN LIQUID OXIDIZER TEST O.2

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Liquid

Date Made: 5/23/16

SRR #: 57710

Task Order #: 160622-1

Reference Substances

Mean pressure rise time, msec		
(1:1) 50 % perchloric acid and cellulose	(1:1) 40% aqueous sodium chlorate and cellulose	(1:1) 65% nitric acid and cellulose
0.131	0.645	6.784

Test Substance

Sample ID	SwRI System ID	Mean pressure rise time, msec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
Sod Nit A	598446	8.026	Not Division 5.1	07/01/16
Sod Nit B	598457	9.067	Not Division 5.1	6/30/16, 7/01/16

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in a 1:1 mixture, by mass, of substance and cellulose tested, spontaneously ignites; or the mean pressure rise time of a 1:1 mixture, by mass, of substance and cellulose is less than that of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose.	Packing group I
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chloreate solution and cellulose; and the criteria for Packing group I are not met	Packing group II
Any substance which, in the 1:1 mixtuer, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose; and the criteria for Packing groups I and II are not met.	Packing group III
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a pressure rise of less than 2070 kPa gauge; or exhibits a mean pressure rise time greater than the mean pressure rise time of a 1:1 mixture, by mass, of a 65% aqueous nitric acid and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160622-1
SwRI SRR: 57710
SDG: 598446
VTSR: 05.31.2016

UN Oxidizer

Raw Data

Southwest Research Institute

UN Test O.2: Test for Oxidizing liquids

Client	LANL
Project #	21592.01.006
TO#	160622-1

Standardization	
50% (w/w) HCLO4	Time, msec
1	0.108
2	0.133
3	0.117
4	0.163
5	0.134
avg	0.131
40% (w/w) NaCLO3	Time, msec
1	0.747
2	0.772
3	0.480
4	0.776
5	0.451
avg	0.645
65% (w/w) HNO3	Time, msec
1	6.845
2	7.765
3	6.749
4	5.951
5	6.611
avg	6.784

Standard Verification

STD	Time, msec
50% (w/w) HCLO4	0.119
40% (w/w) NaCLO3	0.615
65% (w/w) HNO3	7.714

06/30/16

Sample Results

Sod Nit B	Time, msec	Classification
1	9.242	
2	9.910	
3	8.703	
4	8.666	
5	8.816	
avg	9.067	Not Div 5.1
Sod Nit A	Time, msec	
1	7.700	
2	8.562	
3	8.055	
4	7.788	
avg	8.026	Not Div 5.1

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160622-1
SwRI SRR: 57710
SDG: 598446
VTSR: 05.31.2016

UN Oxidizer
Solution Prep'd Logs

Work continued from Page

SWRI

124-01-WCS12 1M NaOH

40.01441 g NaOH (#62694) TGAM 5/12/16 to F.V. 1L with DI H_2O
balance #135 exp 5/12/17

124-02-WCS12 1M HNO_3 WO 5AM 5/17/16

63.3mL HNO_3 (#67843) to F.V. 1L with DI H_2O
Sooc-R. exp 5/12/17

124-03-WCS12 Saturated HNO_3

1L 124-02-WCS12 + 1000.27g sodium nitrate (#69610)
balance #135

124-04-WCS12 Saturated 1M NaOH

1L 124-01-WCS12 + 1000.29g sodium nitrate (#69610)

5 AM 5/17/16

www.scientificbindery88yrs.com

Work continued to Page

SIGNATURE [signature] DATE 5/12/16

DISCLOSED TO AND UNDERSTOOD BY M. Bradley DATE WITNESS DATE 5/13/16

TITLE Los Alamos

PROJECT NO. 21592.01.006
BOOK NO. 15-0406-052

Work continued from Page

SWRI

131-01-WCS12 - UVT5 (1:3)

500mL UVT solution (# 128-03-WCS12) + 1500mL solvent
tray #8 let sit for 48 hours start: 5/16/16 15:00

131-02-WCS12 1M HNO_3

63.3mL HNO_3 (# 67843) to FV. 1L with DI H_2O
5000-2 exp 5/16/17

131-03-WCS12 Saturated 1M HNO_3

1L 1M HNO_3 (# 131-02-WCS12) to unsaturated salts from (124-03-WCS12)
then added 600.217g sodium nitrate (#69610)
balance #135

SAM 5/17/16

www.scientificbindery88yrs.com

Work continued to Page

SIGNATURE James Mohr DATE 5/16/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon DATE WITNESS DATE 5/25/16

Work continued from Page

SWRI

135-01-WCS12 1M NaOH

40.0814 g NaOH (# 62693) to FV. 1L with DI H_2O
balance # 135 exp 5/23/17

135-02-WCS1L 1M HNO_3

63.3mL HNO_3 (# 69790) to FV. 1L with DI H_2O
exp 5/23/17

135-03-WCS12 saturated HNO_3

1L 1M HNO_3 (135-01-WCS12) to undissolved salts from (131-03-WCS12) then added 683.21 g $NaNO_3$ (# 69610). balance # 135

135-04-WCS12 saturated NaOH

1L 1M NaOH (135-02-WCS12) to undissolved salts from (124-04-WCS12) then added 721.82 g $NaNO_3$ (# 69610, 70359) balance #135

~~124-04~~ TESAM 5/23/16

JAM 5/24/16

SIGNATURE		DATE
		5/23/16
DISCLOSED TO AND UNDERSTOOD BY	DATE	WITNESS	DATE
M. Granados			5/25/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160622-1
SwRI SRR: 57710
SDG: 598446
VTSR: 05.31.2016

UN Oxidizer
Balances and DI Water Verification Logs

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
4/15/16	JAM	199.9996	2.00005	0.02001
4/16/16	JAM	199.9998	2.00000	0.01999
4/18/16	JAM	199.9995	1.99998	0.02002
4/19/16	JAM	199.9997	2.00001	0.01996
4/20/16	JAM	199.9997	2.00000	0.02000
4/21/16	JAM	199.9997	1.99994	0.02000
4/22/16	JAM	199.9996	1.99998	0.01998
4/25/16	JAM	199.9998	1.99999	0.02001
4/26/16	JAM	200.0000	2.00000	0.01999
4/27/16	JAM	200.0000	2.00001	0.02002
4/28/16	JAM	199.9995	1.99994	0.02002
4/29/16	VK	199.9995	1.99995	0.01997
5/2/16	JAM	199.9993	2.00000	0.02003
5/3/16	JAM	199.9996	1.99998	0.02001
5/4/16	JAM	199.9996	1.99994	0.02003
5/5/16	JAM	199.9998	① 2.00005	0.02000
5/6/16	JAM	199.9995	① 2.00006	0.02003
5/9/16	JAM	200.0002	① 2.00004	0.02000
5/10/16	JAM	199.9996	① 1.99994	0.02002
5/11/16	JAM	199.9998	1.99998	0.01999
5/12/16	JAM	199.9996	2.00000	0.01999
5/13/16	JAM	199.9997	1.99998	0.02003

Comments: ① we out for calibration using ID# 011999

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
5/14/16	JT	199.9998	1.99997	0.01998
5/16/16	VF	199.9999	1.99997	0.01997
5/17/16	JAM	199.9994	1.99997	0.02002
5/18/16	MG	200.0002	1.99999	0.02001
5/19/16	MG	199.9998	2.00001	0.01999
5/20/16	JAM	200.0000	2.00001	0.02000
5/22/16	JCM	199.9993	1.99999	0.02000
5/23/16	MG	200.0000	1.99999	0.01999
5/24/16	JAM	199.9994	2.00000	0.02001
5/25/16	JAM	199.9996	2.00001	0.01999
5/26/16	JAM	200.0000	1.99999	0.02002
5/27/16	JAM	199.9996	2.00002	0.01999
5/28/16	JAM	199.9998	2.00000	① 0.02003
5/29/16	JAM	199.9996	1.99999	① 0.01999
5/31/16	JCM	199.9996	1.99999	① 0.01999
6/1/16	JAM	199.9995	1.99994	① 0.01999
6/2/16	JCM	200.0000	2.00005	0.01999
6/3/16	JAM	199.9998	1.99999	0.02000
6/6/16	MG	199.9999	1.99996	0.01999
6/7/16	JAM	199.9998	1.99999	0.01998
6/8/16	JCM	199.9993	1.99997	0.01997
6/9/16	JCM	199.9991	1.99996	0.01999

Comments: ① wgt out for calibration use ID# 013790 20mg wgt

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
6/10/16	JAM	199.9998	2.00003	0.01995
6/13/16	SAM	199.9996	1.99996	0.02001
6/14/16	SAM	199.9998	1.99999	0.02003
6/15/16	SAM	199.9996	1.99997	0.01999
6/16/16	[illegible]	199.9998	2.00013	0.02002
6-17-16	KE	199.9998	2.00000	0.02001
6-19-16	SAM	199.9997	1.99998	0.02000
6-20-16	KE	199.9994	2.00005	0.01998
6/21/16	SAM	199.9997	1.99998	0.01997
6-22-16	KE	199.9997	1.99996	0.01996
6-23-16	KE	199.9996	1.99995	0.01998
6-24-16	KE	199.9996	1.99996	0.01997
6/27/16	SAM	199.9997	2.00004	0.02000
6-28-16	KE	199.9998	2.00000	0.02002
6/29/16	SAM	199.9998	2.00003	0.01999
6/30/16	SAM	199.9998	2.00000	0.02001
7/1/16	SAM	199.9996	1.99996	0.02000

Comments:

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
5/9/16 1735	DRmz	17.93	✓	✓	✓	n/a	✓
5/10/16 1801	DRmz	17.94	✓	✓	✓	n/a	✓
5/13/16 1810	DRmz	17.94	✓	✓	✓	n/a	✓
5/16/16 1715	DRmz	17.93	✓	✓	✓	n/a	✓
5/17/16 1936	DRmz	17.94	✓	✓	✓	n/a	✓
5/18/16 1801	DRmz	17.94	✓	✓	✓	n/a	✓
5/19/16 1805	DRmz	17.94	✓	✓	✓	n/a	✓
5/20/16 1650	DRmz	17.94	✓	✓	✓	n/a	✓
5/23/16 1807	DRmz	17.93	✓	✓	✓	n/a	✓
5/24/16 1811	DRmz	17.93	✓	✓	✓	n/a	✓
5/25/16 1747	DRmz	17.93	✓	✓	✓	n/a	✓
5/26/16 1800	DRmz	17.93	✓	✓	✓	n/a	✓
5/27/16 1547	DRmz	17.93	✓	✓	✓	n/a	✓
5/31/16 1651	DRmz	17.94	✓	✓	✓	n/a	✓
6/1/16 1801	DRmz	17.93	✓	X	✓	n/a	X-change needed ??
6/2/16 1710	DRmz	17.93	✓	X	✓	n/a	tank xchange needed

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
5/9/16 1736	DRmz	✓	✓ 18.0	37402.4	✓
5/10/16 1800	DRmz	✓	✓ 18.0	37408.1	✓
5/13/16 1812	DRmz	✓	✓ 18.0	37411.8	✓
5/16/16 1716	DRmz	✓	✓ 18.0	37426.5	✓
5/17/16 1931	DRmz	✓	✓ 18.0	37427.6	✓
5/18/16 1803	DRmz	✓	✓ 18.0	37435.3	✓
5/19/16 1806	DRmz	✓	✓ 18.0	37446.7	✓
5/20/16 1451	DRmz	✓	✓ 18.0	37448.4	✓
5/23/16 1808	DRmz	✓	✓ 18.0	37462.1	✓
5/24/16 1810	DRmz	✓	✓ 18.0	37463.5	✓
5/25/16 1748	DRmz	✓	✓ 18.0	37464.6	✓
5/26/16 1821	DRmz	✓	✓ 18.0	37471.5	✓
5/27/16 1548	DRmz	✓	✓ 18.0	37473.0	✓
5/31/16 1651	DRmz	✓	✓ 18.0	37473.9	✓
6/1/16 1802	DRmz	✓	✓ 18.0	37476.7	✓
6/2/16 1711	DRmz	✓	✓ 18.0	37480.1	✓

Legend: Check = Green (OK); X = Red (call for service)

Book ID#: 14-0406-024

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/3/16 1757	DRmz	17.94	✓	X	✓	n/A	TAIL PLATED
6/6/16 1806	DRmz	17.94	✓	X	✓	n/A	pending
6/7/16 1700	DRmz	17.93	✓	X	✓	n/A	Pending
6/8/16 1702	DRmz	17.93	✓	X	✓	n/A	Still pending
6/9/16 1728	DRmz	17.93	✓	X	✓	n/A	Pending
6/10/16 1630	DRmz	17.93	✓	X	✓	n/A	PENDING EXCHANGE
6/13/16 1655	DRmz	17.93	✓	✓	✓	n/A	MIXED BED TANK V-Changed. All DI'C
6/14/16 1815	DRmz	17.93	✓	✓	✓	n/A	✓
6/15/16 1817	DRmz	17.93	✓	✓	✓	n/A	✓
6/16/16 1750	DRmz	17.93	✓	✓	✓	n/A	✓
6/17/16 1850	DRmz	17.93	✓	✓	✓	n/A	✓
6/20/16 1755	DRmz	17.94	✓	✓	✓	n/A	✓
6/21/16 1735	DRmz	17.92	✓	✓	✓	n/A	✓
6/22/16 1800	DRmz	17.93	✓	✓	✓	n/A	✓
6/23/16 1751	DRmz	17.92	✓	✓	✓	n/A	✓
6/24/16 1729	DRmz	17.92	✓	✓	✓	n/A	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/3/16 1758	DRmz	✓	✓ 18.0	37482.2	✓
6/6/16 1807	DRmz	✓	✓ 18.0	37484.3	✓
6/7/16 1701	DRmz	✓	✓ 18.0	37489.2	✓
6/8/16 1703	DRmz	✓	✓ 18.0	37491.8	✓
6/9/16 1729	DRmz	✓	✓ 18.0	37492.6	✓
6/10/16 1631	DRmz	✓	✓ 18.0	37499.3	✓
6/13/16 1656	DRmz	✓	✓ 18.0	37501.4	✓
6/14/16 1816	DRmz	✓	✓ 18.0	37520.5	✓
6/15/16 1818	DRmz	✓	✓ 18.0	37521.3	✓
6/16/16 1751	DRmz	✓	✓ 18.0	37522.6	✓
6/17/16 1951	DRmz	✓	✓ 18.0	37527.3	✓
6/20/16 1757	DRmz	✓	✓ 18.0	37530.8	✓
6/21/16 1736	DRmz	✓	✓ 18.0	37538.4	✓
6/22/16 1801	DRmz	✓	✓ 18.0	37540.1	✓
6/23/16 1752	DRmz	✓	✓ 18.0	37541.4	✓
6/24/16 1730	DRmz	✓	✓ 18.0	37548.3	✓

Legend: Check = Green (OK); X = Red (call for service)

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160622-1
SwRI SRR: 57710
SDG: 598446
VTSR: 05.31.2016

UN Oxidizer

Certificates of Calibration

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	48788
Asset Number:	022992	Calibrated:	3/18/2016
Description:	PRESSURE TRANSDUCER	Calibration Due:	3/18/2017
Manufacturer:	OMEGA	Data Type:	FOUND / LEFT
Model Number:	PX309-500GI	Temp./RH:	68 °F / 40 %
Serial Number:	122010D089	Work Order #	403138243
Calibration Procedure:	PRESSURE GAUGES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
007001	AGILENT-HP	3458A OPT 002	MULTIMETER	4/29/2016
021448	FLUKE	PPC4	Pressure Controller	11/18/2016

Approved By

Calibrated By: RLC
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403138243	Mfr:	Omega	Technician:	RLC
Asset No.:	022992	Model:	PX309-500GI	Type Data:	Found-left
Serial No.:	122010D089	Type:	Pressure Transducer	Cal Date:	18-Mar-16
Remarks: Data is referenced to a Best Fit Straight Line.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Output for psi applied	mA	mA	mA	mA	mA		
0	3.993	3.981	-0.012	0.040	0.019	Pass	30%
100	7.185	7.188	0.003			Pass	8%
200	10.378	10.382	0.004			Pass	10%
300	13.570	13.580	0.010			Pass	25%
400	16.763	16.755	-0.008			Pass	20%
500	19.955	19.943	-0.012			Pass	30%
400	16.763	16.764	0.001			Pass	2%
300	13.570	13.577	0.007			Pass	17%
200	10.378	10.386	0.008			Pass	20%
100	7.185	7.190	0.005			Pass	13%
0	3.993	3.985	-0.008			Pass	20%
Zero Balance	4.000	3.981	-0.019	0.400	0.019	Pass	5%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39984
Asset Number:	020014	Calibrated:	10/7/2015
Description:	BALANCE	Calibration Due:	10/7/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	72 °F / 49 %
Serial Number:	B338797310	Work Order #	403134943
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute

Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0002	0.0002	0.0006	Pass	33%
Left Rear		100.0003	0.0003		Pass	50%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0002	0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	80.00001				
2		80.00002				
3		80.00001				
4		80.00002				
5		80.00001				
6		80.00002				
7		80.00002				
8		80.00002				
9		80.00002				
10		80.00002				
Std Deviation		0.000005		0.00008	Pass	6%
< 220 g Range						
1	200	200.0001				
2		200.0000				
3		200.0002				
4		200.0001				
5		200.0002				
6		200.0001				
7		200.0002				
8		200.0002				
9		200.0002				
10		200.0002				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.06	Pass	0%
	8.00001	8.00002	0.01			Pass	3%
	15.99996	15.99995	-0.01			Pass	3%
	24.00005	24.00010	0.05			Pass	13%
	32.00000	32.00006	0.06			Pass	15%
	40.00002	40.00007	0.05			Pass	13%
	48.00003	48.00006	0.03			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99998	56.00006	0.08	0.40	0.06	Pass	20%
	63.99999	64.00014	0.15			Pass	38%
	72.00002	72.00018	0.16			Pass	40%
	79.99998	80.00009	0.11			Pass	28%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.18	Pass	0%
< 220 g Range	20.0000	20.0001	0.1			Pass	25%
	40.0000	40.0000	0.0			Pass	0%
	60.0000	60.0001	0.1			Pass	25%
	80.0000	80.0001	0.1			Pass	25%
	100.0001	100.0000	-0.1			Pass	25%
	120.0001	120.0001	0.0			Pass	0%
	140.0001	140.0002	0.1			Pass	25%
	160.0001	160.0002	0.1			Pass	25%
	180.0001	180.0002	0.1			Pass	25%
	199.9999	200.0002	0.3			Pass	75%

END OF REPORT

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160622-1
SwRI SRR: 57710
SDG: 598446
VTSR: 05.31.2016

UN Oxidizer

Certificates of Analysis

SwRI Chem ID: 62694

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Sodium hydroxide - ACS reagent, ≥97.0%, pellets

Product Number:	**221465**
Batch Number:	**MKBV3988V**
Brand:	SIAL
CAS Number:	1310-73-2
MDL Number:	MFCD00003548
Formula:	HNaO
Formula Weight:	40.00 g/mol
Quality Release Date:	22 APR 2015
Recommended Retest Date:	APR 2017

NaOH

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form)	Pellets	Pellets
X-Ray Diffraction	Conforms to Structure	Conforms
Titration by HCL	≥ 97.0 %	99.0 %
Impurity % Na2CO3 by HCl Titration	≤ 1.0 %	0.3 %
Sulfate (SO4)	≤ 0.003 %	0.003 %
Chloride Content	≤ 0.005 %	0.005 %
Nitrogen Compounds (as N)	≤ 0.001 %	0.001 %
Phosphate (PO4)	≤ 0.001 %	0.001 %
Heavy Metals (as Ag)	≤ 0.002 %	0.002 %
Iron (Fe)	≤ 0.001 %	0.001 %
Nickel (Ni)	≤ 0.001 %	0.001 %
Mercury (Hg)	≤ 0.1 ppm	0.1 ppm
Calcium (Ca)	≤ 0.005 %	0.005 %
Magnesium (Mg)	≤ 0.002 %	0.002 %
Potassium (K)	≤ 0.02 %	0.02 %
Meets ACS Requirements 10th Edition	Current ACS Specification	Conforms

SwRI Chem ID: 62694

SwRI Chem ID: 62694

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 62694

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3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 221465
Batch Number: MKBV3988V

Test	Specification	Result
Recommended Retest Period 2 Years	----------	----------

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 62694

SwRI Chem ID: 62694

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

This is to certify that units of the above mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

SwRI Chem ID: 67843

Catalog Number	**A509**	**Mfg. Date**	11/4/2015
Lot Number	**1115100**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	11/04/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

SwRI Chem ID: 67843

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Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

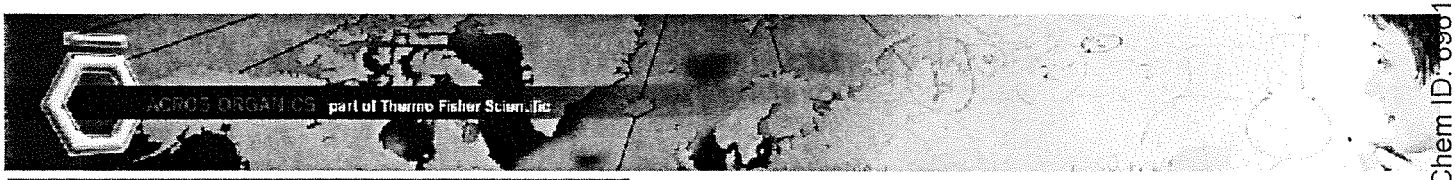
CERTIFIED BY

Edgar E Hess
Lab Manager Fair Lawn

Joel Boland
Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1.800.227.6701.

SwRI Chem ID: 67843
SwRI Chem ID: 67843
SwRI Chem ID: 67843



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

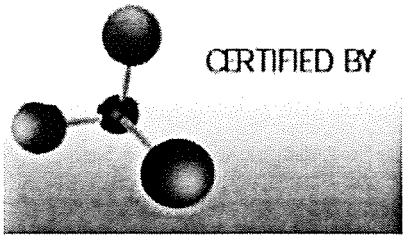
This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69610
SwRI Chem ID: 69610
SwRI Chem ID: 69610



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr t350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 t4/59.34.34 Intemet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69610
SwRI Chem ID: 69610
SwRI Chem ID: 69610

SwRI Chem ID: 62693

SIGMA-ALDRICH®

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Sodium hydroxide - ACS reagent, ≥97.0%, pellets

Product Number:	**221465**
Batch Number:	**MKBV3988V**
Brand:	SIAL
CAS Number:	1310-73-2
MDL Number:	MFCD00003548
Formula:	HNaO
Formula Weight:	40.00 g/mol
Quality Release Date:	22 APR 2015
Recommended Retest Date:	APR 2017

NaOH

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form)	Pellets	Pellets
X-Ray Diffraction	Conforms to Structure	Conforms
Titration by HCL	≥ 97.0 %	99.0 %
Impurity % Na2CO3 by HCl Titration	≤ 1.0 %	0.3 %
Sulfate (SO4)	≤ 0.003 %	0.003 %
Chloride Content	≤ 0.005 %	0.005 %
Nitrogen Compounds (as N)	≤ 0.001 %	0.001 %
Phosphate (PO4)	≤ 0.001 %	0.001 %
Heavy Metals (as Ag)	≤ 0.002 %	0.002 %
Iron (Fe)	≤ 0.001 %	0.001 %
Nickel (Ni)	≤ 0.001 %	0.001 %
Mercury (Hg)	≤ 0.1 ppm	0.1 ppm
Calcium (Ca)	≤ 0.005 %	0.005 %
Magnesium (Mg)	≤ 0.002 %	0.002 %
Potassium (K)	≤ 0.02 %	0.02 %
Meets ACS Requirements 10th Edition	Current ACS Specification	Conforms

SwRI Chem ID: 62693

SwRI Chem ID: 62693

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 62693

SIGMA-ALDRICH®

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 221465
Batch Number: MKBV3988V

Test	Specification	Result
Recommended Retest Period 2 Years	----------	----------

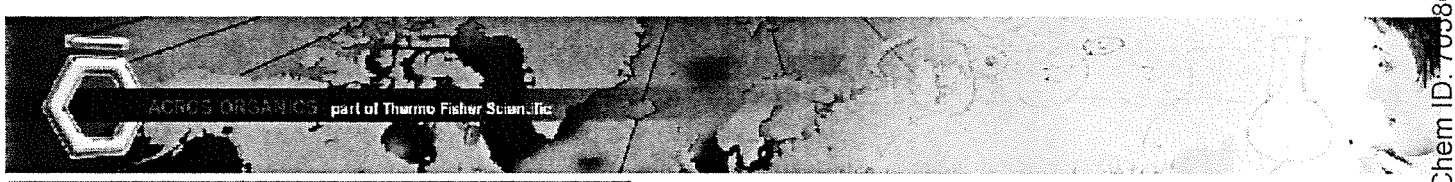
ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, Wi US

SwRI Chem ID: 62693

SwRI Chem ID: 62693

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

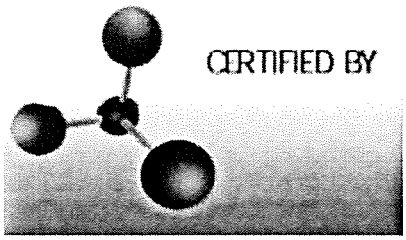
This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	42434	**Quality Test / Release Date**	23 December 2015
Lot Number	A0367952	**Suggested Retest Date**	December 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5 % at 25°C)	5.7 (5 % at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 70580
SwRI Chem ID: 70580
SwRI Chem ID: 70580



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 20 May 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 70580
SwRI Chem ID: 70580
SwRI Chem ID: 70580

Appendix P
SwRI Test Report, August 30, 2016

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

August 30, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Victor Garde

Subject:		
	SwRI Project Number:	21592.01.00X
	SDG:	600677
	SwRI Task Order Number:	160712-3
	SwRI Sample Receipt Number:	57965
	Samples Received:	07.11.2016
	Analysis:	Solid BVT, UVT, and WLVT Surrogates

Dear Mr. Garde,

Please find the enclosed results for the twenty-five overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Group Leader – R&D

APPROVED:

Michael J. Dammann
Director

RPS: jz

Cc: Anya Gonzales, Los Alamos National Laboratory

Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Chain-of-Custody
&
Sample Receipt Paperwork

Total Page Count: 010061 -
Fraction: BVT, UV Pages: 010207
+ WLVT Surrogates

Douglas, Steven M.

From: Moken, James A.
Sent: Saturday, July 09, 2016 5:49 PM
To: Douglas, Steven M.
Cc: Spies, Radonna S.
Subject: Sample ID's and SRR

Steven,

Can I get sample ID's and an SRR for the following LANL samples under project 21592.01.006. Thanks. If you have any questions please let me know.

Client ID	Matrix
BVT1	Solid
BVT2	Solid
BVT3	Solid
BVT4	Solid
BVT5	Solid
BVT6	Solid
BVT7	Solid
BVT8	Solid
BVT9	Solid
BVT10	Solid
BVT11	Solid
BVT12	Solid
UVT1	Solid
UVT2	Solid
UVT3	Solid
UVT4	Solid
UVT5	Solid
UVT6	Solid
WLVT1	Solid
WLVT2	Solid
WLVT3	Solid
WLVT4	Solid
WLVT5	Solid
WLVT6	Solid
WLVT7	Solid

Jamie



Client: Los Alamos National Laboratory
SRR # 57965
Project # 21592.01.00X
Case: J. Moken
VTSR: 07/11/2016
Sample(s) Received: Intact
Temperature: N/A °C/ SN #: N/A

Southwest Research Institute

Laboratory Task Order

TO #: 160712-3 Revision: 0

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 08/02/16

SDG: 600677

SRR #'s: 57965
Client(s): Los Alamos National Laboratory

Instructions

Continued testing for LANL Kitty litter.

Documents Related to this task order: 203445[COC for SRR 57965], 203446[SRR Paperwork for SRR 57965]

Deliverables --> Hard Copy: no EDD: no PDF: -YES-

Test: COMB_1050
Section: WETCHEM

Holding: 180 days from CED

SW846 1050 Test A & C Spontaneous Combustion

Cnt: 25

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
600677		1	Solid	BVT1	NO DATA	NO DATA
600678		1	Solid	BVT10	NO DATA	NO DATA
600679		1	Solid	BVT11	NO DATA	NO DATA
600680		1	Solid	BVT12	NO DATA	NO DATA
600681		1	Solid	BVT2	NO DATA	NO DATA
600682		1	Solid	BVT3	NO DATA	NO DATA
600683		1	Solid	BVT4	NO DATA	NO DATA
600684		1	Solid	BVT5	NO DATA	NO DATA
600685		1	Solid	BVT6	NO DATA	NO DATA
600686		1	Solid	BVT7	NO DATA	NO DATA
600687		1	Solid	BVT8	NO DATA	NO DATA
600688		1	Solid	BVT9	NO DATA	NO DATA
600689		1	Solid	UVT1	NO DATA	NO DATA
600690		1	Solid	UVT2	NO DATA	NO DATA
600691		1	Solid	UVT3	NO DATA	NO DATA
600692		1	Solid	UVT4	NO DATA	NO DATA
600693		1	Solid	UVT5	NO DATA	NO DATA
600694		1	Solid	UVT6	NO DATA	NO DATA
600695		1	Solid	WLVT1	NO DATA	NO DATA
600761		1	Solid	WLVT2	NO DATA	NO DATA
600762		1	Solid	WLVT3	NO DATA	NO DATA
600763		1	Solid	WLVT4	NO DATA	NO DATA
600764		1	Solid	WLVT5	NO DATA	NO DATA
600765		1	Solid	WLVT6	NO DATA	NO DATA
600766		1	Solid	WLVT7	NO DATA	NO DATA

Test: IGNIT_1030
Section: WETCHEM

Holding: 180 days from CED

SW 846 Method 1030 Ignitability of solids

Cnt: 25

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
600677		1	Solid	BVT1	NO DATA	NO DATA
600678		1	Solid	BVT10	NO DATA	NO DATA
600679		1	Solid	BVT11	NO DATA	NO DATA
600680		1	Solid	BVT12	NO DATA	NO DATA
600681		1	Solid	BVT2	NO DATA	NO DATA
600682		1	Solid	BVT3	NO DATA	NO DATA
600683		1	Solid	BVT4	NO DATA	NO DATA
600684		1	Solid	BVT5	NO DATA	NO DATA
600685		1	Solid	BVT6	NO DATA	NO DATA

Southwest Research Institute

Laboratory Task Order

TO #: 160712-3 Revision: 0

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 08/02/16

SDG: 600677

SRR #'s: 57965
Client(s): Los Alamos National Laboratory

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
600686		1	Solid	BVT7	NO DATA	NO DATA
600687		1	Solid	BVT8	NO DATA	NO DATA
600688		1	Solid	BVT9	NO DATA	NO DATA
600689		1	Solid	UVT1	NO DATA	NO DATA
600690		1	Solid	UVT2	NO DATA	NO DATA
600691		1	Solid	UVT3	NO DATA	NO DATA
600692		1	Solid	UVT4	NO DATA	NO DATA
600693		1	Solid	UVT5	NO DATA	NO DATA
600694		1	Solid	UVT6	NO DATA	NO DATA
600695		1	Solid	WLVT1	NO DATA	NO DATA
600761		1	Solid	WLVT2	NO DATA	NO DATA
600762		1	Solid	WLVT3	NO DATA	NO DATA
600763		1	Solid	WLVT4	NO DATA	NO DATA
600764		1	Solid	WLVT5	NO DATA	NO DATA
600765		1	Solid	WLVT6	NO DATA	NO DATA
600766		1	Solid	WLVT7	NO DATA	NO DATA

Test: Oxidizer_UN
Section: WETCHEM

Holding: 180 days from CED

United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.

Cnt: 25

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
600677		1	Solid	BVT1	NO DATA	NO DATA
600678		1	Solid	BVT10	NO DATA	NO DATA
600679		1	Solid	BVT11	NO DATA	NO DATA
600680		1	Solid	BVT12	NO DATA	NO DATA
600681		1	Solid	BVT2	NO DATA	NO DATA
600682		1	Solid	BVT3	NO DATA	NO DATA
600683		1	Solid	BVT4	NO DATA	NO DATA
600684		1	Solid	BVT5	NO DATA	NO DATA
600685		1	Solid	BVT6	NO DATA	NO DATA
600686		1	Solid	BVT7	NO DATA	NO DATA
600687		1	Solid	BVT8	NO DATA	NO DATA
600688		1	Solid	BVT9	NO DATA	NO DATA
600689		1	Solid	UVT1	NO DATA	NO DATA
600690		1	Solid	UVT2	NO DATA	NO DATA
600691		1	Solid	UVT3	NO DATA	NO DATA
600692		1	Solid	UVT4	NO DATA	NO DATA
600693		1	Solid	UVT5	NO DATA	NO DATA
600694		1	Solid	UVT6	NO DATA	NO DATA
600695		1	Solid	WLVT1	NO DATA	NO DATA
600761		1	Solid	WLVT2	NO DATA	NO DATA
600762		1	Solid	WLVT3	NO DATA	NO DATA
600763		1	Solid	WLVT4	NO DATA	NO DATA
600764		1	Solid	WLVT5	NO DATA	NO DATA
600765		1	Solid	WLVT6	NO DATA	NO DATA
600766		1	Solid	WLVT7	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

VTSR: 07/11/16 Time: 10:00:00

Sample Receipt Number: 57965
Revision: 1

This Receipt was Revised 07/12/2016

Project: 21592.01.00X
Case #: J. Moken
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 07/11/16

Notes

Email was received to create an SRR for the following.

Parameters: Analysis/located on Task Order

FRM-070 (J. Moken)

See chain of custody as part of the work order system for more information.

Rev. 1
Added samples missing from SRR.

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
600677	BVT1		Solid	1	
600678	BVT10		Solid	1	
600679	BVT11		Solid	1	
600680	BVT12		Solid	1	
600681	BVT2		Solid	1	
600682	BVT3		Solid	1	
600683	BVT4		Solid	1	
600684	BVT5		Solid	1	
600685	BVT6		Solid	1	
600686	BVT7		Solid	1	
600687	BVT8		Solid	1	
600688	BVT9		Solid	1	
600689	UVT1		Solid	1	
600690	UVT2		Solid	1	
600691	UVT3		Solid	1	
600692	UVT4		Solid	1	
600693	UVT5		Solid	1	
600694	UVT6		Solid	1	
600695	WLVT1		Solid	1	
600761	WLVT2		Solid	1	
600762	WLVT3		Solid	1	
600763	WLVT4		Solid	1	
600764	WLVT5		Solid	1	
600765	WLVT6		Solid	1	
600766	WLVT7		Solid	1	

Containers: 25 **Samples: 25**

These documents are associated with this receipt: 203445[COC for SRR 57965], 203446[SRR Paperwork for SRR 57965]

Thermometer: N/A
Temperature: N/A

Page Printed: 08/29/2016 13:06
ver: (7/18/2014)

57965 Los Alamos National Laborato

Southwest Research Institute

Traffic Report

Sample Custodian Signature: _____

1. Custody Seal — Not Present or Damaged
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: J. Moken / SDG: _____

Sample Receipt: 57965

Airbill: Email

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
07/11/16	10:00:00	Email	BVT1	N/A	600677	YES	Intact
07/11/16	10:00:00	Email	BVT10	N/A	600678	YES	Intact
07/11/16	10:00:00	Email	BVT11	N/A	600679	YES	Intact
07/11/16	10:00:00	Email	BVT12	N/A	600680	YES	Intact
07/11/16	10:00:00	Email	BVT2	N/A	600681	YES	Intact
07/11/16	10:00:00	Email	BVT3	N/A	600682	YES	Intact
07/11/16	10:00:00	Email	BVT4	N/A	600683	YES	Intact
07/11/16	10:00:00	Email	BVT5	N/A	600684	YES	Intact
07/11/16	10:00:00	Email	BVT6	N/A	600685	YES	Intact
07/11/16	10:00:00	Email	BVT7	N/A	600686	YES	Intact
07/11/16	10:00:00	Email	BVT8	N/A	600687	YES	Intact
07/11/16	10:00:00	Email	BVT9	N/A	600688	YES	Intact
07/11/16	10:00:00	Email	UVT1	N/A	600689	YES	Intact
07/11/16	10:00:00	Email	UVT2	N/A	600690	YES	Intact
07/11/16	10:00:00	Email	UVT3	N/A	600691	YES	Intact
07/11/16	10:00:00	Email	UVT4	N/A	600692	YES	Intact
07/11/16	10:00:00	Email	UVT5	N/A	600693	YES	Intact
07/11/16	10:00:00	Email	UVT6	N/A	600694	YES	Intact
07/11/16	10:00:00	Email	WLVT1	N/A	600695	YES	Intact
07/11/16	10:00:00	Email	WLVT2	N/A	600761	YES	Intact
07/11/16	10:00:00	Email	WLVT3	N/A	600762	YES	Intact
07/11/16	10:00:00	Email	WLVT4	N/A	600763	YES	Intact
07/11/16	10:00:00	Email	WLVT5	N/A	600764	YES	Intact
07/11/16	10:00:00	Email	WLVT6	N/A	600765	YES	Intact
07/11/16	10:00:00	Email	WLVT7	N/A	600766	YES	Intact

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 2
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 07/11/2016
Received By (Signature): [signature]	
Case Number: J. Moken	Sample Delivery Group No.: N/A
Remarks: 21592.01.00X	SAS Number: N/A

1.	Custody Seal(s)	Present/(Absent*) Intact/Broken
2.	Custody Seal Nos.	N/A
3.	Chain-of Custody Records	(Present)/Absent*
4.	Traffic Reports or Packing Lists	Present (Absent)
5.	Airbill	Airbill/Sticker (Present)/Absent*
6.	Airbill No.	Email
7.	Sample Tags	Present (Absent)
	Sample Tag Numbers	Listed/(Not listed on Chain of Custody
8.	Sample Condition	(Intact)/Broken*/ Leaking
9.	Cooler Temperature	N/AC
10.	Does Information on custody records, traffic reports, and sample tags agree?	(Yes)/No*
11.	Date Received at Lab	07/11/2016
12.	Time Received	10:00:00

Sample Transfer	
Fraction: INORG	Fraction
Area #: J. Moken	Area #
By: STEVEN DOUGLAS	By
On: 07/11/2016	On

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
BVT1	N/A	600677	Intact
BVT10	N/A	600678	Intact
BVT11	N/A	600679	Intact
BVT12	N/A	600680	Intact
BVT2	N/A	600681	Intact
BVT3	N/A	600682	Intact
BVT4	N/A	600683	Intact
BVT5	N/A	600684	Intact
BVT6	N/A	600685	Intact
BVT7	N/A	600686	Intact
BVT8	N/A	600687	Intact
BVT9	N/A	600688	Intact
UVT1	N/A	600689	Intact
UVT2	N/A	600690	Intact
UVT3	N/A	600691	Intact
UVT4	N/A	600692	Intact
UVT5	N/A	600693	Intact
UVT6	N/A	600694	Intact
WLVT1	N/A	600695	Intact
WLVT2	N/A	600761	Intact
WLVT3	N/A	600762	Intact
WLVT4	N/A	600763	Intact
WLVT5	N/A	600764	Intact

* Contact SMO and attach record of resolution

Reviewed By: [signature]	Logbook No.: Sample Receipt (57965)
Date: 8.29.16	Logbook Page No.: 9513

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 2 of 2
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 07/11/2016
Received By (Signature): [signature]	
Case Number: J. Moken	Sample Delivery Group No.: N/A
Remarks: 21592.01.00X	SAS Number: N/A

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present/Absent	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	Email	
7. Sample Tags	Present/Absent	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/ Leaking	
9. Cooler Temperature	N/AC	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	07/11/2016	
12. Time Received	10:00:00	

EPA Sample #	Corresponding: Sample Tag #	Corresponding: Assigned Lab #	Remarks: Condition of Sample Shipment, etc
WLVT6	N/A	600765	Intact
WLVT7	N/A	600766	Intact

Sample Transfer	
Fraction: (NORS)	Fraction
Area #: J. Moken	Area #
By: STEVEN DOUGLAS	By
On: 07/11/2016	On

* Contact SMO and attach record of resolution

Reviewed By: [signature]	Logbook No.: Sample Receipt (57965)
Date: 7.12.16	Logbook Page No.: 9513 SEC 1, 20F5

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160712-3

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of the solid BVT, UVT, and WLVT surrogate blends presented in Table 1, which also contains the sample ID's and the methods performed on each of the blends. When preparing each of the three surrogate series, complications were encountered that brought about either the reformulation of the recipes or the cancelations of some of the testing by LANL.

Table 1. Surrogate creation and analysis table

Surrogate ID	Times made	Methods			
		1030	1050	UN Ox solid (DOT 0.1)	Paint filter
BVT1	1	1	1	1	1
BVT2	1	1	1	1	1
BVT3	2	1	1	1	1
BVT4	1	1	1	1	1
BVT5	1	1	1	1	1
BVT6	1	1	1	1	1
BVT7	2	1	1	1	2
BVT8	1	1	1	1	1
BVT9	1	1	1	1	1
BVT10	2	1	1	1	1
BVT11	2	1	1	1	1
BVT12	1	1	1	1	1
UVT1	1	1	1	1	1
UVT2	1	1	1	1	1
UVT3	1	1	1	1	1
UVT4	1	1	1	1	1
UVT5	1	1	1	1	1
UVT6	1	1	1	1	1
WLVT1	1	1	1	1	1
WLVT2	1	1	1	1	1
WLVT3	1	1	1	1	1
WLVT4	1	1	1	1	1
WLVT5	1	1	1	1	1
WLVT6	1	*	*	*	1
WLVT7	1	*	*	*	1

*Testing not performed

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The BVT surrogates had the most modifications beginning with the way the WB8 was prepared. During an initial visit by LANL personnel to observe the mixing of several blends, it was decided that water would not be added when making the WB8 for this series of testing. This would allow the WB8 to have more of a solid consistency and reflect more accurately what would be found in the field. Several small tests showed that the potassium carbonate was reacting with several of the nitrates causing bubbling and liquefying of the salts (Image 1). It was found that adding the potassium carbonate last reduced this reaction and allowed the salts to remain solid. However, if let it sit overnight, the solid WB8 eventually liquefied into a thick pea soup consistency (Image 2). It was decided to make the WB8 mixture and prepare the BVT blends immediately (Image 3). BVT blends 2, 4, 6, and 8 had no modifications made to them. When BVT7 was initially prepared, 1000mL of DI water was added to the WB8 salt before mixing it with the zeolite. This blend was very moist and had a moderate amount of freestanding liquid causing it to fail the paint filter test (Image 4). It was decided to reduce the volume of warm water added down to 100mL for BVT blends 1, 3, 5, and 7 (Image 5). On BVT blends 9-12, the ratio of Zeolite to RNS waste was changed from 2.5:1 to 3:1 and the amount of water added was reduced from 1000mL to 800mL. Images 6 and 7 show BVT12 and BVT10 slurries when 800mL of warm DI was added to the WB8:Swheat dried mixtures. Table 2 shows the pH reading of the liquid/slurry mixtures and the temperature readings of the liquid/slurry and of the final surrogate blend. All blends were allowed to set for 24 hours prior to performing analysis.

The UVT blends only had one modification. UVT 1 and UVT2 Zeolite:Solution ratios were raised to 4:1 and 5:1 respectively since UVT3 (3:1) was almost to moist and anything lower than the 3:1 ratio most likely would fail a paint filter analysis. When mixing in the zeolite to the UVT blends, it was noted that a lot of bubbles and possible off gassing was occurring (Image 8). No modifications were made to the WLVT surrogates, samples were prepped in accordance to the procedure provided by LANL. WLVT7 was very moist and had a layer of water that eventually settled out (Image 9-10). LANL was notified of this and it was decided to stop testing of WLVT6 and WLVT7 after performing paint filter.

Table 2: pH and Temperature readings of prepared surrogates

Surrogate ID	pH reading of waste/slurry	Initial temperature reading of waste/slurry	Final temperature of surrogate blend
BVT1	<1.68	12.6°C	15.7°C
BVT2	<1.68*	16.3°C	19.2°C
BVT3	<1.68	10.8°C	14.7°C
BVT4	<1.68*	19.7°C	20.2°C
BVT5	<1.68	9.2°C	13.7°C
BVT6	<1.68*	19.7°C	19.9°C
BVT7	<1.68	10.2°C	13.9°C
BVT8	<1.68*	19.7°C	20.1°C
BVT9	<1.68	27.4°C	25.3°C
BVT10	<1.68	27.3°C	23.6°C
BVT11	<1.68	35.5°C	29.7°C

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BVT12	<1.68	27.9°C	24.2°C
UVT1	<1.68[+]	21.9°C	26.5°C
UVT2	<1.68[+]	21.9°C	26.4°C
UVT3	<1.68[+]	22.4°C	25.6°C
UVT4	<1.68	28.9°C	27.6°C
UVT5	<1.68	29.0°C	28.6°C
UVT6	<1.68	30.2°C	28.2°C

*WB8 pH used for the initial pH
[+]UNS Solution pH used for initial pH

SW-846 9095B: Paint Filter

For this method 100g of each blend was placed into a Gerson 260um paint filter (PN010714R, Lot# B5140428JF8) that was suspended over a 250 mL beaker for 5 minutes to collect any free liquids. During this 5-min period if any of the sample material drips into the beaker, the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314. WLVT4, WLVT6, and WLVT7 were all deemed to contain free liquids. All other samples were not deemed to contain free liquids under the laboratory conditions. After sitting for several days and even after a week a few samples slowly began releasing liquid in their containers. UVT4 passed paint filter four days after being made but during the analysis liquid droplets did form on the outside of the filter but nothing ever dripped into the beaker during the designated 5 minute test period. This sample was run in duplicate with both tests experiencing this behavior. Eight days after being made, the sample had a puddle of freestanding liquid within the sample (Image 11). BVT1 and BVT3 have some liquid release as well but not to the extent seen in UVT4.

SW-846 1030: Ignitability of Solids

In this test, an ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within 2 minutes. If the material combustion propagates, the burning time was measured over a distance of 100 mm and the rate of burning would be determined. The surrogate material was formed into an unbroken powder train, 250 mm in length atop a ceramic tile with marks at the 80 and 180 mm in from the end of the train. The ceramic tile was placed about 8 inches in a hood with the sash lowered to give airflow of about 0.7 m/sec. One end of the train was exposed to the end of an acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes and if the sample began to burn down the train the time taken to get from the 80 to 180 mm mark was measured to determine the burn rate.

The WLVT and UVT samples all acted similarly with the sample drying and charring but no flame was formed and the sample did not burn (Image 12). On several of the WLVT samples a popping noise, most likely from the heated nitrates, was heard. The BVT surrogates 1-8 acted similarly to each other with the sample bubbling, charring, and popping at the burn zone (Image 13). BVT 9-12 acted similarly to each other with the sample blackening before becoming white and grey (Image 14). All samples were deemed to be nonflammable under the laboratory conditions.

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SW-846 1050: Spontaneous combustion and self heating

In this test, the surrogates for this analysis were first sprinkled several times onto a ceramic tile to observe if they smoked or flamed and could be considered pyrophoric solids by test Method A. Since none of the samples exhibited these characteristics, they were tested by Method C. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200 ^{o}C within the 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 3.

Table 3. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cube was placed into an oven with two thermocouples measuring the oven temp and up to four thermocouples inserted into each sample to measure its temperature during the analysis. Lids were placed onto the top of the test cubes and tungsten weights were placed on top of those samples believed to potentially have an event in order to keep the thermocouples and lids from coming off the sample. Up to two thermocouples were placed in a tray below the sample in case any sample pushed out of the cube and onto the tray. Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for 24-48 hours depending on when the sample reached a stable temperature. Although the method states testing to be conducted for 24 hours, many of the samples did not reach 140°C ± 2°C during the initial 24 hour period, therefore the testing was extended to a minimum of 12 hours after the sample had reached a stable temperature. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C during the time of testing. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample. The oven and sample temperature graphs are located in Attachment A.

Since past samples having similar combinations of waste and zeolite did not self heat, two surrogate blend samples were analyzed simultaneously using the 100mm cube. These blends were allowed to run for at least 45 hours before ending the analysis due to their moisture content. Due to the high moisture content of BVT1, UVT4, and WLVT4, fluffy foam-like material formed on the bottom of the cages, with the appearance of stalactites, and went into the pan below (Image 15 and 16). A majority of the samples began to brown on the exterior regions and several even became hardened cubes (Images 17). Even though there was browning of the samples, none of them had temperatures that exceeded the 140°C oven temperature throughout the testing. WLVT 1 was initially run in duplicate with the sample showing a temperature drop to -45°C on one thermocouple and the duplicate having one thermocouple increase to 222°C during the same time period; however, this is believed to have been either an electrical error or a sign that the thermocouples were being compromised by the high acidic nature of the samples. WLVT 1 was rerun on a later date with four thermocouples inside the sample cube. The sample ran very similarly to other WLVT samples and did not have any temperature spikes or dips in it so it was considered to be not self heating. Since none of the blends exceeded 200°C during the analysis all of them are classified as “Not a Self-

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Heating Waste" as defined by Method 1050 and under the laboratory conditions.

DOT UN Oxidation testing

The surrogate solid blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the samples mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. If the burning time is less than the standard mixture, the burning times should be compared with those from packing group I or II or category I or II oxidizer, reference standards 3:2 and 2:3, by mass, of potassium bromated to cellulose, respectively. See Table 4 for classification. Table 5 presents the results for the reference standards. Tables 6 and 7 lists the comments the analyst noted for each of the two sample-to- cellulose ratio burns.
All surrogate solid blends were classified as "Not Division 5.1".

Table 4. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	UN Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

Table 5. Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
135.32	52.44	19.54

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Table 6. Comments for Sample to Cellulose ratio of 4:1

Sample ID	Comment 4:1
BVT1	Sparkling and sporadic flames, charring and smoke
BVT2	Charring around wire, smoke, no flames, very slight sparkling
BVT3	Charring around wire, smoke, no flames
BVT4	Charring around wire, smoke, no flames
BVT5	Charring around wire, smoke, no flames
BVT6	Charring around wire, smoke, no flames
BVT7	Charring around wire, smoke, no flames
BVT8	Charring around wire, smoke, no flames
BVT9	Charring around wire, smoke, no flames
BVT10	Charring around wire, smoke, no flames
BVT11	Charring around wire, smoke, no flames
BVT12	Charring around wire, smoke, no flames
UVT1	Charring around wire, smoke, no flames
UVT2	Charring around wire, smoke, no flames
UVT3	Charring around wire, smoke, no flames
UVT4	Charring around wire, smoke, no flames
UVT5	Charring around wire, smoke, no flames
UVT6	Charring around wire, smoke, no flames
WLVT1	Charring around wire, smoke, no flames
WLVT2	Charring around wire, smoke, no flames
WLVT3	Charring around wire, smoke, no flames
WLVT4	Charring around wire, smoke, no flames
WLVT5	Charring around wire, smoke, no flames

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Table 7. Comments for Sample to Cellulose ratio of 1:1

Sample ID	Comment 1:1
BVT1	small flames at wire leads, charring and smoke
BVT2	flames would start and stop thoughout analysis. Sparkling and smoking present.
BVT3	Flames at wire leads, smoke and charring. Flames would start and stop thoughout analysis time.
BVT4	Large flames at front wire leads, charring and smoke.
BVT5	Flames at front of wire leads, smoke and charring.
BVT6	Flames at wire leads, charring and smoke. Flames extinguished before 180 sec.
BVT7	Flames at wire leads, charring and smoke.
BVT8	Flames at front wire leads, smoke and charring.
BVT9	Small flames at wire leads, charring and smoke. On one run flame propagated and continued burning beyond 240 seconds. Power turned off at 180 seconds.
BVT10	Tiny flames at wire lead, charring and smoke.
BVT11	Small flames at wire leads charring and smoke. On three runs flame propagated along right side of the mound.
BVT12	Very small flames at wire leads, charring and smoke. On one run flame propagated and continued burning beyond 240 seconds. Power turned off at 180 seconds.
UVT1	Small flames at wire leads, charring and smoke.
UVT2	Flames at front wire leads, charring and smoke
UVT3	Flames at front wire leads, charring and smoke
UVT4	Very small flames at wire leads, charring and smoke.
UVT5	Small flames at wire leads, charring and smoke.
UVT6	Very small flames at wire leads, charring and smoke.
WLVT1	Small flames at wire leads, smoke and charring
WLVT2	Small flames at wire leads, smoke and charring
WLVT3	Small flames at wire leads, smoke and charring
WLVT4	Sparking and small flames at the beginning. Charring and smoke, flames did not last the full 180 seconds.
WLVT5	Sparking and small flames at the beginning. Charring and smoke, flames did not last the full 180 seconds.

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Image 1: Small scale testing showing a reaction between a few of the nitrates and potassium carbonate.

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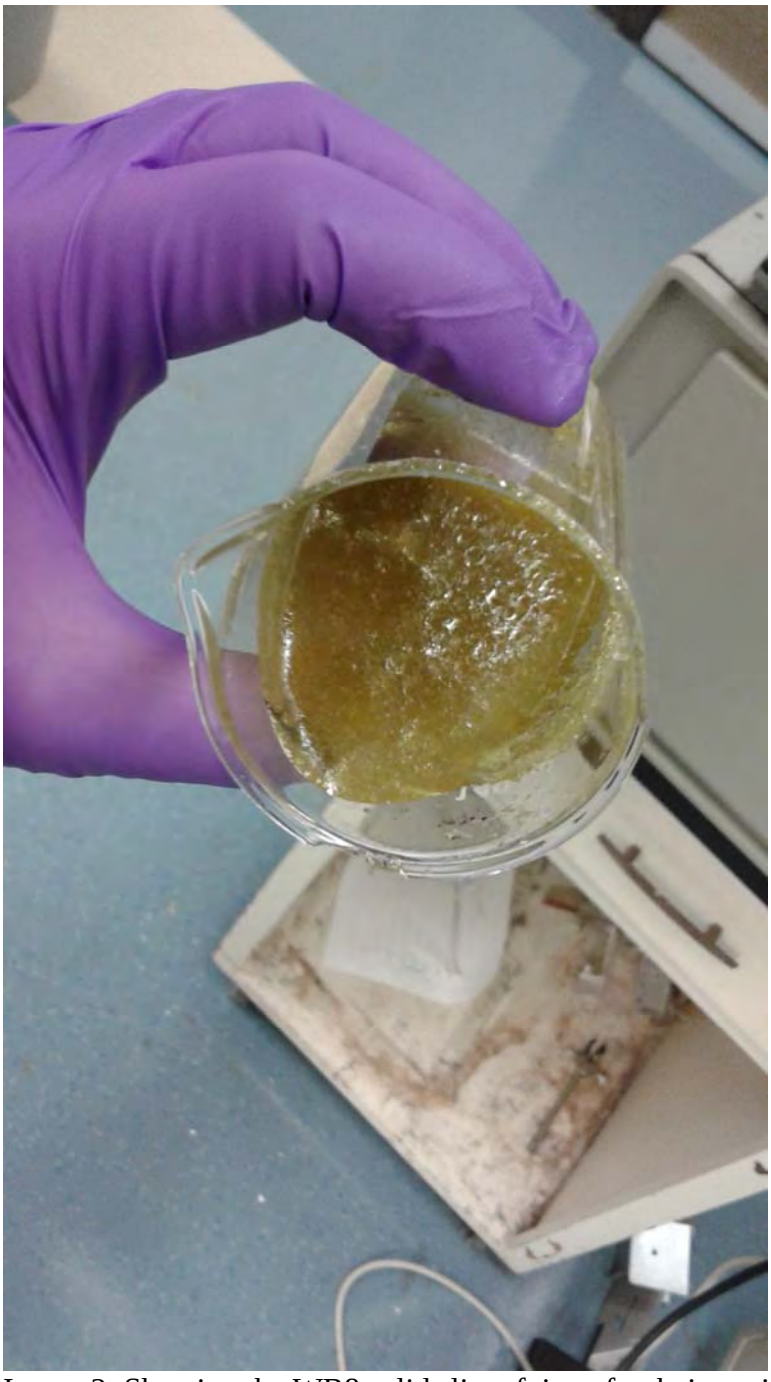


Image 2: Showing the WB8 solids liquefying after being mixed and sitting overnight.

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Image 3: Mixing up of the WB8 and its consistency when used to make the BVT surrogates.



Image 4: BVT7 24 hours after preparation. Unabsorbed freestanding liquid within the sample.

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Image 5: WB8 after mixing in 100mL of DI H2O.



Image 6: BVT12 WB8 and swheat dried blend mixed with 800mL warm DI H2O

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Image 7: BVT10 WB8 and swheat dried blend mixed with 800mL warm DI H2O



Image 8: Formation of bubbles and possibly off gassing when mixing in the zeolite to UVT blends.

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Image 9: WLVT7 after preparation and being transferred out of the mixer.



Image 10: WLVT7 after settling for 24 hours and prior to paint filter analysis.

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Image 11: UVT4 eight days after being prepared.



Image 12: General burn appearance of the UVT samples for 1030 analysis.

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Image 13: General appearance of BVT 1-8 after 1030 analysis



Image 14: General appearance of BVT 9-12 after 1030 analysis.

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Image 15: Stalactite foam formed on the bottom of BVT1 cage.



Image 16: Stalactite foam formed on the bottom of UVT4 cage.

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Image 17: Exterior browning of sample BVT1

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Group Leader **Date** **8/29/16**

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SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Attachment A
Method 1050 Graphs

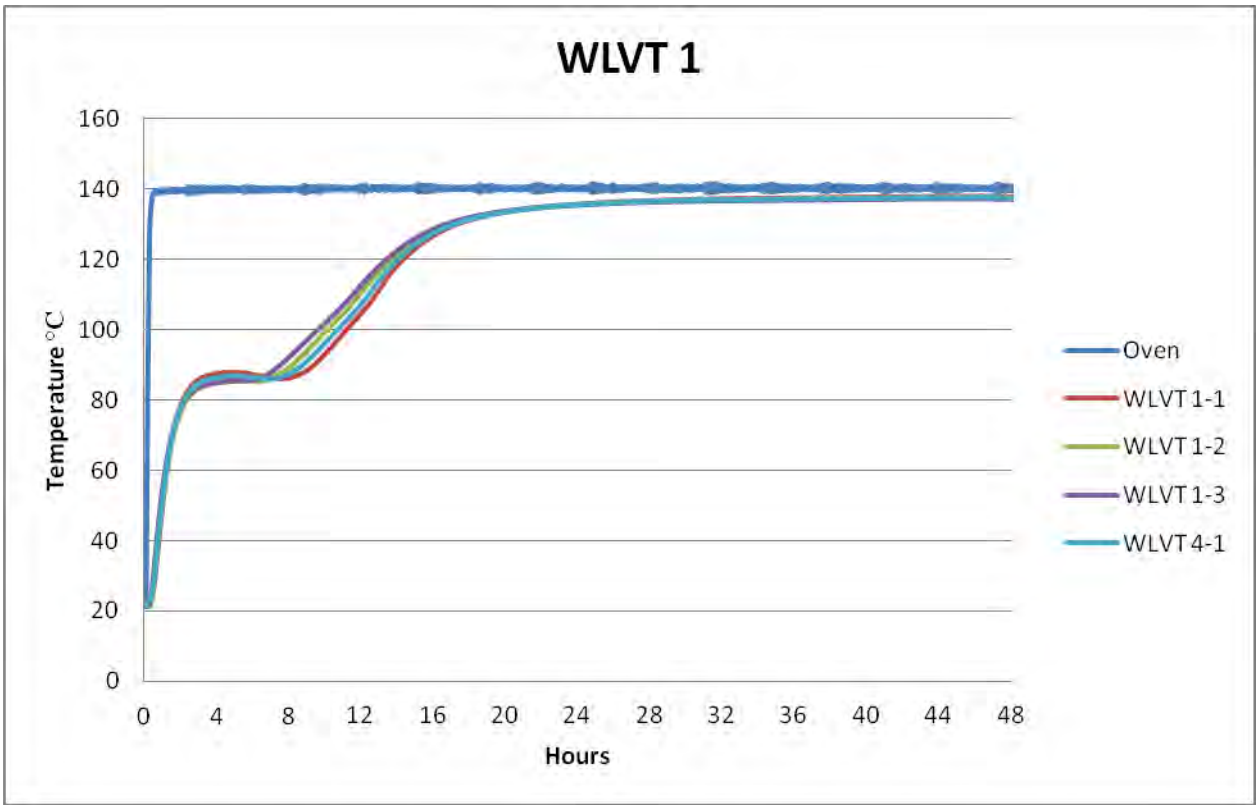


Figure 1. Method 1050 – WLVT 1 (100mm cube) full run.

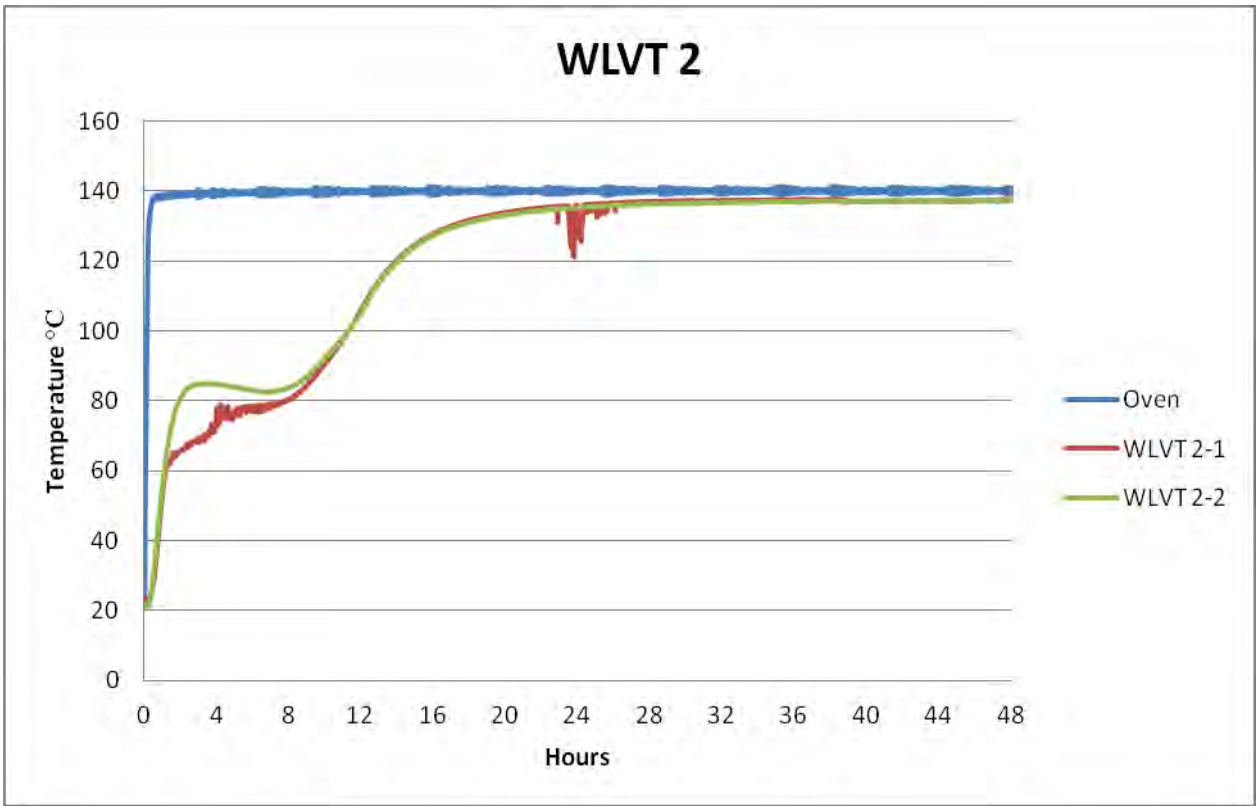


Figure 2. Method 1050 – WLVT 2 (100mm cube) full run.

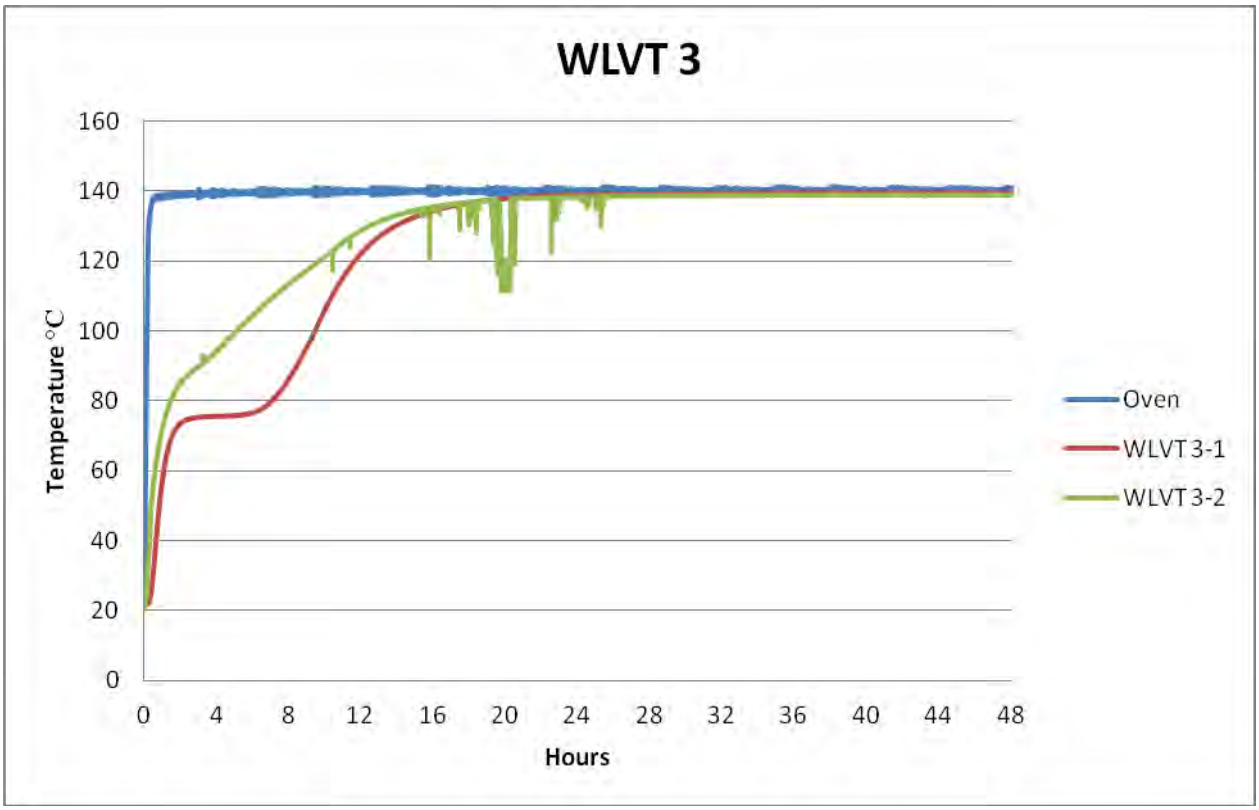


Figure 3. Method 1050 – WLVT 3 (100mm cube) full run.

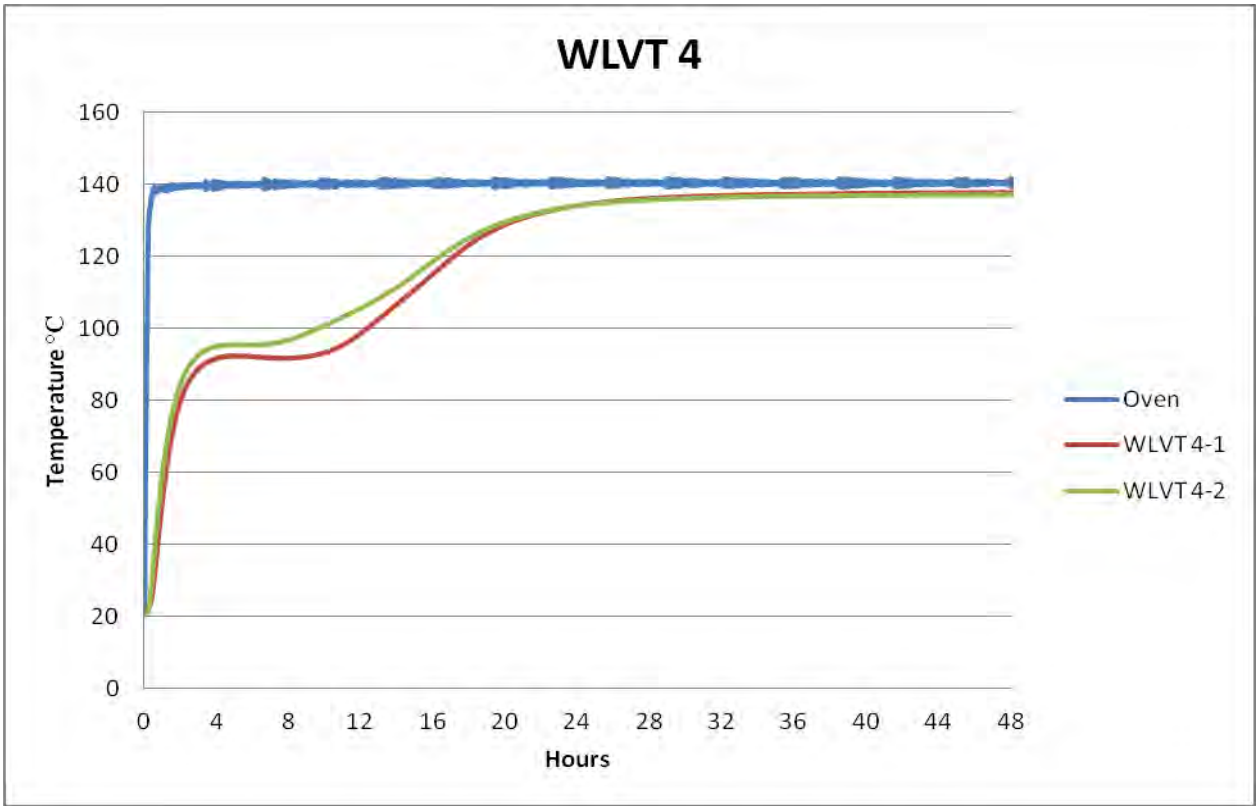


Figure 4. Method 1050 – WLVT 4 (100mm cube) full run.

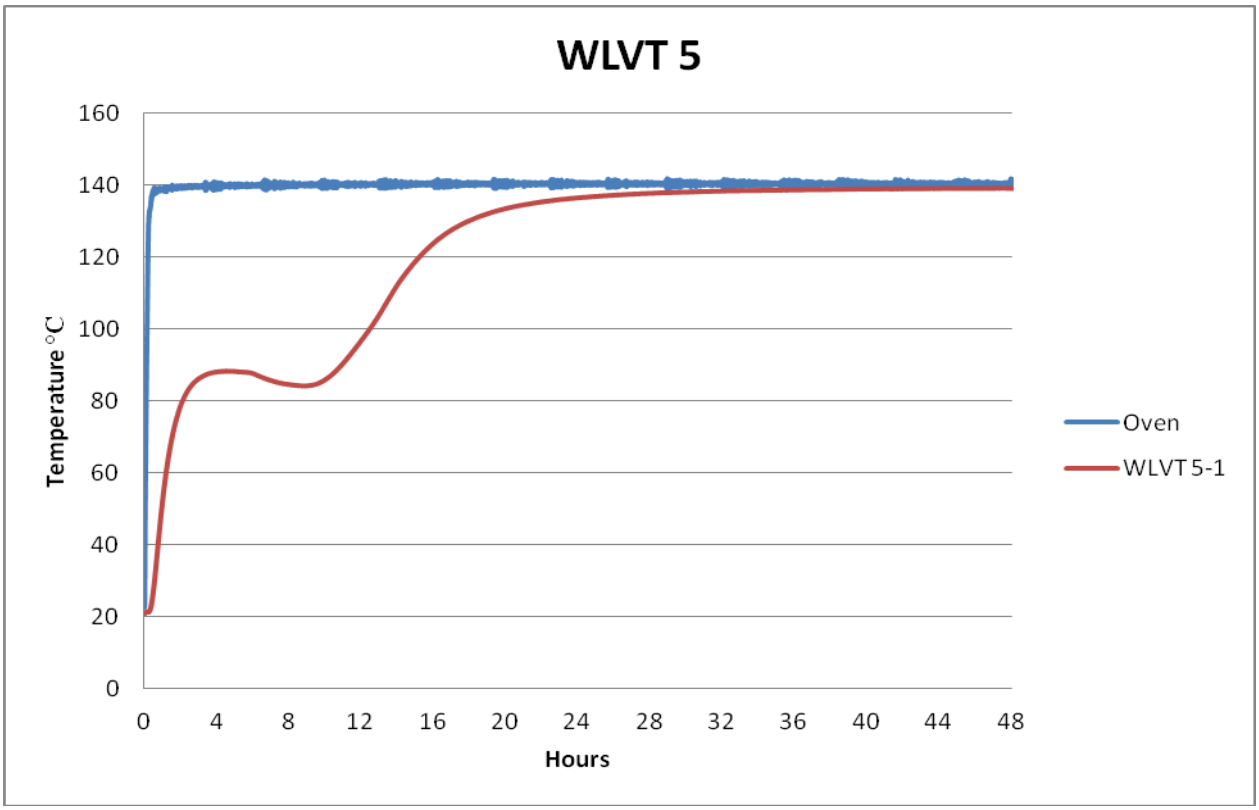


Figure 5. Method 1050 – WLVT 5 (100mm cube) full run.

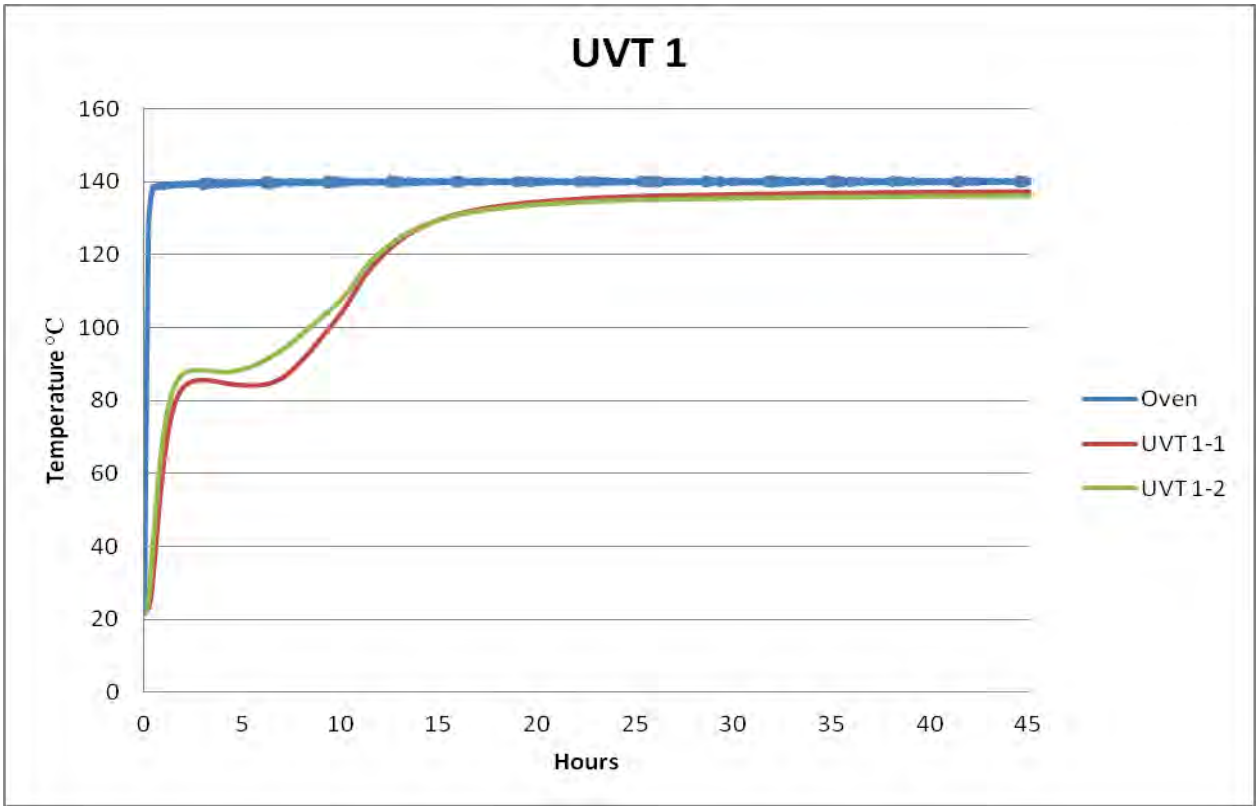


Figure 6. Method 1050 – UVT 1 (100mm cube) full run.

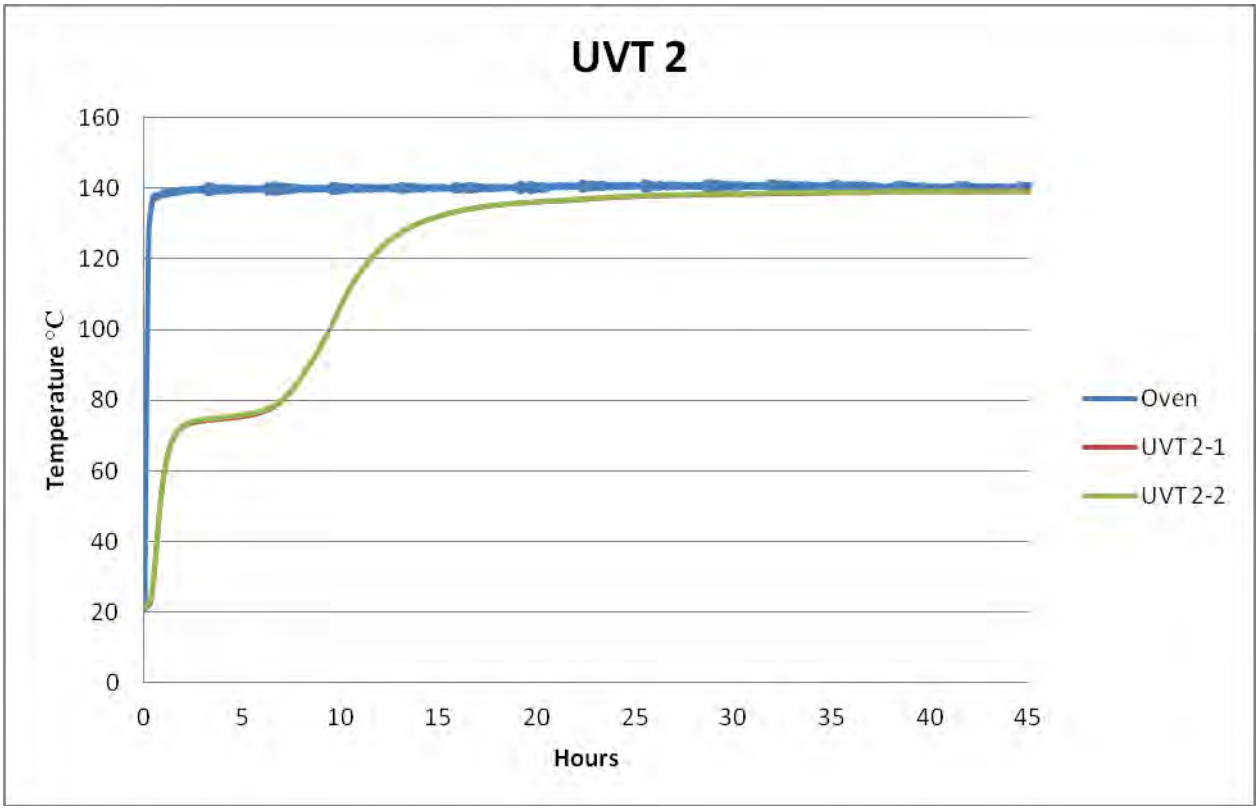


Figure 7. Method 1050 – UVT 2 (100mm cube) full run

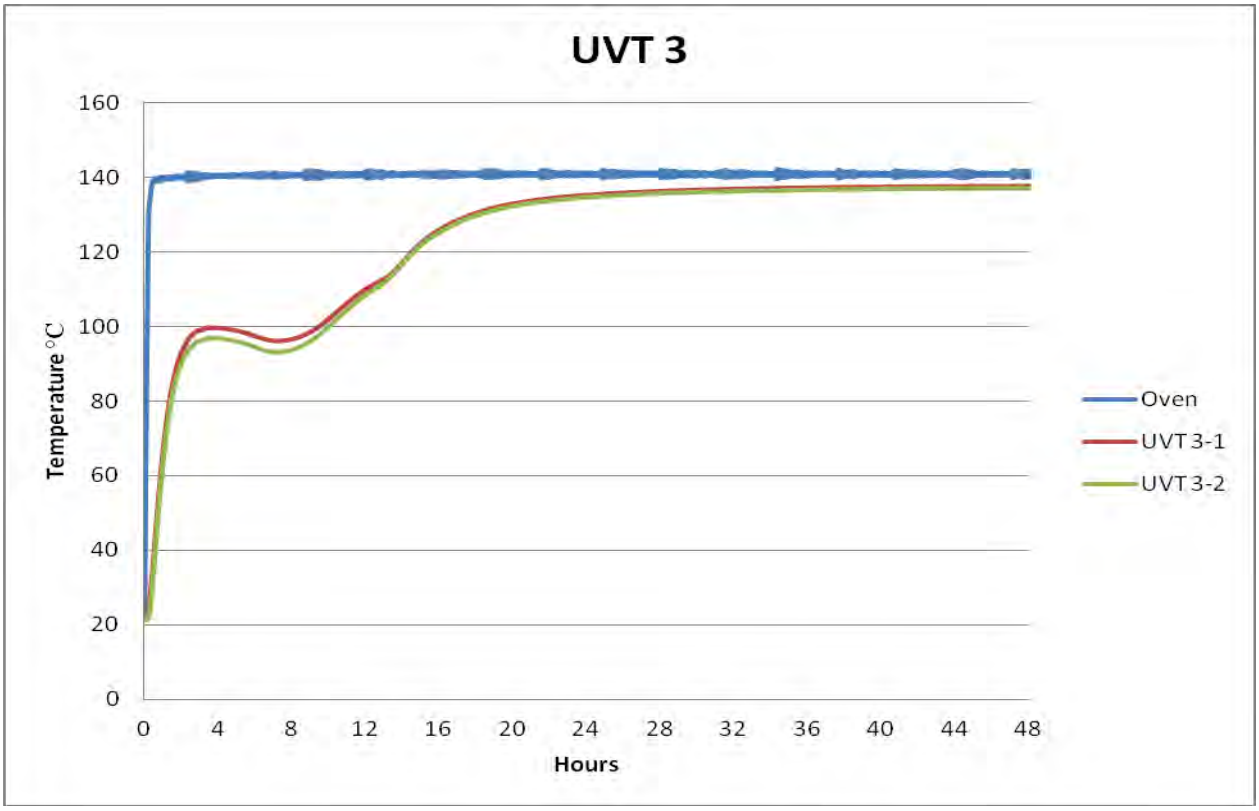


Figure 8. Method 1050 – UVT 3 (100mm cube) full run.

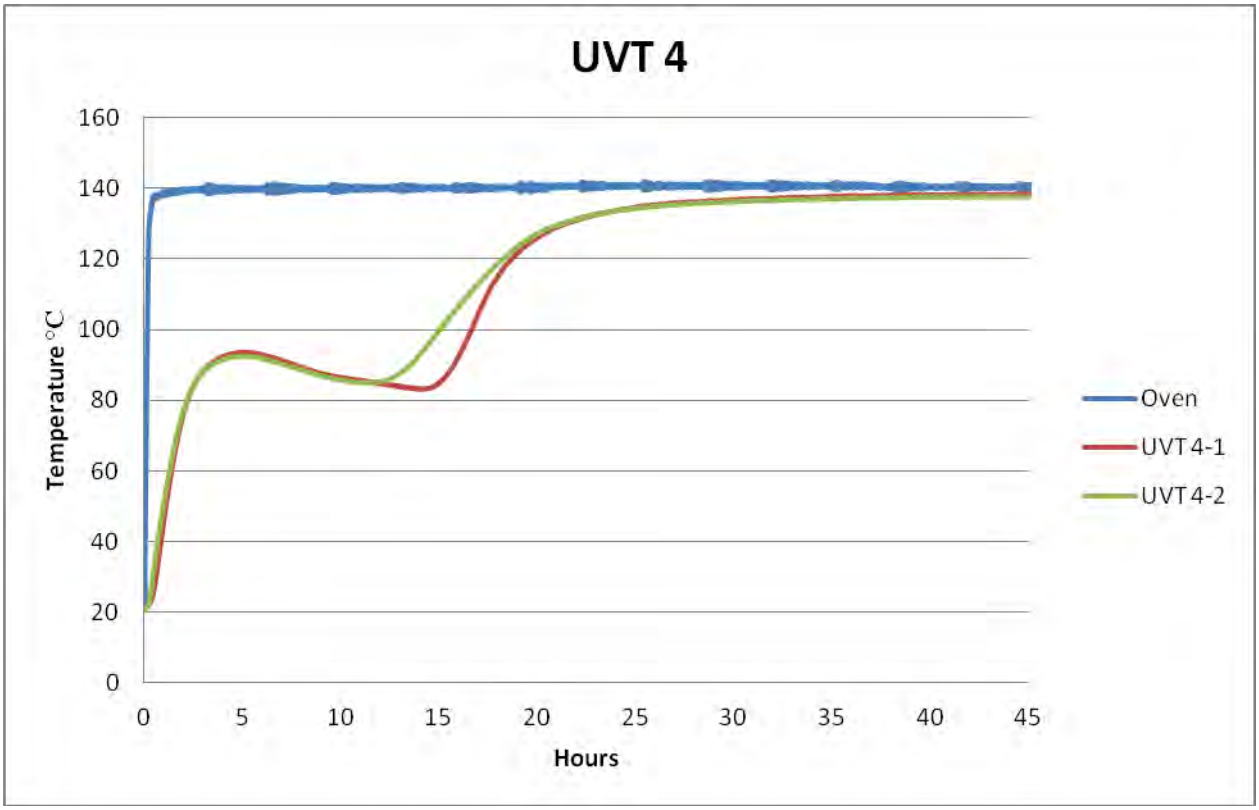


Figure 9. Method 1050 – UVT 4 (100mm cube) full run.

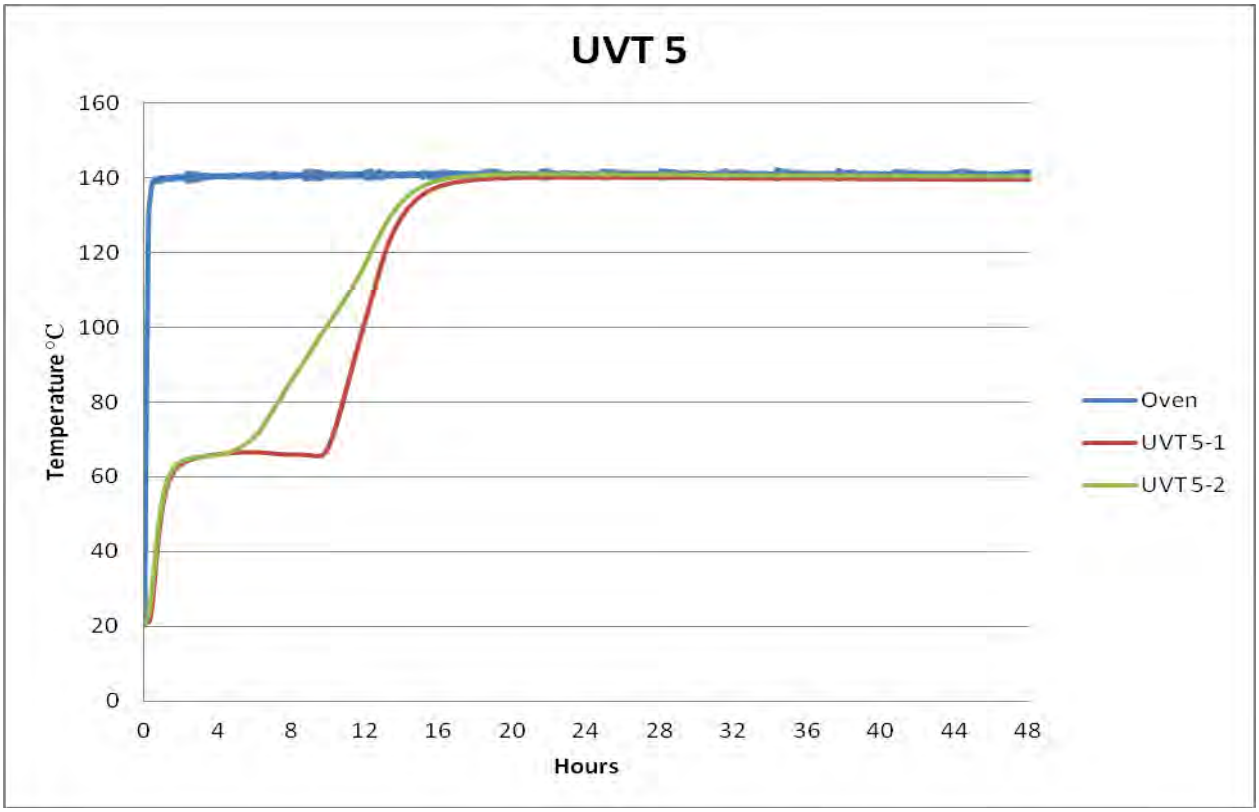


Figure 10. Method 1050 – UVT 5 (100mm cube) full run

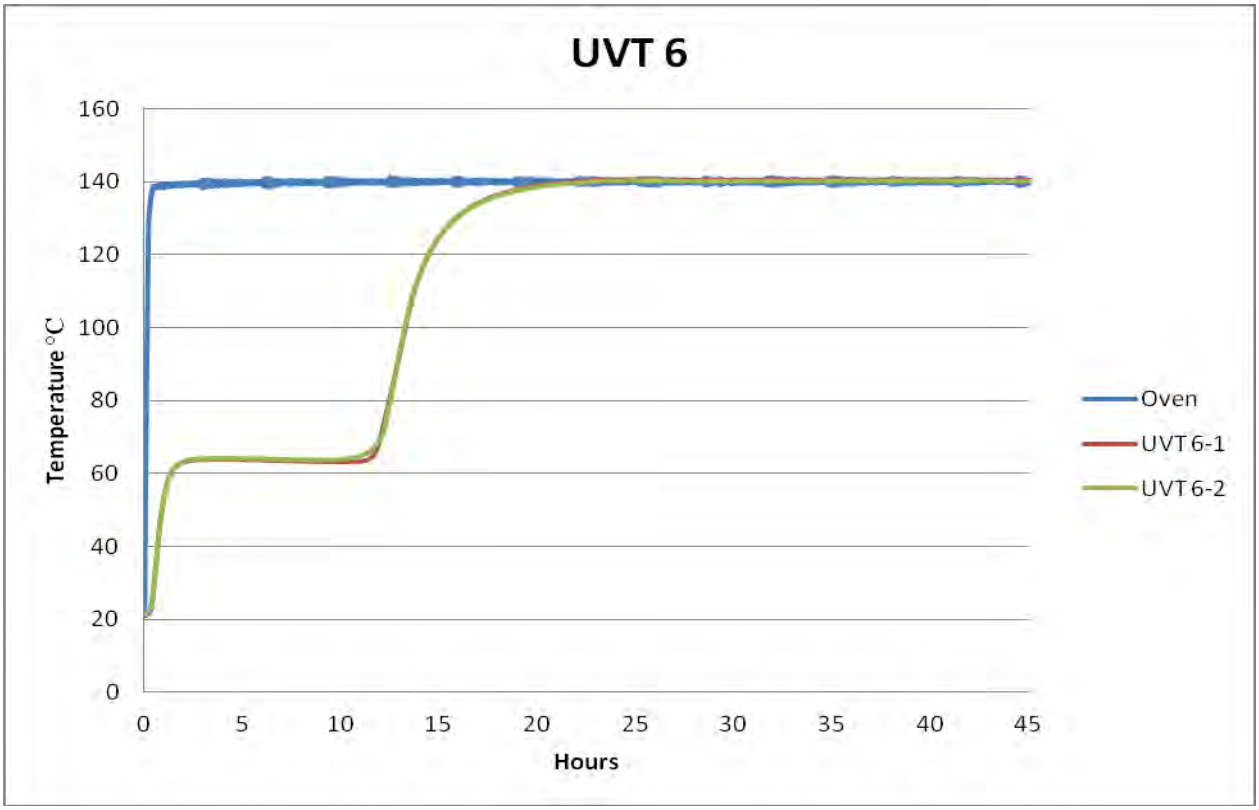


Figure 11. Method 1050 – UVT 6 (100 mm cube) full run.

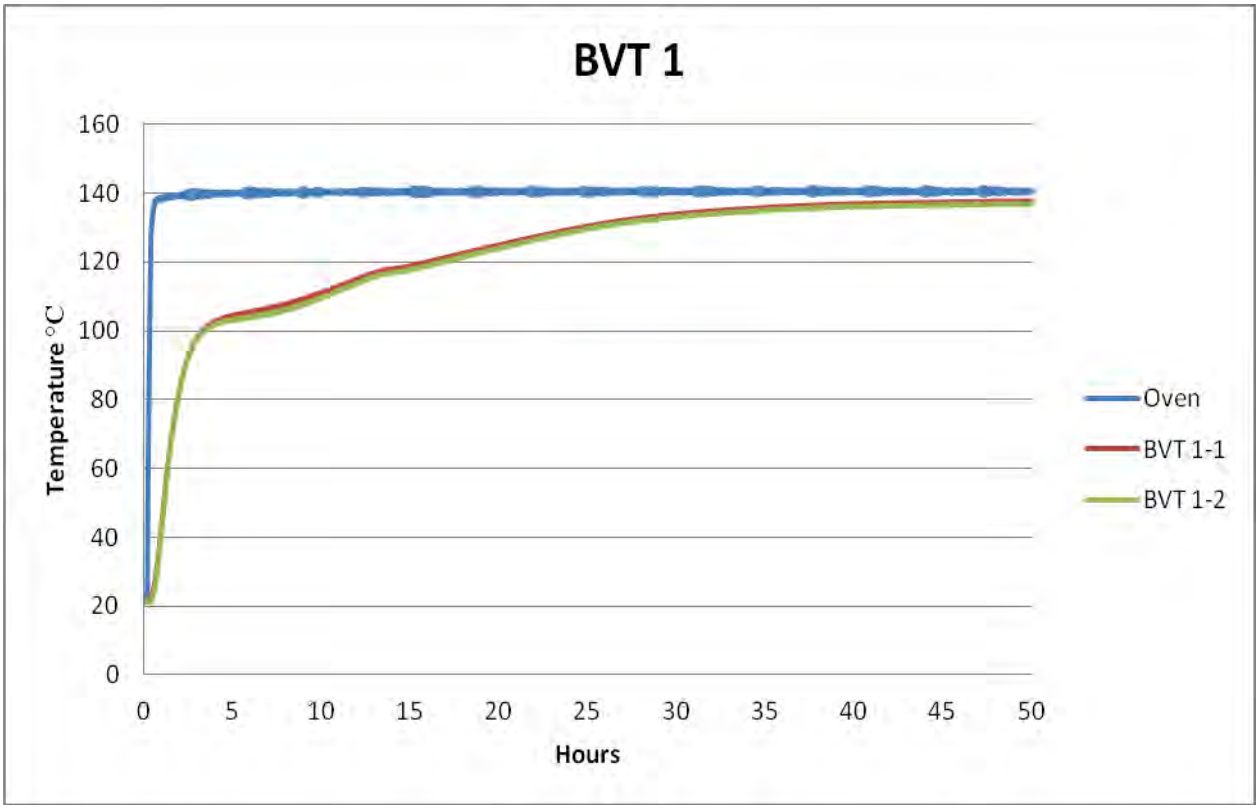


Figure 12. Method 1050 – BVT 1 (100 mm cube) full run.

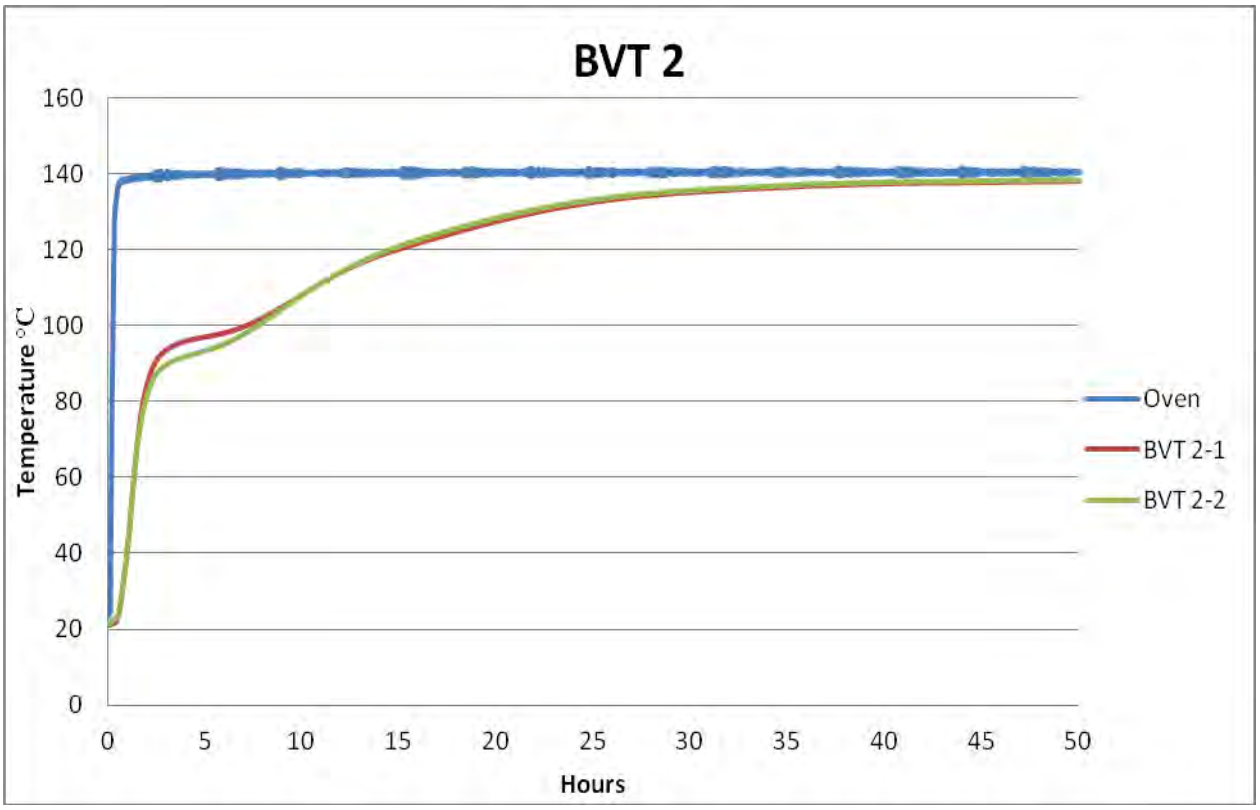


Figure 11. Method 1050 – BVT 2 (100 mm cube) full run.

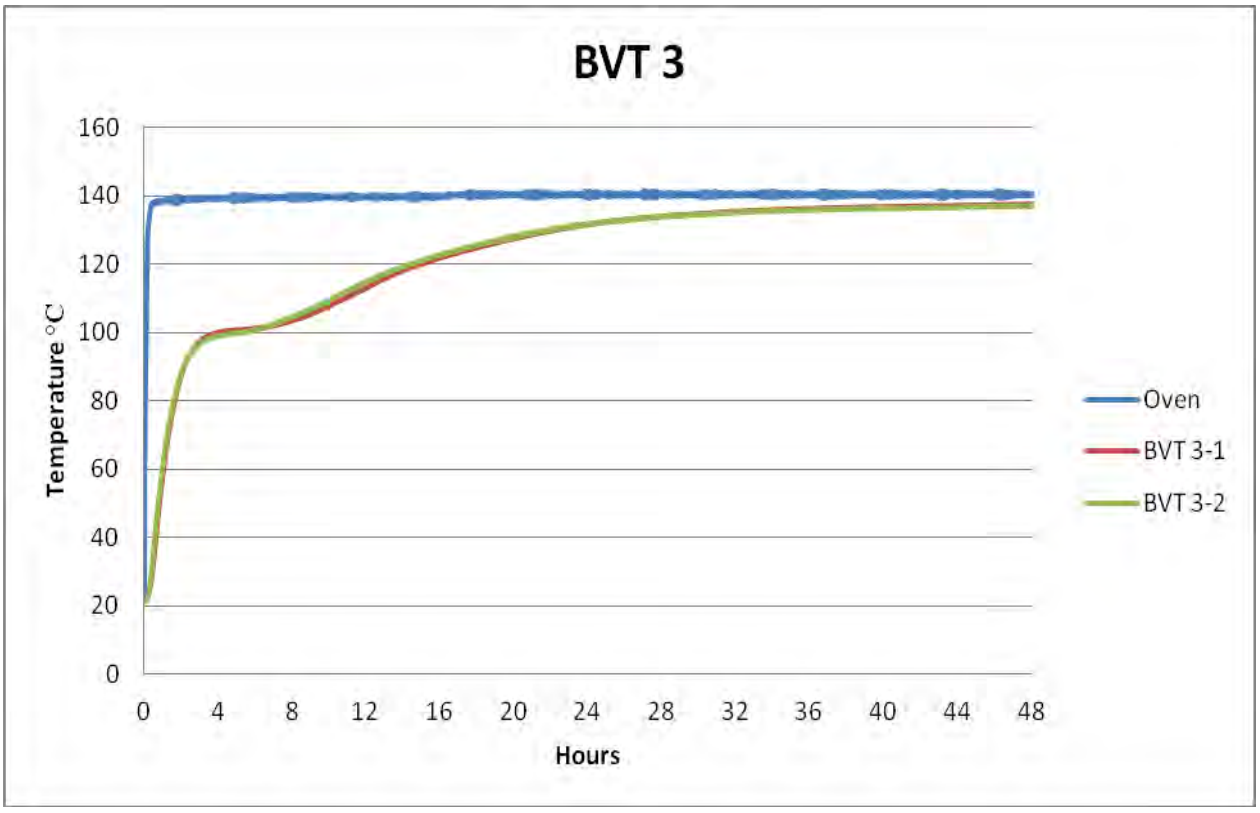


Figure 12. Method 1050 – BVT 3 (100 mm cube) full run.

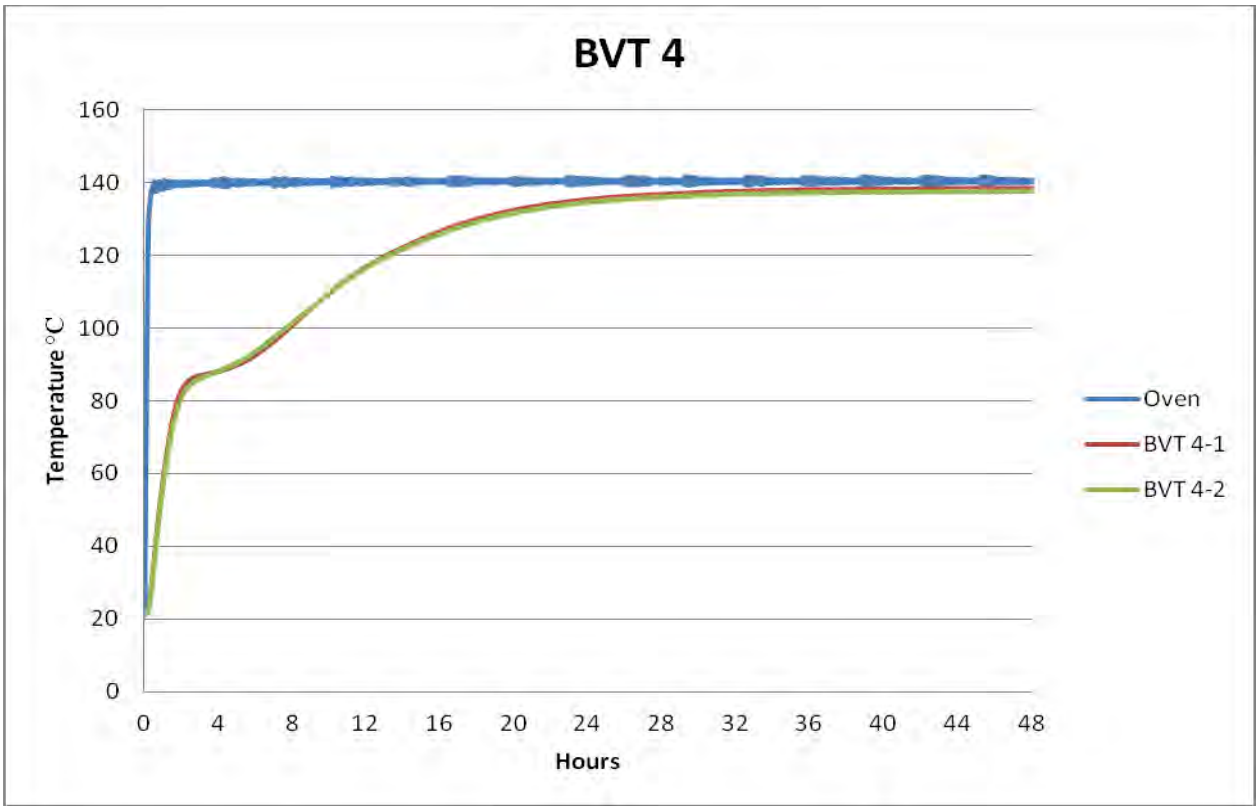


Figure 11. Method 1050 – BVT 4 (100 mm cube) full run.

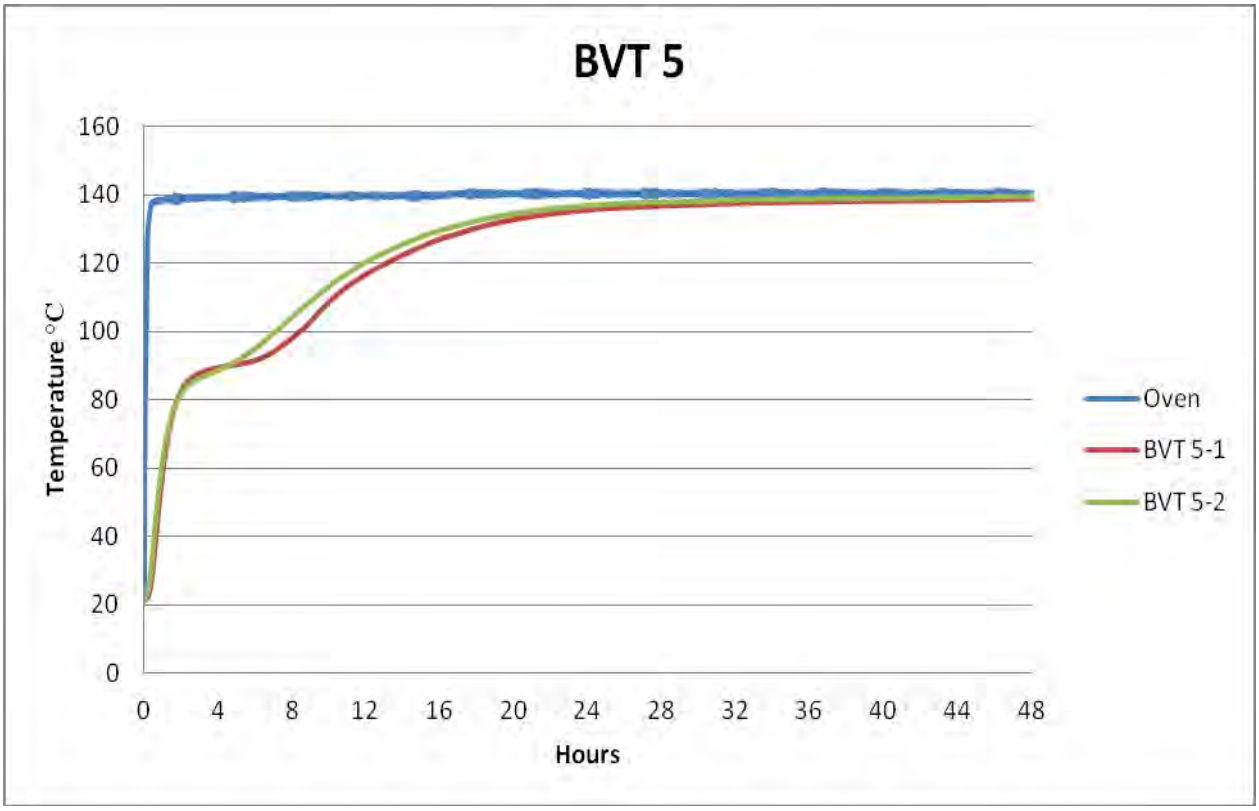


Figure 12. Method 1050 – BVT 5 (100 mm cube) full run.

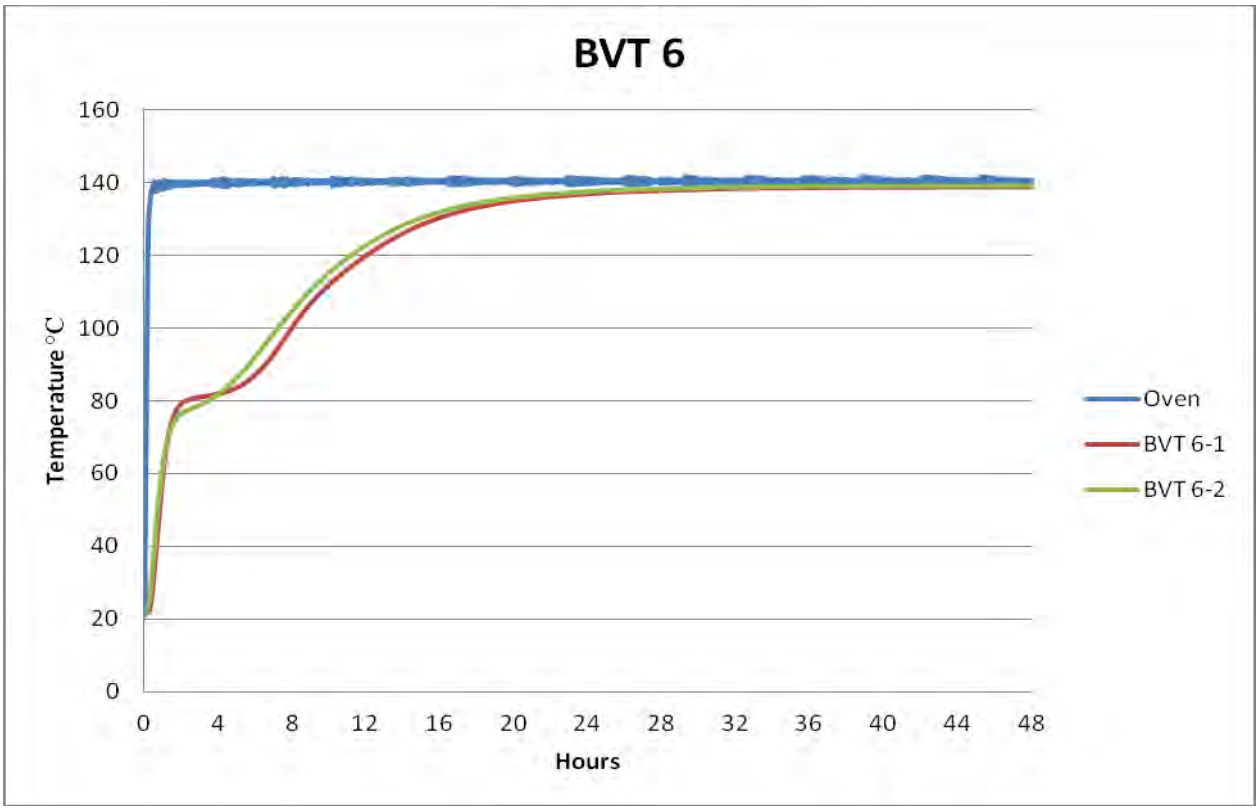


Figure 11. Method 1050 – BVT 6 (100 mm cube) full run.

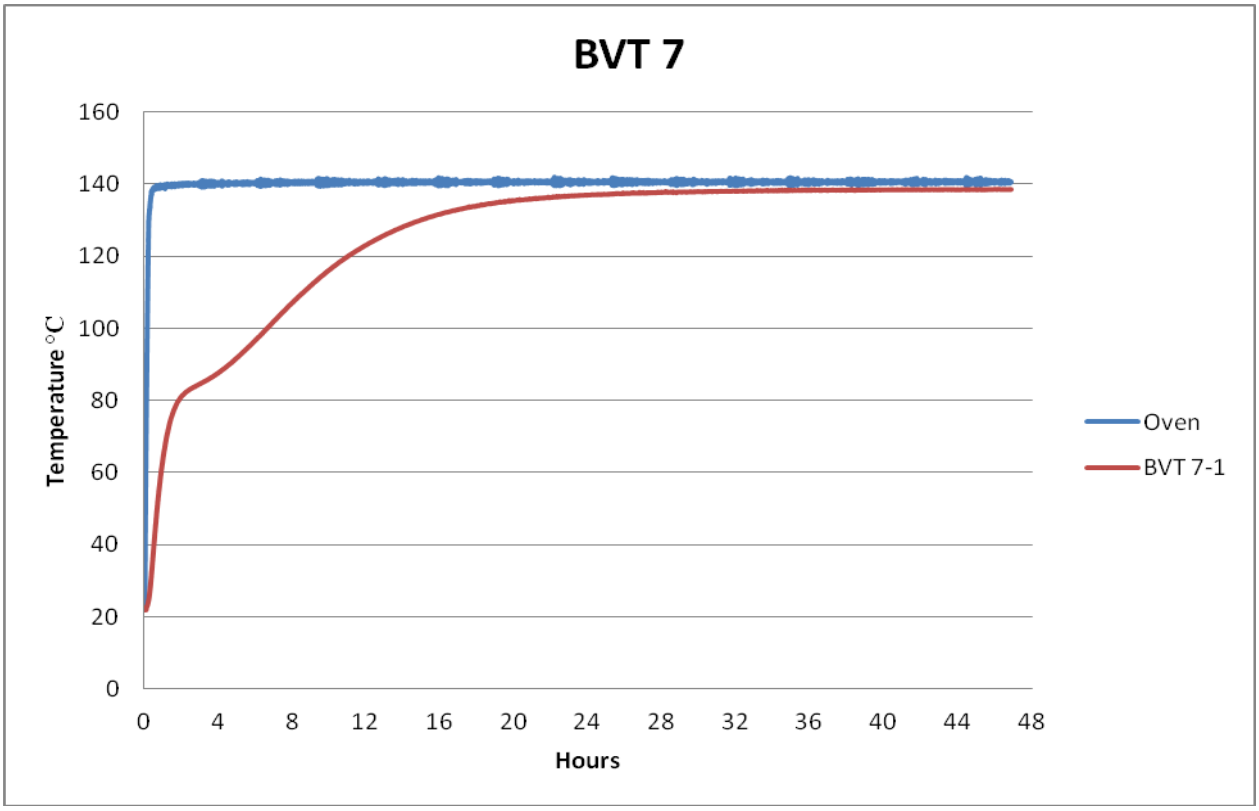


Figure 12. Method 1050 – BVT 7 (100 mm cube) full run.

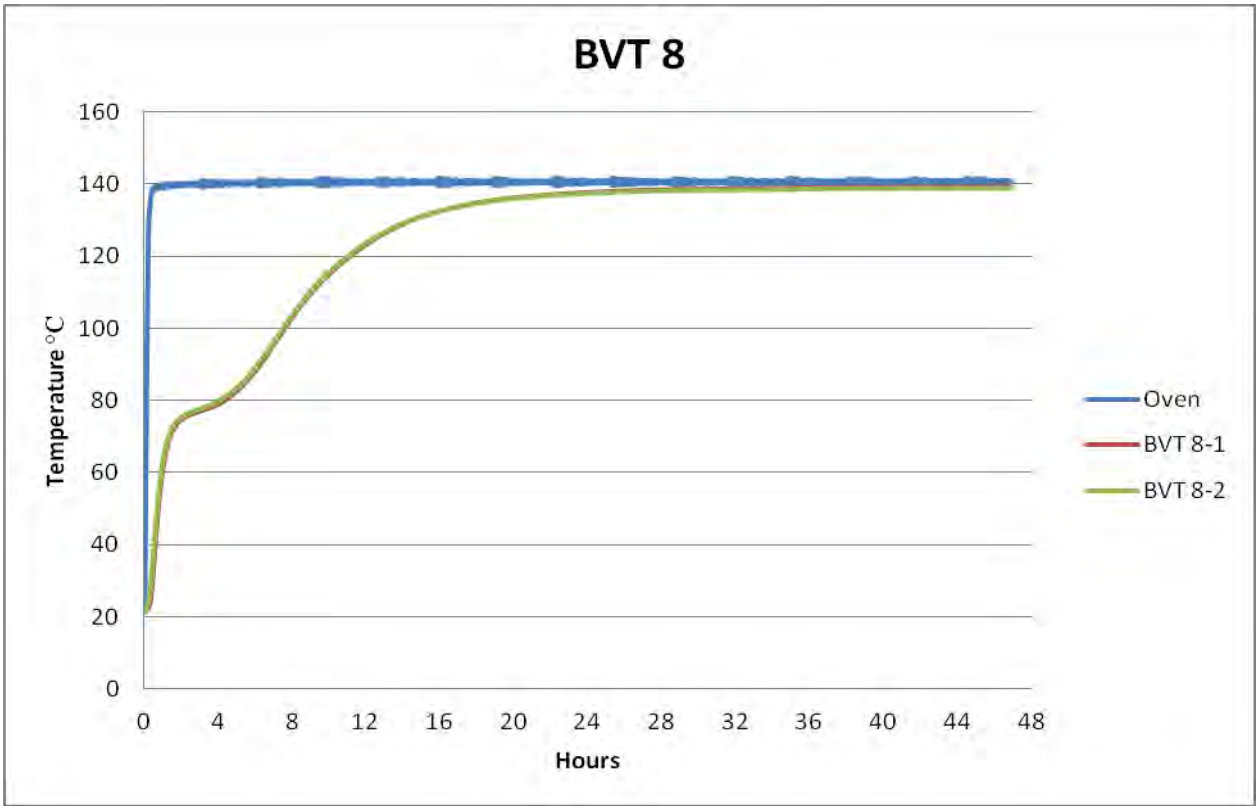


Figure 11. Method 1050 – BVT 8 (100 mm cube) full run.

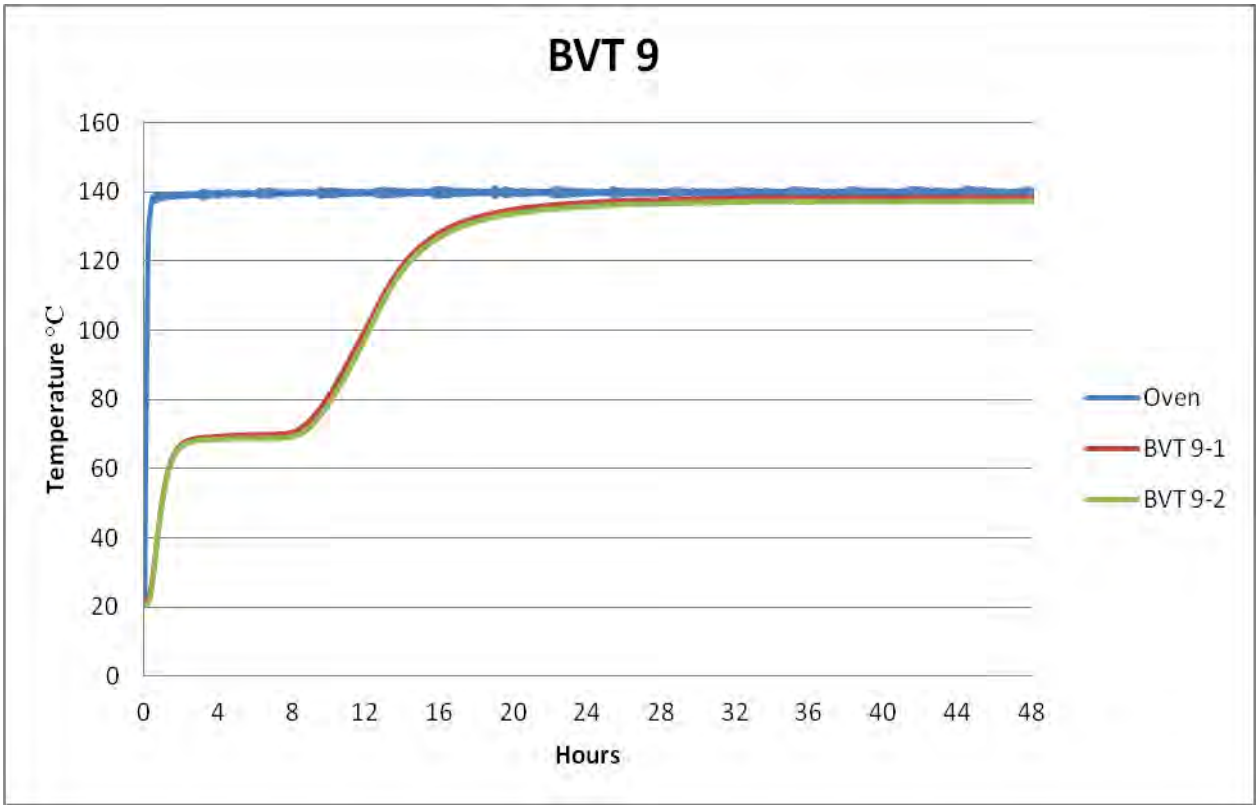


Figure 12. Method 1050 – BVT 9 (100 mm cube) full run.

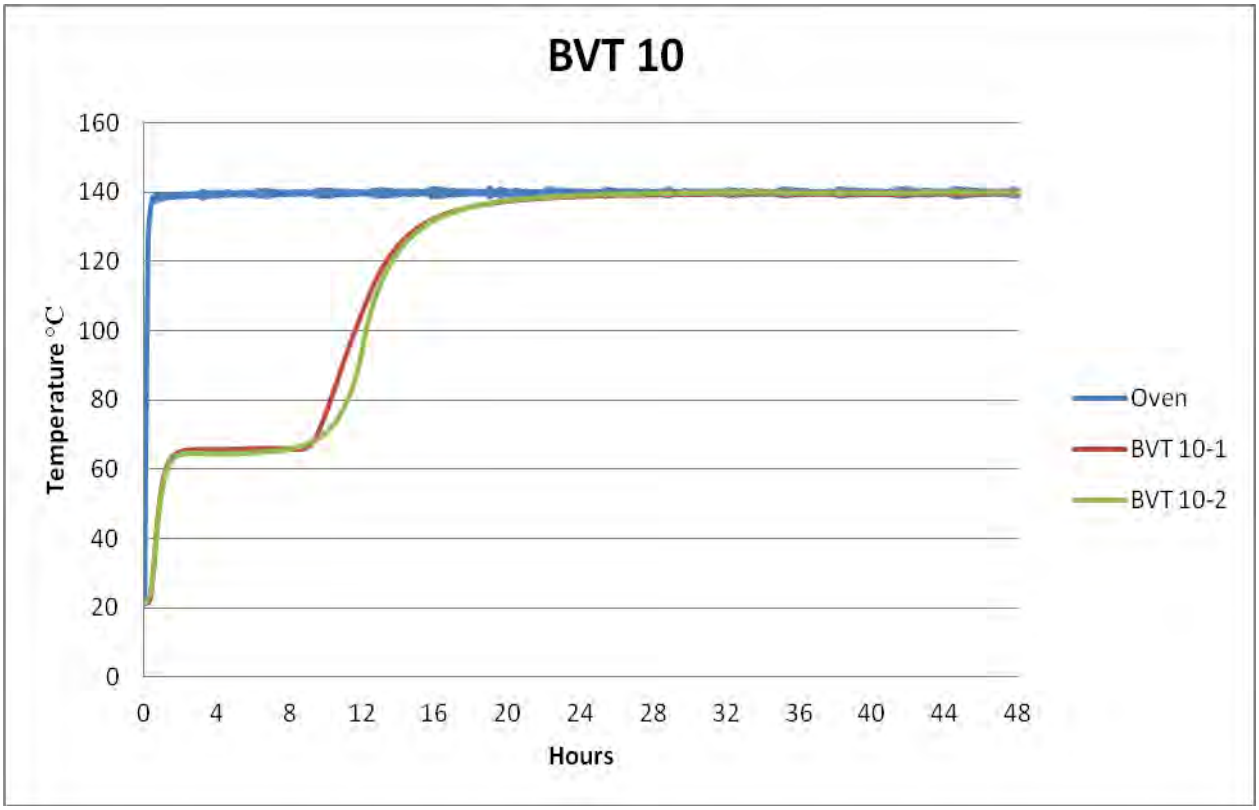


Figure 11. Method 1050 – BVT 10 (100 mm cube) full run.

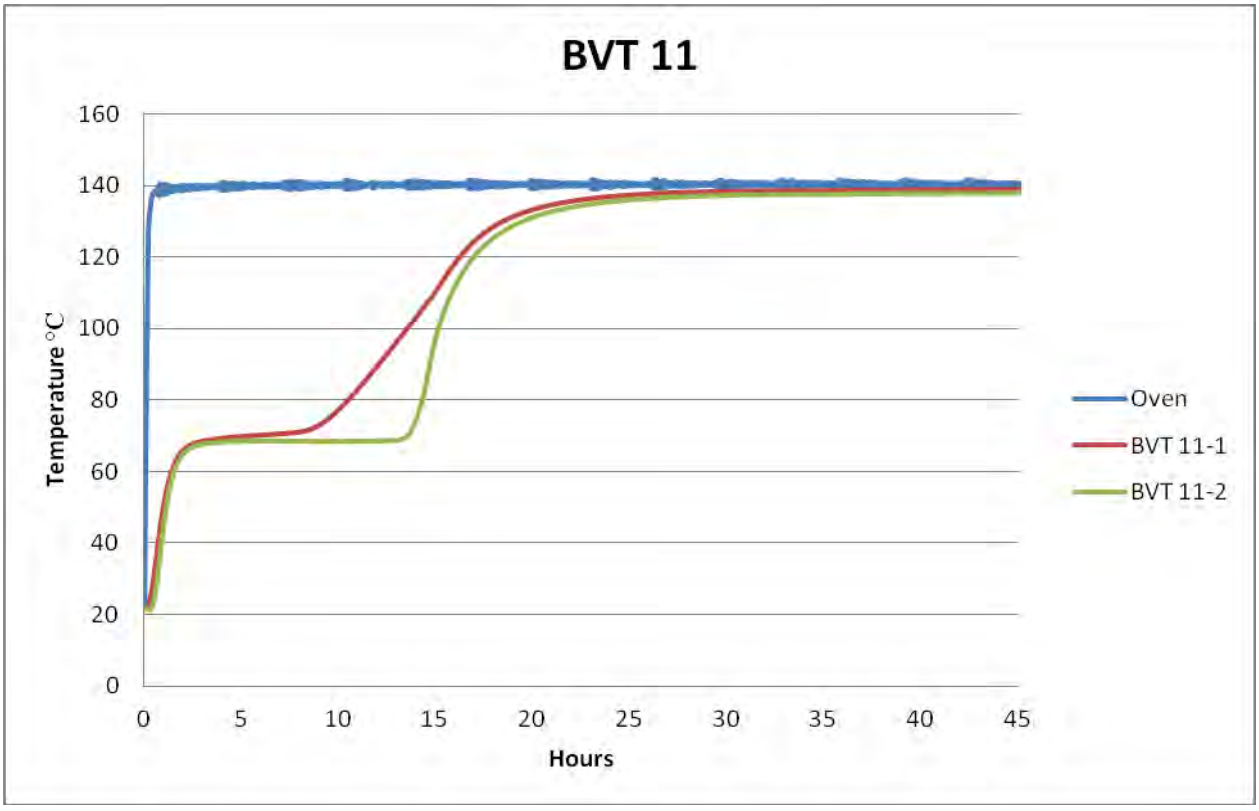


Figure 12. Method 1050 – BVT 11 (100 mm cube) full run.

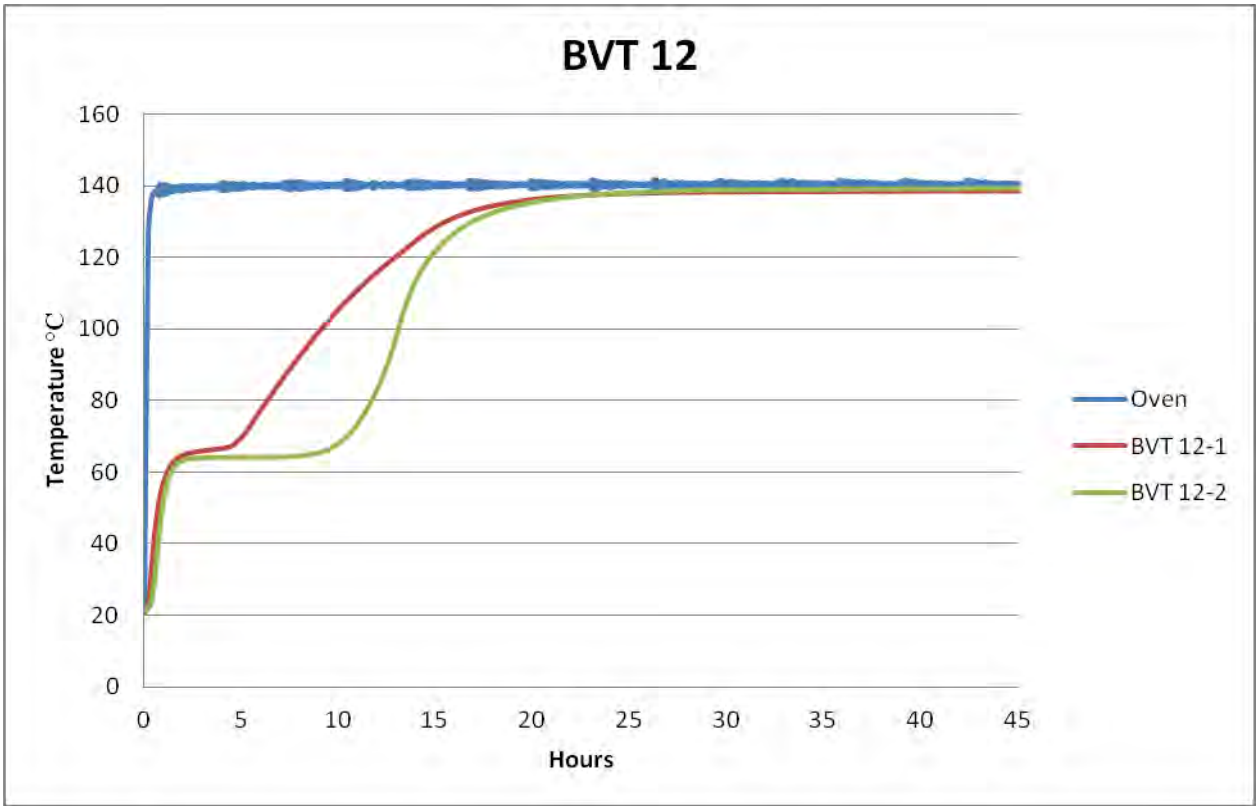


Figure 12. Method 1050 – BVT 12 (100 mm cube) full run.

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Sample Data Sheets

SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/18/16, 7/5/16, 7/27/16 8/2/16, 8/5/16

SRR #: 57965

Task Order #: 160712-3

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
BVT1	600677	Nonflammable	08/08/16
BVT2	600681	Nonflammable	08/08/16
BVT3	600682	Nonflammable	08/08/16
BVT4	600683	Nonflammable	08/08/16
BVT5	600684	Nonflammable	08/08/16
BVT6	600685	Nonflammable	08/09/16
BVT7	600686	Nonflammable	08/09/16
BVT8	600687	Nonflammable	08/09/16
BVT9	600688	Nonflammable	08/09/16
BVT10	600678	Nonflammable	08/09/16
BVT11	600679	Nonflammable	08/09/16
BVT12	600680	Nonflammable	08/09/16
UVT1	600689	Nonflammable	07/22/16
UVT2	600690	Nonflammable	07/22/16
UVT3	600691	Nonflammable	07/08/16
UVT4	600692	Nonflammable	07/22/16
UVT5	600693	Nonflammable	07/08/16
UVT6	600694	Nonflammable	07/22/16
WLVT1	600695	Nonflammable	07/08/16
WLVT2	600761	Nonflammable	07/08/16
WLVT3	600762	Nonflammable	07/08/16
WLVT4	600763	Nonflammable	07/08/16
WLVT5	600764	Nonflammable	07/08/16

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/18/16, 7/5/16, 7/27/16 8/2/16, 8/5/16

SRR #: 57965

Task Order #: 160712-3

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
BVT1	600677	Not a self-heating waste	08/08/16
BVT2	600681	Not a self-heating waste	08/08/16
BVT3	600682	Not a self-heating waste	08/10/16
BVT4	600683	Not a self-heating waste	07/28/16
BVT5	600684	Not a self-heating waste	08/10/16
BVT6	600685	Not a self-heating waste	07/28/16
BVT7	600686	Not a self-heating waste	08/12/16
BVT8	600687	Not a self-heating waste	08/12/16
BVT9	600688	Not a self-heating waste	08/04/16
BVT10	600678	Not a self-heating waste	08/04/16
BVT11	600679	Not a self-heating waste	08/06/16
BVT12	600680	Not a self-heating waste	08/06/16
UVT1	600689	Not a self-heating waste	07/24/16
UVT2	600690	Not a self-heating waste	07/26/16
UVT3	600691	Not a self-heating waste	07/22/16
UVT4	600692	Not a self-heating waste	07/26/16
UVT5	600693	Not a self-heating waste	07/22/16
UVT6	600694	Not a self-heating waste	07/24/16
WLVT1	600695	Not a self-heating waste	07/9/2016, 8/14/16
WLVT2	600761	Not a self-heating waste	07/15/16
WLVT3	600762	Not a self-heating waste	07/15/16
WLVT4	600763	Not a self-heating waste	07/18/16
WLVT5	600764	Not a self-heating waste	07/18/16

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SOUTHWEST RESEARCH INSTITUTE

SW846 9095 Paint Filter Liquids Test

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/18/16, 7/5/16, 7/27/16
8/2/16, 8/5/16

SRR #: 57965

Task Order #: 160712-3

Sample ID	SwRI System ID	Method 9095 *Paint Filter Results*	Date Analyzed
BVT1	600677	No free liquids	08/08/16
BVT2	600681	No free liquids	08/08/16
BVT3	600682	No free liquids	08/08/16
BVT4	600683	No free liquids	08/08/16
BVT5	600684	No free liquids	08/08/16
BVT6	600685	No free liquids	08/09/16
BVT7	600686	No free liquids	08/09/16
BVT8	600687	No free liquids	08/09/16
BVT9	600688	No free liquids	08/09/16
BVT10	600678	No free liquids	08/09/16
BVT11	600679	No free liquids	08/09/16
BVT12	600680	No free liquids	08/09/16
UVT1	600689	No free liquids	07/22/16
UVT2	600690	No free liquids	07/22/16
UVT3	600691	No free liquids	07/07/16
UVT4	600692	No free liquids	07/22/16
UVT5	600693	No free liquids	07/07/16
UVT6	600694	No free liquids	07/22/16
WLVT1	600695	No free liquids	07/07/16
WLVT2	600761	No free liquids	07/07/16
WLVT3	600762	No free liquids	07/07/16
WLVT4	600763	Contains free liquids	07/07/16
WLVT5	600764	No free liquids	07/07/16
WLVT6	600765	Contains free liquids	07/07/16
WLVT7	600766	Contains free liquids	07/07/16

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/18/16, 7/5/16, 7/27/16
8/2/16, 8/5/16

SRR #: 57965

Task Order #: 160712-3

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
135.32	52.44	19.45

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
BVT1	600677	>180	>180	Not Division 5.1	08/09/16
BVT2	600681	>180	>180	Not Division 5.1	08/11/16
BVT3	600682	no reaction	>180	Not Division 5.1	08/11/16
BVT4	600683	no reaction	>180	Not Division 5.1	07/28/16
BVT5	600684	no reaction	>180	Not Division 5.1	08/09/16
BVT6	600685	no reaction	>180	Not Division 5.1	08/02/16
BVT7	600686	no reaction	>180	Not Division 5.1	08/09/16
BVT8	600687	no reaction	>180	Not Division 5.1	08/02/16
BVT9	600688	no reaction	>180	Not Division 5.1	08/05/16
BVT10	600678	no reaction	>180	Not Division 5.1	08/05/16
BVT11	600679	no reaction	>180	Not Division 5.1	08/08/16
BVT12	600680	no reaction	>180	Not Division 5.1	08/08/16
UVT1	600689	no reaction	>180	Not Division 5.1	07/28/16
UVT2	600690	no reaction	>180	Not Division 5.1	07/25/16
UVT3	600691	no reaction	>180	Not Division 5.1	07/25/16
UVT4	600692	no reaction	>180	Not Division 5.1	07/28/16
UVT5	600693	no reaction	>180	Not Division 5.1	07/26/16
UVT6	600694	no reaction	>180	Not Division 5.1	07/26/16
WLVT1	600695	no reaction	>180	Not Division 5.1	07/12/16
WLVT2	600761	no reaction	>180	Not Division 5.1	07/12/16
WLVT3	600762	no reaction	>180	Not Division 5.1	07/20/16
WLVT4	600763	no reaction	>180	Not Division 5.1	07/20/16
WLVT5	600764	no reaction	>180	Not Division 5.1	07/20/16

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

LABORATORY CONTROL SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 5/18/16, 7/5/16, 7/27/16
8/2/16, 8/5/16

SRR #: 57965

Task Order #: 160712-3

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
108-162 sec	42-63 sec	15-23 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	118.41	60.34	18.69	07/12/16
LCS	124.34	59.90	22.34	07/20/16
LCS	126.48	55.18	19.62	07/25/16
LCS	132.25	47.00	19.25	07/26/16
LCS	124.00	51.63	21.38	07/28/16
LCS	113.25	49.91	17.18	08/02/16
LCS	117.94	52.03	18.40	08/05/16
LCS	126.19	54.12	19.69	08/08/16
LCS	117.32	58.50	21.57	08/09/16
LCS	139.28	51.56	22.29	08/11/16

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SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

pH

Raw Data

Southwest Research Institute® Logbook: pH

Book I.D.: 12-0406-057 Book/Page #: 07 00178

Analysis/Method: pH Project#: 21592.01.006

Client: LANL TO#: 160712-3

QC Source: 60457 TV: 6.16 S.U.

Notes: 6.05 - 6.28 S.U.

Meter I.D.: Accumet 50

Standardization of pH Meter:

Buffer Solution	pH Reading	Inorg #	Expiration Date	Temp, °C
1.68	1.68	64372	11/1/16	22.1
4.0	4.00	65571	10/1/17	22.4
7.0	7.00	65570	10/1/17	22.3
10.0	10.00	67129	1/1/18	22.3

NN 8/10/16

	Liquids	Soils/Solids			
Sample ID	pH	Sample Wt, g	Water Wt, g	pH	Temp, °C
ICV	6.11	N/A	N/A	N/A	22.7
BVT(10)(1:2)	2.20				27.5 25.9
BVT1(1:3)	2.40				27.8 26.4
BVT3(1:10)	<1.68				20.3
LLVT3	<1.68				22.4 25.6
LLVT5(1:3)	<1.68				29.0 28.6
CCV	6.09				22.4

SAM 5/18/16

5/18/16 SAM

Analyst Signature: Date: 5/18/16

Reviewed by: Date: 8/10/16

Southwest Research Institute® Logbook: pH

Book I.D.: 12-0406-057 Book/Page #: 07 00183

Analysis/Method: pH Project#: 21592.01.006

Client: LANL TO#: 160712-3

QC Source: 71223 TV: 6.12 S.U.

Notes: QC Range 6.01 - 6.24 S.U.

Meter I.D.: TOAM 7/18/16 B. Accumet 50

Standardization of pH Meter:

Buffer Solution	pH Reading	Inorg #	Expiration Date	Temp, °C
~~1.68~~	1.68	64372	11/11/16	22.3
4.0	4.00	72232	2/1/18	22.2
7.0	7.00	72230	3/1/18	22.3
10.0				NN 8/10/16

	Liquids	Soils/Solids			
Sample ID	pH	Sample Wt, g	Water Wt, g	pH	Temp, °C
ICV	6.07	NA	NA	NA	22.2
TOAM 7/18/16 ~~UVT1~~ UNS301	<1.68	NA	NA	NA	21.9
UVT1 ½ zeolite	<1.68	NA	NA	NA	26.3
UVT1 full zeolite	<1.68	NA	NA	NA	26.5
UVT2 ½ zeolite	<1.68	NA	NA	NA	26.3
UVT2 full zeolite	<1.68	NA	NA	NA	26.2
UVT4	<1.68	NA	NA	NA	28.9
UVT4 ½ zeolite	<1.68	NA	NA	NA	28.0
UVT4 full zeolite	<1.68	NA	NA	NA	27.6
UVT6	<1.68	NA	NA	NA	30.2
UVT6 ½ zeolite	<1.68	NA	NA	NA	28.2
UVT6 full zeolite	NA	NA	NA	NA	NA
CCV	6.05	NA	NA	NA	22.3
			JAH 8/10/16		

Analyst Signature: Date: 7/18/16

Reviewed by: Date: 8/10/16

Southwest Research Institute® Logbook: pH

Book I.D.: 12-0406-057 Book/Page #: 07 00184

Analysis/Method: pH Project#: 21592.01.006

Client: LANL TO#: 160712-3 ~~160726~~ TBSAM 7/29/16

QC Source: 71223 TV: 6.12 S.U.

Notes: 6.01-6.24 S.U.

Meter I.D.: Accumet 50

Standardization of pH Meter:

Buffer Solution	pH Reading	Inorg #	Expiration Date	Temp, °C
1.68	1.68	64372	11/1/16	22.0
4.0	4.00	72232	2/1/18	22.1
7.0	7.00	72230	3/1/18	22.1
10.0	10.00	72229	5/1/18	22.0

NN 8/10/16

	Liquids	Soils/Solids			
Sample ID	pH	Sample Wt, g	Water Wt, g	pH	Temp, °C
ICV	6.08	NA	NA	NA	22.7
WB8	—	—	—	<1.68 add soln	19.7
BVT8	was a solid unable to obtain pH			NA	20.1
BVT6	was a solid unable to obtain pH			NA	19.9
BVT4	was a solid unable to obtain pH			NA	20.2
BVT2 SBA	<1.68	fizzled when water added		start water 20.9°C	16.8
BVT7 ½ month Zeolite	<1.68	NA	NA	NA	16.9
BVT7 Full Zeolite	<1.68	NA	NA	NA	18.4
CCV	6.07	NA	NA	NA	22.4

SAM 7/28/16

Analyst Signature: Date: 7/27/16

Reviewed by: Date: 8/10/16

Southwest Research Institute® Logbook: pH

Book I.D.: 12-0406-057 Book/Page #: 07 00187

Analysis/Method: pH Project#: 21542.01.006

Client: LANL TO#: 160712-3

QC Source: 71223 TV: 6.12 S.U.

Notes: 6.01 - 6.24 S.U.

Meter I.D.: Accumet 50

Standardization of pH Meter:

Buffer Solution	pH Reading	Inorg #	Expiration Date	Temp, °C
1.68	1.68	64772	11/11/16	21.4
4.0	4.00	72232	2/1/18	21.3
7.0	7.00	72230	3/1/18	21.4
10.0	10.00	72224	5/1/18	21.4
				NN

8/10/16

	Liquids	Soils/Solids			
Sample ID	pH	Sample Wt, g	Water Wt, g	pH	Temp, °C
ICV	6.17	NA	NA	NA	21.4
BVT12	<1.68	NA	NA	NA	27.9
BVT10	<1.68	NA	NA	NA	27.3
BVT9	<1.68	NA	NA	NA	27.4
CCV	6.19	NA	NA	NA	21.5
BVT11	<1.68	NA	NA	NA	35.5°C
CCV2	6.19	NA	NA	NA	21.7

24.2
23.6
25.3
29.7°C

QCLL 8/10/16

BVT12 had an outlier consistency

Analyst Signature: Date: 8/2/16

Reviewed by: Date: 8/10/16

Southwest Research Institute® Logbook: pH

Book I.D.: 12-0406-057 Book/Page #: 07 00188

Analysis/Method: pH Project#: 21592.01.006

Client: LANL TO#: 160712-3

QC Source: 71223 TV: 6.12 S.U.

Notes: 6.01 - 6.24 S.U.

Meter I.D.: Accumet 50

Standardization of pH Meter:

Buffer Solution	pH Reading	Inorg #	Expiration Date	Temp, °C
1.68	1.68	64372	11/11/16	21.4
4.0	4.00	72232	2/1/18	21.6
7.0	7.00	72230	3/1/18	21.6
10.0	10.00	72229	5/1/18	21.6

NN 8/10/16

	Liquids	Soils/Solids				after ferric temp
Sample ID	pH	Sample Wt, g	Water Wt, g	pH	Temp, °C	
ICV	6.17	NA	NA	NA	21.6	
BVT7	4.68	NA	NA	NA	10.2°C	13.9
BVT5	4.68	NA	NA	NA	9.2°C	13.7
BVT3	4.68	NA	NA	NA	10.8°C	14.7
BVT1	4.68	NA	NA	NA	12.6°C	15.7
BVT2	NA	NA	NA	NA	16.3°C	19.2
CCV	6.18	NA	NA	NA	21.4	

JAM 8/9/16

Analyst Signature: Date: 8/5/16

Reviewed by: Date: 8/10/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

UN Oxidizer

Raw Data

Southwest Research Institute

Method: UN-Oxidizer
Project #: 21592.01.006
Client: Los Alamos (LANL)
TO# 16 0712-3

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0120	21.0096	118.41	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0092	18.0074	160.34	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0081	12.0062	18.169	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Grabaldon Balance#: 135 Date: 7/12/16
Tested Samples: Monica Grabaldon Timer ID: 022921 Date: 7/12/16
Potassium Bromate: Inorg# 69450 - 69453 Dried: >12 hrs. @ 65°C
Cellulose: Inorg# 71755 - 71759 Dried: >4 hrs. @ 105°C
Variac Setting: 150±7 W

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600695 WLVT1 (16:7:1) [Black]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0047	6.0064	181.16 ①	charring around wire, smoke, no flames
4:1	2	24.0164	6.0084	180.44 ①	
4:1	3	24.0144	6.0118	180.62 ①	
4:1	4	24.0177	6.0174	180.25 ①	
4:1	5	24.0092	6.0052	180.25 ①	↓
4:1	Avg			>180	① Time when power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0060	15.0051	181.25 ②	small flames at wire leads, smoke & charring
1:1	2	15.0066	15.0061	181.81 ②	
1:1	3	15.0091	15.0102	182.81 ②	
1:1	4	15.0031	15.0122	181.47 ②	
1:1	5	15.0059	15.0091	181.31 ②	↓
1:1	Avg			>180	② time when flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/12/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/12/16
Sample Dried ? YES (NO) Dried: N/A
Cellulose: Inorg# 71755-71759 Dried: >4hrs. @ 105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 16 0712 -3

Sample Analysis

System ID: 600761 WLVT2 (8:3:1) [Green]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0107	6.0082	180.31 ①	charring around wire, smoke, no flames
4:1	2	24.0147	6.0074	180.31 ①	
4:1	3	24.0062	6.0062	180.35 ①	
4:1	4	24.0062	6.0055	180.31 ①	
4:1	5	24.0052	6.0064	180.34 ①	
4:1	Avg			>180	① Time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0079	15.0072	184.77 ②	small flames at wire leads, charring + smoke
1:1	2	15.0245	15.0167	182.25 ②	
1:1	3	15.0161	15.0105	182.22 ②	
1:1	4	15.0082	15.0082	182.44 ②	
1:1	5	15.0109	15.0123	184.47 ②	
1:1	Avg			>180	② Time flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/12/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/12/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 715755 - 71759 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts CI 7/12/16 MG

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0140	21.0082	124.34	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0057	18.0054	59.90	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0029	12.0061	22.34	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/20/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/20/16
Potassium Bromate: Inorg# 69450-69453 Dried: >12 hrs. @ 65°C
Cellulose: Inorg# 71755-71759 Dried: >4 hrs. @ 105°C
Variac Setting: 150 ± 7 Watts

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600762 WLVT3 (4:2:1) [Blue]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0059	6.0090	180.38 ①	charring around wire, smoke, no flames
4:1	2	24.6135	6.0094	180.31 ①	
4:1	3	24.0023	6.0039	180.19 ①	
4:1	4	24.0006	6.0087	180.31 ①	
4:1	5	24.0140	6.0086	180.37 ①	
4:1	Avg			>180	① Time when power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0076	15.0051	181.29 ②	small flames at wire leads, smoke & charring
1:1	2	15.0148	15.0049	190.12 ②	
1:1	3	15.0083	15.0169	222.66 ②	
1:1	4	15.0021	15.0078	183.62 ②	
1:1	5	15.0089	15.0136	182.10 ②	
1:1	Avg			>180	② time when flames extinguished, power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/15/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/20/16
Sample Dried ? YES (NO) Dried: ~~AM~~ NA @ 7/20/16 mm
Cellulose: Inorg# 71755-71759 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600763 WLVT4 (8:3:1) [Red]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0116	6.0026	180.34 ①	charring around wire, smoke, no flames
4:1	2	24.0170	6.0132	180.56 ①	
4:1	3	24.0030	6.0109	180.25 ①	
4:1	4	24.0009	6.0037	180.32 ①	
4:1	5	24.0035	6.0048	180.25 ①	
4:1	Avg			>180	① Time when power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0157	15.0108	180.47 ②	sparking + small flames at beginning, charring + smoke. Flames didn't last full 180 sec.
1:1	2	15.0144	15.0176	181.34 ②	
1:1	3	15.0068	15.0079	181.12 ②	
1:1	4	15.0097	15.0102	181.25 ②	
1:1	5	15.0163	15.0181	180.66 ②	
1:1	Avg			>180	② Time timer turned off. Power turned off at 180sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/15/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/20/16
Sample Dried ? YES (NO) 7 ci 7/20/16 MG Dried: NA
Cellulose: Inorg# 71555 - 71759 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600764 (WLVTS) (8:3:1) [Black]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0048	6.0080	180.28 ①	charring around wire, smoke, no flames
4:1	2	24.0093	6.0026	180.28 ①	
4:1	3	24.0018	6.0293	180.32 ①	
4:1	4	24.0045	6.0051	180.37 ①	
4:1	5	24.0030	6.0086	180.22 ①	↓
4:1	Avg			7180	①Time when power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0122	15.0056	181.66 ②	sparking + small flames at beginning,
1:1	2	15.0248	15.0292	181.87 ②	Flames didn't last all 180 sec.
1:1	3	15.0014	15.0046	181.41 ②	charring + smoke
1:1	4	15.0036	15.0050	181.25 ②	
1:1	5	15.0100	15.0078	181.16 ②	↓
1:1	Avg				②time timer turned off. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/20/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/20/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0043	21.0140	126.48	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0035	18.0076	55.18	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0092	12.0081	19.62	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/25/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/25/16
Potassium Bromate: Inorg# 69450-69453 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755-71759 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 100690 - UVT2 [Blue]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0037	6.0065	180.25 ①	charring around wire, smoke, no flames
4:1	2	24.0061	6.0142	180.34 ①	
4:1	3	24.0086	6.0080	180.31 ①	
4:1	4	24.0027	6.0053	180.28 ①	
4:1	5	24.0093	6.0098	180.32 ①	↓
4:1	Avg			7180	① time when power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0186	15.0064	197.31 ②	flames in front wire leads, charring + smoke
1:1	2	15.0129	15.0223	210.53 ②	
1:1	3	15.0049	15.0060	185.97 ②	
1:1	4	15.0012	15.0080	226.16 ②	
1:1	5	15.0179	15.0082	187.32 ②	↓
1:1	Avg				② time when flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/22/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/25/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 71755 - 71759 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 160691-UVT3 [Red]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0163	6.0176	180.93 ①	charring around wire, smoke, no flames
4:1	2	24.0139	6.0086	180.30 ①	
4:1	3	24.0100	6.0118	180.31 ①	
4:1	4	24.0209	6.0134	180.31 ①	
4:1	5	24.0073	6.0049	180.44 ①	
4:1	Avg			>180	① time when power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0163	15.0180	182.63 ②	flames at front wire leads, charring & smoke
1:1	2	15.0120	15.0124	182.59 ②	
1:1	3	15.0145	15.0144	184.66 ②	
1:1	4	15.0266	15.0258	182.63 ②	
1:1	5	15.0152	15.0136	182.28 ②	
1:1	Avg			>180	② Time when flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/22/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/25/16
Sample Dried ? YES / NO Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0183	21.0118	132.25	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0116	18.0039	47.00	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0148	12.0123	19.25	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/26/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/26/16
Potassium Bromate: Inorg# 69450 - 69453 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755 - 71759 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 160693-WT5 (1:3) [Green]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0153	6.0122	180.32 ①	Charring around wire, smoke, no flames
4:1	2	24.0036	6.0068	180.29 ①	
4:1	3	24.0070	6.0084	180.25 ①	
4:1	4	24.0204	6.0229	180.28 ①	
4:1	5	24.0146	6.0068	180.35 ①	↓
4:1	Avg			7180	① time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0059	15.0091	184.78 ②	Small flames at wire leads, charring + smoke
1:1	2	15.0066	15.0061	187.75 ②	
1:1	3	15.0157	15.0180	185.69 ②	
1:1	4	15.0125	15.0118	186.97 ②	
1:1	5	15.0156	15.0104	184.75 ②	↓
1:1	Avg			7180	② time when flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/22/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/26/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 606694-UVT6 [Black]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0109	6.0108	180.25 ①	charring around wire, smoke, no flames
4:1	2	24.0143	6.0056	180.31 ①	
4:1	3	24.0108	6.0102	180.12 ①	
4:1	4	24.0162	6.0103	180.22 ①	
4:1	5	24.0007	6.0044	180.34 ①	
4:1	Avg			7180	①Time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0042	15.0043	183.65 ②	very small flame at wire lead, charring, smoke
1:1	2	15.0069	15.0024	183.89 ②	
1:1	3	15.0217	15.0136	184.19 ②	
1:1	4	15.0033	15.0051	185.59 ②	
1:1	5	15.0051	15.0078	184.47 ②	
1:1	Avg			7180	②Time when flames extinguished. Power turned off at 180sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/22/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/26/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 71755 - 71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0082	21.0039	124.00	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0144	18.0133	51.63	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0178	12.0078	21.38	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/28/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/28/16
Potassium Bromate: Inorg# 69450 - 69453 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755 - 71759 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 1600689 UVT1 [Blue]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0088	6.0136	180.09 ①	charring around wire, smoke, no flames
4:1	2	24.0082	6.0063	180.07 ①	
4:1	3	24.0134	6.0073	180.35 ①	
4:1	4	24.0081	6.0083	180.29 ①	
4:1	5	24.0164	6.0100	180.25 ①	
4:1	Avg			>180	① time when power was turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0123	15.0124	182.79 ②	small flames at wire leads, charring + smoke
1:1	2	15.0115	15.0037	182.97 ②	
1:1	3	15.0149	15.0155	185.00 ②	
1:1	4	15.0058	15.0098	185.75 ②	
1:1	5	15.0198	15.0146	183.59 ②	
1:1	Avg			>180	② time when flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/26/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/28/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600692 WT4 [Red]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0389	6.0376	180.32 ①	charring around wire, smoke, no flames
4:1	2	24.0067	6.0072	180.46 ①	
4:1	3	24.0246	6.0218	180.10 ①	
4:1	4	24.0174	6.0132	180.34 ①	
4:1	5	24.0061	6.0103	180.33 ①	
4:1	Avg			7180	① time when power was turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0230	15.0217	182.65 ②	very small flames at front wire lead, charring, smoke
1:1	2	15.0150	15.0124	182.09 ②	
1:1	3	15.0190	15.0155	182.75 ②	
1:1	4	15.0296	15.0299	182.06 ②	
1:1	5	15.0117	15.0127	182.75 ②	
1:1	Avg			7180	② Time when flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/26/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/28/16
Sample Dried ? YES / NO Dried: NA
Cellulose: Inorg# 71755 - 71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: W00683 BVT4 [Green]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.6059	6.6059	180.28 ①	charring around wire, smoke, no flames
4:1	2	24.0117	6.0132	180.75 ①	
4:1	3	24.0163	6.0127	180.12 ①	
4:1	4	24.0108	6.0044	180.29 ①	
4:1	5	24.0029	6.0070	180.35 ①	↓
4:1	Avg			>180	①Time when power was turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0192	15.0133	182.09 ②	flames at front wire leads, charring + smoke
1:1	2	15.0048	15.0106	182.56 ②	L large flames
1:1	3	15.0154	15.0091	182.56 ②	
1:1	4	15.0041	15.0054	182.25 ②	
1:1	5	15.0025	15.0070	184.84 ②	↓
1:1	Avg			7180	②Time when flames extinguished. Power turned off at 180sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/28/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 7/28/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 16 07 12-3

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0062	21.0035	113.25	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0109	18.0042	49.91	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0093	12.0084	17.18	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/2/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/2/16
Potassium Bromate: Inorg# 69450-69453 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755-71759 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 110712-3

Sample Analysis

System ID: 600685 BVTU [Black]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0097	6.0114	180.50 ①	charring around wire, smoke, no flames
4:1	2	24.0063	6.0049	180.44 ①	
4:1	3	24.0059	6.0049	180.34 ①	
4:1	4	24.0136	6.0136	180.35 ①	
4:1	5	24.0019	6.0014	180.28 ①	↓
4:1	Avg			>180	① Time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0183	15.0105	181.75 ②	flames at wire leads, charring + smoke
1:1	2	15.0087	15.0085	182.12 ②	
1:1	3	15.0031	15.0030	182.29 ②	
1:1	4	15.0175	15.0136	180.47 ①	flames extinguished befor 180sec.
1:1	5	15.0137	15.0048	180.16 ①	" ↓
1:1	Avg				② Time when flames extinguished. Power turned off @ 180sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/29/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/2/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 000687-BVT8 [Green]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0186	6.0124	180.38 ①	charring around wire, smoke, no flames
4:1	2	24.0145	6.0160	180.38 ①	
4:1	3	24.0035	6.0046	180.34 ①	
4:1	4	24.0108	6.0107	180.53 ①	
4:1	5	24.0091	6.0035	180.36 ①	
4:1	Avg			>180	① Time power turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0129	15.0083	186.34 ②	flames at faint wire leads, smoke charring
1:1	2	15.0103	15.0108	182.84 ②	
1:1	3	15.0056	15.0060	181.87 ②	
1:1	4	15.0077	15.0035	182.06 ②	
1:1	5	15.0086	15.0097	181.75 ②	
1:1	Avg			>180	② Time flames extinguished. Power turned off @ 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 7/29/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/2/16
Sample Dried ? YES / (NO) Dried: N/A
Cellulose: Inorg# 71755-71759 Dried: >4hrs. @ 105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0121	21.0076	117.94	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0155	18.0096	52.03	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0068	12.0059	18,40	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/5/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/5/16
Potassium Bromate: Inorg# Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755-71759 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 000678 BVT10 [Red]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0103	6.0083	180.28 ①	charring around wire, smoke, no flames
4:1	2	24.0111	6.0082	180.44 ①	
4:1	3	24.0067	6.0082	180.43 ①	
4:1	4	24.0065	6.0034	180.37 ①	
4:1	5	24.0011	6.0056	180.29 ①	
4:1	Avg			>180	①Time when power turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0106	15.0104	193.56 ②	tiny flame at wire lead, charring + smoke
1:1	2	15.0092	15.0082	186.63 ②	
1:1	3	15.0053	15.0049	per 3/5/16 MA 215.15 ②	
1:1	4	15.0044	15.0029	187.07 ②	
1:1	5	15.0025	15.0074	197.22 ②	
1:1	Avg			>180	②Time when flame extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/3/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/5/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600688-BVT9 [Blue]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0036	6.0043	180.31 ①	charring around wire, smoke, no flames
4:1	2	24.0063	6.0037	180.38 ①	
4:1	3	24.0082	6.0055	180.47 ①	
4:1	4	24.0064	6.0090	180.28 ①	
4:1	5	24.0015	6.0084	180.35 ①	
4:1	Avg			>180	①Time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0132	15.0016	183.28 ②	small flames at wire leads, charring & smoke
1:1	2	15.0051	15.0054	185.03 ②	
1:1	3	15.0098	15.0128	185.09 ②	
1:1	4	15.0056	15.0063	>240	+ flame propagated, cont. to burn beyond 240sec
1:1	5	15.0091	15.0097	182.09 ②	
1:1	Avg			>180	②Time when flame extinguished. Power turned off @ 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/3/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/5/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0304	21.0062	126.19	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0097	18.0056	54.12	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0239	12.0055	19.69	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/8/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/8/16
Potassium Bromate: Inorg# 69450-69453 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755-71759 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600679 BVT11 [Black]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0106	6.0106	180.34 ①	charring around wire, smoke, no flames
4:1	2	24.0014	6.0071	180.40 ①	
4:1	3	24.0119	6.0147	180.62 ①	
4:1	4	24.0052	6.0082	186.72 ①	
4:1	5	24.0047	6.0089	180.34 ①	
4:1	Avg			7180	①Time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0018	15.0021	181.72 ②	small flames at wire leads, charring + smoke
1:1	2	15.0099	15.0102	224.53 ②	+ flame propagated along right side
1:1	3	15.0099	15.0070	187.07 ②	+
1:1	4	15.0029	15.0083	186.91 ②	+
1:1	5	15.0021	15.0051	182.59 ②	
1:1	Avg			7180	②Time when flames extinguished, power turned off @ 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/5/14
Tested Samples: Monica Gabaldon Timer ID: 622921 Date: 8/8/14
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600680 BVT12 [Green]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0096	6.0167	180.78 ①	Charring around wire, smoke, no flames
4:1	2	24.0044	6.0056	180.53 ①	
4:1	3	24.0056	6.0631	180.31 ①	
4:1	4	24.0156	6.6036	180.28 ①	
4:1	5	24.0069	6.0073	180.28 ①	
4:1	Avg			7180	①Time when power was turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0634	15.0077	184.06 ②	very small flames, charring + smoke.
1:1	2	15.0128	15.0048	184.54 ②	
1:1	3	15.0123	15.0061	186.37 ②	
1:1	4	15.0077	15.0050	184.40 ②	
1:1	5	15.0089	15.0089	>240	Flame continued to burn beyond 240sec
1:1	Avg			>180	②Time when flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/5/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/8/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 71755-71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0067	21.0042	117.32	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0064	18.0082	58.50	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0126	12.0129	21.57	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/9/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/9/16
Potassium Bromate: Inorg# 69450-69453 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755-71759 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600684 BVTS [Blue]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0028	6.0070	180.25 ①	charring around wire, smoke, no flames
4:1	2	24.0088	6.0082	180.38 ①	
4:1	3	24.0093	6.0062	180.28 ①	
4:1	4	24.0081	6.0067	180.25 ①	
4:1	5	24.0032	6.0060	180.25 ①	↓
4:1	Avg			7180	①Time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0102	15.0102	184.22 ②	flame at hot wire leads, smoke + charring
1:1	2	15.0141	15.0125	109.28 ②	
1:1	3	15.0188	15.0142	184.22 ②	
1:1	4	15.0081	15.0160	182.22 ②	
1:1	5	15.0052	15.0090	199.97 ②	↓
1:1	Avg				②Time when flames extinguished. Power turned off at 180sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/8/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/9/16
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 71755 - 71759 Dried: >4hrs. @105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600686 BVT7 [red]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0134	6.0074	180.28 (1)	Charring around wire, smoke, no flames
4:1	2	24.0140	6.0131	180.34 (1)	
4:1	3	24.0037	6.0076	186.29 (1)	
4:1	4	24.0148	6.0155	180.84 (1)	
4:1	5	24.0099	6.0101	180.31 (1)	
4:1	Avg			>180	(1) Time when power was turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0025	15.0032	182.69 (2)	flames at wire leads, smoke + charring
1:1	2	15.0056	15.0110	187.56 (2)	
1:1	3	15.0088	15.0064	192.78 (2)	
1:1	4	15.0135	15.0099	186.41 (2)	
1:1	5	15.0022	15.0093	181.63 (2)	
1:1	Avg			>180	(2) Time when flames extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/8/14
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/9/14
Sample Dried ? YES / (NO) Dried: NA
Cellulose: Inorg# 71755 - 71759 Dried: >4hrs. @ 105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600677 BVT1 [Black]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0108	6.0089	181.40 (1)	sparking & sporadic flames, charring & smoke
4:1	2	24.0123	6.0164	181.50 (1)	
4:1	3	24.0167	6.0110	181.31 (1)	
4:1	4	24.0121	6.0182	181.18 (1)	
4:1	5	24.0184	6.0179	181.19 (1)	
4:1	Avg			>180	(1) Time when time was turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0069	15.0075	181.27 (2)	small flames at wire leads, charring & smoke
1:1	2	15.0184	15.0159	181.35 (2)	
1:1	3	15.0157	15.0111	181.25 (2)	
1:1	4	15.0022	15.0159	184.00 (2)	
1:1	5	15.0162	15.0092	181.25 (2)	
1:1	Avg			>180	(2) Time when flame extinguished. Power turned off at 180 sec.

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/9/16
Tested Samples: Monica Gabaldon Timer ID: 622921 Date: 8/9/16
Sample Dried ? YES / (NO) Dried: N A
Cellulose: Inorg# 71755 - 71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: NO Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0105	21.0049	139.28	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0111	18.0035	51.56	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**				

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0096	12.0046	22.29	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**				

Weighted Samples: Monica Gabaldon Balance#: 135 Date: 8/11/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/11/16
Potassium Bromate: Inorg# 69450-69453 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755-71759 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 11e0712-3

Sample Analysis

System ID: 000681 BVT2 [Green]

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0110	6.0141	180.32 ①	charring around wire, smoke, no flames +
4:1	2	24.0033	6.0074	180.87 ①	+ sparking very slight
4:1	3	24.0049	6.0054	180.22 ①	
4:1	4	24.0109	6.0054	180.29 ①	
4:1	5	24.0122	6.0189	180.53 ①	
4:1	Avg			>180	① Time when power was turned off.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0030	15.0029	181.56 ②	flames would start & stop, sparking, smoke
1:1	2	15.0059	15.0074	180.65 ②	
1:1	3	15.0036	15.0078	188.53 ②	
1:1	4	15.0071	15.0042	180.47 ②	
1:1	5	15.0142	15.0082	191.56 ②	
1:1	Avg			>180	② Time when sparking stopped / flame stopped, power turned off @ 180 sec.

8/10/16 - 8/11/16

Weighted Samples: Monica Gabaldon Balance#: 88/135 Date: 8/10/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/11/16
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 71755 - 71759 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 160712-3

Sample Analysis

System ID: 600687 2 BVT3 [Blue]
RE 8/10/16 MG

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0088	6.0043	180.25 ①	charring around wire, smoke, no flames
4:1	2	24.0013	6.0038	180.28 ①	
4:1	3	24.0042	6.0044	180.31 ①	
4:1	4	24.0102	6.0134	180.22 ①	
4:1	5	24.0034	6.0044	180.25 ①	
4:1	Avg			7180	①Time when power was turned off

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0152	15.0136	181.47 ②	flames at wire leads, smoke + charring
1:1	2	15.0126	15.0024	181.22 ②	+ All samples flames would start + spot
1:1	3	15.0047	15.0075	181.31 ②	
1:1	4	15.0116	15.0084	181.13 ②	
1:1	5	15.0117	15.0113	181.44 ②	
1:1	Avg			7180	②Time flames extinguished. Power turned off at 180 sec.

8/10/16 8/11/16

Weighted Samples: Monica Gabaldon Balance#: 88/135 Date: 8/10/16
Tested Samples: Monica Gabaldon Timer ID: 022921 Date: 8/11/16
Sample Dried ? YES (NO) CE 8/11/16 Dried: NA
Cellulose: Inorg# 71755-71859 MG Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Not Division 5.1

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Method 1050

Raw Data

Book I.D. 16-0406-001 Book/ Page : 13 0048

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050 Project# 21592.9.006

Client: LANL TO# 160712-3

LCS Info: NA TV= NA Balance#: NA

Notes:

WLVT 1 & WLVT 2 ID TESAM 7/14/16

Start 7/9/16

7/12/16

Sample ID: WLVT1 & D
Start Date: 07/09/16 Stop Date: 07/11/16
Start Time: 8:28 AM Stop Time: 10:29 AM

Thermocouple 2 started to dip down to -40°C a little after 1 hour into the test. It came up slowly and met back with thermocouple 1 about 10 hours into the analysis. On the duplicate sample the opposite happened. The second thermocouple peaked at 222°C before coming back down to temperature. Sample maily had a dried zeolite color when removed from the oven with slight browning on the exteriors of the cube. Since this sample and the duplicate both acted weird on one thermocouple each the analysis is to be repeated.

Sample ID: WLVT 2 & 3
Start Date: 07/15/16 Stop Date: 07/17/16
Start Time: 3:30 PM Stop Time: 5:30 PM

Both samples slowly came to temperature due to the moisture content in the samples. WLVT2 reached a steady temperature around 32 hours while WLVT 3 reached a steady temperature around 24 hours into the analysis. When removed from the oven both samples were maily loose with clumping occuring in the lower portion of the cube. Since both samples did not exceed 200°C they are both considered to be not self heating.

Calculation:

Typed in 8/17/2016

Analyst Signature: Date: 7/9/16

Reviewed by: RQ Date: 8/17/16

Book I.D. 16-0406-001 Book/ Page : 13 0049

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160712-3

LCS Info: NA TV= NA Balance#: NA

Notes:

8/12/16

Sample ID: WLVT 4 & 5

Start Date: 07/18/16 Stop Date: 07/20/16

Start Time: 1:17 PM Stop Time: 3:19 PM

Both samples slowly came to temperature due to the moisture content in each of them. One of the thermocopules in WLVT5 became compromised and was removed after the analysis. Both samples seemed to reach a steady temperature about 32 hours into the analysis. WLVT4 had some leaking out of the bottom of the cube which formed stalagtites or fluffy foam. When removed both samples were clumpy with major clumps on the bottom portion of the cube. Since both samples did not exceed 200°C they are both considered to be not self heating.

Sample ID: UVT 3 & 5

Start Date: 07/22/16 Stop Date: 07/24/16

Start Time: 5:05 PM Stop Time: 5:50 PM

Both samples slowly came to temperature due to the moisture content in each of them. UVT 3 came to a steady temperature around 28 hours into the analysis while UVT5 came to a steady temperature about 16 hours in. When removed from the oven UVT3 was a solid block and UVT5 became a brown cube most likely due to the additon of the swheat. Since both samples did not exceed 200°C they are both considered to be not self heating.

Calculation:

taped in 8/12/16

Analyst Signature: B. WOSA M 7/15/16 Date: 7/16/16

Reviewed by: Date: 8/17/16

Book I.D. 16-0406-001 Book/ Page : 13 0061

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050 Project# 21592.01.006

Client: LANL TO# 160712-3

8/12/16

Sample ID: UVT 1 & 6
Start Date: 07/24/16 Stop Date: 07/26/16
Start Time: 7:36 PM Stop Time: 5:00 PM

Both samples slowly came to temperature due to the moisture content in each of them. UVT 1 came to temperature around 30 hours into the analysis and UVT 6 came to a steady temperature in about 22 hours. When removed from the oven UVT1 was a solid block of zeolite while UVT6 was a brown cube of zeolite a swheat. Since both samples did not exceed 200°C they are both considered to be not self heating.

Sample ID: UVT 2 & 4
Start Date: 07/26/16 Stop Date: 07/28/16
Start Time: 7:15 PM Stop Time: 5:05 PM

Both samples slowly came to temperature due to the moisture content in each of them. UVT 2 came to temperature around 30 hours into the analysis and UVT 4 came to a steady temperature in about 35 hours. When removed from the oven UVT4 was found to have been dripping during the analysis and had developed a large stalagtite structure that was fluffy and easy to break off. The cube was a solid hardened block. UVT2 was a solid mass of zeolite. Since both samples did not exceed 200°C they are both considered to be not self heating.

Sample ID: BVT 4 & 6
Start Date: 07/28/16 Stop Date: 07/30/16
Start Time: 6:23 PM Stop Time: 8:24 PM

Both samples slowly came to temperature due to the moisture content in each of them. Both samples came to a stead temperatuer around 32 hours into the analysis. When removed from the oven both samples were fairly loose with a hardened bottom and browning on the exterior portions. Since both samples did not exceed 200°C they are both considered to be not self heating.

Analyst Signature: Date: 8/12/16

Reviewed by: Date: 8/17/16

Book I.D. 16-0406-001 Book/ Page : 13 0062

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050 Project# 21542.01.006

Client: LANL TO# 160712-3

Sample ID: BVT 9 & 10
Start Date: 08/04/16 Stop Date: 08/06/16
Start Time: 7:22 AM Stop Time: 8:20 AM

Both samples slowly came to temperature due to the moisture content in each of them. Both samples were at a steady temperature by 32 hours into the analysis. When removed from the oven both samples were still comprised of loose material that was slightly brown. Since both samples did not exceed 200°C they are both considered to be not self heating.

8/12/16

Sample ID: BVT 11 & 12
Start Date: 08/06/16 Stop Date: 08/08/16
Start Time: 9:28 AM Stop Time: 8:54 AM

Both samples slowly came to temperature due to the moisture content in each of them. Both samples were at a steady temperature by 30 hours into the analysis. When removed from the oven both samples were slightly bown maily made up of loose material with a few clumps. Since both samples did not exceed 200°C they are both considered to be not self heating.

Sample ID: BVT 1 & 2
Start Date: 08/08/16 Stop Date: 08/10/16
Start Time: 10:46 AM Stop Time: 12:47 PM

Both samples slowly came to temperature due to the moisture content in each of them. Both samples were at a steady temperature by 42 hours into the analysis. When removed from the oven both samples were solid blocks that were slightly browned. BVT1 dripped a little from the bottom of the cage during the analysis forming a fluffly stalagtite. Since both samples did not exceed 200°C they are both considered to be not self heating.

Analyst Signature: Date: 8/12/16

Reviewed by: Date: 8/17/16

Book I.D. 16-0406-001

Book/ Page : 13 0064

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050

Project# 21592.01.006

Client: LANL

TO# 16073-12-3

Balance#: 8/17/16

Sample ID: BVT 3 & 5
Start Date: 08/10/16
Start Time: 2:38 PM
Stop Date: 08/12/16
Stop Time: 2:52 PM

Both samples slowly came to temperature due to the moisture content in each of them. Both samples came to a stabalizing temperature around 36 to 40 hours into testing. Upon removal from the oven both samples were solid cubes that had become slightly browned on the exterior regions. Since both samples did not exceed 200°C they are both considered to be not self heating.

Sample ID: BVT 7 & 8
Start Date: 08/12/16
Start Time: 4:13 PM
Stop Date: 08/14/16
Stop Time: 3:08 PM

Both samples slowly came to temperature due to the moisture content in each of them. Both samples reached a stable temperature around 32 hours into testing with BVT7 losing a thermocouple early on. Upon removal from the oven both samples had formed a solid cube and become slightly browned. Since both samples did not exceed 200°C they are both considered to be not self heating.

Sample ID: WLVT 1
Start Date: 08/14/16
Start Time: 4:38 PM
Stop Date: 08/16/16
Stop Time: 6:39 PM

This analysis was a rerun of sample WLVT1 since the first time it was run the thermocouples produced anomalies that would have showed the sample failed the testing. The sample came to temperature in around 32 hours. When removed from the oven the sample had a dried zeolite color to it with slight browning on the exterior of the cube. Since the sample did not exceed 200°C it is considered to be not self heating.

Analyst Signature: Date: 8/17/16

Reviewed by: Date: 8/17/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Method 1030

Raw Data

Book I.D. 16-0406-001 Book/ Page : 13 0047

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1030 Project# 21592.01.006

Client: LANL TO# 160712-3

LCS Info: excelsior shavings TV= 72.2mm/sec Balance#: NA

Notes:

Sample ID	burn time sec	burn rate mm/sec	description		
LCS	14.31	6.99			
WLVT2	DID NOT BURN	Sample dried, CHARRED, NO FLAME			
WLVT3	DID NOT BURN	Sample popped, gave off ZEOLITE, CHARRED, NO FLAME			
WLVT5	DID NOT BURN	"			"
W LVT4	DID NOT BURN	Sample dried, CHARRED, NO FLAME			
WLVT1	DID NOT BURN	Sample dried, popped/cracked, CHARRED, NO FLAME			
WLVT6	DID NOT BURN	"			"
UVT5	DID NOT BURN	Sample dried BLACK & CHARRED, NO FLAME			
UVT3	DID NOT BURN	Sample DRIED, CHARRED, NO FLAME			
WVT7	DID NOT BURN	Sample dried, BUBBLED, CHARRED, CRACKED, NO FLAME			
LCS1 (DUC)	18.25	5.48			
LCS2	5.12	19.53			
LCS3	15.32	6.53			
LCS4	8.17	12.24			

Calculation:

Analyst Signature: Date: 7/8/16

Reviewed by: Date: 7/15/16

Book I.D. 16-0406-001 Book/ Page : 13 0054

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1030 Project# 15720L.006

Client: LANL TO# 16712-3

LCS Info: ascorbic acid TV= 72.2mm/sec Balance#:

Notes:

Sample ID	burn time sec	burn rate mm/sec	description		
LCS	13.56	7.37			
UVT2	no burn	became a greish white color at burn zone, no other changes noted			
UVT1	no burn	became a grey white to charred color at burn zone			
UVT 4C Team 7/24/16	no burn	blackened and charred at burn zone			
UVT4D	no burn	bubbling on the surface and blackening in the heat zone			
UVT 64 Team 7/24/16	no burn	bubbling on the surface and blackening in the heat zone			

SA M 7/25/16

Calculation:

Analyst Signature: Date: 7/22/16

Reviewed by: Date: 8/17/16

Book I.D. 16-0406-001 Book/ Page : 13 0059

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1030 Project# 21592.01.006

Client: LANL TO# 160712-3

LCS Info: excelsior wood TV= >2.2mm/sec Balance#: NA

Notes:

	Sample ID	burn time sec	burn rate mm/sec	notes
	LCS	10.65	9.39	
	BVT 1	did not burn	bubbled when flame was applied, several loud pops were heard, browned, pulverized, and turned a silvery color. (pictures)
	BVT 2	did not burn	bubbled when flame applied. several loud pops heard. similar appearance to BVT 1
	BVT 3	did not burn	only bubbled for the first minute, similar appearance to BVT 1
	BVT 4	did not burn	slight bubbling down the train and a few pops heard. Similar appearance to BVT 1
	BVT 5	did not burn	bubbling during heat application and the burn zone. slight popping similar appearance to BVT 1 (pictures)
8/9/16	BVT 6	did not burn	Popping sounds heard. Similar appearance to BVT 1 without the bubbling
8/9/16	BVT 7	did not burn	few pops heard. Similar in appearance to BVT6
8/9/16	BVT 8	did not burn	lots of popping. similar in appearance to BVT6
8/9/16	BVT 9	did not burn	blackened when flame applied and then would become grey (pictures)
8/9/16	BVT 10	did not burn	Similar to BVT 9
8/9/16	BVT 11	did not burn	primarily blackened and greyed.
8/9/16	BVT 12	did not burn	primarily blackened and greyed.
8/9/16	LCS 11	12.02	8.32

JAM 8/9/16

Calculation:

Analyst Signature: Date: 8/18/16

Reviewed by: Date: 8/17/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Method 9095
Paint Filter
Raw Data

Book I.D. 16-0406-001 Book/ Page : 13 0046

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: Paint Filter 9095 Project# 21592.01.006

Client: LANL TO# 160712-3

LCS Info: DI H2O TV= fail Balance#: 135

Notes:

Sample ID	Pass Fail	Sample wgt (g)
LCSI	Fail	100.1237
WLVT3	PASS	101.7855
WLVT2	PASS	104.2440
WLVT1	PASS	102.8538
WLVT6	FAIL	100.4639
WLVT5	PASS	103.7310
WLVT4	FAIL	102.6226
WLVT7	FAIL	101.2855
UVT3	PASS	102.4609
UVT5	PASS	101.3011

7/8/16

7/8/16

Calculation:

Analyst Signature: Date: 7/7/16

Reviewed by: Date: 7/15/16

Book I.D. 16-0406-001

Book/ Page : 13 0053

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: Paint filter

Project# 21512.01.006

Client: LANL

TO# 160712-3

LCS Info: DI H2O TV= Fail Balance#: 135

Notes:

Sample ID	sample wgt	Pass/Fail			
LCS	100.2149g	Fail			
UVT1	102.1124	Pass			
UVT4	101.0214	Pass	- liquid formed on the outside meniscus of the filter but nothing dripped during the 5 min period		
~~UVT5~~	not needed	run on 7/7/16			
UVT6	101.7471	Pass			
UVT2	103.1117	Pass			
UVT~~7~~ 4 repeat 7/7/16	107.3719	Pass			
~~UVT3~~	not needed	run on 7/7/16			

7/22/16 SAM

Calculation:

Analyst Signature: Date: 7/22/16

Reviewed by: Date: 8/17/16

Book I.D. 16-0406-001 Book/ Page : 13 0060

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: paint filter Project# 21592.01.006

Client: LANL TO# 16007123

LCS Info: DI H2O TV= Fail Balance#: 135

Notes:

Sample ID	pass / fail	Sample wt			
LCS	fail	liquid went through the filter			
BVT1	pass	103.7199g			
BVT2	pass	104.1927			
BVT3	pass	101.2197			
BVT4	pass	105.0139			
BVT5	pass	101.9442			
BVT6	pass	102.7142	8/9/16		
BVT7	pass	101.4441	8/9/16		
BVT8	pass	103.1031	8/9/16		
BVT9	pass	101.0147	8/9/16		
BVT10	pass	101.3989	8/9/16		
BVT11	pass	101.7401	8/9/16		
BVT12	pass	102.0424	8/9/16		
LCSII	Fail	100.7194g	8/9/16		

Calculation:

Analyst Signature: Date: 8/8/16

Reviewed by: Date: 8/11/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Surrogate & Blend Prep Sheets

128 TITLE Los Alamos

PROJECT NO. 21592.01.006

BOOK NO. 15-0406-052

Work continued from Page

SWRI

128-01-WCS12 Nit B Zeo-1

600mL (124-04-WCS12) to 1200mL zeolite

let sit for 24 hr prior to analysis 5/15/16 10:10

128-02-WCS12 Nit B Zeo-2

600mL (124-04-WCS12) to 1800 mL zeolite

128-03-WCS12 UNS solution

8322.851	g aluminum nitrate nonahydrate (# 69597-69598, 69573-69571, 69591-69586)+
840.695	g calcium nitrate (# 69606, 69607)+
61.562	g chromium nitrate (# 66141, 63857)+
595.084	g Iron(III) nitrate (# 63607, 63582)+
40008.600	g magnesium nitrate (# 69603, 69604) +
~~Sodium nitrate~~ 7:23AM 5/16/16 room stirring	
493.5682	g sodium nitrate (# 69611)+
596.525	g lead nitrate (# 65951, 69629, 69625)+
2373.849	g oxalic acid (# 69684)+
2.340	g nickle nitrate (# 65593)+
63.727	g nitric acid (# 67843)
6500.17	g DI H_2O

balance #89

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Work continued to Page

SIGNATURE James Gu DATE 5/15/16

DISCLOSED TO AND UNDERSTOOD BY M. Gradador DATE WITNESS DATE 5/25/16

TITLE Los Alamos

PROJECT NO. 21592.01.006 **131**

BOOK NO. 15-0406-052

Work continued from Page

SWRI

131-01-WCS12 - UVT5 (1:3)

500mL UVS solution (# 128-03-WCS12) + 1500mL solvent
tray #8 let sit for 48 hours start: 5/16/16 15:00

131-02-WCS12 1M HNO_3

63.3mL HNO_3 (# 67843) to FV. 1L with DI H_2O
5000-2 exp 5/16/17

131-03-WCS13 Saturated 1M HNO_3

1L 1M HNO_3 (# 131-02-WCS12) to unsaturated salts from (124-03-WCS12)
then added 600.217g sodium nitrate (#69610)
balance #135

SAM 5/17/16

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Work continued to Page

SIGNATURE [signature] DATE 5/16/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon DATE WITNESS DATE 5/25/16

132 TITLE LANL

PROJECT NO. 21592.01.006
BOOK NO. 15-04006-052

Work continued from Page

SWRI

towels dry 160.066 g
747.00 wet

wypall rags were soaked in UNS solution (128-03-WCS12) for 2 hours and the squeezed to remove excess liquid.

132-01-WCS12 WB1 (1:3)

1 quart of warm water added to blender. Then seven rags were added to blender 1 at a time and blended @ 75% speed for 30 seconds. They were then blended at 75% speed for additional 30 seconds @ end. 1233 mL of this solution was added to the mixer and 1850mL zeolite was slowly added while blending on speed 8 and then speed 3. The remaining 1850mL of zeolite was added while mixing on speed 3 until thoroughly mixed.

132-02-WCS12 WB2 (1:4)

Same procedure as 132-01-WCS12 except only 925mL of wypall solution was added.

132-03-WCS12 WB3 (1:5)

Same procedure as 132-01-WCS12 except only 740mL of wypall solution was added.

132-04-WCS12 UVT 3 (3:1)

1330 mL of UNS solution (128-03-WCS12) added to the mixing bowl. ~~1000mL of warm water was added to the~~ wrong blend AM 5/18/16
2000mL of zeolite slowly added at speed 8 and then lowered to speed 3. The remaining 2000mL of zeolite slowly added at speed 3 until thoroughly mixed.

132-05-WCS12 UVT5 (1:5))

1000mL of warm water and 1500 mL of UNS 1 solvent (131-01-WCS12) added and mixed at speed 4 for 3min. Temp! pH recorded. Then 1850mL zeolite at speed 8 then 3. Remaining 1850mL zeolite added until thoroughly mixed.

Work continued to Page

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SIGNATURE [signature] DATE 5/18/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 5/25/16

178 TITLE LANL

PROJECT NO. 21592.01.0006

BOOK NO. 15-0406-052

Work continued from Page

Waste lock added to each on 7/31/16 SAM

SWRI 178-01-WCS12 · WLVT 1

60mL of wastelock added to 1000mL UNS solution (#128-03-WCS12) and let sit for 48 hours. Blended 1000mL of this solution to 3000mL zeolite and let sit 24 hours prior to analysis.

178-02-WCS12 WLVT 2

120mL of wastelock added to 1000mL UNS solution (#128-03-WCS12) and let sit for 48 hours. Blended 1000mL of this solution to 3000mL zeolite and let sit for 24 hour prior to analysis. TESAM 7/5/16

178-03-WCS12 WLVT 3

240mL wastelock added to 1000mL UNS solution (#128-03-WCS12) and let sit for 48 hours. Blended 1000mL of this solution to 3000mL of zeolite. and let set for 24hr prior to analysis.

178-04-WCS12 WLVT 4

180mL zeolite added to 1000mL UNS solution (#128-03-WCS12) and let set for 48 hours. Blended 1000mL of this solution to 2000mL of zeolite and let set for 24 hours prior to analysis

178-05-WCS12 WLVT 5

120mL wastelock added to 1000mL UNS solution (128-03-WCS12) and let set for 48 hours. Blended 1000mL of this solution to 250mL DI H2O and 3000mL zeolite. Let set for 24 hours prior to analysis.

178-06-WCS12 WLVT 6

120mL wastelock added to 1000mL UNS solution (128-03-WCS12) and let set for 48 hours. Blended 1000mL of this solution with 500mL DI H_2O and 3000mL zeolite. Let set for 24 hours prior to analysis.

178-07-WCS12 WLVT 7

120mL wastelock added to 1000mL UNS solution (128-03-WCS12) and let set for 48 hours Blended 1000mL of this solution with 1000mL DI & 3000 mL zeolite. Let set for 24 hours prior to analysis.

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Work continued to Page

SIGNATURE

DATE 5 WD SAM 7/5/16 7/31/16

DISCLOSED TO AND UNDERSTOOD BY | DATE | WITNESS | DATE 8/1/16

190 TITLE LANL

PROJECT NO. 21542.01.0006

BOOK NO. 15-0106-052

Work continued from Page

SWRI

190-01-WCS12 = WB8

371.804 g aluminum nitrate (#69580, 69577) +
1448.532 g calcium nitrate (#69607) +
18.202 g chromium nitrate (#69635) +
564.727 g iron(III) nitrate (#69599, 63609) +
4149.434 g magnesium nitrate (#69604) +
919.882 g sodium nitrate (#70580) +
326.561 g lead nitrate (#69628, 70093) +
335.577 g oxalic acid (#69684) +
175.071 g potassium carbonate (#69659) mixed and immediately used
balance #05 exp 8/27/16

190-02-WCS12 BVT 8
1300 mL of WB8 (190-01-WCS12) mixed in bowl then 3900mL of zeolite was added and mixed

190-03-WCS12 BVT 6
1490 mL of WB8 (190-01-WCS12) mixed in bowl then 3700mL of zeolite was added and mixed

190-04-WCS12 BVT 4
1730mL of WB8 (190-01-WCS12) mixed in bowl then 3470mL of zeolite was added and mixed

190-05-WCS12 BVT 7
1300mL of WB8 (190-01-WCS12) mixed in bowl with 1000mL warm DI H2O. 3900mL of zeolite mixed into the bowl. still very moist and liquid present.

190-06-WCS12 BVT 9 cut 1/4"
750mL of WB8 (190-01-WCS12) + 750mL sluicate mixed and heated on hotplate @ 60°C until crispy.

190-07-WCS12 BVT 10 cut 1/4"
500mL WB8 (190-01-WCS12) + 1000mL of solvent mixed and heated @ 60°C until crispy

190-08-WCS12 ; 190-09-WCS12 - BVT 11, 12
Same as 06/07 except ratio was 375 WB8 to 1125 solvent
250 WB8 to 1250 solvent

Work continued to Page

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SIGNATURE James Mark DATE 7/27/16

DISCLOSED TO AND UNDERSTOOD BY John M. Gabriel DATE WITNESS DATE 8/9/16

TITLE LANL

PROJECT NO. 21592.01.006 **195**

BOOK NO. 15-0406-052

Work continued from Page BVT 12,10,9

SWRI

195-01-WCS12 BVT 12

1400mL of BVT12 Kitty litter (190-01-WCS12) to 800mL warm DI H_2O (40°C) mixed added 4200mL zeolite while mixing.

195-02-WCS12 BVT10

1400mL of BVT10 kitty litter (190-07-WCS12) to 800mL warm DI H_2O, mixed and then added 4200mL zeolite while mixing.

195-03-WCS12 BVT9

1400 mL of BVT9 kitty litter (190-06-WCS12) to 800mL warm DI H_2O mixed and then added 4200mL zeolite while mixing.

195-04-WCS12 BVT11

1400mL of BVT11 kitty litter (190-08-WCS12) to 800mL warm DI H_2O mixed and then added 4200 mL zeolite while mixing.

JAM 8/12/14

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Work continued to Page

SIGNATURE James Mc

DATE 8/12/16

DISCLOSED TO AND UNDERSTOOD BY W. Brandon

DATE

WITNESS

DATE 8/9/14

198 TITLE LANL

PROJECT NO. 21592.01.006

BOOK NO. 15-0406-052

Work continued from Page

SWRI

198-01-WCS12 WBB

371.806 g aluminum nitrate (#69577, 69575) +
1478.533 g calcium nitrate (#69607, 69640) +
18.201 g chromium nitrate (#69635
564.722 g iron(III) nitrate (#72784, 63604)
4149.437 g magnesium nitrate (#69604, 69601)
919.888 g sodium nitrate (#70580)
326.561 g lead nitrate (#70093) +
335.572 g oxalic acid (#69684) +
175.071 g potassium carbonate (#69609, 69660) mixed and used. balance #05

198-02-WCS12 BVT 7

1300mL WBB (198-01-WCS12) mixed with 100mL warm dI (40°C) mixed. Then 3900mL zeolite added while mixing.

198-03-WCS12 BVT 5

1490mL WBB (198-01-WCS12) mixed with 100mL warm DI (40°C). Then 3700mL zeolite added while mixing.

198-04-WCS12 BVT 3

1730mL WBB (198-01-WCS12) mixed with 100mL warm DI H_2O (40°C). Then 3470 mL zeolite added while mixing.

198-05-WCS12 BVT 1

2080mL WBB (198-01-WCS12) mixed with 100mL warm DI (40°C). Then 3120mL zeolite added while mixing.

198-06-WCS12 BVT 2

2080mL WBB (198-01-WCS12) mixed with ~~100mL warm DI H_2O~~ 3120mL zeolite. JAM 8/5/16

Inadvertently skipped page 197. JAM 8/9/16

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Work continued to Page

SIGNATURE James Mc

DATE 8/5/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon

DATE

WITNESS

DATE 8/9/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Certificates of Calibrations

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38184
Asset Number:	022488	Calibrated:	9/10/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/10/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	73.2°F / 62 %
Serial Number:	22488	Work Order #	403134274
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134274	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022488	Model	08516-96	Type Data:	Found-left
Serial No.	22488	Type.	Thermocouple Probe, Type K	Cal Date:	10-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.3	0.4	3.7	1.3	Pass	9%
	750.3	749.9	-0.4	5.6	1.3	Pass	7%
	1002.9	1000.5	-2.4	7.5	1.3	Pass	32%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38118
Asset Number:	022473	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22473	Work Order #	403134196
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134196	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022473	Model	08516-96	Type Data:	Found-left
Serial No.	22473	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-38.2	1.6	2.2	0.5	Pass	72%
	99.7	99.2	-0.5	2.2	0.5	Pass	24%
	498.0	498.7	0.8	3.7	1.3	Pass	20%
	750.3	750.9	0.6	5.6	1.3	Pass	11%
	1002.9	1001.5	-1.4	7.5	1.3	Pass	19%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	36974
Asset Number:	022396	Calibrated:	8/19/2015
Description:	THERMOCOUPLE, TYPE K	Calibration Due:	8/19/2016
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	93631-11	Temp./RH:	73.6°F / 58 %
Serial Number:	22396	Work Order #	403133757
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -80 °C TO 1000 °C. See Measurement Report for values and limits applied.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-found
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	18-Aug-15
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	2.2	0.5	Fail	159%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	3.0	1.3	Fail?	100%
	699.3	702.6	3.3	5.2	1.3	Pass	63%
	1002.6	1002.4	-0.2	7.5	1.3	Pass	3%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403133757	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022396	Model	93631-11	Type Data:	As-left
Serial No.	22396	Type.	Thermocouple, Type K	Cal Date:	19-Aug-15

Remarks: limits set to ±5% of reading for test point at -80 ℃ and 400 ℃ and above, per customer. Rem ainder of test points calibrated to standard Type K limits.

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.6	-76.1	3.5	4.0	0.5	Pass	88%
	-44.4	-42.8	1.6	2.2	0.5	Pass	73%
	-0.1	0.3	0.4	2.2	0.5	Pass	18%
	99.7	99.3	-0.4	2.2	0.5	Pass	20%
	398.4	401.4	3.0	20.0	1.3	Pass	15%
	699.3	702.6	3.3	35.0	1.3	Pass	9%
	1002.6	1002.4	-0.2	50.0	1.3	Pass	0%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47205
Asset Number:	022923	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22923	Work Order #	403137431
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137431	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022923	Model:	08516-96	Type Data:	As-found
Serial No.:	22923	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-76.3	2.8	2.2	0.5	Fail	127%
	0.2	0.0	-0.2	2.2	0.5	Pass	9%
	396.7	396.0	-0.7	3.0	1.3	Pass	24%
	698.9	698.0	-0.9	5.2	1.3	Pass	17%
	1101.6	1094.9	-6.7	8.3	1.3	Pass	81%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137431	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022923	Model:	08516-96	Type Data:	As-left
Serial No.:	22923	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	3.0	0.5	Pass	63%
	0.2	0.0	-0.2	2.2	0.5	Pass	9%
	396.7	396.5	-0.2	3.0	1.3	Pass	7%
	698.9	698.0	-0.9	5.2	1.3	Pass	17%
	1101.6	1094.9	-6.7	8.3	1.3	Pass	81%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	57053
Asset Number:	023323	Calibrated:	7/27/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	7/27/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	77.2°F / 53 %
Serial Number:	23323	Work Order #	403141261
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -20 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403141261	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023323	Model:	08516-96	Type Data:	Found-left
Serial No.:	23323	Type:	Thermocouple Type K	Cal Date:	27-Jul-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-20.1	-19.1	1.0	2.2	0.5	Pass	45%
	200.5	201.7	1.2	2.2	0.5	Pass	55%
	497.6	499.2	1.6	3.7	1.3	Pass	43%
	752.0	754.5	2.5	5.6	1.3	Pass	44%
	1004.1	1006.1	2.0	7.5	1.3	Pass	27%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	53401
Asset Number:	023174	Calibrated:	5/25/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	5/25/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	75.4°F / 57 %
Serial Number:	23174	Work Order #	403139870
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 200 °C.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403139870	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023174	Model:	08516-96	Type Data:	Found-left
Serial No.:	23174	Type:	Thermocouple Type K	Cal Date:	25-May-16

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if reading meets their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	2.2	0.5	Pass	86%
	0.0	0.3	0.3	2.2	0.5	Pass	14%
	99.7	99.4	-0.3	2.2	0.5	Pass	14%
	200.5	200.8	0.3	2.2	0.5	Pass	14%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	38121
Asset Number:	022476	Calibrated:	9/9/2015
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/9/2016
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	74.3°F / 56 %
Serial Number:	22476	Work Order #	403134199
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	1/13/2016
010281	HART SCIENTIFIC	5628	SPRT	2/19/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/21/2015
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
013908	HART SCIENTIFIC	5628	SPRT	2/18/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/20/2015

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134199	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.	022476	Model	08516-96	Type Data:	Found-left
Serial No.	22476	Type.	Thermocouple Probe, Type K	Cal Date:	9-Sep-15
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.					

Function/Range	Test Point	TI Reading	Difference	+/- Limit	+/- Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.8	-37.9	1.9	2.2	0.5	Pass	86%
	99.7	99.0	-0.7	2.2	0.5	Pass	33%
	498.0	497.7	-0.3	3.7	1.3	Pass	7%
	750.3	749.6	-0.7	5.6	1.3	Pass	12%
	1002.9	999.9	-3.0	7.5	1.3	Pass	40%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47207
Asset Number:	022925	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22925	Work Order #	403137433
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-found
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-75.9	3.2	2.2	0.5	Fail	145%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-left
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-42.5	2.4	3.0	0.5	Pass	80%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	55288
Asset Number:	005420	Calibrated:	6/24/2016
Description:	BALANCE	Calibration Due:	6/24/2017
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	AG245	Temp./RH:	71 °F / 54 %
Serial Number:	1116031935	Work Order #	403140609
Calibration Procedure:	BALANCES & SCALES		

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2016
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute

Calibration Certificate

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Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403140609	Mfr:	Mettler	Technician:	RRV
Asset No:	005420	Model:	AG245	Type Data:	Found-left
Serial No:	1116031935	Type:	Balance	Cal Date:	24-Jun-16

Remarks:The balance has resulted in a <Pass?> at multiple test points. An external calibration was performed but it did not improve the results. Customer to determine if the results found meet their requirements

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Front		99.9999	-0.0001	0.0006	Pass	17%
Rear		100.0000	0.0000		Pass	0%
Left		100.0001	0.0001		Pass	17%
Right		99.9999	-0.0001		Pass	17%
Repeatability						
< 41 g Range						
1	20	20.00002				
2		20.00003				
3		20.00003				
4		20.00002				
5		20.00001				
6		20.00002				
7		20.00000				
8		20.00003				
9		20.00002				
10		20.00003				
Std Deviation		0.000010		0.000040	Pass	25%
Repeatability						
< 205 g Range						
1	100	100.0000				
2		100.0002				
3		100.0000				
4		100.0000				
5		100.0002				
6		100.0001				
7		100.0002				
8		100.0001				
9		100.0001				
10		100.0003				
Std Deviation		0.00010		0.00020	Pass	50%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
< 41 g Range	0.00000	0.00000	0.00000	0.00006	0.000059	Pass	0%
	4.00003	4.00003	0.00000			Pass	0%
	8.00000	8.00002	0.00002			Pass	33%
	11.99998	12.00000	0.00002			Pass	33%
	15.99994	15.99998	0.00004			Pass?	67%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403140609	Mfr:	Mettler	Technician:	RRV
Asset No:	005420	Model:	AG245	Type Data:	Found-left
Serial No:	1116031935	Type:	Balance	Cal Date:	24-Jun-16

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
< 41 g Range *(Cont)*	19.99998	20.00001	0.00003			Pass	50%
	24.00001	24.00007	0.00006	0.00006	0.000059	Pass?	100%
	27.99998	27.99996	-0.00002			Pass	33%
	31.99996	31.99998	0.00002			Pass	33%
	35.99994	36.00000	0.00006			Pass?	100%
	39.99995	40.00000	0.00005			Pass?	83%
< 205 g Range	0.0000	0.0000	0.0000	0.0004	0.00020	Pass	0%
	20.0000	20.0000	0.0000			Pass	0%
	40.0000	40.0000	0.0000			Pass	0%
	60.0000	60.0000	0.0000			Pass	0%
	79.9999	80.0000	0.0001			Pass	25%
	100.0001	100.0000	-0.0001			Pass	25%
	120.0000	119.9999	-0.0001			Pass	25%
	140.0000	139.9999	-0.0001			Pass	25%
	160.0000	159.9999	-0.0001			Pass	25%
	180.0000	179.9999	-0.0001			Pass	25%
	199.9997	199.9997	0.0000			Pass	0%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39984
Asset Number:	020014	Calibrated:	10/7/2015
Description:	BALANCE	Calibration Due:	10/7/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	72 °F / 49 %
Serial Number:	B338797310	Work Order #	403134943
Calibration Procedure:	BALANCES & SCALES		

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2015
001705	TROEMNER	2 G	WEIGHT CLASS 1	7/2/2016
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/8/2016
001707	TROEMNER	5 G	WEIGHT CLASS 1	7/29/2016
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/2/2016
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/5/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0002	0.0002	0.0006	Pass	33%
Left Rear		100.0003	0.0003		Pass	50%
Right Rear		100.0001	0.0001		Pass	17%
Right Front		100.0002	0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	80.00001				
2		80.00002				
3		80.00001				
4		80.00002				
5		80.00001				
6		80.00002				
7		80.00002				
8		80.00002				
9		80.00002				
10		80.00002				
Std Deviation		0.000005		0.00008	Pass	6%
< 220 g Range						
1	200	200.0001				
2		200.0000				
3		200.0002				
4		200.0001				
5		200.0002				
6		200.0001				
7		200.0002				
8		200.0002				
9		200.0002				
10		200.0002				
Std Deviation		0.00007		0.00020	Pass	35%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.06	Pass	0%
	8.00001	8.00002	0.01			Pass	3%
	15.99996	15.99995	-0.01			Pass	3%
	24.00005	24.00010	0.05			Pass	13%
	32.00000	32.00006	0.06			Pass	15%
	40.00002	40.00007	0.05			Pass	13%
	48.00003	48.00006	0.03			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134943	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	7-Oct-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99998	56.00006	0.08	0.40	0.06	Pass	20%
	63.99999	64.00014	0.15			Pass	38%
	72.00002	72.00018	0.16			Pass	40%
	79.99998	80.00009	0.11			Pass	28%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.18	Pass	0%
< 220 g Range	20.0000	20.0001	0.1			Pass	25%
	40.0000	40.0000	0.0			Pass	0%
	60.0000	60.0001	0.1			Pass	25%
	80.0000	80.0001	0.1			Pass	25%
	100.0001	100.0000	-0.1			Pass	25%
	120.0001	120.0001	0.0			Pass	0%
	140.0001	140.0002	0.1			Pass	25%
	160.0001	160.0002	0.1			Pass	25%
	180.0001	180.0002	0.1			Pass	25%
	199.9999	200.0002	0.3			Pass	75%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	55298
Asset Number:	009065	Calibrated:	6/24/2016
Description:	BALANCE	Calibration Due:	6/24/2017
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	PR2003DR	Temp./RH:	71 °F / 54 %
Serial Number:	1120351000	Work Order #	403140638
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/13/2017
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/8/2016
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/6/2017
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/6/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403140638	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	24-Jun-16
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Left Front	1000	1000.000	0.000	0.006	Pass	0%
Left Rear		1000.000	0.000		Pass	0%
Right Rear		1000.000	0.000		Pass	0%
Right Front		1000.000	0.000		Pass	0%
Repeatability						
500 gram Range						
1	200	200.000				
2		200.001				
3		200.002				
4		200.000				
5		200.000				
6		200.001				
7		200.002				
8		200.000				
9		200.001				
10		200.000				
Std Deviation		0.0008		0.0020	Pass	40%
2000 gram Range						
1	1000	1000.00				
2		1000.00				
3		1000.00				
4		1000.00				
5		1000.00				
6		1000.00				
7		1000.00				
8		1000.00				
9		1000.00				
10		1000.00				
Std Deviation		0.000		0.006	Pass	0%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
500 gram Range	0.000	0.000	0.000	0.004	0.0018	Pass	0%
	50.000	50.000	0.000			Pass	0%
	100.000	100.001	0.001			Pass	25%
	150.000	150.001	0.001			Pass	25%
	200.000	200.001	0.001			Pass	25%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403140638	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	24-Jun-16

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing *(cont.)*	grams	grams	grams	grams	grams		
500 gram Range	250.000	250.001	0.001	0.004	0.0018	Pass	25%
	300.000	300.001	0.001			Pass	25%
	350.000	350.001	0.001			Pass	25%
	400.000	400.000	0.000			Pass	0%
	450.000	450.000	0.000			Pass	0%
	500.000	500.000	0.000			Pass	0%
Direct Weighing	0.00	0.00	0.00	0.01	0.012	Pass	0%
2000 gram Range	200.00	200.00	0.00			Pass	0%
	400.00	400.00	0.00			Pass	0%
	600.00	600.00	0.00			Pass	0%
	800.00	800.00	0.00			Pass	0%
	1000.00	1000.00	0.00			Pass	0%
	1200.00	1200.00	0.00			Pass	0%
	1400.00	1400.00	0.00			Pass	0%
	1600.00	1600.00	0.00			Pass	0%
	1800.00	1800.00	0.00			Pass	0%
	2000.00	2000.00	0.00			Pass	0%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39314
Asset Number:	014982	Calibrated:	9/25/2015
Description:	BALANCE	Calibration Due:	9/25/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XP5003SDR	Temp./RH:	73 °F / 48 %
Serial Number:	1129300727	Work Order #	403134658
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/12/2016
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/8/2016
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/7/2016
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016
001718	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

001719 RICE LAKE 5 KG WEIGHT CLASS 1 4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134658	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	25-Sep-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Left Front	1000	1000.000	0.000	0.010	Pass	0%
Left Rear		999.999	-0.001		Pass	10%
Right Rear		1000.000	0.000		Pass	0%
Right Front		1000.001	0.001		Pass	10%
Repeatability						
1000 g Range						
1	500	500.002				
2		500.000				
3		500.001				
4		500.002				
5		500.000				
6		500.000				
7		500.001				
8		500.001				
9		500.001				
10		500.000				
Std Deviation		0.0008		0.0020	Pass	40%
5100 g Range						
1	2000	199.99				
2		200.00				
3		199.99				
4		199.99				
5		200.00				
6		200.00				
7		199.99				
8		199.99				
9		199.99				
10		199.99				
Std Deviation		0.005		0.012	Pass	42%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
1000 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	100.000	100.001	0.001			Pass	8%
	200.000	200.001	0.001			Pass	8%
	300.000	300.001	0.001			Pass	8%
	400.000	400.001	0.001			Pass	8%
	500.000	500.002	0.002			Pass	17%
	600.000	600.003	0.003			Pass	25%
	700.000	700.002	0.002			Pass	17%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134658	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	25-Sep-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	grams	grams	grams		
1000 g Range	800.000	800.002	0.002	0.012	0.003	Pass	17%
	900.000	900.001	0.001			Pass	8%
	1000.000	1000.000	0.000			Pass	0%
5100 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	500.000	500.001	0.001			Pass	8%
	1000.000	999.999	-0.001			Pass	8%
	1500.00	1500.00	0.00	0.02	0.01	Pass	0%
	2000.00	2000.00	0.00			Pass	0%
	2500.00	2500.00	0.00			Pass	0%
	3000.00	3000.00	0.00			Pass	0%
	3500.00	3500.00	0.00			Pass	0%
	4000.00	4000.00	0.00			Pass	0%
	4500.00	4500.00	0.00			Pass	0%
	5000.00	5000.00	0.00			Pass	0%

END OF REPORT

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Certificates of Analysis for Chemicals

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

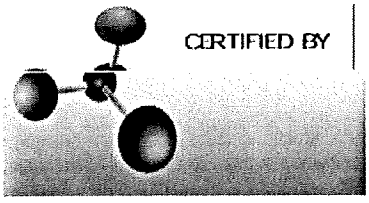
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Elgin E. Hare

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69592
SwRI Chem ID: 69592
SwRI Chem ID: 69592

Fisher Scientific

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Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

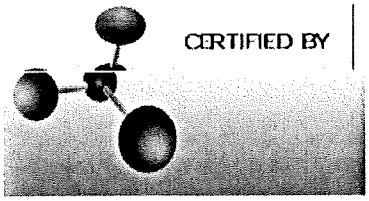
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SwRI Chem ID: 69593

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69593



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69593

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
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201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

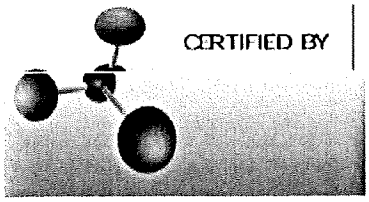
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SwRI Chem ID: 69594

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69594



Elgan E. Hare

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69594

Fisher Scientific

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Fair Lawn, NJ 07410
201.796.7100 tel
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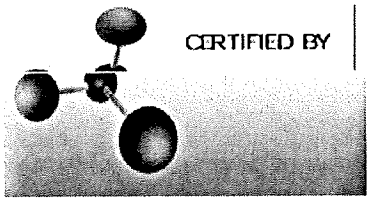
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hans

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69595
SwRI Chem ID: 69595
SwRI Chem ID: 69595

Fisher Scientific

1 Reagent Lane
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Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

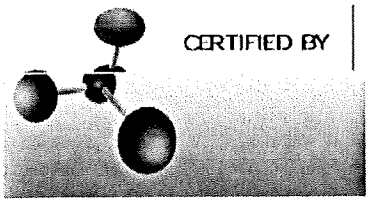
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SwRI Chem ID: 69596

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69596



Elyse E. Hare

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69596

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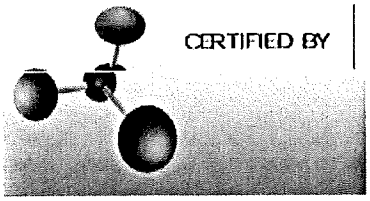
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Elyan E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69597
SwRI Chem ID: 69597
SwRI Chem ID: 69597

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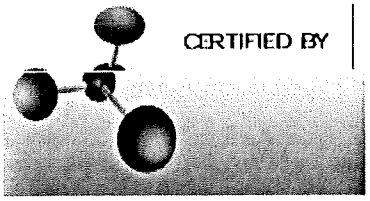
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69571
SwRI Chem ID: 69571
SwRI Chem ID: 69571

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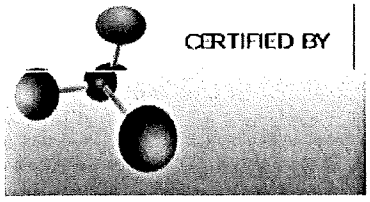
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SwRI Chem ID: 69572

Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69572



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SwRI Chem ID: 69572

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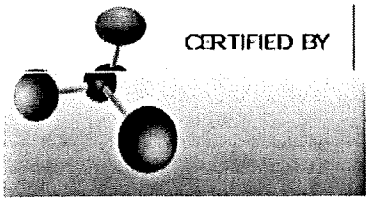
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SwRI Chem ID: 69573

Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69573



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Lab Manager Fair Lawn

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SwRI Chem ID: 69573

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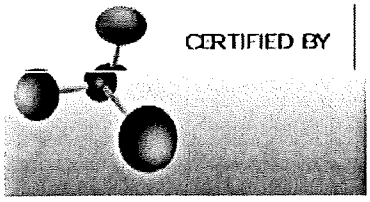
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SwRI Chem ID: 69586

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69586



Edgar E. Hans

Lab Manager Fair Lawn

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SwRI Chem ID: 69586

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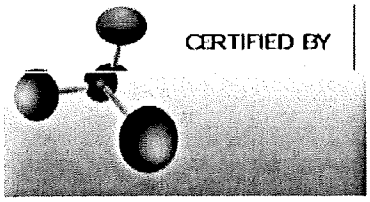
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SwRI Chem ID: 69587

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69587



Elyse E. Hare

Lab Manager Fair Lawn

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SwRI Chem ID: 69587

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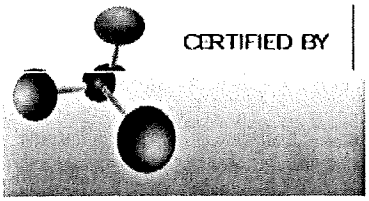
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hess

Lab Manager Fair Lawn

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SwRI Chem ID: 69588
SwRI Chem ID: 69588
SwRI Chem ID: 69588

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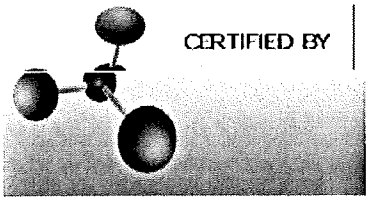
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SwRI Chem ID: 69589

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69589



Elgan E. Hess

Lab Manager Fair Lawn

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SwRI Chem ID: 69589

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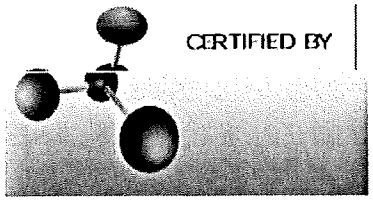
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SwRI Chem ID: 69590

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69590



Lab Manager Fair Lawn

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SwRI Chem ID: 69590

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

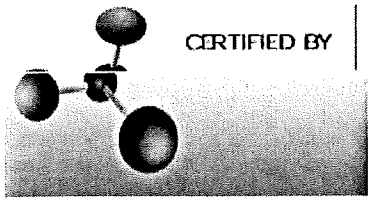
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SwRI Chem ID: 69591

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69591

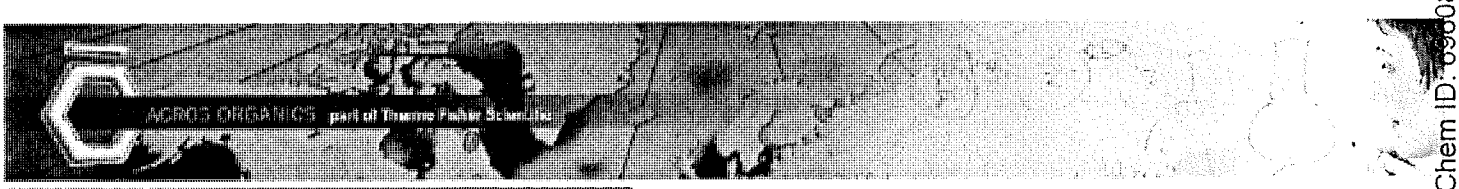


Elyse E. Hare

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69591



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

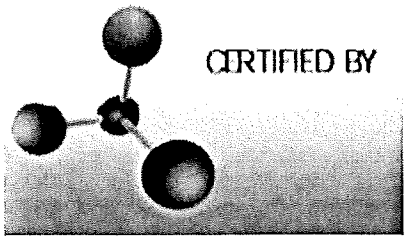
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Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608

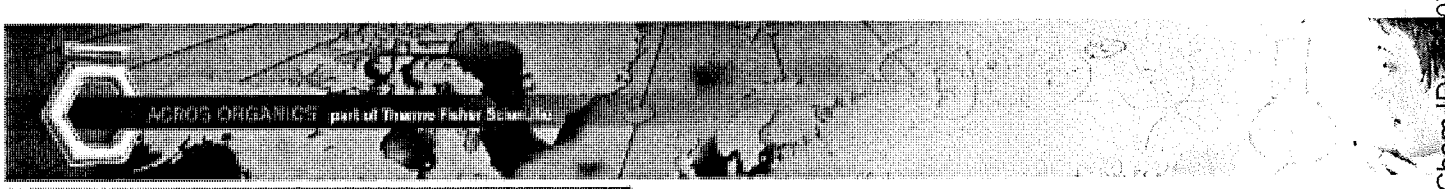


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L. Van den Broek, QA Manager Issued: 25 April 2016

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Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

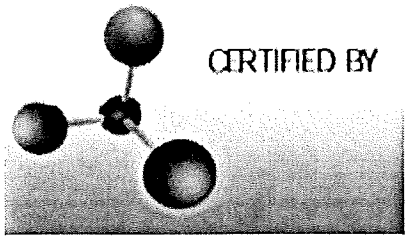
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Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69607
SwRI Chem ID: 69607
SwRI Chem ID: 69607



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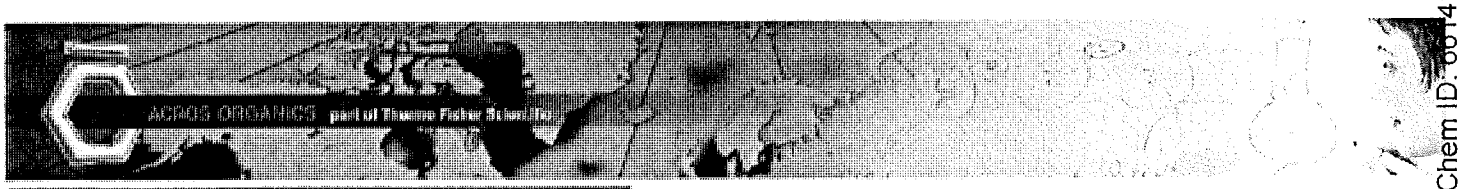
L. Van den Broek, QA Manager Issued: 25 April 2016

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SwRI Chem ID: 69607

SwRI Chem ID: 69607

SwRI Chem ID: 69607



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

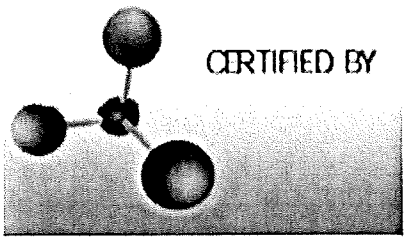
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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm
Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)

SwRI Chem ID: 66141
SwRI Chem ID: 66141
SwRI Chem ID: 66141

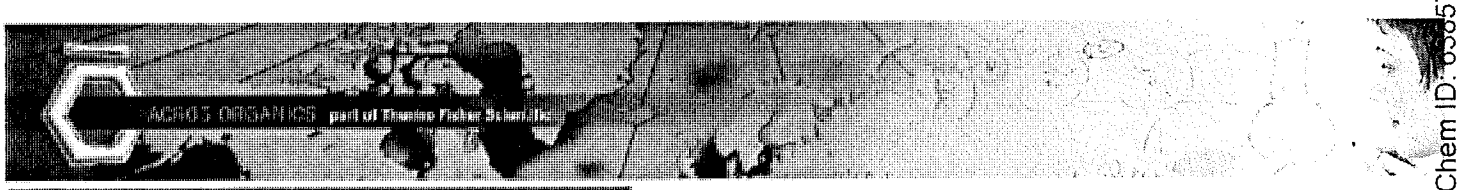


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L. Van den Broek, QA Manager Issued: 14 January 2016

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SwRI Chem ID: 66141
SwRI Chem ID: 66141
SwRI Chem ID: 66141



Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

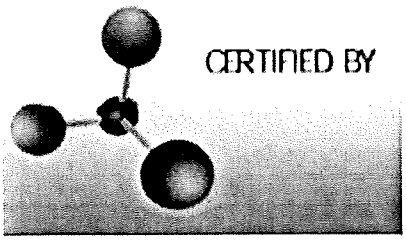
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Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	dark purple to black crystalline chunks	black crystalline chunks
Titration Iodometric	>=98.5 %	101.9 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Trace analysis	Type: Ca measure =< 50 PPM	Type: Ca measure 5 PPM
Trace analysis	Type: Cd measure =< 10 PPM	Type: Cd measure 3 PPM
Trace analysis	Type: Co measure =< 10 PPM	Type: Co measure 5 PPM
Trace analysis	Type: Cu measure =< 10 PPM	Type: Cu measure 7 PPM
Trace analysis	Type: Fe measure =< 200 PPM	Type: Fe measure 178 PPM
Trace analysis	Type: Mg measure =< 50 PPM	Type: Mg measure 6 PPM
Trace analysis	Type: Mn measure =< 10 PPM	Type: Mn measure 7 PPM
Trace analysis	Type: Na measure =< 50 PPM	Type: Na measure 17 PPM
Trace analysis	Type: Ni measure =< 50 PPM	Type: Ni measure 8 PPM
Trace analysis	Type: Pb measure =< 20 PPM	Type: Pb measure 4 PPM
Trace analysis	Type: Sr measure =< 50 PPM	Type: Sr measure 11 PPM
Trace analysis	Type: Zn measure =< 10 PPM	Type: Zn measure 4 PPM
Trace analysis	Type: Cl measure =< 20 PPM	Type: Cl measure =< 20 PPM
Trace analysis	Type: SO4 measure =< 50 PPM	Type: SO4 measure =< 50 PPM
Trace analysis	Type: NH4 measure =< 10 PPM	Type: NH4 measure =< 10 PPM
Subst not pptd by NH4OH	=<0.2 % (as SO4)	=<0.0077 % (as SO4)

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857



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L. Van den Broek, QA Manager Issued: 28 October 2015

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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857

SwRI Chem ID: 63604

SIGMA-ALDRICH®

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate - ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 63604

SwRI Chem ID: 63604

SwRI Chem ID: 65582

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBW6908V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	16 OCT 2015

SwRI Chem ID: 65582

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

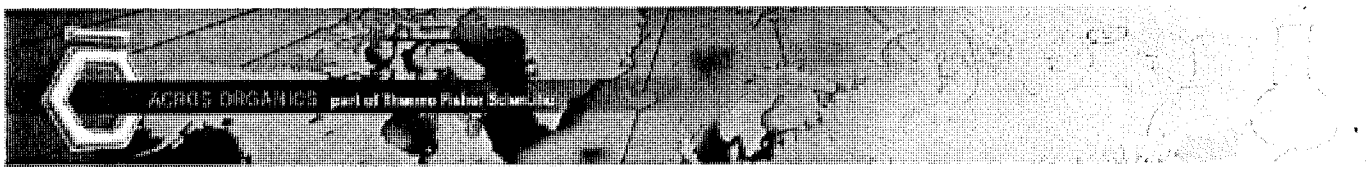
Michael Grady, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 65582

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65582

SwRI Chem ID: 69603



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

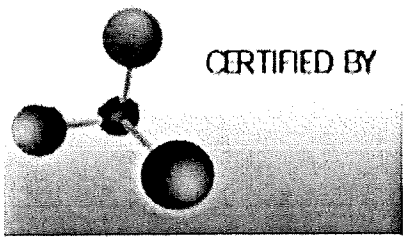
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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



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L. Van den Broek, QA Manager

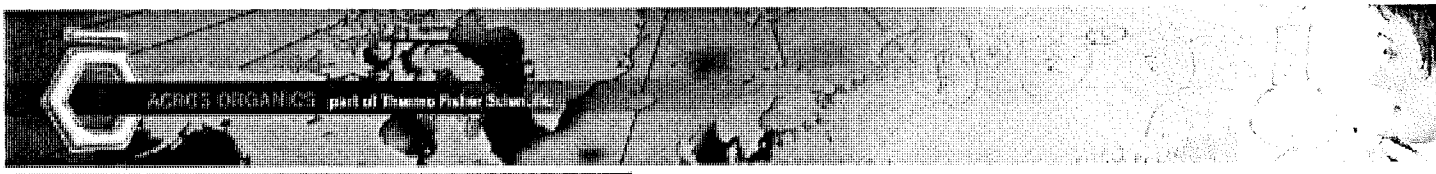
Issued: 25 April 2016

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SwRI Chem ID: 69603

SwRI Chem ID: 69603

SwRI Chem ID: 69604



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

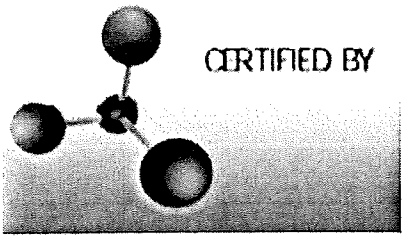
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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



CERTIFIED BY

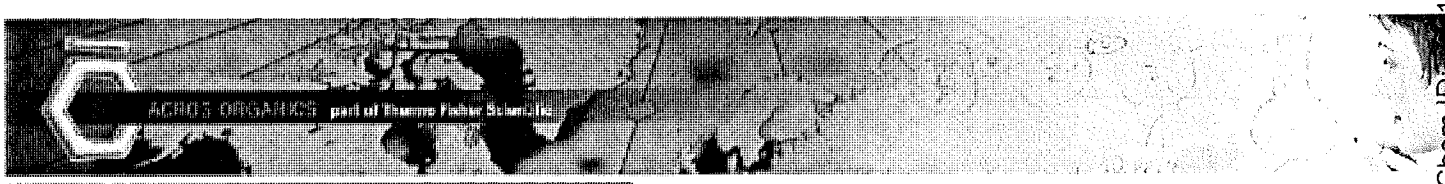
L. Van den Broek, QA Manager

Issued: 25 April 2016

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SwRI Chem ID: 69604

SwRI Chem ID: 69604



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

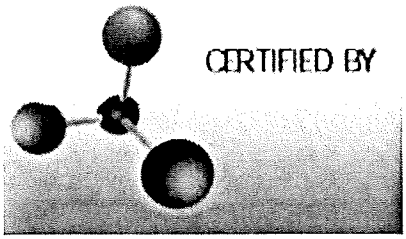
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Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69611
SwRI Chem ID: 69611
SwRI Chem ID: 69611

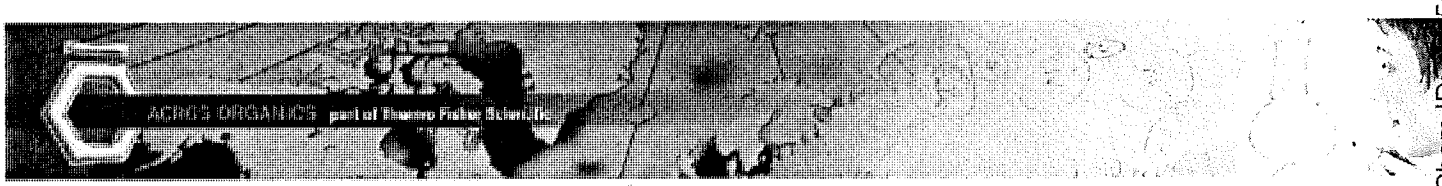


CERTIFIED BY

L. Van den Broek, QA Manager Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69611
SwRI Chem ID: 69611
SwRI Chem ID: 69611



SwRI Chem ID: 65951

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

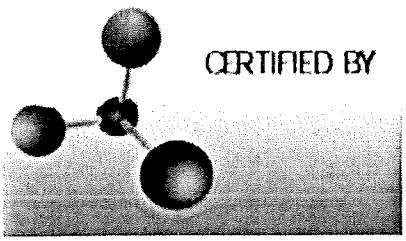
Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 7 January 2016

Acros Organics
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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 65951

SwRI Chem ID: 65951



SwRI Chem ID: 69629

ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

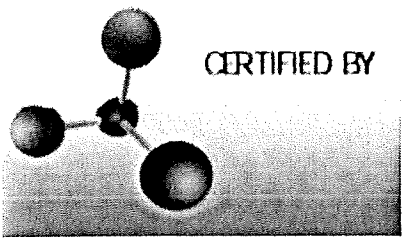
Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

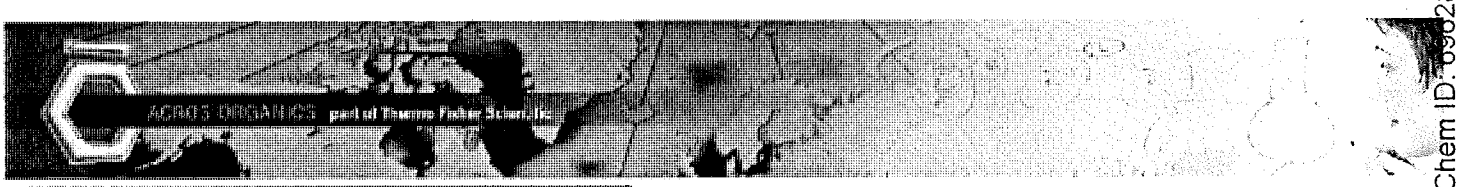
Issued: 26 April 2016

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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69629

SwRI Chem ID: 69629

SwRI Chem ID: 69628



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

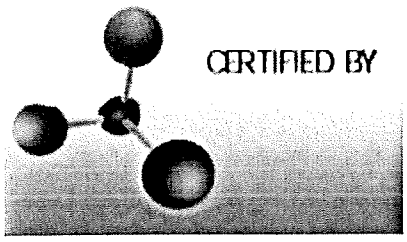
Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

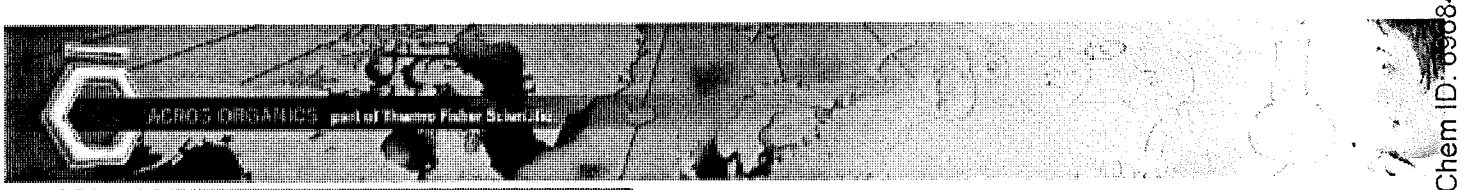
Issued: 26 April 2016

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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69628

SwRI Chem ID: 69628

SwRI Chem ID: 69684



Version	0
Molecular weight	126.04
Molecular formula	C2 H2 O4 . 2 H2 O
CAS No	6153-56-6
Linear formula	HO2CCO2H.2H2O
Flash point (°C)	

Certificate of Analysis

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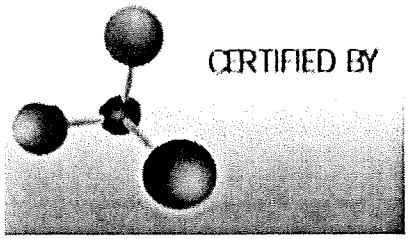
Catalog Number	42315	**Quality Test / Release Date**	10 December 2014
Lot Number	A0354614	**Suggested Retest Date**	December 2019
Description	Oxalic acid dihydrate,99.5+%,ACS reagent		
Country of Origin	SPAIN		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystals
Infrared spectrometry	authentic	authentic
Assay Titrimetry	99.5 to 102.5 %	99.9 %
Heavy metals (as Pb)	=<5 ppm	=<2.5 ppm
Residue after ignition	=<0.01 %	0.004 %
Nitrogen compounds (as N)	=<0.001 %	=<0.001 %
Trace analysis	Type: Cl measure =< 20 ppm	Type: Cl measure < 5 ppm
Trace analysis	Type: SO4 measure =< 50 ppm	Type: SO4 measure < 20 ppm
Trace analysis	Type: Ca measure =< 10 ppm	Type: Ca measure < 1 ppm
Trace analysis	Type: Fe measure =< 2 ppm	Type: Fe measure < 2 ppm
Insoluble matter	=<0.005 %	=<0.005 %
Substance darkened by H2SO4	passes test	passes test

SwRI Chem ID: 69684

SwRI Chem ID: 69684



L. Van den Broek, QA Manager Issued: 27 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69684
SwRI Chem ID: 69684
SwRI Chem ID: 69684

SIGMA-ALDRICH®

3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:	NICKEL(II) NITRATE HEXAHYDRATE purum p.a., crystallized, >= 97.0 % KT
Product Number:	72253
Batch Number:	BCBP4160V
Brand:	Sigma-Aldrich
CAS Number:	13478-00-7
Formula:	$Ni(NO_3)_2 \bullet 6H_2O$
Formula Weight:	290.79
Quality Release Date:	26 JAN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	BLUE-GREEN TO DEEP BLUE-GREEN	BLUE-GREEN
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	97.0 - 103.0 %	97.0 %
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
CADMIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
COBALT (ICP)	≤ 500 MG/KG	< 500 MG/KG
COPPER (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 50 MG/KG	< 50 MG/KG
POTASSIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
SODIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
LEAD (ICP)	≤ 50 MG/KG	< 50 MG/KG
ZINC (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 50 MG/KG	< 50 MG/KG

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65593
SwRI Chem ID: 65593
SwRI Chem ID: 65593

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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SwRI Chem ID: 67843

Catalog Number	**A509**	**Mfg. Date**	11/4/2015
Lot Number	**1115100**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

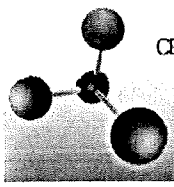
BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	11/04/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

SwRI Chem ID: 67843

SwRI Chem ID: 67843

Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3



CERTIFIED BY

Edgar E Hess — Lab Manager Fair Lawn

Joel Boland — Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1.800.227.6701.

SwRI Chem ID: 67843
SwRI Chem ID: 67843
SwRI Chem ID: 67843

Fisher Scientific

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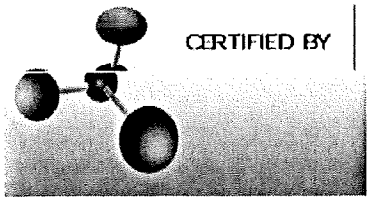
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69580
SwRI Chem ID: 69580
SwRI Chem ID: 69580

Fisher Scientific

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Certificate of Analysis

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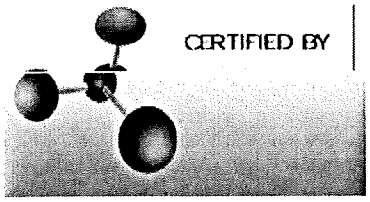
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SwRI Chem ID: 69577

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69577



Elgan E. Hare

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69577

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

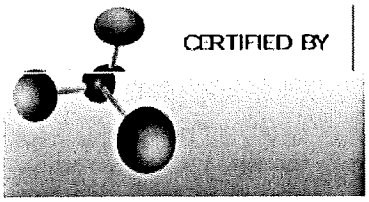
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

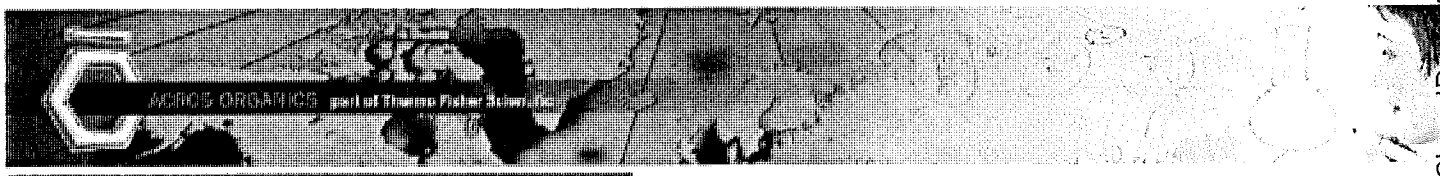
Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69575
SwRI Chem ID: 69575
SwRI Chem ID: 69575



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

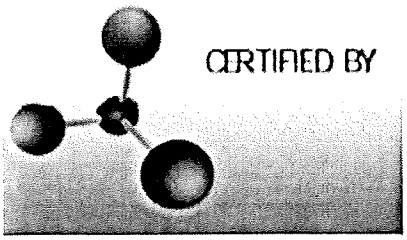
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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm
Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)

SwRI Chem ID: 69635
SwRI Chem ID: 69635
SwRI Chem ID: 69635

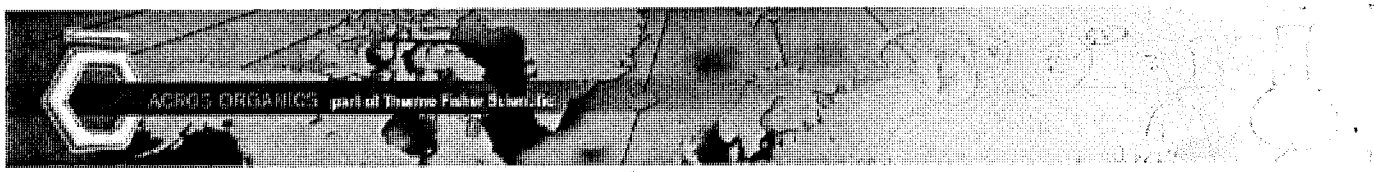


CERTIFIED BY

L. Van den Broek, QA Manager Issued: 26 April 2016

Acros Organics
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Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69635
SwRI Chem ID: 69635
SwRI Chem ID: 69635



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

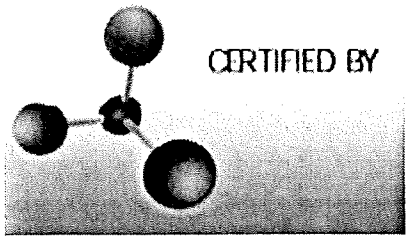
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Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69640
SwRI Chem ID: 69640
SwRI Chem ID: 69640



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L. Van den Broek, QA Manager Issued: 26 April 2016

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SwRI Chem ID: 69640

SwRI Chem ID: 69640

SwRI Chem ID: 69640

SwRI Chem ID: 63604

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate - ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

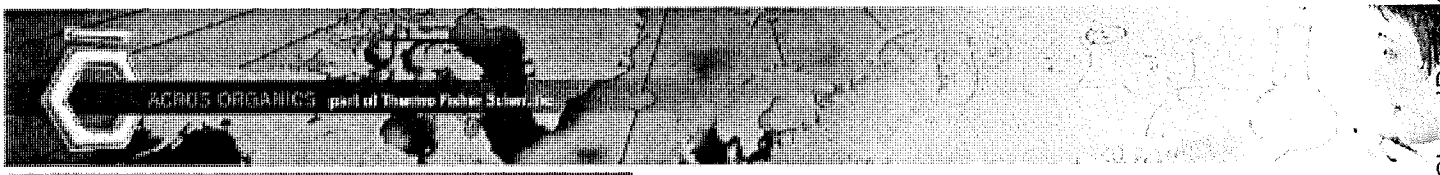
ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 63604

SwRI Chem ID: 63604



Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

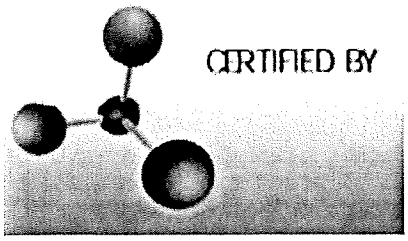
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Catalog Number	42434	**Quality Test / Release Date**	23 December 2015
Lot Number	A0367952	**Suggested Retest Date**	December 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5 % at 25°C)	5.7 (5 % at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 70580
SwRI Chem ID: 70580
SwRI Chem ID: 70580



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L. Van den Broek, QA Manager

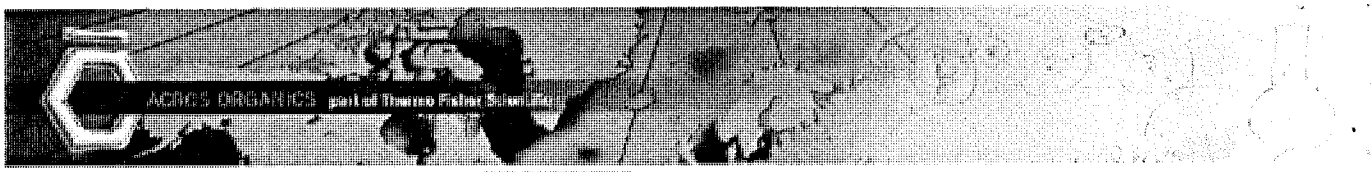
Issued: 20 May 2016

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SwRI Chem ID: 70580

SwRI Chem ID: 70580

SwRI Chem ID: 70580



Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

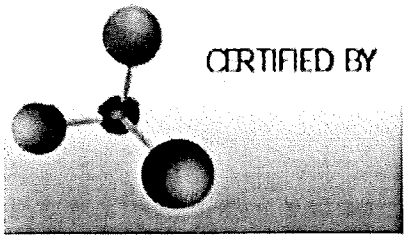
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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm
Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)

SwRI Chem ID: 69635
SwRI Chem ID: 69635
SwRI Chem ID: 69635



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L. Van den Broek, QA Manager

Issued: 26 April 2016

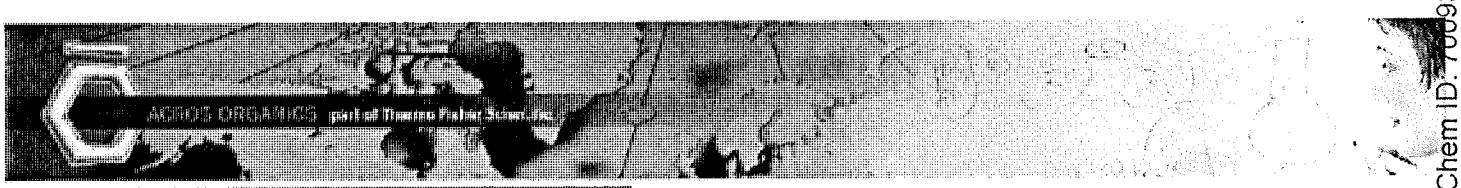
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SwRI Chem ID: 69635

SwRI Chem ID: 69635

SwRI Chem ID: 69635

SwRI Chem ID: 70093



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

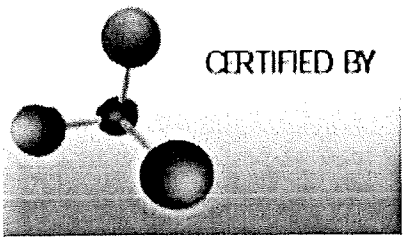
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Catalog Number	21156	**Quality Test / Release Date**	28 May 2015
Lot Number	A0360375	**Suggested Retest Date**	May 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 10 May 2016

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SwRI Chem ID: 70093

SwRI Chem ID: 70093

Fisher Scientific

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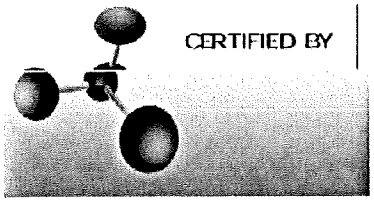
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**I110**	**Quality Test / Release Date**	**11/10/2015**
Lot Number	**157962**		
Description	**FERRIC NITRATE, A.C.S.**		
Country of Origin	**Spain**	*** Suggested Retest Date**	**Nov-2020**
Chemical Origin	**Inorganic-non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

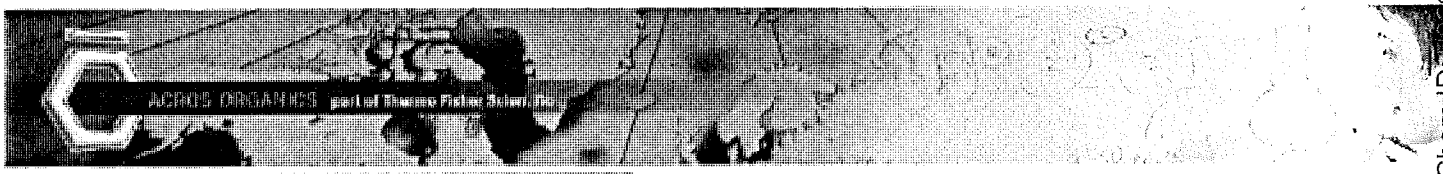
Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	LIGHT-PURPLE CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 101.0	99.9
CALCIUM	%	<= 0.01	<0.010
CHLORIDE	ppm	<= 5	<5.0
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
MAGNESIUM	%	<= 0.005	<0.0050
POTASSIUM (K)	%	<= 0.005	<0.0050
SODIUM (Na)	%	<= 0.05	<0.050
SULFATE (SO4)	%	<= 0.01	<0.010



Quality Control Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 72784
SwRI Chem ID: 72784
SwRI Chem ID: 72784



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

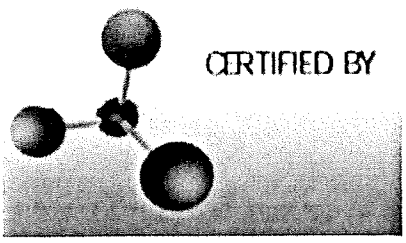
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Catalog Number	44754	**Quality Test / Release Date**	23 December 2015
Lot Number	A0367795	**Suggested Retest Date**	December 2020
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	98 to 102 %	100.2 %
pH	5 to 8.2 (5 % in water)	6 (5 % in water)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 25 April 2016

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SwRI Chem ID: 69601
SwRI Chem ID: 69601
SwRI Chem ID: 69601

Fisher Scientific

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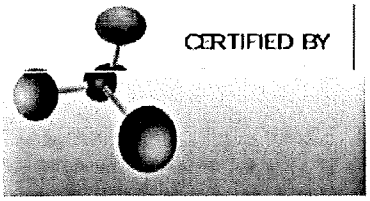
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

This is to certify that units of the lot number below were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	**P208**	**Quality Test / Release Date**	**3/2/2016**
Lot Number	**161550**		
Description	**POTASSIUM CARBONATE, ANHYDROUS, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2021**
Chemical Origin	**Inorganic-non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	White granular powder
ASSAY	%	>= 99.0	99.6
CALCIUM	%	<= 0.005	0.003
CHLORIDE	%	<= 0.003	<0.0030
HEAVY METALS (as Pb)	ppm	<= 5	<5.0
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.01	<0.010
IRON (Fe)	ppm	<= 5	<5.0
MAGNESIUM	%	<= 0.002	<0.0020
PHOSPHATE (PO4)	%	<= 0.001	<0.0010
SILICA (SiO2)	%	<= 0.005	<0.005
SODIUM (Na)	%	<= 0.02	0.002
SULFUR COMPOUNDS	%	<= 0.004	<0.0040



Quality Control Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69659
SwRI Chem ID: 69659
SwRI Chem ID: 69659

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

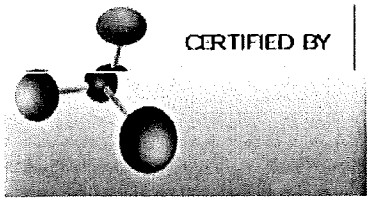
Certificate of Analysis

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Catalog Number	**P208**	**Quality Test / Release Date 3/2/2016**	
Lot Number	**161550**		
Description	**POTASSIUM CARBONATE, ANHYDROUS, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2021**
Chemical Origin	**Inorganic-non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	White granular powder
ASSAY	%	>= 99.0	99.6
CALCIUM	%	<= 0.005	0.003
CHLORIDE	%	<= 0.003	<0.0030
HEAVY METALS (as Pb)	ppm	<= 5	<5.0
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.01	<0.010
IRON (Fe)	ppm	<= 5	<5.0
MAGNESIUM	%	<= 0.002	<0.0020
PHOSPHATE (PO4)	%	<= 0.001	<0.0010
SILICA (SiO2)	%	<= 0.005	<0.005
SODIUM (Na)	%	<= 0.02	0.002
SULFUR COMPOUNDS	%	<= 0.004	<0.0040



Quality Control Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69660
SwRI Chem ID: 69660
SwRI Chem ID: 69660

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160712-3
SwRI SRR: 57965
SDG: 600677
VTSR: 07.11.2016

Balances and DI Water Verification Logs

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
6-15-16	JT	(1) 2000.02	1.999
6-16-16	JT	(1) 2000.02	1.999
6-17-16	JT	(1) 2000.02	1.999
6-20-16	KE	(1) 2000.02	2.000
6-21-16	KE	(1) 2000.02	1.999
6-22-16	KE	(1) 2000.02	2.000
6-23-16	KE	(1) 2000.01	2.000
6-24-16	KE	(2) 2000.00	2.000
6-27-16	JT	(2) 2000.00	1.999
6-28-16	KE	(2) 2000.00	2.002
6/29/16	SAM	(2) 2000.00	1.999
6-30-16	JT	(2) 2000.00	2.000
7-1-16	JT	(2) 2000.00	1.999
7-5-16	KE	(2) 2000.00	2.000
7-6-16	JT	(2) 2000.00	1.999
7-7-16	JT	(2) 2000.00	2.000
7-8-16	KE	(2) 2000.00	2.000
7-11-16	JT	(2) 2000.00	2.000
7-12-16	JT	(2) 2000.00	1.999
7-13-16	KE	(2) 2000.00	1.999
7-14-16	KE	(2) 2000.00	1.999
~~7-15-16~~ 7-15-16 JT	JT	(2) 2000.00	1.999

Comments: (1) See not on page 12 of 15 KE
(2) weight is back. 6-24-16 KE

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.# 15-0406-033

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
7-18-16	KE	2000.00	2.001 KE 7-18-16 ~~2000~~ 2.001
7-19-16	KE	2000.00	2.000
7-20-16	KE	2000.00	2.000
7-21-16	JK	2000,08	1,999
7-22-16	KE	2000.00	2.002
7-25-16	KE	2000.01	2.001
7-26-16	KE	2000.01	2.000
7-27-16	JK	2000.01	1,999
7-28-16	JK	2000,01	2,000
7-29-16	JK	2000,01	2,000
8-1-16	JK	2000,01	2,000
8-2-16	JK	2000,01	2,000
8-3-16	JK	2000,01	2,000
8-4-16	JK	2000,01	2,000
8-5-16	JK	2000,01	2,000
8-6-16	JK	2000,01	2,000
8-8-16	JK	2000,01	1,999
8-9-16	JK	2000,01	1,999
8-10-16	JK	2000,01	1,999
8-11-16	JK	2000,02	2,000
8-12-16	JK	2000,01	1,999
8-15-16	JK	2000,01	1,999

M DQA 8/1/16

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
6/10/16	JCM	199.9998	2.00003	0.01995
6/13/16	SAM	199.9996	1.99996	0.02001
6/14/16	SAM	199.9998	1.99999	0.02003
6/15/16	SAM	199.9996	1.99997	0.01999
6/16/16	M	199.9998	2.00013	0.02002
6-17-16	KE	199.9998	2.00000	0.02001
6-19-16	SAM	199.9997	1.99998	0.02000
6-20-16	KE	199.9994	2.00005	0.01998
6/21/16	SAM	199.9997	1.99998	0.01997
6-22-16	KE	199.9997	1.99996	0.01996
6-23-16	KE	199.9996	1.99995	0.01998
6-24-16	KE	199.9996	1.99996	0.01997
6/27/16	SAM	199.9997	2.00004	0.02000
6-28-16	KE	199.9998	2.00000	0.02002
6/29/16	SAM	199.9998	2.00003	0.01999
6/30/16	SAM	199.9998	2.00000	0.02001
7/1/16	JCM	199.9996	1.99996	0.02000
7-5-16	KE	199.9996	1.99998	0.01996
7/6/16	SAM	199.9999	1.99995	0.01998
7/7/16	SAM	199.9997	2.00004	0.02002
7/8/16	SAM	199.9995	2.00000	0.02000
7/11/16	SAM	199.9998	1.99998	0.02001

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
7/12/16	SAM	199.9996	1.99999	0.01999
7-13-16	KE	199.9995	2.00005	0.02003
7/14/16	SAM	199.9996	1.99999	0.01999
7/15/16	SAM	199.9996	2.00001	0.01996
7/18/16	SAM	199.9998	1.99999	0.02000
7/19/16	JT	199.9994	1.99999	0.02001
7-20-16	KE	199.9996	1.99997	0.01999
7/21/16	MG	199.9997	1.99996	0.01998
7/22/16	JAM	199.99916	1.99999	0.01999
7/25/16	KE	199.9997	1.99991	0.02003
7-26-16	KE	199.9996	1.99999	0.01999
7/27/16	SAM	199.9996	1.99999	0.01999
7/28/16	JAM	199.9996	1.99997	0.01999
7/29/16	MG	199.9998	2.00005	0.02002
8/01/16	SAM	199.9995	1.99998	0.01996
8/2/16	JAM	199.9992	1.99999	0.01999
8/3/16	SAM	199.9996	1.99995	0.01999
8/4/16	JAM	199.9995	1.99998	0.02002
8/5/16	MG	199.9996	1.99998	0.02001
8/8/16	SAM	199.9999	1.99998	0.02000
8/9/16	SAM	199.9999	2.00000	0.01997
8/10/16	MG	199.9998	2.00002	0.02002

D2A-01 MS 7-14-16

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.#_11-0406-062_

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
89	014982	Mettler Toledo	XP5003S	Lab 24	2nd 3rd	5100 g 1000 g

Date	Operator	Asset# 015583 Std Wt. 5000 g Tolerance: 4999.50-5000.50 g Recorded Wt. (mg)	Asset# 015580 Std Wt. 100 g Tolerance: 99.990-100.010 g Recorded Wt. (mg)	Asset# 015584 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (mg)
5/15/16	SAM	4999.97	99.998	1.998
5/18/16	SAM	4999.97	99.998	2.000
6/1/16	SAM	4999.97	99.998	1.999
6/3/16	SAM	4999.97	99.998	2.001
6/17/16	SAM	4999.98	99.998	2.001
6/20/16	SAM	4999.97	99.998	2.000
6/30/16	SAM	4999.97	99.998	2.000
7/7/16	SAM	4999.97	99.999	1.999
7/13/16	MG	4999.98	99.999	2.000
7/14/16	MG	4999.97	99.999	1.999

Comments:

Book ID#: 14-0406-024

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
5/9/16 1735	DRm2	17.93	✓	✓	✓	n/a	✓
5/10/16 1801	DRm2	17.94	✓	✓	✓	n/a	✓
5/13/16 1810	DRm2	17.94	✓	✓	–	n/a	✓
5/16/16 1715	DRm2	17.93	✓	✓	✓	n/a	✓
5/17/16 1930	DRm2	17.94	✓	✓	✓	n/a	✓
5/18/16 1801	DRm2	17.94	✓	✓	✓	n/a	✓
5/19/16 1805	DRm2	17.94	✓	✓	✓	n/a	✓
5/20/16 1650	DRm2	17.94	✓	–	✓	n/a	✓
5/23/16 1807	DRm2	17.93	✓	✓	✓	n/a	✓
5/24/16 1811	DRm2	17.93	✓	✓	✓	n/a	✓
5/25/16 1747	DRm2	17.93	✓	✓	✓	n/a	✓
5/26/16 1800	DRm2	17.93	✓	✓	✓	n/a	✓
5/27/16 1547	DRm2	17.93	✓	✓	✓	n/a	✓
5/31/16 1657	DRm2	17.94	✓	✓	✓	n/a	✓
6/1/16 1801	DRm2	17.93	✓	X	✓	n/a	X-change needed ??
6/2/16 1710	DRm2	17.93	✓	X	✓	n/a	tank xchange needed

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
5/9/16 1736	DRm2	✓	✓ 18.0	37402.4	✓
5/10/16 1802	DRm2	✓	✓ 18.0	37408.1	✓
5/13/16 1812	DRm2	✓	✓ 18.0	37411.8	✓
5/16/16 1716	DRm2	✓	✓ 18.0	37426.5	✓
5/17/16 1931	DRm2	✓	✓ 18.0	37427.6	✓
5/18/16 1803	DRm2	✓	✓ 18.0	37435.3	✓
5/19/16 1806	DRm2	✓	✓ 18.0	37446.7	✓
5/20/16 1451	DRm2	✓	✓ 18.0	37448.4	✓
5/23/16 1808	DRm2	✓	✓ 18.0	37462.1	✓
5/24/16 1812	DRm2	✓	✓ 18.0	37463.5	✓
5/25/16 1748	DRm2	✓	✓ 18.0	37464.6	✓
5/26/16 1821	DRm2	✓	✓ 18.0	37471.5	✓
5/27/16 1548	DRm2	✓	✓ 18.0	37473.0	✓
5/31/16 1657	DRm2	✓	✓ 18.0	37473.9	✓
6/1/16 1803	DRm2	✓	✓ 18.0	37476.7	✓
6/2/16 1711	DRm2	✓	✓ 18.0	37480.1	✓

Legend: Check = Green (OK); X = Red (call for service)

Book ID#: 14-0406-024

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/3/16 1757	DRmz	17.94	✓	X	✓	n/a	CALL PLATED
6/6/16 1804	DRmz	17.94	✓	X	✓	n/a	pending
6/7/16 1700	DRmz	17.93	✓	X	✓	n/a	pending
6/8/16 1702	DRmz	17.93	✓	X	✓	n/a	still pending
6/9/16 1738	DRmz	17.93	✓	X	✓	n/a	pending
6/10/16 1630	DRmz	17.93	✓	X	✓	n/a	PENDING EXCHANGE
6/13/16 1655	DRmz	17.93	✓	✓	✓	n/a	MIXED BED TANK CHANGED. ALL OK
6/14/16 1815	DRmz	17.93	✓	✓	✓	n/a	✓
6/15/16 1817	DRmz	17.93	✓	✓	✓	n/a	✓
6/16/16 1750	DRmz	17.93	✓	✓	✓	n/a	✓
6/17/16 1950	DRmz	17.93	✓	✓	✓	n/a	✓
6/20/16 1755	DRmz	17.94	✓	✓	✓	n/a	✓
6/21/16 1735	DRmz	17.92	✓	✓	✓	n/a	✓
6/22/16 1800	DRmz	17.93	✓	✓	✓	n/a	✓
6/23/16 1751	DRmz	17.92	✓	✓	✓	n/a	✓
6/24/16 1729	DRmz	17.92	✓	✓	✓	n/a	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/3/16 1758	DRmz	✓	✓ 18.0	37482.2	✓
6/6/16 1857	DRmz	✓	✓ 18.0	37484.3	✓
6/7/16 1701	DRmz	✓	✓ 18.0	37489.2	✓
6/8/16 1703	DRmz	✓	✓ 18.0	37491.8	✓
6/9/16 1739	DRmz	✓	✓ 18.0	37492.6	✓
6/10/16 1631	DRmz	✓	✓ 18.0	37499.3	✓
6/13/16 1656	DRmz	✓	✓ 18.0	37501.4	✓
6/14/16 1816	DRmz	✓	✓ 18.0	37520.5	✓
6/15/16 1818	DRmz	✓	✓ 18.0	37521.3	✓
6/16/16 1751	DRmz	✓	✓ 18.0	37522.6	✓
6/17/16 1951	DRmz	✓	✓ 18.0	37527.3	✓
6/20/16 1757	DRmz	✓	✓ 18.0	37530.8	✓
6/21/16 1736	DRmz	✓	✓ 18.0	37538.4	✓
6/22/16 1801	DRmz	✓	✓ 18.0	37540.1	✓
6/23/16 1753	DRmz	✓	✓ 18.0	37541.4	✓
6/24/16 1730	DRmz	✓	✓ 18.0	37548.3	✓

Legend: Check = Green (OK); X = Red (call for service)

Book ID#:__14-0406-024___

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/27/16 1731	DRmz	17.93	✓	✓	✓	n/a	✓
6/28/16 1710	DRmz	17.93	✓	✓	✓	n/a	✓
6/29/16 1801	DRmz	17.93	✓	✓	✓	n/a	✓
6/30/16 1804	DRmz	17.93	✓	✓	✓	n/a	✓
7/1/16 1530	DRmz	17.93	✓	✓	✓	n/a	✓
7/5/16 1742	DRmz	17.93	✓	✓	✓	n/a	✓
7/6/16 1819	DRmz	17.93	✓	✓	✓	n/a	✓
7/7/16 1753	DRmz	17.93	✓	✓	✓	n/a	✓
7/8/16 1800	DRmz	17.93	✓	✓	✓	n/a	✓
7/11/16 1849	DRmz	17.93	✓	✓	✓	n/a	✓
7/12/16 1911	DRmz	17.92	✓	✓	✓	n/a	✓
7/13/16 1655	DRmz	17.92	✓	✓	✓	n/a	✓
7/14/16 1640	DRmz	17.92	✓	✓	✓	n/a	✓
7/15/16 1651	DRmz	17.92	✓	✓	✓	n/a	✓
7/19/16 1702	DRmz	17.92	✓	✓	✓	n/a	✓
7/20/16 1820	DRmz	17.93	✓	✓	✓	n/a	✓

Legend: Check = Green (OK); X = Red (call for service)

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
6/27/16 1732	DRmz	✓	✓ 18.0	37552.2	✓
6/28/16 1711	DRmz	✓	✓ 17.5	37556.4	✓
6/29/16 1803	DRmz	✓	✓ 18.0	37558.0	✓
6/30/16 1805	DRmz	✓	✓ 18.0	37559.9	✓
7/1/16 1531	DRmz	✓	✓ 18.0	37562.4	✓
7/5/16 1743	DRmz	✓	✓ 18.0	37563.2	✓
7/6/16 1820	DRmz	✓	✓ 18.0	37568.6	✓
7/7/16 1754	DRmz	✓	✓ 18.0	37574.3	✓
7/8/16 1801	DRmz	✓	✓ 18.0	37575.2	✓
7/11/16 1850	DRmz	✓	✓ 17.5	37578.4	✓
7/12/16 1912	DRmz	✓	✓ 17.5	37578.6	✓
7/13/16 1656	DRmz	✓	✓ 18.0	37582.3	✓
7/14/16 1641	DRmz	✓	✓ 17.5	37588.4	✓
7/15/16 1652	DRmz	✓	✓ 18.0	37591.2	✓
7/19/16 1703	DRmz	✓	✓ 18.0	37592.3	✓
7/20/16 1821	DRmz	✓	✓ 18.0	37594.5	✓

Legend: Check = Green (OK); X = Red (call for service)

D.I. WATER SYSTEM NOTEBOOK
SOUTHWEST RESEARCH INSTITUTE
BUILDING 70

Contact Envoqua Water Technologies (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

DATE / TIME	INITIALS	RESISTIVITY MONITOR (M OHMS)	RESISTIVITY MONITOR QC LT.	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
7/21/16 1941	DRmz	17.92	✓	✓	✓	n/a	✓
7/22/16 1801	DRmz	17.93	✓	✓	✓	n/a	✓
7/25/16 1720	DRmz	17.92	✓	✓	✓	n/a	✓
7/26/16 1756	DRmz	17.92	✓	✓	✓	n/a	✓
7/27/16 1828	DRmz	17.92	✓	✓	✓	n/a	✓
7/28/16 1817	DRmz	17.92	✓	✓	✓	n/a	✓
7/29/16 1831	DRmz	17.92	✓	✓	✓	n/a	✓
8/1/16 1731	DRmz	17.92	✓	✓	✓	n/a	✓
8/2/16 1736	DRmz	17.92	✓	✓	✓	n/a	✓
8/3/16 1841	DRmz	17.92	✓	✓	✓	n/a	✓
8/4/16 1539	DRmz	17.92	✓	✓	✓	n/a	✓
8/5/16 1705	DRmz	17.92	✓	✓	✓	n/a	✓
8/8/16 1731	DRmz	17.92	✓	✓	✓	n/a	need exchange??
8/9/16 1735	DRmz	17.92	✓	X	✓	n/a	exchange needed
8/10/16 1739	DRmz	17.90	✓	X	✓	n/a	Service call placed
8/11/16 1709	DRmz	17.7	X Red VIRGIN RESIN TANK??	✓	✓	n/a	FILTERS, CARBON TANK, MIXED BED TANK exchanged.

Legend: Check = Green (OK); X = Red (call for service) X VIRGIN TANK IS PROBABLY BAD. Removed from loop. Water At 17.6

LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS QC 1	QC LIGHTS QC 2	USAGE (GALS)	COMMENTS
7/21/16 1942	DRmz	✓	✓ 18.0	37595.9	CARBON, MIXED BED Tank FILTER exchanged. ✓
7/22/16 1807	DRmz	✓	✓ 18.0	37597.1	✓
7/25/16 1721	DRmz	✓	✓ 18.0	37598.6	✓
7/26/16 1757	DRmz	✓	✓ 18.0	37598.9	✓
7/27/16 1829	DRmz	✓	✓ 18.0	37601.7	✓
7/28/16 1818	DRmz	✓	✓ 18.0	37603.2	✓
7/29/16 1832	DRmz	✓	✓ 18.0	37608.0	✓
8/1/16 1732	DRmz	✓	✓ 18.0	37611.7	✓
8/2/16 1737	DRmz	✓	✓ 18.0	37621.2	✓
8/3/16 1842	DRmz	✓	✓ 18.0	37626.3	✓
8/4/16 1540	DRmz	✓	✓ 18.0	37627.1	✓
8/5/16 1706	DRmz	✓	✓ 18.0	37627.9	✓
8/8/16 1732	DRmz	✓	✓ 18.0	37628.5	✓
8/9/16 1736	DRmz	✓	✓ 17.5	37636.1	✓
8/10/16 1740	DRmz	✓	✓ 17.5	37636.5	✓
8/11/16 1710	DRmz	✓	✓ 18.0	37637.5	✓

Legend: Check = Green (OK); X = Red (call for service)

Appendix Q
SwRI E-Mails with Test Results on Zeolite Analyses, September 21 and 23, 2016

From: Anast, Kurt Roy
To: Hargis, Kenneth Marshall
Subject: FW: zeolite particle size
Date: Tuesday, February 28, 2017 4:53:57 PM
Attachments: zeolite.xlsx

From: Spies, Radonna S. [mailto:radonna.spies@swri.org]
Sent: Wednesday, September 21, 2016 3:45 PM
To: Anast, Kurt Roy <kanast@lanl.gov>
Subject: [Not Virus Scanned] [Not Virus Scanned] FW: zeolite particle size

Excel is particle size
F6939 attachment – XRD of the Zeolite

From: Moken, James A.
Sent: Tuesday, May 03, 2016 7:01 PM
To: Spies, Radonna S.
Subject: zeolite particle size

Radonna,

Here is the preliminary data for the particle size. The #20 looks a little off from the sample duplicate but we can run it a third time if needed. It's a big bag.

Jamie

SOUTHWEST RESEARCH INSTITUTE

PARTICLE SIZE DISTRIBUTION DATA SHEET

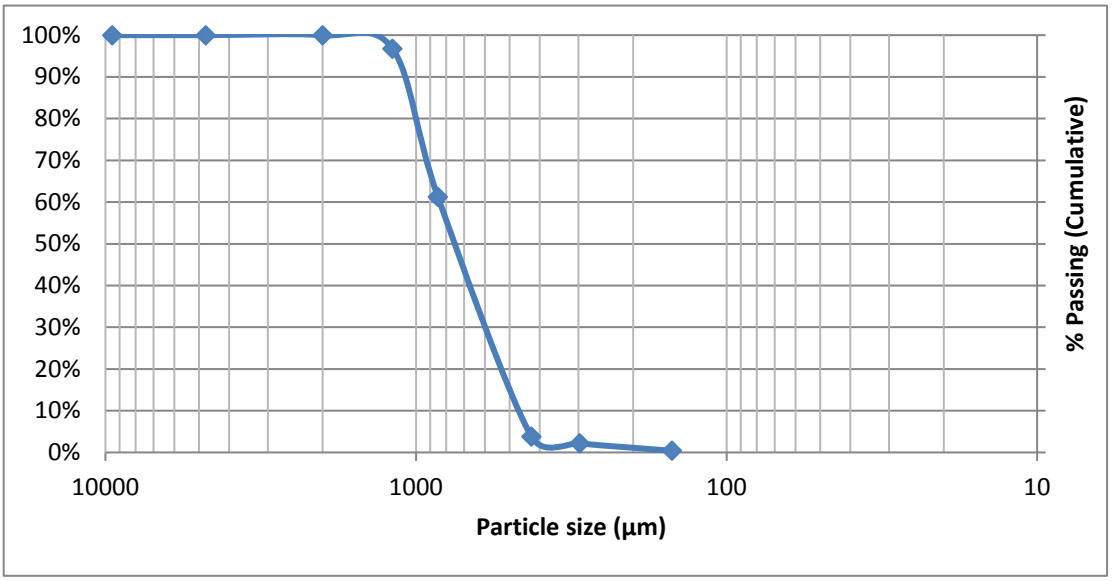
Sample ID: Zeolite

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Solid
SDG:
Lab System ID:

Client: LANL
Project No.: 21592.01.006
Date Received:
SRR #:
TO#:

Sample dry wgt used for sieving (g): 90.1630

			Cumulative	
Sieve	Micron Size	Wt on sieve (g)	% pass	% retained
3/8"	9500	0	100.0%	0.0%
#4	4750	0	100.0%	0.0%
#10	2000	0	100.0%	0.0%
#16	1190	2.9513	96.7%	3.3%
#20	850	31.9854	61.3%	38.7%
#40	425	51.7699	3.8%	96.2%
#50	297	1.5036	2.2%	97.8%
#100	150	1.5961	0.4%	99.6%



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SOUTHWEST RESEARCH INSTITUTE
PARTICLE SIZE DISTRIBUTION DATA SHEET

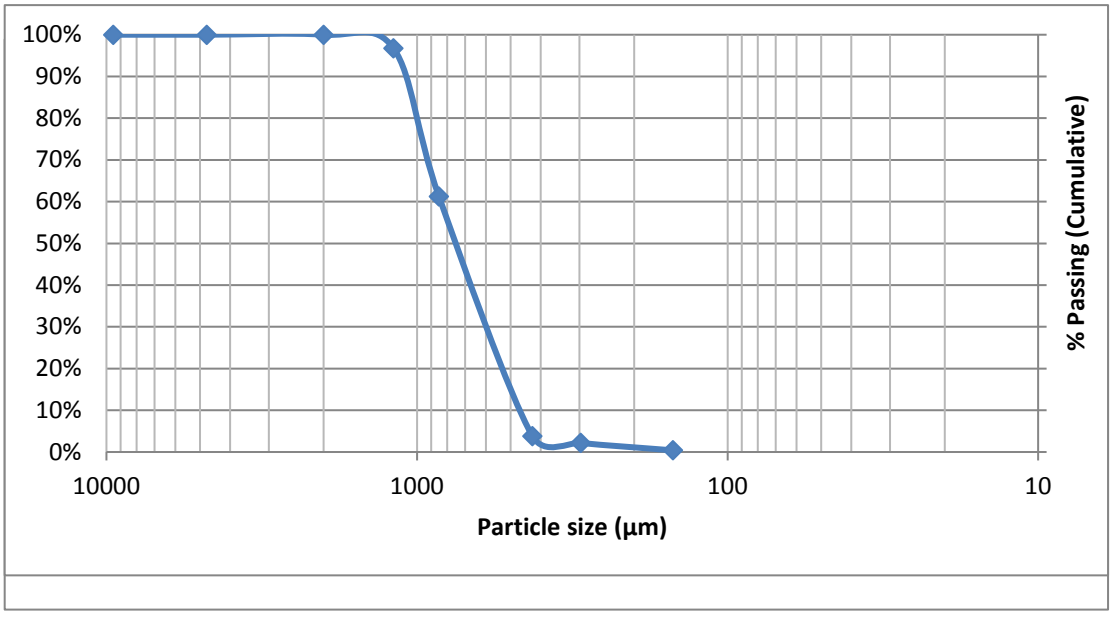
Sample ID: Zeolite Duplicate

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Solid
SDG:
Lab System ID:

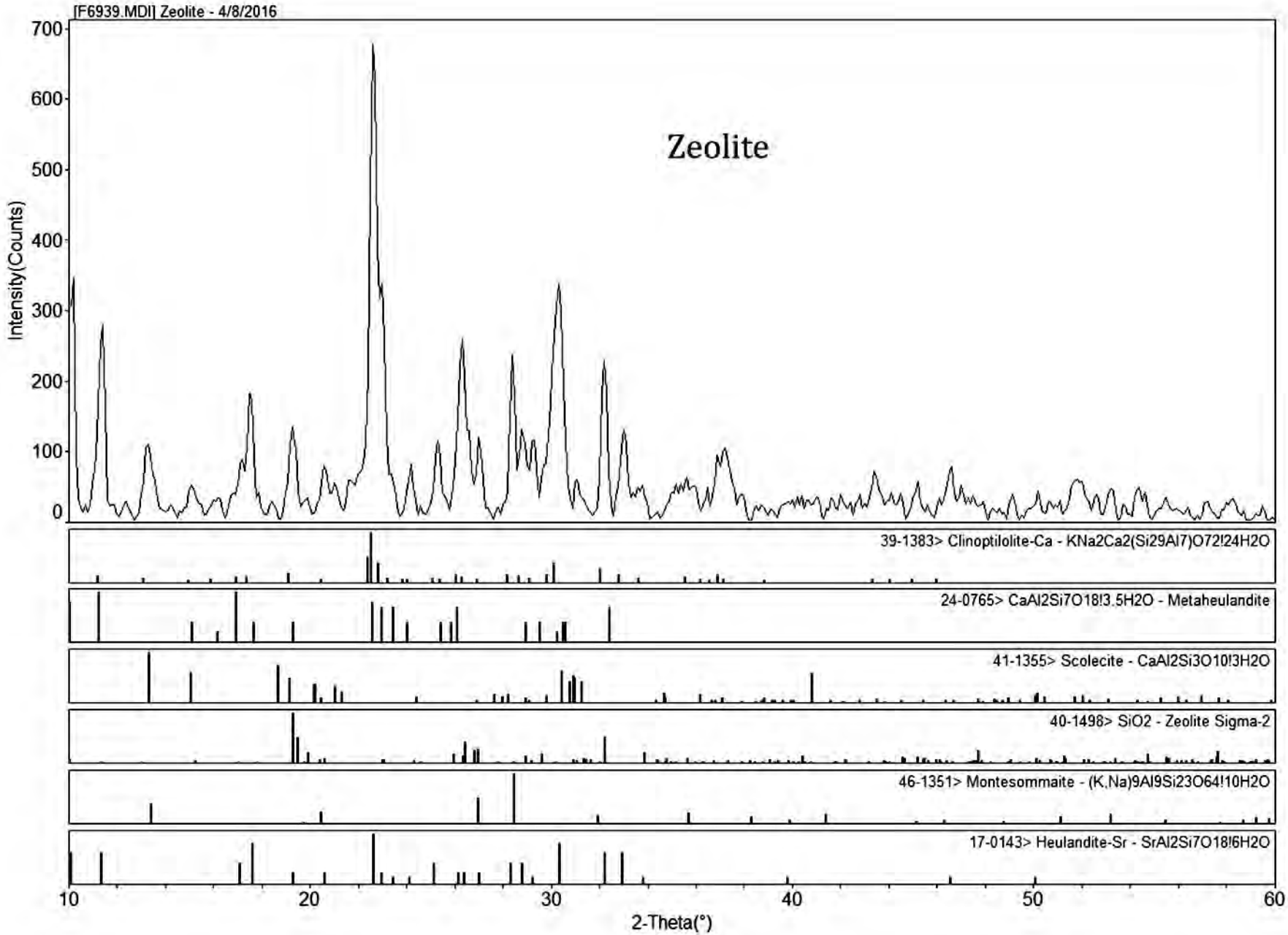
Client: LANL
Project No.: 21592.01.006
Date Received:
SRR #:
TO#:

Sample dry wgt used for sieving (g): 90.9465

			Cumulative	
Sieve	Micron Size	Wt on sieve (g)	% pass	% retained
3/8"	9500	0	100.0%	0.0%
#4	4750	0	100.0%	0.0%
#10	2000	0	100.0%	0.0%
#16	1190	3.3528	96.3%	3.7%
#20	850	38.09880	54.4%	45.6%
#40	425	46.1992	3.6%	96.4%
#50	250	1.2215	2.3%	97.7%
#100	150	1.7638	0.3%	99.7%



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[F6939.MDI] Zeolite - 4/8/2016
Zeolite
Intensity(Counts)
700
600
500
400
300
200
100
0
39-1383> Clinoptilolite-Ca - KNa2Ca2(Si29Al7)O72!24H2O
24-0765> CaAl2Si7O18!3.5H2O - Metaheulandite
41-1355> Scolecite - CaAl2Si3O10!3H2O
40-1498> SiO2 - Zeolite Sigma-2
46-1351> Montesommaite - (K,Na)9Al9Si23O64!10H2O
17-0143> Heulandite-Sr - SrAl2Si7O18!6H2O
10
20
30
40
50
60
2-Theta(°)

From:	Anast, Kurt Roy
To:	Hargis, Kenneth Marshall
Subject:	FW:
Date:	Tuesday, February 28, 2017 4:54:17 PM
Attachments:	%solid zeolite.pdf

From: Moken, James A. [mailto:james.moken@swri.org]
Sent: Friday, September 23, 2016 6:16 AM
To: Anast, Kurt Roy <kanast@lanl.gov>
Cc: Spies, Radonna S. <radonna.spies@swri.org>
Subject:

Kurt,

Attached is the pdf of the % solids performed on the zeolite. The % solid of the zeolite was 92.5% so the % moisture would be 7.5%. For the processing of the drums, you would probably want the zeolite to have a % solid greater than 90%.

Jamie

%Solids

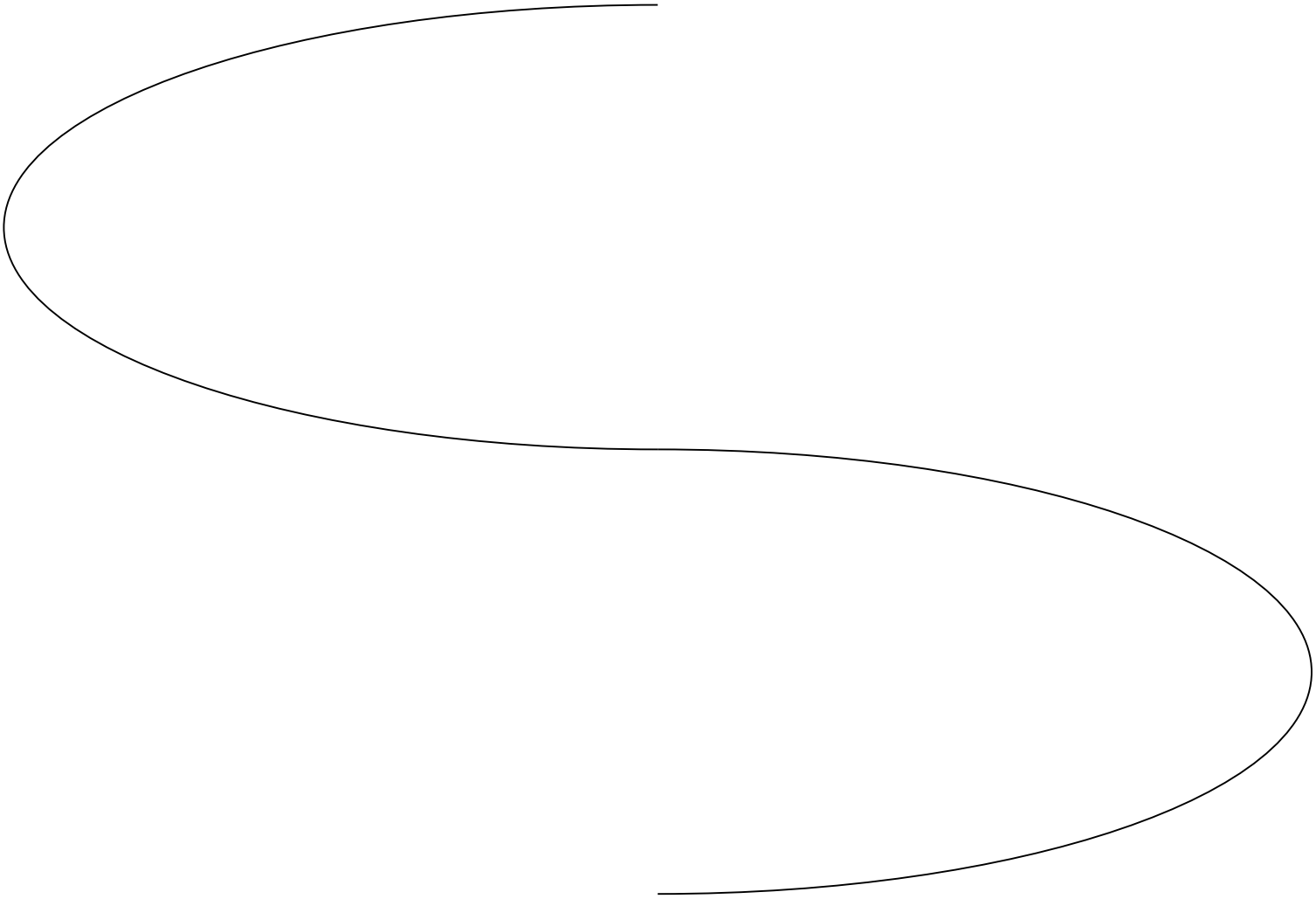
Southwest Research Institute
San Antonio, Texas 78228

Batch: 20160914-P001 (Ver. 1)
Status: APPROVED

Customer: Los Alamos National Laboratory, LLC
Project: 21592.01.006
Balance: Bal #135
Heating Device: Oven #22
Prep Test: %Solids
Matrix: Zeolite
Start Time: 09/14/2016 18:46:23

Sample Identification	Client Identification	Tare Wt (g)	WetSample +TareWt (g)	Wet Weight (g)	DriedSample +TareWt (g)	Dry Weight (g)	%Solids (%)
PB16J14PB1	NA	0.9893	0.9893	0.0000	0.9894	0.0001	< 0.01
Zeolite 1	NA	1.0010	11.3295	10.3285	10.5580	9.5570	92.53
Zeolite 1D	NA	1.0072	11.6524	10.6452	10.8690	9.8618	92.64

Comments: NA



U - Result is less than the SwRI Reporting Limit (RL)

Prepared by: MOKEN, JAMES Date: 09/14/2016

Reviewed by: HERRERA, JUDY Date: 09/16/2016

Program version(8/11/2011)

Appendix R
SwRI Test Report , December 22, 2016

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

December 22, 2016

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Victor Garde

Subject:	SwRI Project Number:	21592.01.00X
	SDG:	605029
	SwRI Task Order Number:	161026-1
	SwRI Sample Receipt Number:	58485, 58617
	Samples Received:	10.11.2016, 11.01.2016
	Analysis:	Solid and Liquid Waste Surrogates

Dear Mr. Garde,

Please find the enclosed results for the fourteen overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Principal Scientist

APPROVED:

Michael J. Dammann
Director

RPS: jz

Cc: Anya Gonzales, Los Alamos National Laboratory

Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 161026-1
SwRI SRR: 58485, 58617
SDG: 605029
VTSR: 10.11.2016, 11.01.2016

Chain-of-Custody
&
Sample Receipt Paperwork

Total Page Count: 010001-
Fraction: Solid & Liquid Waste Surrogates Pages: 010213

Garcia, David

From: Moken, James A.
Sent: Tuesday, October 11, 2016 6:58 AM
To: Douglas, Steven M.
Cc: Garcia, David
Subject: Sample ID

Steven or David,

Can I get samples ID's for the following samples. The client is Los Alamos and the Project number is 21592.01.006. Thanks.

Client ID	Date Made
UNS Blend 19-R	10/7/16
UNS Blend 20-R	10/7/16

Jamie

Rec by: David Garcia 10/11/16 08:30

Douglas, Steven M.

From: Moken, James A.
Sent: Tuesday, November 01, 2016 12:13 PM
To: Douglas, Steven M.
Cc: Garcia, David
Subject: FW: Sample ID

Steven or David,

Can I get sample ID's and an SRR for the following samples. The client is Los Alamos and the Project number is 21592.01.006. Thanks.

Client ID	Matrix
RNS Blend 20R	Solid
RNS Blend 21R	Solid
RNS Blend 22R	Solid
UNS Blend 6a	Solid
UNS Blend 7a	Solid
UNS Blend 8a	Solid
UNS Blend 9a	Solid
Sod Nit A pH Adjusted	Liquid
45% Sod Nit Solution	Liquid
Sod Nit A & Swheat	Solid
Sod Nit B & Swheat	Solid
Sod Nit A pH Adjusted & Swheat	Solid



Client: Los Alamos National Laboratory
SRR # 58617
Project # 21592.01.006
Case: Canada
VTSR: 11/01/2016
Sample(s) Received: Intact
Temperature: N/A °C/ SN #: N/A

Thanks

Jamie

From: Moken, James A.
Sent: Tuesday, October 11, 2016 6:58 AM
To: Douglas, Steven M.
Cc: Garcia, David
Subject: Sample ID

Steven or David,

Can I get samples ID's for the following samples. The client is Los Alamos and the Project number is 21592.01.006. Thanks.

Client ID	Date Made
UNS Blend 19-R	10/7/16
UNS Blend 20-R	10/7/16

Jamie

Southwest Research Institute

Laboratory Task Order

TO #: 161026-1 Revision: 1

Project(s): 21592.01.006, 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 12/20/16

SDG: 605029

SRR #'s: 58485, 58617
Client(s): Los Alamos National Laboratory

Instructions

Documents Related to this task order: 208875[COC for SRR 58485], 208876[Paperwork for SRR 58485], 210366[COC for SRR 58617], 210367[Paperwork for SRR 58617]

Deliverables --> Hard Copy: no EDD: no PDF: -YES-

Test: EPA 1050
Section: FT ADMIN

Holding: 30 days from VTSR

Test Methods to Determine Substances likely to Spontaneously Combust

Cnt: 12

System ID	Type	Cont	Matrix	Customer ID	VTSR	Method Date
605029		1	Solids	UNS Blend 19-R	11 Oct 16	10 Nov 16
605030		1	Solids	UNS Blend 20-R	11 Oct 16	10 Nov 16
606279		1	Solid	RNS Blend 20R	01 Nov 16	01 Dec 16
606280		1	Solid	RNS Blend 21R	01 Nov 16	01 Dec 16
606281		1	Solid	RNS Blend 22R	01 Nov 16	01 Dec 16
606282		1	Solid	Sod Nit A & Swheat	01 Nov 16	01 Dec 16
606284		1	Solid	Sod Nit A pH Adjusted & Swheat	01 Nov 16	01 Dec 16
606285		1	Solid	Sod Nit B & Swheat	01 Nov 16	01 Dec 16
606286		1	Solid	UNS Blend 6a	01 Nov 16	01 Dec 16
606287		1	Solid	UNS Blend 7a	01 Nov 16	01 Dec 16
606288		1	Solid	UNS Blend 8a	01 Nov 16	01 Dec 16
606289		1	Solid	UNS Blend 9a	01 Nov 16	01 Dec 16

Test: IGNIT_1030
Section: WETCHEM

Holding: 180 days from CED

SW 846 Method 1030 Ignitability of solids

Cnt: 12

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
605029		1	Solids	UNS Blend 19-R	07 Oct 16	05 Apr 17
605030		1	Solids	UNS Blend 20-R	07 Oct 16	05 Apr 17
606279		1	Solid	RNS Blend 20R	NO DATA	NO DATA
606280		1	Solid	RNS Blend 21R	NO DATA	NO DATA
606281		1	Solid	RNS Blend 22R	NO DATA	NO DATA
606282		1	Solid	Sod Nit A & Swheat	NO DATA	NO DATA
606284		1	Solid	Sod Nit A pH Adjusted & Swheat	NO DATA	NO DATA
606285		1	Solid	Sod Nit B & Swheat	NO DATA	NO DATA
606286		1	Solid	UNS Blend 6a	NO DATA	NO DATA
606287		1	Solid	UNS Blend 7a	NO DATA	NO DATA
606288		1	Solid	UNS Blend 8a	NO DATA	NO DATA
606289		1	Solid	UNS Blend 9a	NO DATA	NO DATA

Test: Oxidizer_UN
Section: WETCHEM

Holding: 180 days from CED

United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.

Cnt: 12

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
605029		1	Solids	UNS Blend 19-R	07 Oct 16	05 Apr 17
605030		1	Solids	UNS Blend 20-R	07 Oct 16	05 Apr 17
606279		1	Solid	RNS Blend 20R	NO DATA	NO DATA
606280		1	Solid	RNS Blend 21R	NO DATA	NO DATA

Southwest Research Institute

Laboratory Task Order

TO #: 161026-1 Revision: 1

Project(s): 21592.01.006, 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 12/20/16

SDG: 605029

SRR #'s: 58485, 58617
Client(s): Los Alamos National Laboratory

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
606281		1	Solid	RNS Blend 22R	NO DATA	NO DATA
606282		1	Solid	Sod Nit A & Swheat	NO DATA	NO DATA
606284		1	Solid	Sod Nit A pH Adjusted & Swheat	NO DATA	NO DATA
606285		1	Solid	Sod Nit B & Swheat	NO DATA	NO DATA
606286		1	Solid	UNS Blend 6a	NO DATA	NO DATA
606287		1	Solid	UNS Blend 7a	NO DATA	NO DATA
606288		1	Solid	UNS Blend 8a	NO DATA	NO DATA
606289		1	Solid	UNS Blend 9a	NO DATA	NO DATA

Test: Oxidizing Liq_UN
Section: WETCHEM

Holding: 180 days from CED

Test for Oxidizing Liquids - UN Manual of Tests and Criteria Part 3

Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
606278		1	Liquid	45% Sod Nit Solution	NO DATA	NO DATA
606283		1	Liquid	Sod Nit A pH Adjusted	NO DATA	NO DATA

Test: PAINT_9095
Section: WETCHEM

Holding: 180 days from CED

SW846 9095 Paint Filter Liquids Test

Cnt: 9

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
605029		1	Solids	UNS Blend 19-R	07 Oct 16	05 Apr 17
605030		1	Solids	UNS Blend 20-R	07 Oct 16	05 Apr 17
606279		1	Solid	RNS Blend 20R	NO DATA	NO DATA
606280		1	Solid	RNS Blend 21R	NO DATA	NO DATA
606281		1	Solid	RNS Blend 22R	NO DATA	NO DATA
606286		1	Solid	UNS Blend 6a	NO DATA	NO DATA
606287		1	Solid	UNS Blend 7a	NO DATA	NO DATA
606288		1	Solid	UNS Blend 8a	NO DATA	NO DATA
606289		1	Solid	UNS Blend 9a	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 58485

VTSR: 10/11/16

Time: 08:30:00

Project: 21592.01.00X
Case #: J. Moken
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: DXGARCIA
Creation Date: 10/11/16

Notes

Email was received to create an SRR for the following.

Parameters: Analysis/located on Task Order

See chain of custody as part of the work order system for more information

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
605029	UNS Blend 19-R	10/07/16	Solids	1	
605030	UNS Blend 20-R	10/07/16	Solids	1	

Containers: 2 **Samples: 2**

These documents are associated with this receipt: 208875[COC for SRR 58485], 208876[Paperwork for SRR 58485]

Thermometer: NA
Temperature: NA

Page Printed: 12/22/2016 14:20
ver: (7/18/2014)

58485 Los Alamos National Laborato

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 58617

VTSR: 11/01/16

Time: 12:50:00

Project: 21592.01.006
Case #: J. Moken
Client: Los Alamos National Laboratory

Manager: SPIES, RADONNA
Logged in by: SDOUGLAS
Creation Date: 11/01/16

Notes
Email was received to create an SRR for the following. Parameters: Analysis/located on Task Order FRM-070 (J. Moken) See chain of custody as part of the work order system for more information

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
606278	45% Sod Nit Solution		Liquid	1	
606279	RNS Blend 20R		Solid	1	
606280	RNS Blend 21R		Solid	1	
606281	RNS Blend 22R		Solid	1	
606282	Sod Nit A & Swheat		Solid	1	
606283	Sod Nit A pH Adjusted		Liquid	1	
606284	Sod Nit A pH Adjusted & Swheat		Solid	1	
606285	Sod Nit B & Swheat		Solid	1	
606286	UNS Blend 6a		Solid	1	
606287	UNS Blend 7a		Solid	1	
606288	UNS Blend 8a		Solid	1	
606289	UNS Blend 9a		Solid	1	

Containers: 12 **Samples: 12**

These documents are associated with this receipt: 210366[COC for SRR 58617], 210367[Paperwork for SRR 58617]

Thermometer: NA
Temperature: NA

Page Printed: 12/22/2016 14:21
ver: (7/18/2014)

58617 Los Alamos National Laborato

Southwest Research Institute

Traffic Report

Sample Custodian Signature: David Lamm

1. Custody Seal	Not Present or Damaged
2. Chain of Custody	Present
3. Sample Tags	Not Present
Sample Tag Numbers	Not on COC
4. SMO Forms	Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.00X

Case: J. Moken / SDG: _____

Sample Receipt: 58485

Airbill: Email

Custody Seal #(s): NA

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
10/11/16	08:30:00	Email	UNS Blend 19-R	N/A	605029	YES	Intact
10/11/16	08:30:00	Email	UNS Blend 20-R	N/A	605030	YES	Intact

Sample Custodian Signature: _____

Southwest Research Institute

Traffic Report

1. Custody Seal — Not Present or Damaged
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory

Project: 21592.01.006

Case: J. Moken / SDG: _____

Sample Receipt: 58617

Airbill: Email

Custody Seal #(s): NA

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
11/01/16	12:50:00	Email	45% Sod Nit Solution	N/A	606278	YES	Intact
11/01/16	12:50:00	Email	RNS Blend 20R	N/A	606279	YES	Intact
11/01/16	12:50:00	Email	RNS Blend 21R	N/A	606280	YES	Intact
11/01/16	12:50:00	Email	RNS Blend 22R	N/A	606281	YES	Intact
11/01/16	12:50:00	Email	Sod Nit A & Swheat	N/A	606282	YES	Intact
11/01/16	12:50:00	Email	Sod Nit A pH Adjusted	N/A	606283	YES	Intact
11/01/16	12:50:00	Email	Sod Nit A pH Adjusted & Swheat	N/A	606284	YES	Intact
11/01/16	12:50:00	Email	Sod Nit B & Swheat	N/A	606285	YES	Intact
11/01/16	12:50:00	Email	UNS Blend 6a	N/A	606286	YES	Intact
11/01/16	12:50:00	Email	UNS Blend 7a	N/A	606287	YES	Intact
11/01/16	12:50:00	Email	UNS Blend 8a	N/A	606288	YES	Intact
11/01/16	12:50:00	Email	UNS Blend 9a	N/A	606289	YES	Intact

010011

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): DAVID GARCIA	Log-in Date: 10/11/2016
Received By (Signature): David Garcia	
Case Number: J. Moken	Sample Delivery Group No.: N/A
Remarks: 21592.01.00X	SAS Number: N/A

1. Custody Seal(s)	Present/Absent* Intact/Broken		
2. Custody Seal Nos.	NA		
3. Chain-of Custody Records	Present/Absent*		
4. Traffic Reports or Packing Lists	Present/Absent*		
5. Airbill	Airbill/Sticker Present/Absent*		
6. Airbill No.	Email		
7. Sample Tags	Present/Absent*		
Sample Tag Numbers	Listed/Not listed on Chain of Custody		
8. Sample Condition	Intact/Broken*/Leaking		
9. Cooler Temperature	NAC		
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*		
11. Date Received at Lab	10/11/2016		
12. Time Received	08:30:00		

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
UNS Blend 19-R	N/A	605029	Intact
UNS Blend 20-R	N/A	605030	Intact

Sample Transfer		
Fraction: INORG	Fraction	
Area #: S. Moken	Area #	
By: DAVID GARCIA	By	
On: 10/11/2016	On	

* Contact SMO and attach record of resolution

Reviewed By: [signature]	Logbook No.: Sample Receipt (58485)
Date: 10.11.16	Logbook Page No.: ✓9605 SOC 1 of 1

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 11/01/2016
Received By (Signature): SDouglas	
Case Number: J. Moken	Sample Delivery Group No.: NA
Remarks: 21592.01.006	SAS Number: NA

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	NA	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present/Absent*	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	Email	
7. Sample Tags	Present/Absent*	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/Leaking	
9. Cooler Temperature	NAC	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	11/01/2016	
12. Time Received	12:50:00	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
45% Sod Nit Solution	N/A	606278	Intact
RNS Blend 20R	N/A	606279	Intact
RNS Blend 21R	N/A	606280	Intact
RNS Blend 22R	N/A	606281	Intact
Sod Nit A & Sw heat	N/A	606282	Intact
Sod Nit A pH Adjusted	N/A	606283	Intact
Sod Nit A pH Adjusted & Swheat	N/A	606284	Intact
Sod Nit B & Sw heat	N/A	606285	Intact
UNS Blend 6a	N/A	606286	Intact
UNS Blend 7a	N/A	606287	Intact
UNS Blend 8a	N/A	606288	Intact
UNS Blend 9a	N/A	606289	Intact

Sample Transfer		
Fraction: INORG	Fraction	
Area #: J. Moken	Area #	
By: STEVEN DOUGLAS	By	
On: 11/01/2016	On	

* Contact SMO and attach record of resolution

Reviewed By:	Logbook No.: Sample Receipt (58617)
Date: 11.2.16	Logbook Page No.: 9626 SDG 20472

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 161026-1
SwRI SRR: 58485, 58617
SDG: 605029
VTSR: 10.11.2016, 11.01.2016

Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 161026-1

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of both the solid and liquid waste surrogates presented in Table 1, which also contains the methods performed on each of the blends. All surrogate blends were made in accordance to the scope of work revised on 10/4/2016 with no deviations needed.

Table 1. Waste Surrogate analysis table

Surrogate ID	Times made	Methods				
		1030	1050	UN Ox solid (DOT 0.1)	Paint filter	UN Ox Liquid (DOT 0.2)
RNS Blend 20R	1	1	1	1	1	*
RNS Blend 21R	1	1	1	1	1	*
RNS Blend 22R	1	1	1	1	1	*
UNS Blend 6a	1	1	1	1	1	*
UNS Blend 7a	1	1	1	1	1	*
UNS Blend 8a	1	1	1	1	1	*
UNS Blend 9a	1	1	1	1	1	*
UNS Blend 19-R	1	1	1	1	1	*
UNS Blend 20-R	1	1	1	1	1	*
Sod Nit A & Swheat	1	1	1	1	*	*
Sod Nit B & Swheat	1	1	1	1	*	*
Sod Nit A pH & Swheat	1	1	1	1	*	*
45% Sod Nit Solution	1	*	*	*	*	1
Sod Nit A pH Adjusted	1	*	*	*	*	1

*Testing not performed

SW-846 9095B: Paint Filter

For this method 100g of each blend was placed into a Gerson 260um paint filter (PN010714R, Lot# B5140428JF8) that was suspended over a 250 mL graduated cylinder for 5 minutes to collect any free liquids. During this 5-min period if any of the sample material drips into the beaker, the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314. All surrogate blends tested were not deemed to contain free liquids under the laboratory conditions.

SW-846 1030: Ignitability of Solids

In this test, an ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within 2 minutes. If the material combustion propagates, the burning time was measured over a distance of 100 mm and the rate of burning would be determined. The surrogate material was formed into an unbroken powder train, 250 mm in length atop a ceramic tile with marks at the 80 and 180 mm in from the end of the train. The ceramic tile

was placed about 8 inches in a hood with the sash lowered to give airflow of about 0.7 m/sec. One end of the train was exposed to the end of an acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes and if the sample began to burn down the train the time taken to get from the 80 to 180 mm mark was measured to determine the burn rate.

All of the UNS and RNS blends appeared as charred and dried zeolite at the end of the 2 minute burn period (Image 1). UNS Blend 8a, 9a, 19, and 20 had popping and crackling of the sample but no flames ever formed or propagated. The three sodium nitrate and Swheat blends caused the flame to enlarge throughout the testing period but the flame did not propagate. The samples also sparked, crackled, and burned away only in the area of flame application (Image 2). Since the propagation of the flame did not occur on any of the samples they are all considered to be nonflammable under the laboratory test conditions.

SW-846 1050: Spontaneous combustion and self heating

In this test, the surrogates for this analysis were first sprinkled several times onto a ceramic tile to observe if they smoked or flamed and could be considered pyrophoric solids by test Method A. Since none of the samples exhibited these characteristics, they were tested by Method C. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200 °C within the 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 2.

Table 2. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cube was placed into an oven with two thermocouples measuring the oven temp and up to four thermocouples inserted into each sample to measure its temperature during the analysis. Lids were placed onto the top of the test cubes and tungsten weights were placed on top of those samples believed to potentially have an event in order to keep the thermocouples and lids from coming off the sample. Up to two thermocouples were placed in a tray below the sample in case any sample pushed out of the cube and onto the tray. Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for 24-48 hours depending on when the sample reached a stable temperature. Although the method states testing to be conducted for 24 hours, many of the samples did not reach 140°C ± 2°C during the initial 24 hour period; therefore, the testing was extended to a minimum of 12 hours after the sample had reached a stable temperature. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C during the time of testing. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample. The oven and sample temperature graphs are located in Attachment A.

Since previous samples having similar combinations of waste and zeolite did not self heat, two surrogate blend samples were analyzed simultaneously using the 100mm cube during the RNS and

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UNS testing. These blends were allowed to run for at least 45 hours before ending the analysis due to their moisture content. All but one of the UNS and RNS blends had a dry zeolite appearance with little to no clumping at the end of the test period when removed from the oven (Image 3). UNS Blend 8a was a hardened brown mass when removed from the oven (Image 4,5). No charring or blackening, was observed. All the UNS and RNS Blends are not considered to be self-heating waste as defined by Method 1050 and under the laboratory conditions.

The sodium nitrate and Swheat blends were analyzed one at a time due to past samples with similar consistencies having events. The Sod Nit B & Swheat as well as the Sod Nit A pH Adjusted both formed grey and brown hardened masses during the analysis (Image 6,7). No blackening or charring was observed. Sod Nit A & Swheat appeared to have an event occur around four hours into the analysis. During this time the sample appears to have liquefied and made its way through the bottom of the cage and into the tray below (Image 8). This event caused the tray thermocouple to decrease in temperature as sample covered it. The temperature rose to 141°C and never exceeded 200°C anytime during the analysis. When removed from the oven, the sample left in the cage had formed a shell with the inside being blackened and charred showing that some sort of event occurred (Image 9). The analysis was repeated again in the 100mm cube with a very similar outcome. The test was repeated using the 25mm cube. The sample did not leak through the cube but showed similar properties to the 100mm cube run. Although both tests temperatures never exceeded 200°C, Sod Nit A & Swheat was deemed a DOT Packing Group III since it does appear that the sample is unstable in the 100mm cube. Sod Nit B & Swheat and Sod Nit A pH & Swheat were both deemed to not be self-heating waste under the laboratory conditions.

DOT UN Oxidation testing

The surrogate solid blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the samples mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. If the burning time is less than the standard mixture, the burning times should be compared with those from packing group I or II or category I or II oxidizer, reference standards 3:2 and 2:3, by mass, of potassium bromated to cellulose, respectively. See Table 3 for classification. Table 4 presents the results for the reference standards. Tables 5 and 6 lists the comments the analyst noted for each of the two sample-to- cellulose ratio burns. All RNS and UNS surrogate solid blends were classified as "Not Division 5.1". Sod Nit A & Swheat and Sod Nit B & Swheat were both classified as Packing Group II.

Sod Nit A pH & Swheat was classified as a Packing Group III. It should be noted that the classification for Sod Nit A pH & Swheat was less than 1 second over the Packing Group II limit. To error on the side of caution Sod Nit A pH & Swheat was reported as a Packing Group II.

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Table 3. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	UN Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

Table 4. Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
118.07	51.33	18.65

Table 5. Comments for Sample to Cellulose ratio of 4:1

Sample ID	Comment 4:1
RNS Blend 20R	Charring and smoke around the wire with a small flickering flame.
RNS Blend 21R	Charring and smoke around the wire
RNS Blend 22R	Charring and smoke around the wire
UNS Blend 6a	Charring and smoke around the wire
UNS Blend 7a	Charring and smoke around the wire
UNS Blend 8a	Charring and smoke around the wire with a small flickering flame.
UNS Blend 9a	Charring and smoke around the wire
UNS Blend 19	Charring and smoke around the wire
UNS Blend 20	Charring, smoke, and small flickering flame.
Sod Nit A & Swheat	Sample produced large amounts of flames around 10sec into the analysis. Would sparkly minutes after power was turned off
Sod Nit B & Swheat	Would have a large initial reaction with flames forming quickly throughout the sample. Would sparkly and char minutes after power was turned off
Sod Nit A pH & Swheat	Initially just smoke formed then the flames formed all over the sample. Would sparkly minutes after power was turned off

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Table 6. Comments for Sample to Cellulose ratio of 1:1

Sample ID	Comment 1:1
RNS Blend 20R	Charring, smoke, and flames around the wire and on the outer edges of the sample.
RNS Blend 21R	Charring, smoke, and flames around the wire and on the outer edges of the sample.
RNS Blend 22R	Charring, smoke, and a small flame periodically or throughout the testing period.
UNS Blend 6a	Charring, smoke, and a small flame periodically or throughout the testing period.
UNS Blend 7a	Charring, smoke, and flames around the wire and on the outer edges of the sample.
UNS Blend 8a	Charring, smoke, and flames around the wire and on the outer edges of the sample.
UNS Blend 9a	Charring, smoke, and a small flame throughout the testing period.
UNS Blend 19	Charring, smoke, and a small flame throughout the testing period.
UNS Blend 20	Charring, smoke, and a small flame throughout the testing period.
Sod Nit A & Swheat	Sample reacted and would then proceed to sparkle and smolder several minutes after turning off the power.
Sod Nit B & Swheat	Large flames would form throughout the sample and last for some time before all went out. Would sparkle and flash strongly minutes after power was turned off.
Sod Nit A pH & Swheat	Three of the runs reacted with flames forming throughout the sample before stopping and two runs had one main flame around the wire that was present throughout testing.

DOT UN Liquid Oxidizer test

Sod Nit A pH Adjusted and 45% Sod Nit samples were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1 Test O.2 Test for oxidizing liquid.* The test method measures the potential for a liquid substance to increase the burn rate or intensity mixed at a 1:1 ratio with fibrous cellulose. The mixture is heated in a pressure vessel and the rate of pressure rise is determined and pressure rise time is compared to three reference materials (50% perchloric acid, 40% sodium chlorate and 65% nitric acid) when also mixed at a 1:1 ratio with the cellulose. All standards were prepared on a weight to weight basis. The mean pressure rise of the reference substances are listed in Table 7 and the classifications are listed in the Table 8.

Sod Nit A pH adjusted and 45% Sod Nit samples had a mean pressure rise time of 11.927 and 7.770 sec respectively; therefore, they are Not Division 5.1 under the tested laboratory conditions.

Table 7. Reference Substances

Mean pressure rise time, sec		
(1:1) 50 % perchloric acid and cellulose	(1:1) 40% aqueous sodium chlorate and cellulose	(1:1) 65% nitric acid and cellulose
0.110	0.531	4.511

The 50% perchloric acid and 65% nitric acid solutions both agree closely with the times stated in method 0f 0.121 and 4.133 seconds respectively. However, 40% aqueous sodium chlorate had a mean pressure rise time that was significantly faster than the 2.555 seconds stated in the method. A second source of sodium chlorate was obtained and tested once with result of 0.746 seconds. Saturated ferric nitrate solution was tested once with a pressure rise time of 4.764 seconds which is

around the 4.133 seconds stated in the method. Two 45% sodium nitrate solutions were made with results ranging from 8.275 to 7.401 seconds which was above the 4.133 seconds stated in the method. One of the 45% sodium nitrate solutions used the sodium nitrate as received and the other was dried overnight prior to making the 45% solution. A saturated sodium nitrate solution was then made and analyzed with a result of 5.715 seconds which is still well above the 4.133 seconds the method states it should take a 45% sodium nitrate solution to rise. These additional sodium nitrate tests were performed because of the concern that the method classifies the 45% sodium nitrate solution as a Packing Group II and we are classifying it as Not Division 5.1.

Table 8. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in a 1:1 mixture, by mass, of substance and cellulose tested, spontaneously ignites; or the mean pressure rise time of a 1:1 mixture, by mass, of substance and cellulose is less than that of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose.	Packing group I
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chlorate solution and cellulose; and the criteria for Packing group I are not met	Packing group II
Any substance which, in the 1:1 mixture, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose; and the criteria for Packing groups I and II are not met.	Packing group III
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a pressure rise of less than 2070 kPa gauge; or exhibits a mean pressure rise time greater than the mean pressure rise time of a 1:1 mixture, by mass, of a 65% aqueous nitric acid and cellulose.	Not Division 5.1

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Image 1: Appearance of the UNS and RNS blends after 1030 analysis.



Image 2: Appearance of the Sodium nitrate & Swheat blends after 1030 analysis.

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Image 3: Example of a normal UNS and RNS blend after 1050 analysis



Image 4: UNS blend 8a in the cube showing the clumpy and loose portion of the sample.

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Image 5: UNS Blend 8a showing the lower portion of the cube to be a hardened brown mass after 1050 analysis.



Image 6: Sodium nitrate B & swheat after 1050 analysis

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Image 7: Sodium nitrate A pH adjusted & swheat after 1050 analysis.



Image 8: Sodium Nitrate A & Swheat showing the liquefied material making its way into the tray below after the 1050 analysis.

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Image 9: Sodium Nitrate A & Swheat showing the charred center of the material remaining in the cube after 1050 analysis.

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."

Group Leader

12/22/16.
Date

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SwRI TASK ORDER: 161026-1
SwRI SRR: 58485, 58617
SDG: 605029
VTSR: 10.11.2016, 11.01.2016

Attachment A
Method 1050 Graphs

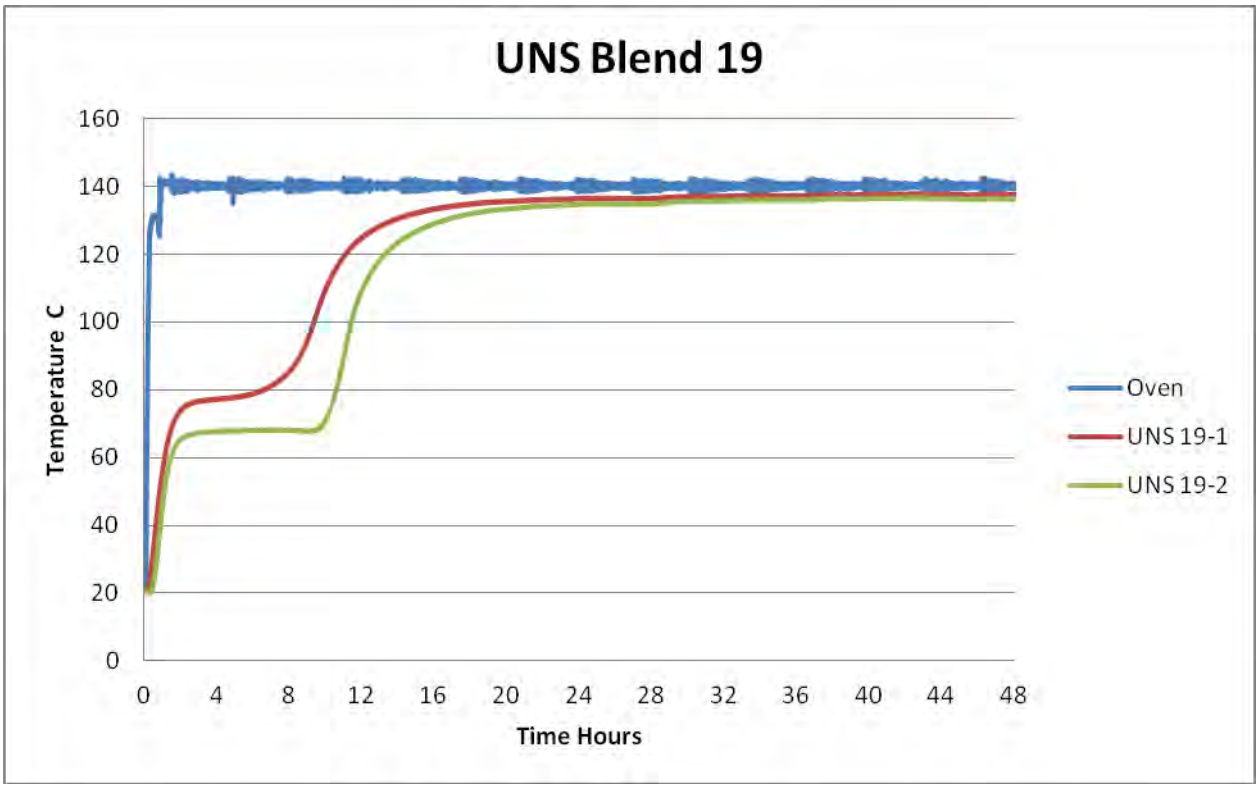


Figure 1. Method 1050 – UNS Blend 19 (100mm cube) full run.

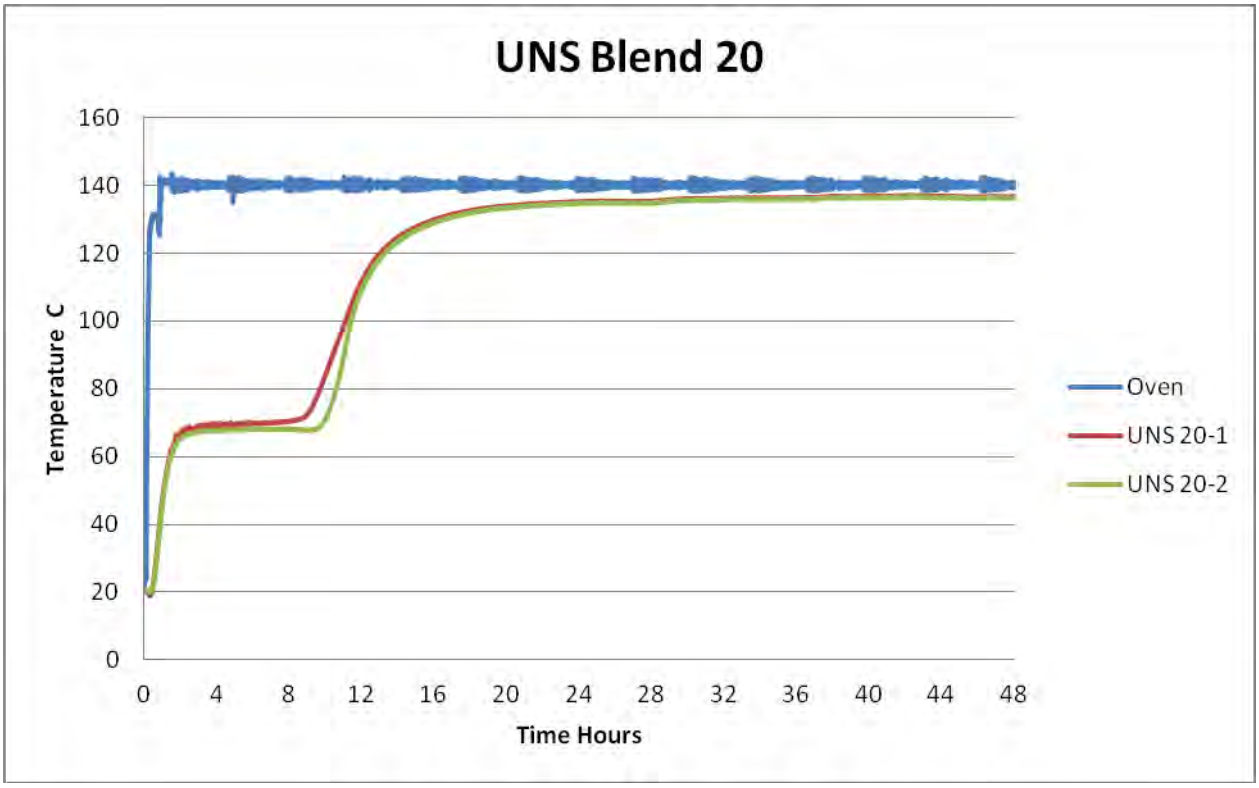


Figure 2. Method 1050 – UNS Blend 20 (100mm cube) full run.

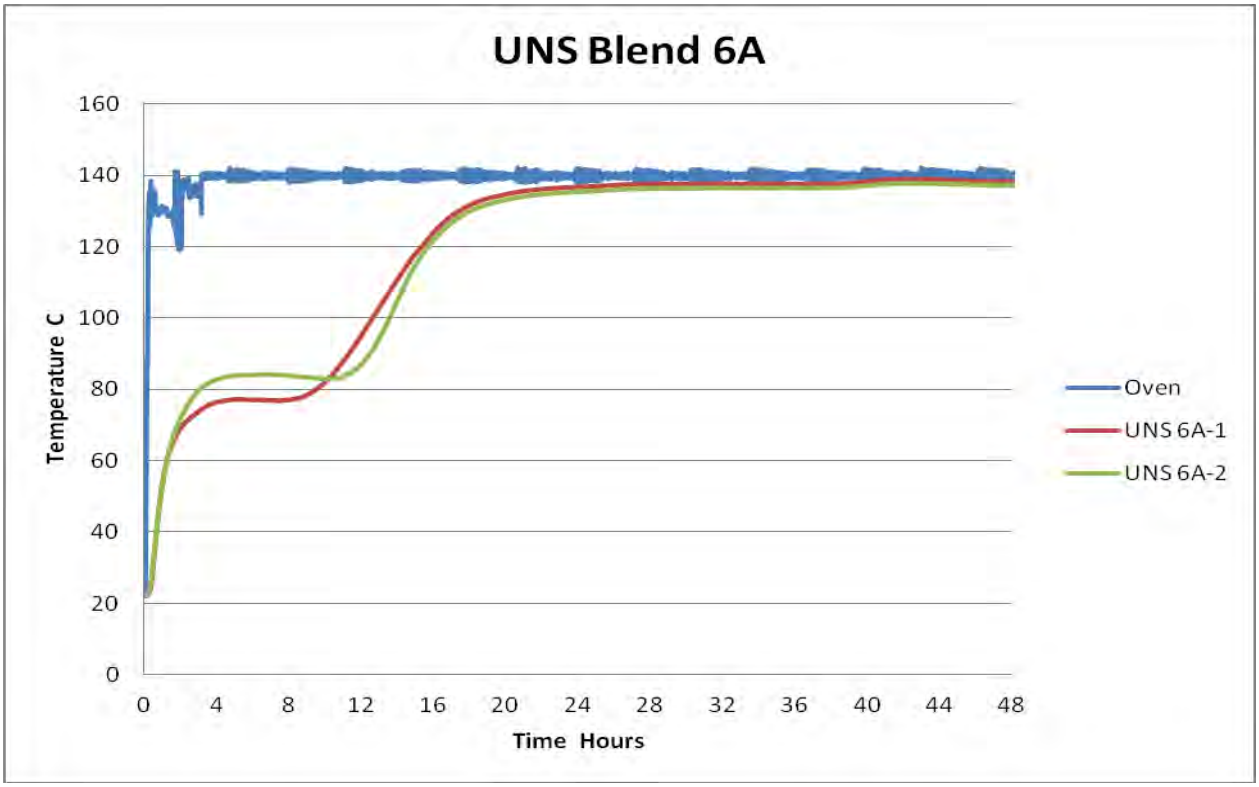


Figure 3. Method 1050 – UNS Blend 6a (100mm cube) full run.

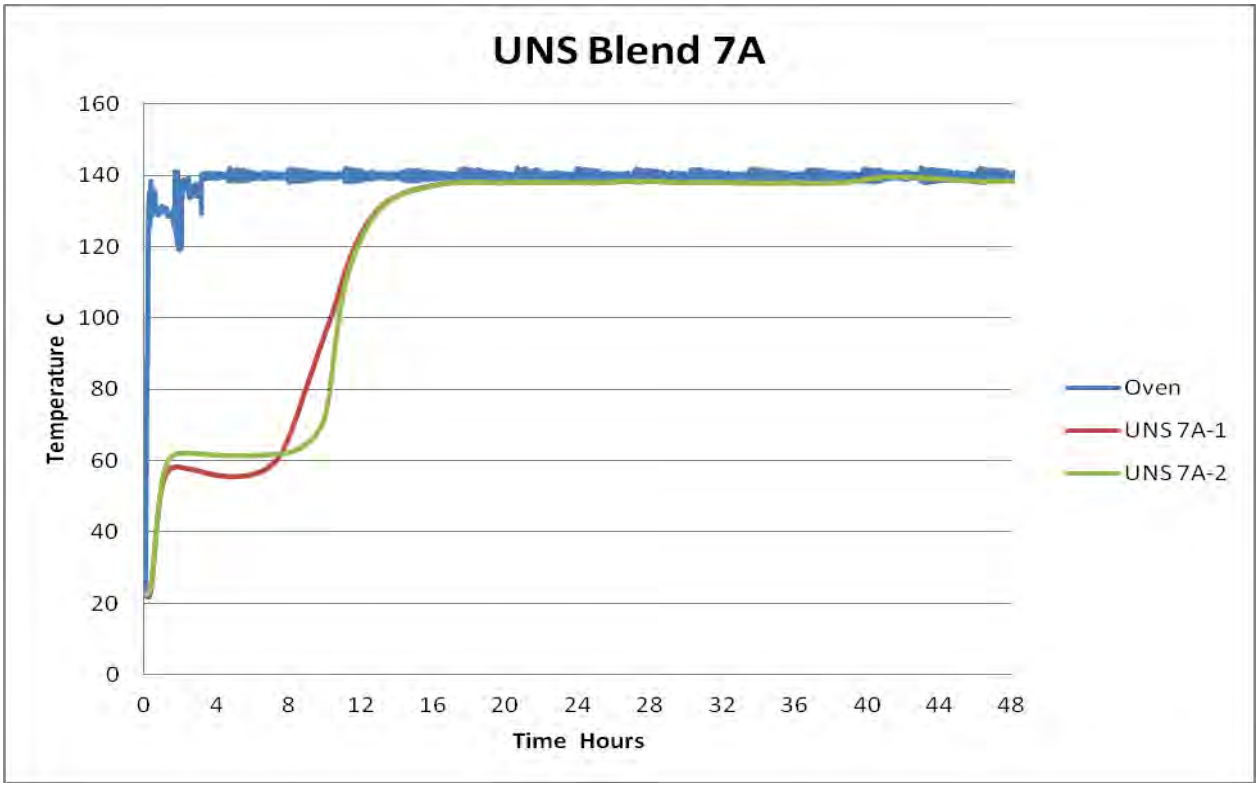


Figure 4. Method 1050 – UNS Blend 7a (100mm cube) full run.

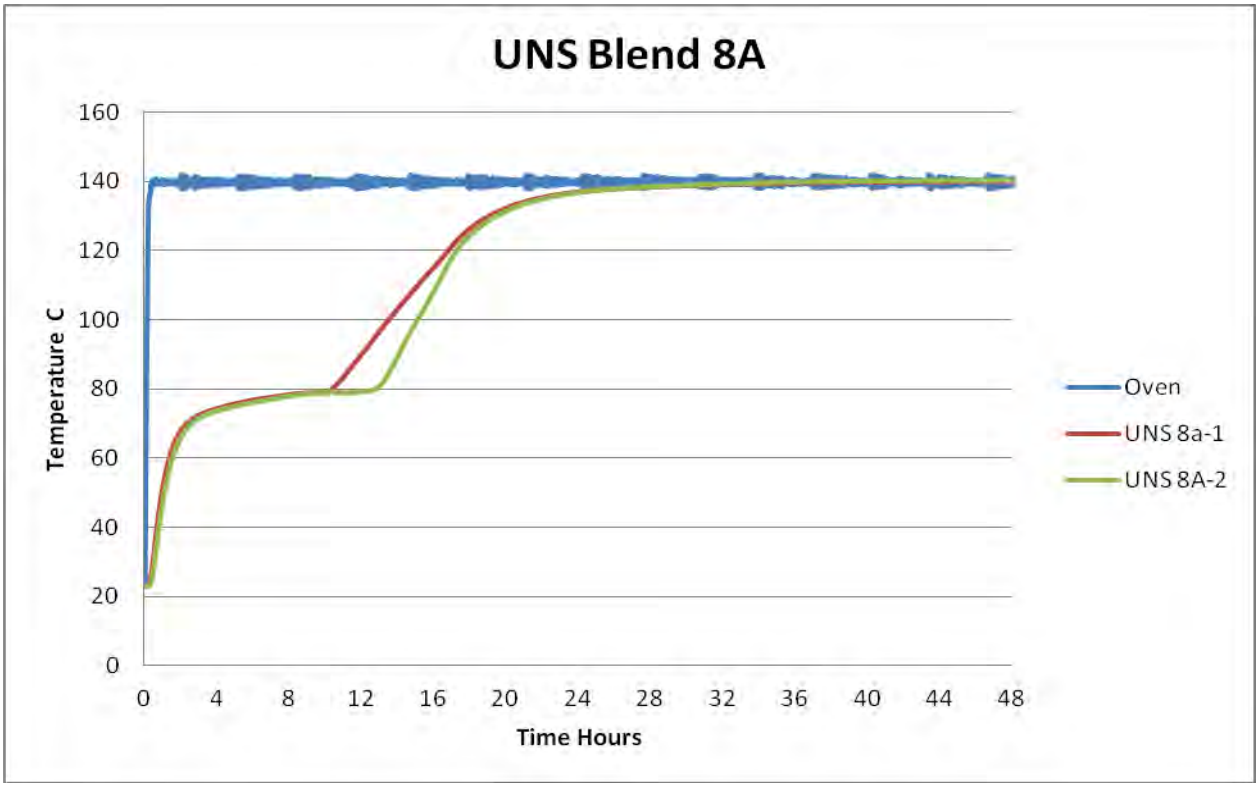


Figure 5. Method 1050 – UNS Blend 8A (100mm cube) full run.

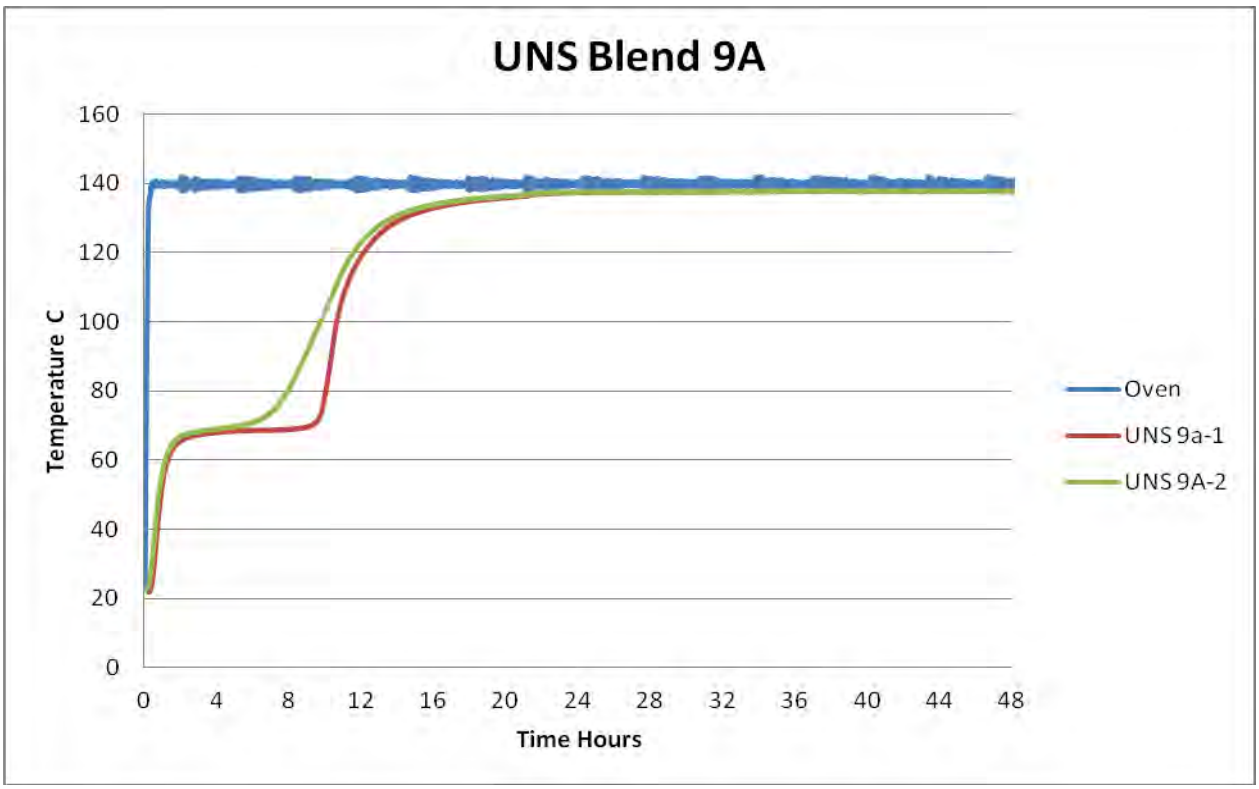


Figure 6. Method 1050 – UNS Blend 9A (100mm cube) full run.

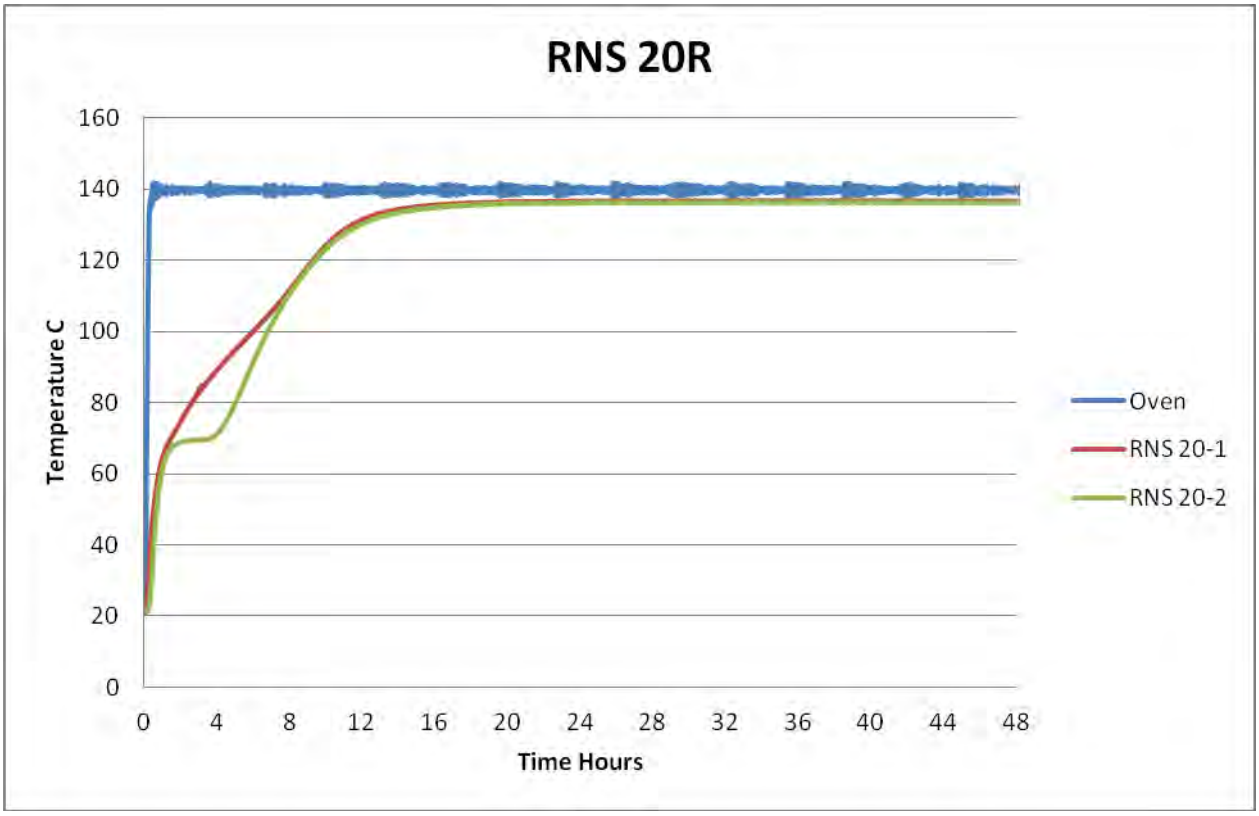


Figure 7. Method 1050 – RNS Blend 20R (100mm cube) full run

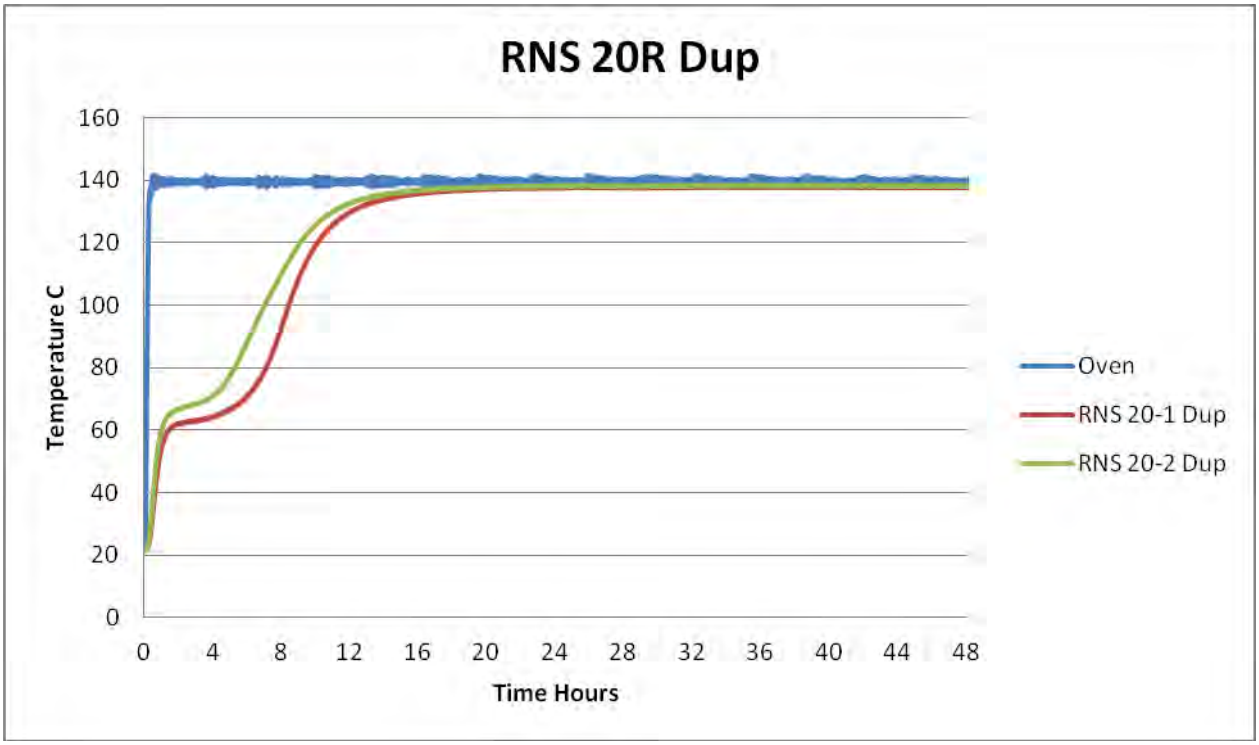


Figure 8. Method 1050 – RNS Blend 20R Duplicate (100mm cube) full run.

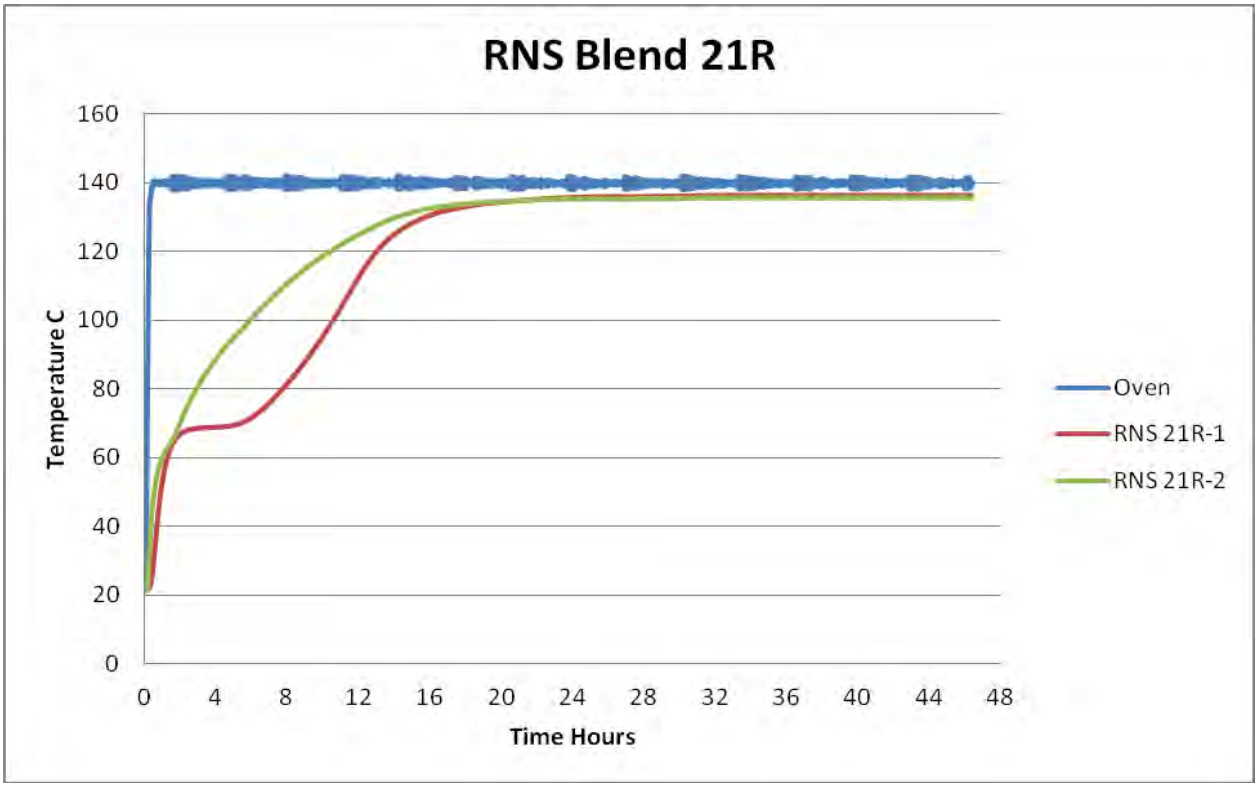


Figure 9. Method 1050 – RNS Blend 21R (100mm cube) full run.

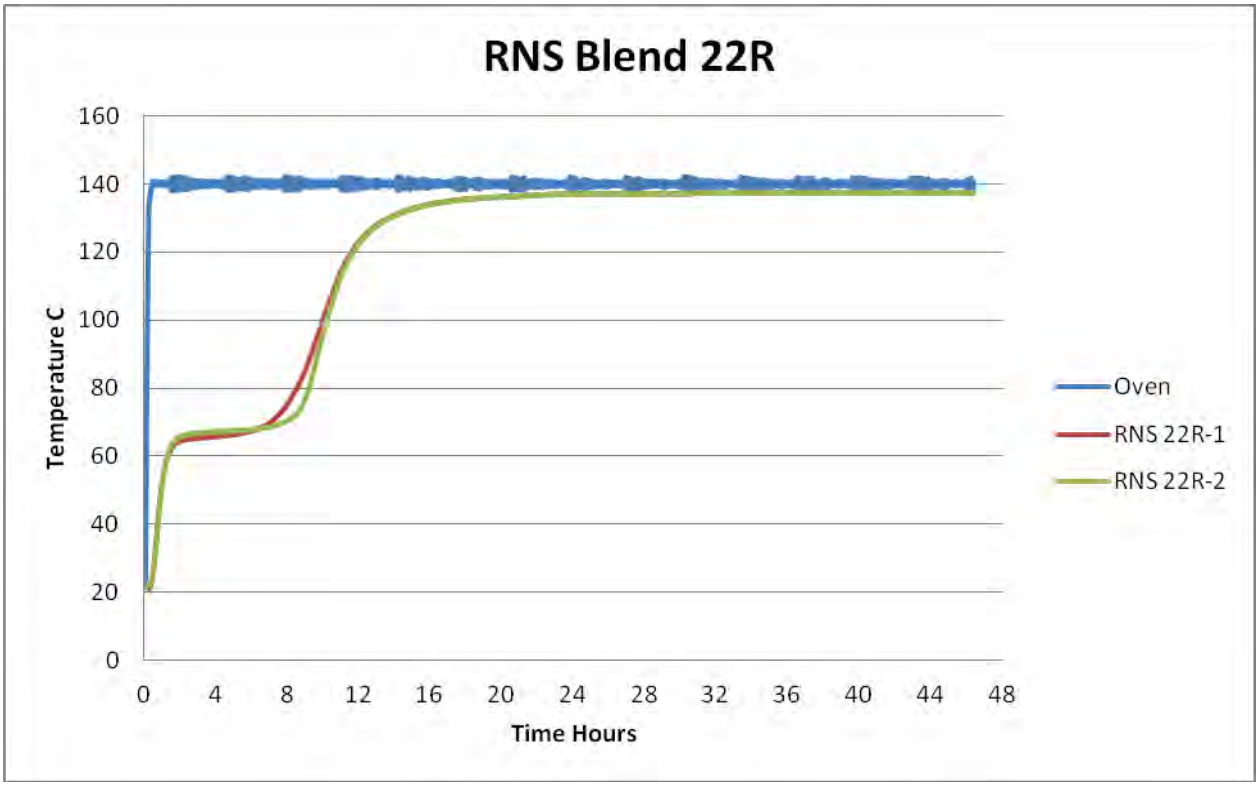


Figure 10. Method 1050 – RNS Blend 22R (100mm cube) full run

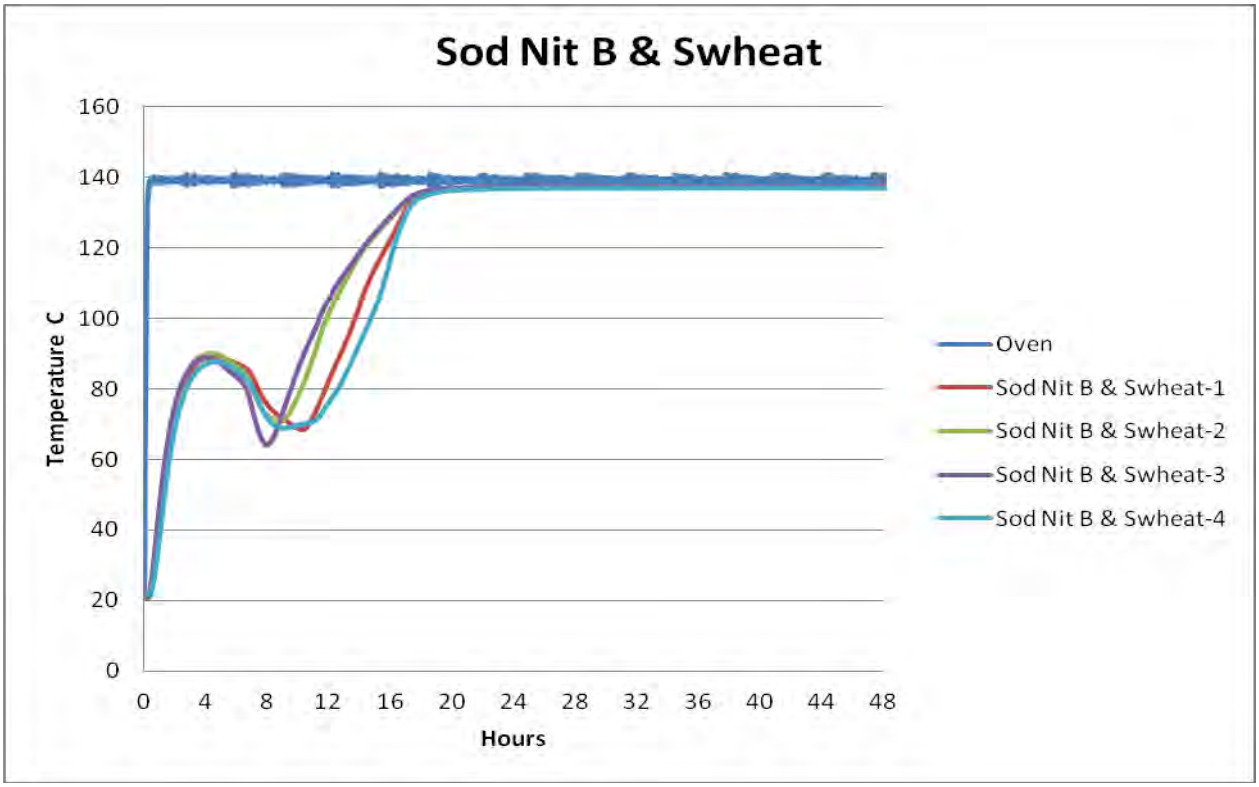


Figure 11. Method 1050 – Sod Nit B & Swheat (100 mm cube) full run.

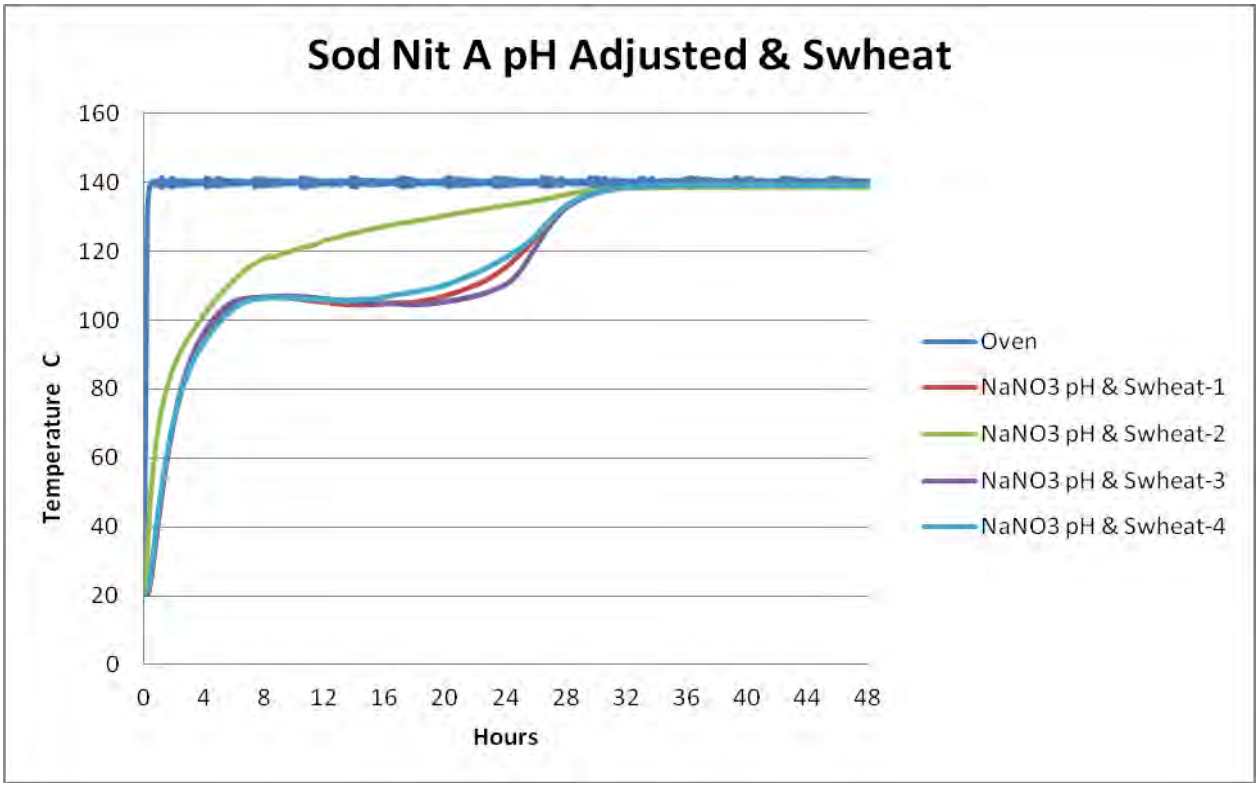


Figure 12. Method 1050 – Sod Nit A pH Adjusted & Swheat (100 mm cube) full run.

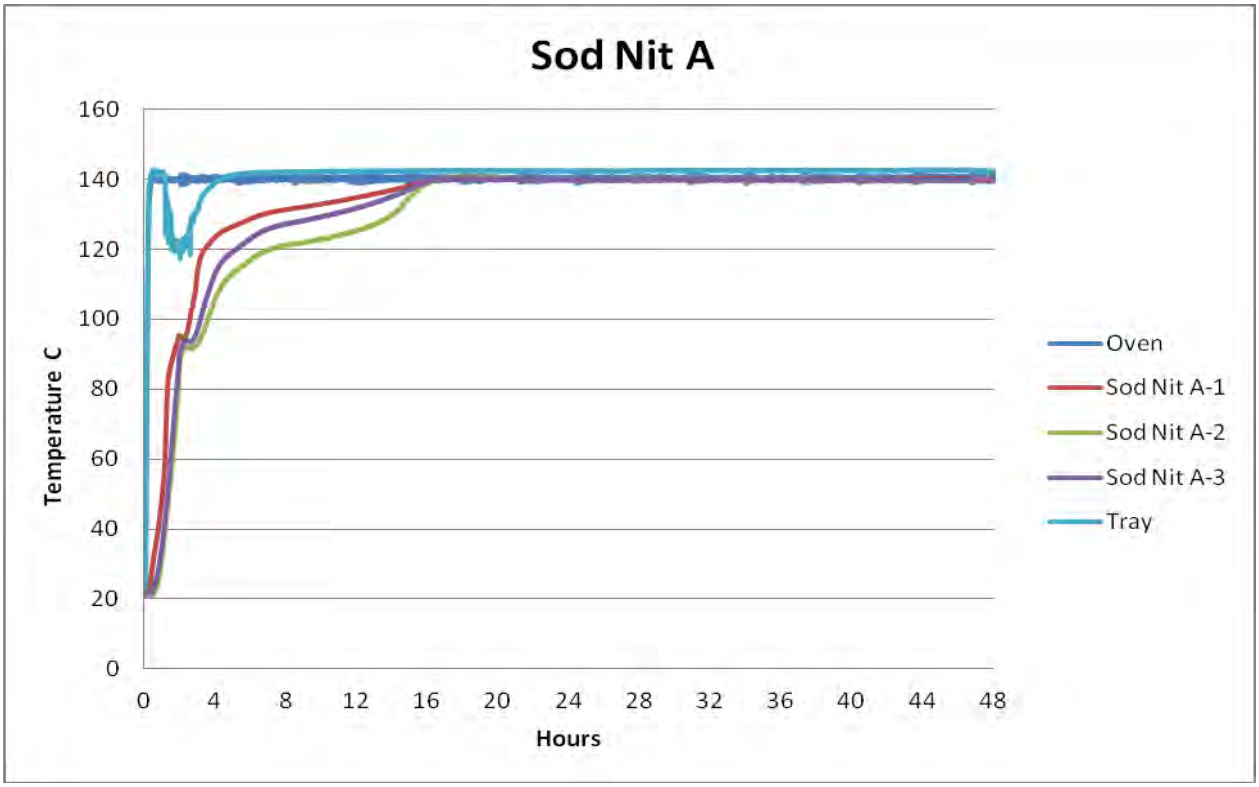


Figure 11. Method 1050 – Sod Nit A (100 mm cube) full run showing an event occuring to the sample causing it to heat quickly and then pool out the bottom of the cage and into the pan below causing the tray thermocouples to cool.

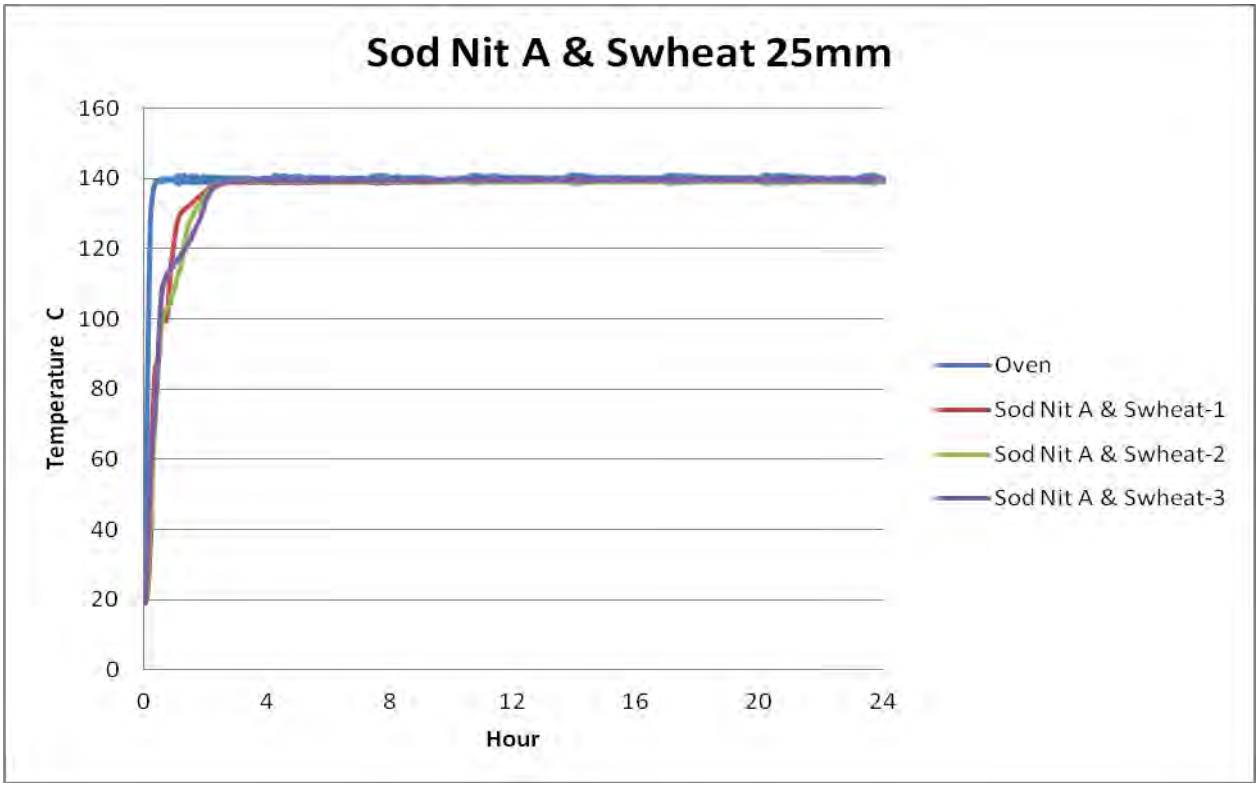


Figure 12. Method 1050 – Sod Nit A (25 mm cube) full run.

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 161026-1
SwRI SRR: 58485, 58617
SDG: 605029
VTSR: 10.11.2016, 11.01.2016

Wetchem Analyses

Sample Results

SOUTHWEST RESEARCH INSTITUTE

UN LIQUID OXIDIZER TEST O.2

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Liquid

Date Made: 12/12/16

SRR #: 58617

Task Order #: 161026-1

Reference Substances

Mean pressure rise time, sec		
(1:1) 50 % perchloric acid and cellulose	(1:1) 40% aqueous sodium chlorate and cellulose	(1:1) 65% nitric acid and cellulose
0.110	0.531	4.511

Test Substance

Sample ID	SwRI System ID	Mean pressure rise time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
45% Sod Nit Solution	606278	7.770	Not Division 5.1	12/15/16
Sod Nit A pH Adjusted	606283	11.927	Not Division 5.1	12/15/16

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in a 1:1 mixture, by mass, of substance and cellulose tested, spontaneously ignites; or the mean pressure rise time of a 1:1 mixture, by mass, of substance and cellulose is less than that of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose.	Packing group I
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chloreate solution and cellulose; and the criteria for Packing group I are not met	Packing group II
Any substance which, in the 1:1 mixtuer, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose; and the criteria for Packing groups I and II are not met.	Packing group III
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a pressure rise of less than 2070 kPa gauge; or exhibits a mean pressure rise time greater than the mean pressure rise time of a 1:1 mixture, by mass, of a 65% aqueous nitric acid and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 10/9/16, 10/17/16, 10/18/16
10/28/16, 11/3/16, 11/14/16, 12/12/16

SRR #: 58485, 58617

Task Order #: 161026-1

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
118.07	51.33	18.65

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
RNS Blend 20R	606279	>180	>180	Not Division 5.1	11/03/16
RNS Blend 21R	606280	no reaction	>180	Not Division 5.1	11/03/16
RNS Blend 22R	606281	no reaction	> 180	Not Division 5.1	11/08/16
UNS Blend 6a	606286	no reaction	> 180	Not Division 5.1	11/08/16
UNS Blend 7a	606287	no reaction	> 180	Not Division 5.1	11/14/16
UNS Blend 8a	606288	>180	>180	Not Division 5.1	11/14/16
UNS Blend 9a	606289	no reaction	> 180	Not Division 5.1	11/21/16
UNS Blend 19	605029	no reaction	> 180	Not Division 5.1	11/29/16
UNS Blend 20	605030	> 180	> 180	Not Division 5.1	11/29/16
Sod Nit A & Swheat	606282	53.95	49.25	Packing Group II	11/21/16
Sod Nit B & Swheat	606285	34.12	138.34	Packing Group II	11/25/16
Sod Nit A pH & Swheat	606284	52.29	164.38	Packing Group II	11/25/16

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

LABORATORY CONTROL SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 10/9/16, 10/17/16, 10/18/16
10/28/16, 11/3/16, 11/14/16, 12/12/16

SRR #: 58485, 58617

Task Order #: 161026-1

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
95-142 sec	41-62 sec	15-22 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	120.72	47.31	19.97	11/03/16
LCS	127.41	58.94	19.50	11/08/16
LCS	131.28	52.28	18.10	11/14/16
LCS	139.97	44.72	16.69	11/21/16
LCS	134.12	53.16	16.81	11/25/16
LCS	118.97	57.14	19.94	11/29/16

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 10/9/16, 10/17/16, 10/18/16 10/28/16, 11/3/16, 11/14/16, 12/12/16

SRR #: 58485, 58617

Task Order #: 161026-1

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
RNS Blend 20R	606279	Nonflammable	11/01/16
RNS Blend 20R Dup	606279	Nonflammable	11/01/16
RNS Blend 21R	606280	Nonflammable	11/01/16
RNS Blend 22R	606281	Nonflammable	11/01/16
UNS Blend 6a	606286	Nonflammable	11/01/16
UNS Blend 7a	606287	Nonflammable	11/01/16
UNS Blend 8a	606288	Nonflammable	11/01/16
UNS Blend 9a	606289	Nonflammable	11/01/16
UNS Blend 19-R	605029	Nonflammable	10/10/16
UNS Blend 20-R	605030	Nonflammable	10/10/16
Sod Nit A & Swheat	606282	Nonflammable	12/07/16
Sod Nit B & Swheat	606285	Nonflammable	12/07/16
Sod Nit A pH & Swheat	606284	Nonflammable	12/07/16

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 10/9/16, 10/17/16, 10/18/16 10/28/16, 11/3/16, 11/14/16, 12/12/16

SRR #: 58485, 58617

Task Order #: 161026-1

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
RNS Blend 20R	606279	Not a self-heating waste	11/01/16
RNS Blend 20R Dup	606279	Not a self-heating waste	11/01/16
RNS Blend 21R	606280	Not a self-heating waste	10/30/16
RNS Blend 22R	606281	Not a self-heating waste	10/30/16
UNS Blend 6a	606286	Not a self-heating waste	10/21/16
UNS Blend 7a	606287	Not a self-heating waste	10/21/16
UNS Blend 8a	606288	Not a self-heating waste	10/27/16
UNS Blend 9a	606289	Not a self-heating waste	10/27/16
UNS Blend 19-R	605029	Not a self-heating waste	10/08/16
UNS Blend 20-R	605030	Not a self-heating waste	10/08/16
Sod Nit A & Swheat	606282	DOT Packing Group III	11/7, 11/21, 12/09/16
Sod Nit B & Swheat	606285	Not a self-heating waste	11/04/16
Sod Nit A pH & Swheat	606284	Not a self-heating waste	11/15/16

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SOUTHWEST RESEARCH INSTITUTE

SW846 9095 Paint Filter Liquids Test

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 10/9/16, 10/17/16, 10/18/16 10/28/16, 11/3/16, 11/14/16, 12/12/16

SRR #: 58485, 58617

Task Order #: 161026-1

Sample ID	SwRI System ID	Method 9095 *Paint Filter Results*	Date Analyzed
RNS Blend 20R	606279	No free liquids	11/01/16
RNS Blend 20R Dup	606279	No free liquids	11/01/16
RNS Blend 21R	606280	No free liquids	11/01/16
RNS Blend 22R	606281	No free liquids	11/01/16
UNS Blend 6a	606286	No free liquids	11/01/16
UNS Blend 7a	606287	No free liquids	11/01/16
UNS Blend 8a	606288	No free liquids	11/01/16
UNS Blend 9a	606289	No free liquids	11/01/16
UNS Blend 19-R	605029	No free liquids	10/10/16
UNS Blend 20-R	605030	No free liquids	10/10/16

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SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 161026-1
SwRI SRR: 58485, 58617
SDG: 605029
VTSR: 10.11.2016, 11.01.2016

UN Oxidizer

Raw Data

Southwest Research Institute

UN Test O.2: Test for Oxidizing liquids

Client	LANL
Project #	21592.01.006
TO#	161026-1

Standardization	
50% (w/w) HCLO4	Time, sec
1	0.114
2	0.101
3	0.127
4	0.107
5	0.103
avg	0.110
40% (w/w) NaCLO3	Time, sec
1	0.602
2	0.341
3	0.538
4	0.608
5	0.568
avg	0.531
65% (w/w) HNO3	Time, sec
1	4.377
2	4.290
3	4.706
4	4.510
5	4.671
avg	4.511

Standard Verification

STD	Time, sec		
65% (w/w) HNO3	4.671	12/14/16	104%
65% (w/w) HNO3	4.190	12/15/16	92.9%

Additional Verification

Sample	Time, sec
Saturated NaNO3	5.715
Saturated Ferric Nitrate	4.764
40% (w/w) NaCLO3	0.746

Sample Results

45% NaNO3	Time, sec	Classification
1	7.609	
2	8.275	
3	7.443	
4	8.120	
5	7.401	*
avg	7.770	Not Division 5.1
Sod Nit A pH Adj	Time, sec	
1	10.865	
2	12.791	
3	10.320	
4	13.201	
5	12.456	
avg	11.927	Not Division 5.1

* Dried NaNO3 used to make this 45% solution

010043

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 161026-1

Reference Substance

Nichrome 80 22 gauge 180W

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0160	21.0265	110.71	
3:7	2	9.0300	21.0355	122.90	
3:7	3	9.0641	21.0238	121.84	
3:7	4	9.0231	21.0763	112.38	
3:7	5	9.0538	21.0433	122.54	
3:7	**Avg**			118.07	94.46 to 141.69

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0460	18.0115	44.62	
2:3	2	12.0082	18.0492	42.97	
2:3	3	12.0292	18.0785	50.00	
2:3	4	12.0468	18.0451	60.84	
2:3	5	12.0590	18.0421	58.23	
2:3	**Avg**			51.33	41.06 to 61.60

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0758	12.0553	14.28	
3:2	2	18.0626	12.0142	18.84	
3:2	3	18.0518	12.0728	20.72 RSBM 11/2/16	
3:2	4	18.0721	12.0152	20.38	
3:2	5	18.0724	12.0318	19.04	
3:2	**Avg**			18.65	14.92 to 22.38

Weighted Samples: James Moken Balance#: 135 Date: 11/2/16
Tested Samples: James Moken Timer ID: 022021 Date: 11/2/16
Potassium Bromate: Inorg# 69450 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755 Dried: ≥4hrs. @ 105°C
Variac Setting: 180 ± 7 Watts 8 on SRM 11/3/16

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 1610260-1

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0291	21.0479	120.72	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**			120.72	94.46 to 141.69

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0224	18.1047	47.31	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**			47.31	41.06 to 61.60

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0771	12.0272	19.97	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**			19.97	14.92 to 22.38

Weighted Samples: James Moken Balance#: 135 Date: 11/3/16
Tested Samples: James Moken Timer ID: 02121 Date: 11/3/16
Potassium Bromate: Inorg# 69450 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts
8 a.s.a.m.
11/3/16

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 1610226-1

Sample Analysis

System ID: Blend 20B

nichrome 80 22 gauge wire 180W with EC1000S AC/DC power supply

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0763	6.0727	181.31	small flame flicker slight charring around wire, slight smoke,
4:1	2	24.0397	6.0749	180.19	charring around wire, slight smoke
4:1	3	24.0010	6.0746	182.32	charring around wire, slight smoke & flame
4:1	4	24.0734	6.1092	180.43	charring around wire, slight smoke & flame
4:1	5	24.0098	6.0162	180.88	charring around wire, slight smoke & flame
4:1	Avg			>180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0714	15.0199	197.42	charring flame and smoke around wire throughout
1:1	2	15.1427	15.0194	250.31	charring, flame, and smoke around wire throughout
1:1	3	15.0074	15.0116	287.38	charring, flame, and smoke throughout
1:1	4	15.0247	15.0432	220.53	charring, flame, and smoke throughout
1:1	5	15.0529	15.0371	289.34 TESAM 11/3/16	charring, flame, and smoke around wire throughout time when flame extinguishes, power off @ 180s
1:1	Avg			>180	

blue flame escapes across surface several times during initial minute after applying power

Weighted Samples: James Moken Balance#: 135 Date: 11/3/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/3/16
Sample Dried ? (YES) NO TESAM 11/3/16 Dried: No
Cellulose: Inorg# 71755 Dried: >4hrs.@105C
Variac Setting: 180 ± 7 Watts 8 CI SAM 11/3/16

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 1610726-1

Sample Analysis

System ID: Blend 21R

nichrome 80 22gauge wire
180W with EC1000S
AC/DC power supply

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0543	6.0047	181.38	charring and smoke around wire
4:1	2	24.0185	6.0191	181.31	charring and smoke around wire
4:1	3	24.0607	6.0503	182.40	charring and smoke around wire, small flame pliers
4:1	4	24.0251	6.0832	180.66	charring and smoke around wire
4:1	5	24.0332	6.0103	183.59	charring and smoke around wire
4:1	Avg			>180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0127	15.0025	200.01	charring, smoke, and flame around wire
1:1	2	15.0724	15.0231	209.90	charring, smoke, and flame throughout
1:1	3	15.0492	15.0812	408.53	charring, smoke, and flames throughout
1:1	4	15.0871	15.0692	189.12	charring, smoke, and flames around wire
1:1	5	15.0867	15.0334	229.51	
1:1	Avg			7180	time when flame extinguished, power stopped at 180 seconds

Weighted Samples: James Moken Balance#: 135 Date: 11/3/16
Tested Samples: James Moken Timer ID: ~~011550~~ ~~8044327~~ 0229421 TESAM 11/3/16 Date: 11/3/16
Sample Dried ? YES / (NO) Dried: No
Cellulose: Inorg# 71955 Dried: >4hrs.@105C
Variac Setting: 180 ± 7 Watts
8 CJSAM 11/3/16

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 1601026-1

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Nichrome 80 22gauge 180W with Eclipse AC/DC power supply

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0192	21.0235	127.41	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**			127.41	94.46 to 141.69
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0244	18.0102	58.94	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**			58.94	41.06 to 61.60
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0419	12.0399	19.50	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**			19.50	14.92 to 22.38

Weighted Samples: James Moken Balance#: 135 Date: 11/8/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/8/16
Potassium Bromate: Inorg# 69450 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755 Dried: ≥4hrs. @ 105°C
Variac Setting: ~~150~~ 8 ± 7 Watts
11/8/16

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 1161026-1

Sample Analysis

System ID: Blend 22R

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0495	6.0570	181.00	cherring around wire, little smoke
4:1	2	24.0666	6.0036	180.09	cherring around wire, little smoke
4:1	3	24.0595	6.0409	181.41	cherring around wire, little smoke
4:1	4	24.0207	6.0611	185.27	cherring around wire, little smoke
4:1	5	24.0299	6.0104	181.53	cherring around wire, little smoke
4:1	Avg			>180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0158	15.0522	220.00	cherring and smoke around wire, small flame throughout
1:1	2	15.0001	15.0034	467.94	cherring and smoke around wire, small flames throughout
1:1	3	15.0284	15.0364	198.00	cherring and smoke around wire, small flame periodically
1:1	4	15.0776	15.0664	216.00	cherring and smoke around wire, small flames throughout
1:1	5	15.0161	15.0465	328.04	cherring and smoke around wire, small flame throughout
1:1	Avg			>180	Stop time is when flame went out. power turned off @ 180 seconds

blue flame kicked across sample during 1st minute of power application

Weighted Samples: James Moken Balance#: 135 Date: 11/18/16

Tested Samples: James Moken Timer ID: 022921 Date: 11/18/16

Sample Dried ? YES / (NO) Dried:

Cellulose: Inorg# 71755 Dried: >4hrs.@105C

Variac Setting: 180 ± 7 Watts
8 a.m. AM 11/18/16

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 161026-1

Sample Analysis

System ID: 6a

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0534	6.0744	183.53	charring and smoke around wire
4:1	2	24.0551	6.0646	182.78	charring and smoke around wire
4:1	3	24.0152	6.0407	183.44	charring and smoke around wire
4:1	4	24.6400	6.0292	181.28	charring and smoke around wire
4:1	5	24.6355	6.6914	181.34	charring and smoke around wire
4:1	Avg			7|80	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.6378	15.0576	201.41	charring and smoke around wire, flame thghout
1:1	2	15.0945	15.0526	194.84	charring and smoke around wire, flames throughout
1:1	3	15.0100	15.0401	189.22	charring and smoke and flame around wire
1:1	4	15.0198 TEQAM 11/6/16	15.0150	244.53	charring and smoke and flame around wire
1:1	5	15.0506	15.0961	192.81	charring, smoke, and flame around wire
1:1	Avg			>180	time is when flame went out on sample. Power turned off @ 180 seconds

Weighted Samples: James Moken Balance#: 135 Date: 11/8/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/8/16
Sample Dried ? YES / (NO) Dried: N/A
Cellulose: Inorg# ~~64450~~ 71755 CJZAM 11/9/16 Dried: >4hrs.@105C
Variac Setting: 130 ± 7 Watts
8 CJZAM 12/16/16

Classification: Not Division 5.1

010050

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 161026-1

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Nichrome 80 22 gauge
180W

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0718	21.0168	131.28	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**			131.28	94.46 to 141.69
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0261	18.0213	52.28	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**			52.28	41.06 to 61.60
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0192	12.0132	18.10	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**			18.10	14.92 to 22.38

Weighted Samples: James Moken Balance#: 135 Date: 11/14/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/14/16
Potassium Bromate: Inorg# 69450 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts
8 CJSAM 11/14/16

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 161026-1

Sample Analysis

System ID: 7A

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0675	6.0279	182.16	charring and smoke around the wire
4:1	2	24.0498	6.0136	181.23	charring and smoke around the wire
4:1	3	24.0375	6.0148	182.13	charring and smoke around the wire
4:1	4	24.0159	6.0196	180.25	charring and smoke around the wire
4:1	5	24.0298	6.0116	181.72	charring and smoke around the wire
4:1	Avg			> 180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0575	15.0127	230.72	charring, smoke, and flame around wire
1:1	2	15.0147	15.0123	198.72	charring, smoke, and flames around wire
1:1	3	15.0228	15.0131	190.00	charring, smoke, and flames around wire
1:1	4	15.0131	15.0369	191.72	charring, smoke, and flames around wire
1:1	5	15.0632	15.0465	193.16	charring, smoke, and flames around wire
1:1	Avg			>180	time stopped when flames went out, power turned off @ 180sec

Weighted Samples: James Moken Balance#: 135 Date: 11/14/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/14/16
Sample Dried ? YES (NO) Dried: No
Cellulose: Inorg# 71755 Dried: >4hrs.@105C
Variac Setting: 180 ± 7 Watts
8 CJSAM 11/14/16

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 161026-1

Sample Analysis

System ID: 8A

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0007	6.0177	120.75	charring, smoke, and small flame around wire present
4:1	2	24.0085	6.0316	180.85	charring, smoke, and wire
4:1	3	24.0037	6.0176	181.25	charring and smoke around wire
4:1	4	24.0295	6.0208	181.22	charring and smoke around wire
4:1	5	24.0791	6.0127	182.71	charring, smoke, and small flame around wire
4:1	Avg			>180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0345	15.0407	190.75	charring, smoke, and flames around wire
1:1	2	15.0472	15.0444	190.09	charring, smoke, and flames around wire
1:1	3	15.0670	15.0779	189.69	charring, smoke, and flame around wire
1:1	4	15.0252	15.0142	192.71	charring, smoke, and flame around wire
1:1	5	15.0371	15.0524	193.28	charring, smoke, and flame around wire
1:1	Avg			>180	time stopped when flames went out, power turned off @ 180sec

Weighted Samples: James Moken Balance#: 135 Date: 11/14/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/14/16
Sample Dried ? YES / (NO) Dried: NO
Cellulose: Inorg# 71755 Dried: >4hrs.@105C
Variac Setting: 180 ± 7 Watts
8 @ SAM 11/14/16

Classification: Not Division 5.1

010053

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 161026-1

Reference Substance

Nichrome 80 22gauge
180W

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0187	21.0122	139.97	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**			139.97	94.46 to 141.69

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0112	18.0233	44.72	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**			44.72	41.06 to 61.66

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0119	12.0187	16.69	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**			16.69	14.92 to 22.38

Weighted Samples: James Moken Balance#: 135 Date: 11/21/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/21/16
Potassium Bromate: Inorg# 64450 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755 Dried: ≥4hrs. @ 105°C
Variac Setting: 180 ± 7 Watts
8 JAM 11/26/16

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 1601026-1

Sample Analysis

System ID: 9A

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0568	6.0332	180.79	charring and smoke around the wire
4:1	2	24.0432	6.0076	180.81	charring and smoke around the wire
4:1	3	24.0032	6.0237	181.66	charring and smoke around the wire
4:1	4	24.0614	6.0383	181.25	charring and smoke around the wire
4:1	5	24.0021	6.0132	183.06	charring and smoke around the wire
4:1	Avg			>180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0309	15.0092	306.66	charring, ~~smoke and~~ smoke, and flame throughout run TESAM 11/21/16
1:1	2	15.0785	15.0103	204.16	charring, smoke, and flame throughout run
1:1	3	15.0008	15.0644	247.35	charring, smoke, and flame throughout run
1:1	4	15.0837	15.0463	208.78	charring, smoke, and flame throughout run
1:1	5	15.0009	15.0079	198.87	charring, smoke, and flame throughout run
1:1	Avg			>180	time is when flame went out with power being turned off @ 180 sec

forethrough pose SAM 11/21/16

Weighted Samples: James Moken Balance#: 135 Date: 11/21/16

Tested Samples: James Moken Timer ID: 022921 Date: 11/21/16

Sample Dried ? YES (NO) Dried: No

Cellulose: Inorg# 71755 Dried: >4hrs.@105C

Variac Setting: 180 ± 7 Watts
B CJSAM 11/21/16

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 1610126-1

Sample Analysis

System ID: Sod Nt A+ scrub +

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0433	6.0269	52.37	" "
4:1	2	24.0417	6.0510	68.00	Sample caused in flame 2 times after apying heat
4:1	3	24.0704	6.0249	58.97	" " Sample appeared to shoot off particles that would burst and ignite,
4:1	4	24.0701	6.0276	42.15	" "
4:1	5	24.0173	6.0281	48.24	" "
4:1	Avg		42 - 68	53.95	stopped timer when flames from main reaction ended central core of sample was a molten mass when removed would shoot sample when moved

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0641	15.0392	42.47	Sample reacting took about 15 sec to begin then stopped after more flame
1:1	2	15.0156	15.0503	42.07	" would not burn all the cellulose mainly just the sample "
1:1	3	15.0296	15.0179	52.84	" "
1:1	4	15.0755	15.0448	50.15	" "
1:1	5	~~15.0755~~		58.74	" "
1:1	Avg			49.25	Sample smoldered and sparked several minutes after testing was the paper

range 42-58

Weighted Samples: James Moken Balance#: 135 Date: 11/21/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/21/16
Sample Dried ? YES / (NO) Dried: No
Cellulose: Inorg# ~~64450~~ 71755 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts

Classification: Packing Group II

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 116026-1

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0553	21.0682	134.12	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**			134.12	94.46 to 141.69

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0478	18.0439	53.16	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**			53.16	41.06 to 61.60

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0373	12.0269	16.81	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**			16.81	14.92 to 22.38

Weighted Samples: James Moken Balance#: 135 Date: 11/25/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/25/16
Potassium Bromate: Inorg# 69450 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755 Dried: ≥4hrs. @ 105°C
Variac Setting: 180 ± 7 Watts
8 95AM 12/16/16

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 161026-1

Sample Analysis

System ID: Sod Nit B ; solvent

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0229	6.0215	~~35.21~~ 187.19 (11/25/16)	smoke and major reacting with power on, flames would form and last for ~5 sec, several times continued to reacte ①
4:1	2	24.0078	6.0577	36.59 flames stopped 184.41	"
4:1	3	24.0392	6.0746	33.74 182.13	"
4:1	4	24.0106	6.0577	34.94 183.41	"
4:1	5	24.0129	6.0217	30.14 182.14	"
4:1	Avg			34.12	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0205	15.0109	189.78	flame present throughout analysis, would become large and encompass sample several times during analysis ②
1:1	2	15.0512	15.0111	110.19	large flames present and all flames overall went out
1:1	3	15.0317	15.0097	137.41	"
1:1	4	15.0282	15.0495	101.54	"
1:1	5	15.0206	15.0181	152.47	flames present for a while mainly in the front near the curves not moving in center of sample like runs 2 through 4
1:1	Avg			138.34	

Weighted Samples: James Moken Balance#: 135 Date: 11/25/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/25/16
Sample Dried ? YES / (NO) Dried: NO
Cellulose: Inorg# 71755 Dried: >4hrs.@105C
Variac Setting: 180 ± 7 Watts
8 at 9Am 12/16/16

Classification: Packing Group II

① minutes after turning off the power. (Sparkling)

flames shorter than those on the sod Nit A ; solvent

② would sparkle and flash strongly during and minutes after analysis

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 16162601

Sample Analysis

System ID: ~~Sod NTA~~ DH adjusted

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0044	6.0149	51.47 (55.19)	Initiall just smoke then flames formed all over the sample for some time and then stopped. ①
4:1	2	24.0379	6.0341	50.15	" "
4:1	3	24.0085	6.0641	62.38	" "
4:1	4	24.0004	6.0491	45.00	" "
4:1	5	24.0011	6.0224	52.44	" "
4:1	Avg			52.29	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0871	15.0396	150.72	flames primarily in the front where wires enter the sample, flames would appear around sample periodically
1:1	2	15.0866	15.0168	138.72	" "
1:1	3	15.0060	15.0124	181.75	besides a flame at the wire entering the sample no other reaction occured besides smoke and sparklas
1:1	4	15.0641	15.0096	186.81	" "
1:1	5	15.0318	15.0615	163.90	flames were seen throughout sample.
1:1	Avg			164.38	

Weighted Samples: James Moken Balance#: 135 Date: 11/25/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/25/16
Sample Dried ? YES / (NO) Dried: No
Cellulose: Inorg# 71705 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts
6 of SAM 12/16/16

Classification: Packing Group ~~III~~ II

① Did not sparkle as vigorously as the other subsect blends after power was turned off.

Error on the side of caution made a packing Group II
SAM 12/21/16

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 161026-1

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0281	21.0196	118.97	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**			118.97	94.46 to 141.64

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0151	18.0090	57.14	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**			57.14	41.06 to 61.60

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0124	12.0528	19.94	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**			19.94	14.92 to 22.38

Weighted Samples: James Moken Balance#: 135 Date: 11/29/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/29/16
Potassium Bromate: Inorg# 69450 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 71755 Dried: ≥4hrs. @ 105°C
Variac Setting: 150 ± 7 Watts
8 cysm 12/16/16

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 1610260-1

Sample Analysis

System ID: UNS Blend #19

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0135	6.0285	182.04	charring and smoke around wire
4:1	2	24.0323	6.0168	182.47	charring and smoke around wire
4:1	3	24.0284	6.0315	188.93	charring and smoke around wire
4:1	4	24.0194	6.0240	185.31	charring and smoke around wire
4:1	5	24.0116	6.0080	183.79	charring and smoke around wire
4:1	Avg			>180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0167	15.0058	>420	charring, smoke, and flame that slowly moved away
1:1	2	15.0093	15.0087	210	charring, smoke, and flame around wire
1:1	3	15.0051	15.0037	195.17	charring, smoke, and flame around wire
1:1	4	15.0066	15.0050	219.71	charring, smoke, and flame around wire
1:1	5	15.0301	15.0376	373.91	charring, smoke, and flame around wire
1:1	Avg			7180	time is when flame went of power tried off @180sec

Weighted Samples: James Moken Balance#: 135 Date: 11/29/16
Tested Samples: James Moken Timer ID: 022921 Date: 11/29/16
Sample Dried ? YES (NO) Dried: NO
Cellulose: Inorg# 71755 Dried: >4hrs.@105C
Variac Setting: 180 ± 7 Watts
8 @ SAM 12/1/16 JH

① across the sample

Classification: Not Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 16 1026-1

Sample Analysis

System ID: UNS Blend #20

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0443	6.0156	183.03	charring, smoke, small flame periodically sparking
4:1	2	24.0341	6.0193	182.71	charring, smoke, crackling and popping of sample
4:1	3	24.0086	6.0037	185.29	charring, smoke, crackling and popping of sample
4:1	4	24.0775	6.0233	183.15	charring, smoke, popping of sample, periodic small flame
4:1	5	24.0843	6.0435	183.92	charring, smoke, and popping of sample
4:1	Avg			7180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0134	15.0277	227.93	charring, smoke, flames around valve present throughout test time
1:1	2	15.0092	15.0199	218.36	charring, smoke, flame throughout testing thru
1:1	3	15.0245	15.0213	209.51	" "
1:1	4	15.0259	15.0007	400.72	" "
1:1	5	15.0233	15.0243	237.45	" "
1:1	Avg			7180	type B wren flame went out, power turned off @ 180 sec

blue flame would shoot off around the top surface of the sample for the first 30 seconds

Weighted Samples: James Moken Balance#: 135 Date: 11/29/16
Tested Samples: James Moken Timer ID: 027921 Date: 11/29/16
Sample Dried ? YES / (NO) Dried: No
Cellulose: Inorg# 71755 Dried: >4hrs.@105C
Variac Setting: 180 ± 7 Watts
8 CI DAM 12/1/16

Classification: Not Division 5.1

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

SW-846 Method 1050
Raw Data

SOUTHWEST RESEARCH INSTITUTE

SW-846 1050

Client: Los Alamos National Laboratory
Project No: 21592.01.00X

Task Order: 161026-1
SRR: 58617, 58485

Sample ID: UNS Blend 19 & 20
Start Date: 10/08/16 Stop Date: 10/10/16
Start Time: 2:57 PM Stop Time: 4:58 PM

Both samples came to temperature slowly due to the moisture content in each of them. Samples reached a steady temperature around 20 hours into the analysis and held constant until the test was stopped. When removed from the oven both samples appeared as a dry zeolite with dried brown portions of waste mixture within the zeolite. No events appeared to have taken place and the sample temperature did not exceed 200°C during the testing time so both are considered to not be self heating.

Sample ID: UNS Blend 6a & 7a
Start Date: 10/21/16 Stop Date: 10/19/02
Start Time: 8:03 AM Stop Time: 9:21 AM

Both samples came to temperature slowly due to the moisture content in each of them. UNS Blend 6a came to a stable temperature around 24 hours into the analysis and 7a came to temprature around 16 hours into the analysis. Once at temperature both samples held constant. When removed from the oven 6a was mostly a loose mass that crumbled with a little hand pressure, and 7a was all loose material with no clumping. No events appeared to have taken place and the sample temperature did not exceed 200°C during the testing time so both are considered to not be self heating.

Sample ID: UNS Blend 8a & 9a
Start Date: 10/27/16 Stop Date: 10/29/16
Start Time: 1:30 PM Stop Time: 3:30 PM

Both samples came to temperature slowly due to the moisture content in each of them. UNS Blend 8a came to a stable temperature around 32 hours into the analysis and 9a came to temprature around 26 hours into the analysis. Once at temperature both samples held constant. When removed from the oven 8a was a hardened brown mass but no evidence of burning or an event was apparant. 9a was all loose material with very little clumping. No events appeared to have taken place and the sample temperature did not exceed 200°C during the testing time so both are considered to not be self heating.

SOUTHWEST RESEARCH INSTITUTE

SW-846 1050

Client: Los Alamos National Laboratory
Project No: 21592.01.00X

Task Order: 161026-1
SRR: 58617, 58485

Sample ID: UNS Blend 21R and 22R

Start Date:	10/30/16	Stop Date:	11/01/16
Start Time:	12:11 PM	Stop Time:	10:36 AM

Both samples came to temperature slowly due to the moisture content in each of them. Both blends came to temperatue around 22 to 24 hours into analysis. Once at temperature both samples held constant. When removed from the oven both samples were pretty much all loose material with a dry zeolite appearance to them. No events appeared to have taken place and the sample temperature did not exceed 200°C during the testing time so both are considered to not be self heating.

Sample ID: RNS Blend 20R and 20R Duplicate

Start Date:	11/01/16	Stop Date:	11/03/16
Start Time:	1:08 PM	Stop Time:	3:08 PM

Both samples came to temperature slowly due to the moisture content in each of them. The sample and duplicate both came to temprature around 16 hours into the analysis. Once at temperature the sample and duplicate both held constant. When removed from the oven the sample was mostly loose with a dry zeolite appearance. No events appeared to have taken place and the sample temperature did not exceed 200°C during the testing time so both are considered to not be self heating.

Sample ID: Sod Nit B & Swheat

Start Date:	11/04/16	Stop Date:	11/06/16
Start Time:	6:34 PM	Stop Time:	8:34 PM

The sample initially heated up to around 90°C and then cooled down to around 70°C before the sample came to a stable temperature around 24 hours into the analysis. When removed from the oven, the sample had formed a hardened mass that was mudlike in appearance. The sample did not cook out of the cube or seep out through the mesh and no visible event seems to have occured. Since no events appeared to have taken place and the sample temperature did not exceed 200°C during the testing time so both are considered to not be self heating.

SOUTHWEST RESEARCH INSTITUTE

SW-846 1050

Client: Los Alamos National Laboratory
Project No: 21592.01.00X

Task Order: 161026-1
SRR: 58617, 58485

Sample ID: Sod Nit A pH & Swheat
Start Date: 11/15/16 Stop Date: 11/17/16
Start Time: 7:52 PM Stop Time: 9:52 PM

The sample was fairly moist when it was initially placed into the oven and therefore it took around 32 hours for the sample to come to temperature. Once at temperature the sample remained constant. When removed from the oven the sample was a hardnened grey to browninsh mass and had a similar appearance to when it was placed into the oven. Since no events appeared to have taken place and the sample temperature did not exceed 200°C during the testing time so both are considered to not be self heating.

Sample ID: Sod Nit A & Swheat
Start Date: 11/21/16 Stop Date: 11/23/16
Start Time: 8:34 AM Stop Time: 10:35 AM

The sample temperature began to rise quickly in the beginning and some sort of event occurred causing the sample to liquify and drip though the bottom of the cage and into the tray below. During this time the tray thermocouples cooled as the sample built up on top of them. When removed from the oven the central region of the sample in the cube was cavernouse with blackened material showing that an event occured. During the test none of the thermocouples showed temperatures to exceed 200°C but since an event seems to have drained the cube of sample the 25 mm test was performed and the sample was classified as a Packing Group III material. The 25mm test was performed on 12/09/16 and showed similar sample appearance as with the 100mm cube.

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Method 1030
Logbook Pages

Book I.D. 16-0406-001 Book/ Page : 13 010067 0069

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1030 Project# 21592.01.006

Client: LANL TO# 161026-1

LCS Info: excelsior wood (#61753) TV= 72.2 mm/sec Balance#: NA

Notes: thermocouple: 023331 TEMP 10/10/16 9/29/15 Humidity: 54.1% & meter 020917

thermocouple meter: 022940 Room temp: 22.2°C

ID: 007251

Hood 42 70-19 flow: 0.69 m/sec 9/29/15 torch: 1000°C

Samples measured @ room temperature

Sample ID	time to burn down 100mm	burn rate mm/sec	comments
LCS	11.22 sec	8.91	
Pig UNS Blend 20	no burn	NA	When flame was applied to the sample, began throwing sparks and zeolite as well as causing a lot of crackling. No flame.
Citric UNS Blend 19	no burn	NA	Sample crackled when torch was applied but no flame was observed. Sample became blackened to burnt grey.
Citric UNS Blend 19D	no burn	NA	

ID's

Pig UNS Blend 20 : 6005030

Citric UNS Blend 19 : 6005029

SAM 10/12/16

SAM 10/10/16

Calculation:

Analyst Signature: Date: 10/10/16

Reviewed by: Date: 10/24/16

Book I.D. 16-0406-001 Book/ Page : 13 0074

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1030 Project# 21592.02.006

Client: LANL TO# 16-1026-1

LCS Info: excelsior TV= >2.2 mm/sec Balance#: NA

Notes: Hood 42 70-19 flow 0.69 m/sec furnace 1000 °C

excelsior #61753 thermocouple: 023331

Omega temp/humidity # 020917 exp. 7/1/17 meter: 0228940

temp: 22.1 °C RH: 54.6% all samples measured @ room temp

Sample ID	burn	burn time (s)	burn rate mm/sec		
LCS	Yes	12.72	7.86		
RNS Blend 20A	No	Sample cracked slightly but only charred the zeolite			
RNS Blend 20B	No	at the base of the flame	no observed flame		
RNS Blend 21B	No	charred and blacked the sample.	no observed flame or cracking.		
RNS Blend 22B	No	dried and charred the zeolite, no observed flame			
UNS Blend 9a	No	dried and charred the zeolite. no observed flame some popping and cracking of the sample			
UNS Blend 8a	No	dried and charred the zeolite, no observed flame sample shot off and sparked during analysis			
UNS Blend 7a	No	dried and charred the zeolite. no observed flame			
UNS Blend Cocs	No	dried and charred the zeolite. no observed flame			

JAM 11/3/16

Calculation:

Analyst Signature: James Mu Date: 11/1/16

Reviewed by: [signature] Date: 11/30/16

Book I.D. 16-0406-001 Book/ Page : 13 0078

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1030 Project# 21542.01.006

Client: LANL TO# 161076-1

LCS Info: excelsior wood (Lot# 61453) TV= 22.2mm/sec Balance#: NA

Notes: Hood 42 70-19 flows 0.69 m/sec tarom 71000°C

omega temperature meter : 020917 thermocouple : 023331

timer # 022421 temp. 22.0°C meter : 022940

RH= 57.2%

Sample ID	burn	burn time (s)	rate mm/sec		
LCS	Yes	12.84	7.79		
Sod NitA + substrate	No	caused an enlargement of the flame @ the burn zone. Charring, sparkling of sample, and burning up the burn zone.			
Sod NitB + substrate	No	enlargement of flame out burn zone charring, popping and sparkling of sample. Burnt outside burn zone			
Sod NitpHA + substrate	No	enlargement of flame out the burn zone, charring and sparkling of sample.			
Sod NitA + substrate Dup	No	Same as the sample run			

12/8/16

SAM

Calculation:

Analyst Signature: Date: 12/7/16

Reviewed by: Date: 12/16/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Method 9095
Paint Filter
Logbook Pages

Book I.D. 16-0406-001 Book/ Page : 13 0068

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: paint filter Project# 21592.01.006

Client: LANL TO# 160102b-1

LCS Info: DI H_2O TV= fail Balance#: 05

Notes: test fails if any material passed into the beaker below the filter holding the test sample in 5 minutes

Filter: Gerson Lot# B5146428FB

Sample ID	sample wgt (g)	pass / fail			
LCS	101.2431g TEAM 10/10/16	fail			
Pig UNS Blend 3D	101.451	pass			
Citric UNS Blend 19	103.459	pass			
Citric UNS Blend 19D	101.203	pass			

10/10/16 SAM

Calculation:

Analyst Signature: Date: 10/10/16

Reviewed by: Date: 10/31/16

Book I.D. 16-0406-001 Book/ Page : 13 0073

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: Paint filter Project# 21592.01.006

Client: LANL TO# 161026-1

LCS Info: DI H_2O TV= Fail Balance#: #135 TESAM 11/1/16

Notes:

timer ID: 011550 exp 10/19/17

paint filter Lot# B5140428JFB

Sample ID	pass/fail	sample wgt (g)			
LCS	Fail	101.741			
RNS Blend 20R	Pass	103.259			
RNS Blend 20RD	Pass	100.704			
RNS Blend 21R	Pass	100.521			
RNS Blend 22R	Pass	101.243			
UNS Blend 9a	Pass	100.934			
UNS Blend 8a	Pass	102.114			
UNS Blend 7a	Pass	101.724			
UNS Blend 6a	Pass	104.223			

DAM 11/3/16

Calculation:

Analyst Signature: Date: 11/1/16

Reviewed by: Date: 11/30/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Preparation Logbook Pages

126 TITLE Kitty litter

PROJECT NO. 21542101.006
BOOK NO. 15-0106-052

Work continued from Page

SWRI

Sod Nit A-2001 126-01-WCS12 (2:1)

600mL (124-03-WCS12) to 1200mL zeolite (made crackling noises when setting)

126-02-WCS12 Sod Nit A-2002 (3:1) let zeolite set for 24hr

600mL (124-03-WCS12) to 1800mL zeolite

126-03-WCS14 WB8

✓	743.801 (TGSAM 5/13/16)	g	Aluminum nitrate (#65579) +
✓	2957.067	g	calcium nitrate (#65736) + (#63614) + (65735) + (#69600)
✓	36.405 (TGSAM 5/13/16)	g	chromium nitrate (#63857) +
	1129.441	g	iron nitrate (TGSAM 5/13/16 #65581) + (63604) A
✓	8298.857	g	magnesium nitrate (#65737) + 69602
✓	1839.762	g	sodium nitrate (#69610, 69611) +
✓	653.127	g	lead nitrate (#66142, 65951) +
✓	Oxalic acid	671.146	g (#69684) +
✓	potassium carbonate	350.133	g (#65914, 69660) + B
	water	1000.148	g

balance #89

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Work continued to Page

SIGNATURE [signature] DATE 5/13/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon DATE WITNESS DATE 5/25/14

128 TITLE Los Alamos

PROJECT NO. 21592.01.006
BOOK NO. 15-0406-052

Work continued from Page

SWRI

128-01-WCS12 Nit B Zeo-1

600mL (124-04-WCS12) to 1200mL zeolite

let sit for 24hr prior to analysis
5/15/16
16:10

128-02-WCS12 Nit B Zeo-2

600mL (124-04-WCS12) to 1800mL zeolite

128-03-WCS12 UNS solution

8322.851 g aluminum nitrate nanohydrate (# 69597-69542, 69593-69541, 69591-69586)+
840.695 g calcium nitrate (# 69606, 69607)+
61.562 g chromium nitrate (# 66141, 63857)+
595.084 g Iron(III) nitrate (# 63607, 65552)+
40008.600 g magnesium nitrate (# 69603, 69604) +
~~Sodium~~ TSJ 5/16/16 TSJ 5/15/16
493.5682 g sodium nitrate (# 69611)+
596.525 g lead nitrate (# 65951, 69629, 69625)+
2373.849 g oxalic acid (# 69684)+
2.340 g nickle nitrate (# 65593)+

63.727 g nitric acid (# 67843)
6500.17 g DI H2O

balance #89

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Work continued to Page

SIGNATURE [signature] DATE 5/15/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon DATE WITNESS DATE 5/25/16

24 TITLE

LANL

PROJECT NO. 21592.01.006

BOOK NO. 16-0406-023

SWRI

Work continued from Page

24-01-WCS13 UNS Blend 19

300mL UNS solution pH adjusted 24-03-WCS13 + 300mL citric acid (#74190) + 300mL sorbent mix and let set for 24 hours

TO 600mL waste add 300mL DI H_2O and 1800mL zeolite.

24-02-WCS13 UNS Blend 20

300mL UNS solution pH adjusted 24-03-WCS13 + 300mL Pig base (# 71804) and 300mL sorbent, mix and let set for 24 hours

TO 600mL waste add 300mL DI H_2O and 1800mL zeolite

24-03-WCS13 UNS pH adjusted solution

480 TEMPORARY mL UNS solution 24-03-WCS12 was adjusted to pH ~6.5 (5 TEMP 10/19/16) with 670mL spilfyter neutralizer (6595)

SAM 10/12/16

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Work continued to Page

SIGNATURE

DISCLOSED TO AND UNDERSTOOD BY

Gudelia Herrera

DATE

WITNESS

DATE 10/9/16

DATE 12/14/16

SWRI

Work continued from Page

Blend 21R 27-01-WCS13 tray #9

800mL sWheat + 270mL WB8 (126-03-WCS12) dry to crispy on hot plate @68°C TEJAM 10/17/16

Blend 22R TEJAM 10/17/16 27-02-WCS13

800mL sWheat + 200mL WB8 (126-03-WCS12) dry to crispy on hot plate 60°C

Blend 23R TEJAM 10/17/16 27-03-WCS13

800mL sWheat + 800mL WB8 (126-03-WCS12) dry to crispy on hotplate @60°C

UNS Blend 6a 27-04-WCS13 tray #11

800mL sWheat + 800mL UNS solution (128-03-WCS12) let set for 24 hours. Took 800mL of waste and added 400mL DI H_2O, mixed. Then added 1600mL zeolite. let set 24 hr prior to analysis

UNS Blend 7a 27-05-WCS13 tray # 10

TEJAM 10/17/16

810mL sWheat + 270mL UNS solution (128-03-WCS12) let set for 24 hours Took 800mL of waste and added 460mL DI H_2O, mixed. Then added this to 1600mL zeolite, let set 24 hr prior to testing

UNS Blend 8a 27-06-WCS13 tray # 12

600mL sWheat + 600mL UNS neutralized solution (128-03-WCS12) TEJAM 10/17/16 27-07-WCS13 let set for 24 hours Took 800mL of waste and added 400mL DI H_2O, mixed. Then added 1600mL zeolite and let set 24 hr prior to analysis.

UNS neutralized solution 27-07-WCS13

300mL UNS solution (128-03-WCS12) + 500 450mL spyllsyter TEJAM 10/19/16

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Work continued to Page

SIGNATURE

DATE 10/17/16

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE 10/18/16

Work continued from Page

UNS Blend 9a - 29-01-WCS12

810mL sunheat + 270 mL UNS solution neutralized (27-07-WCS13) let set for 24 hours. Took 800mL of waste and added 400mL DI H_2O, mixed. Then added 1600 mL zeolite. let set 24 hour prior to analysis.

JAM 10/19/16

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Work continued to Page

SIGNATURE [signature] DATE 10/18/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 10/18/16

34 TITLE LAWL

PROJECT NO. 21592.01.006
BOOK NO. 16-0406-023

Work continued from Page

SWRI

34-01-WCS13 20R

600mL of dried waste (# 27-03-WCS13) to 300mL DI H_2O mixed and then added to 1200mL zeolite. Let set 24 hr prior to analysis

34-02-WCS13 21R

600mL of dried waste (# 27-01-WCS13) to 300mL DI H_2O mixed and then added to 1200 mL zeolite. Let set 24 hour prior to analysis

34-03-WCS13 22R

600mL of dried waste (# 27-02-WCS13) to 300mL DI H_2O mixed and then added to 1200 mL zeolite. Let set 24 hr prior to analysis.

SAM 10/31/16

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Work continued to Page

SIGNATURE

DATE 10/28/16

DISCLOSED TO AND UNDERSTOOD BY Judy Clemons

DATE

WITNESS

DATE 12/14/16

38 TITLE

PROJECT NO. —
BOOK NO. 16-0406-023

SWRI

Work continued from Page

38-01-WCS13 2% Boric acid

10.0729 g Boric acid (# 35869) to FV 500mL with DI H_2O
balance #135 exp 11/3/17

38-02-WCS13 EDTA Buffer

2.5092 g EDTA (# ~~32472~~ 29726 TEXM 11/3/16) + 6 pellets NaOH (# 61581) to FV 50mL with DI H_2O.
balance #135 exp 11/3/17

38-03-WCS13 1N NaOH saturated with sodium nitrate

40.0762g NaOH (#61581) to FV 1L with DI H_2O
added 104.9 g sodium nitrate (# 70579, 72382) until saturated
balance #135 exp 11/3/17

38-04-WCS13 1M HNO_3 Saturated with sodium nitrate

63.3mL HNO_3 (# 74198) to FV 1L with DI H_2O
added g sodium nitrate (# 70579) until saturated
balance #135 exp 11/3/17 Epp. 5000-R

38-05-WCS13 - Sod Nit B ; sulfeat

1000mL Sod Nit B (38-03-WCS13) to 1000mL sulfeat, mix for 2 min
let set for 24 hour prior to analysis

38-06-WCS13 Sod Nit A ; sulfeat

1000mL sod nit A (38-04-WCS13) to 1000mL sulfeat, mix for 2 min
let set for 24 hour prior to analysis.

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Work continued to Page

SIGNATURE [signature] DATE 11/3/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 11/16/16

SWRI

Work continued from Page

49-01-WCS13 sod nit A saturated

(49-02-WCS13)

Added 500mL 1N HNO_3 to remaining salts from 35-04-WCS13 and added and additional 302.49 g sod nit (705379) balance used

49-02-WCS13 1M HNO_3

31.65mL HNO_3 (#74198) to 500mL F.V. with DI H_2O

Exp 500mL R exp 11/14/17

49-07-WCS13 1M HNO_3

49-03-WCS13 sod nit A pH adjusted

adjusted to F.V. 1L with 49-01-WCS13 & spiking (#65915) pH 7.97

49-04-WCS13 sod nit A pH & solvent

1000mL of solvent to 1000mL of sod nit A pH adjusted (49-03-WCS13) expired

mix for 2min and let set for 24 hour prior to analysis.

TESAM 11/14/16

49-05-WCS13 silica gel

@ 230°C

~ 100mL # 33685 placed into Furnace #1 11/14/16 9:15am

removed 11/15/16 9:16 am

placed into sealed centrifuge tubes #463

49-06-WCS13 sodium sulfate

~200mL # 70256 placed into Furnace #1 11/14/16 9:15am

removed 11/15/16 9:16 am

Placed into sealed centrifuge tubes #463

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Work continued to Page

SIGNATURE [signature] DATE 11/14/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 11/14/16

66 TITLE LANL

PROJECT NO. 21592.01.006

BOOK NO. 16-0406-023

SWRI

Work continued from Page

66-01-WCS13 - 65% HNO_3

(#34444)

23.5507 g HNO_3 to FW 25.0009 g with DI H_2O

balance #135 exp 12/12/17

66-02-WCS13 - 50% perchloric acid

13.8575 g perchloric acid (#61372) to FW ~~25~~ (redone 12/12/16) 25.0021 g with DI H_2O

balance #135 exp 12/12/17

66-03-WCS13 - sodium chlorate 40%

9.0017 g sodium chlorate (# 26268) to FW 22.5004 g DI H_2O

balance #135 exp 12/12/17

66-04-WCS13 - 45% sodium nitrate

13.5004 g sodium nitrate (#70579) to FW 30.0025 g with DI H_2O

balance #135 exp 12/12/17

66-05-WCS13 pH adjusted saturated 1M HNO_3 with sod Nit

25mL of 1M HNO_3 saturated (38-04-WCS13) + spilfyter (# 65915) to pH 7.27.

Epp. Soccer exp 12/12/17

JAM 12/14/16

www.scientificbindery88yrs.com

Work continued to Page

SIGNATURE James Mel DATE 12/12/16

DISCLOSED TO AND UNDERSTOOD BY Judy Clemer DATE WITNESS DATE 12/14/16

pH 9040

Southwest Research Institute
San Antonio, Texas 78228

Batch: 20161216-A001 (Ver. 1)
Status: CONSUMED

Customer: Los Alamos National Laboratory
Project: 21592.01.00X
SDG: 605029
Task Order: 161026-1
Instrument: Accumet 50
Balance: Bal #135
Start Time: 12/12/2016 12:43:18
Analyte Test: pH 9040
Analysis Method: pH 9040 (TAP: TAP 01-0406-100)
Reagent: (pH) Buffer 4.0 (72232), (pH) buffer 7.0 (72230), (pH) buffer 10.0 (72229)

pH

Sample Identification	Client Identification	pH	Temp (C)
4.00	NA	4.00	22.1
7.00	NA	7.01	22.0
10.00	NA	10.04	22.1
ICV ^	NA	6.17	22.1
66-05-WCS13	NA	7.27	22.4
CCV ^	NA	6.15	22.2

^ spiked 10 mL of pH Reference Material-71222 (ChemInv# P246-977, Source: ERA, Exp: 11/30/2018) at 6.12 S.U.

Comments: NA

U - Result is less than the SwRI Reporting Limit (RL)

Prepared by: MOKEN, JAMES Date: 12/12/2016

Reviewed by: HERRERA, JUDY Date: 12/20/2016

Program version(8/11/2011)

pH 9040

Southwest Research Institute
San Antonio, Texas 78228

Batch: 20161216-A002 (Ver. 1)
Status: CONSUMED

Customer: Los Alamos National Laboratory
Project: 21592.01.00X
SDG: 605029
Task Order: 161026-1
Instrument: Accumet 50
Balance: Bal #135
Start Time: 11/14/2016 15:27:00
Analyte Test: pH 9040
Analysis Method: pH 9040 (TAP: TAP 01-0406-100)
Reagent: (pH) Buffer 4.0 (72232), (pH) buffer 7.0 (72230), (pH) buffer 10.0 (72229)

pH

Sample Identification	Client Identification	pH	Temp (C)
4.00	NA	4.00	21.8
7.00	NA	7.01	21.4
10.00	NA	10.03	21.5
ICV ^	NA	6.20	21.4
49-03-WCS13	NA	7.97	22.1
CCV ^	NA	6.19	21.4

^ spiked 10 mL of pH Reference Material-71222 (ChemInv# P246-977, Source: ERA, Exp: 11/30/2018) at 6.12 S.U.

Comments: NA

U - Result is less than the SwRI Reporting Limit (RL)

Prepared by: MOKEN, JAMES Date: 11/14/2016

Reviewed by: HERRERA, JUDY Date: 12/20/2016

Program version(8/11/2011)

pH 9040

Southwest Research Institute
San Antonio, Texas 78228

Batch: 20161216-A003 (Ver. 1)
Status: CONSUMED

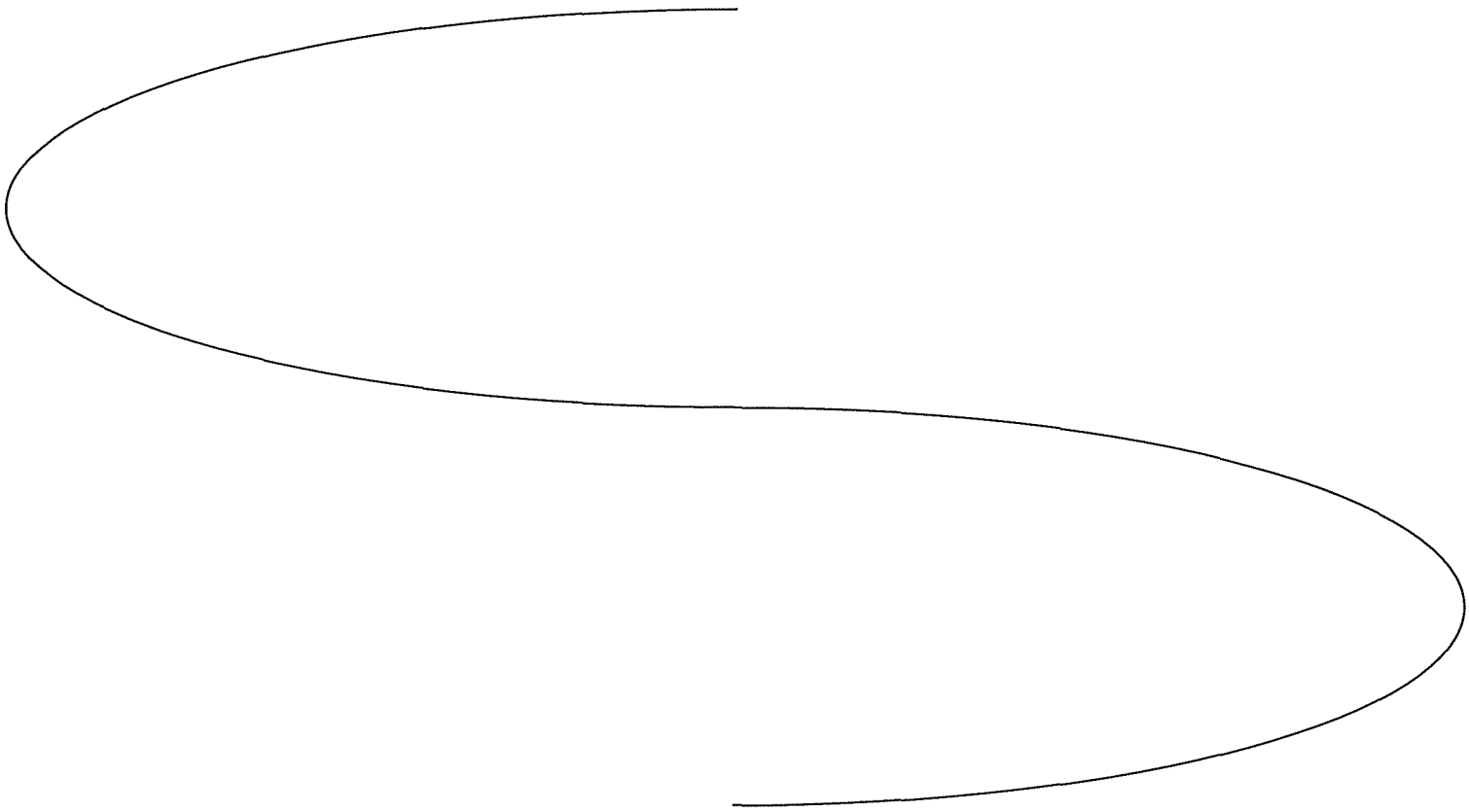
Customer: Los Alamos National Laboratory
Project: 21592.01.00X
SDG: 605029
Task Order: 161026-1
Instrument: Accumet 50
Balance: Bal #135
Start Time: 10/09/2016 16:50:00
Analyte Test: pH 9040
Analysis Method: pH 9040 (TAP: TAP 01-0406-100)
Reagent: (pH) Buffer 4.0 (72232), (pH) buffer 7.0 (72230), (pH) buffer 10.0 (72229)

pH

Sample Identification	Client Identification	pH	Temp (C)
4.00	NA	4.00	21.4
7.00	NA	7.01	21.3
10.00	NA	10.04	21.3
ICV ^	NA	6.10	21.4
24-03-WCS13	NA	5.50	21.7
CCV ^	NA	6.12	21.4

^ spiked 10 mL of pH Reference Material-71222 (ChemInv# P246-977, Source: ERA, Exp: 11/30/2018) at 6.12 S.U.

Comments: NA



U - Result is less than the SwRI Reporting Limit (RL)

Prepared by: MOKEN, JAMES Date: 10/09/2016

Reviewed by: HERRERA, JUDY Date: 12/20/2016

Program version(8/11/2011)

68 TITLE

PROJECT NO.

BOOK NO. 16-0406-023

SWRI

Work continued from Page

68-01-WCS13 45% $NaNO_3$

$NaNO_3$ # 70579 dried in oven #135 @ 95°C overnight 12/14 - 12/15

13.501 g $NaNO_3$ (70579) to FW 30.0009 g with DI H_2O

balance #135 exp 12/15/17

68-02-WCS13 Sodium chlorate 40%

9.0012 g sodium chlorate (# 77143) to FW 22.5007 g with DI H_2O

balance # 135 exp 12/15/17

68-03-WCS13 Saturated $FeNO_3$

* SAM 12/16/16 2 out page prior to finishing filling in the reagent details.

20.0729 g $FeNO_3$ (063604) added to 10 mL DI H_2O shook for 30 min and continued to add $FeNO_3$ until it would no longer dissolve after shaking for 30 min

12/16/16

JAM

www.scientificbindery88yrs.com

Work continued to Page

SIGNATURE

DATE 12/15/16

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE 12/19/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 161026-1
SwRI SRR: 58485, 58617
SDG: 605029
VTSR: 10.11.2016, 11.01.2016

Balances and DI Water Verification Logs

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.# 16-0406-028

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
11-16-16	JK	1999.99	2.000
11-17-16	JK	2000.00	2.000
11-18-16	KE	1999.99	2.001
11-21-16	JK	1999.96	2.000
11-22-16	JK	1999.98	1.999
11-23-16	KE	1999.98	1.999
11-28-16	KE	1999.98	2.002
11-29-16	KE	1999.97	1.999
11-30-16	KE	1999.96	2.000
12-1-16	KE	1999.95	1.999
12-2-16	KE	1999.97	2.000
12-5-16	SAM	1999.97	2.000
12/6/16	SAM	1999.96	2.001
12/7/16	KE	1999.96	2.000
12/8/16	SAM	1999.97	2.000
12-9-16	JK	1999.93	2.000
12-12-16	JK	1999.96	2.001
12-13-16	KE	1999.97	2.001
12-14-16	KE	1999.96	2.000
12-15-16	KE	1999.96	2.000
12-16-16	KE	1999.97	2.000

Comments:

010089

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.# 16-0406-028

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
10-17-16	KE	10/17/16 KE (WE) ~~1999.999~~ 2000.01	2.000
10-18-16	JT	2000.01	1.999
10-19-16	KE	2000.01	1.999
10-20-16	KE	2000.01	(1) 2.000
10-21-16	JT	1999.99	(1) 2.001
10-24-16	KE	2000.00	(1) 1.999
10-25-16	JT	2000.00	(1) 2.000
10-26-16	KE	2000.00	(1) 2.000
10-27-16	KE	2000.00	(1) 1.999
10-28-16	KE	2000.00	(1) 2.000
10-31-16	KE	2000.01	(1) 2.000
11-1-16	JT	2000.00	(1) 2.000
11-2-16	JT	2000.00	(1) 2.000
11-3-16	KE	2000.01	2.000
11-4-16	KE	2000.00	2.000
11-7-16	KE	2000.00	2.001
11-8-16	KE	2000.00	2.000
11-9-16	KE	2000.00	1.999
11-10-16	KE	1999.99	2.000
11-11-16	KE	2000.00	2.000
11-14-16	KE	2000.02	2.000
11-15-16	KE	2000.00	2.000

Comments: (1) 011999 out for cal, used 020641. 10-20-16 KE, ~~11-2-16~~ #11999 wt. @ 11999 is back in service, 11-2-16 KE 11-3-16 KE (KE)

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.# 16-0406-028

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
9-19-16	JK	2000,01	2,000
9/20/16	KE	2000.01	1.999
9-21-16	JK	2000,01	1,999
9-22-16	KE	2000.01	2.000
9.23-16	KE	2000.01	2.000
9-26-16	KE	2000.01	2.000
9-27-16	KE	2000.01	2.001
9-28-16	KE	2000.01	2.000
9-29-16	KE	2000.01	2.001
9-30-16	JK	2000,00	2,000
10-1-16	JK	2000,00	2,000
10-3-16	KE	2000.01	2.000
10-4-16	JK	2000,01	2,000
10-5-16	KE	2000.01	2.000
10-6-16	KE	2000.01	2.000
10-7-16	KE	2000.01	2.000
10-10-16	KE	1999.99	1,999
10-11-16	JK	1999,99	2,000
10-12-16	KE	2000.00	2.000
10-13-16	KE	2000.00	2.000
10-14-16	KE	2000.00	1.999
10-15-16	JK	2000,00	2,000

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.#_11-0406-062_

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
89	014982	Mettler Toledo	XP5003S	Lab 24	2nd 3rd	5100 g 1000 g

Date	Operator	Asset# 015583 Std Wt. 5000 g Tolerance: 4999.50-5000.50 g Recorded Wt. (mg)	Asset# 015580 Std Wt. 100 g Tolerance: 99.990-100.010 g Recorded Wt. (mg)	Asset# 015584 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (mg)
5/15/16	SAM	4999.97	99.998	1.998
5/18/16	SAM	4999.97	99.998	2.000
6/1/16	SAM	4999.97	99.998	1.999
6/3/16	SAM	4999.97	99.998	2.001
6/17/16	SAM	4999.98	99.998	2.001
6/20/16	SAM	4999.97	99.998	2.000
6/30/16	SAM	4999.97	99.998	2.000
7/7/16	SAM	4999.97	99.999	1.999
7/13/16	MG	4999.98	99.999	2.000
7/14/16	MG	4999.97	99.999	1.999
7/8/25/16 TB SAM 8/25/16	SAM	4999.97	99.998	1.999
10/11/16	SAM	4999.97	100.000	2.001
10/12/16	SAM	4999.98	99.999	2.001
11/11/16	JT	4999.94	99.997	1.998
11-22-16	KE	4999.97	100.000	2.000
12/7/16	SAM	4999.98	100.001	1.999

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.#_11-0406-062_

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
89	014982	Mettler Toledo	XP5003S	Lab 24	2nd 3rd	5100 g 1000 g

Date	Operator	Asset# 015583 Std Wt. 5000 g Tolerance: 4999.50-5000.50 g Recorded Wt. (mg)	Asset# 015580 Std Wt. 100 g Tolerance: 99.990-100.010 g Recorded Wt. (mg)	Asset# 015584 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (mg)
2/26/15	JAM	5000.00	99.998	1.999
3/3/15	JAM	4999.98	99.999	2.000
6/8/15	JAM	4999.97	99.997	1.999
6/12/15	JAM	4999.97	100.002	1.999
6/13/15	JAM	4999.98	99.997	1.999
6/15/15	JAM	4999.97	99.999	1.999
8-5-15	BV	4999.96	99.999	1.999
8/6/15	JAM	4999.97	100.000	2.000
8/10/15	JAM	4999.96	100.001	2.000
9/1/15	JAM	4999.98	99.999	1.999
9/4/15	JAM	4999.97	100.000	2.000
9/5/15	JAM	4999.97	99.998	2.000
9/6/15	JAM	4999.99	99.999	1.999
9/7/15	JAM	4999.96	99.999	2.000
9/8/15	JAM	4999.97	99.997	1.998
9/24/15	JAM	4999.97	99.999	2.000
12/2/15	JAM	4999.97	99.997	2.000
12/7/15	JAM	4999.98	99.998	1.999
3-2-16	KE	4999.99	99.999	1.999
3-24-16	KE	4999.99	99.999	1.999
5/12/16	JAM	4999.98	99.999	2.001
5/13/16	JAM	4999.97	99.998	1.998

DQA RL

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
12/14/16	JAM	200.0001	1.99995	0.02002
12/15/16	JAM	199.9997	1.99996	0.01998
12-16-16	KE	200.0000	1.999999	0.02002

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
11/14/16	SAM	200.0002	2.00002	0.01998
11/15/16	SAM	199.9998	1.99998	0.01997
11-16-16	AM	199.9994	2.00007	0.02001
11/17/16	SAM	199.9998	1.99998	0.01998
11/18/16	JAM	199.9995	1.99996	0.01999
11/19/16	RSS	199.9997	1.99998	0.01998
11/21/16	SAM	199.9998	1.99999	0.02001
11/22/16	SAM	200.0001	2.00002	0.02001
11/23/16	SAM	199.9995	1.99997	0.02000
11-27-16	SM	199.9999	1.99999	0.02002
11/28/16	SAM	199.9999	2.00002	0.01997
11/29/16	SAM	199.9996	2.00002	0.01999
11/30/16	SAM	199.9997	2.00002	0.02003
12/1/16	SAM	199.9999	2.00001	0.02002
12/2/16	SAM	199.9996	2.00000	0.01998
12/5/16	SAM	199.9998	1.99996	0.02000
12/6/16	SAM	199.9997	1.99994	0.02003
12/7/16	SAM	199.9999	1.99999	0.01999
12/8/16	SAM	199.9999	1.99999	0.01998
12/9/16	JAM	199.9995	1.99999	0.02002
12/12/16	SAM	200.0000	2.00000	0.01998
12/13/16	SAM	199.9996 TESAM 12/13/16	1.99996	0.02003

Comments:

Book I.D.: 15-0406-055

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (mg)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (mg)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (mg)
10/13/16	SAM	200.0001	1.99995	TE SAM 10/13/16 0.02001
10/17/16	SAM	200.0000	2.00002	0.02003
10/18/16	SAM	199.9997	2.00001	0.02000
10/19/16	SAM	199.9997	1.99997	0.02002
10/20/16	SAM	200.0002	1.99992	0.01998
10/21/16	SAM	200.0000	1.99994	0.01997
10/24/16	SAM	199.9997	1.99995	0.01998
10/25/16	SAM	199.9999	1.99996	0.01998
10/26/16	SAM	200.0000	2.00002	0.01998
10/27/16	SAM	199.9998	1.99999	0.02000
10/28/16	SAM	199.9998	1.99996	0.01999
10/30/16	SAM	199.9999	2.00004	0.02003
10/31/16	JCW	199.9999	1.99995	0.01996
11/1/16	SAM	199.9999	2.00001	0.02000
11/2/16	SAM	199.9999	2.00000	0.01997
11/3/16	SAM	199.9997	2.00000	0.01997
11/4/16	JCW	199.9998	1.99998	0.01999
11/7/16	SAM	199.9999	1.99998	0.01997
11/8/16	SAM	199.9996	1.99996	0.01997
11/9/16	SAM	199.9995	2.00002	0.02003
11/10/16	SAM	199.9996	2.00004	0.02003
11-11-16	KE	199.9996	1.99999	0.02000

Comments:

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 160627-5
SwRI SRR: 57871
SDG: 599959
VTSR: 06.24.2016

Certificates of Calibration

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	46011
Asset Number:	018344	Calibrated:	2/1/2016
Description:	OVEN	Calibration Due:	2/1/2017
Manufacturer:	THERMO SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	HERATHERM OMS60	Temp./RH:	70 °F / 42 %
Serial Number:	41241291	Work Order #	403137157
Calibration Procedure:	OVENS, CHAMBERS, INCUBA		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
015454	HART SCIENTIFIC	5627A	THERMOMETER PRT	2/18/2016
018495	FLUKE	1523	TEMPERATURE METER	2/18/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137157	Mfr:	Thermo Scientific	Technician:	RRV
Asset No:	018344	Model:	Heratherm OMS60	Type Data:	Found-left
Serial No:	41241291	Type:	Oven Chamber	Cal Date:	1-Feb-16

Remarks: Calibration limits per customer request. Chamber exceeds 70% of limit at the 200 °C test point. Customer to determine if the result found meets their requirements. Temperature uniformity not calibrated

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
50 °C	50.4	50.0	-0.4	2.0	0.18	Pass	20%
100 °C	101.0	100.0	-1.0			Pass	50%
150 °C	152.1	150.0	-2.1	3.0		Pass	70%
200 °C	203.2	200.0	-3.2	4.0		Pass	80%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39314
Asset Number:	014982	Calibrated:	9/25/2015
Description:	BALANCE	Calibration Due:	9/25/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XP5003SDR	Temp./RH:	73 °F / 48 %
Serial Number:	1129300727	Work Order #	403134658
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/12/2016
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/8/2016
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/7/2016
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016
001718	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

001719 RICE LAKE 5 KG WEIGHT CLASS 1 4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134658	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	25-Sep-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit		Result	% Limit
Corner Load	grams	grams	grams	grams			
Left Front	1000	1000.000	0.000	0.010		Pass	0%
Left Rear		999.999	-0.001			Pass	10%
Right Rear		1000.000	0.000			Pass	0%
Right Front		1000.001	0.001			Pass	10%
Repeatability							
1000 g Range							
1	500	500.002					
2		500.000					
3		500.001					
4		500.002					
5		500.000					
6		500.000					
7		500.001					
8		500.001					
9		500.001					
10		500.000					
Std Deviation		0.0008		0.0020		Pass	40%
5100 g Range							
1	2000	199.99					
2		200.00					
3		199.99					
4		199.99					
5		200.00					
6		200.00					
7		199.99					
8		199.99					
9		199.99					
10		199.99					
Std Deviation		0.005		0.012		Pass	42%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
1000 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	100.000	100.001	0.001			Pass	8%
	200.000	200.001	0.001			Pass	8%
	300.000	300.001	0.001			Pass	8%
	400.000	400.001	0.001			Pass	8%
	500.000	500.002	0.002			Pass	17%
	600.000	600.003	0.003			Pass	25%
	700.000	700.002	0.002			Pass	17%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134658	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	25-Sep-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	grams	grams	grams		
1000 g Range	800.000	800.002	0.002	0.012	0.003	Pass	17%
	900.000	900.001	0.001			Pass	8%
	1000.000	1000.000	0.000			Pass	0%
5100 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	500.000	500.001	0.001			Pass	8%
	1000.000	999.999	-0.001			Pass	8%
	1500.00	1500.00	0.00	0.02	0.01	Pass	0%
	2000.00	2000.00	0.00			Pass	0%
	2500.00	2500.00	0.00			Pass	0%
	3000.00	3000.00	0.00			Pass	0%
	3500.00	3500.00	0.00			Pass	0%
	4000.00	4000.00	0.00			Pass	0%
	4500.00	4500.00	0.00			Pass	0%
	5000.00	5000.00	0.00			Pass	0%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	57059
Asset Number:	023331	Calibrated:	7/28/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	7/28/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	76.5°F / 60 %
Serial Number:	23331	Work Order #	403141269
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -20 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403141269	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023331	Model:	08516-96	Type Data:	Found-left
Serial No.:	23331	Type:	Thermocouple Type K	Cal Date:	28-Jul-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-20.1	-19.0	1.1	2.2	0.5	Pass	50%
	200.5	201.6	1.1	2.2	0.5	Pass	50%
	499.2	498.9	-0.3	3.7	1.3	Pass	8%
	752.0	749.6	-2.4	5.6	1.3	Pass	43%
	1004.2	999.1	-5.1	7.5	1.3	Pass	68%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47748
Asset Number:	022940	Calibrated:	3/2/2016
Description:	DIGITAL THERMOMETER	Calibration Due:	3/2/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	20250-02	Temp./RH:	74.1°F / 36 %
Serial Number:	150709174	Work Order #	403137647
Calibration Procedure:	DIGITAL THERMOMETERS-MO		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
017979	FLUKE	525B	CALIBRATOR, TEMPERATURE/PF	9/23/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137647	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022940	Model:	20250-02	Type Data:	Found-left
Serial No.:	150709174	Type:	Temperature Meter	Cal Date:	2-Mar-16

Remarks: Due to resolution of the unit, limits are rounded up.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
T1	°F	°F	°F	°F	°F		
Type K	-300.0	-299.9	0.1	5.1	0.8	Pass	2%
	390.0	390.2	0.2	3.8	0.6	Pass	5%
	1075	1075	0	7	0.3	Pass	0%
	1760	1760	0	11	0.3	Pass	0%
	2450	2451	1	14	1.0	Pass	7%
	°C	°C	°C	°C	°C		
	-150.0	-150.1	-0.1	2.8	0.5	Pass	4%
	210.0	210.1	0.1	2.1	0.3	Pass	5%
	575.0	575.4	0.4	3.9	0.3	Pass	10%
	940.0	940.4	0.4	5.7	0.3	Pass	7%
	1350	1350	0	8	1.0	Pass	0%
T2	°F	°F	°F	°F	°F		
Type K	-300.0	-299.7	0.3	5.1	0.8	Pass	6%
	390.0	390.3	0.3	3.8	0.6	Pass	8%
	1075	1075	0	7	1.0	Pass	0%
	1760	1761	1	11	1.0	Pass	9%
	2450	2451	1	14	1.0	Pass	7%
	°C	°C	°C	°C	°C		
	-150.0	-150.1	-0.1	2.8	0.5	Pass	4%
	210.0	210.1	0.1	2.1	0.3	Pass	5%
	575.0	575.3	0.3	3.9	0.3	Pass	8%
	940.0	940.3	0.3	5.7	0.3	Pass	5%
	1350	1350	0	8	1.0	Pass	0%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	55674
Asset Number:	020917	Calibrated:	7/1/2016
Description:	DATA LOGGER	Calibration Due:	7/1/2017
Manufacturer:	OMEGA	Data Type:	FOUND / LEFT
Model Number:	OM-CP-PRHTEMP2000	Temp./RH:	69 °F / 40 %
Serial Number:	P28381	Work Order #	403140685
Calibration Procedure:	TEMPERATURE, HUMIDITY-D		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
Not referenced to sea level.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
006404	THUNDER SCIENTIFIC	2500	HUMIDITY GENERATOR	5/25/2017
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/7/2017
015895	HART SCIENTIFIC	5618B	RTD	6/7/2017
021448	FLUKE	PPC4	Pressure Controller	11/18/2016

Authorized Signatory

Calibrated By: RLC
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403140685	Mfr.:	Omega	Technician:	MAR / RLC
Asset No.:	020917	Model:	OM-CP-PRHTEMP2000	Type Data:	Found-left
Serial No.:	P28381	Type:	Data Logger	Cal Date:	1-Jul-16
Remarks: Pressure test points established per customer request.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Humidity	% RH	% RH	% RH	% RH	% RH		
	35.0	37.1	2.1	3.0	0.68	Pass	70%
	50.0	49.3	-0.7		0.68	Pass	23%
	65.0	63.6	-1.4		0.68	Pass	47%
Temperature	°C	°C	°C	°C	°C		
	20.3	20.3	0.0	0.5	0.18	Pass	0%
	25.0	24.9	-0.1		0.18	Pass	20%
	29.9	29.8	-0.1		0.18	Pass	20%
Pressure	psia	psia	psi	psi	psi		
	12	11.994	-0.006	0.060	0.01	Pass	10%
	18	18.002	0.002		0.02	Pass	3%
	24	23.996	-0.004			Pass	7%
	30	29.970	-0.030			Pass	50%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47078
Asset Number:	022921	Calibrated:	2/19/2016
Description:	TIMER	Calibration Due:	2/19/2017
Manufacturer:	FISHER SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	14-649-55	Temp./RH:	73.6°F / 40 %
Serial Number:	80494146	Work Order #	403137429
Calibration Procedure:	STOPWATCHES & TIMERS		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009759	FLUKE	910R	RUBIDIUM GPS FREQUENCY STA	12/3/2019

Approved By

Calibrated By: CER
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137429	Mfr.	Fisher Scientific	Technician	CER
Asset No.	022921	Model	14-649-55	Type Data:	Found/Left
Serial No.	80494146	Type.	Timer	Cal Date.	19-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Time Interval	Seconds	Seconds	Seconds	Seconds	Seconds		
	11160	11159	-1	2	1.2	Pass	50%
	12960	12959	-1	2	1.2	Pass	50%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	53400
Asset Number:	023173	Calibrated:	5/25/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	5/25/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	75.4°F / 57 %
Serial Number:	23173	Work Order #	403139869
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Remarks:
CAL -45 °C TO 200 °C.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403139869	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023173	Model:	08516-96	Type Data:	Found-left
Serial No.:	23173	Type:	Thermocouple Type K	Cal Date:	25-May-16

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if reading meets their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.2	1.7	2.2	0.5	Pass	77%
	0.0	0.1	0.1	2.2	0.5	Pass	5%
	99.7	99.0	-0.7	2.2	0.5	Pass	32%
	200.5	200.7	0.2	2.2	0.5	Pass	9%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47207
Asset Number:	022925	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22925	Work Order #	403137433
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-found
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-75.9	3.2	2.2	0.5	Fail	145%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137433	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022925	Model:	08516-96	Type Data:	As-left
Serial No.:	22925	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-42.5	2.4	3.0	0.5	Pass	80%
	0.2	0.2	0.0	2.2	0.5	Pass	0%
	396.7	396.4	-0.3	3.0	1.3	Pass	10%
	698.9	698.5	-0.4	5.2	1.3	Pass	8%
	1101.6	1095.9	-5.7	8.3	1.3	Pass	69%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47205
Asset Number:	022923	Calibrated:	2/22/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	2/22/2017
Manufacturer:	DIGI-SENSE	Data Type:	AS LEFT
Model Number:	08516-96	Temp./RH:	74.7°F / 38 %
Serial Number:	22923	Work Order #	403137431
Calibration Procedure:	TEMPERATURE PROBES		

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 1100 °C. Limits at -45 °C ±3 °C, rest of range meets normal type K specifications.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009414	HART SCIENTIFIC	1502A	TEMPERATURE METER W/PROBI	6/22/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	5/8/2016
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016
015895	HART SCIENTIFIC	5618B	RTD	6/22/2016

Approved By

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137431	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022923	Model:	08516-96	Type Data:	As-found
Serial No.:	22923	Type:	Thermocouple Type K	Cal Date:	18-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-79.1	-76.3	2.8	2.2	0.5	Fail	127%
	0.2	0.0	-0.2	2.2	0.5	Pass	9%
	396.7	396.0	-0.7	3.0	1.3	Pass	24%
	698.9	698.0	-0.9	5.2	1.3	Pass	17%
	1101.6	1094.9	-6.7	8.3	1.3	Pass	81%

END OF REPORT

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137431	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022923	Model:	08516-96	Type Data:	As-left
Serial No.:	22923	Type:	Thermocouple Type K	Cal Date:	22-Feb-16

Remarks: customer requested limits for test point -45 ℃ be ±3 ℃. A reading exceeded 70% of limits. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	3.0	0.5	Pass	63%
	0.2	0.0	-0.2	2.2	0.5	Pass	9%
	396.7	396.5	-0.2	3.0	1.3	Pass	7%
	698.9	698.0	-0.9	5.2	1.3	Pass	17%
	1101.6	1094.9	-6.7	8.3	1.3	Pass	81%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	59802
Asset Number:	023428	Calibrated:	9/13/2016
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/13/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	76.1°F / 58 %
Serial Number:	23428	Work Order #	403142235
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142235	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023428	Model:	08516-96	Type Data:	Found-left
Serial No.:	23428	Type:	Thermocouple Probe Type K	Cal Date:	13-Sep-16
Remarks: unit exceeded 70% of limits at low test point, near maximum allowed limit. No adjustment possible. Customer to determine if readings meet their needs.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.9	-37.8	2.1	2.2	0.5	Pass?	95%
	99.8	98.9	-0.9	2.2	0.5	Pass	41%
	498.4	499.1	0.7	3.7	1.3	Pass	19%
	751.8	751.8	0.0	5.6	0.5	Pass	0%
	1006.9	1004.8	-2.1	7.6	1.3	Pass	28%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	57056
Asset Number:	023328	Calibrated:	7/28/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	7/28/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	76.5°F / 60 %
Serial Number:	23328	Work Order #	403141266
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -20 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403141266	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023328	Model:	08516-96	Type Data:	Found-left
Serial No.:	23328	Type:	Thermocouple Type K	Cal Date:	28-Jul-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-20.1	-19.1	1.0	2.2	0.5	Pass	45%
	200.5	201.5	1.0	2.2	0.5	Pass	45%
	499.2	499.6	0.4	3.7	1.3	Pass	11%
	752.0	750.7	-1.3	5.6	1.3	Pass	23%
	1004.2	1000.8	-3.4	7.5	1.3	Pass	45%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	53401
Asset Number:	023174	Calibrated:	5/25/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	5/25/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	75.4°F / 57 %
Serial Number:	23174	Work Order #	403139870
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 200 °C.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403139870	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023174	Model:	08516-96	Type Data:	Found-left
Serial No.:	23174	Type:	Thermocouple Type K	Cal Date:	25-May-16
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if reading meets their requirements.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	2.2	0.5	Pass	86%
	0.0	0.3	0.3	2.2	0.5	Pass	14%
	99.7	99.4	-0.3	2.2	0.5	Pass	14%
	200.5	200.8	0.3	2.2	0.5	Pass	14%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	57053
Asset Number:	023323	Calibrated:	7/27/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	7/27/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	77.2°F / 53 %
Serial Number:	23323	Work Order #	403141261
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -20 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403141261	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023323	Model:	08516-96	Type Data:	Found-left
Serial No.:	23323	Type:	Thermocouple Type K	Cal Date:	27-Jul-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-20.1	-19.1	1.0	2.2	0.5	Pass	45%
	200.5	201.7	1.2	2.2	0.5	Pass	55%
	497.6	499.2	1.6	3.7	1.3	Pass	43%
	752.0	754.5	2.5	5.6	1.3	Pass	44%
	1004.1	1006.1	2.0	7.5	1.3	Pass	27%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	61226
Asset Number:	020014	Calibrated:	10/10/2016
Description:	BALANCE	Calibration Due:	10/10/2017
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	70 °F / 44 %
Serial Number:	B338797310	Work Order #	403142842
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2016
001705	TROEMNER	2 G	WEIGHT CLASS 1	6/30/2017
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/7/2017
001707	TROEMNER	5 G	WEIGHT CLASS 1	8/3/2017
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/14/2017
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/3/2017
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/3/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute

Calibration Certificate

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001711	TROEMNER	50 G	WEIGHT CLASS 1	6/30/2017
001712	TROEMNER	100 G	WEIGHT CLASS 1	8/3/2017
001713	RICE LAKE	200 G	WEIGHT CLASS 1	7/14/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142842	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	10-Oct-16
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0000	0.0000	0.0006	Pass	0%
Left Rear		99.9999	-0.0001		Pass	17%
Right Rear		100.0000	0.0000		Pass	0%
Right Front		99.9998	-0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	79.99999				
2		79.99998				
3		79.99999				
4		79.99998				
5		79.99998				
6		79.99999				
7		80.00000				
8		79.99998				
9		80.00000				
10		79.99998				
Std Deviation		0.000008		0.00008	Pass	10%
< 220 g Range						
1	200	200.0000				
2		200.0000				
3		200.0001				
4		200.0001				
5		200.0000				
6		200.0002				
7		200.0002				
8		200.0002				
9		200.0001				
10		200.0002				
Std Deviation		0.00009		0.00020	Pass	45%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.07	Pass	0%
	7.99999	7.99999	0.00			Pass	0%
	16.00000	16.00000	0.00			Pass	0%
	23.99999	24.00004	0.05			Pass	13%
	32.00000	32.00005	0.05			Pass	13%
	39.99992	40.00002	0.10			Pass	25%
	47.99991	47.99995	0.04			Pass	10%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142842	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	10-Oct-16

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99994	55.99998	0.04	0.40	0.07	Pass	10%
	64.00000	64.00002	0.02			Pass	5%
	71.99994	71.99995	0.01			Pass	3%
	79.99995	79.99995	0.00			Pass	0%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.21	Pass	0%
< 220 g Range	20.0000	19.9999	-0.1			Pass	25%
	39.9999	39.9999	0.0			Pass	0%
	60.0000	59.9999	-0.1			Pass	25%
	80.0000	80.0000	0.0			Pass	0%
	100.0000	99.9999	-0.1			Pass	25%
	119.9999	119.9999	0.0			Pass	0%
	139.9999	139.9999	0.0			Pass	0%
	159.9999	159.9998	-0.1			Pass	25%
	179.9999	179.9998	-0.1			Pass	25%
	200.0002	200.0000	-0.2			Pass	50%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	55298
Asset Number:	009065	Calibrated:	6/24/2016
Description:	BALANCE	Calibration Due:	6/24/2017
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	PR2003DR	Temp./RH:	71 °F / 54 %
Serial Number:	1120351000	Work Order #	403140638
Calibration Procedure:	BALANCES & SCALES		

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Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/13/2017
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/8/2016
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/6/2017
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/6/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403140638	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	24-Jun-16
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit		Result	% Limit
Corner Load	grams	grams	grams	grams			
Left Front	1000	1000.000	0.000	0.006		Pass	0%
Left Rear		1000.000	0.000			Pass	0%
Right Rear		1000.000	0.000			Pass	0%
Right Front		1000.000	0.000			Pass	0%
Repeatability							
500 gram Range							
1	200	200.000					
2		200.001					
3		200.002					
4		200.000					
5		200.000					
6		200.001					
7		200.002					
8		200.000					
9		200.001					
10		200.000					
Std Deviation		0.0008		0.0020		Pass	40%
2000 gram Range							
1	1000	1000.00					
2		1000.00					
3		1000.00					
4		1000.00					
5		1000.00					
6		1000.00					
7		1000.00					
8		1000.00					
9		1000.00					
10		1000.00					
Std Deviation		0.000		0.006		Pass	0%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
500 gram Range	0.000	0.000	0.000	0.004	0.0018	Pass	0%
	50.000	50.000	0.000			Pass	0%
	100.000	100.001	0.001			Pass	25%
	150.000	150.001	0.001			Pass	25%
	200.000	200.001	0.001			Pass	25%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403140638	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	24-Jun-16

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing *(cont.)*	grams	grams	grams	grams	grams		
500 gram Range	250.000	250.001	0.001	0.004	0.0018	Pass	25%
	300.000	300.001	0.001			Pass	25%
	350.000	350.001	0.001			Pass	25%
	400.000	400.000	0.000			Pass	0%
	450.000	450.000	0.000			Pass	0%
	500.000	500.000	0.000			Pass	0%
Direct Weighing	0.00	0.00	0.00	0.01	0.012	Pass	0%
2000 gram Range	200.00	200.00	0.00			Pass	0%
	400.00	400.00	0.00			Pass	0%
	600.00	600.00	0.00			Pass	0%
	800.00	800.00	0.00			Pass	0%
	1000.00	1000.00	0.00			Pass	0%
	1200.00	1200.00	0.00			Pass	0%
	1400.00	1400.00	0.00			Pass	0%
	1600.00	1600.00	0.00			Pass	0%
	1800.00	1800.00	0.00			Pass	0%
	2000.00	2000.00	0.00			Pass	0%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	60532
Asset Number:	014982	Calibrated:	9/28/2016
Description:	BALANCE	Calibration Due:	9/28/2017
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XP5003SDR	Temp./RH:	72 °F / 51 %
Serial Number:	1129300727	Work Order #	403142529
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001712	TROEMNER	100 G	WEIGHT CLASS 1	8/3/2017
001713	RICE LAKE	200 G	WEIGHT CLASS 1	7/14/2017
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/13/2017
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/7/2017
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/6/2017
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/6/2017
001718	RICE LAKE	2 KG	WEIGHT CLASS 1	4/6/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

001719 RICE LAKE 5 KG WEIGHT CLASS 1 4/6/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142529	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	28-Sep-16
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit		Result	% Limit
Corner Load	grams	grams	grams	grams			
Left Front	1000	999.999	-0.001	0.010		Pass	10%
Left Rear		999.999	-0.001			Pass	10%
Right Rear		999.998	-0.002			Pass	20%
Right Front		999.999	-0.001			Pass	10%
Repeatability							
1000 g Range							
1	500	500.001					
2		500.001					
3		500.000					
4		500.001					
5		500.001					
6		500.000					
7		500.000					
8		500.001					
9		500.000					
10		500.001					
Std Deviation		0.0005		0.0020		Pass	25%
5100 g Range							
1	2000	2000.00					
2		2000.00					
3		2000.00					
4		2000.00					
5		2000.00					
6		2000.00					
7		2000.00					
8		2000.00					
9		2000.00					
10		2000.00					
Std Deviation		0.000		0.012		Pass	0%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
1000 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	100.000	100.002	0.002			Pass	17%
	200.000	200.001	0.001			Pass	8%
	300.000	300.001	0.001			Pass	8%
	400.000	400.002	0.002			Pass	17%
	500.001	500.002	0.001			Pass	8%
	600.001	600.002	0.001			Pass	8%
	700.001	700.000	-0.001			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142529	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	28-Sep-16

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	grams	grams	grams		
1000 g Range	800.001	800.003	0.002	0.012	0.003	Pass	17%
	900.000	900.003	0.003			Pass	25%
	999.999	1000.000	0.001			Pass	8%
5100 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	500.001	500.000	-0.001			Pass	8%
	999.999	999.999	0.000			Pass	0%
	1500.00	1499.99	-0.01	0.02	0.01	Pass	50%
	2000.00	2000.00	0.00			Pass	0%
	2500.00	2500.00	0.00			Pass	0%
	3000.00	2999.99	-0.01			Pass	50%
	3500.00	3499.99	-0.01			Pass	50%
	4000.00	4000.00	0.00			Pass	0%
	4500.00	4500.00	0.00			Pass	0%
	5000.00	5000.00	0.00			Pass	0%

END OF REPORT

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 161026-1
SwRI SRR: 58485, 58617
SDG: 605029
VTSR: 10.11.2016, 11.01.2016

Certificates of Analysis for Chemicals

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

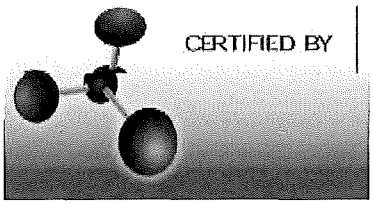
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

This is to certify that units of the lot number below were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	**SB101**	**Quality Test / Release Date**	**2/24/2016**
Lot Number	**160779**	**Expiration Date**	**Feb/18**
Description	**BUFFER SOLUTION, PH 4.00, CERTIFIED**		
Country of Origin	**United States**		
Chemical Origin	**Organic - non animal**		
BSE/TSE Comment	No aniimal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		
Chemical Comment	This material does not contain any potential allergens, including peanuts, milk, wheat, eggs, gluten, or soybean and does not contain any genetically modified organisms (GMO's)		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Clear, Red Liquid
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
NIST STD USED: pH 4	POT HYDROGEN PHTHAL	= LOT 185I	LOT 185I
NIST STD USED: pH 7a	POT DIHYDRO PHOS	= LOT 186IG	LOT 186IG
NIST STD USED: pH 7b	DISOD HYDRO PHOS	= LOT 186IIG	LOT 186IIG
OPTICAL ABSORBANCE	PASS/FAIL	= PASS TEST	PASS TEST
PH AT 25 DEGREES C		Inclusive Between 3.99 - 4.01	4.00
TRACEABLE TO NIST	PASS/FAIL	= PASS TEST	PASS TEST



Quality Control Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 72232
SwRI Chem ID: 72232
SwRI Chem ID: 72232

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

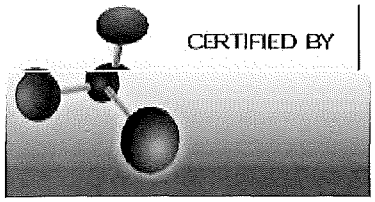
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

This is to certify that units of the lot number below were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	**SB107**	**Quality Test / Release Date**	**3/10/2016**
Lot Number	**160909**	**Expiration Date**	**Mar/18**
Description	**BUFFER SOLUTION, CERTIFIED, PH 7.00**		
Country of Origin	**United States**		
Chemical Origin	**Organic - non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Clear, yellow liquid
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
NIST STD : pH 9.180	BORAX	= LOT 187E	LOT 187E
NIST STD USED: pH 7a	POT DIHYDRO PHOS	= LOT 186IG	LOT 186IG
NIST STD USED: pH 7b	DISOD HYDRO PHOS	= LOT 186IIG	LOT 186IIG
OPTICAL ABSORBANCE	PASS/FAIL	= PASS TEST	PASS TEST
PH AT 25 DEGREES C		Inclusive Between 6.99 - 7.01	7.00
TRACEABLE TO NIST	PASS/FAIL	= PASS TEST	PASS TEST



Quality Control Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 72230
SwRI Chem ID: 72230
SwRI Chem ID: 72230

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

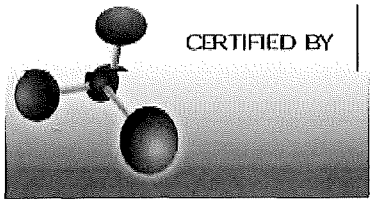
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0090918

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Catalog Number	**SB115**	**Quality Test / Release Date**	**5/4/2016**
Lot Number	**162803**	**Expiration Date**	**May/18**
Description	**BUFFER SOLUTION, PH 10.00, CERTIFIED**		
Country of Origin	**United States**		
Chemical Origin	**Organic - non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Clear, blue liquid
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
NIST STD USED: pH 10	SOD BICARBONATE	= LOT 191D	LOT 191D
NIST STD USED: pH 10	SOD CARBONATE	= LOT 191D	LOT 191D
NIST STD USED: pH 7a	POT DIHYDRO PHOS	= LOT 186IG	LOT 186IG
NIST STD USED: pH 7b	DISOD HYDRO PHOS	= LOT 186IIG	LOT 186IIG
OPTICAL ABSORBANCE	PASS/FAIL	= PASS TEST	PASS TEST
PH AT 25 DEGREES C		Inclusive Between 9.98 - 10.02	9.99
TRACEABLE TO NIST	PASS/FAIL	= PASS TEST	PASS TEST



Quality Control Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 72229
SwRI Chem ID: 72229
SwRI Chem ID: 72229

Reference Materials

▪ Certificate of Analysis ▪

SwRI Chem ID: 71222

Product:	WatR™ Pollution pH
Catalog Number:	977
Lot No.	P246-977
Certificate Issue Date:	November 25, 2015
Expiration Date:	November 30, 2018
Revision Number:	Original

CERTIFICATION

Parameter	Certified Value[1]	Uncertainty[2]	QC Performance Acceptance Limits[3]	PT Performance Acceptance Limits[4]
	S.U.	%	S.U.	S.U.
pH	6.12	0.969	6.01 - 6.24	5.92 - 6.32

ANALYTICAL VERIFICATION

Parameter	Certified Value[1]	Proficiency Testing Study			NIST Traceability	
		Mean	Recovery[5]	n	SRM Number	Recovery
	S.U.	S.U.	%			%
pH	6.12	6.11	99.9	494	185i	100

SwRI Chem ID: 71222

SwRI Chem ID: 71222

16341 Table Mountain Pkwy ▪ Golden, CO 80403 ▪ T: 800.372.0122 ▪ 303.431.8454 ▪ www.eraqc.com

Reference Materials

▪ Certificate of Analysis ▪

SwRI Chem ID: 71222

1. The **Certified Values** are the actual "made-to" concentrations confirmed by ERA analytical verification. The certified values are monitored and purchasers will be notified of any significant changes resulting in recertification or withdrawal of this certified reference material during the period of validity of this certificate.

2. The **Uncertainty** is the total propagated uncertainty at the 95% confidence interval. The uncertainty is based on the preparation and internal analytical verification of the product by ERA, multiplied by a coverage factor. The uncertainty applies to the product as supplied and does not take into account any required or optional dilution and/or preparations the laboratory may perform while using this product.

3. The **QC Performance Acceptance Limits (QC PALs™)**are based on actual historical data collected in ERA's Proficiency Testing program. The QC PALs™ reflect any inherent biases in the methods used to establish the limits and closely approximate a 95% confidence interval of the performance that experienced laboratories should achieve using accepted environmental methods. Use the QC PALs™ to realistically evaluate your performance against your peers.

4. The **PT Performance Acceptance Limits (PT PALs™)** are calculated using the regression equations and fixed acceptance criteria specified in the NELAC proficiency testing requirements. Use the PT PALs™ when analyzing this QC standard alongside USEPA and NELAC compliant PT standards. Please note that many PT study acceptance limits are concentration dependent (some non-linearly) and, therefore, the acceptance limits of this QC standard and any PT standard may differ relative to their difference in concentrations.

5. The **PT Data/Traceability** data include the mean value, percent recovery and number of data points reported by the laboratories in our Proficiency Testing study compared to the Certified Values. In addition, where NIST Standard Reference Materials (SRMs) are available, each analyte has been analytically traced to the NIST SRM listed. This product is traceable to the lot numbers of its starting materials. All gravimetric and volumetric measurements related to its manufacture are traceable to NIST through an unbroken chain of comparisons.
Traceability Recovery (%) = [(% recovery certified standard)/(% recovery NIST SRM)]*100
The traceability data shown were compiled by analyzing the ERA standards or their associated stock solutions against the applicable NIST SRMs.

6. For additional information on this product such as intended use, instructions for use, level of homogeneity, and safety information, please refer to the provided Instruction Sheet

If you have any questions or need technical assistance, please call ERA technical assistance at 1-800-372-0122 or send an email to info@eraqc.com.

Certifying Officer	Quality Officer
Tom Widera	David Kilhefner

SwRI Chem ID: 71222

SwRI Chem ID: 71222

16341 Table Mountain Pkwy ▪ Golden, CO 80403 ▪ T: 800.372.0122 ▪ 303.431.8454 ▪ www.eraqc.com

SIGMA-ALDRICH®

3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

SwRI Chem ID: 65579

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBQ1780V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	10 JUN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	99.6 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	CORRESPONDS TO ACS (10TH ED.)
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	INSOLUBLE MATTER < 0.005 % HEAVY METALS (AS PB) < 0.001 %
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 20 MG/KG	< 20 MG/KG
POTASSIUM (ICP)	≤ 20 MG/KG	< 20 MG/KG
MAGNESIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

SwRI Chem ID: 65579

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

SwRI Chem ID: 65579

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65736

SIGMA-ALDRICH®

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate – ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

SwRI Chem ID: 65736

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

SwRI Chem ID: 65736

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65736

SIGMA-ALDRICH®

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 65736

SwRI Chem ID: 65736

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SwRI Chem ID: 63614

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate – ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

SwRI Chem ID: 63614

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

SwRI Chem ID: 63614

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SwRI Chem ID: 63614

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 63614

SwRI Chem ID: 63614

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SwRI Chem ID: 65735

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Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate – ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

SwRI Chem ID: 65735

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

SwRI Chem ID: 65735

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SwRI Chem ID: 65735

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Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

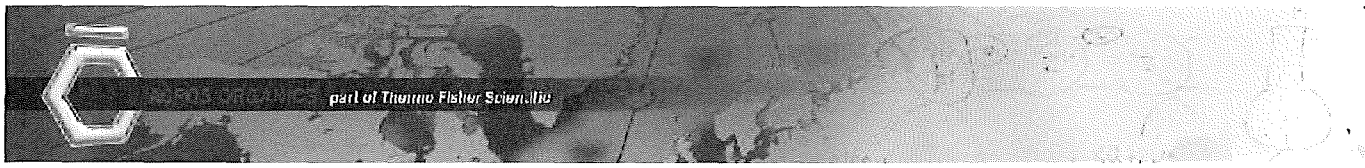
Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 65735

SwRI Chem ID: 65735

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SwRI Chem ID: 69608



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

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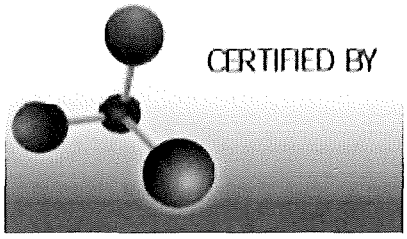
Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69608

SwRI Chem ID: 69608



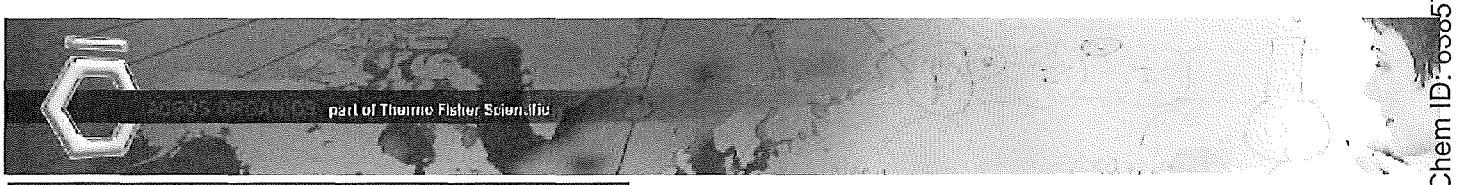
CERTIFIED BY

L. Van den Broek, QA Manager Issued: 25 April 2016

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SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608

SwRI Chem ID: 63857



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

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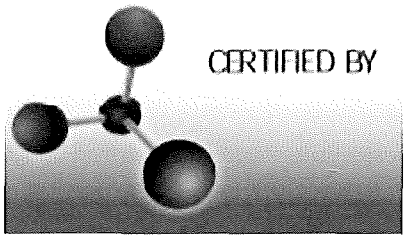
Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	dark purple to black crystalline chunks	black crystalline chunks
Titration Iodometric	>=98.5 %	101.9 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Trace analysis	Type: Ca measure =< 50 PPM	Type: Ca measure 5 PPM
Trace analysis	Type: Cd measure =< 10 PPM	Type: Cd measure 3 PPM
Trace analysis	Type: Co measure =< 10 PPM	Type: Co measure 5 PPM
Trace analysis	Type: Cu measure =< 10 PPM	Type: Cu measure 7 PPM
Trace analysis	Type: Fe measure =< 200 PPM	Type: Fe measure 178 PPM
Trace analysis	Type: Mg measure =< 50 PPM	Type: Mg measure 6 PPM
Trace analysis	Type: Mn measure =< 10 PPM	Type: Mn measure 7 PPM
Trace analysis	Type: Na measure =< 50 PPM	Type: Na measure 17 PPM
Trace analysis	Type: Ni measure =< 50 PPM	Type: Ni measure 8 PPM
Trace analysis	Type: Pb measure =< 20 PPM	Type: Pb measure 4 PPM
Trace analysis	Type: Sr measure =< 50 PPM	Type: Sr measure 11 PPM
Trace analysis	Type: Zn measure =< 10 PPM	Type: Zn measure 4 PPM
Trace analysis	Type: Cl measure =< 20 PPM	Type: Cl measure =< 20 PPM
Trace analysis	Type: SO4 measure =< 50 PPM	Type: SO4 measure =< 50 PPM
Trace analysis	Type: NH4 measure =< 10 PPM	Type: NH4 measure =< 10 PPM
Subst not pptd by NH4OH	=<0.2 % (as SO4)	=<0.0077 % (as SO4)

SwRI Chem ID: 63857

SwRI Chem ID: 63857



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L. Van den Broek, QA Manager Issued: 28 October 2015

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SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857

SwRI Chem ID: 65581

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Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBW6908V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	16 OCT 2015

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Michael Grady, Manager
Quality Control
Milwaukee, WI US

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SwRI Chem ID: 65581

SwRI Chem ID: 65581

SwRI Chem ID: 63604

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Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

SwRI Chem ID: 63604

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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SwRI Chem ID: 63604

SwRI Chem ID: 65737

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Certificate of Analysis

Product Name:
Magnesium nitrate hexahydrate – ACS reagent, 99%

$Mg(NO_3)_2 \cdot 6H_2O$

Product Number:	**237175**
Batch Number:	**MKBX1623V**
Brand:	SIAL
CAS Number:	13446-18-9
MDL Number:	MFCD00149779
Formula:	MgN2O6 · 6H2O
Formula Weight:	256.41 g/mol
Quality Release Date:	10 DEC 2015

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Chips or Crystals	Conforms to Requirements	Crystals
X-Ray Diffraction	Conforms to Structure	Conforms
Complexometric EDTA	98.0 - 102.0 %	99.8 %
Insoluble Matter C= 10%, H2O	≤ 0.005 %	< 0.005 %
Barium	≤ 0.005 %	< 0.005 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Chloride Content	≤ 0.001 %	< 0.001 %
Iron (Fe)	≤ 5 ppm	< 5 ppm
Heavy Metals as Pb	≤ 5 ppm	< 1 ppm
Potassium (K)	≤ 0.005 %	< 0.005 %
Manganese (Mn)	≤ 5 ppm	< 5 ppm
Sodium (Na)	≤ 0.005 %	< 0.005 %
Ammonia (NH4)	≤ 0.003 %	< 0.003 %
pH C= 5%, H2O @ 25 Deg C	5.0 - 8.2	5.0
Phosphate (PO4)	≤ 5 ppm	< 5 ppm
Strontium (Sr)	≤ 0.005 %	< 0.005 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %

SwRI Chem ID: 65737

SwRI Chem ID: 65737

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SwRI Chem ID: 65737

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Certificate of Analysis

Product Number: 237175
Batch Number: MKBX1623V

Test	Specification	Result
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

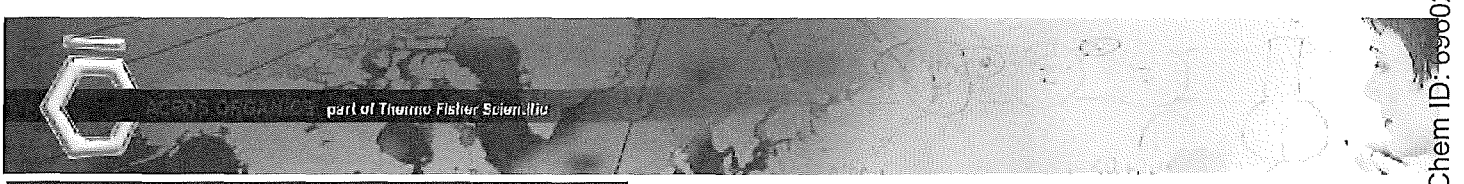
Michael Grady, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 65737

SwRI Chem ID: 65737

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SwRI Chem ID: 69602



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

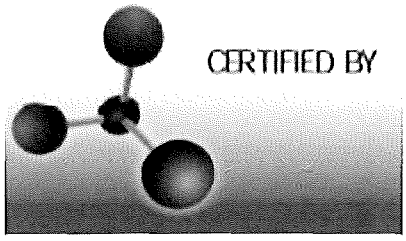
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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



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L. Van den Broek, QA Manager

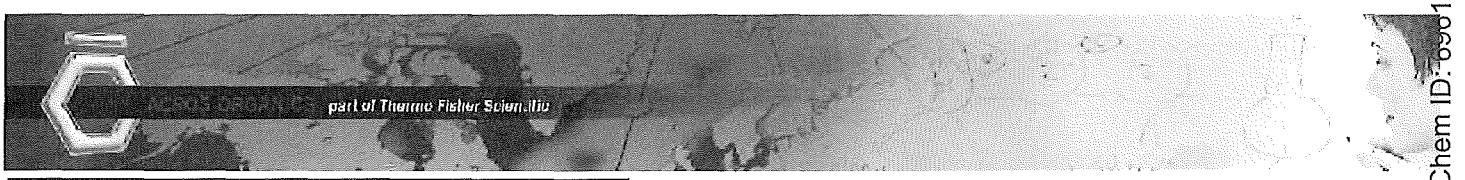
Issued: 25 April 2016

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SwRI Chem ID: 69602

SwRI Chem ID: 69602

SwRI Chem ID: 69610



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

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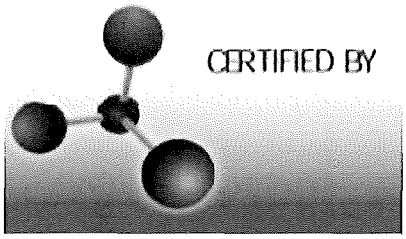
Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69610

SwRI Chem ID: 69610



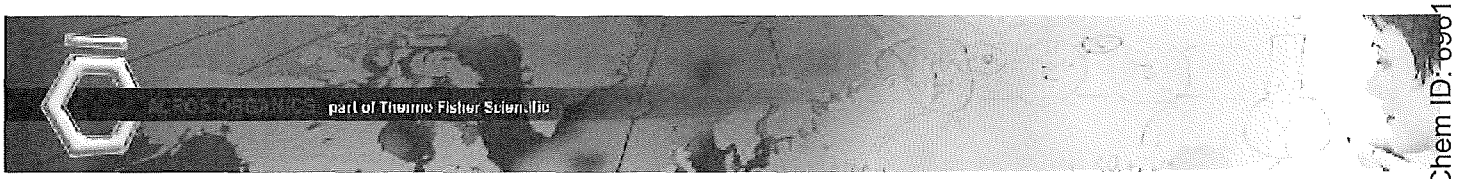
CERTIFIED BY

L. Van den Broek, QA Manager Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69610
SwRI Chem ID: 69610
SwRI Chem ID: 69610

SwRI Chem ID: 69611



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

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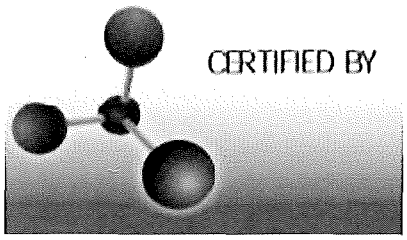
Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69611

SwRI Chem ID: 69611



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L. Van den Broek, QA Manager Issued: 25 April 2016

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SwRI Chem ID: 69611

SwRI Chem ID: 69611

SwRI Chem ID: 69611

SwRI Chem ID: 65951

part of Thermo Fisher Scientific

ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm

CERTIFIED BY

L. Van den Broek, QA Manager

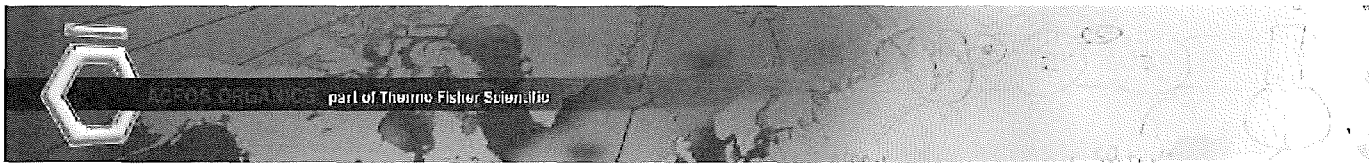
Issued: 7 January 2016

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SwRI Chem ID: 65951

SwRI Chem ID: 65951

SwRI Chem ID: 66141



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

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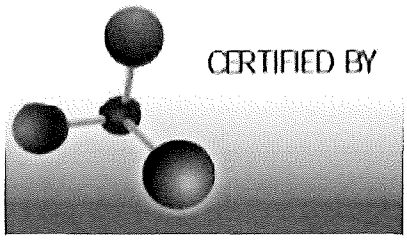
Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm
Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)

SwRI Chem ID: 66141

SwRI Chem ID: 66141



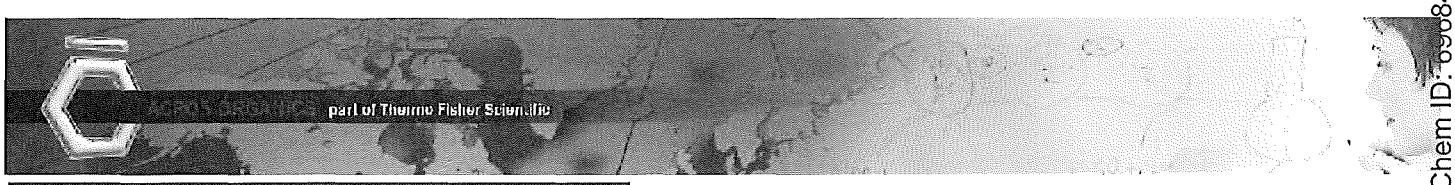
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L. Van den Broek, QA Manager Issued: 14 January 2016

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SwRI Chem ID: 66141
SwRI Chem ID: 66141
SwRI Chem ID: 66141

SwRI Chem ID: 69684



ACROS ORGANICS

Version	0
Molecular weight	126.04
Molecular formula	C2 H2 O4 . 2 H2 O
CAS No	6153-56-6
Linear formula	HO2CCO2H.2H2O
Flash point (°C)	

Certificate of Analysis

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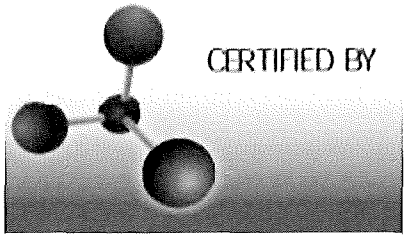
Catalog Number	42315	**Quality Test / Release Date**	10 December 2014
Lot Number	A0354614	**Suggested Retest Date**	December 2019
Description	Oxalic acid dihydrate,99.5+%,ACS reagent		
Country of Origin	SPAIN		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystals
Infrared spectrometry	authentic	authentic
Assay Titrimetry	99.5 to 102.5 %	99.9 %
Heavy metals (as Pb)	=<5 ppm	=<2.5 ppm
Residue after ignition	=<0.01 %	0.004 %
Nitrogen compounds (as N)	=<0.001 %	=<0.001 %
Trace analysis	Type: Cl measure =< 20 ppm	Type: Cl measure < 5 ppm
Trace analysis	Type: SO4 measure =< 50 ppm	Type: SO4 measure < 20 ppm
Trace analysis	Type: Ca measure =< 10 ppm	Type: Ca measure < 1 ppm
Trace analysis	Type: Fe measure =< 2 ppm	Type: Fe measure < 2 ppm
Insoluble matter	=<0.005 %	=<0.005 %
Substance darkened by H2SO4	passes test	passes test

SwRI Chem ID: 69684

SwRI Chem ID: 69684



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L. Van den Broek, QA Manager

Issued: 27 April 2016

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SwRI Chem ID: 69684

SwRI Chem ID: 69684

SwRI Chem ID: 69684

SwRI Chem ID: 63914

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Potassium carbonate - ACS reagent, ≥99.0%

K_2CO_3

Product Number:	**209619**
Batch Number:	**SLBM3461V**
Brand:	SIAL
CAS Number:	584-08-7
MDL Number:	MFCD00011382
Formula:	CK2O3
Formula Weight:	138.21 g/mol
Quality Release Date:	28 JAN 2015
Recommended Retest Date:	JAN 2018

SwRI Chem ID: 63914

Test	Specification	Result
Assay	≥ 99.0 %	99.8 %
Insoluble Matter < or = 0.01%	Pass	Pass
Chloride (Cl) < or = 0.003%	Pass	Pass
Phosphate (PO4) < or = 0.001%	Pass	Pass
Silica < or = 0.005%	Pass	Pass
Sulfur coumpounds < or = 0.004%	Pass	Pass
Calcium < or = 0.005%	Pass	Pass
Magnesium < or = 0.002%	Pass	Pass
Sodium < or = 0.02%	Pass	Pass
Iron (Fe) < or = 5 ppm	Pass	Pass
Heavy Metals (as Lead)	< = 5 ppm	< 5 ppm

SwRI Chem ID: 63914

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 63914

SwRI Chem ID: 63914

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Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 209619
Batch Number: SLBM3461V

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

SwRI Chem ID: 63914

SwRI Chem ID: 63914

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Fisher Scientific

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Certificate of Analysis

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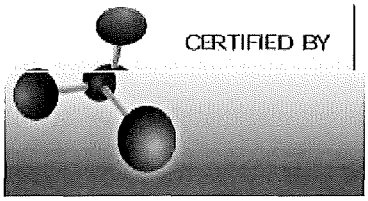
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SwRI Chem ID: 69660

Catalog Number	**P208**	**Quality Test / Release Date 3/2/2016**	
Lot Number	**161550**		
Description	**POTASSIUM CARBONATE, ANHYDROUS, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2021**
Chemical Origin	**Inorganic-non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	White granular powder
ASSAY	%	>= 99.0	99.6
CALCIUM	%	<= 0.005	0.003
CHLORIDE	%	<= 0.003	<0.0030
HEAVY METALS (as Pb)	ppm	<= 5	<5.0
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.01	<0.010
IRON (Fe)	ppm	<= 5	<5.0
MAGNESIUM	%	<= 0.002	<0.0020
PHOSPHATE (PO4)	%	<= 0.001	<0.0010
SILICA (SiO2)	%	<= 0.005	<0.005
SODIUM (Na)	%	<= 0.02	0.002
SULFUR COMPOUNDS	%	<= 0.004	<0.0040

SwRI Chem ID: 69660



Quality Control Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69660

SwRI Chem ID: 66142

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm

CERTIFIED BY

L. Van den Broek, QA Manager Issued: 16 December 2016

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SwRI Chem ID: 66142

SwRI Chem ID: 66142

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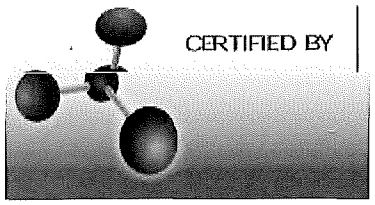
Certificate of Analysis

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Catalog Number	**A104**	**Quality Test / Release Date**	**12/19/2015**
Lot Number	**158634**		
Description	**CITRIC ACID, GRANULAR, MONOHYDRATE, A.C.S.**		
Country of Origin	**Austria**	*** Suggested Retest Date**	**Dec-2020**
Chemical Origin	**Organic - Plant**		
BSE/TSE Comment	This material is derived from plant material. It does not contain or come into contact with any animal-containing materials or components.		
Chemical Comment	No genetically modified organisms are used in the production of Citric Acid.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	White granules
ASSAY	%	Inclusive Between 99.0 - 102.0	100.5
CHLORIDE	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
IGNITION RESIDUE	%	<= 0.02	0.008
INSOLUBLE MATTER	%	<= 0.005	<0.0050
IRON (Fe)	ppm	<= 3	<3.0
LEAD (Pb)	ppm	<= 2	<2.0
OXALATE		= P.T. (ABOUT 0.05%)	P.T. (ABOUT 0.05%)
PHOSPHATE (PO4)	%	<= 0.001	<0.0010
SUBSTANCES CARBONIZED BY H2SO4	PASS/FAIL	= PASS TEST	PASS TEST
SULFUR COMPOUNDS	%	<= 0.002	<0.0020



Quality Control Chemist Group Leader Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 74190
SwRI Chem ID: 74190
SwRI Chem ID: 74190

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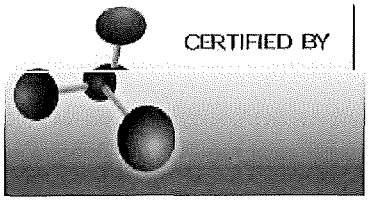
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SwRI Chem ID: 69597

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69597



Elgan E. Hans

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69597

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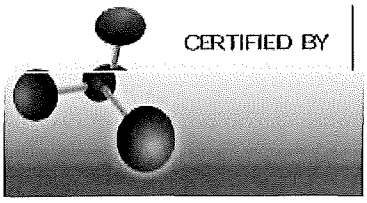
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69596
SwRI Chem ID: 69596
SwRI Chem ID: 69596

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Certificate of Analysis

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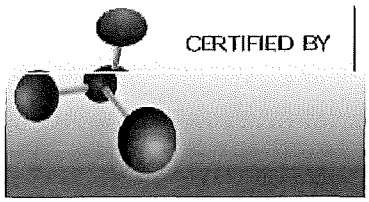
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SwRI Chem ID: 69595

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69595



Elgan E. Hare

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69595

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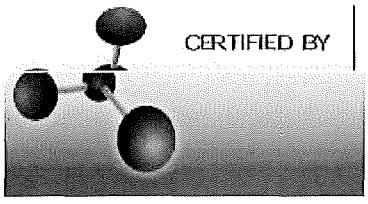
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SwRI Chem ID: 69594

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69594



Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69594

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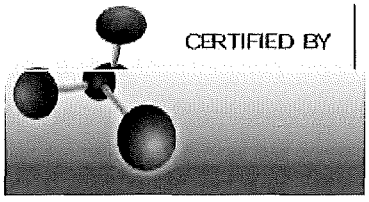
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SwRI Chem ID: 69593

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69593



Elyse E. Hans

Lab Manager Fair Lawn

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SwRI Chem ID: 69593

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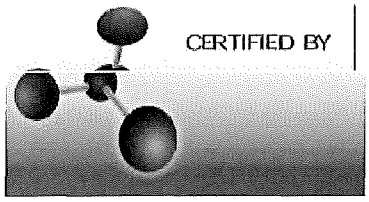
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69592
SwRI Chem ID: 69592
SwRI Chem ID: 69592

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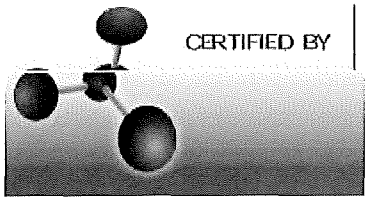
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SwRI Chem ID: 69573

Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69573



Elyse E. Hare

Lab Manager Fair Lawn

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SwRI Chem ID: 69573

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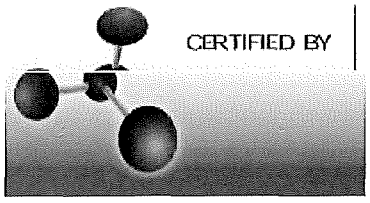
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SwRI Chem ID: 69574

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69574



Elyse E. Hess

Lab Manager Fair Lawn

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SwRI Chem ID: 69574

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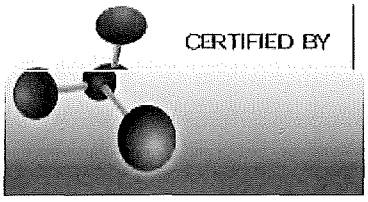
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SwRI Chem ID: 69575

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69575



Elyse E. Hess

Lab Manager Fair Lawn

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SwRI Chem ID: 69575

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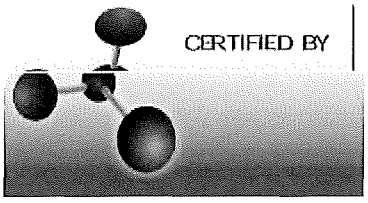
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SwRI Chem ID: 69576

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69576



Elyse E. Hess

Lab Manager Fair Lawn

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SwRI Chem ID: 69576

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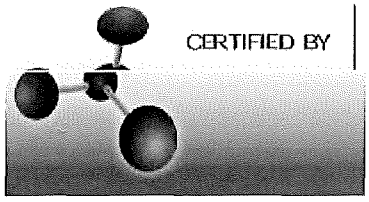
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SwRI Chem ID: 69577

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69577



Elyse E. Hare

Lab Manager Fair Lawn

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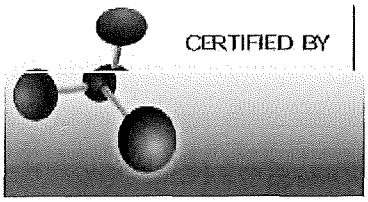
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SwRI Chem ID: 69578

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69578



Elyse E. Hess

Lab Manager Fair Lawn

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SwRI Chem ID: 69578

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Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

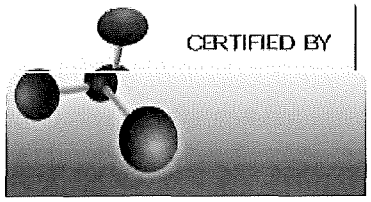
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SwRI Chem ID: 69579

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69579



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69579

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

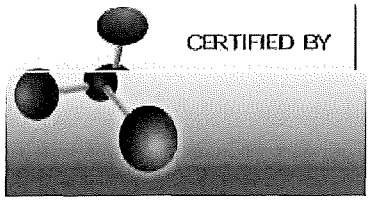
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69591
SwRI Chem ID: 69591
SwRI Chem ID: 69591

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

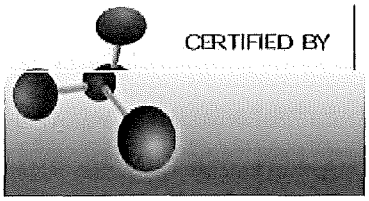
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SwRI Chem ID: 69590

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69590



Elyse E. Hare

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69590

Fisher Scientific

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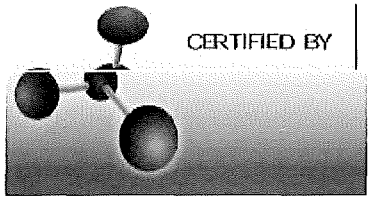
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hare

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69589
SwRI Chem ID: 69589
SwRI Chem ID: 69589

Fisher Scientific

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Fair Lawn, NJ 07410
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Certificate of Analysis

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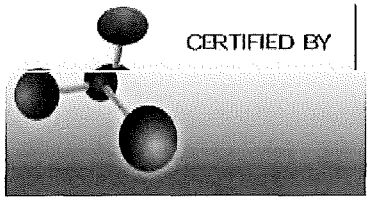
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SwRI Chem ID: 69588

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69588



Elyse E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69588

Fisher Scientific

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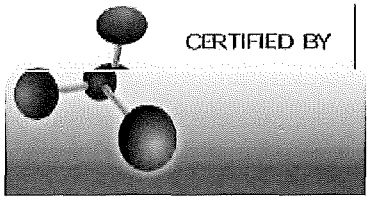
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69587
SwRI Chem ID: 69587
SwRI Chem ID: 69587

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

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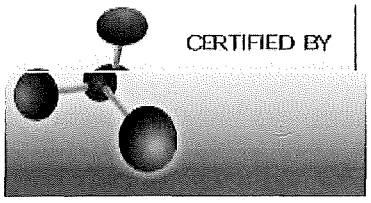
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SwRI Chem ID: 69586

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69586



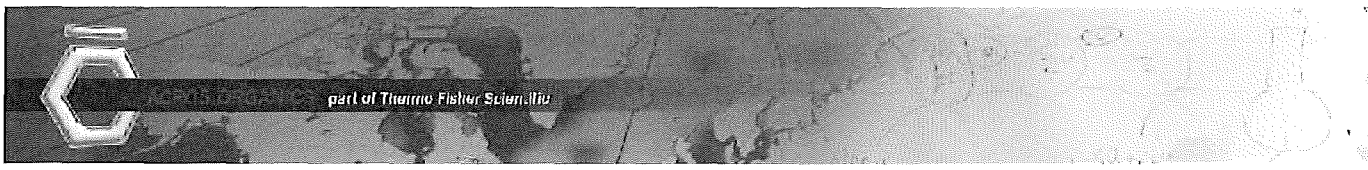
Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69586

SwRI Chem ID: 69607



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

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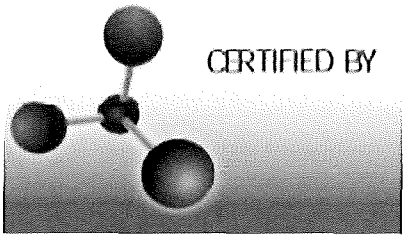
Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69607

SwRI Chem ID: 69607



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69607
SwRI Chem ID: 69607
SwRI Chem ID: 69607

SwRI Chem ID: 65582

SIGMA-ALDRICH®

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBW6908V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	16 OCT 2015

SwRI Chem ID: 65582

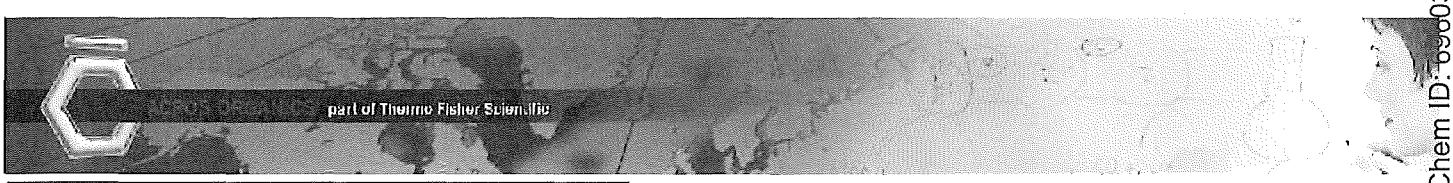
Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Michael Grady, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 65582

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 69603



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

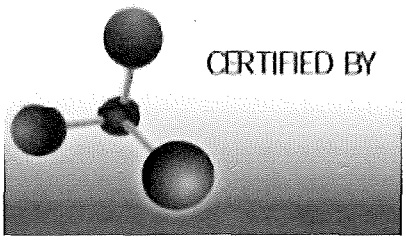
Certificate of Analysis

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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



CERTIFIED BY

L. Van den Broek, QA Manager

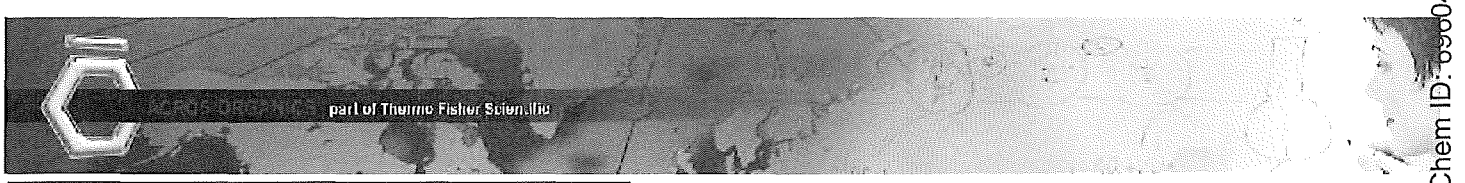
Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69603

SwRI Chem ID: 69603

SwRI Chem ID: 69604



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

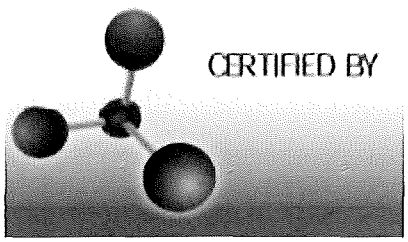
Certificate of Analysis

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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



CERTIFIED BY

L. Van den Broek, QA Manager

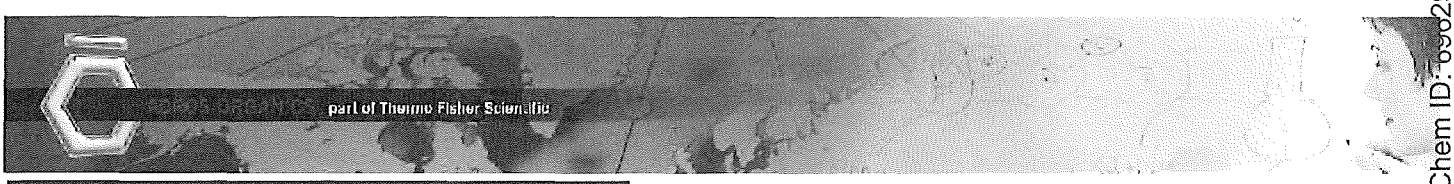
Issued: 25 April 2016

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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69604

SwRI Chem ID: 69604

SwRI Chem ID: 69629



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

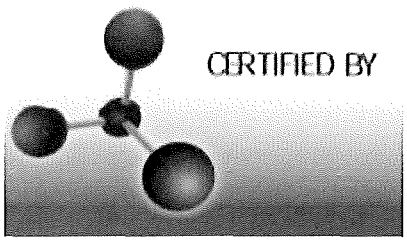
Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

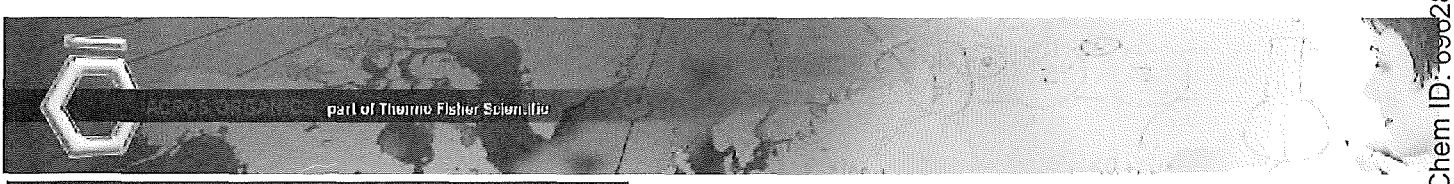
Issued: 26 April 2016

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SwRI Chem ID: 69629

SwRI Chem ID: 69629

SwRI Chem ID: 69628



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

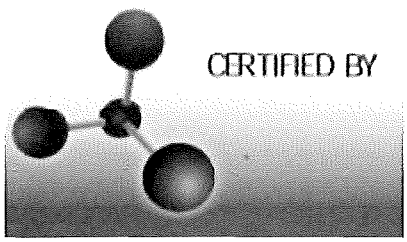
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



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L. Van den Broek, QA Manager

Issued: 26 April 2016

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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69628

SwRI Chem ID: 69628

SIGMA-ALDRICH®

3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

SwRI Chem ID: 65593

Product Name:	NICKEL(II) NITRATE HEXAHYDRATE purum p.a., crystallized, >= 97.0 % KT
Product Number:	72253
Batch Number:	BCBP4160V
Brand:	Sigma-Aldrich
CAS Number:	13478-00-7
Formula:	$Ni(NO_3)_2 \bullet 6H_2O$
Formula Weight:	290.79
Quality Release Date:	26 JAN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	BLUE-GREEN TO DEEP BLUE-GREEN	BLUE-GREEN
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	97.0 - 103.0 %	97.0 %
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
CADMIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
COBALT (ICP)	≤ 500 MG/KG	< 500 MG/KG
COPPER (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 50 MG/KG	< 50 MG/KG
POTASSIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
SODIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
LEAD (ICP)	≤ 50 MG/KG	< 50 MG/KG
ZINC (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 50 MG/KG	< 50 MG/KG

SwRI Chem ID: 65593

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

SwRI Chem ID: 65593

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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SwRI Chem ID: 67843

Catalog Number	**A509**	**Mfg. Date**	11/4/2015
Lot Number	**1115100**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	11/04/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

SwRI Chem ID: 67843

SwRI Chem ID: 67843

Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

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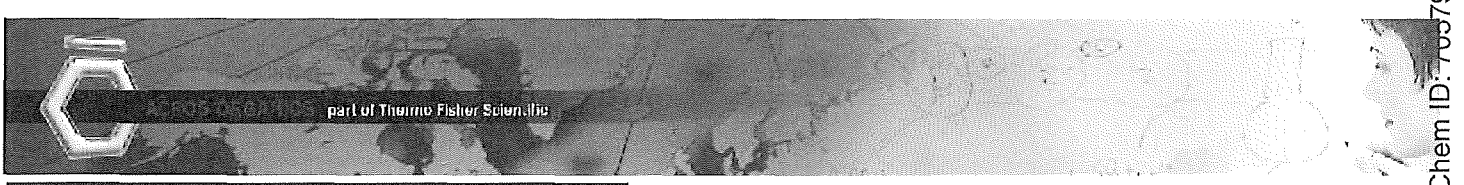
Edgar E Hess
Lab Manager Fair Lawn

Joel Boland
Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1 800 227 6701

SwRI Chem ID: 67843
SwRI Chem ID: 67843
SwRI Chem ID: 67843

SwRI Chem ID: 70579



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

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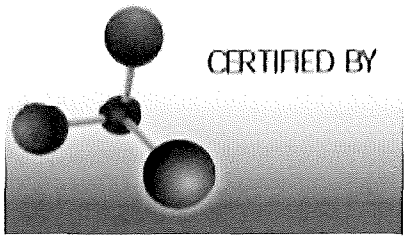
Catalog Number	42434	**Quality Test / Release Date**	23 December 2015
Lot Number	A0367952	**Suggested Retest Date**	December 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5 % at 25°C)	5.7 (5 % at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 70579

SwRI Chem ID: 70579



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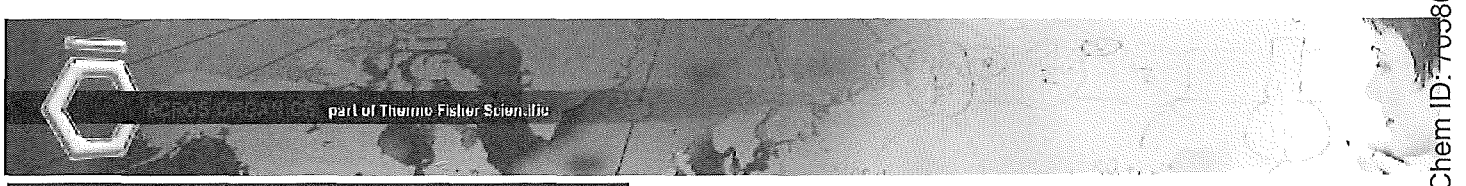
L. Van den Broek, QA Manager Issued: 20 May 2016

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SwRI Chem ID: 70579

SwRI Chem ID: 70579

SwRI Chem ID: 70579



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

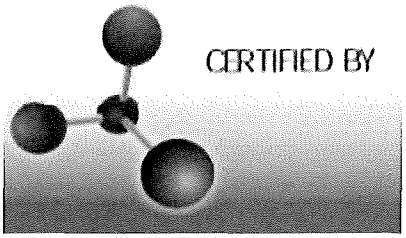
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Catalog Number	42434	**Quality Test / Release Date**	23 December 2015
Lot Number	A0367952	**Suggested Retest Date**	December 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5 % at 25°C)	5.7 (5 % at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 70580
SwRI Chem ID: 70580
SwRI Chem ID: 70580



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L. Van den Broek, QA Manager Issued: 20 May 2016

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SwRI Chem ID: 70580

SwRI Chem ID: 70580

SwRI Chem ID: 70580

Fisher Scientific

1 Reagent Lane
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201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 Standard by SAI Global Certificate Number CERT - 0090918

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Catalog Number	**A509**	**Mfg. Date**	5/19/2016
Lot Number	**1116050**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	05/19/2018
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.8
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

SwRI Chem ID: 74198
SwRI Chem ID: 74198
SwRI Chem ID: 74198

Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

CERTIFIED BY

Jerome Gilman, Quality Control Lab Manager

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1.800.227.6701.

SwRI Chem ID: 74198
SwRI Chem ID: 74198
SwRI Chem ID: 74198

GFS Chemicals, Inc.
Columbus, Ohio 43223

LOT ANALYSIS

ITEM: 66 PERCHLORIC ACID, 70%, REAGENT (ACS)

LOT#:C580211

Test	PASS/FAIL	NUMERICAL RESULT
Assay 69.0-72.0%	PASS	69.7%
Residue after ignition 0.003%	PASS	< 0.003%
Silicate + phosphate 0.0005%	PASS	< 0.0005%
Chloride 0.001%	PASS	< 0.001%
Sulfate 0.001%	PASS	< 0.001%
Nitrogen compounds (as N) 0.001%	PASS	< 0.001%
Heavy metals (as Pb) 0.0001%	PASS	< 0.0001%
Iron 0.0001%	PASS	< 0.0001%
Color (APHA) 10 max	PASS	< 10

TRACEABLE TO N.I.S.T. (Y/N)? Y
Comment:
Reported by: Alysa Panepinto
QC Supervisor: Alysa Panepinto
Quality Assured to Retest Point: 60 months from shipment
C/A Print Date: 09/16/2015

Not for direct use in food, cosmetics, finished pharmaceuticals or drug products. Supplier is not responsible for compliance with FDA Current Good Manufacturing Practice (CGMP) requirements, including without limitation those for finished drug products in 21 C.F.R Parts 210 and 211. Consult warranty limitations at www.gfschemicals.com/statics/documents/aboutus/termsandconditions.html For resale by GFS authorized distributors only.

GFS Chemicals, Inc. P.O. Box 245 Powell, OH 43065 * Signed Orig. Doc. on File
800-858-9682 (U.S. and Canada) 740-881-5501(International) 740-881-5989 (Fax)

SwRI Chem ID: 61372
SwRI Chem ID: 61372
SwRI Chem ID: 61372

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 Standard by SAI Global Certificate Number CERT - 0090918

This is to certify that units of the above mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	**A509**	**Mfg. Date**	5/19/2016
Lot Number	**1116050**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	05/19/2018
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.8
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

SwRI Chem ID: 74444
SwRI Chem ID: 74444
SwRI Chem ID: 74444

Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

CERTIFIED BY

Jerome Gilman, Quality Control Lab Manager

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1 800 227 6701.

SwRI Chem ID: 74444
SwRI Chem ID: 74444
SwRI Chem ID: 74444

SwRI Chem ID: 26268

Certificate of Analysis

SIGMA-ALDRICH

Product Name	Sodium chlorate, ACS reagent, ≥99.0%
Product Number	403016
Product Brand	SIGALD
CAS Number	7775-09-9
Molecular Formula	$NaClO_3$
Molecular Weight	106.44

TEST	SPECIFICATION	LOT 08722AF RESULTS
APPEARANCE	WHITE CRYSTALS, CRYSTALLINE POWDER OR	MOIST WHITE CRYSTALS
X-RAY DIFFRACTION	CONFORMS TO STANDARD PATTERN.	CONFORMS TO STANDARD PATTERN.
INSOLUBLE MATTER	0.005% (MAXIMUM) (C=8%, H2O)	0.004%
ACS TESTS	99.0% NACLO3 (MINIMUM)	99.4% ASSAY
ARSENIC		<0.5 PPM
BROMATE	0.015% (MAXIMUM)	<0.01%
CHLORIDE	0.005% (MAXIMUM)	<0.005%
IRON	5 PPM (MAXIMUM)	<0.0005%
HEAVY METALS	0.001% (MAXIMUM) (AS PB)	<0.001%
POTASSIUM	0.01% (MAXIMUM)	0.00%
NITROGEN COMPOUNDS		<0.001%
CALCIUM, MAGNESIUM &		<0.005%
SULFATE	0.001% (MAXIMUM)	<0.001%

Barbara Rajzer, Supervisor
Quality Control
Milwaukee, Wisconsin USA

SwRI Chem ID: 26268

SwRI Chem ID: 26268

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

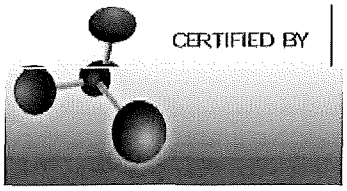
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

This is to certify that units of the lot number below were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	S318	Quality Test / Release Date 3/10/2015	
Lot Number	152074		
Description	SODIUM HYDROXIDE, A.C.S.		
Country of Origin	United States	* Suggested Retest Date	Mar-2020
Chemical Origin	Inorganic		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	White pellets
ASSAY	%	>= 97.0	99.1
CALCIUM	%	<= 0.005	<0.0050
CHLORIDE	%	<= 0.005	<0.005
HEAVY METALS (as Ag)	%	<= 0.002	<0.0020
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
IRON (Fe)	%	<= 0.001	<0.0010
MAGNESIUM	%	<= 0.002	<0.0020
MERCURY (Hg)	ppm	<= 0.1	<0.10
NICKEL (Ni)	%	<= 0.001	<0.0010
NITROGEN COMPOUNDS	%	<= 0.001	<0.0010
PHOSPHATE (PO4)	%	<= 0.001	<0.0010
POTASSIUM (K)	%	<= 0.02	<0.020
SODIUM CARBONATE	%	<= 1.0	0.3
SULFATE (SO4)	%	<= 0.003	<0.0030



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 61581
SwRI Chem ID: 61581
SwRI Chem ID: 61581

Appendix S
SwRI Test Report , February 16, 2017

SOUTHWEST RESEARCH INSTITUTE®

6220 CULEBRA ROAD 78238-5166 • P.O. DRAWER 28510 78228-0510 • SAN ANTONIO, TEXAS, USA • (210) 684-5111 • WWW.SWRI.ORG

CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

February 16, 2017

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Victor Garde

Subject:		
	SwRI Project Number:	21592.01.00X
	SDG:	609624
	SwRI Task Order Number:	170127-2
	SwRI Sample Receipt Number:	59039
	Samples Received:	01.27.2017
	Analysis:	Solid and Liquid Waste Surrogates

Dear Mr. Garde,

Please find the enclosed results for the three overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Principal Scientist

APPROVED:

Michael J. Dammann
Director

RPS: jz

Cc: Anya Gonzales, Los Alamos National Laboratory

Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 170127-2
SwRI SRR: 59039
SDG: 609624
VTSR: 01.27.2017

Chain-of-Custody
&
Sample Receipt Paperwork

Total Page Count: 010001-
Fraction: DOT Pages: 010035
UN Oxidation Testing

Garcia, David

From: Moken, James A.
Sent: Friday, January 27, 2017 7:17 AM
To: Douglas, Steven M.; Garcia, David
Cc: Spies, Radonna S.
Subject: Sample ID's

Steven and David,

Can I get three sample ID's and an SRR generated for LANL, project# 21591.01.00X.

1) 65% Ammonium Nitrate
2) 65% Ammonium Nitrate – Zeo 1
3) 65% Ammonium Nitrate – Zeo 2

Thanks

Jamie

Client: LANL Los Almos
SRR # 59039
Project # 21591.01.00X
Case: J. Moken
VTSR: 01/27/17
Sample(s) Received: Intact
Temperature: N/A SN # 021055

Southwest Research Institute

Laboratory Task Order

TO #: 170127-2 Revision: 1

Project(s): 21592.01.00X
Manager(s): SPIES, RADONNA
To Client: 02/28/17

SDG: 609624

SRR #'s: 59039
Client(s): Los Alamos National Laboratory

Instructions

Three ammonium nitrate samples.

Ammonium nitrate 65% for UN DOT 0.2 and two Zeolite blends for UN DOT 0.1

Documents Related to this task order: 214961[COC for SRR 59039], 214962[Paperwork for SRR 59039]

Deliverables --> Hard Copy: no EDD: no PDF: -YES-

Test: Oxidizer_UN
Section: WETCHEM

Holding: 180 days from CED

United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.

Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
609625		1	Solid	65% Ammonium Nitrate - Zeo 2	NO DATA	NO DATA
609626		1	Solid	65% Ammonium Nitrate - Zeo 1	NO DATA	NO DATA

Test: Oxidizing Liq_UN
Section: WETCHEM

Holding: 180 days from CED

Test for Oxidizing Liquids - UN Manual of Tests and Criteria Part 3

Cnt: 1

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
609624		1	Liquid	65% Ammonium Nitrate	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

Project: 21592.01.00X
Case #: J. Moken
Client: Los Alamos National Laboratory

Sample Receipt Number: 59039
Revision: 2

This Receipt was Revised 02/07/2017

VTSR: 01/27/17

Time: 08:10:00

Manager: SPIES, RADONNA
Logged in by: DXGARCIA
Creation Date: 01/27/17

Notes

Email was received to create an SRR for the following.

Parameters: Analysis/located on Task Order

See chain of custody as part of the work order system for more information.

Revision, 1

Corrected project number per Vicky Lozano.

Revision, 2

Corrected project number 21592.01.00X per PM.

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
609624	65% Ammonium Nitrate		Liquid	1	
609625	65% Ammonium Nitrate - Zeo 2		Solid	1	
609626	65% Ammonium Nitrate - Zeo 1		Solid	1	

Containers: 3 **Samples: 3**

These documents are associated with this receipt: 214961[COC for SRR 59039], 214962[Paperwork for SRR 59039]

Thermometer: NA
Temperature: NA

Page Printed: 02/15/2017 14:22
ver: (7/18/2014)

59039 Los Alamos National Laborato

Southwest Research Institute

Traffic Report

Sample Custodian Signature: David Lara

1. Custody Seal	Not Present or Damaged
2. Chain of Custody	Present
3. Sample Tags	Not Present
Sample Tag Numbers	Not on COC
4. SMO Forms	Not Present

Client: LANL Los Alamos

Project: 21591.01.00X

Case: J. Moken / SDG: _____

Sample Receipt: 59039

Airbill: Email

Custody Seal #(s): NA

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
01/27/17	08:10:00	Email	65% Ammonium Nitrate	N/A	609624	YES	Intact
01/27/17	08:10:00	Email	65% Ammonium Nitrate - Zeo 2	N/A	609625	YES	Intact
01/27/17	08:10:00	Email	65% Ammonium Nitrate - Zeo 1	N/A	609626	NO	Intact

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): DAVID GARCIA	Log-in Date: 01/27/2017
Received By (Signature): David Garcia	
Case Number: J. Moken	Sample Delivery Group No.: N/A
Remarks: 21591.01.00X	SAS Number: N/A

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	NA	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present/Absent*	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	Email	
7. Sample Tags	Present/Absent*	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/ Leaking	
9. Cooler Temperature	NAC	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	01/27/2017	
12. Time Received	08:10:00	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
65% Ammonium Nitrate	N/A	609624	Intact
65% Ammonium Nitrate - Zeo 2	N/A	609625	Intact
65% Ammonium Nitrate - Zeo 1	N/A	609626	Intact

Sample Transfer		
Fraction	InOrg	Fraction
Area #	J. Moken	Area #
By	DAVID GARCIA	By
On	01/27/2017	On

* Contact SMO and attach record of resolution

Reviewed By:	Logbook No.: Sample Receipt (59039)
Date: 1.27.17	Logbook Page No.: 9713 SRC 10F4

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 170127-2
SwRI SRR: 59039
SDG: 609624
VTSR: 01.27.2017

Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 170127-2

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of both the solid and liquid waste surrogates presented in Table 1, which also contains the methods performed on each of the blends. All surrogate blends were made in accordance to the scope of work revised on 01/26/17 with no deviations needed.

Table 1. Waste Surrogate analysis table

Surrogate ID	Times made	Methods	
		UN Ox solid (DOT 0.1)	UN Ox Liquid (DOT 0.2)
65% Ammonium Nitrate	1	*	1
65% Ammonium Nitrate – Zeo 1	1	1	*
65% Ammonium Nitrate – Zeo 2	1	1	*

*Testing not performed

DOT UN Oxidation testing

The solid blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the samples mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. If the burning time is less than the standard mixture, the burning times should be compared with those from packing group I or II or category I or II oxidizer, reference standards 3:2 and 2:3, by mass, of potassium bromated to cellulose, respectively. See Table 2 for classification. Table 3 presents the results for the reference standards. Tables 4 and 5 lists the comments the analyst noted for each of the two sample-to-cellulose ratio burns. All solid blends were classified as "Not Division 5.1" under the tested laboratory conditions.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 170127-2

Table 2. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	UN Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

Table 3. Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
118.07	51.33	18.65

Table 4. Comments for Sample to Cellulose ratio of 4:1

Sample ID	Comment 4:1
65% Ammonium Nitrate - Zeo 1	Sampled charred and smoked around the wire and produced a lot of smoke. Sparkling was observed throughout the analysis and a small flame was periodically present around the wire going into the sample on several of the runs.
65% Ammonium Nitrate - Zeo 2	Smoke and charring around the wire with sparkling periodically throughout the analysis.

Table 5. Comments for Sample to Cellulose ratio of 1:1

Sample ID	Comment 1:1
65% Ammonium Nitrate - Zeo 1	Flames formed and held throughout the analysis. Sparking and lots of smoke was also present. A blue flame formed on several of the runs and would quickly appear on the top surface of the sample. Flames continued to burn after power was turned off after 180 seconds.
65% Ammonium Nitrate - Zeo 2	Flames formed and the sample burned throughout the analysis. Flames continued to burn after power was turned off after 180 seconds.

DOT UN Liquid Oxidizer test

The 65% Ammonium Nitrate was tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1 Test O.2 Test for oxidizing liquid.* The test method measures the potential for a liquid substance to increase the burn

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 170127-2

rate or intensity mixed at a 1:1 ratio with fibrous cellulose. The mixture is heated in a pressure vessel and the rate of pressure rise is determined and pressure rise time is compared to three reference materials (50% perchloric acid, 40% sodium chlorate and 65% nitric acid) when also mixed at a 1:1 ratio with the cellulose. All standards were prepared on a weight to weight basis. The mean pressure rise of the reference substances are listed in Table 6 and the classifications are listed in the Table 7.

The 65% Ammonium Nitrate sample had a mean pressure rise time of 3.438 sec and was therefore classified as Packing Group III under the tested laboratory conditions.

Table 6. Reference Substances

Mean pressure rise time, sec		
(1:1) 50 % perchloric acid and cellulose	(1:1) 40% aqueous sodium chlorate and cellulose	(1:1) 65% nitric acid and cellulose
0.110	0.531	4.511

Table 7. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in a 1:1 mixture, by mass, of substance and cellulose tested, spontaneously ignites; or the mean pressure rise time of a 1:1 mixture, by mass, of substance and cellulose is less than that of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose.	Packing group I
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chlorate solution and cellulose; and the criteria for Packing group I are not met	Packing group II
Any substance which, in the 1:1 mixture, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose; and the criteria for Packing groups I and II are not met.	Packing group III
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a pressure rise of less than 2070 kPa gauge; or exhibits a mean pressure rise time greater than the mean pressure rise time of a 1:1 mixture, by mass, of a 65% aqueous nitric acid and cellulose.	Not Division 5.1

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."

Group Leader

2/15/17
Date

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 170127-2
SwRI SRR: 59039
SDG: 609624
VTSR: 01.27.2017

Wetchem Analyses

Sample Results

SOUTHWEST RESEARCH INSTITUTE

UN LIQUID OXIDIZER TEST O.2

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Liquid

Date Made: 01/27/17

SRR #: 59039

Task Order #: 170127-2

Reference Substances

Mean pressure rise time, sec		
(1:1) 50 % perchloric acid and cellulose	(1:1) 40% aqueous sodium chlorate and cellulose	(1:1) 65% nitric acid and cellulose
0.110	0.531	4.511

Test Substance

Sample ID	SwRI System ID	Mean pressure rise time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
65% Amonium Nitrate	609624	3.438	Packing Group III	02/03/17

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in a 1:1 mixture, by mass, of substance and cellulose tested, spontaneously ignites; or the mean pressure rise time of a 1:1 mixture, by mass, of substance and cellulose is less than that of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose.	Packing group I
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chloreate solution and cellulose; and the criteria for Packing group I are not met	Packing group II
Any substance which, in the 1:1 mixtuer, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose; and the criteria for Packing groups I and II are not met.	Packing group III
Any substance which, in a 1:1 mixture, by mass, of a substance and cellulose tested, exhibits a pressure rise of less than 2070 kPa gauge; or exhibits a mean pressure rise time greater than the mean pressure rise time of a 1:1 mixture, by mass, of a 65% aqueous nitric acid and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 01/27/17

SRR #: 59039

Task Order #: 170127-2

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
118.07	51.33	18.65

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
65% Ammonium Nitrate - Zeo 1	609626	>180	>180	Not Division 5.1	02/06/07
65% Ammonium Nitrate - Zeo 2	609625	>180	>180	Not Division 5.1	02/06/07

The test criteria for determining oxidizing properties of the substance are:	Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

LABORATORY CONTROL SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 21592.01.00X

Matrix: Solid

Date Made: 02/06/17

SRR #: 59039

Task Order #: 170127-2

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
95-142 sec	41-62 sec	15-22 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	115.06	54.44	21.25	02/06/17

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SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 170127-2
SwRI SRR: 59039
SDG: 609624
VTSR: 01.27.2017

UN Oxidizer

Raw Data

Southwest Research Institute

UN Test O.2: Test for Oxidizing liquids

Client: LANL
Project #: 21592.01.006
TO#: 170127-2

Analyst: James Moken
Date: 02/03/17

Standardization	
50% (w/w) HCLO4	Time, sec
1	0.114
2	0.101
3	0.127
4	0.107
5	0.103
avg	0.110
40% (w/w) NaCLO3	Time, sec
1	0.602
2	0.341
3	0.538
4	0.608
5	0.568
avg	0.531
65% (w/w) HNO3	Time, sec
1	4.377
2	4.290
3	4.706
4	4.510
5	4.671
avg	4.511

Standard Verification

STD	Time, sec		
40% (w/w) NaCLO3	0.516	02/03/17	97.1%
65% (w/w) HNO3	4.368	02/03/17	96.8%

Sample Results

65% NH4NO3	Time, sec	Classification
1	3.268	
2	3.369	
3	3.211	
4	3.252	
5	4.092	
avg	3.438	Packing Group III

010017

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 170127-2

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0065	21.0089	115.06	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**			115.06	95-142 sec
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0099	18.0279	54.44	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**			54.44	41-62 sec
Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0100	12.0094	21.25	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**			21.25	15-27 sec

Weighted Samples: James Moken Balance#: 135 Date: 2/6/17
Tested Samples: James Moken Timer ID: 022921 Date: 2/6/17
Potassium Bromate: Inorg# 69450 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 75298 Dried: ≥4hrs. @ 105°C
Variac Setting: 130 ± 7 Watts CLSHM 2/9/17

010018

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 170127-2

Sample Analysis

System ID: 6096626 65% Ammonium nitrate Zeol (2:1)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0076	6.0091	183.44	Sample charred and the wire and produced a lot of smoke. Sparkling observed throughout and small flame observed
4:1	2	24.0172	6.0033	183.04	Sample charred and produced a lot of smoke. Sparkling and a small flame was observed where wires entered the sample.
4:1	3	24.0002	6.0084	182.78	Sample charred and smoked a lot, sparkling occured throughout analysis. no flame
4:1	4	24.0168	6.0028	185.24	Sample charred and sparkled throughout analysis. Also lots of smoke was produced, no flame.
4:1	5	24.0068	6.0058	182.72	Sample charred and sparked throughout analysis. lots of smoke and small periodic flame.
4:1	Avg			>180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0050	15.0045	186.69	Flame formed and held throughout analysis. sparkling and lots of smoke. Blue flame over surface observed throughout min
1:1	2	15.0182	15.0219	238.38	Flame formed and propagated across sample during analysis violet sparkling. Power turned off @ 180 sec.
1:1	3	15.0110	15.0177	192.19	Flame formed and held throughout the analysis. sparkling and smoke.
1:1	4	15.0145	15.0072	200.81	Flame formed and propagated across sample. sparkling and excessive smoke formed.
1:1	5	15.0191	15.0048	186.60	flame formed and propagated across sample sparkling and smoke formed
1:1	Avg			>180	Blue flame would appear and disappear during initial first minute of analysis.

*Power turned off @ 180 sec and wire stopped when flame went out

Weighted Samples: James Moken Balance#: 135 Date: 2/6/17
Tested Samples: James Moken Timer ID: 022921 Date: 2/6/17
Sample Dried ? YES (NO) Dried: NA
Cellulose: Inorg# 75298 Dried: >4hrs.@105C
Variac Setting: 180 ± 7 Watts

Classification: NOT Division 5.1

Southwest Research Institute

Method: UN Oxidizer
Project #: 21592.01.006
Client: Los Alamos
TO# 170127-2

Sample Analysis

System ID: 609625 65% Ammonium Nitrate - Zeo 2 (3:1)

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0074	6.0080	184.19	smoke, charring around the wire, sparklers throughout the test period
4:1	2	24.0153	6.0068	183.85	Smoke, charring around wire, sparkling throughout analysis.
4:1	3	24.0046	6.0011	183.40	Smoke, charring around wire, violent sparking throughout analysis
4:1	4	24.0091	6.0043	183.82	Smoke, charring around wire, sparkling throughout analysis
4:1	5	24.0121	6.0035	187.97	Smoke, charring around wire, periodic sparkling
4:1	Avg			>180.	Chose central area but no event took place small flame at entrance of wire into the sample periodically slowly smolder after analysis

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0035	15.0032	187.63	Flames formed at the entrance of the wires into the sample and propagated throughout the analysis power turned off @ 180sec
1:1	2	15.0197	15.0035	212.78	Flames appeared across the sample and burned throughout analysis power turned off at 180sec and time stopped when flame went out
1:1	3	15.0106	15.0024	215.60	Flames propagated across the sample throughout the analysis power turned off at 180sec and time stopped when flame went out
1:1	4	15.0098	15.0047	273.25	flames propagated throughout analysis and lasted well after the power was turned off at 180sec
1:1	5	15.0108	15.0181	213.84	flame propagated around wire throughout analysis
1:1	Avg			>180	

Weighted Samples: James Moken Balance#: 135 Date: 2/6/17
Tested Samples: James Moken Timer ID: 022921 Date: 2/6/17
Sample Dried ? YES / NO Dried: NA
Cellulose: Inorg# 75298 Dried: >4hrs.@105C
Variac Setting: 150 ± 7 Watts 2/9/17 SHM

Classification: Not Division 5.1

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 170127-2
SwRI SRR: 59039
SDG: 609624
VTSR: 01.27.2017

Preparation Logbook Pages

Book I.D. 16-0406-001

Book/ Page : 13 0081 **010021**

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: UV oxidation Liquid Project# 21592.01.006

Client: LANL TO# 170127-2

LCS Info: TV= Balance#: 135

Notes: 65% HNO_3 66-01-WC013

50% perchloric 66-02-WC013

40% sodium chlorate 66-03-WC013

Sample ID	cellulose wgt	sample wgt			
40% sodium chlorate	2.5082	2.5071			
65% HNO3	2.5072	2.5076			
609624-1	2.5084	2.5104			
609624-2	2.5099	2.5037			
609624-3	2.5056	2.5127			
609624-4	2.5068	2.5082			
609624-5	2.5019	2.5037			

SAM 2/3/17

SAM 2/3/17

Calculation:

Analyst Signature: Date: 2/3/17

Reviewed by: Date: 2/10/17

82 TITLE LANL

21592.01.006 PROJECT NO. —

BOOK NO. 16-0406-023

SWRI

Work continued from Page

82-01-WCS13 - 65% ammonium nitrate w/w

650.07 g ammonium nitrate (# 72340) to 350.01 g DI H_2O

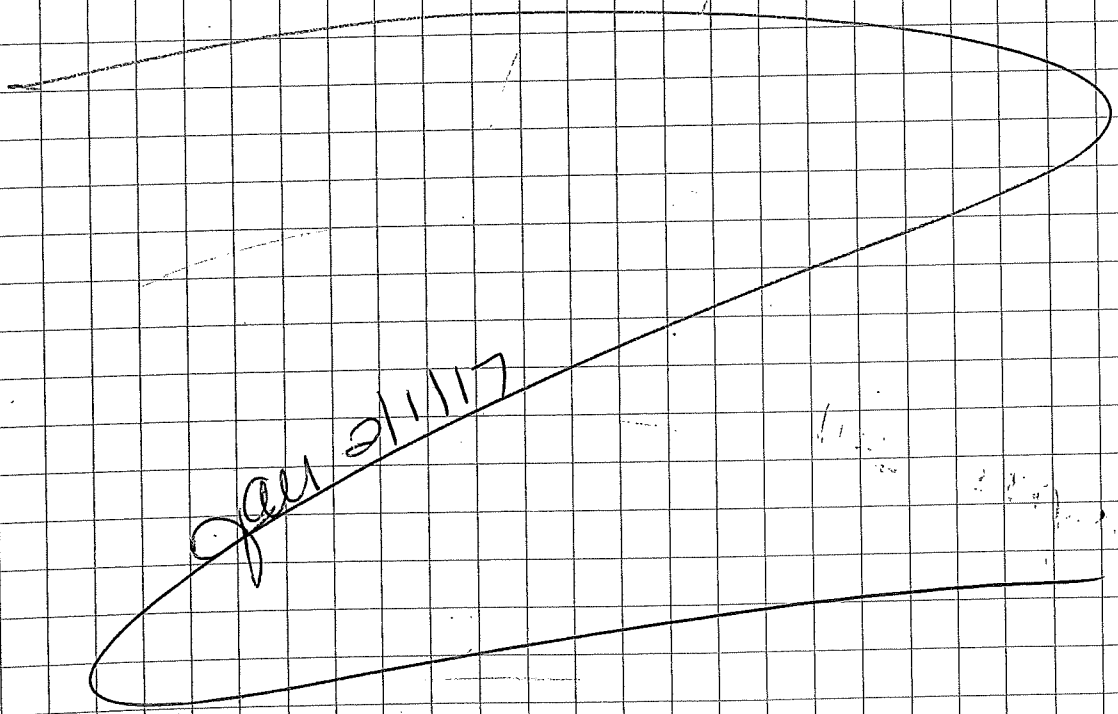
balance # 05 exp. 1/27/18

82-02-WCS13 65% ammonium nitrate - zeo1

200mL waste (82-01-WCS13) to 400mL zeolite

82-03-WCS13 65% ammonium nitrate zeo2

200mL waste (82-01-WCS13) to 600mL zeolite



Work continued to Page

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SIGNATURE

DATE 1/24/17

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE 2/1/17

66 TITLE LANL

PROJECT NO. 21592.01.006

BOOK NO. 16-0406-023

SWRI

Work continued from Page

66-01-WCS13 - 65% HNO_3 (#34444)

23.5507 g HNO_3 to FW 25.0009 g with DI H_2O
balance #135 exp 12/12/17

66-02-WCS13 - 50% perchloric acid

17.8575 g perchloric acid (#61372) to FW ~~25~~ 25.0021 g with DI H_2O
balance #135 exp 12/12/17 redone 12/12/16

66-03-WCS13 - sodium chlorate 40%

9.0017 g sodium chlorate (# 26268) to FW 22.5004 g DI H_2O
balance #135 exp 12/12/17

66-04-WCS13 - 45% sodium nitrate

13.5004 g sodium nitrate (#70579) to FW 30.0025 g with DI H_2O
balance #135 exp 12/12/17

66-05-WCS13 pH adjusted saturated 1M HNO_3 with sod Nit

25mL of 1M HNO_3 saturated (33-04-WCS13) + spitfyter (# 65915) to pH 7.27.
Exp. Soccer exp 12/12/17

DAM 12/14/16

www.scientificbindery88yrs.com

Work continued to Page

SIGNATURE [signature] DATE 12/12/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 12/14/16

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 170127-2
SwRI SRR: 59039
SDG: 609624
VTSR: 01.27.2017

Certificates of Calibration

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	47078
Asset Number:	022921	Calibrated:	2/19/2016
Description:	TIMER	Calibration Due:	2/19/2017
Manufacturer:	FISHER SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	14-649-55	Temp./RH:	73.6°F / 40 %
Serial Number:	80494146	Work Order #	403137429
Calibration Procedure:	STOPWATCHES & TIMERS		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009759	FLUKE	910R	RUBIDIUM GPS FREQUENCY STA	12/3/2019

Approved By

Calibrated By: CER
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403137429	Mfr.	Fisher Scientific	Technician	CER
Asset No.	022921	Model	14-649-55	Type Data:	Found/Left
Serial No.	80494146	Type.	Timer	Cal Date.	19-Feb-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Time Interval	Seconds	Seconds	Seconds	Seconds	Seconds		
	11160	11159	-1	2	1.2	Pass	50%
	12960	12959	-1	2	1.2	Pass	50%

END OF REPORT

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	55298
Asset Number:	009065	Calibrated:	6/24/2016
Description:	BALANCE	Calibration Due:	6/24/2017
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	PR2003DR	Temp./RH:	71 °F / 54 %
Serial Number:	1120351000	Work Order #	403140638
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001711	TROEMNER	50 G	WEIGHT CLASS 1	7/2/2016
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	9/30/2016
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/13/2017
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/8/2016
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/6/2017
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/6/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403140638	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	24-Jun-16
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Left Front	1000	1000.000	0.000	0.006	Pass	0%
Left Rear		1000.000	0.000		Pass	0%
Right Rear		1000.000	0.000		Pass	0%
Right Front		1000.000	0.000		Pass	0%
Repeatability						
500 gram Range						
1	200	200.000				
2		200.001				
3		200.002				
4		200.000				
5		200.000				
6		200.001				
7		200.002				
8		200.000				
9		200.001				
10		200.000				
Std Deviation		0.0008		0.0020	Pass	40%
2000 gram Range						
1	1000	1000.00				
2		1000.00				
3		1000.00				
4		1000.00				
5		1000.00				
6		1000.00				
7		1000.00				
8		1000.00				
9		1000.00				
10		1000.00				
Std Deviation		0.000		0.006	Pass	0%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
500 gram Range	0.000	0.000	0.000	0.004	0.0018	Pass	0%
	50.000	50.000	0.000			Pass	0%
	100.000	100.001	0.001			Pass	25%
	150.000	150.001	0.001			Pass	25%
	200.000	200.001	0.001			Pass	25%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403140638	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	24-Jun-16

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing *(cont.)*	grams	grams	grams	grams	grams		
500 gram Range	250.000	250.001	0.001	0.004	0.0018	Pass	25%
	300.000	300.001	0.001			Pass	25%
	350.000	350.001	0.001			Pass	25%
	400.000	400.000	0.000			Pass	0%
	450.000	450.000	0.000			Pass	0%
	500.000	500.000	0.000			Pass	0%
Direct Weighing	0.00	0.00	0.00	0.01	0.012	Pass	0%
2000 gram Range	200.00	200.00	0.00			Pass	0%
	400.00	400.00	0.00			Pass	0%
	600.00	600.00	0.00			Pass	0%
	800.00	800.00	0.00			Pass	0%
	1000.00	1000.00	0.00			Pass	0%
	1200.00	1200.00	0.00			Pass	0%
	1400.00	1400.00	0.00			Pass	0%
	1600.00	1600.00	0.00			Pass	0%
	1800.00	1800.00	0.00			Pass	0%
	2000.00	2000.00	0.00			Pass	0%

END OF REPORT

010030

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	54947
Asset Number:	011992	Calibrated:	6/20/2016
Description:	WEIGHT ULTRA CLASS	Calibration Due:	6/20/2017
Manufacturer:	TROEMNER	Data Type:	FOUND / LEFT
Model Number:	2 KG	Temp./RH:	69 °F / 40 %
Serial Number:	07368	Work Order #	403139989
Calibration Procedure:	WEIGHTS		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
2 kg weight conventional mass value: 1 999.999 g. UNC ± 1.7 mg. Ultra Class Tol ± 3.0 mg.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
012070	SARTORIUS	CC10000	MASS COMPARATOR	12/29/2016
012761	TROEMNER	2 KG *	WEIGHT CLASS E1	6/10/2018

Authorized Signatory

Calibrated By: RRV
Metrology Technician

010031

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	62044
Asset Number:	011999	Calibrated:	10/24/2016
Description:	WEIGHT ULTRA CLASS	Calibration Due:	10/24/2017
Manufacturer:	TROEMNER	Data Type:	FOUND / LEFT
Model Number:	2 G	Temp./RH:	67 °F / 42 %
Serial Number:	1000033133	Work Order #	403143065
Calibration Procedure:	WEIGHTS		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
Conventional mass value of the 2 g weight is: 2000.003 1 mg. Unc ± 0.004 5 mg. Ultra CL Tol ± 0.02 mg.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
012067	SARTORIUS	CC6	MASS COMPARATOR	12/29/2016
012750	TROEMNER	2 G *	WEIGHT CLASS E1	6/10/2018

Authorized Signatory

Calibrated By: RRV
Metrology Technician

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 170127-2
SwRI SRR: 59039
SDG: 609624
VTSR: 01.27.2017

Certificates of Analysis for Chemicals

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

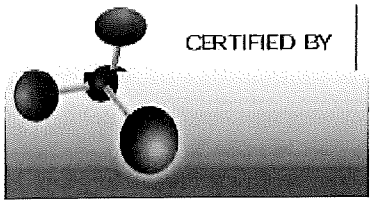
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

This is to certify that units of the lot number below were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	**A676**	**Quality Test / Release Date**	**2/25/2016**
Lot Number	**160507**		
Description	**AMMONIUM NITRATE, A.C.S.**		
Country of Origin	**Mexico**	*** Suggested Retest Date**	**Feb-2021**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless to white granules
ASSAY	%	>= 98.0	99.9
CHLORIDE	ppm	<= 5	<5.0
HEAVY METALS (as Pb)	ppm	<= 5	<5.0
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
IGNITION RESIDUE	%	<= 0.01	0.006
INSOLUBLE MATTER	%	<= 0.005	0.004
IRON (Fe)	ppm	<= 2	<2.0
NITRITE (NO2)	ppm	<= 5	<5.0
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 4.5 - 6.0	4.9
PHOSPHATE (PO4)	ppm	<= 5	<5.0
SULFATE (SO4)	%	<= 0.002	<0.0020



Quality Control Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 72340
SwRI Chem ID: 72340
SwRI Chem ID: 72340

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 21592.01.00X
SwRI TASK ORDER: 170127-2
SwRI SRR: 59039
SDG: 609624
VTSR: 01.27.2017

Balance
Verification Log

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.# 16-0406-028

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
1-23-17	KE	1999.94	1.999
1-24-17	KE	1999.94	2.000
1-25-17	KE	1999.94	2.000
1-26-17	KE	1999.93	1.999
1/27/17	JAM	1999.92	2.000
1-30-17	KE	1999.91	2.000
1-31-17	KE	1999.92	2.001
2-1-17	KE	1999.93	2.000
2-2-17	JK	1999.92	1.999
2-3-17	JK	1999.91	2.000
2-6-17	KE	1999.95	2.000
2-7-17	KE	1999.95	2.000
2-8-17	KE	1999.94	1.999
2-9-17	KE	1999.92	1.999

Comments:

Appendix T
SwRI Test Report, May 17, 2017

SOUTHWEST RESEARCH INSTITUTE®

6220 CULEBRA ROAD 78238-5166 • P.O. DRAWER 28510 78228-0510 • SAN ANTONIO, TEXAS, USA • (210) 684-5111 • WWW.SWRI.ORG

CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

May 17, 2017

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Victor Garde

Subject:		
	SwRI Project Number:	19869.01.00X
	SDG:	615200
	SwRI Task Order Number:	170511-1
	SwRI Sample Receipt Number:	59663
	Samples Received:	05.05.2017
	Analysis:	Cheesecloth-UNS Surrogate Solution Blends

Dear Mr. Garde,

Please find the enclosed results for the two overall samples received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Principal Scientist

APPROVED:

Michael J. Dammann
Director

RPS: jz

Cc: Anya Gonzales, Los Alamos National Laboratory

Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170511-1
SwRI SRR: 59663
SDG: 615200
VTSR: 05.05.2017

Chain-of-Custody
&
Sample Receipt Paperwork

Total Page Count: 010001 -
Fraction: Cheese Lab Testing Pages: 010116

010002

General Sample Chain of Custody

Ver (8/25/2011)

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

SRR #:	59663	Thermometer:	021056
Project	19869.01.00X	Temperature:	22.0
CASE:	D. Cline	Airbill #:	712428243255
Customer:	Los Alamos National Laboratory	Logged in by:	SDOUGLAS
Samples Received:	May 5 2017 9:20AM	Logged in:	May 5 2017 9:21AM
Manager:	DAMMANN, MIKE		
Disposal Instructions:	Contact project manager for disposal authority.		

System ID	Customer ID	CED	Matrix	# Cont	Special Requirements	Sample Condition
615070	Cheesecloth #2050		Solid	1		Intact

Reliquished by (Print/Signature): FedEx	Date 5/5/2017	Time 0920
Received by (Print/Signature): Steven Douglas	Date 5/5/2017	Time 0920
Reliquished by (Print/Signature):	Date	Time
Received by (Print/Signature):	Date	Time
Reliquished by (Print/Signature):	Date	Time

010003

Southwest Research Institute

Laboratory Task Order

TO #: 170511-1 Revision: 0

Project(s): 19869.01.00X
Manager(s): DAMMANN, MIKE
To Client: 05/16/17

SDG: 615200

SRR #'s: 59663
Client(s): Los Alamos National Laboratory

Instructions

SW846:1030, Ignitability Ignitability of Solids
SW846:1050, Pyrophoric Solids Spontaneous Combustion
SW846:1040 or UN Oxidizer Solids Oxidizer solids

Preparations

Cheesecloth-UNS-Zeolite

Need to soak the cheesecloth (45 grams) in the "UNS Surrogate Solution" (recipe from the previous testing). Then let the soaked cheese cloth drip until it is no longer dripping. (note amount of solution absorbed g and ml).

Then process as follows:
Add approximately 0.7 qt. of water to tray
Soak cloth material in water for 1 min
Wring rag out into transfer tray
Add 4 qt. of zeolite to the transfer tray
Mix the zeolite and the liquid with a hand-mixing tool
Size reduce cloth material to approximately 1-in. squares
Mix the material into the zeolite with a hand tool for 60 s
Dry the resulting material to constant weight

Cheesecloth-UNS

Need to soak the cheesecloth in the "UNS Surrogate Solution" (recipe from the previous testing).Then let the soaked cheese cloth drip until it is no longer dripping. (note amount of solution absorbed g and ml)

Size reduce cloth material to approximately 1-in. squares
Dry the resulting material to constant weight

Documents Related to this task order: 220958[COC for SRR 59663], 220959[Paperwork for SRR 59663], 220985[]

Deliverables --> Hard Copy: -YES- EDD: no PDF: no

Test: COMB_1050 Holding: 180 days from CED
Section: WETCHEM — **SW846 1050 Test A & C Spontaneous Combustion** Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
615200		1	Solid	Cheesecloth-UNS	NO DATA	NO DATA
615201		1	Solid	Cheesecloth-UNS-Zeolite	NO DATA	NO DATA

Test: IGNIT_1030 Holding: 180 days from CED
Section: WETCHEM — **SW 846 Method 1030 Ignitability of solids** Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
615200		1	Solid	Cheesecloth-UNS	NO DATA	NO DATA
615201		1	Solid	Cheesecloth-UNS-Zeolite	NO DATA	NO DATA

Test: OXIDIZING_1040 Holding: 180 days from CED
Section: WETCHEM — **SW846 Method 1040 for Oxidizing Solids** Cnt: 2

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
615200		1	Solid	Cheesecloth-UNS	NO DATA	NO DATA

Southwest Research Institute

Laboratory Task Order

TO #: 170511-1 Revision: 0

Project(s): 19869.01.00X
Manager(s): DAMMANN, MIKE
To Client: 05/16/17

SDG: 615200

SRR #'s: 59663
Client(s): Los Alamos National Laboratory

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
615201		1	Solid	Cheesecloth-UNS-Zeolite	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

Project: 19869.01.00X
Case #: D. Cline
Client: Los Alamos National Laboratory

Sample Receipt Number: 59663
Revision: 1

This Receipt was Revised 05/08/2017

VTSR: 05/05/17

Time: 09:20:00
Manager: DAMMANN, MIKE
Logged in by: SDOUGLAS
Creation Date: 05/05/17

Notes

Sample was delivered intact. (no ice).

Fed Ex #(s):
712428243255 - 22.0 °C

See Task Order for full requirements.

See chain of custody as part of the SRR system for more information.

Phases:
001 - admin
006 - metals/radchem
007 - drg

Rev. 1
Added samples per J. Moken see email.

Backaround CPM: <150 cpm
Container Wipe CPM: <150 cpm
Total CPM: <150

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
615070	Cheesecloth #2050		Solid	1	
615200	Cheesecloth-UNS		Solid	1	
615201	Cheesecloth-UNS-Zeolite		Solid	1	

Containers: 3 **Samples: 3**

These documents are associated with this receipt: 220958[COC for SRR 59663], 220959[Paperwork for SRR 59663], 220985[]

Thermometer: 021056
Temperature: 22.0

Page Printed: 05/08/2017 11:03
ver: (4/10/2017)

59663 Los Alamos National Laborato

010006

Southwest Research Institute

Traffic Report

Sample Custodian Signature: _____

1. Custody Seal — Not Present or Damaged
2. Chain of Custody — Not Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

N/A

Client: Los Alamos National Laboratory

Project: 19869.01.00X

Case: D. Cline / SDG: SEE T.O.

Sample Receipt: 59663

Airbill: 712428243255

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
05/05/17	09:20:00	SwRI COC	Cheesecloth #2050	N/A	615070	YES	Intact
05/05/17	09:20:00	SwRI COC	Cheesecloth-UNS	N/A	615200	YES	Intact
05/05/17	09:20:00	SwRI COC	Cheesecloth-UNS-Zeolite	N/A	615201	YES	Intact

SAMPLE LOG-IN SHEET

010007

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): STEVEN DOUGLAS	Log-in Date: 05/05/2017
Received By (Signature):	
Case Number: D. Cline	Sample Delivery Group No.: N/A
Remarks: 19869.01.00X	SAS Number: N/A

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present/Absent*	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	712428243255	
7. Sample Tags	Present/Absent*	
Sample Tag Numbers	Listed/Not listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/Leaking N/A	
9. Cooler Temperature	22.0C	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	05/05/2017	
12. Time Received	09:20:00	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Cheesecloth #2 050	N/A	615070	Intact
Cheesecloth-UNS	N/A	615200	Intact
Cheesecloth-UNS-Zeolite	N/A	615201	Intact

Sample Transfer		
Fraction: INORG	Fraction	
Area #: CABINET	Area #	
By: STEVEN DOUGLAS	By	
On: 05/05/2017	On	

* Contact SMO and attach record of resolution

Reviewed By: 5.8.17	Logbook No.: Sample Receipt (59663)
Date	Logbook Page No.: 9811 SEC 1 OF 2

010008

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170511-1
SwRI SRR: 59663
SDG: 615200
VTSR: 05.05.2017

Item Receipt

Record of Sample Discrepancy

Discrepancy Entry: 2590
Sample Receipt: 59663
Sample(s): Various
Project: 19869.01.00X
Client: Los Alamos National Laboratory
Manager: SPIES, RADONNA
Initiator: SDOUGLAS

SDOUGLAS 5/5/2017 2:51:28 PM	Samples were received with no client chain of custody. An internal COC was created.
New Information	Submit

010010

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170511-1
SwRI SRR: 59663
SDG: 615200
VTSR: 05.05.2017

Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170511-1

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of the solid waste surrogates presented in Table 1, which also contains the methods performed on each of the blends. All surrogate blends were made in accordance to the directions provided in email directly from Los Alamos. Samples took several days to dry to a constant weight with the Cheesecloth-UNS sample taking almost a week. The weight and volume of UNS solution absorbed by the Cheesecloth can be found in Table 2.

Table 1. Waste Surrogate analysis table

Surrogate ID	Times made	Methods		
		1030	1050	UN Ox solid (DOT 0.1)
Cheesecloth-UNS	1	1	1	1
Cheesecloth-UNS-Zeolite	1	1	1	1

*Testing not performed

Table 2. Weight and Volume of UNS solution absorbed by Cheesecloth

Customer ID	Tests	Cheesecloth wgt (g)	Weight of UNS absorbed (g)	Volume of UNS absorbed (mL)	Milliliters of UNS absorbed per gram of cheesecloth
Cheesecloth-UNS	1050	133.739	1195.15	848	6.34
Cheesecloth-UNS	1030 & UN Ox	104.003	914.92	649	6.24
Cheesecloth-UNS-Zeolite	All	45.626	406.83	289	6.32

SW-846 1030: Ignitability of Solids

In this test, an ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within 2 minutes. If the material combustion propagates, the burning time was measured over a distance of 100 mm and the rate of burning would be determined. The surrogate material was formed into an unbroken powder train, 250 mm in length atop a ceramic tile with marks at the 80 and 180 mm in from the end of the train. The ceramic tile was placed about 8 inches in a hood with the sash lowered to give airflow of about 0.7 m/sec. One end of the train was exposed to the end of an acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes and if the sample began to burn down the train the time taken to get from the 80 to 180 mm mark was measured to determine the burn rate.

The Cheesecloth-UNS-Zeolite blend saw the cloth portions of the samples burn but the zeolite prevented any propagation past the burn zone. The Cheesecloth-UNS sample was run both as prepared and at a reduced particle size with the sample being broken up and passed through a #4 sieve. Both forms of the material acted identically to each other. The firm and hard sample would shrivel slightly and then begin to turn white and grey in color with slight periodic popping sounds

(Image 1). No flames or propagation was observed during the testing. After testing, it was noticed that the burn area was moist and sticky even though it began as crisp and firm. Since the propagation of the flame did not occur on any of the samples they are both considered to be nonflammable under the laboratory test conditions.

SW-846 1050: Spontaneous combustion and self heating

In this test, the surrogates for this analysis were first sprinkled several times onto a ceramic tile to observe if they smoked or flamed and could be considered pyrophoric solids by test Method A. Since none of the samples exhibited these characteristics, they were tested by Method C. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200 °C within the 24 hours. If the results of the preliminary test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 3.

Table 3. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cube was placed into an oven with two thermocouples measuring the oven temp and up to four thermocouples inserted into each sample to measure its temperature during the analysis. Lids were placed onto the top of the test cubes and tungsten weights were placed on top of those samples believed to potentially have an event in order to keep the thermocouples and lids from coming off the sample. Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for 24-48 hours depending on when the sample reached a stable temperature. Although the method states testing to be conducted for 24 hours, the Cheesecloth-UNS-Zeolite sample did not reach 140°C ± 2°C until late in the initial 24 hour period; therefore, the testing was extended to a minimum of 12 hours after the sample had reached a stable temperature. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C during the time of testing. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample. The oven and sample temperature graphs are located in Attachment A.

Since previous samples having similar combinations of waste and zeolite did not self-heat, the Cheesecloth-UNS-Zeolite sample was analyzed in duplicate simultaneously using two 100mm cube. The sample and duplicate ran for 35 hours before the testing was terminated. Upon removal the towel portion of the sample had browned but the zeolite appeared as if it had been dried. The sample was also still loose with no visible clumping. Since no reaction appears to have occurred the sample was deemed to not be a self-heating waste under the laboratory conditions.

The Cheesecloth-UNS sample was initially run in the 100mm cube. Thirty minutes into the analysis it was noticed that brown colored smoke was coming out of the back vent on the oven. It was not until around two hours and fifteen minutes into the analysis did an event take place. At this time, all four of the sample thermocouples rose in temperature to a max of 619°C. This temperature spike

lasted for an hour before the thermocouple returned to 140°C. The heat from this event caused the oven temperature to rise up to 160°C. When removed from the oven it was noted that the sample volume was reduced in half, the sample was very brittle and crumbled easily, and there were signs of burning present (Image 2). Testing proceeded to the 25mm cube which was performed in duplicate. During this testing the samples came to temperature very quickly and remained at temperature for the duration of the testing. When removed from the oven the samples had browned and become slightly more brittle than when they began (Image 3). Since an event occurred in the 100mm cube but not in the 25mm cube, the sample is categorized as a DOT Packing Group III under the laboratory conditions.

DOT UN Oxidation testing

The surrogate solid blends were tested in accordance with the United Nations (UN) "Recommendations on the Transport of Dangerous Goods", Section 34, *Classification Procedures, Test Methods and Criteria Relating to Oxidizing Substances of Division 5.1.* The UN procedure assesses the relative hazard of oxidizing substances so that an appropriate classification for transport can be made. Tests are conducted on the samples mixed with dry fibrous cellulose in mixing ratios of 1:1 and 4:1, by mass, of sample to cellulose. The burning characteristics of the mixtures are compared with the standard 3:7 mixture, by mass, of potassium bromated to cellulose. If the burning time is less than the standard mixture, the burning times should be compared with those from packing group I or II or category I or II oxidizer, reference standards 3:2 and 2:3, by mass, of potassium bromated to cellulose, respectively. See Table 4 for classification. Table 5 presents the results for the reference standards. Tables 6 and 7 lists the comments the analyst noted for each of the two sample-to- cellulose ratio burns. The Cheesecloth-UNS sample was analyzed as prepared and at a reduced particle size where the sample was passed through a #4 sieve prior to mixing with cellulose. Both material sizes produced the same results with one slight exception noted in the 1:1 sample ratio. Both Cheesecloth blends were classified as "Not Division 5.1" under the laboratory conditions.

Table 4. Oxidizer Classifications

The test criteria for determining oxidizing properties of the substance are:	UN Classification
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170511-1

Table 5. Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
123.75	62.56	20.08

Table 6. Comments for Sample to Cellulose ratio of 4:1

Sample ID	Comment 4:1
Cheesecloth-UNS	Charring around the wire and lots of brown smoke throughout analysis. Only one of the five runs produced a flame which held throughout the analysis.
Cheesecloth-UNS-Zeolite	Charring around the wire and on the pieces of cloth. Slight smoke but no flames.

Table 7. Comments for Sample to Cellulose ratio of 1:1

Sample ID	Comment 1:1
Cheesecloth-UNS	Charring around the wire. Several flames formed throughout the analysis with larger flames being present when the sample was not particle size reduced.
Cheesecloth-UNS-Zeolite	Low flames formed and burnt throughout and after power was turned off. Flames formed primarily around where the wire entered the sample pile.



Image 1: Appearance of the Cheesecloth-UNS sample after 1030 analysis.

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170511-1



Image 2: Appearance of the Cheesecloth-UNS sample after 100mm cube 1050 analysis.



Image 3: Appearance of the Cheesecloth-UNS sample after 25mm cube 1050 analysis.

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170511-1

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."

Principal Scientist

5/16/17
Date

010017

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170511-1
SwRI SRR: 59663
SDG: 615200
VTSR: 05.05.2017

Attachment A
Method 1050 Graphs

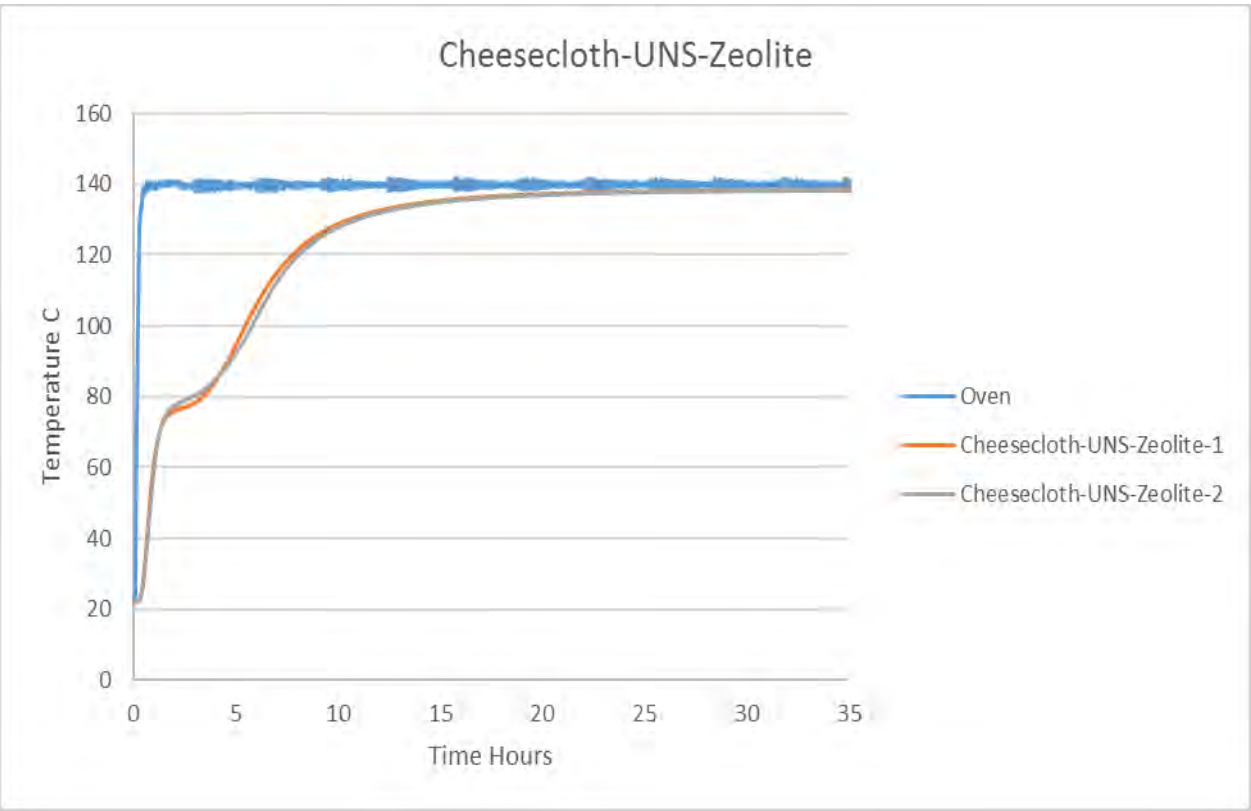


Figure 1. Method 1050 – Cheesecloth-UNS-Zeolite (100mm cube) full run.

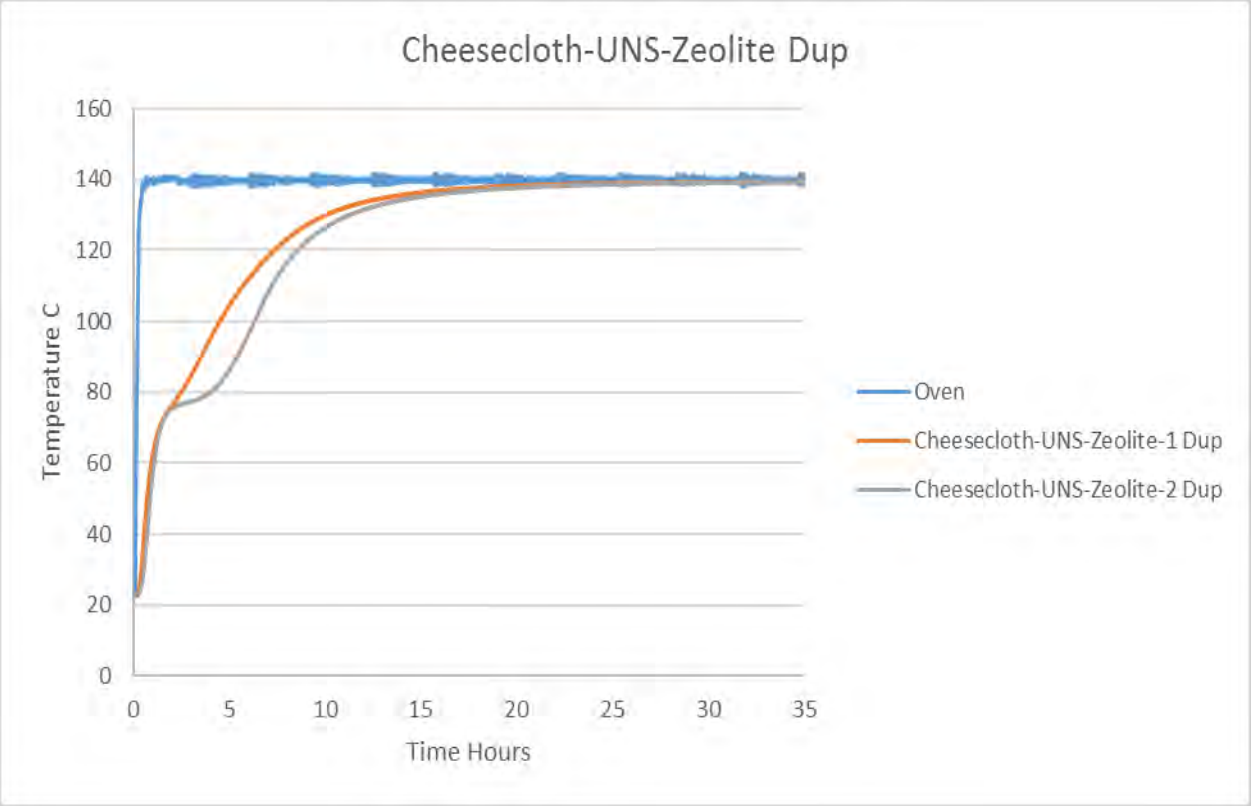


Figure 2. Method 1050 – Cheesecloth-UNS-Zeolite (100mm cube) full run duplicate.

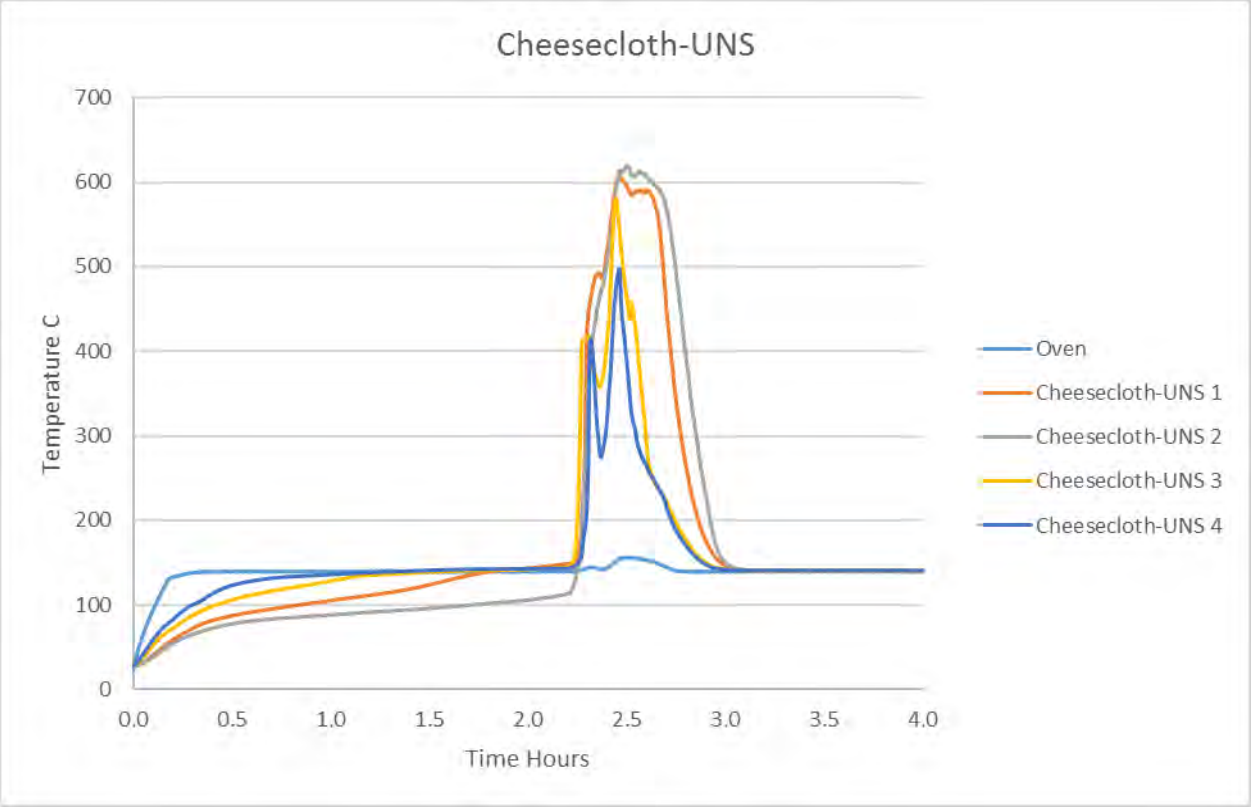


Figure 3. Method 1050 – Chesecloth-UNS (100mm cube) with event.

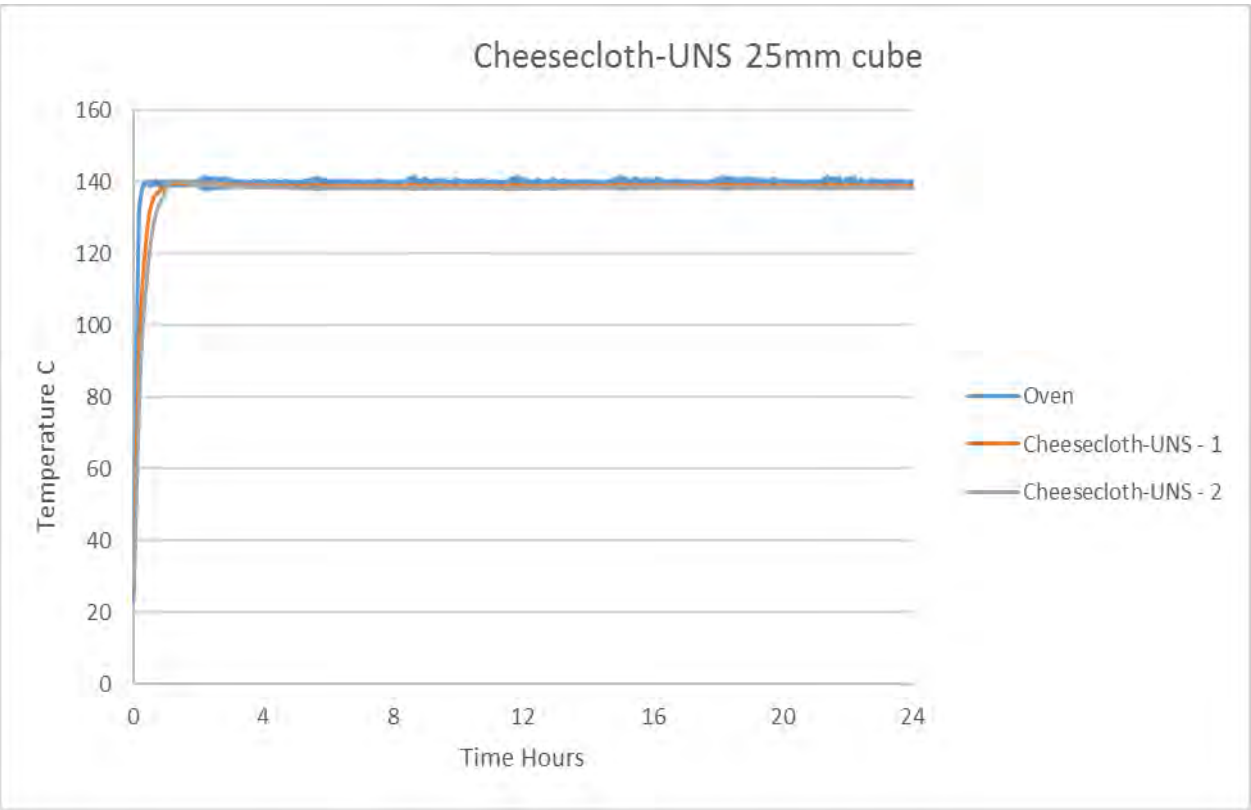


Figure 4. Method 1050 – Cheesecloth-UNS (25mm cube) full run.

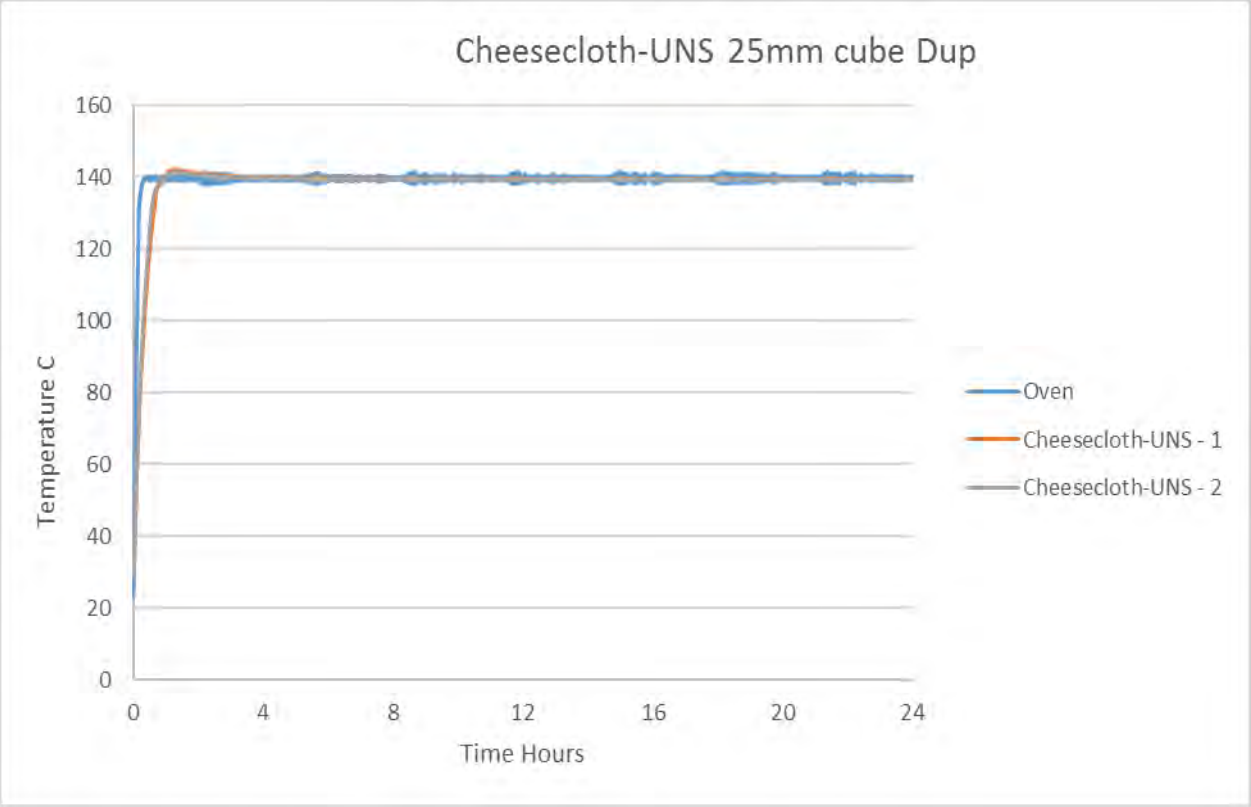


Figure 5. Method 1050 – Cheesecloth-UNS duplicate (25mm cube) full run.

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SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170511-1
SwRI SRR: 59663
SDG: 615200
VTSR: 05.05.2017

Sample Data Sheets

SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Solid

Date Made: 05/05/17

SRR #: 59663

Task Order #: 170511-1

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
Cheesecloth-UNS	615200	Nonflammable	05/11/17
Cheesecloth-UNS Dup	615200	Nonflammable	05/11/17
Cheesecloth-UNS-Zeolite	615201	Nonflammable	05/11/17
Cheesecloth-UNS-Zeolite Dup	615201	Nonflammable	05/11/17

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Solid

Date Made: 05/05/17

SRR #: 59663

Task Order #: 170511-1

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
Cheesecloth-UNS	615200	DOT Packing Group III	05/12/17
Cheesecloth-UNS-Zeolite	615201	Not a self-heating waste	05/10/17
Cheesecloth-UNS-Zeolite Dup	615201	Not a self-heating waste	05/10/17

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010024

SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Solid

Date Made: 5/5/17

SRR #: 59663

Task Order #: 170511-1

Potassium Bromate and Cellulose Reference Mixtures

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
123.75	62.56	20.08

Test Substance

Sample ID	SwRI System ID	Mean Burn Time, sec 4:1 Sample:Cellulose Ratio	Mean Burn Time, sec 1:1 Sample:Cellulose Ratio	Classification	Date Analyzed
Cheesecloth-UNS	615200	>180 .	>180	Not Division 5.1	05/11/17
Cheesecloth-UNS-Zeolite	615201	no reaction	>180	Not Division 5.1	05/10/17

The test criteria for determining oxidizing properties of the substance are:	**Classification**
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose.	Packing group I
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing group I	Packing group II
Any substance which, in the 4:1 or 1:1 sample-to-cellulose ration (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose; and which does not meet the criteria for packing groups I and II.	Packing group III
Any substance which, in both the 4:1 and 1:1 sample-to-cellulose ration(by mass) tested, does not ignite and burn, or exhibit mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.	Not Division 5.1

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SOUTHWEST RESEARCH INSTITUTE

UN OXIDIZER TEST

LABORATORY CONTROL SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Solid

Task Order #: 170511-1

SRR #: 59663

Acceptance Criteria for Daily Laboratory Control Samples

Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio
111 - 136 sec	56 - 69 sec	18 - 22 sec

Sample ID	Mean Burn Time, sec 3:7 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 2:3 $KBrO_3$:Cellulose Ratio	Mean Burn Time, sec 3:2 $KBrO_3$:Cellulose Ratio	Data Analyzed
LCS	124.09	65.90	21.74	05/11/17

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010026

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170511-1
SwRI SRR: 59663
SDG: 615200
VTSR: 05.05.2017

UN Oxidizer

Raw Data

Southwest Research Institute

010027

Method: UN Oxidizer

Project #: 19869.01.006 TEDAM 5/10/17

Client: TTC Los Alamos

TO# 170511-1

5/10/17

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

RSS 5/16/17 5/17/17 6

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0447	21.0328	120.38	
3:7	2	9.0563	21.0424	128.71	
3:7	3	9.0413	21.0262	122.62	
3:7	4	9.0242	21.0627	119.75	
3:7	5	9.0051	21.0492	127.28	
3:7	**Avg**			123.75	111.38 to 136.13

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0046	18.0125	58.68	
2:3	2	12.0188	18.0098	67.22	
2:3	3	12.0083	18.0078	66.82	
2:3	4	12.0080	18.0202	61.28	
2:3	5	12.0172	18.0055	58.79	
2:3	**Avg**			62.56	56.30 to 68.82

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0162	12.0094	22.87	
3:2	2	18.0059	12.0102	20.19	
3:2	3	18.0113	12.0328	17.22	
3:2	4	18.0070	12.0097	21.09	
3:2	5	18.0053	12.0416	19.03	
3:2	**Avg**			20.08	18.07 to 22.09 ~~16.06 to 24.10~~

TEDAM 5/10/17

Weighted Samples: James Moken Balance#: 135 Date: 5/10/17

Tested Samples: James Moken Timer ID: 023702 Date: 5/10/17

Potassium Bromate: Inorg# 62823 Dried: ≥12hrs. @65°C

Cellulose: Inorg# 75298 Dried: ≥4hrs. @ 105°C

Variac Setting: 150W

Southwest Research Institute

010028

Method: UN Oxidizer

Project #: 19869.01.006

Client: Los Alamos

TO# 170511-1

5/10/17

Sample Analysis

System ID: 6152201 UNS + cheesecloth + zeolite

5/16/17

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0050	6.0817	180.87	charring around wire and slight smoke from the cloth. No flames
4:1	2	24.0107	6.0286	180.41	charring around wire and cloth. No flames
4:1	3	24.0142	6.0204	180.57	charring around wire and cloth. No flames
4:1	4	24.0085	6.0398	180.22	charring around wire and cloth. No flames
4:1	5	24.0179	6.0217	180.34	charring around wire and cloth. No flames
4:1	Avg			>180	slight charring. No flames.

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0218	15.0107	256.97	low flame formed and burnt throughout analysis. power turned off at 180 seconds.
1:1	2	15.0155	15.0403	283.66	low flame formed where wire enter sample pile and burned around sample throughout analysis.
1:1	3	15.0053	15.0054	>300	low flame formed around wire and cloth and burned throughout analysis. Power turned off at 180 sec
1:1	4	15.0592	15.0023	232.41	low flame from around entry of wire into the sample charring and smoke around sample
1:1	5	15.0320	15.0091	194.84	low flame as wire enters the sample, charring around wire
1:1	Avg			>180	

Weighted Samples: James Moken Balance#: 135 Date: 5/10/17

Tested Samples: James Moken Timer ID: 023702 Date: 5/10/17

Sample Dried ? (YES) NO Dried: 50 to 55°C until constant weight

Cellulose: Inorg# 75298 Dried: >4hrs.@105C

Variac Setting: 150w

Classification: Not Division 5.1

Southwest Research Institute

010029

Method: UN Oxidizer
Project #: 19869.01.006
Client: Los Alamos
TO# 170511-1

5/11/17

5/16/17

Reference Substance

$KBrO_3$:Cellulose	Wt $KBrO_3$, g	Wt Cellulose, g
3:7	9	21
2:3	12	18
3:2	18	12

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:7	1	9.0074	21.0364	124.09	
3:7	2				
3:7	3				
3:7	4				
3:7	5				
3:7	**Avg**			124.09	

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
2:3	1	12.0099	18.0079	65.90	
2:3	2				
2:3	3				
2:3	4				
2:3	5				
2:3	**Avg**			65.90	

Ratio	Rep	Actual KBrO3 Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
3:2	1	18.0124	12.0227	21.74	
3:2	2				
3:2	3				
3:2	4				
3:2	5				
3:2	**Avg**			21.74	

Weighted Samples: James Moken Balance#: 135 Date: 5/11/17
Tested Samples: James Moken Timer ID: 023702 Date: 5/11/17
Potassium Bromate: Inorg# 62823 Dried: ≥12hrs. @65°C
Cellulose: Inorg# 75298 Dried: ≥4hrs. @ 105°C
Variac Setting: 150W

Southwest Research Institute 010030

Method: UN Oxidizer
Project #: 19869.01.006
Client: Los Alamos
TO# 170511-1

Sample Analysis

System ID: 615200

VR Spuls 5/16/17

Sample:Cellulose	Wt Sample, g	Wt Cellulose, g
4:1	24	6
1:1	15	15

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
4:1	1	24.0602	6.0067	184.64	Charring around wire, lots of nox smoke throughout test No Flame
4:1	2	24.0410	6.0305	180.49	charring around wire, lots of smoke throughout test No Flame
4:1	3	24.0080	6.0486	181.25	charring around wire, less of nox smoke throughout analysis. No Flame, particle size reduced
4:1	4	24.0723	6.0092	180.25	charring around wire and lost of nox smoke throughout analysis. No Flame, particle size reduced.
4:1	5	24.0095	6.0348	189.42	small flame formed and held throughout analysis power turned off @ 180 sec.
4:1	Avg			>180	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	15.0546	15.0077	>300	charring around wire
1:1	2	15.0119	15.0088	>300	charring around wire, Flame formed at entry of wire into sample held throughout analysis power turned off at 1/30 sec
1:1	3	15.0721	15.0214	192.09	Several flames formed and burned throughout analysis lots of smoke and charring around wire power turned off @ 1/30 sec
1:1	4	15.0750	15.0185	>300	same as prior two trials ①
1:1	5	15.0043	15.0420	>300	Ran without reduction in particle size, several large flames formed and held throughout analysis. power turned off at 1/30 sec
1:1	Avg			>180	same as other non reduced runs, ④ ① particle size reduced #4 sieve

forms sticky mound after analysis. particle sizing seemed to reduce the height of flames on 1:1 and how much sample burned

Weighted Samples: James Moken Balance#: 135 Date: 5/10 11 17 WD 5/10/17

Tested Samples: James Moken Timer ID: 023702 Date: 5/11/17

Sample Dried ? (YES) NO Dried: @ 50°C until constant weight

Cellulose: Inorg# 752548 Dried: >4hrs.@105C

Variac Setting: 150W

Classification: Not Division 5.1

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170511-1
SwRI SRR: 59663
SDG: 615200
VTSR: 05.05.2017

Preparation
Logbook Pages

010032

RDpts 5/16/17

Southwest Research Institute

Client LANL
Project # 19869.01.006
TO#: 170511-1

Date: 05/05/17
Analyst: Jmoken

Determination of the volume and weight of UNS absorbed by the Cheesecloth

Sample ID	Customer ID	Tests	Cheesecloth wgt (g)	Cheesecloth + UNS (g)	Wgt of UNS absorbed (g)	Bulk Density of UNS (g/mL)	Volume of UNS absorbed (mL)	Milliliters of UNS absorbed per gram of cheesecloth
615200	Cheesecloth-UNS	1050	133.739	1328.89	1195.15	1.41	848	6.34
615200	Cheesecloth-UNS	1030 & UN Ox	104.003	1018.92	914.92	1.41	649	6.24
615201	Cheesecloth-UNS-Zeolite	All	45.626	452.454	406.83	1.41	289	6.32

Determination of Constant weight for the Surrogate blends

Sample ID	Customer ID	Dates in and out of oven	Container wt (g)	Container + Sample (g)	Container + sample after drying (g)	Wt Change (%)	Time in oven hours	Wt Change % based on 4 hour drying cycle
615200	Cheesecloth-UNS	5/5/17 - 5/8/17	1268.09	2596.95	2029.42	74.5%	67.5	4.42%
		5/8/17 - 5/9/17	1268.09	2029.42	1972.95	8.01%	12.3	2.62%
	Sample portion for 1050	5/9/17 - 5/9/17	1268.09	1972.95	1961.85	1.60%	4	1.60%
		5/9/17 - 5/10/17	1268.09	1961.85	1931.92	4.51%	15	1.20%
		5/10/17 - 5/10/17	1268.09	1931.92	1925.03	1.05%	4	1.05%
		5/10/17 - 5/11/17	1268.09	1925.03	1900.48	3.88%	16	0.971%
		5/11/17 - 5/11/17	1268.09	1900.48	1897.75	0.434%	4	0.434%
615200	Cheesecloth-UNS	5/5/17 - 5/8/17	772.231	1791.11	1375.00	69.0%	67.5	4.09%
		5/8/17 - 5/9/17	772.231	1375.00	1328.93	8.28%	12.3	2.70%
	Sample portion for 1030	5/9/17 - 5/9/17	772.231	1328.93	1317.41	2.11%	4	2.11%
	and UN Oxidation	5/9/17 - 5/10/17	772.231	1317.41	1292.35	4.82%	15	1.28%
		5/10/17 - 5/10/17	772.231	1292.35	1286.33	1.17%	4	1.17%
		5/10/17 - 5/11/17	772.231	1286.33	1262.42	4.88%	16	1.22%
		5/11/17 - 5/11/17	772.231	1262.42	1259.79	0.539%	4	0.539%
615201	Cheesecloth-UNS-Zeolite	5/5/17 - 5/8/17*	1594.718	5710.06	5186.96	14.6%	67	0.869%
		5/8/17 - 5/8/17*	1594.718	5186.96	5173.33	0.381%	4.25	0.358%
	All aliquots mixed and added to one container	5/8/17 - 5/9/17	232.8	3803.4	3706.25	2.80%	12.25	0.913%
	Aliquot mixed	5/9/17 -5/9/17	232.8	3706.25	3689.96	0.471%	4	0.471%

*For Sample 615201 all sample containers and weights combined

Sample calc 615200 1030

Wgt of UNS absorbed = 1328.89 - 133.739 = 1195.15 g

Volume of UNS absorbed = 1195.15 / 1.41 = 848 mL

mL of UNS per gram of cheesecloth = $\frac{848 mL}{133.739 g}$ = 6.34 mL UNS/g cheesecloth

TODAM 5/16/17

Southwest Research Institute

010033

Specific Gravity / Bulk Density (Rev 0)

Controlled Electronic Benchsheet

5/16/17

Client: Los Alamos National Laboratory
Project #: 19869.01.006
TO# 170511-1
Method: ASTM 5057

Date: 05/05/17
Analyst: James Moken
Matrix: Solid / Liquid Sludge
Sig Figs: 3

LCS Source: Deionized Water TV = 0.998 g/mL

NOTES: Balance #135 was used.
UNS Solution #128-03-WCS12

Sample ID	W Container Empty (g)	R Container & DI H2O (g)	S Container & Sample (g)	BD or SG g/ml	%Rec %RPD
LCS	9.4028	19.3625	19.3572	0.999	100%
UNS Solution	9.4028	19.3625	23.4328	1.41	
UNS Solution D	9.4028	19.3625	23.4521	1.41	0.00%

Sample calculations; UNS solution

$$\frac{23.4328_g - 9.4028_g}{19.3625_g - 9.4028_g} = 1.4086 = \boxed{1.41\ g/mL}$$

ASG = (S-W)/(R-W)

Book I.D. 16-0406-001

Book/ Page : 13 0092 **010034**

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050 Project# 19869.01.006

Client: Los Alamos TO# 17051-1

LCS Info: TV= Balance#:

Notes:

Fluke temperature calibrator ID# 012017 Cal due 2/2018

Board # 18200-80 calibration ①TES 5/10/17

Sample ID / temperature °C	channel 0	channel 1 ①	channel 2 ①	channel 3 ①	channel 4	channel 5	Thermocouple
0°C	-0.1	0.1	0.3	0.4	0.5	0.6	0 = 023330 1 = 023428 2 = 023323 3 = 023372 4 = 023328 5 = 023374
50°C	50.0	50.1	50.3	50.5	50.5	50.6	
100°C	99.9	99.9	100.3	100.4	100.4	100.5	
150 ① ~~300~~ °C	150.0	149.9	150.4	150.5	150.5	150.6	
200 ① ~~150~~ °C	200.1	200.1	200.3	200.4	200.6	200.6	

5/10/17 UNS - towel - zeolite

0-1 = oven

2-3 = UNS - towel - zeolite

4-5 = UNS - towel - zeolite Dup

towel portions of the sample browned, but the zeolite appeared as a dry zeolite. No clumps or signs of a reaction

5/11/17 UNS - Chaparral

Nox being produced about 30 min into analysis

Sample event occured about 2-2.5 hrs into analysis

Sample had char bits and crumbled after removal from oven.

Started the 75mm cube testing in duplicate

Calculation:

Analyst Signature: Date: 5/10/17

Reviewed by: Date: 5/16/17

Book I.D. 16-0406-001

Book/ Page : 13 0093

010035

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1030 Project# 19869.01.006

Client: Los Alamos TO# 170511-1

#61753

LCS Info: excelsior wood TV= > 2.2mm/sec Balance#:

Notes:

thermocouple: #022943 Room temp 22.8°C TESAM 5/11/17

meter: # 022940 timer #023702

Sample ID	burn time (sec)	burn rate mm/sec	description		
LCS	18.06	5.53 mm/sec			
UNS-towel-zeolite	NO	—	clam in the zeolite burn area would burn but flame did not propagate down cloth past burn zone. Some cracking heard. zeolite was burned.		
UNS-towel-zeolite ①	NO	—			
UNS-towel not reduced	NO	—	sample would shrivel up and form a white and grey layer on the outside. some flames would form but no propagation was observed. Back side of the burn zone was		from ①
UNS-towel not reduced	NO	—			
UNS-towel reduced	NO	—	similar to the non reduced burns		
UNS-towel reduced	NO	—			
			① moist and the cloth near burn point had give from firm a hard to moist and mushy.		
		JAM	5/11/17		

Calculation:

Analyst Signature: Date: 5/11/17

Reviewed by: Date: 5/16/17

Southwest Research Institute
WC Sample Prep Logbook

010036

Book/Page: _22_ 00199_ Book I.D. # _14-0406-043_

Analysis: Sample prep / drying Project #: 19869.01.006
Method (circle) Digestion / Distillation / Extraction / Bomb Task Order#: 170511-1
Client: Los Alamos TAP#:

Balance ID: #89 SN# 014982 Pipette ID: 5000- E (TEDAM 5/15/17) 1000- / 200- /
Digestion Apparatus: NA Temperature: 50 to 55 °C
LCS ID: NA LCS TV = NA
Notes / Prep:

Sample ID	Sample Wt (g) / Sample Vol (ml)	Final Volume (ml)	wt after soaking	container 1 wt	container 2 wt	
Zeolite cheesecloth blend (Cheesecloths)	451.626g	soaked 452.454g →		535.837	529.664	initial
				2022.54	2208.96	container + sample
		wt soaked	container	1803.84	2022.38	container + dry sample
cube cheesecloth as is	133.739 92.742	1328.89	128.09	1796.68 (cont + samp TEDAM 5/15/17)	2016.73	container + dry sample
			2596.95 cont + samp			
			2029.42 cont + dry			
			1972.95 cont + dry			
			1961.85	container #3		
			1431.92	529.217	cont	
		1897.75	1925.03	1483.56	cont + sample	12:30 5/15 5/18 TEDAM
		soaked	1900.48	1360.74	cont + dry	
cheese cloths (1 or 2)	104.003	1018.92	772.281	1354.92		
			1791.11 cont + samp			
		in 5/15/17 16:30 out 5/18/17 12:00	1375.00 cont + dry	zeolite combined in one tray		
		in 11:00 5/18/17 out 6:15 5/19/17	1328.93 cont + dry	232.80g	container	
		in 8:30 5/19/17 out 12:30 5/19/17	1317.41	3803.40g	samp + cont 16.743	in 11:00 5/19 out 6:15 5/
		in 15:40 5/19/17 out 6:40 5/20/17	1292.35	3706.25g	samp + cont dry	in 8:30 5/ out 12:30 5/
		in 9:00 5/20/17 out 13:00 5/20/17	1286.33	3689.96		
		in 14:30 5/20/17 out 6:30 5/21/17	1262.42			
		in 8:30 5/15/17 (TEDAM 5/15/17) out 2:00 5/21/17	1259.79			

Analyst Signature: Date: 5/15/17
Reviewed by: Date: 5/16/17

128 TITLE Los Alamos

PROJECT NO. 21592.01.006/19869.01.004

BOOK NO. 75-0406-052

Work continued from Page

SWRI

128-01-WCS12 Nit B Zeo-1

600mL (124-04-WCS12) to 1200mL zeolite

let sit for 24 hr prior to analysis 5/15/16 10:10

128-02-WCS12 Nit B Zeo-2

600mL (124-04-WCS12) to 1800mL zeolite

128-03-WCS12 UNS solution

8322.851 g aluminum nitrate nanohydrate (# 69597-69592, 69573-69571, 69591-69586) +

840.695 g calcium nitrate (# 69606, 69607) +

61.562 g chromium nitrate (# 66141, 63857) +

595.084 g Iron (III) nitrate (# 63607, 65582) +

40008.600 g magnesium nitrate (# 69603, 69604) +

~~Sodium nitrate~~ 5/16/16

493.562 g sodium nitrate (# 69611) +

596.525 g lead nitrate (# 65951, 69629, 69623 +

2373.849 g oxalic acid (# 69684) +

2.310 g nickle nitrate (# 65593) +

63.727 g nitric acid (# 67843)

6500.17 g DI H2O

balance #89

Work continued to Page

www.scientificbindery88yrs.com

SIGNATURE

DATE 5/15/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabaldon

DATE

WITNESS

DATE 5/25/16

146 TITLE Los Alamos

PROJECT NO. 19869.01.006

BOOK NO. 16-0406-023

SWRI

Work continued from Page

146-01-WC513 Cheesecloth zeolite blend

weighed 45.626g cheesecloth SampleID # 615070

Soaked it in UNS solution 128-03-WC512 for 1 minute

Removed and Let drip until it was no longer dripping.

Soaked towels in 6623.4mL DI H2O for 1min. TOM 5/15/17

Wrung out towels and added in 3785mL zeolite to the water.

mixed by hand and then cut up towels and added to the zeolite. Mixed and then placed in oven to dry @ 50°C

Start: 12:30 5/15/17

Out: 7:00 5/18/17

1) towels still moist took out of trays and layed sheet by sheet on the trucks

2) zeolite blend looking dry

Zeolite in 10:00 oven 22 5/18/17

Out 14:15

146-02-WC513 cheesecloth - UNS

Soaked two seperate portions.

1st) 133.739 g cheese cloth soaked in UNS solution (128-03-WC512) for 1 minute. removed and let drip until it was no longer dripping. Dried to constant weight.

2nd) 104.008 g cheese cloth soaked in UNS solution (128-03-WC512) for 1 minute removed and let drip until it was no longer dripping. Dried to constant weight.

www.scientificbindery88yrs.com

Work continued to Page

SIGNATURE

DISCLOSED TO AND UNDERSTOOD BY

DATE 5/15/17

DATE 5/16/17

WITNESS

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170511-1
SwRI SRR: 59663
SDG: 615200
VTSR: 05.05.2017

Balance Verification Logs

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010040

Book I.D.: 17-0406-018

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN # 011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (g)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (g)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (g)
4/26/17	SAM	199.9997	1.99996	0.02002
4-27-17	KE	200.0000	1.99997	0.02000
9-28-17	JK	200.0001	1.99997	0.01999
4-29-17	AM	199.9998	2.01001	0.01998
5-1-17	KE	199.9997	1.99998	0.01998
5/2/17	JAM	199.9997	1.99999	0.02000
5/3/17	JAM	199.9996	1.99999	0.01998
5-4-17	KE	199.9996	2.00000 (1)	0.01998
5/5/17	JAM	199.9993	1.99996 (1)	0.02000
5/8/17	SAM	199.9997	2.00000 (1)	0.01997
5/9/17	SAM	199.9998	2.00000 (1)	0.02002
5/10/17	SAM	199.9999	2.00000 (1)	0.02000
5/11/17	SAM	199.9998	1.99995 (1)	0.01999
5-12-17	KE	199.9997	2.00000 (1)	0.01998
5/15/17	SAM	199.9998	1.99998 (1)	0.02000

5 TEAM 5/12/17

Comments: (1) used 2g # 11999 (1) 5-4-17 KE

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010041

Book I.D.#_11-0406-062_

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
89	014982	Mettler Toledo	XP5003S	Lab 24	2nd 3rd	5100 g 1000 g

Date	Operator	Asset# 015583 Std Wt. 5000 g Tolerance: 4999.50-5000.50 g ① Recorded Wt. (mg)	Asset# 015580 Std Wt. 100 g Tolerance: 99.990-100.010 g ① Recorded Wt. (mg)	Asset# 015584 Std Wt. 2 g Tolerance: 1.996-2.004 g ① Recorded Wt. (mg)
5/15/16	SAM	4999.97	99.998	1.998
5/18/16	SAM	4999.97	99.998	2.000
6/1/16	SAM	4999.97	99.998	1.999
6/3/16	SAM	4999.97	99.998	2.001
6/17/16	SAM	4999.98	99.998	2.001
6/20/16	SAM	4999.97	99.998	2.002
6/30/16	SAM	4999.97	99.998	2.000
7/7/16	SAM	4999.97	99.999	1.999
7/13/16	MG	4999.98	99.999	2.000
7/14/16	MG	4999.97	99.999	1.999
8/25/16	SAM	4999.97	99.998	1.999
10/11/16	SAM	4999.97	100.000	2.001
10/12/16	SAM	4999.98	99.999	2.001
11/11/16	JT	4999.94	99.997	1.998
11-22-16	KE	4999.97	100.000	2.000
12/7/16	SAM	4999.98	100.001	1.999
			3-28-17 KE	

2/15/17 QA RL

Comments:
① RSS 3/21/17 grams. END of book.

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010042

Book I.D.# 17-0406-017

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
89	014982	Mettler Toledo	XP5003S	Lab 24	2nd 3rd	5100 g 1000 g

Date	Operator	Asset# 015583 Std Wt. 5000 g Tolerance: 4999.50-5000.50 g Recorded Wt. (g)	Asset# 015580 Std Wt. 100 g Tolerance: 99.990-100.010 g Recorded Wt. (g)	Asset# 015584 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
4/25/17	SAM ①	4999.97	99.996	1.999
5/5/17	SAM ①	4999.99	99.999	2.000
5/8/17	SAM ①	4999.96	99.997	1.999
5/9/17	SAM ①	4999.97	100.001	2.000
5/10/17	SAM ①	4999.97	99.998	1.998
5/11/17	SAM ①	4999.97	99.998	1.999

Comments: ① top open, sides removed for analysis and calibration.

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170511-1
SwRI SRR: 59663
SDG: 615200
VTSR: 05.05.2017

Certificates of Calibration

010044

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	73396
Asset Number:	018344	Calibrated:	5/8/2017
Description:	OVEN	Calibration Due:	5/8/2018
Manufacturer:	THERMO SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	HERATHERM OMS60	Temp./RH:	74 °F / 46 %
Serial Number:	41241291	Work Order #	403147524
Calibration Procedure:	OVENS, CHAMBERS, INCUBA		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
TEMPERATURE UNIFORMITY NOT CALIBRATED

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
015454	HART SCIENTIFIC	5627A	THERMOMETER PRT	3/23/2018
018495	FLUKE	1523	TEMPERATURE METER	3/23/2018

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403147524	Mfr:	Thermo Scientific	Technician:	RRV
Asset No:	018344	Model:	Heratherm OMS60	Type Data:	Found-left
Serial No:	41241291	Type:	Oven Chamber	Cal Date:	8-May-17

Remarks: Calibration limits per customer request. Chamber exceeds 70% of limit at multiple test points. Customer to determine if the result found meets their requirements. Temperature uniformity not calibrated

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
50 °C	50.3	50.0	-0.3	2.0	0.18	Pass	15%
100 °C	101.5	100.0	-1.5			Pass	75%
150 °C	152.4	150.0	-2.4	3.0		Pass	80%
200 °C	203.2	200.0	-3.2	4.0		Pass	80%

END OF REPORT

010046

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	57058
Asset Number:	023330	Calibrated:	7/28/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	7/28/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	76.5°F / 60 %
Serial Number:	23330	Work Order #	403141268
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -20 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

010047

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403141268	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023330	Model:	08516-96	Type Data:	Found-left
Serial No.:	23330	Type:	Thermocouple Type K	Cal Date:	28-Jul-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-20.1	-19.0	1.1	2.2	0.5	Pass	50%
	200.5	201.5	1.0	2.2	0.5	Pass	45%
	499.2	499.3	0.1	3.7	1.3	Pass	3%
	752.0	749.2	-2.8	5.6	1.3	Pass	50%
	1004.2	999.1	-5.1	7.5	1.3	Pass	68%

END OF REPORT

010048

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	59802
Asset Number:	023428	Calibrated:	9/13/2016
Description:	THERMOCOUPLE PROBE TYPE K	Calibration Due:	9/13/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	76.1°F / 58 %
Serial Number:	23428	Work Order #	403142235
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

010049

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142235	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023428	Model:	08516-96	Type Data:	Found-left
Serial No.:	23428	Type:	Thermocouple Probe Type K	Cal Date:	13-Sep-16

Remarks: unit exceeded 70% of limits at low test point, near maximum allowed limit. No adjustment possible. Customer to determine if readings meet their needs.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.9	-37.8	2.1	2.2	0.5	Pass?	95%
	99.8	98.9	-0.9	2.2	0.5	Pass	41%
	498.4	499.1	0.7	3.7	1.3	Pass	19%
	751.8	751.8	0.0	5.6	0.5	Pass	0%
	1006.9	1004.8	-2.1	7.6	1.3	Pass	28%

END OF REPORT

010050

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	57053
Asset Number:	023323	Calibrated:	7/27/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	7/27/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	77.2°F / 53 %
Serial Number:	23323	Work Order #	403141261
Calibration Procedure:	TEMPERATURE PROBES		

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Remarks:
CAL -20 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

010051

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403141261	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023323	Model:	08516-96	Type Data:	Found-left
Serial No.:	23323	Type:	Thermocouple Type K	Cal Date:	27-Jul-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-20.1	-19.1	1.0	2.2	0.5	Pass	45%
	200.5	201.7	1.2	2.2	0.5	Pass	55%
	497.6	499.2	1.6	3.7	1.3	Pass	43%
	752.0	754.5	2.5	5.6	1.3	Pass	44%
	1004.1	1006.1	2.0	7.5	1.3	Pass	27%

END OF REPORT

010052

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	53398
Asset Number:	023172	Calibrated:	5/25/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	5/25/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	75.4°F / 57 %
Serial Number:	23172	Work Order #	403139868
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 200 °C.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

010053

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403139868	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023172	Model:	08516-96	Type Data:	Found-left
Serial No.:	23172	Type:	Thermocouple Type K	Cal Date:	25-May-16
Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if reading meets their requirements.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-42.9	2.0	2.2	0.5	Pass?	91%
	0.0	0.3	0.3	2.2	0.5	Pass	14%
	99.7	99.3	-0.4	2.2	0.5	Pass	18%
	200.5	200.7	0.2	2.2	0.5	Pass	9%

END OF REPORT

010054

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	57056
Asset Number:	023328	Calibrated:	7/28/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	7/28/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	76.5°F / 60 %
Serial Number:	23328	Work Order #	403141266
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -20 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

010055

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403141266	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023328	Model:	08516-96	Type Data:	Found-left
Serial No.:	23328	Type:	Thermocouple Type K	Cal Date:	28-Jul-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-20.1	-19.1	1.0	2.2	0.5	Pass	45%
	200.5	201.5	1.0	2.2	0.5	Pass	45%
	499.2	499.6	0.4	3.7	1.3	Pass	11%
	752.0	750.7	-1.3	5.6	1.3	Pass	23%
	1004.2	1000.8	-3.4	7.5	1.3	Pass	45%

END OF REPORT

010056

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	53401
Asset Number:	023174	Calibrated:	5/25/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	5/25/2017
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	08516-96	Temp./RH:	75.4°F / 57 %
Serial Number:	23174	Work Order #	403139870
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 200 °C.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010281	HART SCIENTIFIC	5628	SPRT	4/29/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

010057

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403139870	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	023174	Model:	08516-96	Type Data:	Found-left
Serial No.:	23174	Type:	Thermocouple Type K	Cal Date:	25-May-16

Remarks: a reading exceeded 70% of limits. No adjustment possible. Customer to determine if reading meets their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-44.9	-43.0	1.9	2.2	0.5	Pass	86%
	0.0	0.3	0.3	2.2	0.5	Pass	14%
	99.7	99.4	-0.3	2.2	0.5	Pass	14%
	200.5	200.8	0.3	2.2	0.5	Pass	14%

END OF REPORT

010058

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	69649
Asset Number:	022943	Calibrated:	3/14/2017
Description:	THERMOCOUPLE PROBE	Calibration Due:	3/14/2018
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	TYPE K	Temp./RH:	77.7°F / 35 %
Serial Number:	22943	Work Order #	403146051
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -45 °C TO 400 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	11/23/2017
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/7/2017
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	3/1/2018
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/7/2017

Authorized Signatory

Calibrated By: MAR
Metrology Technician

010059

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403146051	Mfr.	Digi-Sense	Technician:	Mark Romero
Asset No.:	022943	Model	Type K	Type Data:	Found-left
Serial No.:	22943	Type.	Thermocouple Probe	Cal Date:	14-Mar-17

Remarks: a couple readings exceeded 70% of limits. No adjustment possible. Customer to determine if readings meet their requirements.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-45.0	-43.2	1.9	2.2	0.5	Pass	84%
	200.5	201.7	1.2	2.2	0.5	Pass	55%
	398.3	396.1	-2.2	3.0	0.5	Pass	74%

END OF REPORT

010060

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	69552
Asset Number:	022940	Calibrated:	3/13/2017
Description:	DIGITAL THERMOMETER	Calibration Due:	3/13/2018
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	20250-02	Temp./RH:	77.5°F / 38 %
Serial Number:	150709174	Work Order #	403145801
Calibration Procedure:	DIGITAL THERMOMETERS-MO		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
017979	FLUKE	525B	CALIBRATOR, TEMPERATURE/PF	9/20/2017

Authorized Signatory

Calibrated By: MAR
Metrology Technician

010061

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403145801	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022940	Model:	20250-02	Type Data:	Found-left
Serial No.:	150709174	Type:	Temperature Meter	Cal Date:	13-Mar-17

Remarks: Due to resolution of the unit, limits are rounded up.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
T1	°F	°F	°F	°F	°F		
Type K	-300.0	-299.2	0.8	5.1	0.8	Pass	16%
	390.0	390.4	0.4	3.8	0.6	Pass	11%
	1075	1075	0	7	0.3	Pass	0%
	1760	1760	0	11	0.3	Pass	0%
	2450	2451	1	14	1.0	Pass	7%
	°C	°C	°C	°C	°C		
	-150.0	-149.6	0.4	2.7	0.5	Pass	15%
	210.0	210.0	0.0	2.1	0.3	Pass	0%
	575.0	575.1	0.1	3.9	0.3	Pass	3%
	940.0	940.5	0.5	5.7	0.3	Pass	9%
	1350	1350	0	8	1.0	Pass	0%
T2	°F	°F	°F	°F	°F		
Type K	-300.0	-300.1	0.1	5.1	0.8	Pass	2%
	390.0	390.5	0.5	3.8	0.6	Pass	13%
	1075	1075	0	7	1.0	Pass	0%
	1760	1760	0	11	1.0	Pass	0%
	2450	2451	1	14	1.0	Pass	7%
	°C	°C	°C	°C	°C		
	-150.0	-150.0	0.0	2.8	0.5	Pass	0%
	210.0	210.1	0.1	2.1	0.3	Pass	5%
	575.0	575.1	0.1	3.9	0.3	Pass	3%
	940.0	940.2	0.2	5.7	0.3	Pass	4%
	1350	1350	0	8	1.0	Pass	0%

END OF REPORT

010062

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	67888
Asset Number:	023702	Calibrated:	2/14/2017
Description:	TIMER	Calibration Due:	2/14/2018
Manufacturer:	FISHER SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	14-649-54	Temp./RH:	72.7°F / 42 %
Serial Number:	80493827	Work Order #	403145405
Calibration Procedure:	STOPWATCHES & TIMERS		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009759	FLUKE	910R	RUBIDIUM GPS FREQUENCY STA	7/15/2017

Authorized Signatory

Calibrated By: CER
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403145405	Mfr:	Fisher Scientific	Technician:	CER
Asset No.:	023702	Model:	14-649-54	Type Data:	Found/Left
Serial No.:	80493827	Type:	Timer	Cal Date:	14-Feb-17
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Time Interval	Seconds	Seconds	Seconds	Seconds	Seconds		
	11580	11580	0	2	1	Pass	0%
	13440	13440	0	2	1	Pass	0%

END OF REPORT

010064

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	68159
Asset Number:	012017	Calibrated:	2/20/2017
Description:	CALIBRATOR, TEMPERATURE	Calibration Due:	2/20/2018
Manufacturer:	FLUKE	Data Type:	FOUND / LEFT
Model Number:	724	Temp./RH:	72.7°F / 41 %
Serial Number:	8776066	Work Order #	403145514
Calibration Procedure:	FLUKE 724, 725, 726		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
Ohm source not calibrated below 240 Ohms per customer.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
011729	FLUKE	8508A-01	MULTIMETER, REFERENCE	2/7/2018
021436	FLUKE	5522A	MULTI-PRODUCT CALIBRATOR	11/2/2017

Authorized Signatory

Calibrated By: COM
Metrology Technician

010065

Southwest Research Institute
Calibration Laboratory
Measurement Report.

Work Order:	403145514	Mfr:	Fluke	Technician:	COM
Asset No:	012017	Model:	724	Type Data:	Found-left
Serial No:	8776066	Type:	Calibrator	Cal Date:	20-Feb-17
Remarks: Ohm source not calibrated below 240 Ohms per customer.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
V DC Measure	V	V	V	V	V		
Upper Display	0	0.000	0.000	0.002	0.0012	Pass	0%
	15	15.001	0.001	0.005	0.0013	Pass	20%
	30	30.002	0.002	0.008	0.0013	Pass	25%
mV DC Measure	mV	mV	mV	mV	mV		
Lower Display	0	0.00	0.00	0.02	0.012	Pass	0%
	50	49.99	-0.01	0.03	0.013	Pass	33%
	89	88.99	-0.01	0.04	0.013	Pass	25%
V DC Measure	V	V	V	V	V		
Lower Display	0	0.000	0.000	0.002	0.0012	Pass	0%
	10	9.999	-0.001	0.004	0.0013	Pass	25%
	20	19.998	-0.002	0.006	0.0013	Pass	33%
mA DC Measure	mA	mA	mA	mA	mA		
Upper Display	4	4.001	0.001	0.003	0.0014	Pass	33%
	12	12.003	0.003	0.005	0.0020	Pass	60%
	24	24.004	0.004	0.007	0.0033	Pass	57%
Resistance	Ω	Ω	Ω	Ω	Ω		
4-Wire Measure	15	14.98	-0.02	0.10	0.01	Pass	20%
Lower Display	350	349.99	-0.01	0.10	0.036	Pass	10%
	500	500.0	0.0	0.5	0.10	Pass	0%
	1500	1500.0	0.0	0.5	0.12	Pass	0%
	3200	3200.1	0.1	1.0	0.20	Pass	10%
3-Wire RTD	Ω	Ω	Ω	Ω	Ω		
Lower Display	350	349.97	-0.03	0.20	0.036	Pass	15%
Type J TC Measure	°C	°C	°C	°C	°C		
Lower Display	0	0.0	0.0	0.7	0.22	Pass	0%
Type J TC Source	°C	°C	°C	°C	°C		
Lower Display	0	-0.03	-0.03	0.70	0.17	Pass	4%
mV DC Source	mV	mV	mV	mV	mV		
Lower Display	0	-0.002	-0.002	0.020	0.0004	Pass	10%
	45	44.999	-0.001	0.030	0.002	Pass	4%
	100	99.999	-0.001	0.040	0.002	Pass	3%

Southwest Research Institute
Calibration Laboratory
Measurement Report.

Work Order:	403145514	Mfr:	Fluke	Technician:	COM
Asset No:	012017	Model:	724	Type Data:	Found-left
Serial No:	8776066	Type:	Calibrator	Cal Date:	20-Feb-17

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
V DC Source	V	V	V	V	V		
Lower Display	0	0.0000	0.0000	0.0020	0.00001	Pass	1%
	5	4.9999	-0.0001	0.0030	0.00006	Pass	2%
	10	9.9999	-0.0001	0.0040	0.00006	Pass	3%
Resistance Source	Ω	Ω	Ω	Ω	Ω		
Lower Display	15	n/a	#VALUE!	0.100	0.006	######	######
	360	360.067	0.067	0.100	0.006	Pass	67%
	500	500.11	0.11	0.50	0.04	Pass	22%
	1500	1500.12	0.12	0.50	0.04	Pass	24%
	3200	3200.17	0.17	1.00	0.07	Pass	17%

END OF REPORT

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Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	60532
Asset Number:	014982	Calibrated:	9/28/2016
Description:	BALANCE	Calibration Due:	9/28/2017
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XP5003SDR	Temp./RH:	72 °F / 51 %
Serial Number:	1129300727	Work Order #	403142529
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001712	TROEMNER	100 G	WEIGHT CLASS 1	8/3/2017
001713	RICE LAKE	200 G	WEIGHT CLASS 1	7/14/2017
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/13/2017
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/7/2017
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/6/2017
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/6/2017
001718	RICE LAKE	2 KG	WEIGHT CLASS 1	4/6/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute

Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

001719 RICE LAKE 5 KG WEIGHT CLASS 1 4/6/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142529	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	28-Sep-16
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit		Result	% Limit
Corner Load	grams	grams	grams	grams			
Left Front	1000	999.999	-0.001	0.010		Pass	10%
Left Rear		999.999	-0.001			Pass	10%
Right Rear		999.998	-0.002			Pass	20%
Right Front		999.999	-0.001			Pass	10%
Repeatability							
1000 g Range							
1	500	500.001					
2		500.001					
3		500.000					
4		500.001					
5		500.001					
6		500.000					
7		500.000					
8		500.001					
9		500.000					
10		500.001					
Std Deviation		0.0005		0.0020		Pass	25%
5100 g Range							
1	2000	2000.00					
2		2000.00					
3		2000.00					
4		2000.00					
5		2000.00					
6		2000.00					
7		2000.00					
8		2000.00					
9		2000.00					
10		2000.00					
Std Deviation		0.000		0.012		Pass	0%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
1000 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	100.000	100.002	0.002			Pass	17%
	200.000	200.001	0.001			Pass	8%
	300.000	300.001	0.001			Pass	8%
	400.000	400.002	0.002			Pass	17%
	500.001	500.002	0.001			Pass	8%
	600.001	600.002	0.001			Pass	8%
	700.001	700.000	-0.001			Pass	8%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142529	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	28-Sep-16

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	grams	grams	grams		
1000 g Range	800.001	800.003	0.002	0.012	0.003	Pass	17%
	900.000	900.003	0.003			Pass	25%
	999.999	1000.000	0.001			Pass	8%
5100 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	500.001	500.000	-0.001			Pass	8%
	999.999	999.999	0.000			Pass	0%
	1500.00	1499.99	-0.01	0.02	0.01	Pass	50%
	2000.00	2000.00	0.00			Pass	0%
	2500.00	2500.00	0.00			Pass	0%
	3000.00	2999.99	-0.01			Pass	50%
	3500.00	3499.99	-0.01			Pass	50%
	4000.00	4000.00	0.00			Pass	0%
	4500.00	4500.00	0.00			Pass	0%
	5000.00	5000.00	0.00			Pass	0%

END OF REPORT

010071

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	39314
Asset Number:	014982	Calibrated:	9/25/2015
Description:	BALANCE	Calibration Due:	9/25/2016
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XP5003SDR	Temp./RH:	73 °F / 48 %
Serial Number:	1129300727	Work Order #	403134658
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001712	TROEMNER	100 G	WEIGHT CLASS 1	7/29/2016
001713	RICE LAKE	200 G	WEIGHT CLASS 1	10/1/2015
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/12/2016
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/8/2016
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/7/2016
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016
001718	RICE LAKE	2 KG	WEIGHT CLASS 1	4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

001719 RICE LAKE 5 KG WEIGHT CLASS 1 4/7/2016

Approved By

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134658	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	25-Sep-15
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit		Result	% Limit
Corner Load	grams	grams	grams	grams			
Left Front	1000	1000.000	0.000	0.010		Pass	0%
Left Rear		999.999	-0.001			Pass	10%
Right Rear		1000.000	0.000			Pass	0%
Right Front		1000.001	0.001			Pass	10%
Repeatability							
1000 g Range							
1	500	500.002					
2		500.000					
3		500.001					
4		500.002					
5		500.000					
6		500.000					
7		500.001					
8		500.001					
9		500.001					
10		500.000					
Std Deviation		0.0008		0.0020		Pass	40%
5100 g Range							
1	2000	199.99					
2		200.00					
3		199.99					
4		199.99					
5		200.00					
6		200.00					
7		199.99					
8		199.99					
9		199.99					
10		199.99					
Std Deviation		0.005		0.012		Pass	42%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
1000 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	100.000	100.001	0.001			Pass	8%
	200.000	200.001	0.001			Pass	8%
	300.000	300.001	0.001			Pass	8%
	400.000	400.001	0.001			Pass	8%
	500.000	500.002	0.002			Pass	17%
	600.000	600.003	0.003			Pass	25%
	700.000	700.002	0.002			Pass	17%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403134658	Mfr:	Mettler	Technician:	RRV
Asset No.:	014982	Model:	XP5003SDR	Type Data:	Found-left
Serial No.:	1129300727	Type:	Balance	Cal Date:	25-Sep-15

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	grams	grams	grams		
1000 g Range	800.000	800.002	0.002	0.012	0.003	Pass	17%
	900.000	900.001	0.001			Pass	8%
	1000.000	1000.000	0.000			Pass	0%
5100 g Range	0.000	0.000	0.000	0.012	0.003	Pass	0%
	500.000	500.001	0.001			Pass	8%
	1000.000	999.999	-0.001			Pass	8%
	1500.00	1500.00	0.00	0.02	0.01	Pass	0%
	2000.00	2000.00	0.00			Pass	0%
	2500.00	2500.00	0.00			Pass	0%
	3000.00	3000.00	0.00			Pass	0%
	3500.00	3500.00	0.00			Pass	0%
	4000.00	4000.00	0.00			Pass	0%
	4500.00	4500.00	0.00			Pass	0%
	5000.00	5000.00	0.00			Pass	0%

END OF REPORT

010075

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	61226
Asset Number:	020014	Calibrated:	10/10/2016
Description:	BALANCE	Calibration Due:	10/10/2017
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	70 °F / 44 %
Serial Number:	B338797310	Work Order #	403142842
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2016
001705	TROEMNER	2 G	WEIGHT CLASS 1	6/30/2017
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/7/2017
001707	TROEMNER	5 G	WEIGHT CLASS 1	8/3/2017
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/14/2017
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/3/2017
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/3/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute

Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	6/30/2017
001712	TROEMNER	100 G	WEIGHT CLASS 1	8/3/2017
001713	RICE LAKE	200 G	WEIGHT CLASS 1	7/14/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142842	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	10-Oct-16
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0000	0.0000	0.0006	Pass	0%
Left Rear		99.9999	-0.0001		Pass	17%
Right Rear		100.0000	0.0000		Pass	0%
Right Front		99.9998	-0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	79.99999				
2		79.99998				
3		79.99999				
4		79.99998				
5		79.99998				
6		79.99999				
7		80.00000				
8		79.99998				
9		80.00000				
10		79.99998				
Std Deviation		0.000008		0.00008	Pass	10%
< 220 g Range						
1	200	200.0000				
2		200.0000				
3		200.0001				
4		200.0001				
5		200.0000				
6		200.0002				
7		200.0002				
8		200.0002				
9		200.0001				
10		200.0002				
Std Deviation		0.00009		0.00020	Pass	45%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.07	Pass	0%
	7.99999	7.99999	0.00			Pass	0%
	16.00000	16.00000	0.00			Pass	0%
	23.99999	24.00004	0.05			Pass	13%
	32.00000	32.00005	0.05			Pass	13%
	39.99992	40.00002	0.10			Pass	25%
	47.99991	47.99995	0.04			Pass	10%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142842	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	10-Oct-16

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99994	55.99998	0.04	0.40	0.07	Pass	10%
	64.00000	64.00002	0.02			Pass	5%
	71.99994	71.99995	0.01			Pass	3%
	79.99995	79.99995	0.00			Pass	0%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.21	Pass	0%
< 220 g Range	20.0000	19.9999	-0.1			Pass	25%
	39.9999	39.9999	0.0			Pass	0%
	60.0000	59.9999	-0.1			Pass	25%
	80.0000	80.0000	0.0			Pass	0%
	100.0000	99.9999	-0.1			Pass	25%
	119.9999	119.9999	0.0			Pass	0%
	139.9999	139.9999	0.0			Pass	0%
	159.9999	159.9998	-0.1			Pass	25%
	179.9999	179.9998	-0.1			Pass	25%
	200.0002	200.0000	-0.2			Pass	50%

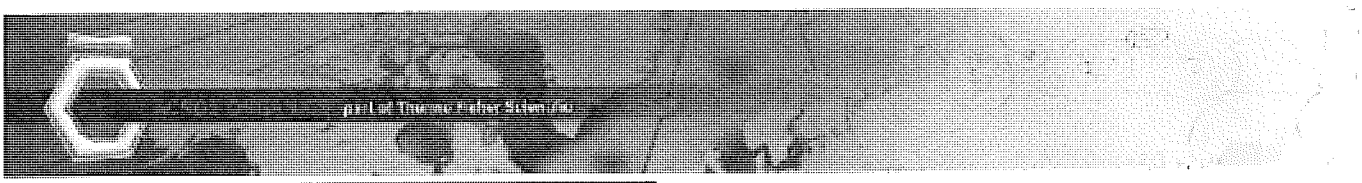
END OF REPORT

010079

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170511-1
SwRI SRR: 59663
SDG: 615200
VTSR: 05.05.2017

Certificates of Analysis for Chemicals

SwRI Chem ID: 69608



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

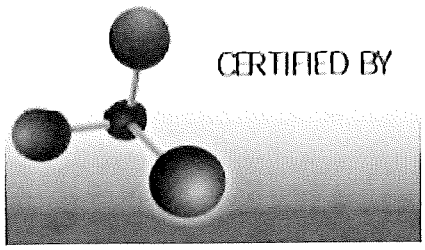
Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69608

SwRI Chem ID: 69608



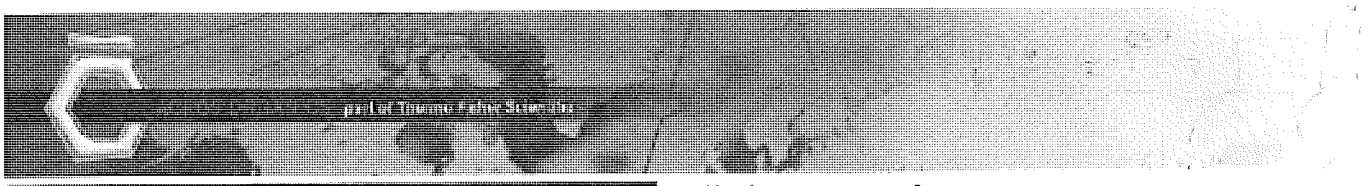
CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
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SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

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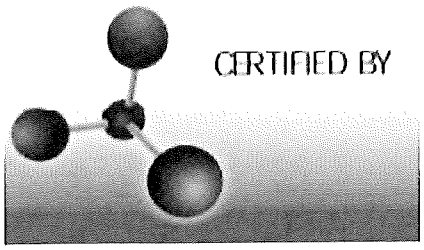
Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69607
SwRI Chem ID: 69607
SwRI Chem ID: 69607

010083



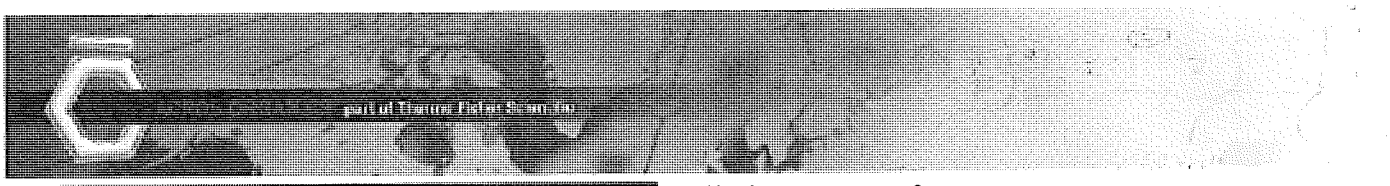
CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 25 April 2016

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SwRI Chem ID: 69607
SwRI Chem ID: 69607
SwRI Chem ID: 69607



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

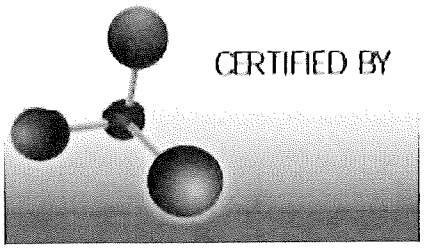
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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm
Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)

SwRI Chem ID: 66141
SwRI Chem ID: 66141
SwRI Chem ID: 66141



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L. Van den Broek, QA Manager

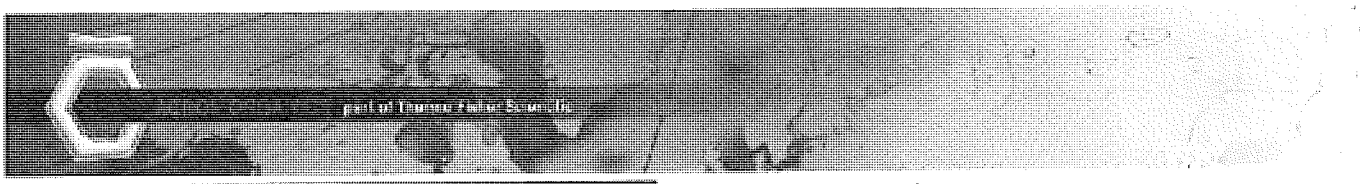
Issued: 14 January 2016

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SwRI Chem ID: 66141

SwRI Chem ID: 66141

SwRI Chem ID: 66141



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

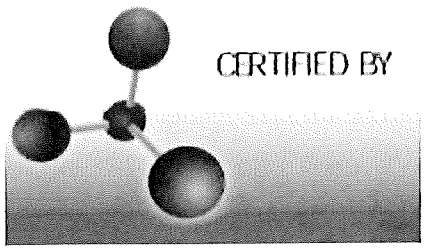
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Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	dark purple to black crystalline chunks	black crystalline chunks
Titration Iodometric	>=98.5 %	101.9 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Trace analysis	Type: Ca measure =< 50 PPM	Type: Ca measure 5 PPM
Trace analysis	Type: Cd measure =< 10 PPM	Type: Cd measure 3 PPM
Trace analysis	Type: Co measure =< 10 PPM	Type: Co measure 5 PPM
Trace analysis	Type: Cu measure =< 10 PPM	Type: Cu measure 7 PPM
Trace analysis	Type: Fe measure =< 200 PPM	Type: Fe measure 178 PPM
Trace analysis	Type: Mg measure =< 50 PPM	Type: Mg measure 6 PPM
Trace analysis	Type: Mn measure =< 10 PPM	Type: Mn measure 7 PPM
Trace analysis	Type: Na measure =< 50 PPM	Type: Na measure 17 PPM
Trace analysis	Type: Ni measure =< 50 PPM	Type: Ni measure 8 PPM
Trace analysis	Type: Pb measure =< 20 PPM	Type: Pb measure 4 PPM
Trace analysis	Type: Sr measure =< 50 PPM	Type: Sr measure 11 PPM
Trace analysis	Type: Zn measure =< 10 PPM	Type: Zn measure 4 PPM
Trace analysis	Type: Cl measure =< 20 PPM	Type: Cl measure =< 20 PPM
Trace analysis	Type: SO4 measure =< 50 PPM	Type: SO4 measure =< 50 PPM
Trace analysis	Type: NH4 measure =< 10 PPM	Type: NH4 measure =< 10 PPM
Subst not pptd by NH4OH	=<0.2 % (as SO4)	=<0.0077 % (as SO4)

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857



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L. Van den Broek, QA Manager

Issued: 28 October 2015

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SwRI Chem ID: 63857

SwRI Chem ID: 63857

SwRI Chem ID: 63857

SwRI Chem ID: 63604

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Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

$Fe(NO_3)_3 \cdot 9H_2O$

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 63604

SwRI Chem ID: 63604

SwRI Chem ID: 65582

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBW6908V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	16 OCT 2015

SwRI Chem ID: 65582

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Michael Grady, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 65582

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65582

SwRI Chem ID: 69603

ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

Certificate of Analysis

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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %

CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 25 April 2016

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SwRI Chem ID: 69603

SwRI Chem ID: 69603

SwRI Chem ID: 69604

ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

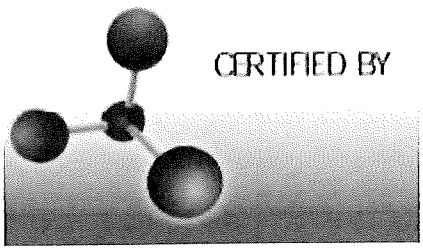
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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



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L. Van den Broek, QA Manager

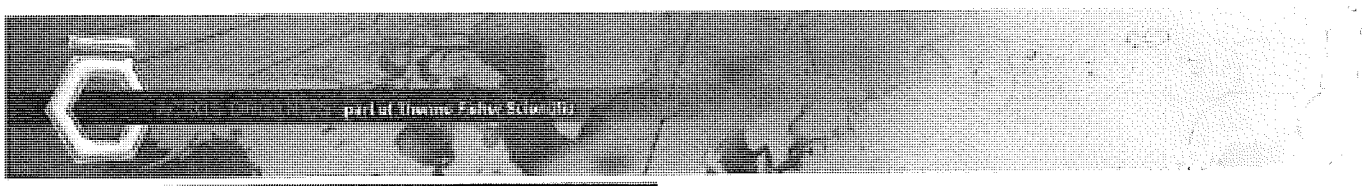
Issued: 25 April 2016

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SwRI Chem ID: 69604

SwRI Chem ID: 69604

SwRI Chem ID: 69611



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

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Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

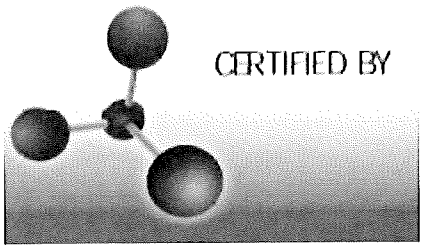
Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69611

SwRI Chem ID: 69611

010093



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L. Van den Broek, QA Manager

Issued: 25 April 2016

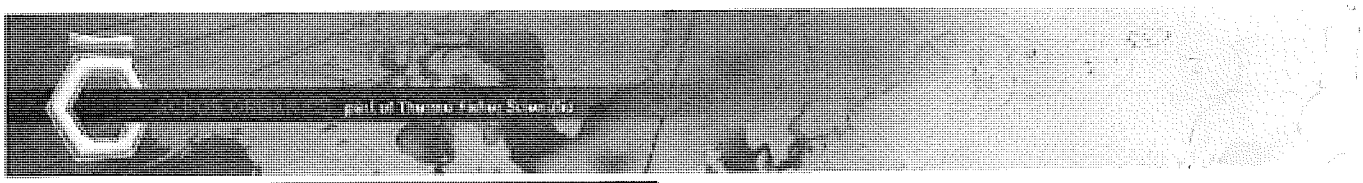
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SwRI Chem ID: 69611

SwRI Chem ID: 69611

SwRI Chem ID: 69611

SwRI Chem ID: 65951



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

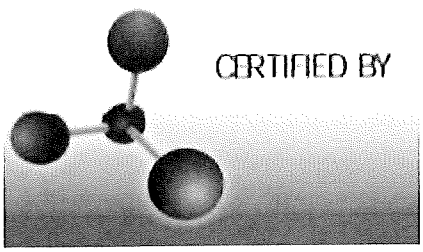
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



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L. Van den Broek, QA Manager

Issued: 7 January 2016

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SwRI Chem ID: 65951

SwRI Chem ID: 65951

SwRI Chem ID: 69629

ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

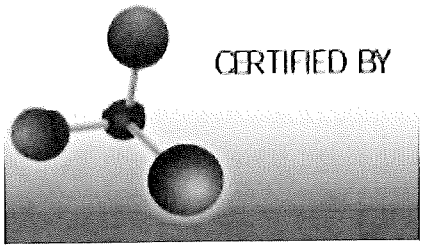
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 26 April 2016

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SwRI Chem ID: 69629

SwRI Chem ID: 69629

SwRI Chem ID: 69628

ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

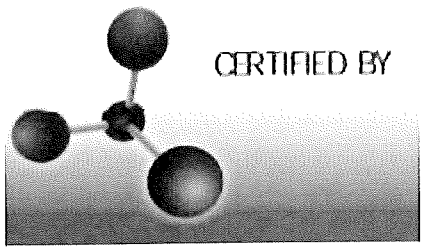
Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



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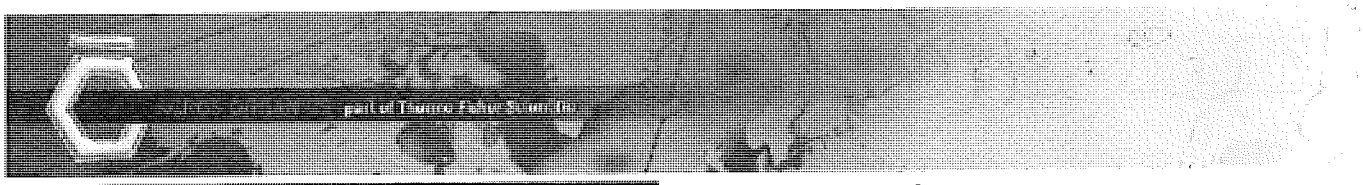
L. Van den Broek, QA Manager

Issued: 26 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69628

SwRI Chem ID: 69628



ACROS ORGANICS

Version	0
Molecular weight	126.04
Molecular formula	C2 H2 O4 . 2 H2 O
CAS No	6153-56-6
Linear formula	HO2CCO2H.2H2O
Flash point (°C)	

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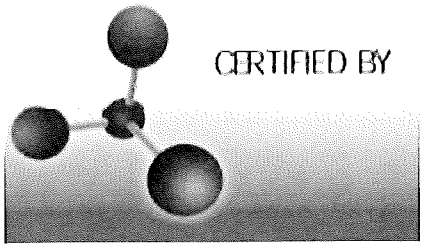
Catalog Number	42315	**Quality Test / Release Date**	10 December 2014
Lot Number	A0354614	**Suggested Retest Date**	December 2019
Description	Oxalic acid dihydrate,99.5+%,ACS reagent		
Country of Origin	SPAIN		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystals
Infrared spectrometry	authentic	authentic
Assay Titrimetry	99.5 to 102.5 %	99.9 %
Heavy metals (as Pb)	=<5 ppm	=<2.5 ppm
Residue after ignition	=<0.01 %	0.004 %
Nitrogen compounds (as N)	=<0.001 %	=<0.001 %
Trace analysis	Type: Cl measure =< 20 ppm	Type: Cl measure < 5 ppm
Trace analysis	Type: SO4 measure =< 50 ppm	Type: SO4 measure < 20 ppm
Trace analysis	Type: Ca measure =< 10 ppm	Type: Ca measure < 1 ppm
Trace analysis	Type: Fe measure =< 2 ppm	Type: Fe measure < 2 ppm
Insoluble matter	=<0.005 %	=<0.005 %
Substance darkened by H2SO4	passes test	passes test

SwRI Chem ID: 69684
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SwRI Chem ID: 69684

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L. Van den Broek, QA Manager

Issued: 27 April 2016

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SwRI Chem ID: 69684

SwRI Chem ID: 69684

SwRI Chem ID: 69684

3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:	NICKEL(II) NITRATE HEXAHYDRATE purum p.a., crystallized, >= 97.0 % KT
Product Number:	72253
Batch Number:	BCBP4160V
Brand:	Sigma-Aldrich
CAS Number:	13478-00-7
Formula:	$Ni(NO_3)_2 \bullet 6H_2O$
Formula Weight:	290.79
Quality Release Date:	26 JAN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	BLUE-GREEN TO DEEP BLUE-GREEN	BLUE-GREEN
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	97.0 - 103.0 %	97.0 %
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
CADMIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
COBALT (ICP)	≤ 500 MG/KG	< 500 MG/KG
COPPER (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 50 MG/KG	< 50 MG/KG
POTASSIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
SODIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
LEAD (ICP)	≤ 50 MG/KG	< 50 MG/KG
ZINC (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 50 MG/KG	< 50 MG/KG

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65593
SwRI Chem ID: 65593
SwRI Chem ID: 65593

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Fisher Scientific

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Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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Catalog Number	**A509**	**Mfg. Date**	11/4/2015
Lot Number	**1115100**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	11/04/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

SwRI Chem ID: 67843
SwRI Chem ID: 67843
SwRI Chem ID: 67843

Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

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Edgar E Hess
Lab Manager Fair Lawn

Joel Boland
Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1 800 227 6701.

SwRI Chem ID: 67843
SwRI Chem ID: 67843
wRI Chem ID: 67843

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Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

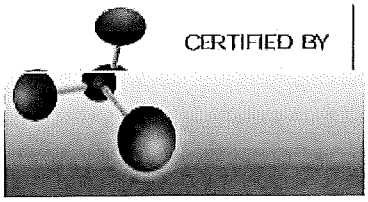
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SwRI Chem ID: 69597

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69597



Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69597

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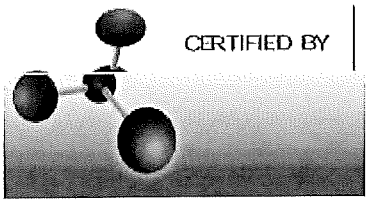
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

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SwRI Chem ID: 69596
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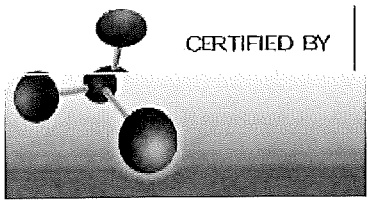
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SwRI Chem ID: 69595

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69595



Elyse E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69595

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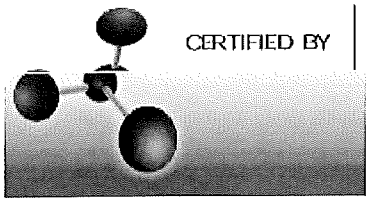
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Elgan E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69594
SwRI Chem ID: 69594
SwRI Chem ID: 69594

Fisher Scientific

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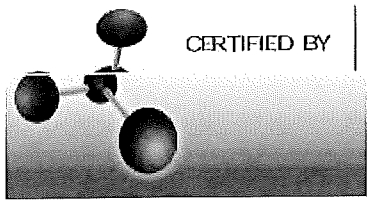
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SwRI Chem ID: 69593

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69593



Lab Manager Fair Lawn

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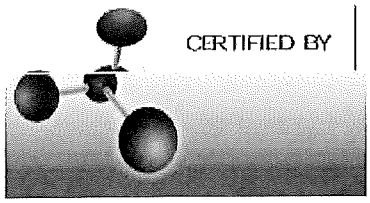
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hans

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69592
SwRI Chem ID: 69592
SwRI Chem ID: 69592

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

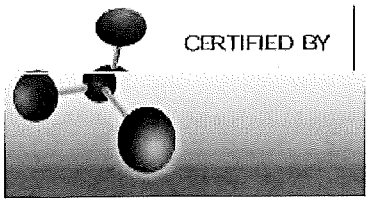
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005



Elgan E. Hans

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69573
SwRI Chem ID: 69573
SwRI Chem ID: 69573

Fisher Scientific

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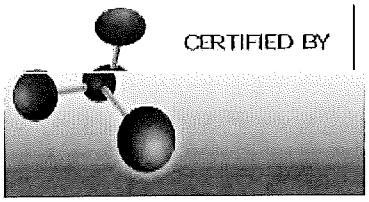
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005



Elgin E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69572
SwRI Chem ID: 69572
SwRI Chem ID: 69572

Fisher Scientific

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Fair Lawn, NJ 07410
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201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

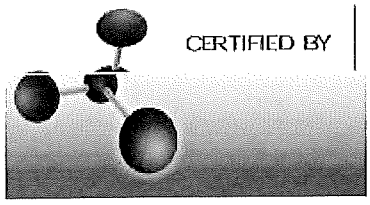
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SwRI Chem ID: 69571

Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69571



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69571

Fisher Scientific

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201.796.7100 tel
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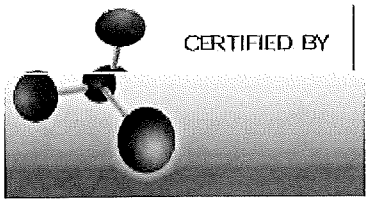
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69591
SwRI Chem ID: 69591
SwRI Chem ID: 69591

Fisher Scientific

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Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

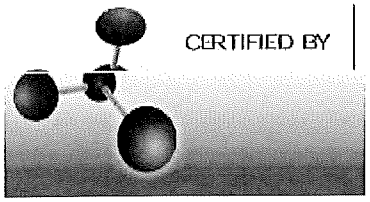
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69590
SwRI Chem ID: 69590
SwRI Chem ID: 69590

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
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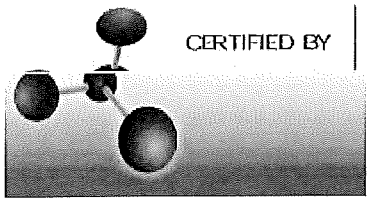
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69589
SwRI Chem ID: 69589
SwRI Chem ID: 69589

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

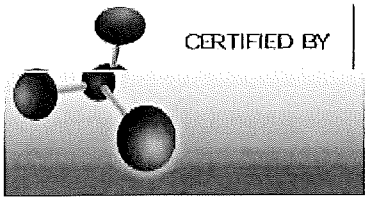
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69588
SwRI Chem ID: 69588
SwRI Chem ID: 69588

Fisher Scientific

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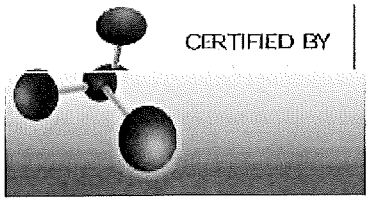
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69587
SwRI Chem ID: 69587
SwRI Chem ID: 69587

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

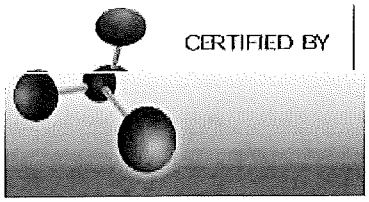
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69586
SwRI Chem ID: 69586
SwRI Chem ID: 69586

Appendix U
SwRI Test Report, August 1, 2017

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

August 1, 2017

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Keith R. Greene

Subject:	SwRI Project Number:	19869.01.00X
	SDG:	617476
	SwRI Task Order Number:	170713-5
	SwRI Sample Receipt Number:	59998, 60031
	Samples Received:	06.20.2017, 07.14.2017
	Analysis:	Various

Dear Mr. Greene,

Please find the enclosed results for the samples generated by the lab on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

Judy Herrera for
Radonna Spies
Principal Scientist

APPROVED:

for Michael J. Dammann
Director

RPS: jz

Cc: Nita Patel, Los Alamos National Laboratory
Kurt Anast, Los Alamos National Laboratory

Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Chain-of-Custody
&
Sample Receipt Paperwork

Total Page Count: 010001-
Fraction: IC, M905 Pages: 010184
GC-TCD

Garcia, David

From: Spies, Radonna S.
Sent: Monday, July 10, 2017 12:03 PM
To: 01-Login-Doc
Cc: Moken, James A.
Subject: Sample to log in

David -
Can you please create a TO

19869.01.00X

Vtsr: 6/20/17

Sample IDs

UNS/Zeo 1
UNS/Zeo 2
UNS/Zeo 3
UNS/Zeo 4
UNS/Zeo 5

Client: Los Alamos National Laboratory
SRR # 59998
Project # 19869.01.00X
Case: R. Spies
VTSR: 06/20/17
Sample(s) Received: Intact
Temperature: N/A SN # N/A

Matrix: Solid

Radonna Spies
Principal Scientist
Southwest Research Institute
Analytical & Environmental Chemistry Department
Chemistry & Chemical Engineering, Division 01
6220 Culebra Road | San Antonio, Texas 78228
email: rspies@swri.org
210.522.3242: office, 210.522.3649: fax

SwRI has state-of-the-art equipment and facilities located on more than 1,200 acres in San Antonio, Texas. More than 2 million square feet of laboratories, offices, and test facilities support work on nearly 2,000 client projects at any given time. SwRI has a wide range of technical competencies and breadth. Its more than 2,600 staff members in 9 technical divisions have expertise in such areas as chemistry, space sciences, nondestructive evaluation, automation, engine design, mechanical engineering, electronics, and more. The Institute can assemble a multidisciplinary team of experts required by any technical project, giving SwRI a teaming flexibility difficult to find at other R&D organizations.

010003

Client: Los Alamos National Laboratory
SRR # 60031
Project # 19869.01.00X
Case: R. Spies
VTSR: 07/14/17
Sample(s) Received: Intact
Temperature: N/A SN # N/A

SAMPLE LIST/CHAIN OF CUSTODY

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

Requested Turnaround:
- [ ] 2 Weeks
- [ ] 3 Weeks
- [ ] Other: ↙

1 week

Shipper Name/ Address

Client: Los Alamos National Laboratories

Client Purchase Order/Other ID:

Site/Zone ID:

SwRI Contact: R. Spies

Analyses Requested

Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers	NOx (NO2, NO3)	+ H2 • O2 • N2 • CO, • CO2								
617480	7/14/17		G		2	x	x								

REMARKS
Preservation
a = HCl to pH <2
b = HNO_3 to pH <2
c = H_2SO_4 to pH <2
d = NaOH to pH >12
e = Cool (4°C±2°C)
f = Other (specify)

Matrix Types:
A – Air
B – Biota
D - Dust
E – Emission/Stack
L - Liquid
P – Product
Sd - Solid
S – Soil
SED – Sediment
T - Tissue
W - Water
WP - Wipe

Sample Types:
D - Duplicate
ER – Equipment Rinsate
ES – Environmental Sample
FB – Field Blank
FD – Field Duplicate
MS – Matrix Spike
MSD – Matrix Spike Dup
TB – Trip Blank

Temp:

Therm #:

Comments:

	Date	Time
Relinquished by (Print/Signature): Dustin Noll Dustin Noll	7-14-17	9:05
Received by (Print/Signature):		
Relinquished by (Print/Signature):		
Received by (Print/Signature):		
Relinquished by (Print/Signature):		

SwRI Project#: 19869.01.00x

Received by SwRI Lab: (Signature)

Date	Time
07-14-17	9:05

Samples Disposed:

Date	Time

Samples Disposed by:

Southwest Research Institute

Laboratory Task Order

TO #: 170713-5 Revision: 1

Project(s): 19869.01.00X
Manager(s): DAMMANN, MIKE
To Client: 07/27/17

SDG: 617476

SRR #'s: 59998, 60031
Client(s): Los Alamos National Laboratory

Instructions

19869.01.006
Step 1: Combine the surrogate solution and the zeolite in a beaker and mix with a spatula for 3 minutes to absorb the solution.
Step 2: After mixing is complete place the mixture atop a 325 mesh stainless steel screen with a pan below. Place the screen and the pan in a zip lock plastic bag.
Step 3: Let the material set in the bag for 2 weeks checking daily for any observed free liquid in the pan.
Step 4:After two weeks weigh the liquid that reported to the pan.

UNS SolZeolite
(ml) (ml)
Vol Ratio
UNS/Zeo 1100200
UNS/Zeo 275225
UNS/Zeo 360240
UNS/Zeo 450250

2.2UNS Solution Blending Off Gas Evaluation
The UNS solution and zeolite blending process is expected to evolve gas. The amount of gas and the type of gas evolved is of interest.

2.2.1Sample Preparation
Sample preparation of the gas for gas composition evaluation requires the following:
Step 1: Add 100 ml of zeolite to autoclave and purge with nitrogen or argon to remove air.
Step 2:Close and seal the autoclave.
Step 3:Sample the gas cap in the autoclave for background information.
Step 4:Note pressure and temperature in autocalve before adding UNS solution.
Step 5: Add 100 ml of UNS Surrogate Solution as prepared in Section 1.0.
Step 6: Ensure autoclave is sealed and note pressure and temperature:
oevery 5 minutes for first hour,
o hourly for 4 hours and
oafter 24 hours.
•Step 7:Sample gas in autoclave.

2.2.2Gas Composition Testing
Submit gas samples (background and 24 hour sample) for evaluation ensuring the following gas species are noted on composition analyses:
•NO2
•NOx
•H2
•O2
•N2
•CO
•CO2

Documents Related to this task order: 224859[COC for SRR 59998], 224860[Paperwork for SRR 59998], 225250[COC for SRR 60031], 225251[Paperwork for SRR 60031]

Deliverables --> Hard Copy: no EDD: no PDF: -YES-

Test: GC-TCD
Section: CHROM

Holding: 30 days from CED

ANALYSIS BY METHOD GC-TCD

Cnt: 1

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
617727		1	Gas	617480	14 Jul 17	13 Aug 17
617727		2	Gas	617480	14 Jul 17	13 Aug 17

Test: IC-300.0
Section: WETCHEM

Holding: 28 days from CED

IC Method 300.0 anions (only for Bromide, Chloride, Fluoride, Sulfate)

Cnt: 1

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
617727		1	Gas	617480	14 Jul 17	11 Aug 17

Southwest Research Institute

Laboratory Task Order

TO #: 170713-5 Revision: 1

Project(s): 19869.01.00X
Manager(s): DAMMANN, MIKE
To Client: 07/27/17

SDG: 617476

SRR #'s: 59998, 60031
Client(s): Los Alamos National Laboratory

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
617727		2	Gas	617480	14 Jul 17	11 Aug 17

Test: IC-300.0-PREP
Section: WETCHEM

Holding: 28 days from CED

IC Method 300.0 anions after preparation for gas

Cnt: 1

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
617727		1	Gas	617480	14 Jul 17	11 Aug 17
617727		2	Gas	617480	14 Jul 17	11 Aug 17

Test: PAINT_9095
Section: WETCHEM

Holding: 180 days from CED

SW846 9095 Paint Filter Liquids Test

Cnt: 4

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
617476		1	Solid	UNS/Zeo 1	20 Jun 17	17 Dec 17
617477		1	Solid	UNS/Zeo 2	20 Jun 17	17 Dec 17
617478		1	Solid	UNS/Zeo 3	20 Jun 17	17 Dec 17
617479		1	Solid	UNS/Zeo 4	20 Jun 17	17 Dec 17

Test: WET-MISC
Section: WETCHEM

Holding: 60 days from CED

Any miscellaneous wetchem test.

Cnt: 5

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
617476		1	Solid	UNS/Zeo 1	20 Jun 17	19 Aug 17
617477		1	Solid	UNS/Zeo 2	20 Jun 17	19 Aug 17
617478		1	Solid	UNS/Zeo 3	20 Jun 17	19 Aug 17
617479		1	Solid	UNS/Zeo 4	20 Jun 17	19 Aug 17
617480		1	Solid	UNS/Zeo 5	20 Jun 17	19 Aug 17

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 59998
Revision: 2

This Receipt was Revised 07/27/2017

VTSR: 06/20/17

Time: 12:03:00

Project: 19869.01.00X
Case #: R. Spies
Client: Los Alamos National Laboratory

Manager: DAMMANN, MIKE
Logged in by: DXGARCIA
Creation Date: 07/10/17

Notes

Email was received to create an SRR for the following.

See Task Order for full requirements.

See chain of custody as part of the SRR system for more information.

Phases:
001 - admin
002 - extraction
005 - 8082
006 - metals/radchem
007 - drg

REVISION, 1. Corrected date to 06/20/17.

REVISION, 2. Corrected date.

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
617476	UNS/Zeo 1	06/20/17	Solid	1	
617477	UNS/Zeo 2	06/20/17	Solid	1	
617478	UNS/Zeo 3	06/20/17	Solid	1	
617479	UNS/Zeo 4	06/20/17	Solid	1	
617480	UNS/Zeo 5	06/20/17	Solid	1	

Containers: 5 **Samples: 5**

These documents are associated with this receipt: 224859[COC for SRR 59998], 224860[Paperwork for SRR 59998]

Thermometer: N/A
Temperature: N/A

Page Printed: 07/27/2017 15:28
ver: (4/10/2017)

59998 Los Alamos National Laborato

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 60031

VTSR: 07/14/17

Time: 09:05:00

Project: 19869.01.00X
Case #: R. Spies
Client: Los Alamos National Laboratory

Manager: DAMMANN, MIKE
Logged in by: DXGARCIA
Creation Date: 07/14/17

Notes

COC was hand delivered to create an SRR for the following.

See Task Order for full requirements.

See chain of custody as part of the SRR system for more information.

Phases:
001 - admin
002 - extraction
005 - 8082
006 - metals/radchem
007 - drg

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
617727	617480	07/14/17	Gas	2	

Containers: 2

Samples: 1

These documents are associated with this receipt: 225250[COC for SRR 60031], 225251[Paperwork for SRR 60031]

Thermometer: N/A
Temperature: N/A

Page Printed: 07/27/2017 15:41
ver: (4/10/2017)

60031 Los Alamos National Laborato

Southwest Research Institute
Traffic Report

Sample Custodian Signature: David Kamm

1. Custody Seal — Not Present or Damaged
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC NA
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Case: R. Spies / SDG: SEE T.O.
Sample Receipt: 59998
Airbill: Email

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
06/20/17	12:03:00	Email	UNS/Zeo 1	N/A	617476	YES	Intact
06/20/17	12:03:00	Email	UNS/Zeo 2	N/A	617477	YES	Intact
06/20/17	12:03:00	Email	UNS/Zeo 3	N/A	617478	YES	Intact
06/20/17	12:03:00	Email	UNS/Zeo 4	N/A	617479	YES	Intact
06/20/17	12:03:00	Email	UNS/Zeo 5	N/A	617480	YES	Intact

Southwest Research Institute

Traffic Report

Sample Custodian Signature: David Garcia

1. Custody Seal	Not Present or Damaged
2. Chain of Custody	Present
3. Sample Tags	Not Present N/A
Sample Tag Numbers	Not on COC
4. SMO Forms	Not Present

Client: Los Alamos National Laboratory

Project: 19869.01.00X

Case: R. Spies / SDG: See T.O.

Sample Receipt: 60031

Airbill: Hand Delivered

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
07/14/17	09:05:00	SwRI COC	617480	N/A	617727	YES	Intact

010010

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): DAVID GARCIA	Log-in Date: 07/10/2017
Received By (Signature): David Garcia	
Case Number: R. Spies	Sample Delivery Group No.: N/A
Remarks: 19869.01.00X	SAS Number: N/A

1. Custody Seal(s)	Present/(Absent*) Intact/~~Broken~~	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	(Present)/Absent*	
4. Traffic Reports or Packing Lists	Present/(Absent)	
5. Airbill	Airbill/Sticker (Present)/Absent*	
6. Airbill No.	Email	
7. Sample Tags	Present/(Absent)	
Sample Tag Numbers	Listed/(Not) listed on Chain of Custody	
8. Sample Condition	Intact/Broken*/ ~~Leaking~~	
9. Cooler Temperature	N/AC	
10. Does Information on custody records, traffic reports, and sample tags agree?	(Yes)/No*	
11. Date Received at Lab	06/20/2017	
12. Time Received	12:03:00	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
UNS/Zeo 1	N/A	617476	Intact
UNS/Zeo 2	N/A	617477	Intact
UNS/Zeo 3	N/A	617478	Intact
UNS/Zeo 4	N/A	617479	Intact
UNS/Zeo 5	N/A	617480	Intact

Sample Transfer	
Fraction: Inorg	Fraction
Area #: R. Spies	Area #
By: DAVID GARCIA	By
On: 06/20/2017	On

* Contact SMO and attach record of resolution

Reviewed By: Jennifer Brooks	Logbook No.: Sample Receipt (59998)
Date: 7.27.17	Logbook Page No.: 9857

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): DAVID GARCIA	Log-in Date: 07/14/2017
Received By (Signature): David Garcia	
Case Number: R. Spies	Sample Delivery Group No.: N/A
Remarks: 19869.01.00X	SAS Number: N/A

		EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
1.	Custody Seal(s) — Present/Absent* Intact/Broken	617480	N/A	617727	Intact
2.	Custody Seal Nos. — N/A				
3.	Chain-of Custody Records — Present/Absent*				
4.	Traffic Reports or Packing Lists — Present/Absent*				
5.	Airbill — Airbill/Sticker Present/Absent*				
6.	Airbill No. — Hand Delivered				
7.	Sample Tags — Present/Absent*				
	Sample Tag Numbers — Listed/Not listed on Chain of Custody				
8.	Sample Condition — Intact/Broken*/Leaking				
9.	Cooler Temperature — N/AC				
10.	Does Information on custody records, traffic reports, and sample tags agree? — Yes/No*				
11.	Date Received at Lab — 07/14/2017				
12.	Time Received — 09:05:00				

Sample Transfer		
Fraction: Inorg	Fraction	
Area #: J. Zhang	Area #	
By: DAVID GARCIA	By	
On: 07/14/2017	On	

* Contact SMO and attach record of resolution

Reviewed By: [signature]	Logbook No.: Sample Receipt (60031)
Date: 7.14.17	Logbook Page No.: 9881 pg 2 of 4

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.00X
SwRI Task Order Number(s): 170713-5

I. Formulation of UNS Salt Solution Surrogate

The UNS solution mix was provided by LANL and prepared as follows. The recipe was cut in half so as to try and minimize the amount of excess solution being left over after analysis. All the salts were weighed out and added to a 4L container. Then 850 mL of 7M nitric acid was added to dissolve the salts. After shaking only about a third of the salts had been dissolved. Another 850 mL of 7M nitric was added and the solution was shaken again. At this point about a third of the salts remained so 100 to 150 mL increments of 7M nitric acid were added until only about 2% of salts remained. This brought the volume of nitric added up to 2400 mL and the total volume of solution up to almost 4L.

II. UNS Solution Treatment Technology Testing

This report encompasses the preparation and analysis of the solid waste surrogates presented in Table 1 used in the testing of the solution blending formulation and evaluation. Additionally, a 1:1 UNS to zeolite mixture was used in the solution blending off gas evaluation.

Table 1 - UNS Surrogate Solution and Zeolite Blending Recipes

Blend ID	UNS/Zeolite Formulation		
	UNS Sol (ml)	Zeolite (ml)	Zeolite : UNS Sol Vol Ratio
UNS/Zeo 1	100	200	2
UNS/Zeo 2	75	225	3
UNS/Zeo 3	60	240	4
UNS/Zeo 4	50	250	5

The sieve apparatus for testing was made by taking a square sheet of 325 um mesh and placing it over the opening of a 1L beaker. A depression was made in the mesh in the center of the beaker in which the sample would be placed. The mesh was then held in place by several rubber bands. This would allow for ease of removal of the sample and mesh once the analysis was completed. The blends in table 1 were made and added to their respective beakers. The sample and beaker where then placed into a zip lock bag and sealed for two weeks (Image 1). Observations were made each day to see if free liquid seeped through the mesh and into the beakers. After two weeks, the samples were removed and the beakers were reweighed to see how much material had seeped into the beakers.

Blends Zeo 3 and Zeo 4 showed no signs of free liquids during the entirety of the two-week period. They did have slight moisture on the mesh but nothing seeped into the beaker. Zeo 2 had a small amount of solution seep through the mesh about 20 minutes after adding it to the beaker. Zeo 1 started seeping through the mesh several seconds after adding it to the beaker (Image 2). The amount of solution passing the mesh sieve can be found in table 2.

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.00X
SwRI Task Order Number(s): 170713-5

Table 2 – Amount of Solution Passing Through 325mesh

Blend ID	Amount of Solution passing 325um mesh (g)
UNS/Zeo1	31.09
UNS/Zeo2	1.54
UNS/Zeo3	< 0.01
UNS/Zeo4	< 0.01
UNS/Zeo4D	< 0.01

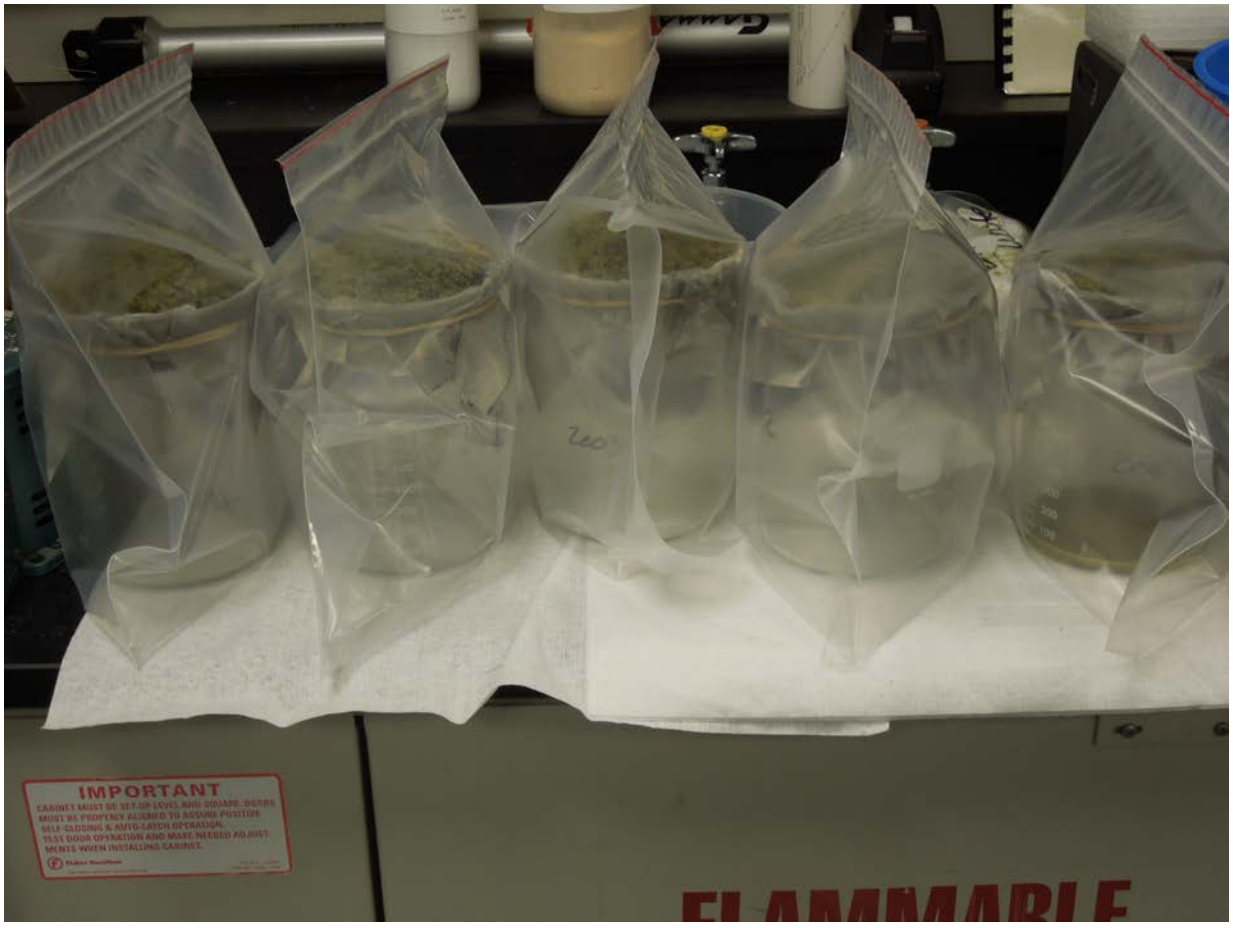


Image 1. Setup of the Solution Blending Formulation and Evaluation testing.

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.00X
SwRI Task Order Number(s): 170713-5



Image 2. Zeo 1 several minutes after adding to sieve

III. UNS Solution Blending Off Gas Evaluation

7-12-17

- 1L of Zeolite was placed inside the 1 gallon HC276 reaction vessel and sealed, vessel was then purged with N_2 to 250psi and bled to zero three times and blocked in.
- 1L of UNS solution was placed in a transfer vessel and purged with N2 overnight.

7-13-17

- The temperature of the process material and the pressure inside the sealed vessel were monitored throughout the test. The pressure and temperature graph is presented in Figure 1.
- 8AM - 1 L of UNS solution was transferred into the autoclave and completed by 8:45AM, pressure was noted to rise approximate 11 psi during that time, mostly believed to be from the displacement of volume by addition of the 1 liter solution. Temperature rose from 69^{o}F to a peak of about 84^{o}F in the first 15 or 20 minutes, then settled and gradually dropped back to 69^{o}F by midnight (the mass of the HC276 vessel acting as a heat sink or the temperatures may have gone higher).

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.00X
SwRI Task Order Number(s): 170713-5

7-14-17

- 9AM - After a 24 hr hold gas samples were taken in two-1 L Tedlar bags, each having the manifold to the sample bag evacuated prior to taking the sample, both samples consumed the pressure that was in the vessel. Approximately 1.5 L of gas was removed from the vessel.
- The vessel was then purged with N_2 for several hours, then the cover removed. Mostly liquid solution was seen and the solids of Zeolite could be felt on the bottom via stirring with an HC276 rod.

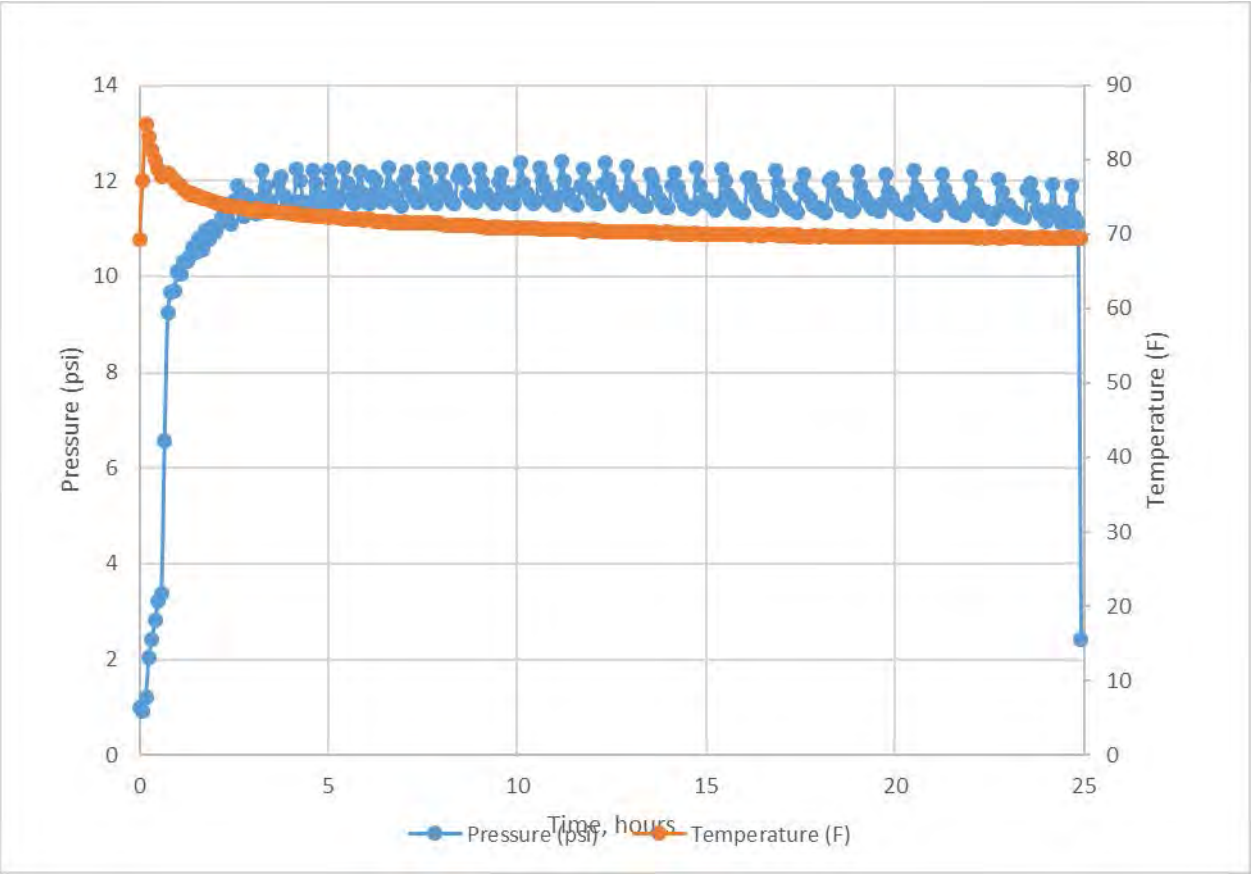


Figure 1. Pressure and Temperature Graph during Autoclave test

The gas samples were logged into the LIMS system and given sample ID 617480. One Tedlar bag was used for the analysis of NOx using ion chromatography. A 100-mL aliquot of gas was scrubbed through 20 mL of a trapping solution in duplicate. The solutions were analyzed for nitrate-N and nitrite-N and were quantitated as NOx (vol %) in the gas sample.

The other Tedlar bag was used for analysis of the Hydrogen, Oxygen, Nitrogen, Carbon Dioxide and Carbon Monoxide by GC/TCD. Two analytical sequences were used to analyze the samples. The analysis of Hydrogen was performed using a Thermal Conductivity detector set in negative [-] mode equipped with a Carbosphere stainless steel column with Nitrogen as a carrier gas. The analysis of Oxygen, Nitrogen, Carbon Monoxide and Carbon Dioxide was performed using a Thermal

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.00X
SwRI Task Order Number(s): 170713-5

Conductivity detector set in positive [+] mode equipped with a Carbosphere stainless steel column with Helium as a carrier gas.

Table 3 contains the sample results for the gas samples. Sample was analyzed in duplicate.

Table 3

Gas	617480 Gas	617480Dup Gas	%RPD
Hydrogen	<0.5	<0.5	0.0%
Oxygen	<1.0	<1.0	0
Nitrogen	50.1	49.4	1.4%
Carbon Dioxide	52.1	52.1	0.0%
Carbon Monoxide	<1.0	<1.0	0
NOx	0.118%	0.136%	14.2%

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."

R Spies

Principal Scientist

7/25/17

Date

Client: Los Alamos National Laboratory
SDG: 617476
SwRI Project Number: 19869.01.00X
SwRI Task Order Number: 170713-5

GAS ANALYSIS

The gas samples were direct injected and analyzed following SwRI TAP 01-0405-013"Gas Chromatography (GC) Analyses for Miscellaneous Gas Analyses". There is no hold time for this analysis.

Two analytical sequences were used to analyze the samples. The analysis of Hydrogen was performed using a Thermal Conductivity detector set in negative [-] mode equipped with a Carbosphere stainless steel column with Nitrogen as a carrier gas. The analysis of Oxygen, Nitrogen, Carbon Monoxide and Carbon Dioxide was performed using a Thermal Conductivity detector set in positive [+] mode equipped with a Carbosphere stainless steel column with Helium as a carrier gas. Multi-point calibration curves were generated for the analytes. If %RSDs for compounds were within the 30% criteria, the compounds were quantitated using the average response factor from the initial calibration curve. If the %RSD was greater than 30%, a linear regression type curve was used ($R^2 > 0.990$). Results are found on Form VI of the data package.

All ICV and CCV results were achieved at less than or equal to a 30% average difference. Results are summarized on Form VII of the data package.

Detected target analytes are reported on Form I.

There are no surrogates used in this method.

There was no LCS analysis required for this analysis.

A sample/sample duplicate was performed for this analysis. Results were within the QC limits of 30% difference. See Form III of the data package.

There was no MS/MSD analysis required for this analysis.

No target analytes were detected in the method blank above the reporting limit. All samples associated with a method blank are summarized on Form IV of the data package.

The analytical sequence is summarized on Form VIII of the data package.

Sample Calculation for target analyte Carbon Dioxide concentration on the Carbosphere column:

Nitrogen Calibration Standard GRPA STD4/STD2017:39:04
20 % Carbon Dioxide, area = 2374052

$$RF_{Carbon\ Dioxide} = \frac{(Area\ of\ Analyte)}{(Conc\ of\ analyte)} = \frac{2374052}{20} = 118703\ (Form\ VI)$$

$$Mean\ RF_{Carbon\ Dioxide} = 114738\ (Form\ VI)$$

Client: Los Alamos National Laboratory
SDG: 617476
SwRI Project Number: 19869.01.00X
SwRI Task Order Number: 170713-5

Sample ID: 617727 Client ID: 617480
Area of Carbon Dioxide = 5976558

$$Conc. = \frac{(Area\ of\ Analyte)\ (\%)}{(Mean\ RF\ of\ Analyte)}\ X\ Dilution\ Factor$$

$$Conc. = \frac{(5976558)\%}{(114738)} \times 1.0 = 52.089\ \%$$

Reported as 52.1 % Carbon Dioxide on Form I.

Sample Calculation for target analyte Nitrogen concentration on the Carbosphere column using linear curve:

Y = BX + A .....Linear regression curve of Nitrogen

Where

X = $Concnetration_{(analyte)}$
Y = $Area_{(analyte)}$
B = 62216.....Slope of calibration curve of Nitrogen

A = 33276.....Y-intercept of calibration curve of Nitrogen

Sample ID: 617727 Client ID: 617480
Area of Nitrogen = 3146405
$X_{Nitrogen}$ = (Y-A) / B
= [3146405-33276] / 62216
= 50.037

Concentration of Nitrogen in sample = $X_{Nitrogen}$ x *Dilution Factor*
= 50.037 x 1.0
= 50.037 %

Reported as 50.0 % Nitrogen on Form I.

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full, without the written approval of SwRI."

Manager **Date** 7/25/17

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Free Liquids

Southwest Research Institute

7/25/17

Client LANL
Project # 19869.01.006
TO#: 170713-5

Date: 7/5/17 to 7/19/17
Analyst: Jmoken

Sample ID	Customer ID	Beaker Initial wgt (g)	Beaker Final wgt (g)	Amount of Solution passing 325um mesh (g)
617476	UNS/Zeo 1	403.976	435.069	31.093
617477	UNS/Zeo 2	397.811	399.346	1.535
617478	UNS/Zeo 3	402.645	402.650	< 0.01
617479	UNS/Zeo 4	402.578	402.582	< 0.01
617479D	UNS/Zeo 4 Dup	400.274	400.278	< 0.01

Sample ID	Customer ID	Day Free Liquids Seen	Comments
617476	UNS/Zeo 1	Day 1	Free Liquids appeared immediately
617477	UNS/Zeo 2	Day 1	Free Liquids appeared roughly 20 minutes after pouring
617478	UNS/Zeo 3	No Free Liquids	NA
617479	UNS/Zeo 4	No Free Liquids	NA
617479D	UNS/Zeo 4 Dup	No Free Liquids	NA

Southwest Research Institute
WC Sample Prep Logbook

010022

Book/Page: _23_ 0011_ Book I.D. # _17-0406-021_

Analysis: UNS/zeo since test Project #: 19869.01.00x
Method (circle) Digestion / Distillation / Extraction / Bomb Task Order#: 170713-5
Client: LANL TAP#:

Balance ID: 05 Pipette ID: 5000- / 1000- / 200- /
Digestion Apparatus: NA Temperature: NA
LCS ID: NA LCS TV = NA
Notes / Prep: UNS solution (191-09-WCS13) Zeolite # 614641

Sample ID	Sample Wt (g) container wgt / Sample Vol (ml)	Final Volume (ml)	UNS tubes # 419 / mL	Zeolite / mL	
UNS/zeo 1	403.9676 TSAM 7/5/17	435.069	100	200	WCS in working solid solution
UNS/zeo 2	~~400.184~~ TSAM 7/5/17 397.811	399.396	75	225	
UNS/zeo3	402.645	402.650	60	240	
UNS/zeo4	402.578	402.582	50mL	250mL	
UNS/zeo4D	~~76.887~~ TSAM 7/5/17 400.274	400.278	50	250	

Start 12:40 7/5/17

Liquid pass through sieve	7/5 to 7/6 Day 1	7/7 Day 2	7/8 Day 3	7/9 Day 4	7/10 Day 5	7/11 Day 6	7/12 Day 7	7/13 Day 8	7/14 Day 9	7/15 Day 10
zeo1	Beginning to dry somewhat	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
zeo2	Beginning to drip 20 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
zeo3	No visible liquid	Slight moisture on sieve	No	No	No	No	No	No	No	No
zeo4	No visible liquid	No	No	No	No	No	No	No	No	No
zeo4D	No visible liquid	No	No	No	No	No	No	No	No	No

Liquid pass through sieve	7/16 Day 11	7/17 Day 12	7/18 Day 13	7/19 Day 14
zeo1	Yes	Yes	Yes	Yes
zeo2	Yes	Yes	Yes	Yes
zeo3	No	No	No	No
zeo4	No	No	No	No
zeo4D	No	No	No	No

① no free liquid in the beaker

slight moisture on sieve and outside of beaker
slight moisture on sieve
slight moisture on sieve

Analyst Signature: Date: 7/5/17
Reviewed by: Date: 7/25/17

010023

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

NOx Gas Analysis

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID
617480 Gas Sample

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Gas

Date Received: 07/14/17

Task Order #: 170713-5

SRR #: 60031

Lab System ID: 617727

Analysis	Sample Result	Q	Reporting Limit	Units	Date Analyzed	Method
NOx	0.118	*	0.014	%(v/v)	7/14/2017	IC - 300

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SOUTHWEST RESEARCH INSTITUTE
DUPLICATE SUMMARY

Sample ID
617480 Gas Sample

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Gas

Date Received: 07/14/17

Task Order #: 170713-5

SRR #: 60031

Lab System ID: 617727D

Analysis	Duplicate Result	Q	RPD	Units	Date Analyzed	Method
NOx	0.136	*	14.2%	%(v/v)	7/14/2017	IC - 300

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SOUTHWEST RESEARCH INSTITUTE
BLANK SUMMARY

Sample ID
Prep Blank

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Gas

Date Received: NA

Task Order #: 170713-5

SRR #: NA

Lab System ID: PB

Analysis	Sample Result	Q	Reporting Limit	Units	Date Analyzed	Method
Nitrate-N	0.100	U	0.100	mg/L	7/14/2017	IC - 300
Nitrite-N	0.100	U	0.100	mg/L	7/14/2017	IC - 300

U in the Q (qualifier) column indicates undetected. NA - Not Applicable.

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SOUTHWEST RESEARCH INSTITUTE
LABORATORY CONTROL SAMPLE

Sample ID
ICV

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Liquid

Date Received: NA

Task Order #: 170713-5

SRR #: NA

Lab System ID: ICV

Analysis	Sample Result	Q	True Value	Recovery	Units	Date Analyzed	Method
Nitrate-N	90.2		90.4	99.8%	mg/L	7/14/2017	IC - 300
Nitrite-N	197		191	103%	mg/L	7/14/2017	IC - 300

U in the Q (qualifier) column indicates undetected. NA - Not Applicable.

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SOUTHWEST RESEARCH INSTITUTE
BLANK SUMMARY

Sample ID
ICB

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Liquid

Date Received: NA

Task Order #: 170713-5

SRR #: NA

Lab System ID: ICB

Analysis	Sample Result	Q	Reporting Limit	Units	Date Analyzed	Method
Nitrate-N	0.100	U	0.100	mg/L	7/14/2017	IC - 300
Nitrite-N	0.100	U	0.100	mg/L	7/14/2017	IC - 300

U in the Q (qualifier) column indicates undetected.

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SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

NOx Gas Analysis
Raw Data

Southwest Research Institute
TO #170713-5
Analyst: J. Herrera

Sample	NO2N, mg/L	NO3N, mg/L	Sum as N, mg/L	Gas Vol, mL	Impinger Vol, mL	NOx, vol%
617480	2.55	0.8	3.35	100	20	0.118%
617480 D	2.63	1.23	3.86	100	20	0.136%

Sum as N, mg/L x (24.6/ 14000) x (impinger vol, mL/Gas Vol, ml) x 100 = NOx vol%

Sample calc

$617480 = (2.55 + 0.8) \times \frac{24.6}{14000} \times \frac{20}{100} \times 100 = 0.118\%$

VR Spiers
7/25/17

010031

Southwest Research Institute
WC Sample Prep Logbook

Book/Page: 23 0015 Book I.D. # 17-0406-021

Analysis: gas prep Project #: 19869.01.006
Method (circle) Digestion / Distillation / Extraction / Bomb Task Order#: 170713-5
Client: LANL TAP#:

Balance ID: NA Pipette ID: 5000- R 1000- 1 200- 1
Digestion Apparatus: NA Temperature: NA
LCS ID: NA LCS TV = NA
Notes / Prep:

Sample ID	Sample Wt (g) Sample Vol (ml)	Final Volume (ml) element			
PB	100mL	20mL			
617727	100mL	20mL			
617727D	100mL	20mL			

SAM 7/14/17

Analyst Signature: Date: 7/14/17
Reviewed by: Date: 7/25/17

IC EPA 300

Southwest Research Institute
San Antonio, Texas 78228

Batch: 20170717-A005 (Ver. 5)
Status: CONSUMED

Analyte Test: IC EPA 300
Limit: IC EPA 300
Analysis Method: IC EPA 300 (TAP: TAP-01-0406-042)
Instrument: IC DX500
Data File Name: 170714.csv
Start Time: 07/14/2017 09:59:44
Stop Time: 07/14/2017 16:55:22
Qualifier Set: Default
Pipette: 5000-R, 1000-1, 200-2
SDG: 617476
Project: 19869.01.00X
Task Order: 170713-5
Customer: Los Alamos National Laboratory

			Nitrite as N			Nitrate as N		
Sample Identification	Client Identification	DF	Analyte Result (ug/L)	Final Result (mg/L)	RL (mg/L)	Analyte Result (ug/L)	Final Result (mg/L)	RL (mg/L)
ICV ①	NA	25	197000 D	197 D	2.50 D	90200 D	90.2 D	2.50 D
ICB	NA		0.00 U	0.100 U	0.100	0.00 U	0.100 U	0.100
LLC ②	NA		195	0.195	0.100	211	0.211	0.100
CCV ①	NA	25	199000 D	199 D	2.50 D	91300 D	91.3 D	2.50 D
CCB	NA		0.00 U	0.100 U	0.100	0.00 U	0.100 U	0.100
PB17G14PB1	NA		0.00 U	0.100 U	0.100	0.00 U	0.100 U	0.100
617727	617480		2550	2.55	0.100	800 *	0.800 *	0.100
617727D	617480		2630	2.63	0.100	1230 *	1.23 *	0.100
617727S ③	617480		5490	5.49	0.100	2760 *	2.76 *	0.100
CCV2 ①	NA	25	200000 D	200 D	2.50 D	91200 D	91.2 D	2.50 D
CCB2	NA		0.00 U	0.100 U	0.100	0.00 U	0.100 U	0.100

① spiked 0.200 mL of 181-01-IC10 (Lot# 67661, Source: Fisher, Exp:) with Nitrite as N at 191 mg/L to FV 5 mL0.200 mL of CI# 84129 IC Instrument Check Standard 2 (Lot# 1-72PWY, Source: Spex Certriprep, Exp: 03/30/2018) with Nitrate as N at 90.4 mg/L to FV 5 mL
② spiked 0.100 mL of 181-02-IC10 (Lot# 181-02-IC10, Source: UNDEFINED, Exp:) with Nitrate as N at 10 mg/L and Nitrite as N at 10 mg/L to FV 5 mL
③ spiked 0.1 mL of 181-01-IC10 (Lot# 67661, Source: Fisher, Exp:) with Nitrite as N at 191 mg/L to FV 5 mL0.1 mL of CI# 84129 IC Instrument Check Standard 2 (Lot# 1-72PWY, Source: Spex Certriprep, Exp: 03/30/2018) with Nitrate as N at 90.4 mg/L to FV 5 mL

Comments: NA

U - Result is less than the SwRI Reporting Limit (RL)

Prepared by: HERRERA, JUDY Date: 07/14/2017

Reviewed by: MOKEN, JAMES Date: 07/18/2017

Schedule File: C:\PeakNet\Schedule_500\14JULY17.sch

010033

Line	Sample	Sample Type	Level	Method	Data File	Dilution
1	ICV	Sample		anions170703.met	170714_001.dxd	25
2	ICB	Sample		anions170703.met	170714_002.dxd	1
3	LLC	Sample		anions170703.met	170714_003.dxd	1
4	PB	Sample		anions170703.met	170714_004.dxd	1
5	615949	Sample		anions170703.met	170714_005.dxd	1
6	615950	Sample		anions170703.met	170714_006.dxd	1
7	615951	Sample		anions170703.met	170714_007.dxd	1
8	616496	Sample		anions170703.met	170714_008.dxd	1
9	616497	Sample		anions170703.met	170714_009.dxd	1
10	616498	Sample		anions170703.met	170714_010.dxd	1
11	616653	Sample		anions170703.met	170714_011.dxd	1
12	616654	Sample		anions170703.met	170714_012.dxd	1
13	CCV	Sample		anions170703.met	170714_013.dxd	25
14	CCB	Sample		anions170703.met	170714_014.dxd	1
15	616655	Sample		anions170703.met	170714_015.dxd	1
16	615949D	Sample		anions170703.met	170714_016.dxd	1
17	615949S	Sample		anions170703.met	170714_017.dxd	1
18	617041	Sample		anions170703.met	170714_018.dxd	1
19	617041D	Sample		anions170703.met	170714_019.dxd	1
20	617041S	Sample		anions170703.met	170714_020.dxd	1
21	PB-Div.18	Sample		anions170703.met	170714_021.dxd	1
22	617727	Sample		anions170703.met	170714_022.dxd	1
23	617727D	Sample		anions170703.met	170714_023.dxd	1
24	617727S	Sample		anions170703.met	170714_024.dxd	1
25	CCV2	Sample		anions170703.met	170714_025.dxd	25
26	CCB2	Sample		anions170703.met	170714_026.dxd	1
27	615949S	Sample		anions170703.met	170714_027.dxd	1
28	617041	Sample		anions170703.met	170714_028.dxd	5
29	617041D	Sample		anions170703.met	170714_029.dxd	5
30	617041S	Sample		anions170703.met	170714_030.dxd	5
31	CCV3	Sample		anions170703.met	170714_031.dxd	25
32	CCB3	Sample		anions170703.met	170714_032.dxd	1
33	STOP	Sample		astop.met	170714	1

Default Method Path: C:\PEAKNET\METHOD
Default Data Path: C:\PEAKNET\DATA_500\170714
Comment:
[redacted]
Los Alamos National Laboratory; 19869.01.006; TO#

"M" INDICATES MANUAL INTEGRATION

#20170717-A005
~~20170717-P003~~ CI SAM 7/18/17

ICV Sources:
1) SPEX (INORG#84129)
F = 100 mg/L
Cl = 200 mg/L
Br = 400 mg/L
NO3N = 90.4 mg/L
PO4P = 194 mg/L
SO4 = 400 mg/L

2) NO2-N 181-01-IC10
T.V. = 191 mg/L

3) LLC 181-02-IC10

EP: 5000-R
1000-1
200-2

Dilutions:

Schedule File: C:\PeakNet\Schedule_500\14JULY17.sch

df 25 = 0.200 mL SPEX #84129 + 0.200 #181-01-IC10 + 4.60 mL DI water
df 5 = 1.00 mL sample + 4.00 mL DI water

All of Div.14 and LANL sample were treated with OnGuard II H
samples:
615949-615951
616496-616498
616653-616655
617727

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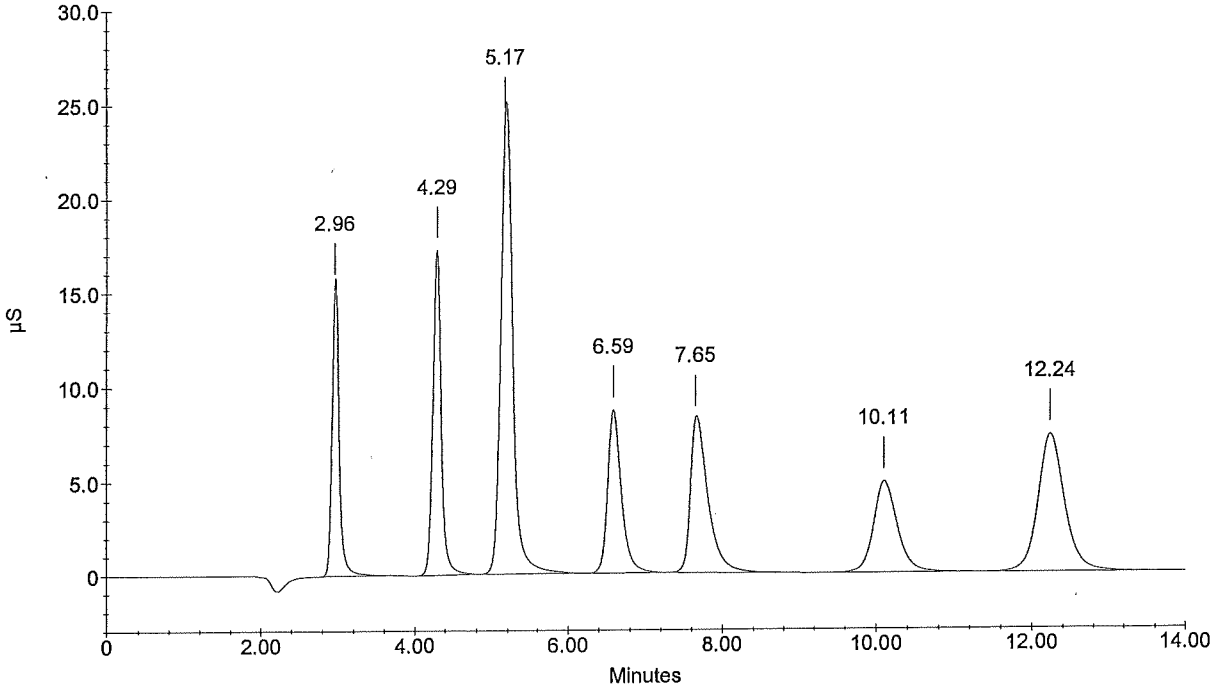
Sample Name : ICV
Dilution Factor : 25.00
Injection Number : 1
Data File Name : ...\170714_001.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 9:59:44 AM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.96	FLUORIDE	100196.101	153432	998613	1	-1.00
2	4.29	CHLORIDE	203124.578	172348	1311211	1	-0.62
3	5.17	NITRITE-N	197189.581	240444	2740254	1	-1.46
4	6.59	BROMIDE	422710.084	86552	1076511	1	-0.80
5	7.65	NITRATE-N	90198.994	81884	1335637	1	1.10
6	10.11	PHOSPHATE-P	195282.844	48824	1055409	1	-1.30
7	12.24	SULFATE	410436.984	73273	1783210	1	-2.16
	0.00		---total(s)--- 1619139.166		10300846		

ICV



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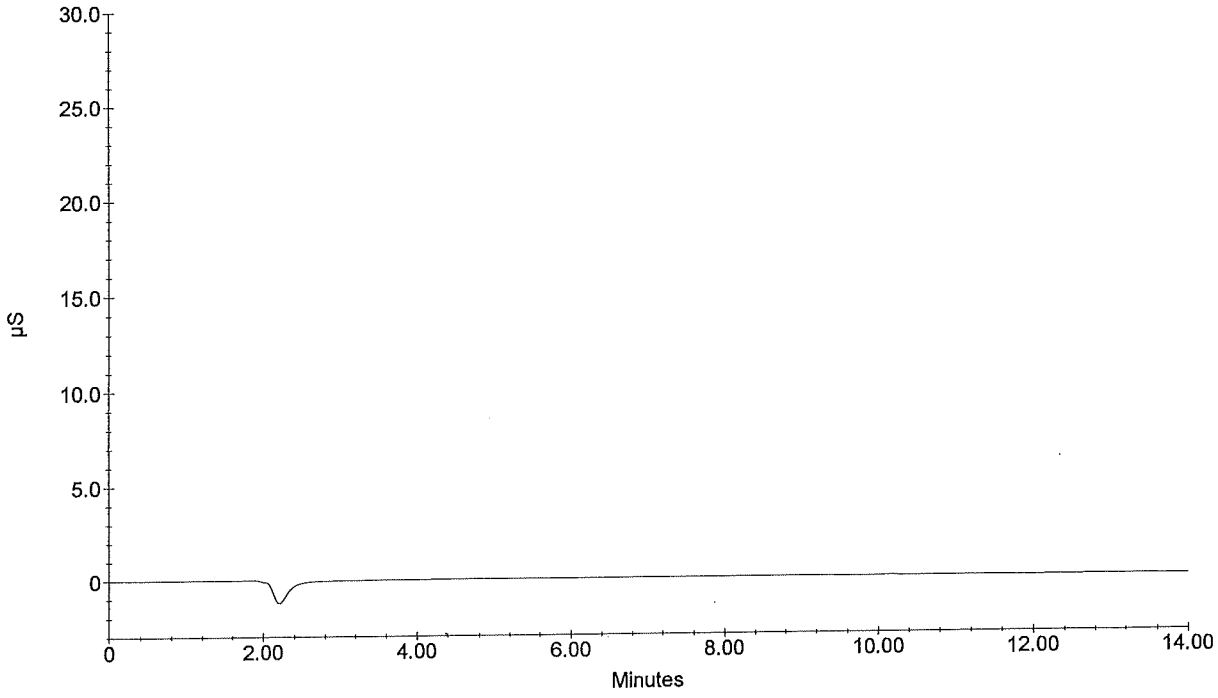
Sample Name : ICB
Dilution Factor : 1.00
Injection Number : 2
Data File Name : ...\170714_002.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 10:16:23 AM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
0	0.00	(null) CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P SULFATE	0.000	0	0	0	0.00
	0.00	---total(s)---	0.000		0		

ICB



Southwest Research Institute

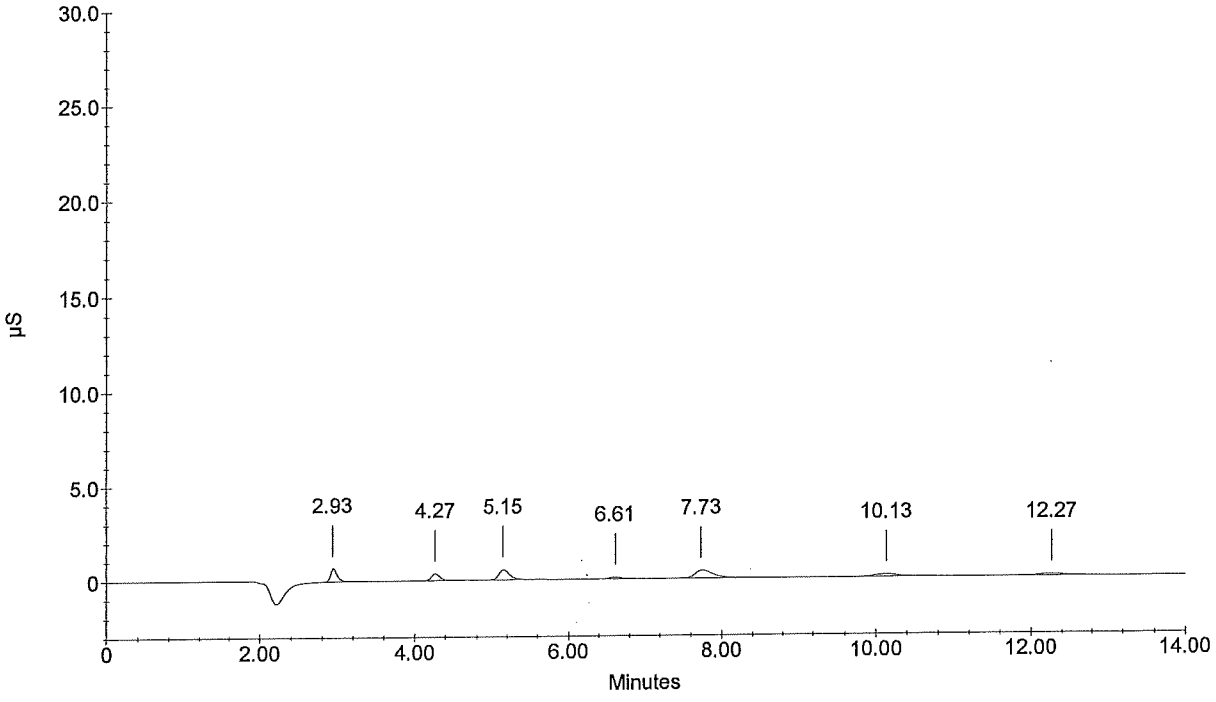
Sample Name : LLC
Dilution Factor : 1.00
Injection Number : 3
Data File Name : ...\170714_003.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 10:33:00 AM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.93	FLUORIDE	228.772	6742	43301	1	-1.90
2	4.27	CHLORIDE	225.660	3602	29329	1	-1.23
3	5.15	NITRITE-N	195.154	5309	54935	1	-1.97
4	6.61	BROMIDE	200.443	860	10337	1	-0.40
5	7.73	NITRATE-N	210.663	4059	68428	1	2.16
6	10.13	PHOSPHATE-P	211.455	1307	28251	1	-1.04
7	12.27	SULFATE	208.913	863	19931	1	-1.95
	0.00		---total(s)--- 1481.059		254512		

LLC



Southwest Research Institute

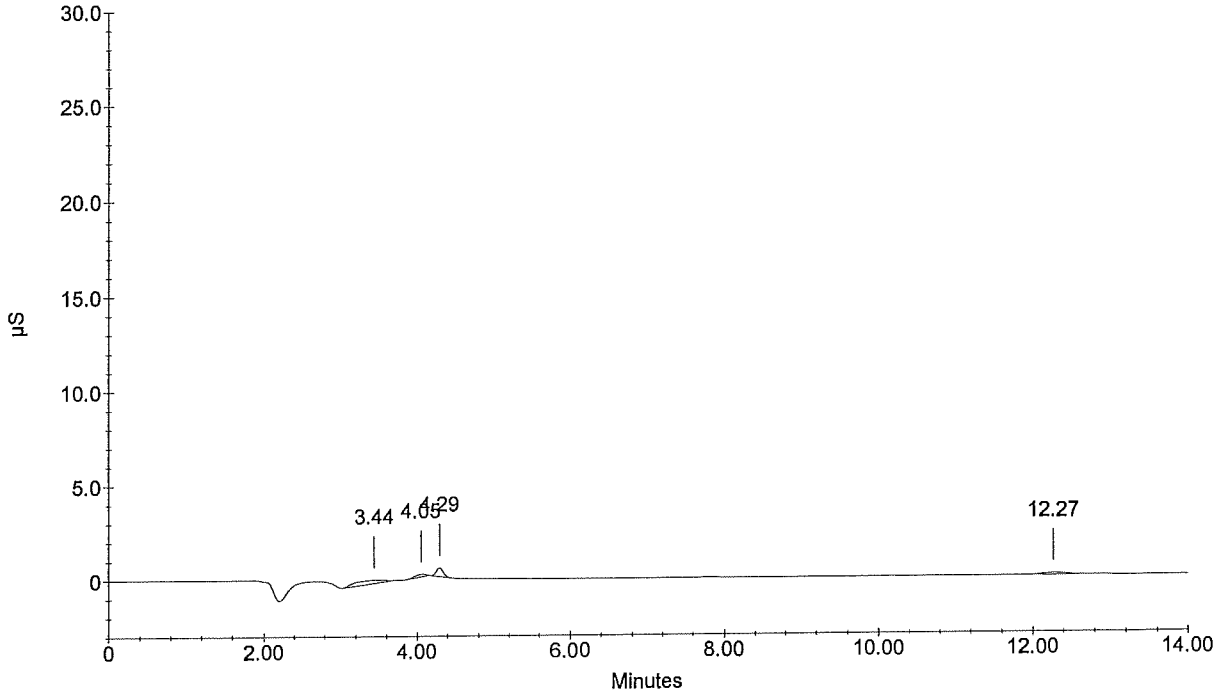
Sample Name : PB
Dilution Factor : 1.00
Injection Number : 4
Data File Name : ...\170714_004.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 10:49:38 AM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.44		0.000	1814	54020	1	
3	4.29	CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P	224.153	4614	29098	1	-0.62
4	12.27	SULFATE	239.149	884	22984	1	-1.95
	0.00		---total(s)--- 463.302		106102		

PB



Southwest Research Institute

010039

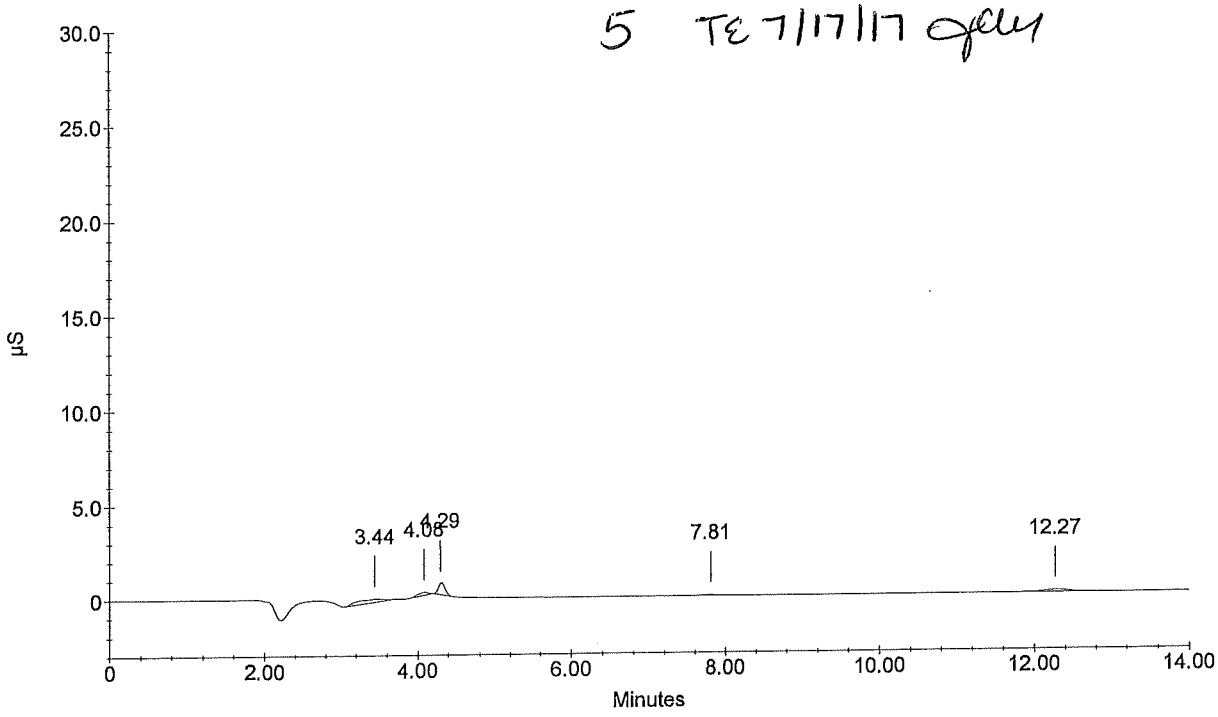
Sample Name : 616949
Dilution Factor : 1.00
Injection Number : 5
Data File Name : ...\170714_005.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 11:06:17 AM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.44		0.000	1657	45448	1	
3	4.29	CHLORIDE NITRITE-N BROMIDE	293.186	5830	39665	1	-0.62
4	7.81	NITRATE-N PHOSPHATE-P	35.477	416	6067	1	3.21
5	12.27	SULFATE	266.945	1059	25792	1	-1.95
	0.00		---total(s)--- 595.607		116972		

616949
5 TE 7/17/17 qcly



Southwest Research Institute

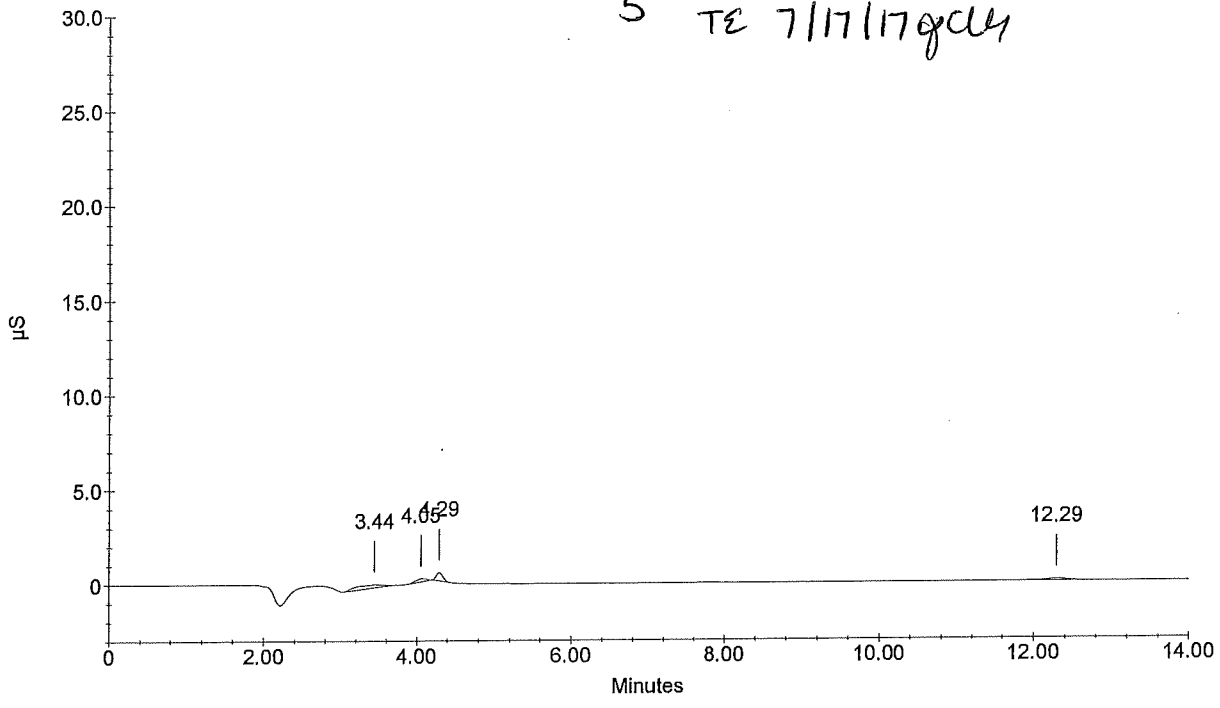
Sample Name : 616950
Dilution Factor : 1.00
Injection Number : 6
Data File Name : ...\170714_006.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 11:22:54 AM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.44		0.000	1647	46940	1	
3	4.29	CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P	197.314	4205	24992	1	-0.62
4	12.29	SULFATE	190.942	781	18116	1	-1.73
	0.00		---total(s)--- 388.255		90049		

616950
5 TE 7/17/17 qcw



Southwest Research Institute

010041

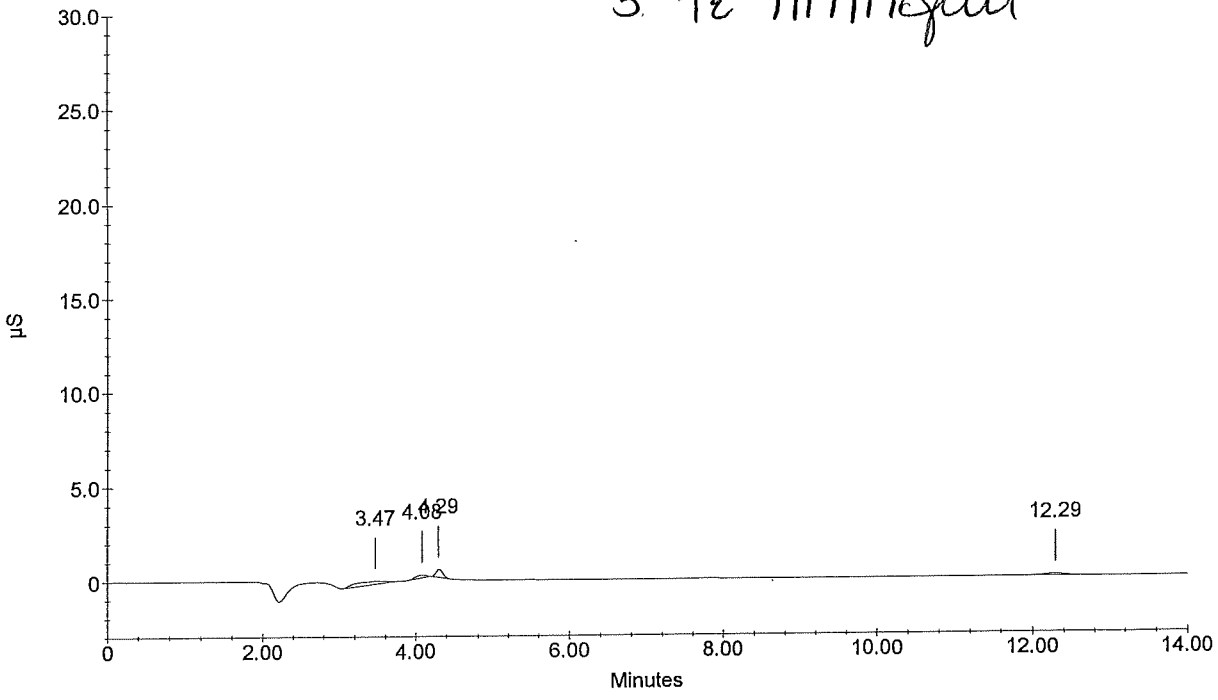
Sample Name : 616951
Dilution Factor : 1.00
Injection Number : 7
Data File Name : ...\170714_007.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 11:39:32 AM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.47		0.000	1626	49732	1	
3	4.29	CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P	203.381	4057	25920	1	-0.62
4	12.29	SULFATE	204.276	834	19463	1	-1.73
	0.00		---total(s)--- 407.657		95115		

616951
5 TE 7/17/17 ofcm



Southwest Research Institute

010042

Sample Name : 616496
Dilution Factor : 1.00
Injection Number : 8
Data File Name : ...\170714_008.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

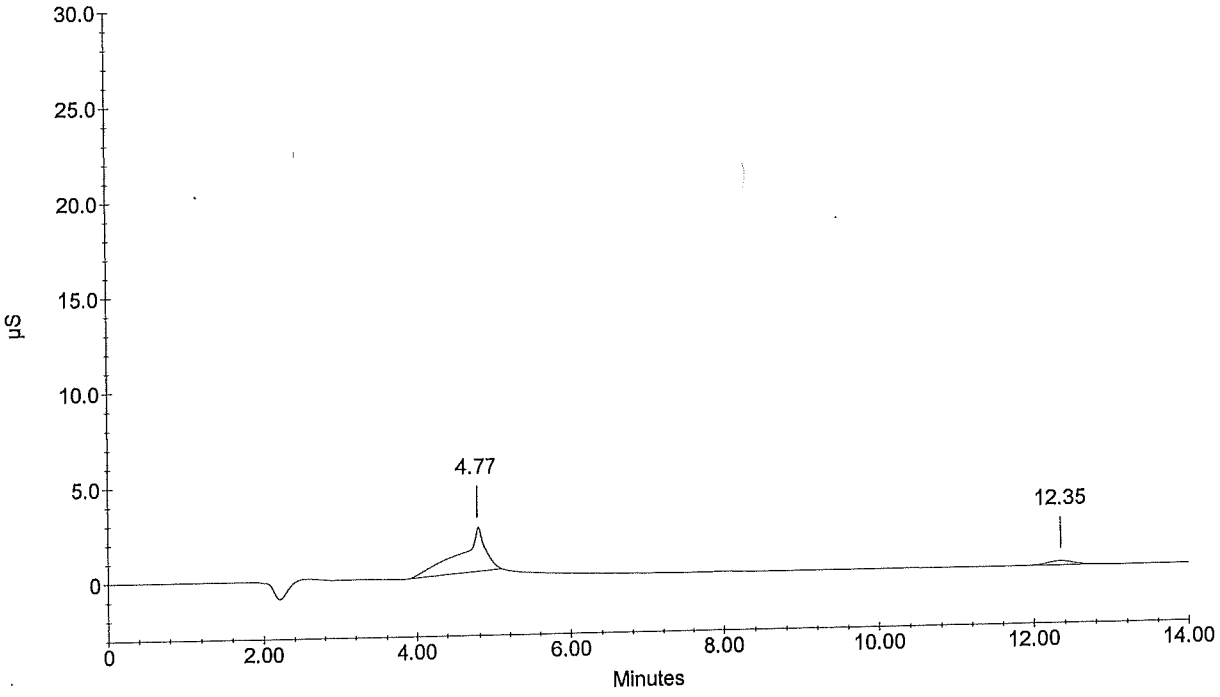
Date Time Collected : 7/14/17 11:56:10 AM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	4.77	CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P	0.000	21646	539672	1	
2	12.35	SULFATE	504.216	2108	49784	1	-1.31
	0.00		---total(s)--- 504.216		589456		

m = 7/17/17 ajdy

616496



Southwest Research Institute

010043

Sample Name : 616497
Dilution Factor : 1.00
Injection Number : 9
Data File Name : ...\170714_009.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

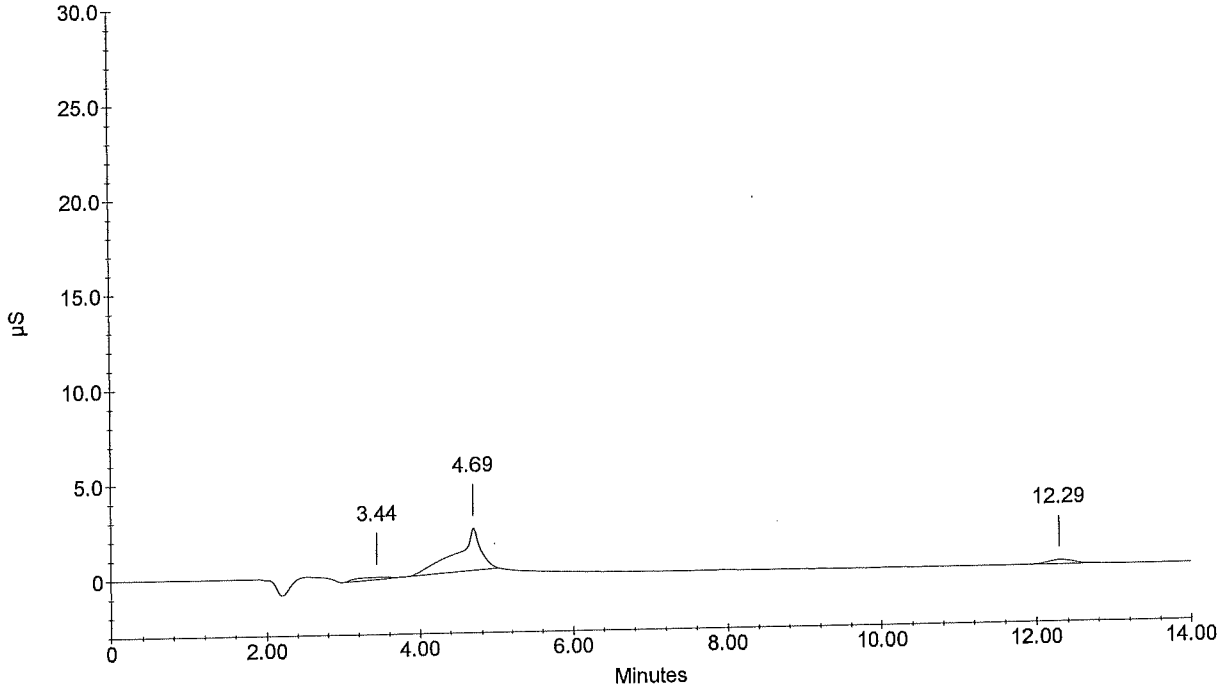
Date Time Collected : 7/14/17 12:12:47 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.44	CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P	0.000	1226	43468	1	
3	12.29	SULFATE	517.722	2121	51151	1	-1.73
			---total(s)---				
	0.00		517.722		94619		

4.69 m = 7/17/17 JCH

616497



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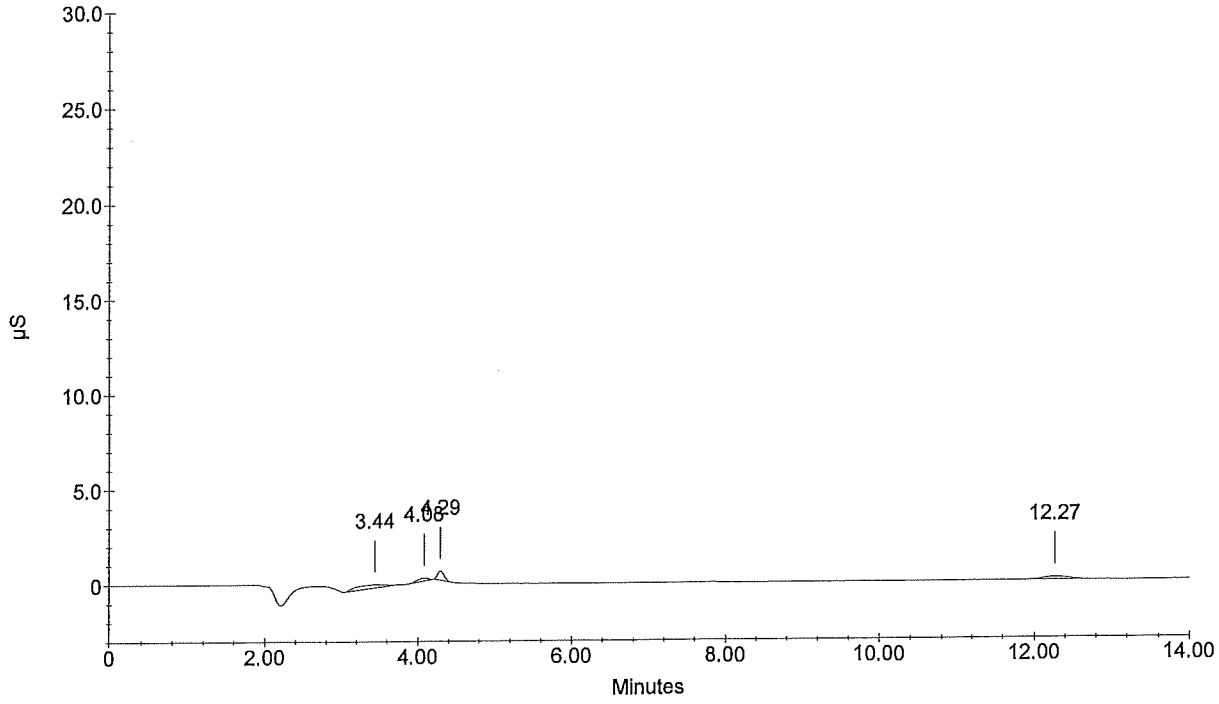
Sample Name : 616498
Dilution Factor : 1.00
Injection Number : 10
Data File Name : ...\170714_010.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 12:29:24 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.44		0.000	1743	50161	1	
3	4.29	CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P	214.578	4680	27633	1	-0.62
4	12.27	SULFATE	396.415	1577	38877	1	-1.95
	0.00	---total(s)---	610.993		116672		

616498



Southwest Research Institute

010045

Sample Name : 616653
Dilution Factor : 1.00
Injection Number : 11
Data File Name : ...\170714_011.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

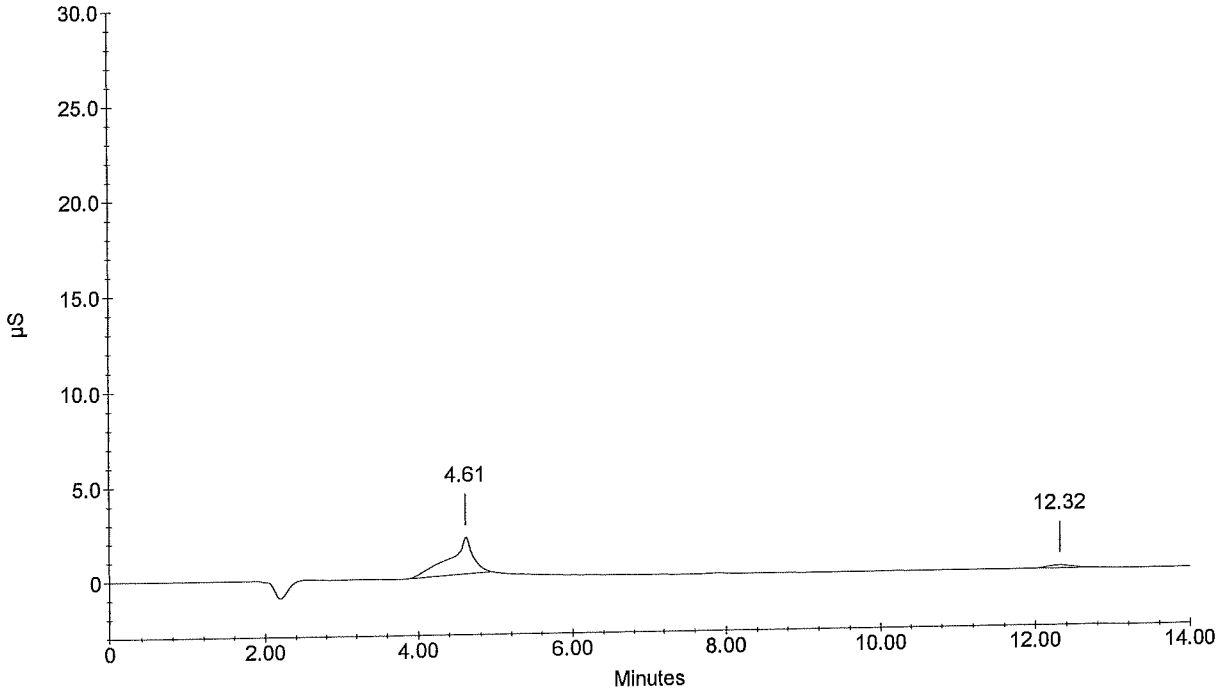
Date Time Collected : 7/14/17 12:45:59 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	4.61	CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P	0.000	19296	412417	1	
2	12.32	SULFATE	382.010	1600	37421	1	-1.52
	0.00		---total(s)--- 382.010		449837		

m = 7/17/17 JCH

616653



Southwest Research Institute

010046

Sample Name : 616654
Dilution Factor : 1.00
Injection Number : 12
Data File Name : ...\170714_012.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

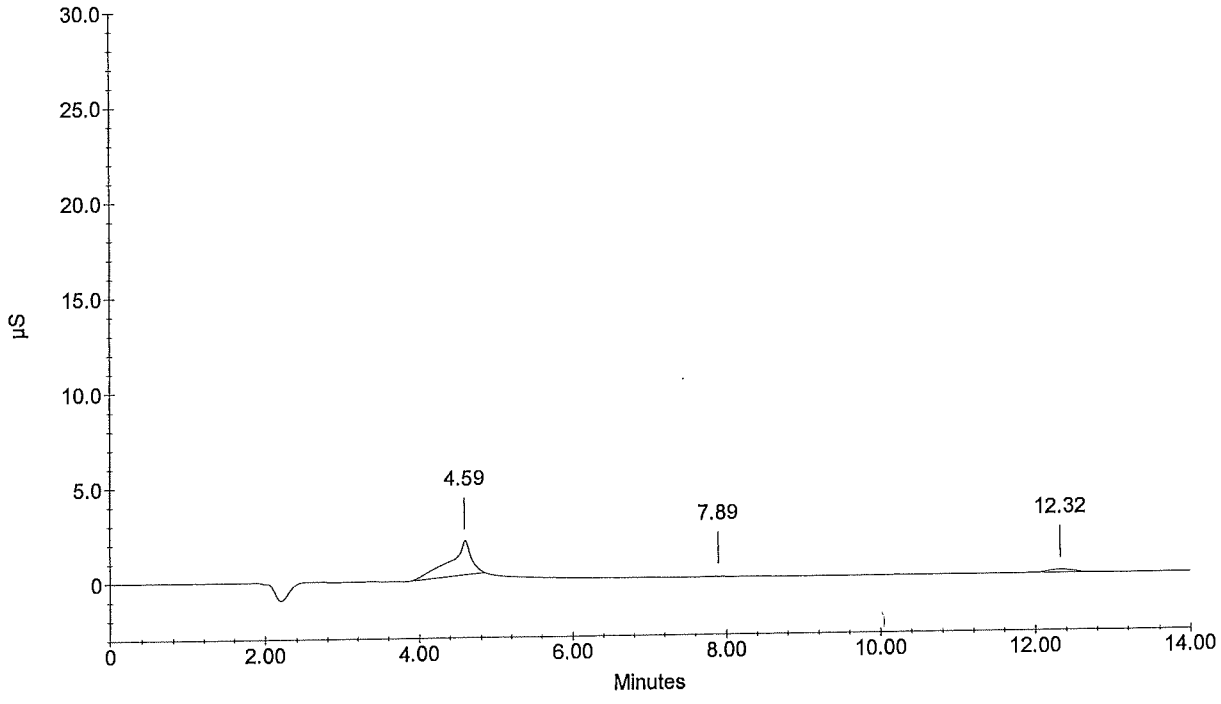
Date Time Collected : 7/14/17 1:02:35 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num		Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	M	4.59	CHLORIDE NITRITE-N BROMIDE	0.000	17453	351090	1	
2		7.89	NITRATE-N PHOSPHATE-P	35.323	419	6012	1	4.27
3		12.32	SULFATE	376.345	1563	36848	1	-1.52
				---total(s)---				
		0.00		411.668		393951		

M = 7/17/17 JCH

616654



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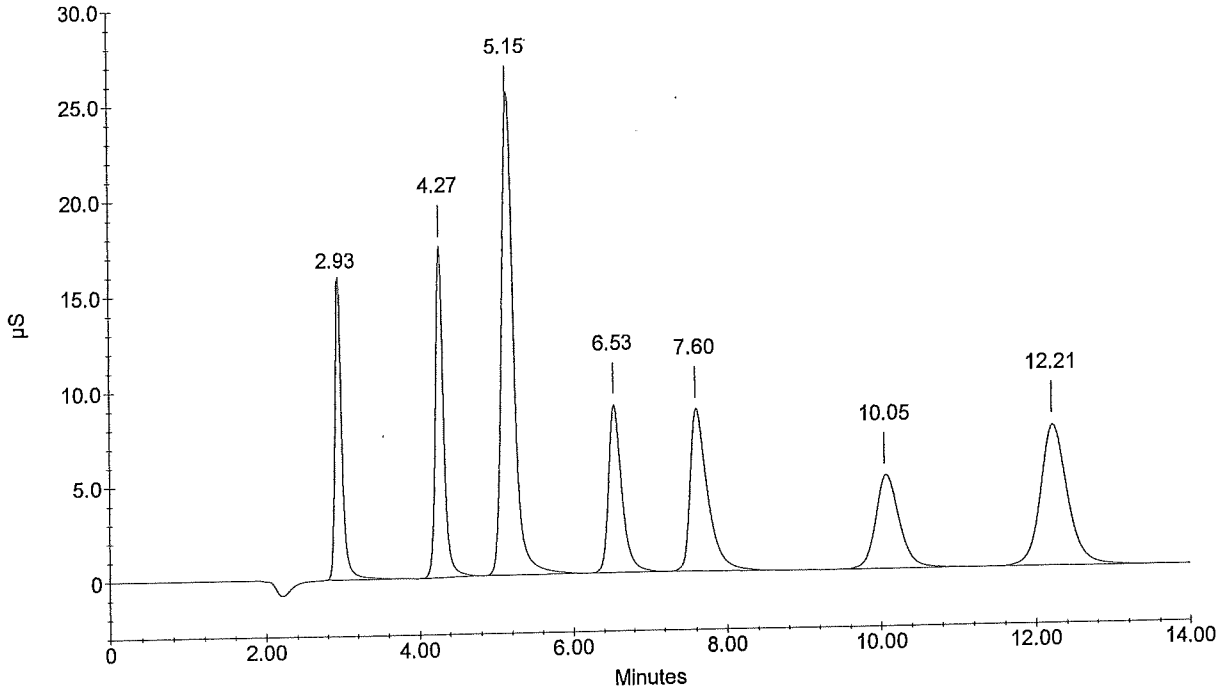
Sample Name : CCV
Dilution Factor : 25.00
Injection Number : 13
Data File Name : ...\170714_013.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 1:19:12 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.93	FLUORIDE	102440.417	134138	1021375	1	-1.90
2	4.27	CHLORIDE	204512.007	172605	1320803	1	-1.23
3	5.15	NITRITE-N	199369.566	244248	2772868	1	-1.97
4	6.53	BROMIDE	427210.771	87651	1089167	1	-1.61
5	7.60	NITRATE-N	91332.679	84943	1353372	1	0.40
6	10.05	PHOSPHATE-P	198158.524	48792	1071841	1	-1.82
7	12.21	SULFATE	417932.783	74169	1818625	1	-2.37
	0.00		---total(s)--- 1640956.747		10448051		

CCV



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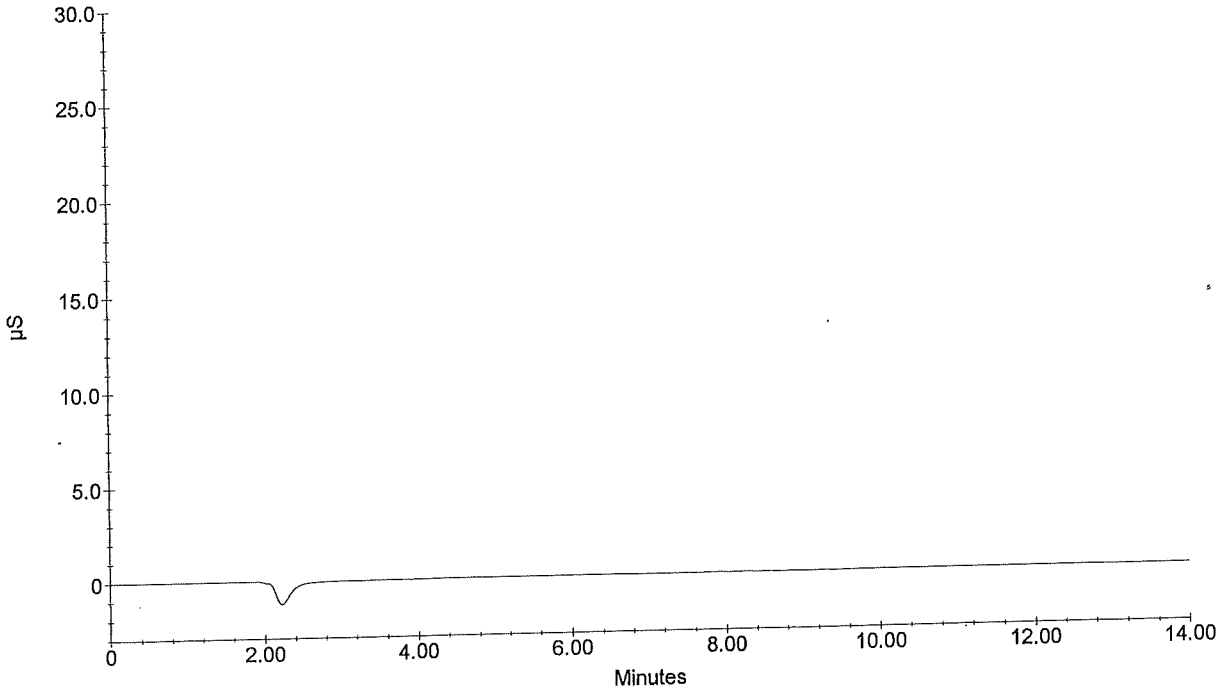
Sample Name : CCB
Dilution Factor : 1.00
Injection Number : 14
Data File Name : ...\170714_014.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 1:35:48 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
0	0.00	(null) CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P SULFATE	0.000	0	0	0	0.00
	0.00		---total(s)--- 0.000		0		

CCB



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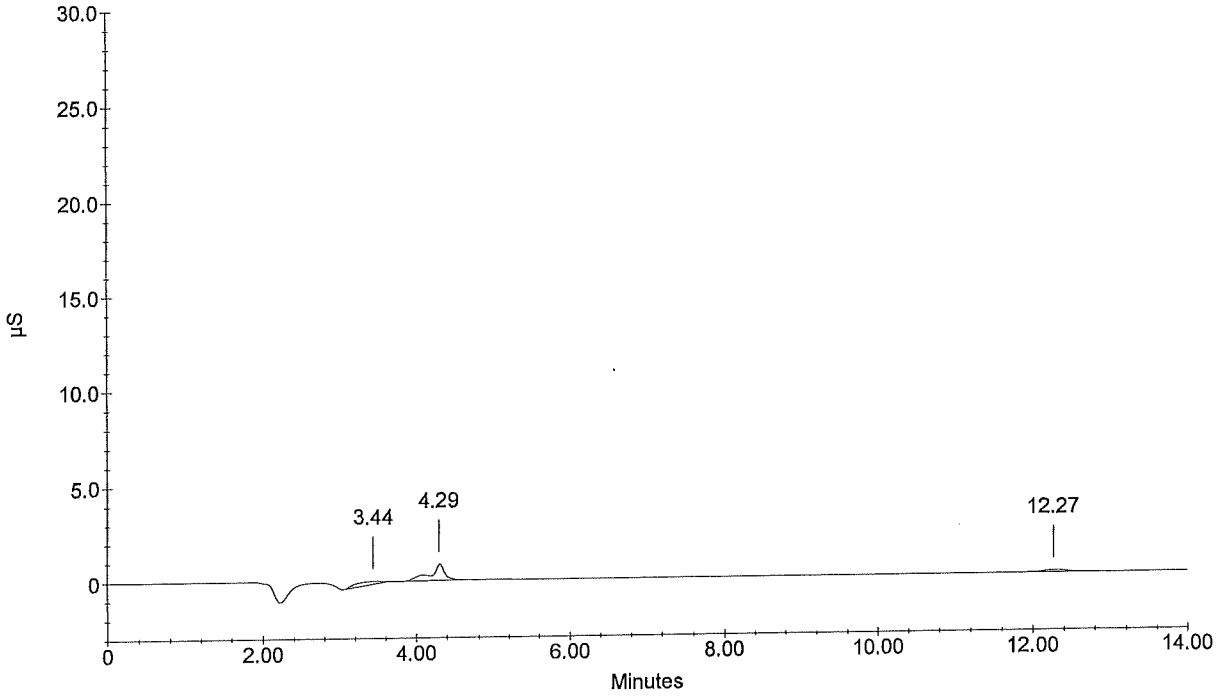
Sample Name : 616655
Dilution Factor : 1.00
Injection Number : 15
Data File Name : ...\170714_015.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 1:52:25 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.44		0.000	1678	44263	1	
2	4.29	CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P	771.797	8388	113204	1	-0.62
3	12.27	SULFATE	267.768	1082	25875	1	-1.95
	0.00		---total(s)--- 1039.566		183342		

616655



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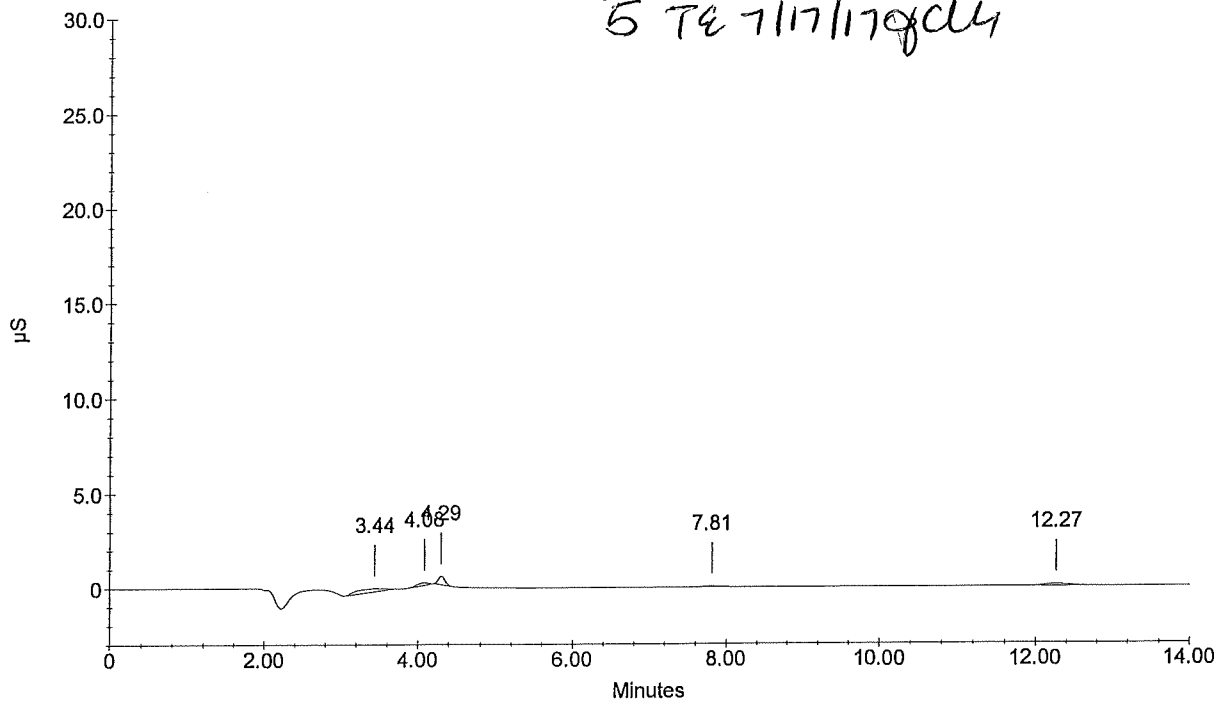
Sample Name : 616949D
Dilution Factor : 1.00
Injection Number : 16
Data File Name : ...\170714_016.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 2:09:03 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.44		0.000	1736	47727	1	
3	4.29	CHLORIDE NITRITE-N BROMIDE	210.503	4358	27010	1	-0.62
4	7.81	NITRATE-N PHOSPHATE-P	36.579	443	6459	1	3.21
5	12.27	SULFATE	270.744	1071	26175	1	-1.95
	0.00		---total(s)--- 517.826		107371		

616949D
5 TE 7/17/17 9CM



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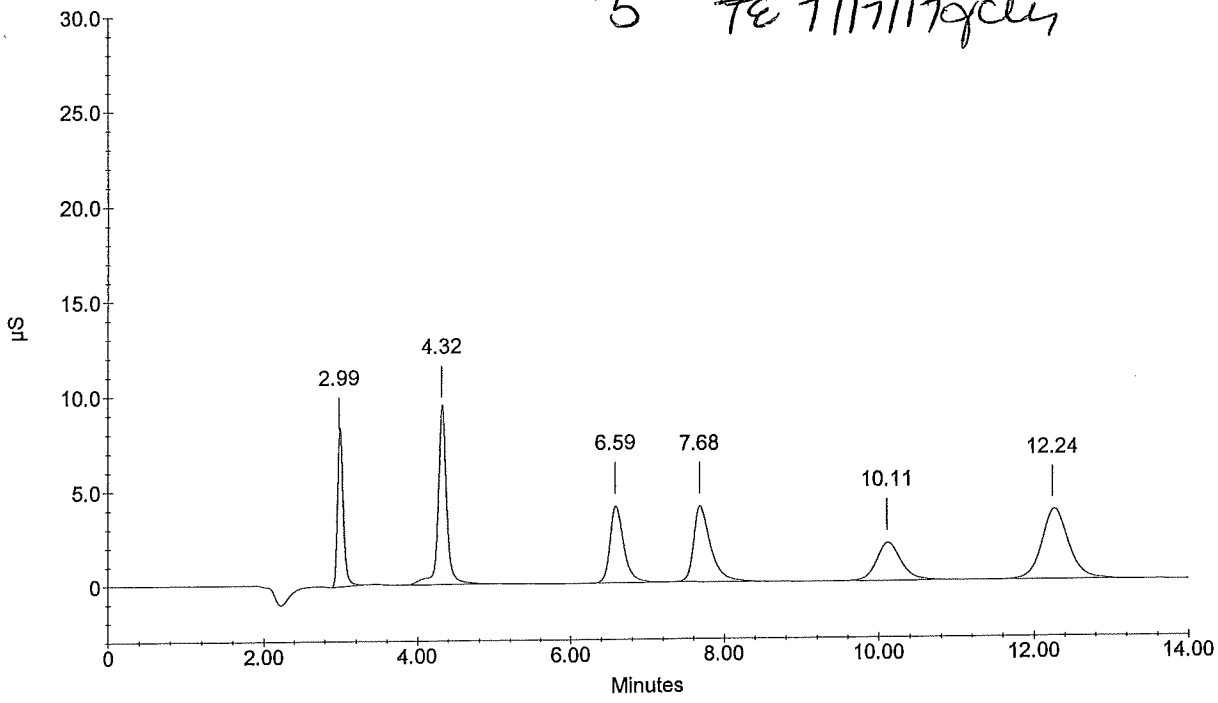
Sample Name : 616949S
Dilution Factor : 1.00
Injection Number : 17
Data File Name : ...\170714_017.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 2:25:40 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.99	FLUORIDE	1755.562	76640	428588	1	-0.11
2	4.32	CHLORIDE	4627.521	92082	724368	1	-0.00
		NITRITE-N					
3	6.59	BROMIDE	8380.425	40593	508107	1	-0.80
4	7.68	NITRATE-N	1766.750	40099	634568	1	1.45
5	10.11	PHOSPHATE-P	3464.590	20316	454703	1	-1.30
6	12.24	SULFATE	8813.340	36823	921869	1	-2.16
	0.00		---total(s)--- 28808.187		3672202		

616949S
5 TE 7/17/17 JCH



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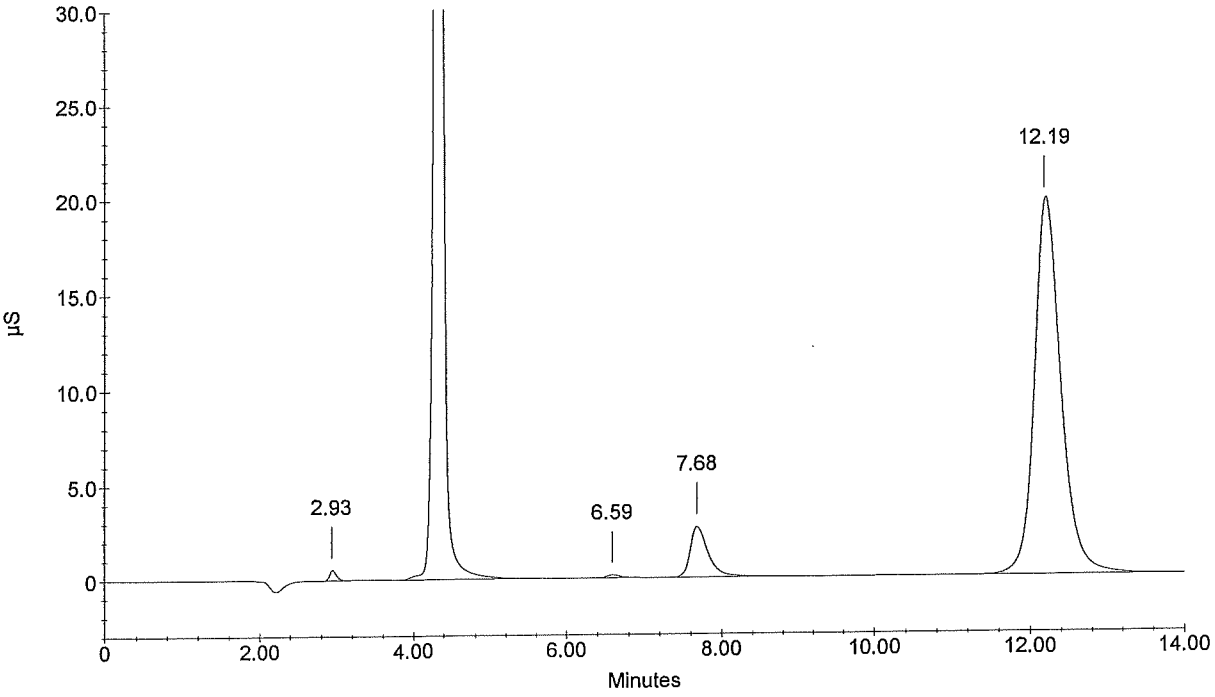
Sample Name : 617041
Dilution Factor : 1.00
Injection Number : 18
Data File Name : ...\170714_018.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 2:42:18 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.93	FLUORIDE	201.126	5346	36333	1	-1.90
2	4.35	CHLORIDE	28901.017	788527	6012659	1	0.62
		NITRITE-N					
3	6.59	BROMIDE	325.312	1449	17643	1	-0.80
4	7.68	NITRATE-N	1221.158	26850	433491	1	1.45
		PHOSPHATE-P					
5	12.19	SULFATE	38002.922	195946	4746348	1	-2.58
			---total(s)---				
	0.00		68651.534		11246474		

617041



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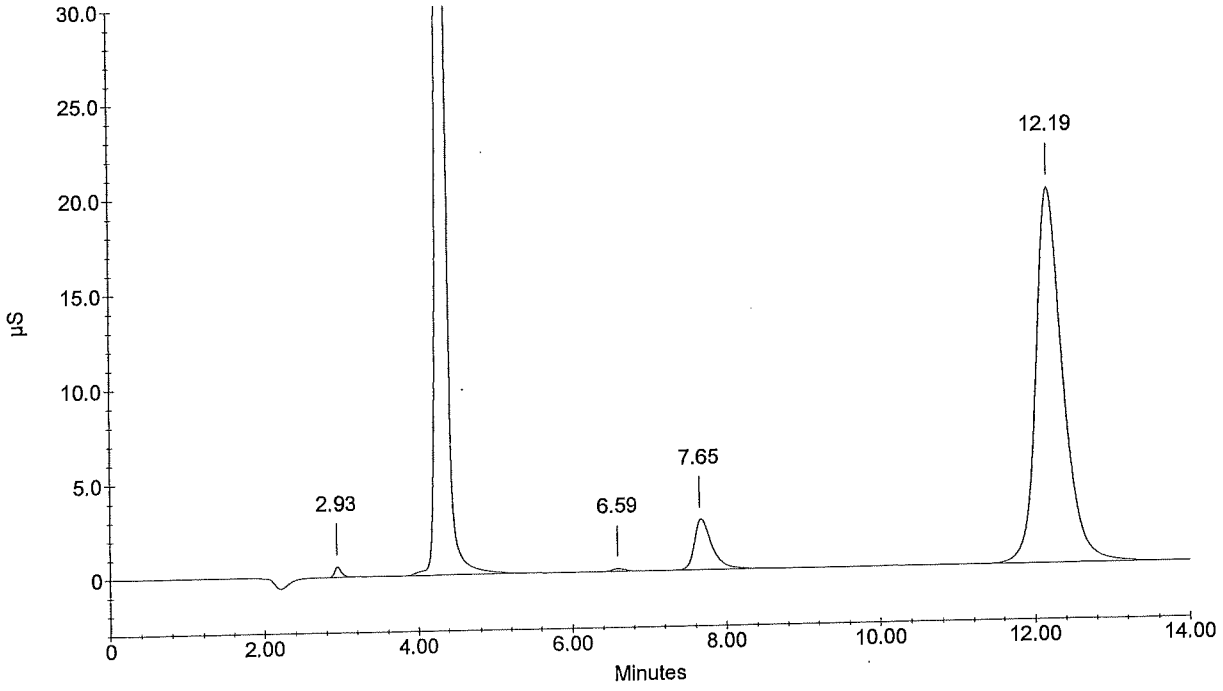
Sample Name : 617041D
Dilution Factor : 1.00
Injection Number : 19
Data File Name : ...\170714_019.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 2:58:57 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.93	FLUORIDE	197.433	5392	35402	1	-1.90
2	4.35	CHLORIDE	28861.974	792953	5999871	1	0.62
3	6.59	NITRITE-N BROMIDE	329.799	1460	17906	1	-0.80
4	7.65	NITRATE-N	1221.061	26120	433456	1	1.10
5	12.19	PHOSPHATE-P SULFATE	38035.696	197544	4751733	1	-2.58
	0.00		---total(s)--- 68645.963		11238367		

617041D



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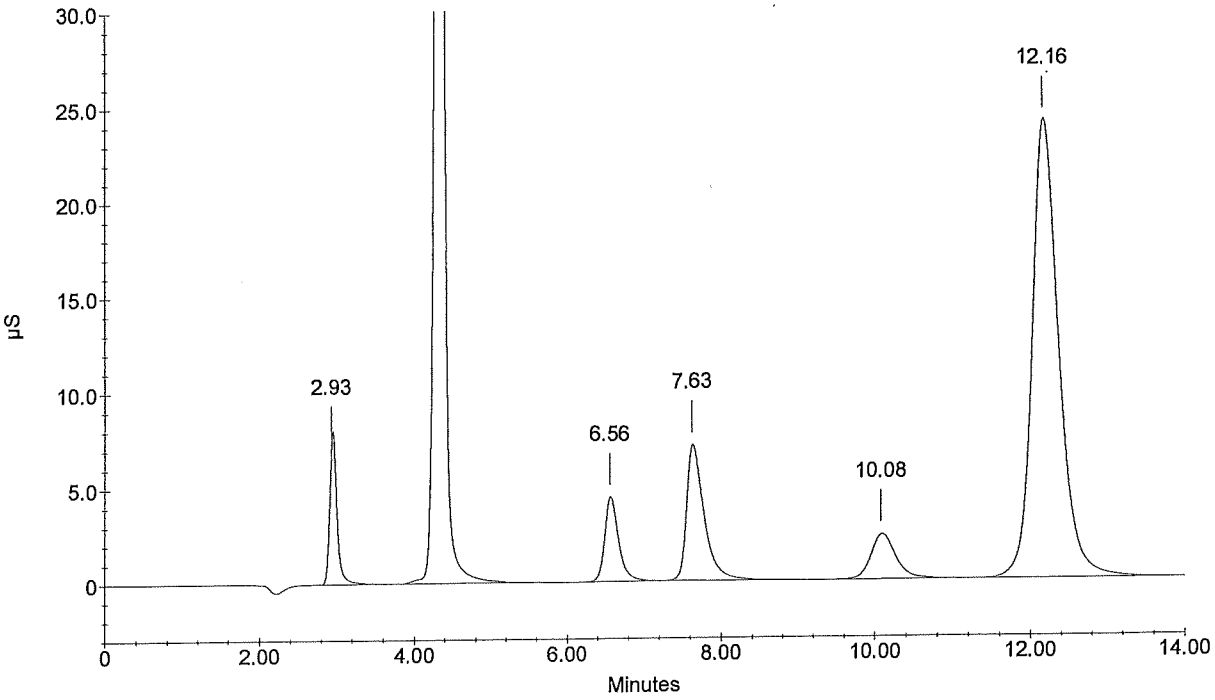
Sample Name : 617041S
Dilution Factor : 1.00
Injection Number : 20
Data File Name : ...\170714_020.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 3:15:34 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.93	FLUORIDE	2188.889	70099	538104	1	-1.90
2	4.35	CHLORIDE	31086.800	851432	6786712	1	0.62
		NITRITE-N					
3	6.56	BROMIDE	9176.482	44225	558819	1	-1.20
4	7.63	NITRATE-N	3088.820	70956	1134269	1	0.75
5	10.08	PHOSPHATE-P	4071.382	23578	536323	1	-1.56
6	12.16	SULFATE	43995.923	239868	5804909	1	-2.80
	0.00		---total(s)--- 93608.297		15359136		

617041S



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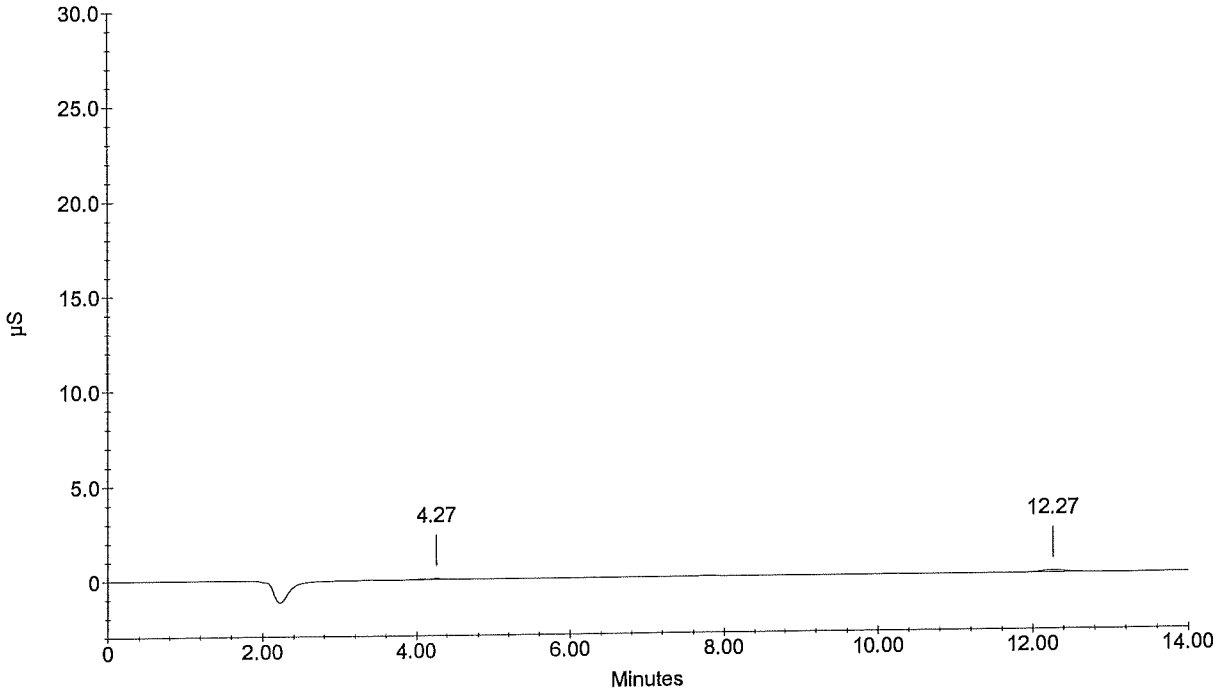
Sample Name : PB-Div.18
Dilution Factor : 1.00
Injection Number : 21
Data File Name : ...\170714_021.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 3:32:11 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	4.27	CHLORIDE	113.128	720	12124	1	-1.23
1	4.27	CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P	113.128	720	12124	1	-1.23
2	12.27	SULFATE	258.792	1088	24968	1	-1.95
	0.00		---total(s)--- 485.048		49216		

PB-Div.18



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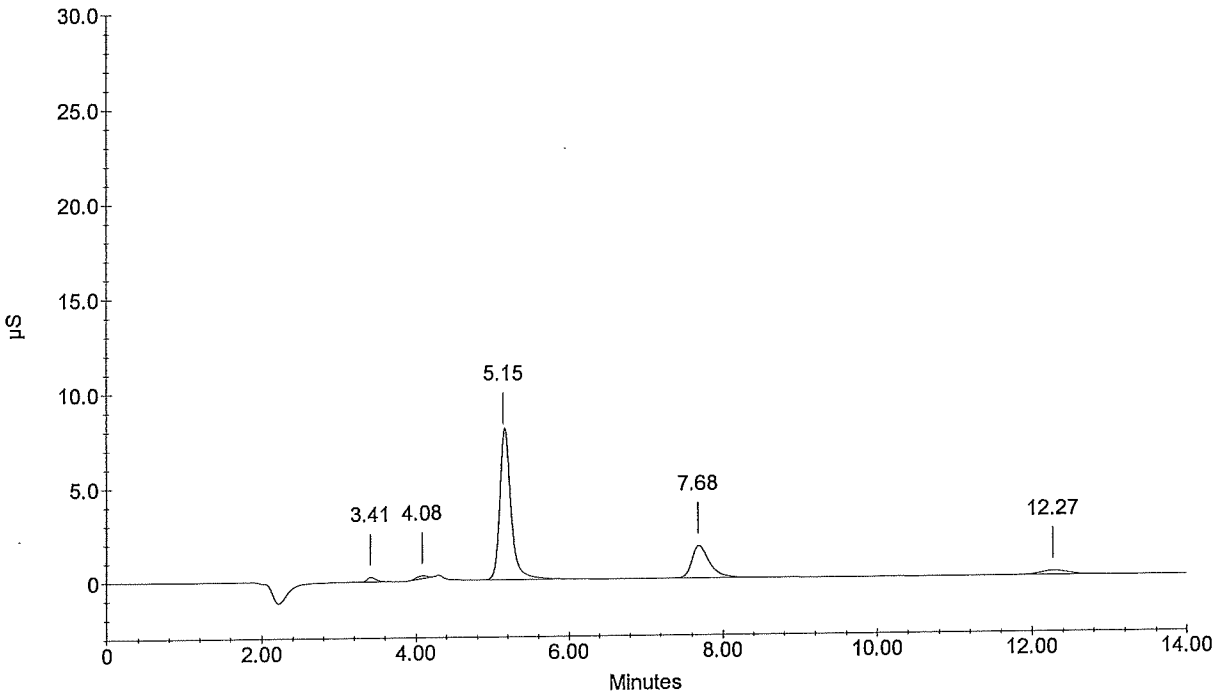
Sample Name : 617727
Dilution Factor : 1.00
Injection Number : 22
Data File Name : ...\170714_022.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 3:48:50 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.41		0.000	2488	23307	1	
3	5.15	CHLORIDE NITRITE-N	2546.115	76039	839067	1	-1.97
4	7.68	BROMIDE NITRATE-N	799.529	17307	280036	1	1.45
5	12.27	PHOSPHATE-P SULFATE	546.317	2182	54046	1	-1.95
	0.00		---total(s)--- 3891.961		1196456		

617727



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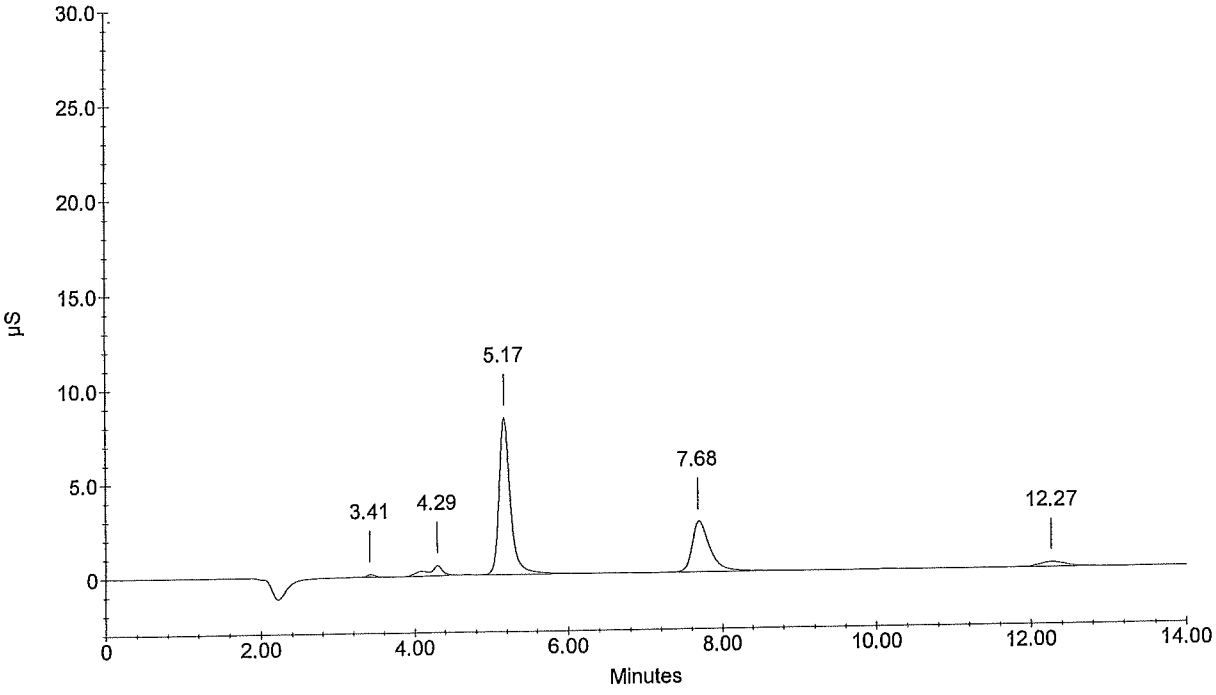
Sample Name : 617727D
Dilution Factor : 1.00
Injection Number : 23
Data File Name : ...\170714_023.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 4:05:29 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.41		0.000	1394	13210	1	
2	4.29	CHLORIDE	560.550	5382	80686	1	-0.62
3	5.17	NITRITE-N	2634.275	83044	869043	1	-1.46
4	7.68	BROMIDE NITRATE-N	1227.589	26726	435845	1	1.45
5	12.27	PHOSPHATE-P SULFATE	619.863	2494	61495	1	-1.95
	0.00		---total(s)--- 5042.277		1460279		

617727D



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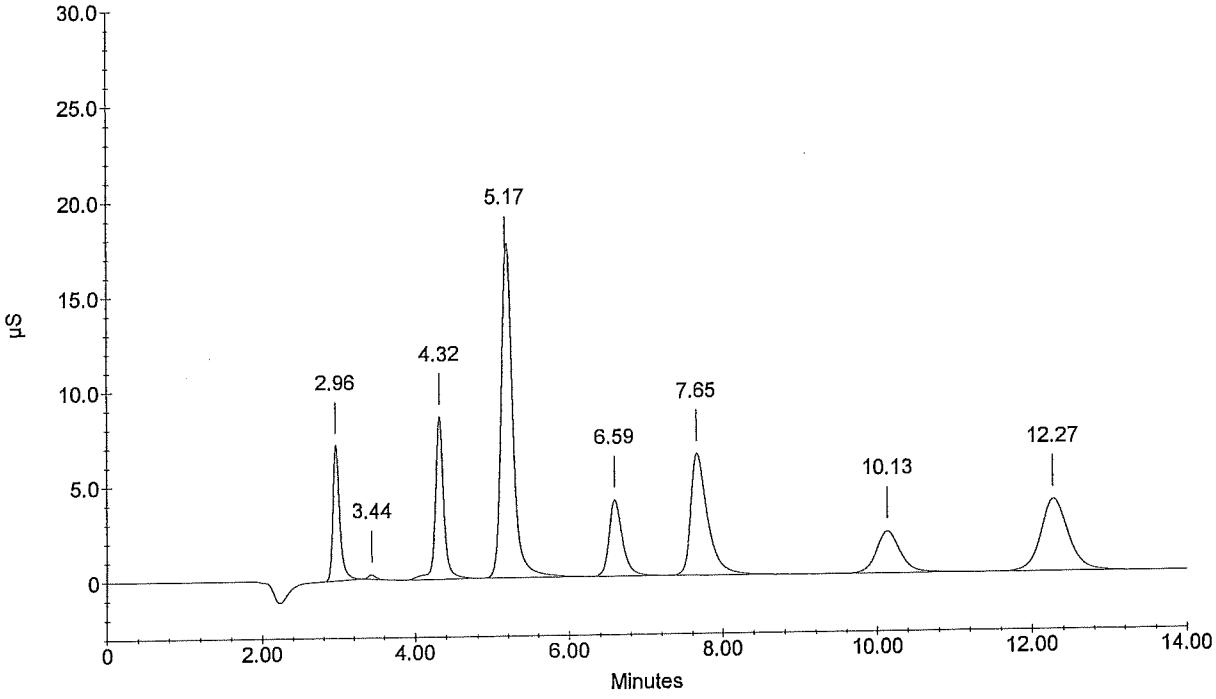
Sample Name : 617727S
Dilution Factor : 1.00
Injection Number : 24
Data File Name : ...\170714_024.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 4:22:06 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.96	FLUORIDE	1850.171	70626	452493	1	-1.00
3	4.32	CHLORIDE	4162.148	85165	648732	1	-0.00
4	5.17	NITRITE-N	5489.956	166937	1864415	1	-1.46
5	6.59	BROMIDE	8155.681	39818	493869	1	-0.80
6	7.65	NITRATE-N	2761.875	63720	1008983	1	1.10
7	10.13	PHOSPHATE-P	3719.875	21912	488958	1	-1.04
8	12.27	SULFATE	8937.201	37709	935376	1	-1.95
	0.00		---total(s)--- 35076.907		5892824		

617727S



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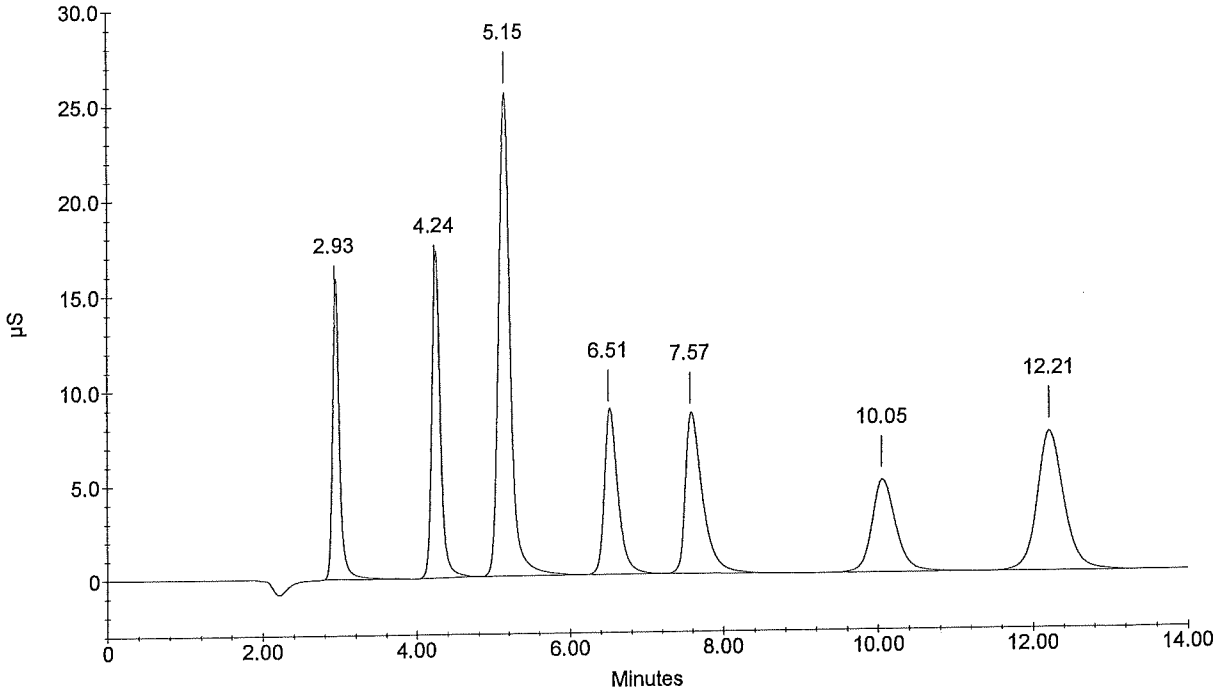
Sample Name : CCV2
Dilution Factor : 25.00
Injection Number : 25
Data File Name : ...\170714_025.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 4:38:44 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.93	FLUORIDE	101675.151	142272	1013613	1	-1.90
2	4.24	CHLORIDE	203374.126	152374	1312936	1	-1.85
3	5.15	NITRITE-N	200019.074	253061	2782596	1	-1.97
4	6.51	BROMIDE	426432.663	85161	1086977	1	-2.01
5	7.57	NITRATE-N	91240.176	83512	1351924	1	0.04
6	10.05	PHOSPHATE-P	198257.853	49324	1072409	1	-1.82
7	12.21	SULFATE	416515.115	74320	1811918	1	-2.37
	0.00		---total(s)--- 1637514.159		10432373		

CCV2



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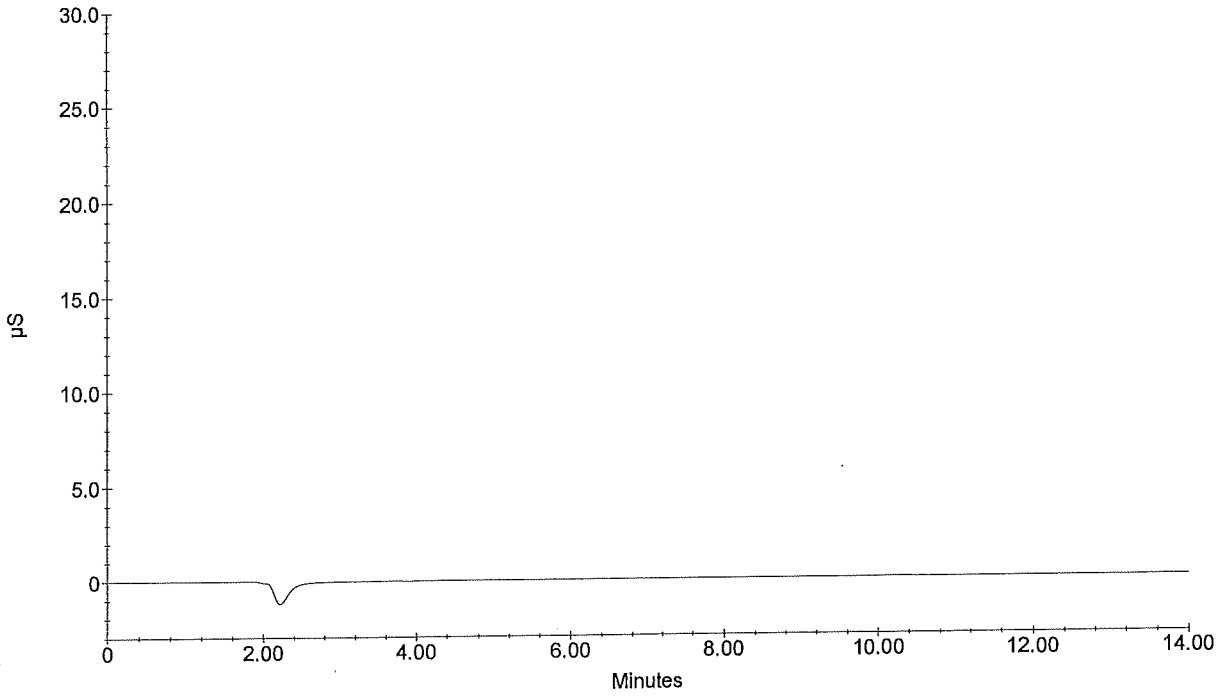
Sample Name : CCB2
Dilution Factor : 1.00
Injection Number : 26
Data File Name : ...\170714_026.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 4:55:22 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
0	0.00	(null) CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P SULFATE	0.000	0	0	0	0.00
	0.00	---total(s)---	0.000		0		

CCB2



010061

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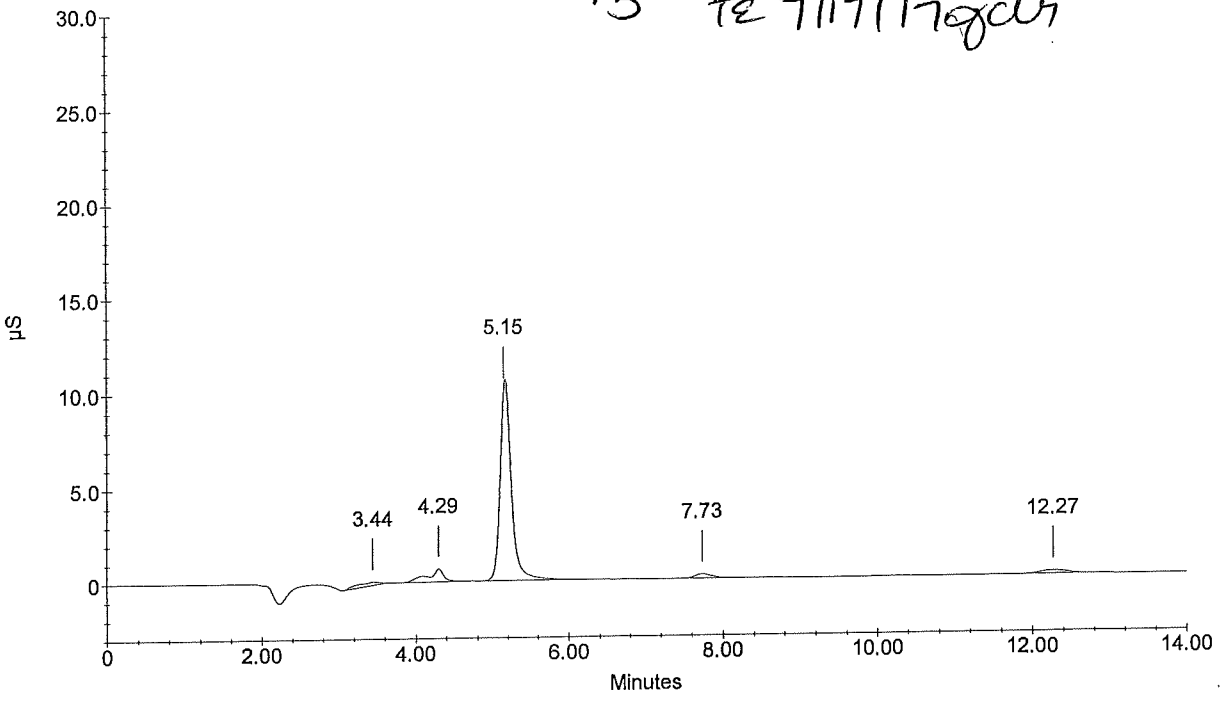
Sample Name : 616949S
Dilution Factor : 1.00
Injection Number : 27
Data File Name : ...\170714_027.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 5:11:59 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	3.44		0.000	1804	40620	1	
2	4.29	CHLORIDE	723.430	6938	105750	1	-0.62
3	5.15	NITRITE-N	3356.355	99916	1116203	1	-1.97
4	7.73	BROMIDE NITRATE-N	116.777	2255	34974	1	2.16
5	12.27	PHOSPHATE-P SULFATE	452.257	1827	44526	1	-1.95
	0.00		---total(s)--- 4648.820		1342072		

616949S
5 TE 7/17/17 JCH



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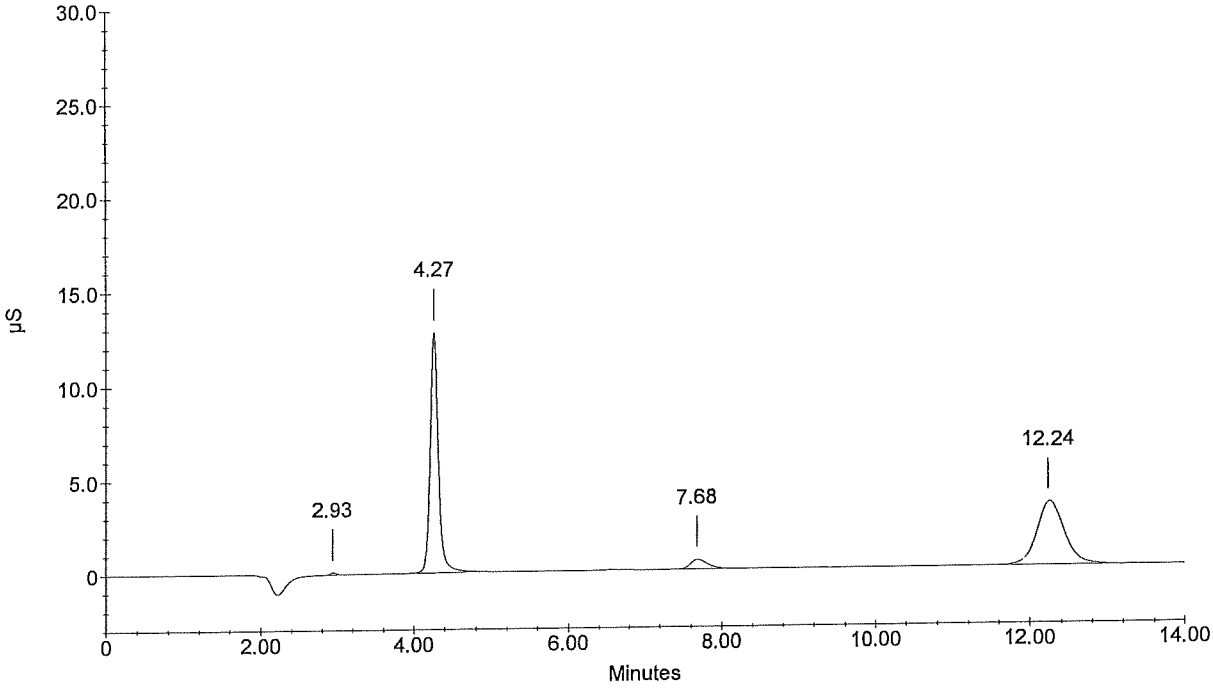
Sample Name : 617041
Dilution Factor : 5.00
Injection Number : 28
Data File Name : ...\170714_028.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 5:28:36 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.93	FLUORIDE	422.785	1174	6955	1	-1.90
2	4.27	CHLORIDE	30177.035	127477	956573	1	-1.23
		NITRITE-N					
		BROMIDE					
3	7.68	NITRATE-N	1230.885	5047	81102	1	1.45
		PHOSPHATE-P					
4	12.24	SULFATE	40256.247	33691	839117	1	-2.16
	0.00		---total(s)--- 72086.952		1883747		

617041



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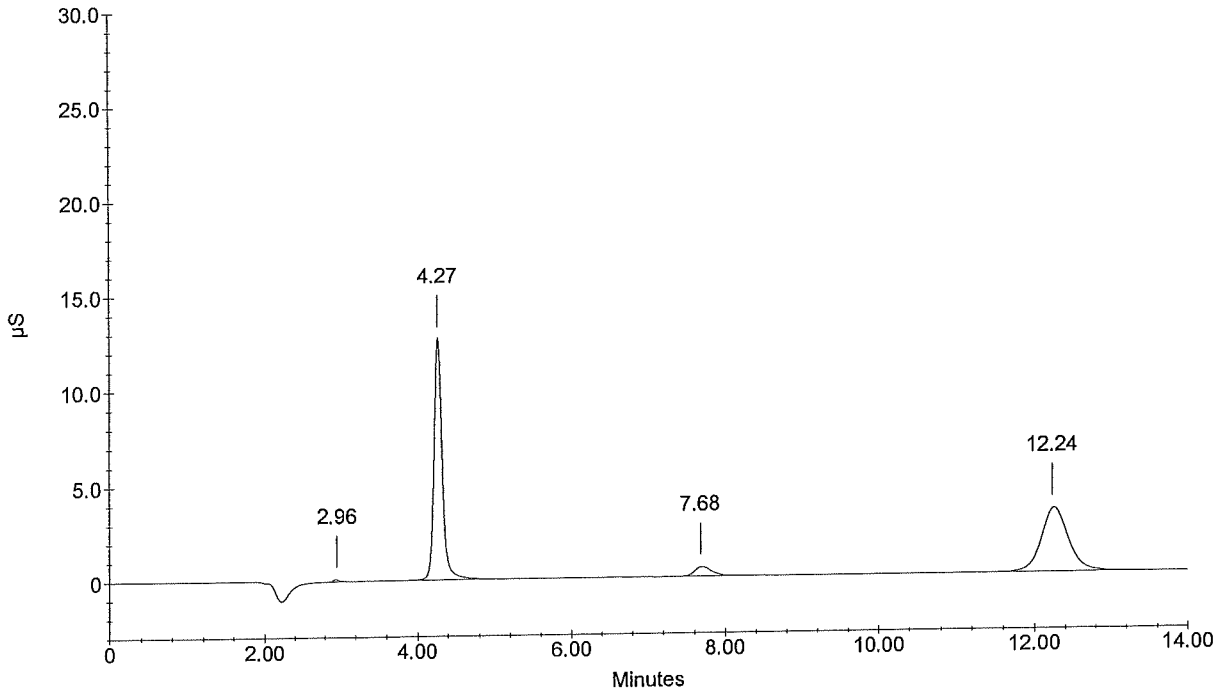
Sample Name : 617041D
Dilution Factor : 5.00
Injection Number : 29
Data File Name : ...\170714_029.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 5:45:14 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.96	FLUORIDE	420.505	1084	6840	1	-1.00
2	4.27	CHLORIDE	30249.479	126205	958990	1	-1.23
		NITRITE-N					
		BROMIDE					
3	7.68	NITRATE-N	1232.859	4957	81243	1	1.45
		PHOSPHATE-P					
4	12.24	SULFATE	39916.154	33455	831760	1	-2.16
	0.00		---total(s)--- 71818.998		1878833		

617041D



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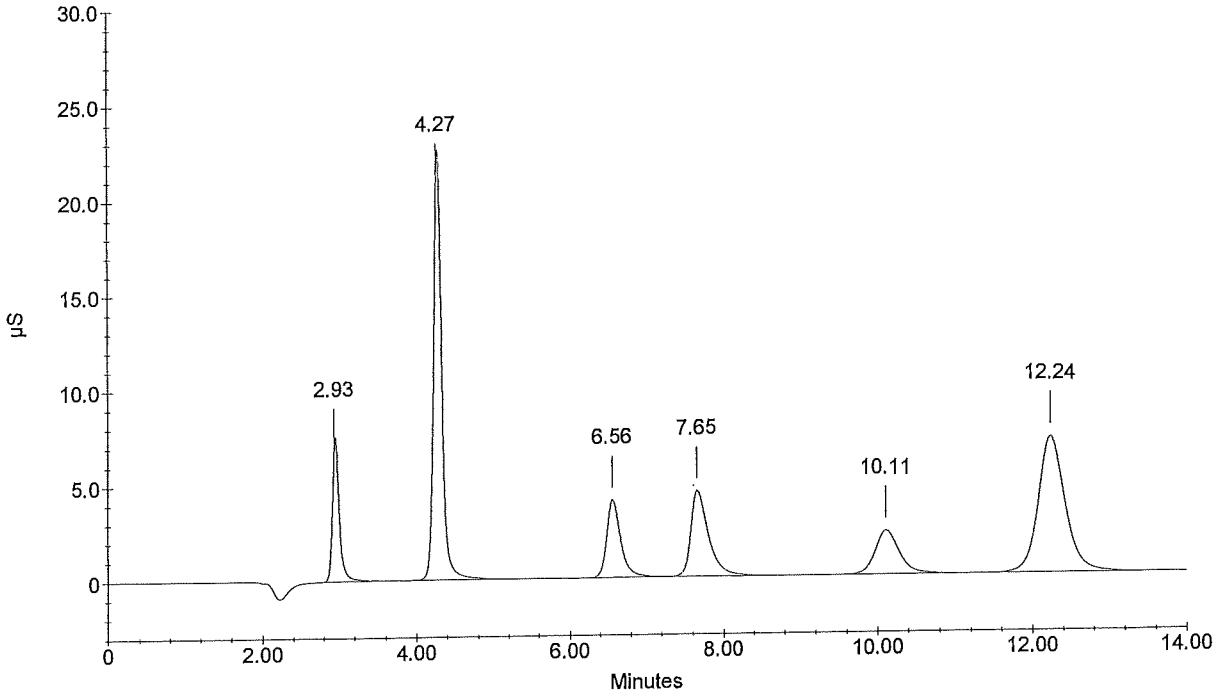
Sample Name : 617041S
Dilution Factor : 5.00
Injection Number : 30
Data File Name : ...\170714_030.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 6:01:51 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.93	FLUORIDE	9797.247	67472	480108	1	-1.90
2	4.27	CHLORIDE	51274.227	206020	1686216	1	-1.23
		NITRITE-N					
3	6.56	BROMIDE	42740.130	40708	518747	1	-1.20
4	7.65	NITRATE-N	10055.945	44860	725601	1	1.10
5	10.11	PHOSPHATE-P	19526.076	23026	513904	1	-1.30
6	12.24	SULFATE	80402.986	71535	1743561	1	-2.16
	0.00		---total(s)--- 213796.612		5668138		

617041S



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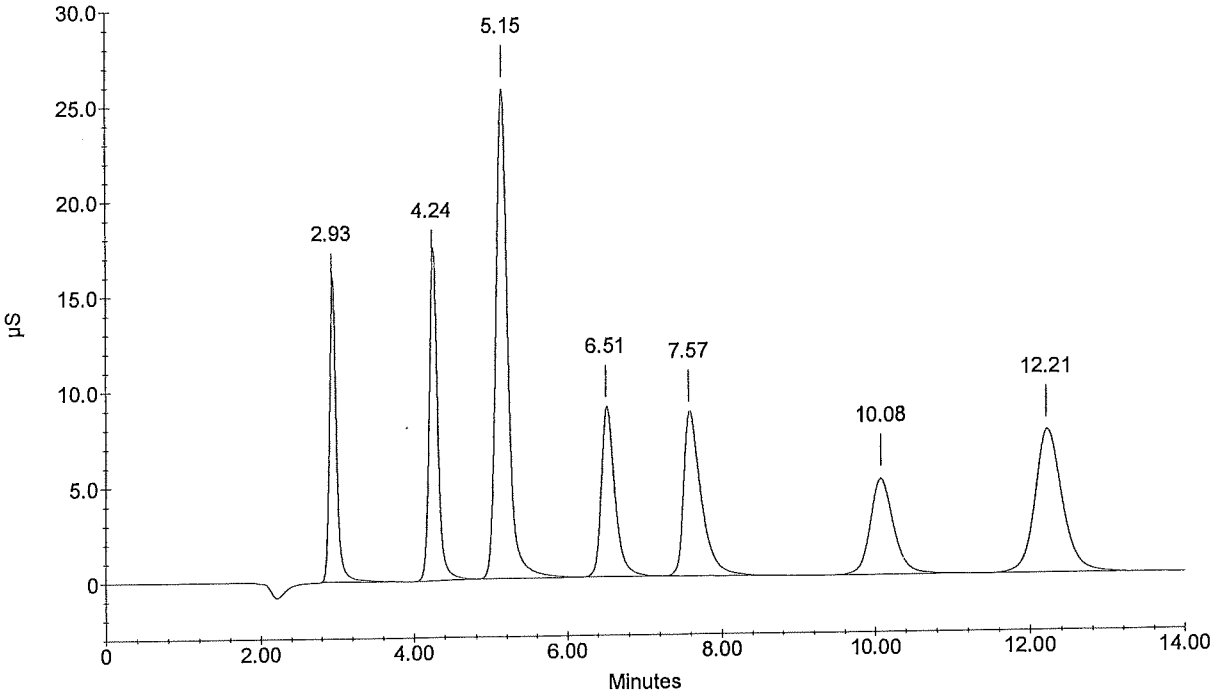
Sample Name : CCV3
Dilution Factor : 25.00
Injection Number : 31
Data File Name : ...\170714_031.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 6:18:28 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.93	FLUORIDE	102199.038	148868	1018926	1	-1.90
2	4.24	CHLORIDE	205915.674	160602	1330516	1	-1.85
3	5.15	NITRITE-N	201935.700	256329	2811330	1	-1.97
4	6.51	BROMIDE	431072.952	87658	1100052	1	-2.01
5	7.57	NITRATE-N	92199.847	84571	1366954	1	0.04
6	10.08	PHOSPHATE-P	200550.292	50202	1085530	1	-1.56
7	12.21	SULFATE	420107.200	74722	1828921	1	-2.37
	0.00		---total(s)--- 1653980.702		10542230		

CCV3



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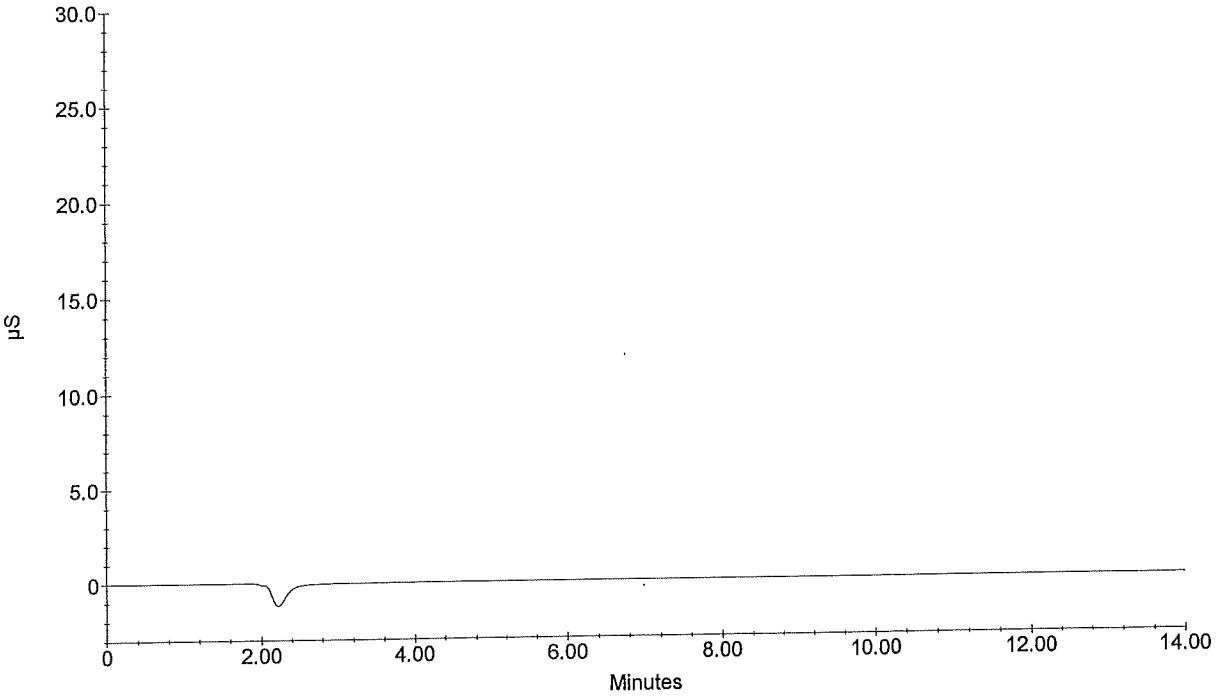
Sample Name : CCB3
Dilution Factor : 1.00
Injection Number : 32
Data File Name : ...\170714_032.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\14july17.sch

Date Time Collected : 7/14/17 6:35:05 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

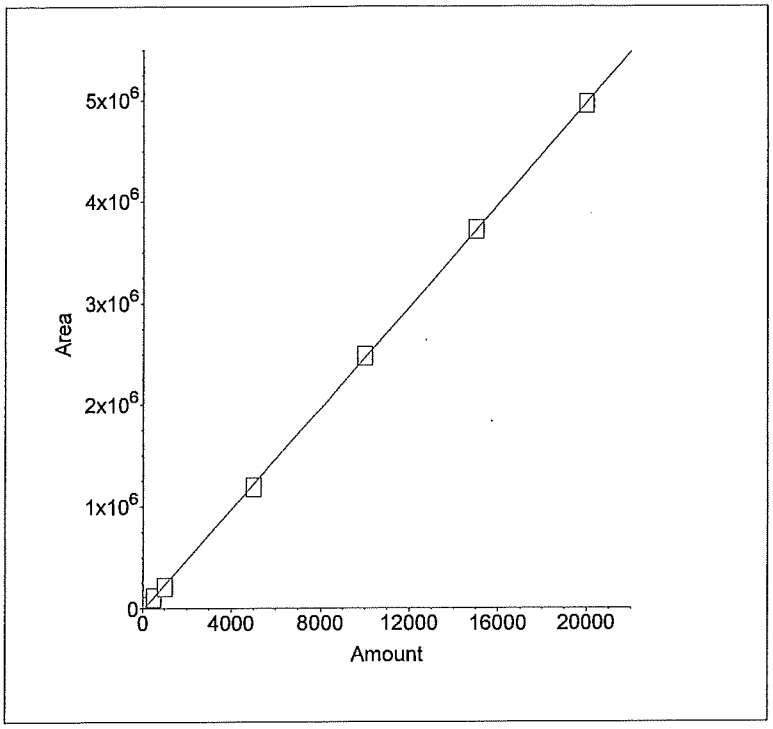
Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
0	0.00	(null) CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P SULFATE	0.000	0	0	0	0.00
	0.00	---total(s)---	0.000		0		

CCB3

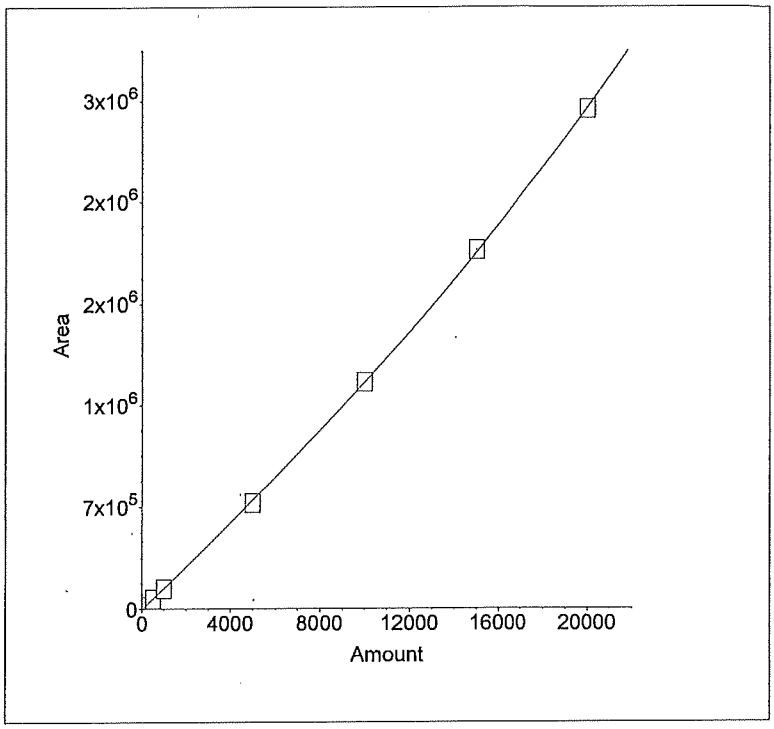


010067

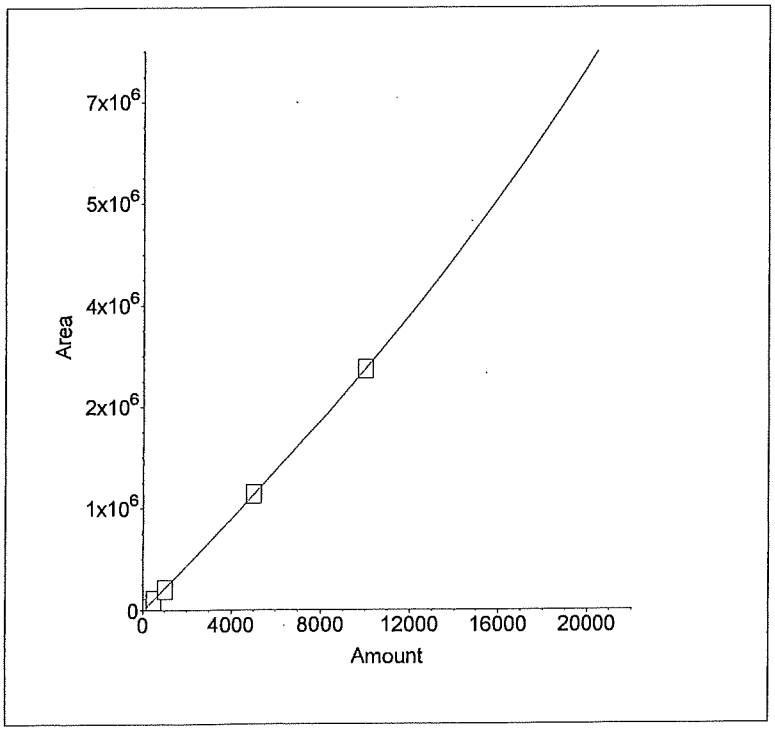
1. Component:FLUORIDE
Standard:External Fit Type:Quadratic
Origin:Include Calibration:Area
r^2=0.999918
Amt=-1.207630e-011*Resp^2+
3.968434e-003*Resp+56.96



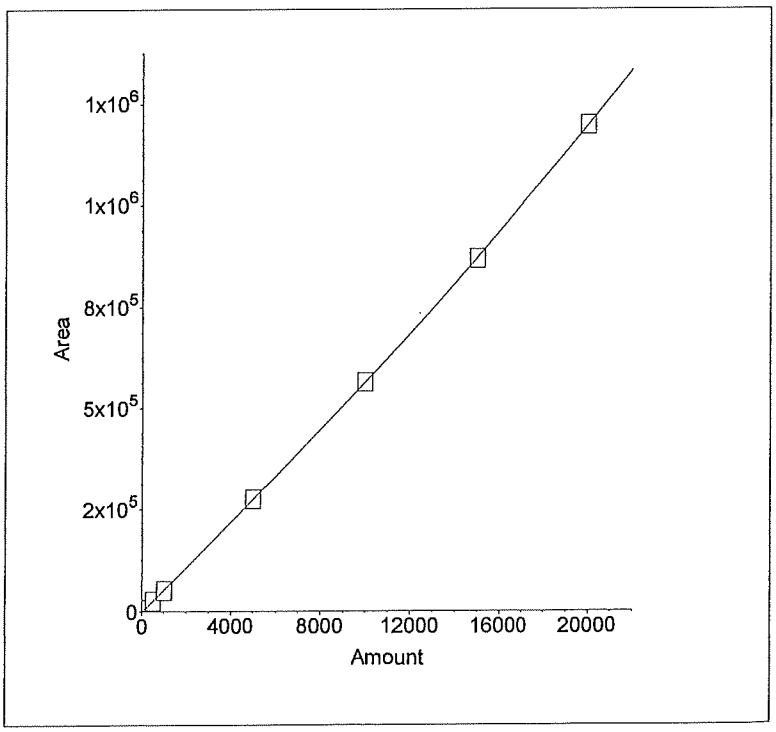
2. Component:CHLORIDE
Standard:External Fit Type:Quadratic
Origin:Include Calibration:Area
r^2=0.999929
Amt=-2.913445e-010*Resp^2+
6.552841e-003*Resp+33.72



3. Component:NITRITE-N
Standard:External Fit Type:Quadratic
Origin:Include Calibration:Area
r^2=0.999946
Amt=-7.024421e-011*Resp^2+
3.060970e-003*Resp+27.21

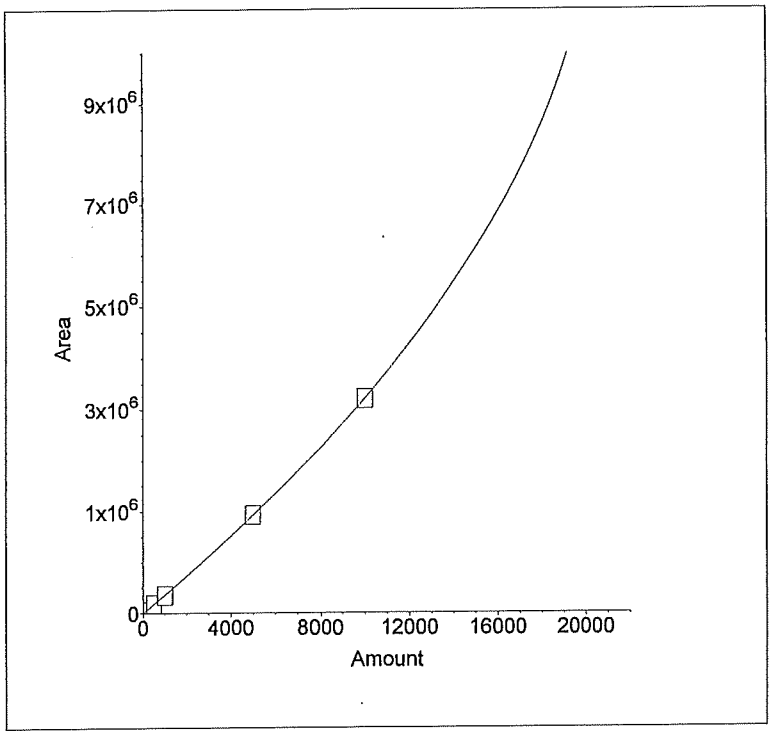


4. Component:BROMIDE
Standard:External Fit Type:Quadratic
Origin:Include Calibration:Area
r^2=0.999992
Amt=-1.341122e-009*Resp^2+
1.712855e-002*Resp+23.53

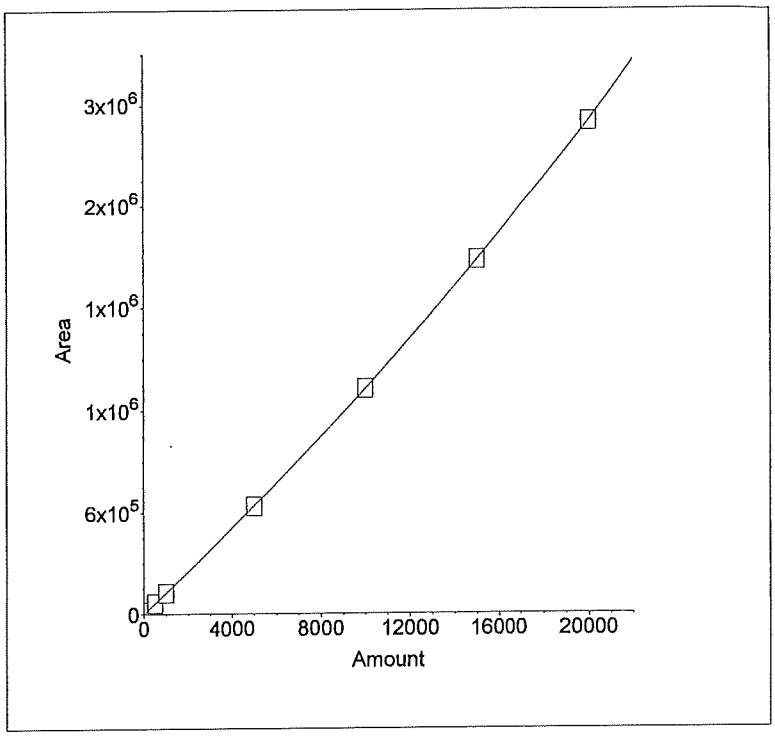


010068

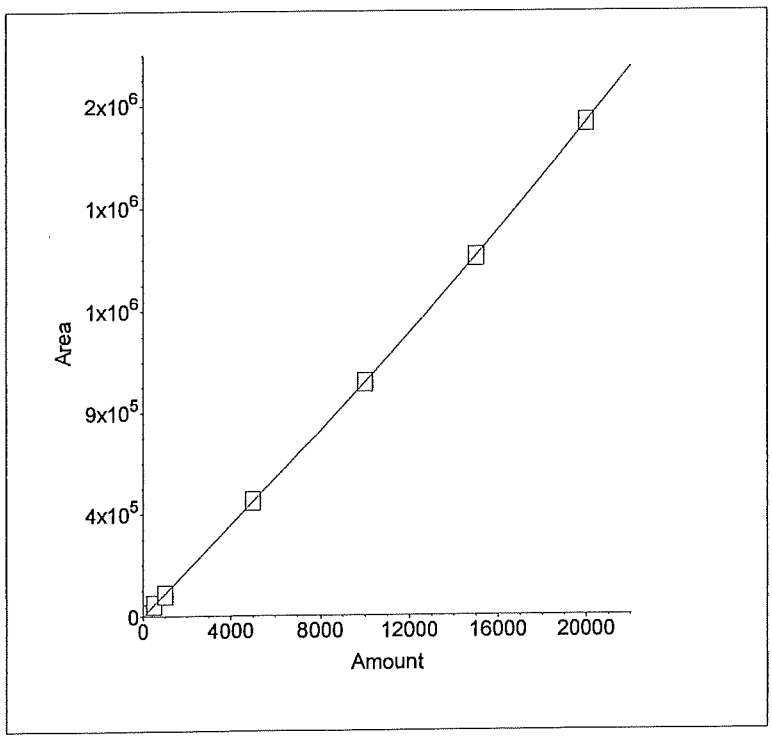
5. Component:NITRATE-N
Standard:External Fit Type:Quadratic
Origin:Include Calibration:Area
r^2=0.999981
Amt=-9.651261e-011*Resp^2+
2.816438e-003*Resp+18.39



6. Component:PHOSPHATE-P
Standard:External Fit Type:Quadratic
Origin:Include Calibration:Area
r^2=0.999995
Amt=-3.819905e-010*Resp^2+
7.812869e-003*Resp+-8.964



7. Component:SULFATE
Standard:External Fit Type:Quadratic
Origin:Include Calibration:Area
r^2=0.999991
Amt=-4.036094e-010*Resp^2+
9.920048e-003*Resp+11.36



Schedule File: C:\PeakNet\Schedule_500\170703.sch

010069

Line	Sample	Sample Type	Level	Method	Data File	Dilution
1	0ppm 186-09-IC10	Calibration St	1	anions170703.met	170703a_001.dxd	1
2	50ppb 186-08-IC10	Calibration St	2	anions170703.met	170703a_002.dxd	1
3	100ppb 186-07-IC10	Calibration St	3	anions170703.met	170703a_003.dxd	1
4	500ppb 186-06-IC10	Calibration St	4	anions170703.met	170703a_004.dxd	1
5	1000ppb 186-05-IC10	Calibration St	5	anions170703.met	170703a_005.dxd	1
6	5000ppb 186-04-IC10	Calibration St	6	anions170703.met	170703a_006.dxd	1
7	10000ppb 186-03-IC10	Calibration St	7	anions170703.met	170703a_007.dxd	1
8	15000ppb 186-02-IC10	Calibration St	8	anions170703.met	170703a_008.dxd	1
9	20000ppb 186-01-IC10	Calibration St	9	anions170703.met	170703a_009.dxd	1
10	ICV	Sample		anions170703.met	170703a_010.dxd	25
11	ICB	Sample		anions170703.met	170703a_011.dxd	1
12	LLC	Sample		anions170703.met	170703a_012.dxd	1

Default Method Path: C:\PEAKNET\METHOD
Default Data Path: C:\PEAKNET\DATA_500\170703A
Comment:
Calibration Curve

"M" INDICATES MANUAL INTEGRATION

ICV Sources:
1) SPEX (INORG#84129)
F = 100 mg/L
Cl = 200 mg/L
Br = 400 mg/L
NO3N = 90.4 mg/L
PO4P = 194 mg/L
SO4 = 400 mg/L

2) NO2-N 181-01-IC10
T.V. = 191 mg/L

3) LLC 181-02-IC10

EP: 5000-M
1000-1
200-2

Dilutions:
df 25 = 0.200 mL SPEX #84129 + 0.200 #181-01-IC10 + 4.60 mL DI water

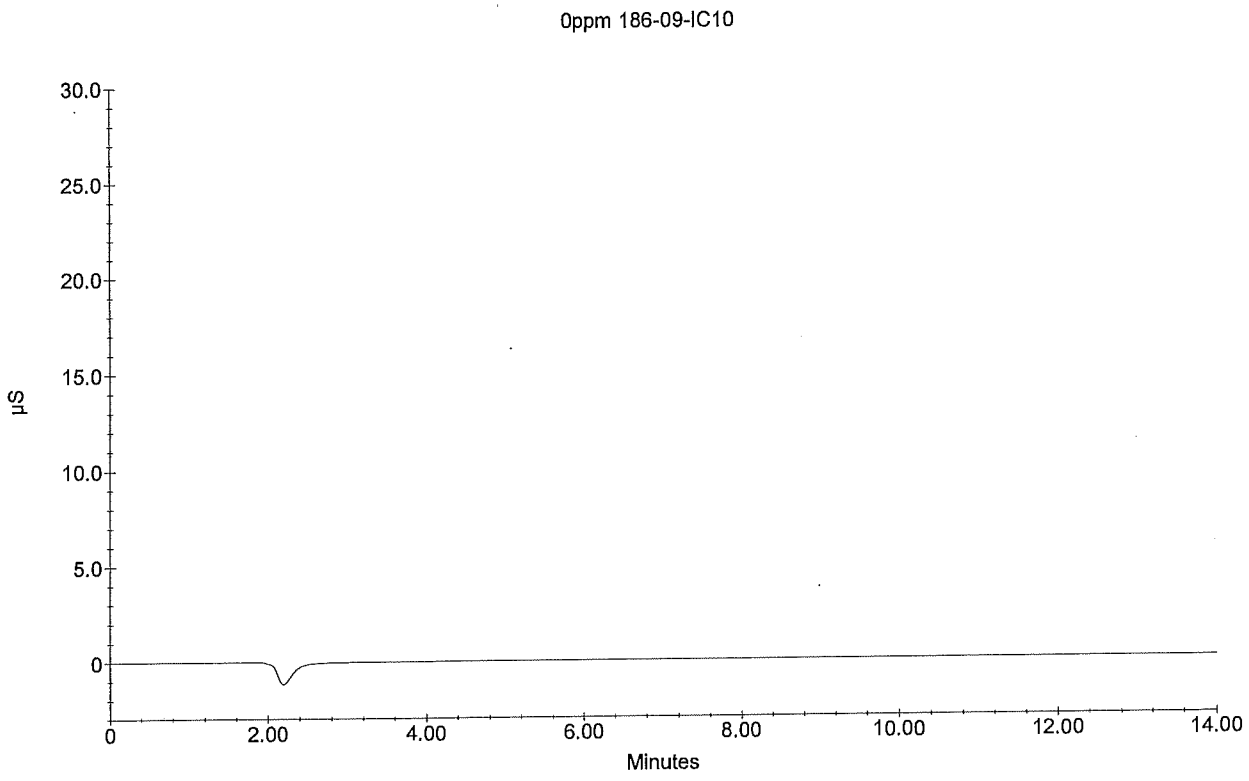
7/5/17

Sample Name : 0ppm 186-09-IC10
Dilution Factor : 1.00
Injection Number : 1
Data File Name : ...\170703a_001.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 4:35:48 PM
Date Time Updated : 7/3/17 4:52:18 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Peak Number	Peak Retention Time	Component Name	Concentration (PPB)	Peak Area	Peak Height
0	0.00	(null) CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P SULFATE	0.00	0	0

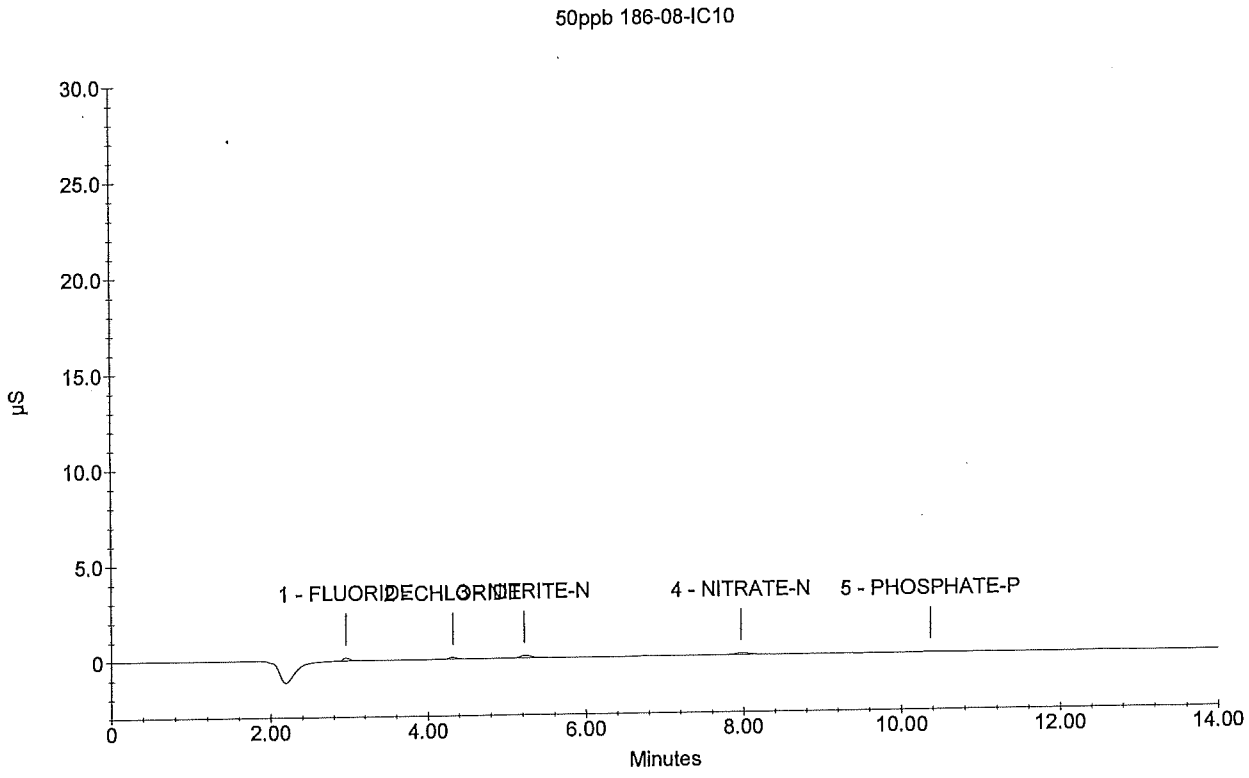


Sample Name : 50ppb 186-08-IC10
Dilution Factor : 1.00
Injection Number : 2
Data File Name : ...\170703a_002.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 4:52:28 PM
Date Time Updated : 7/3/17 5:09:00 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Peak Number	Peak Retention Time	Component Name	Concentration (PPB)	Peak Area	Peak Height
1	2.96	FLUORIDE	50.00	10027	1632
2	4.32	CHLORIDE	50.00	7209	943
3	5.23	NITRITE-N	50.00	12991	1273
		BROMIDE			
4	7.97	NITRATE-N	50.00	14590	877
5	10.37	PHOSPHATE-P	50.00	9554	429
		SULFATE			



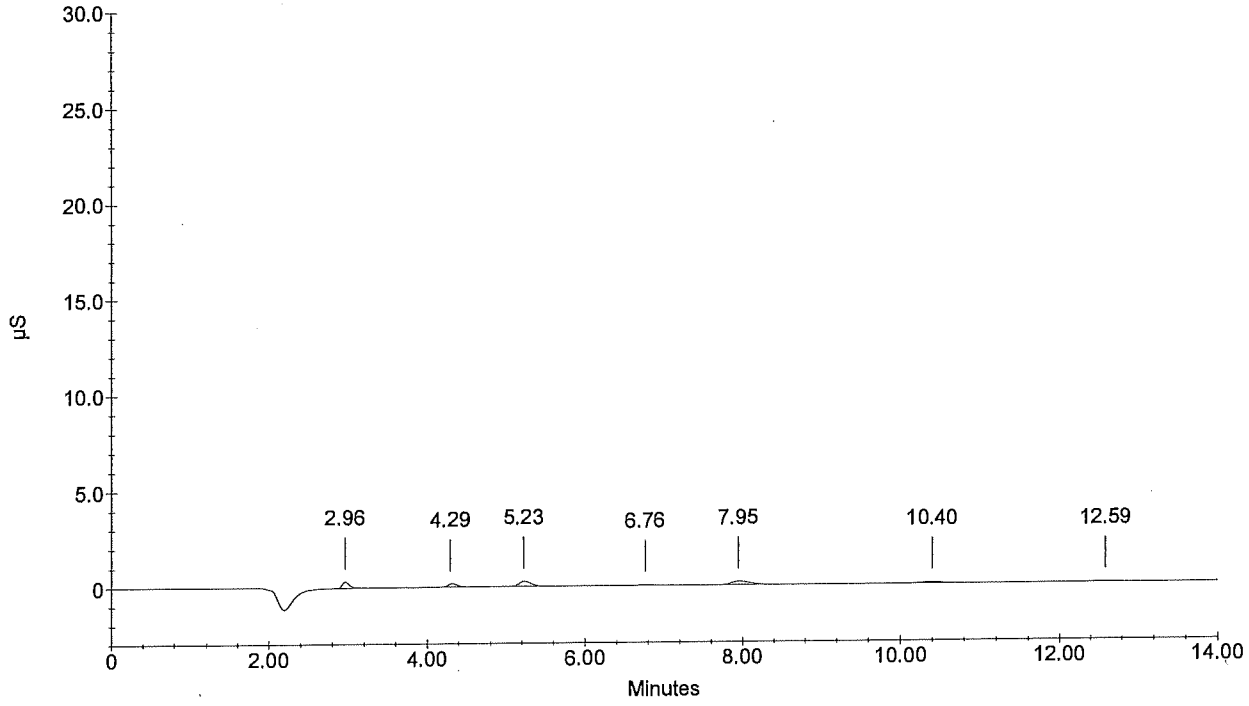
Sample Name : 100ppb 186-07-IC10
Dilution Factor : 1.00
Injection Number : 3
Data File Name : ...\170703A_003.DXD
Method File Name : C:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 5:09:11 PM
Date Time Updated : 7/5/17 9:00:56 AM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Peak Number	Peak Retention Time	Component Name	Concentration (PPB)	Peak Area	Peak Height
1	2.96	FLUORIDE	100.00	21060	3287
2	4.29	CHLORIDE	100.00	13931	1594
3	5.23	NITRITE-N	100.00	28279	2583
4	6.76	BROMIDE	100.00	5407	410
5	7.95	NITRATE-N	100.00	30632	1791
6	10.40	PHOSPHATE-P	100.00	15115	687
7	12.59	SULFATE	100.00	8756	402

100ppb 186-07-IC10

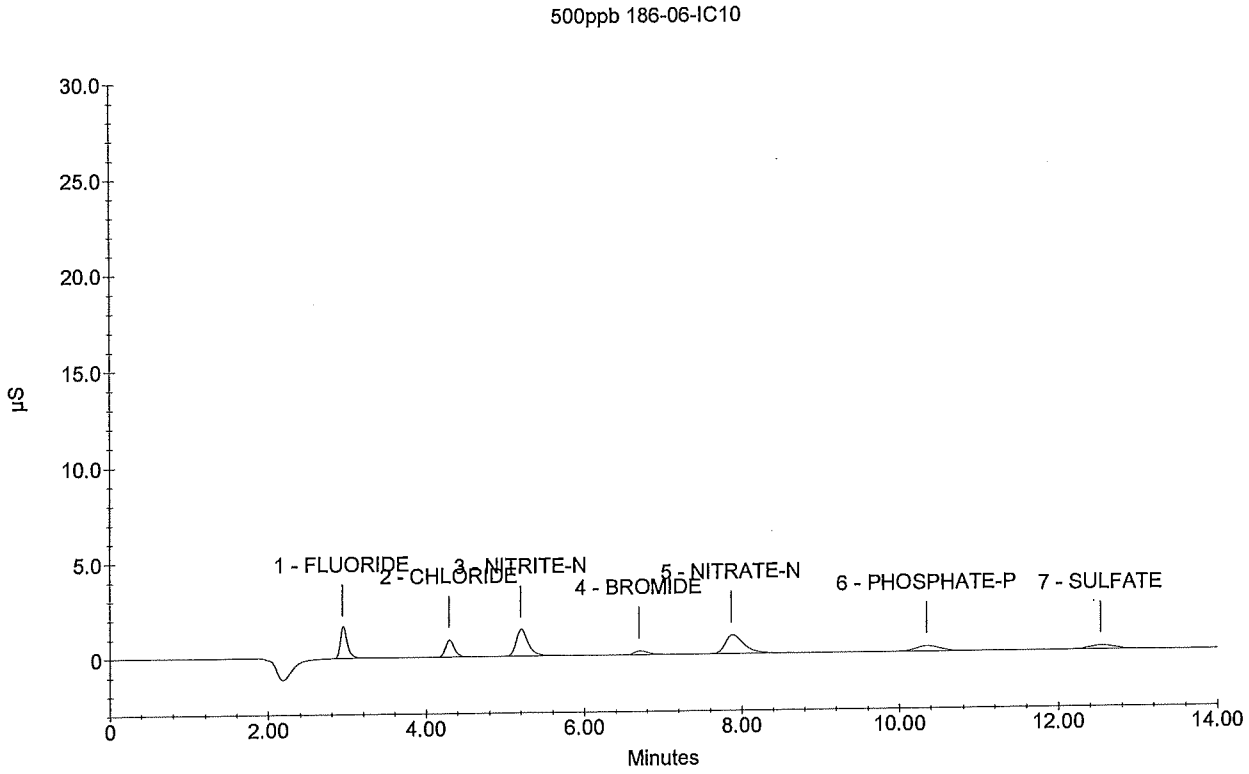


Sample Name : 500ppb 186-06-IC10
Dilution Factor : 1.00
Injection Number : 4
Data File Name : ...\170703a_004.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 5:25:55 PM
Date Time Updated : 7/3/17 5:42:28 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Peak Number	Peak Retention Time	Component Name	Concentration (PPB)	Peak Area	Peak Height
1	2.93	FLUORIDE	500.00	107143	15654
2	4.29	CHLORIDE	500.00	71173	8860
3	5.20	NITRITE-N	500.00	147966	13805
4	6.69	BROMIDE	500.00	27142	2030
5	7.87	NITRATE-N	500.00	168197	9738
6	10.35	PHOSPHATE-P	500.00	66214	2936
7	12.53	SULFATE	500.00	50981	2100

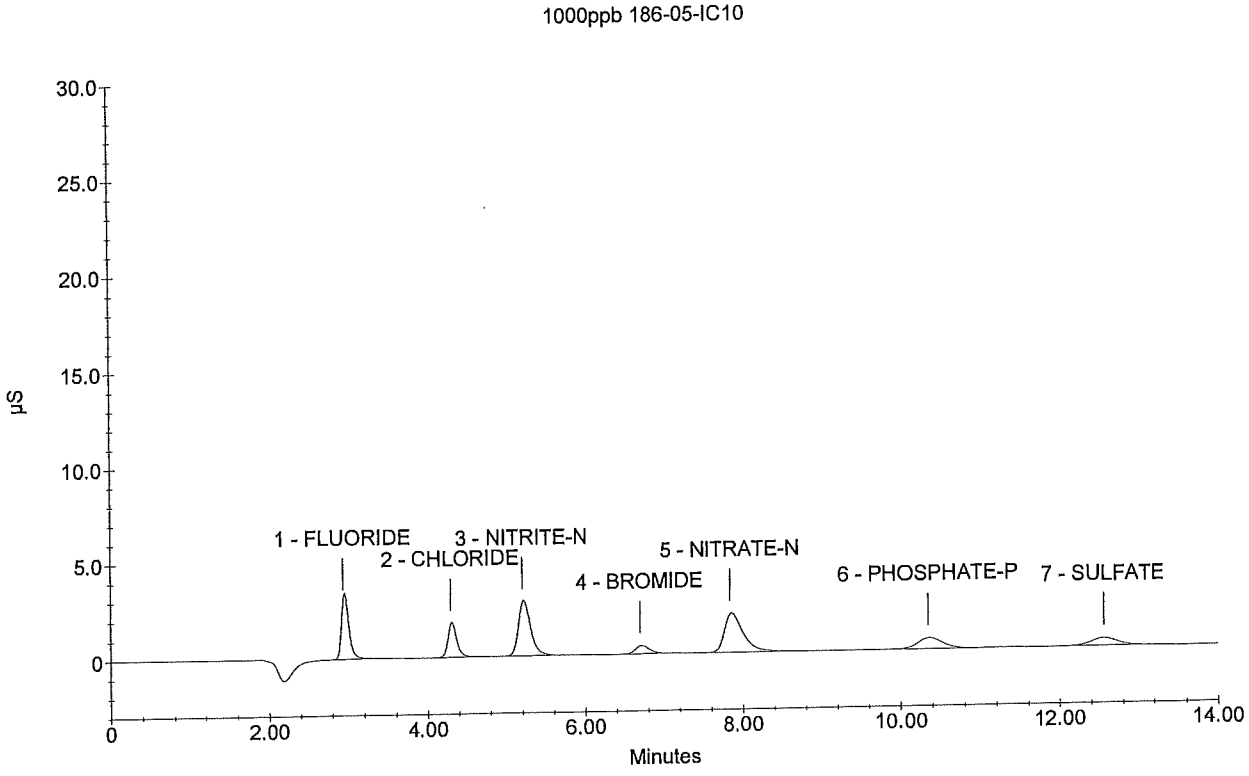


Sample Name : 1000ppb 186-05-IC10
Dilution Factor : 1.00
Injection Number : 5
Data File Name : ...\170703a_005.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 5:42:40 PM
Date Time Updated : 7/3/17 5:59:13 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Peak Number	Peak Retention Time	Component Name	Concentration (PPB)	Peak Area	Peak Height
1	2.93	FLUORIDE	1000.00	217078	29223
2	4.29	CHLORIDE	1000.00	145645	17565
3	5.20	NITRITE-N	1000.00	303108	27761
4	6.69	BROMIDE	1000.00	54990	4180
5	7.84	NITRATE-N	1000.00	341699	20007
6	10.35	PHOSPHATE-P	1000.00	129165	5726
7	12.56	SULFATE	1000.00	95629	4003



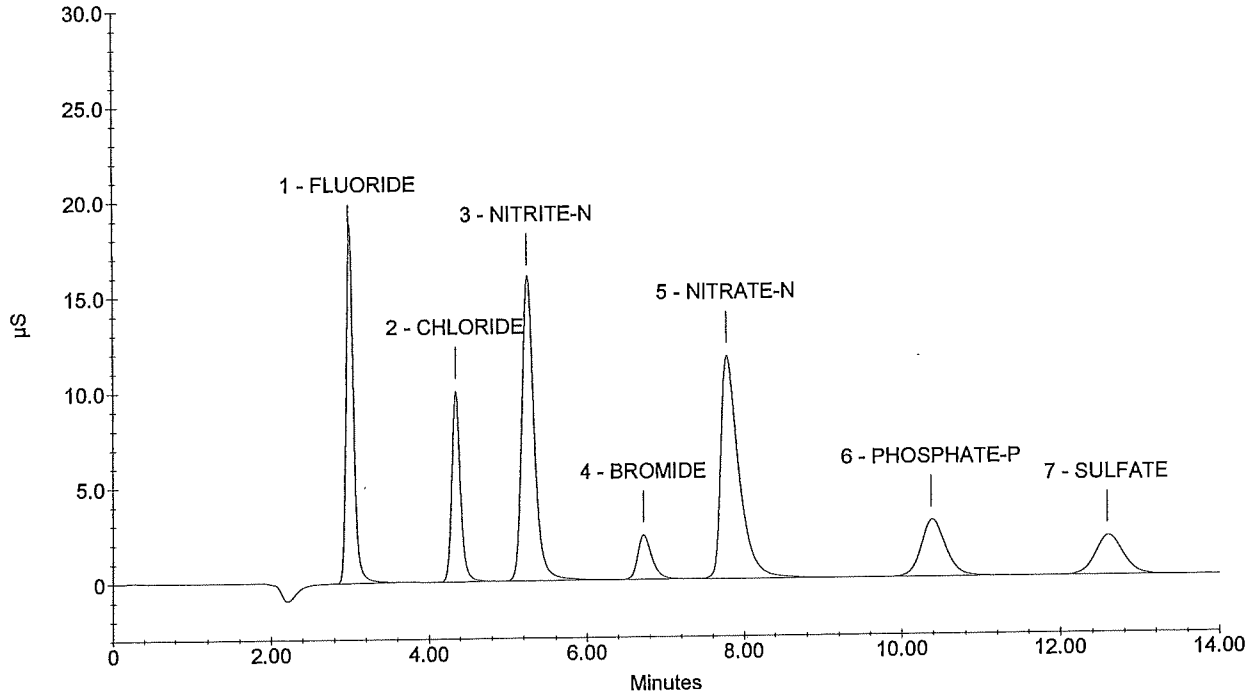
Sample Name : 5000ppb 186-04-IC10
Dilution Factor : 1.00
Injection Number : 6
Data File Name : ...\170703a_006.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 5:59:25 PM
Date Time Updated : 7/3/17 6:15:57 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Peak Number	Peak Retention Time	Component Name	Concentration (PPB)	Peak Area	Peak Height
1	2.99	FLUORIDE	5000.00	1219140	175066
2	4.35	CHLORIDE	5000.00	763584	99752
3	5.25	NITRITE-N	5000.00	1696815	158407
4	6.72	BROMIDE	5000.00	297946	23215
5	7.79	NITRATE-N	5000.00	1895721	116594
6	10.37	PHOSPHATE-P	5000.00	658297	29774
7	12.59	SULFATE	5000.00	516311	20766

5000ppb 186-04-IC10

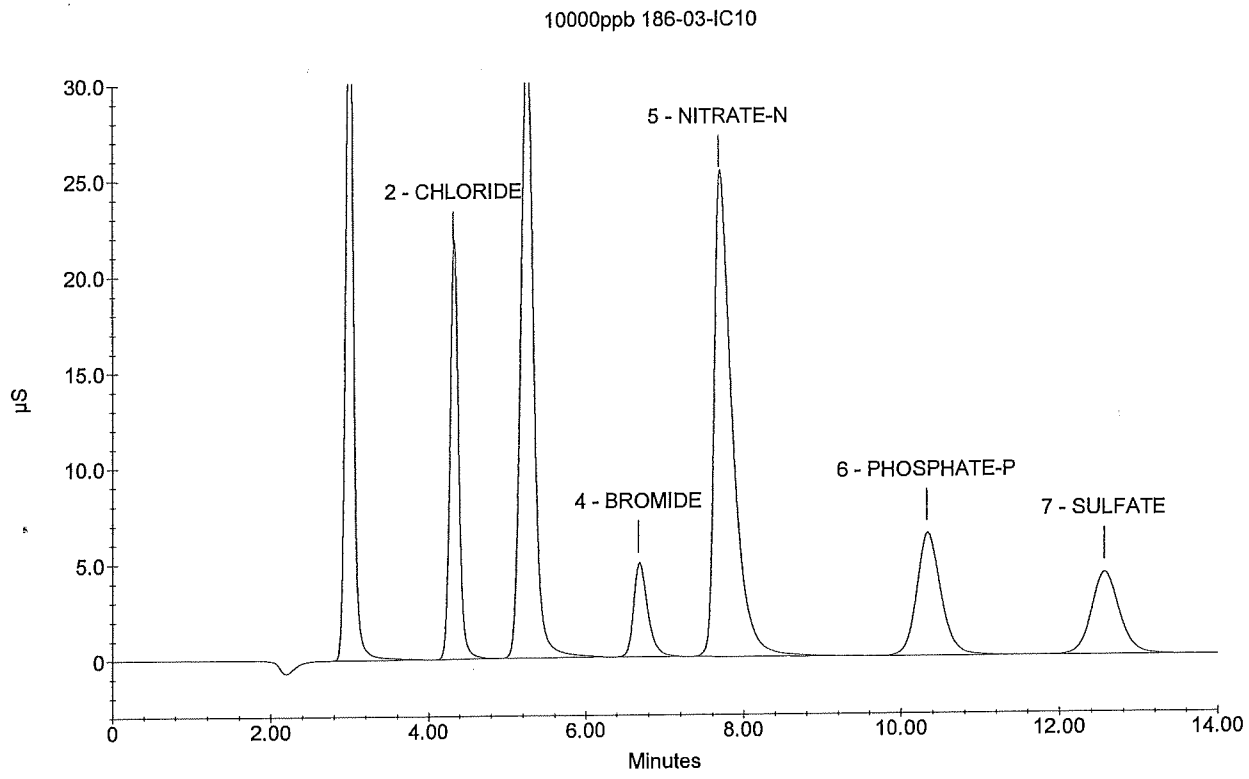


Sample Name : 10000ppb 186-03-IC10
Dilution Factor : 1.00
Injection Number : 7
Data File Name : ...\170703a_007.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 6:16:08 PM
Date Time Updated : 7/3/17 6:32:41 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Peak Number	Peak Retention Time	Component Name	Concentration (PPB)	Peak Area	Peak Height
1	2.99	FLUORIDE	10000.00	2542260	357071
2	4.32	CHLORIDE	10000.00	1642595	209942
3	5.25	NITRITE-N	10000.00	3545196	322121
4	6.67	BROMIDE	10000.00	612848	47647
5	7.68	NITRATE-N	10000.00	4126973	248080
6	10.32	PHOSPHATE-P	10000.00	1373822	63473
7	12.56	SULFATE	10000.00	1052680	42833

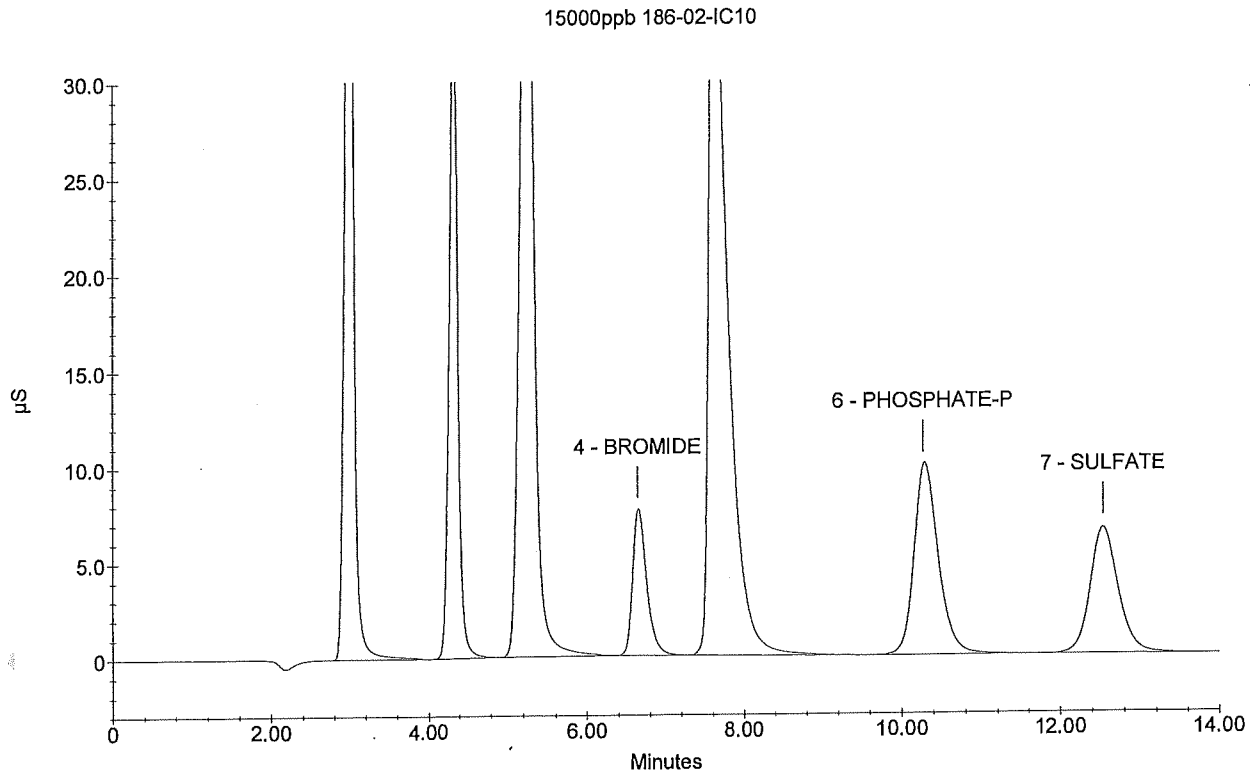


Sample Name : 15000ppb 186-02-IC10
Dilution Factor : 1.00
Injection Number : 8
Data File Name : ...\170703a_008.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 6:32:57 PM
Date Time Updated : 7/3/17 6:49:29 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Peak Number	Peak Retention Time	Component Name	Concentration (PPB)	Peak Area	Peak Height
1	2.99	FLUORIDE	15000.00	3821907	506331
2	4.32	CHLORIDE	15000.00	2599212	339737
3	5.25	NITRITE-N	15000.00	5386738	470855
4	6.64	BROMIDE	15000.00	942818	75763
5	7.63	NITRATE-N	15000.00	6544519	396556
6	10.27	PHOSPHATE-P	15000.00	2149868	99379
7	12.53	SULFATE	15000.00	1614554	66169



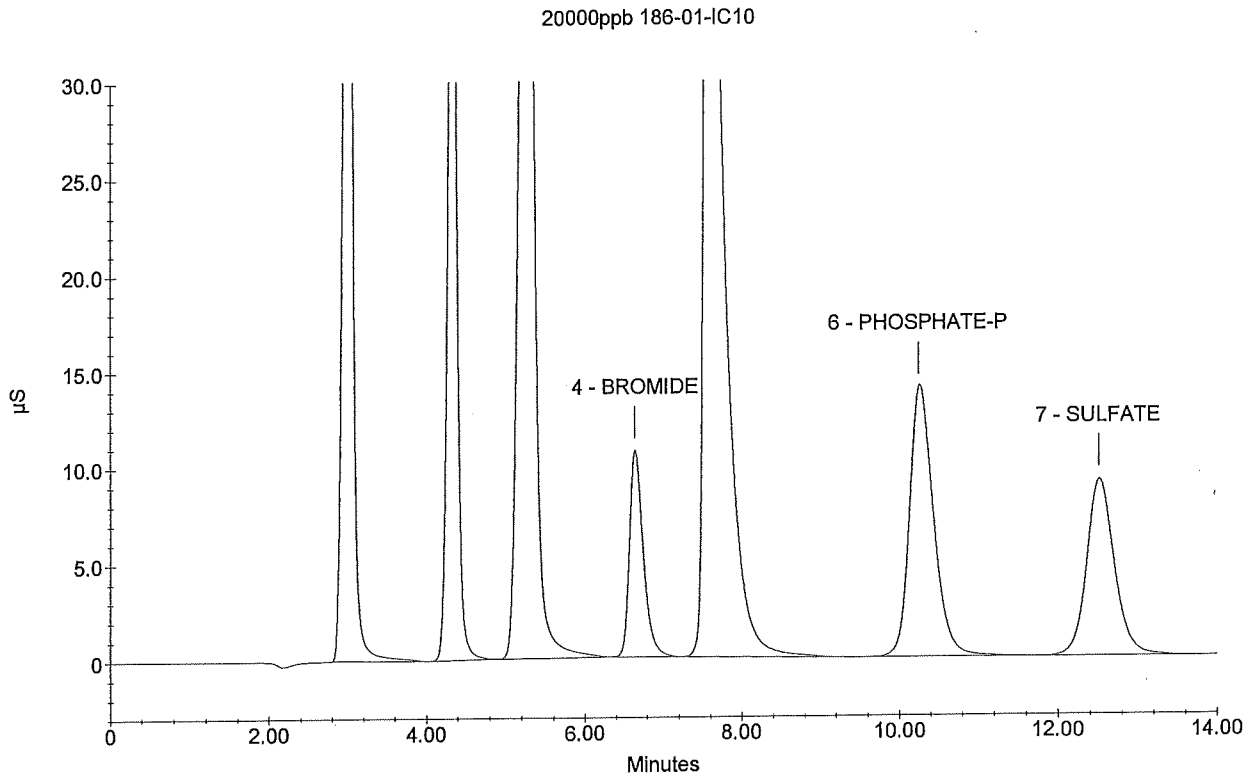
Note: NNN not included in 15 ppm std
CL 7/5/17 gcm

Sample Name : 20000ppb 186-01-IC10
Dilution Factor : 1.00
Injection Number : 9
Data File Name : ...\170703a_009.DXD
Method File Name : c:\peaknet\method\anions170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 6:49:46 PM
Date Time Updated : 7/3/17 7:06:18 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Peak Number	Peak Retention Time	Component Name	Concentration (PPB)	Peak Area	Peak Height
1	2.99	FLUORIDE	20000.00	5095248	586684
2	4.32	CHLORIDE	20000.00	3623654	438236
3	5.25	NITRITE-N	20000.00	7214234	578130
4	6.64	BROMIDE	20000.00	1298680	106634
5	7.57	NITRATE-N	20000.00	9142974	537088
6	10.24	PHOSPHATE-P	20000.00	2999577	139910
7	12.51	SULFATE	20000.00	2215738	91133



Note: NNN not included in 20ppm std
CL 7/5/17 gcm

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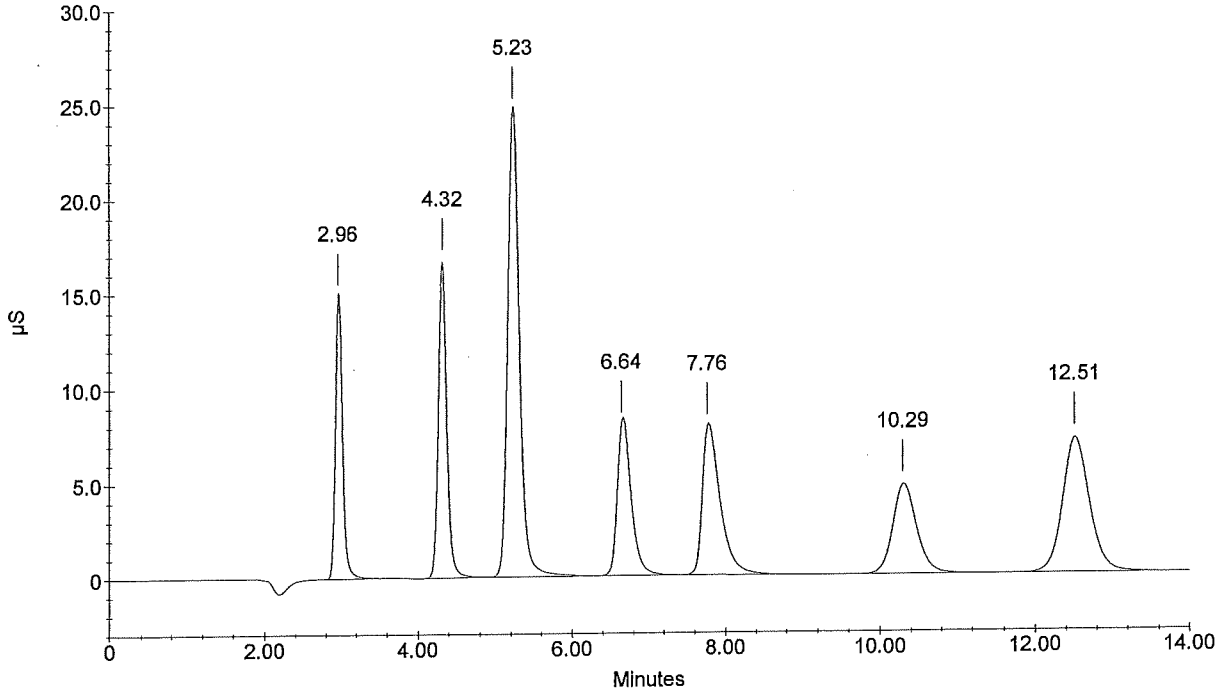
Sample Name : ICV
Dilution Factor : 25.00
Injection Number : 10
Data File Name : ...\170703A_010.DXD
Method File Name : C:\PeakNet\method\ANIONS170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 7:06:34 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.96	FLUORIDE	97190.145	148420	968132	1	-1.00
2	4.32	CHLORIDE	197165.838	166458	1270122	1	-0.00
3	5.23	NITRITE-N	192984.758	245509	2677505	1	-0.44
4	6.64	BROMIDE	411938.977	79346	1046343	1	0.00
5	7.76	NITRATE-N	87823.689	78011	1298555	1	2.51
6	10.29	PHOSPHATE-P	190838.427	47345	1030071	1	0.52
7	12.51	SULFATE	401935.593	71142	1743189	1	-0.03
	0.00		---total(s)--- 1579877.427		10033917		

ICV



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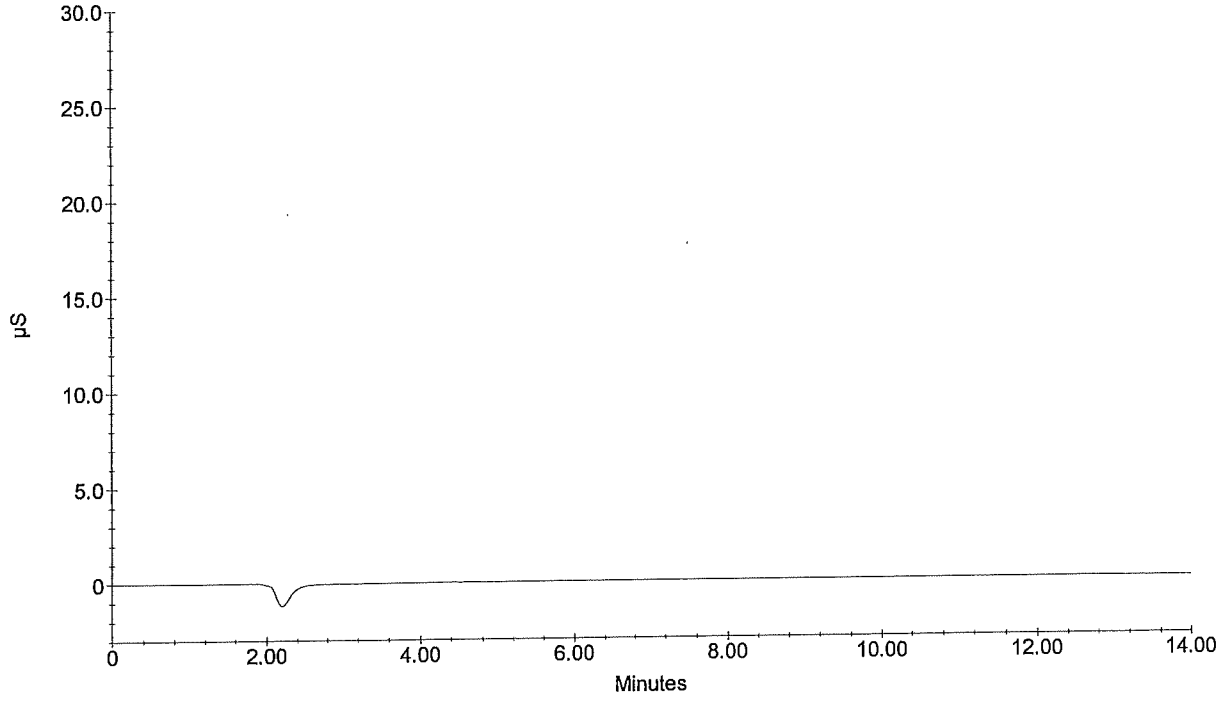
Sample Name : ICB
Dilution Factor : 1.00
Injection Number : 11
Data File Name : ...\170703a_011.DXD
Method File Name : C:\PeakNet\method\ANIONS170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 7:23:22 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
0	0.00	(null) CHLORIDE NITRITE-N BROMIDE NITRATE-N PHOSPHATE-P SULFATE	0.000	0	0	0	0.00
	0.00	---total(s)---	0.000		0		

ICB



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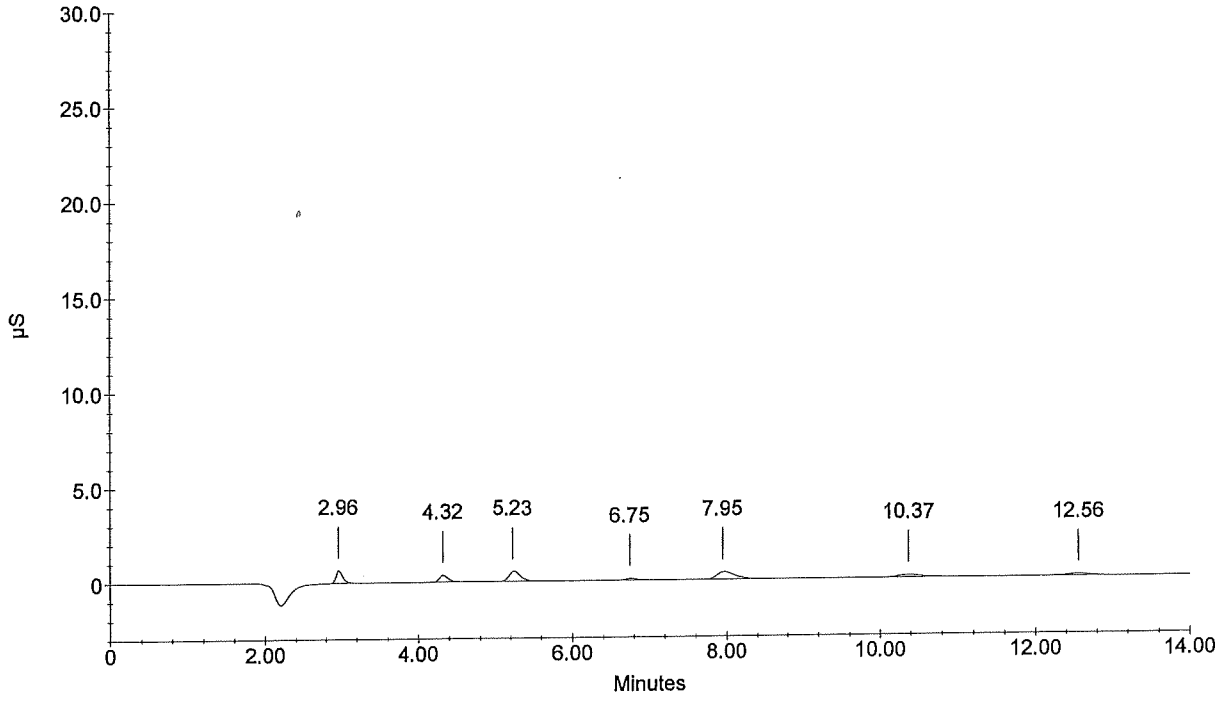
Sample Name : LLC
Dilution Factor : 1.00
Injection Number : 12
Data File Name : ...\170703a_012.DXD
Method File Name : C:\PeakNet\method\ANIONS170703.met
Schedule File Name : c:\peaknet\schedule_500\170703.sch

Date Time Collected : 7/3/17 7:40:07 PM
System Name : Dx-500
Detector Name : Conductivity Detector
Column Type : AS14-SN#034419 AG14-#041004
System Operator : JEHerrera

Peak Information : All Components

Pk. Num	Ret Time	Component Name	Concentration (PPB)	Height	Area	Bl. Code	%Delta
1	2.96	FLUORIDE	222.589	6588	41743	1	-1.00
2	4.32	CHLORIDE	214.910	3440	27684	1	-0.00
3	5.23	NITRITE-N	196.624	4985	55417	1	-0.44
4	6.75	BROMIDE	192.204	781	9855	1	1.61
5	7.95	NITRATE-N	202.453	3775	65499	1	4.98
6	10.37	PHOSPHATE-P	202.232	1231	27068	1	1.30
7	12.56	SULFATE	206.158	834	19653	1	0.40
	0.00		---total(s)--- 1437.170		246918		

LLC



SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Gas Analysis by GC/TCD
Chrom Organics

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Gas Analysis by GC/TCD
QC Summary

SOUTHWEST RESEARCH INSTITUTE

Gas Anaysis by GC-TCD Sample/Duplicate Relative Percent Difference

Sample ID: 617480 DUP

Client ID: Los Alamos National Laboratory
Case: R. Spies
Project: 19869.01.00X
SDG: 617476

Date Received: 07/14/17
Date Extracted: NA
Date Analyzed: 07/14/17
Reporting Unit: %

Lab Sample ID: 617727 DUP
Matrix: Gas

ANALYTE	Sample Concentration %	DUP Concentration %	% RPD	QC Limits % RPD
Oxygen	0.0	0.0	0.0%	30
Nitrogen	50.0	49.4	1.2%	30
Carbon Dioxide	52.1	52.1	0.0%	30
Carbon Monoxide	0.0	0.0	0.0%	30

Southwest Research Institute

Gas Anaysis by GC-TCD Blank Summary

Blank ID: Nitrogen Blank
Lab Sample ID: BLANK_14JUL17
Client: Los Alamos National Laboratory
Matrix: Gas
Extraction: NA

Project: 19869.01.00X
CASE #: R. Spies
SDG: 617476
Analyzed: 07/14/17 9:32:11 AM

This method blank applies to the following samples, MS, and MSD's

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed
617480	617727	07/14/17	9:37:28 AM
617480 DUP	617727 DUP	07/14/17	9:41:41 AM

Southwest Research Institute

Gas Anaysis by GC-TCD Blank Summary

Blank ID: Helium Blank
Lab Sample ID: BLANK_14JUL17
Client: Los Alamos National Laboratory
Matrix: Gas
Extraction: NA

Project: 19869.01.00X
CASE #: R. Spies
SDG: 617476
Analyzed: 07/14/17 1:52:30 PM

This method blank applies to the following samples, MS, and MSD's

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed
617480	617727	07/14/17	2:05:22 PM
617480 DUP	617727 DUP	07/14/17	2:18:01 PM

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Gas Analysis by GC/TCD
Sample Results

SOUTHWEST RESEARCH INSTITUTE
Gas Anaysis by GC-TCD Analysis Data Reporting Form

Client ID: Los Alamos National Laboratory
Case: R. Spies
SDG: 617476
Matrix: Gas
Sample Wt/Vol: NA
Extraction (SEPF/Cont/Sonc): NA
Instrument: GC02

Client Sample ID: 617480
Project: 19869.01.00X
Date Received: 07/14/17
Date Extracted: NA
Date Analyzed: 07/14/17
Decanted (Y/N): N

Lab Sample ID: 617727
Final Extraction Vol: NA
Dilution Factor: 1
pH: NA
Percent Dry: NA
Injection Volume: 50 µL

CAS No.	Compound	%
1333-74-0	Hydrogen	0.500 U

DATA REPORTING QUALIFIERS

D This flag identifies a compound reported at a secondary dilution factor.
E This flag identifies compounds whose concentration exceed the calibration range.
J Indicates an estimated value.
U Indicates the compound was analyzed for but not detected at the reported concentration

SampleName 617727

Column: Carbosphere

Dates Acquired 7/14/2017 9:37:28 AM CDT

GC Conditions: 90°C Isothermal

Detector: TCD

Injection Volume 50.00 uL

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID 617480

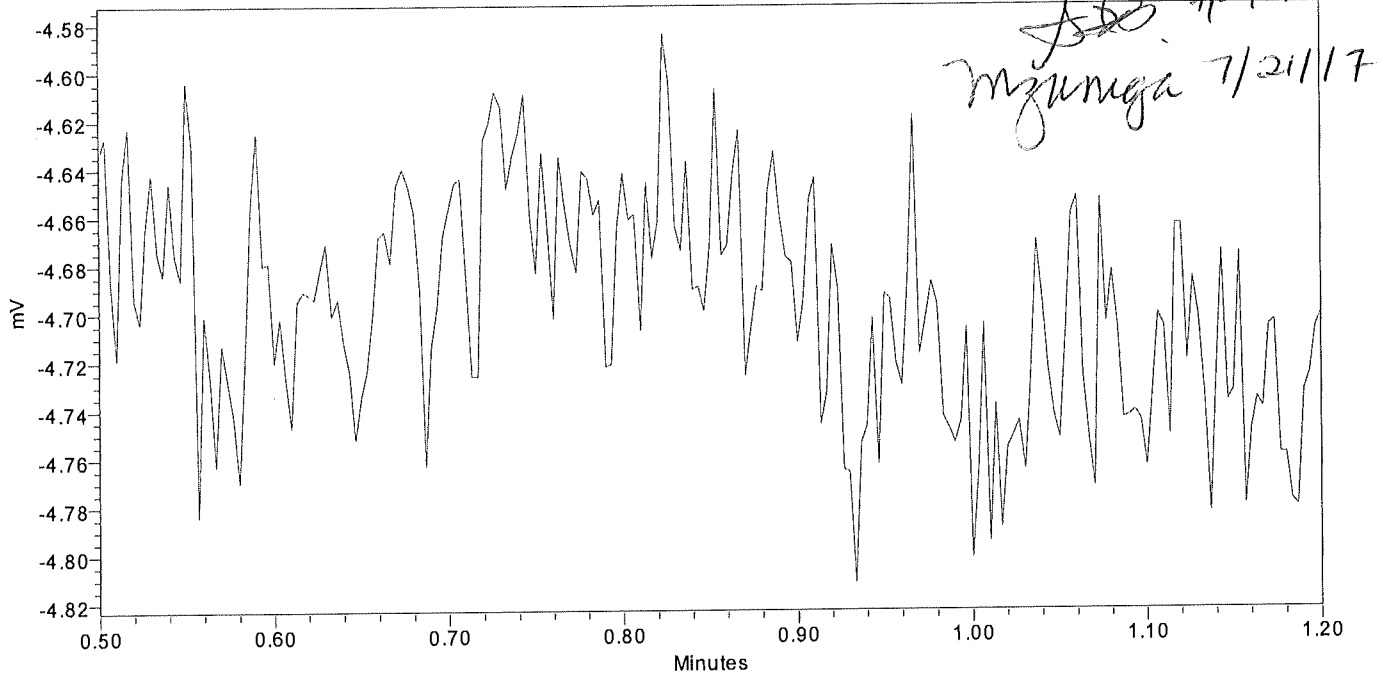
SDG: 617476

System Name GC02_SYS

Project Folder GC02_2017

CYCLE 9

Chromatogram



7/20/17
mzuniga 7/21/17

Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.915			Missing	

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_H2_Carbospher

Processing Method H2_12JUL17

SOUTHWEST RESEARCH INSTITUTE
Gas Anaysis by GC-TCD Analysis Data Reporting Form

Client ID: Los Alamos National Laboratory
Case: R. Spies
SDG: 617476
Matrix: Gas
Sample Wt/Vol: NA
Extraction (SEPF/Cont/Sonc): NA
Instrument: GC02

Client Sample ID: 617480
Project: 19869.01.00X
Date Received: 07/14/17
Date Extracted: NA
Date Analyzed: 07/14/17
Decanted (Y/N): N

Lab Sample ID: 617727
Final Extraction Vol: NA
Dilution Factor: 1
pH: NA
Percent Dry: NA
Injection Volume: 50 µL

CAS No.	Compound	%
7782-44-7	Oxygen	1.00 U
7727-37-9	***Nitrogen***	***50.0***
124-38-9	***Carbon Dioxide***	***52.1***
630-08-0	Carbon Monoxide	1.00 U

DATA REPORTING QUALIFIERS

D This flag identifies a compound reported at a secondary dilution factor.
E This flag identifies compounds whose concentration exceed the calibration range.
J Indicates an estimated value.
U Indicates the compound was analyzed for but not detected at the reported concentration

SampleName 617727

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID 617480

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 2:05:22 PM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

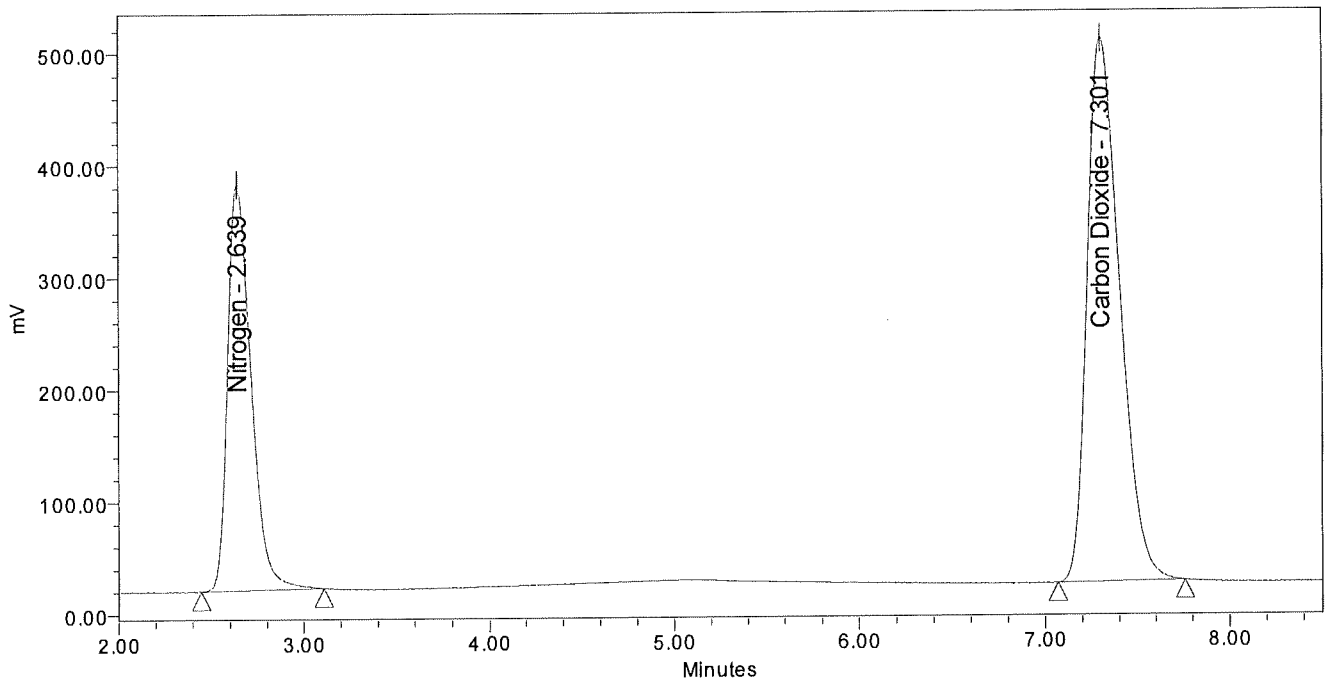
Project Folder GC02_2017

Detector: TCD

CYCLE 10

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.472			Missing	
2	Nitrogen	2.639	3146405	362267	BB	50.037
3	Carbon Monoxide	3.382			Missing	
4	Carbon Dioxide	7.301	5976558	485919	BB	52.089

Manual integrations are identified by lower case letters in the "Int Type" field.

SOUTHWEST RESEARCH INSTITUTE
Gas Anaysis by GC-TCD Analysis Data Reporting Form

Client ID: Los Alamos National Laboratory
Case: R. Spies
SDG: 617476
Matrix: Gas
Sample Wt/Vol: NA
Extraction (SEPF/Cont/Sonc): NA
Instrument: GC02

Client Sample ID: 617480 DUP
Project: 19869.01.00X
Date Received: 07/14/17
Date Extracted: NA
Date Analyzed: 07/14/17
Decanted (Y/N): N

Lab Sample ID: 617727 DUP
Final Extraction Vol: NA
Dilution Factor: 1
pH: NA
Percent Dry: NA
Injection Volume: 50 µL

CAS No.	Compound	%
1333-74-0	Hydrogen	0.500 U

DATA REPORTING QUALIFIERS

D This flag identifies a compound reported at a secondary dilution factor.
E This flag identifies compounds whose concentration exceed the calibration range.
J Indicates an estimated value.
U Indicates the compound was analyzed for but not detected at the reported concentration

SampleName 617727 DUP

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID 617480DUP

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 9:41:41 AM CDT

System Name GC02_SYS

GC Conditions: 90°C Isothermal

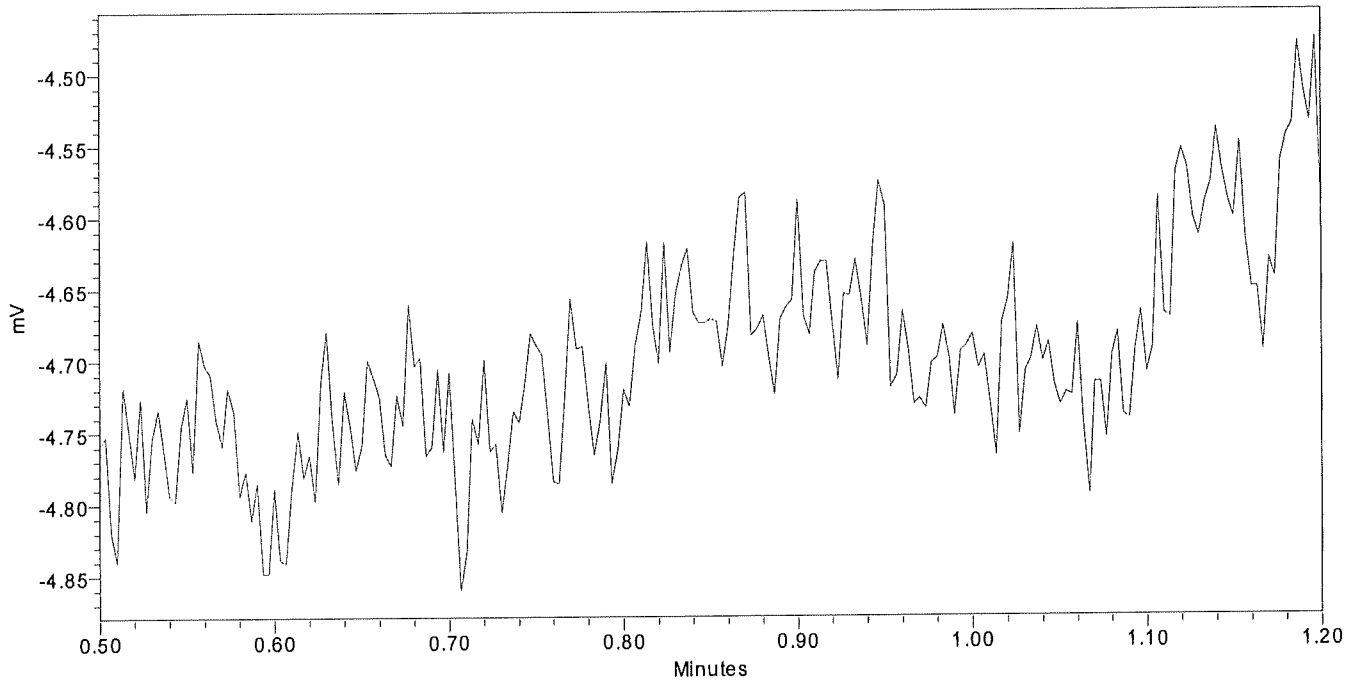
Project Folder GC02_2017

Detector: TCD

CYCLE 10

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.915			Missing	

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_H2_Carbospher

Processing Method H2_12JUL17

SOUTHWEST RESEARCH INSTITUTE
Gas Anaysis by GC-TCD Analysis Data Reporting Form

Client ID: Los Alamos National Laboratory
Case: R. Spies
SDG: 617476
Matrix: Gas
Sample Wt/Vol: NA
Extraction (SEPF/Cont/Sonc): NA
Instrument: GC02

Client Sample ID: 617480 DUP
Project: 19869.01.00X
Date Received: 07/14/17
Date Extracted: NA
Date Analyzed: 07/14/17
Decanted (Y/N): N

Lab Sample ID: 617727 DUP
Final Extraction Vol: NA
Dilution Factor: 1
pH: NA
Percent Dry: NA
Injection Volume: 50 µL

CAS No.	Compound	%
7782-44-7	Oxygen	1.00 U
7727-37-9	***Nitrogen***	***49.4***
124-38-9	***Carbon Dioxide***	***52.1***
630-08-0	Carbon Monoxide	1.00 U

DATA REPORTING QUALIFIERS

D This flag identifies a compound reported at a secondary dilution factor.
E This flag identifies compounds whose concentration exceed the calibration range.
J Indicates an estimated value.
U Indicates the compound was analyzed for but not detected at the reported concentration

SampleName 617727DUP

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID 617480DUP

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 2:18:01 PM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

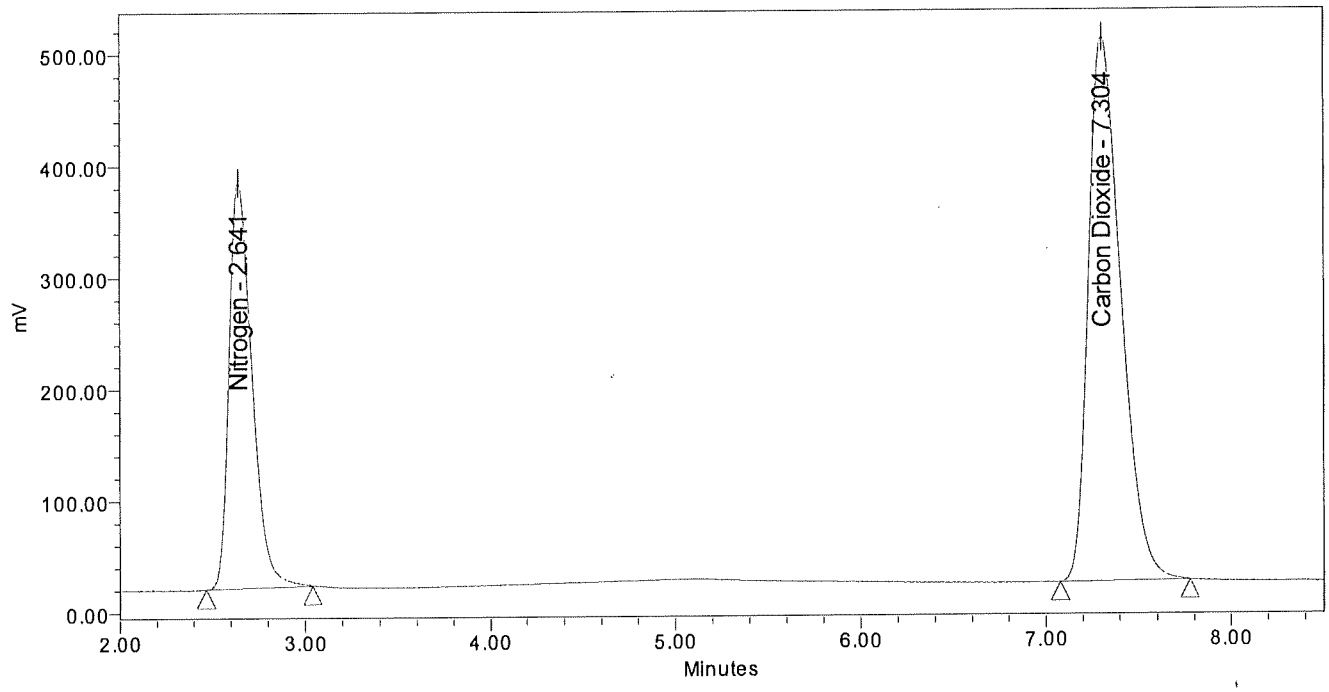
Project Folder GC02_2017

Detector: TCD

CYCLE 11

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.472			Missing	
2	Nitrogen	2.641	3108179	363658	BB	49.423
3	Carbon Monoxide	3.382			Missing	
4	Carbon Dioxide	7.304	5977707	488180	BB	52.099

Manual integrations are identified by lower case letters in the "Int Type" field.

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Gas Analysis by GC/TCD
Raw QC Data

SOUTHWEST RESEARCH INSTITUTE
Gas Anaysis by GC-TCD Analysis Data Reporting Form

Client ID: Los Alamos National Laboratory
Case: R. Spies
SDG: 617476
Matrix: Gas
Sample Wt/Vol: NA
Extraction (SEPF/Cont/Sonc): NA
Instrument: GC02

Client Sample ID: Nitrogen Blank
Project: 19869.01.00X
Date Received: NA
Date Extracted: NA
Date Analyzed: 07/14/17
Decanted (Y/N): N

Lab Sample ID: BLANK_14JUL17
Final Extraction Vol: NA
Dilution Factor: 1
pH: NA
Percent Dry: NA
Injection Volume: 50 µL

CAS No.	Compound	%
1333-74-0	Hydrogen	0.500 U

DATA REPORTING QUALIFIERS

D This flag identifies a compound reported at a secondary dilution factor.
E This flag identifies compounds whose concentration exceed the calibration range.
J Indicates an estimated value.
U Indicates the compound was analyzed for but not detected at the reported concentration

SampleName BLANK_14JUL17

Client: Los Alamos National Laboratory

Project: 19869.01.00X

Method: Gas Analysis by GC-TCD

Client_ID Nitrogen Blank

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 9:32:11 AM CDT

System Name GC02_SYS

GC Conditions: 90°C Isothermal

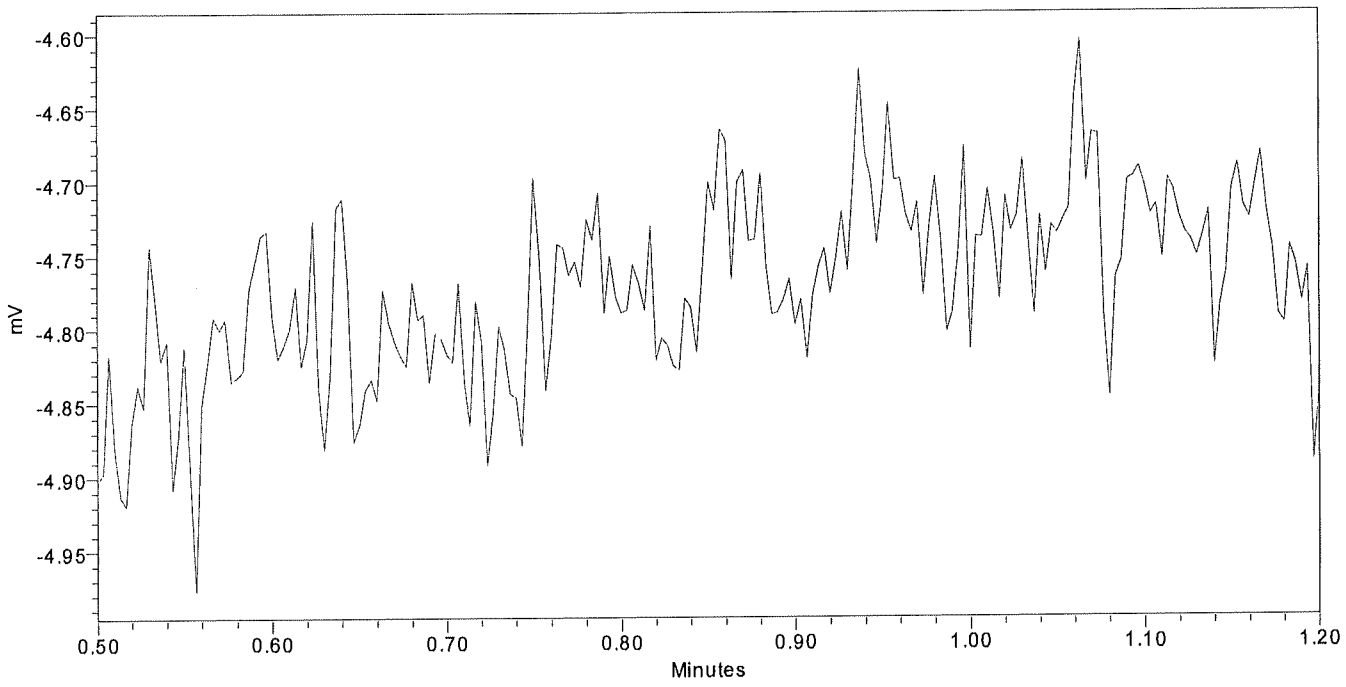
Project Folder GC02_2017

Detector: TCD

CYCLE 8

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.915			Missing	

Manual integrations are identified by lower case letters in the "Int Type" field.

SOUTHWEST RESEARCH INSTITUTE
Gas Anaysis by GC-TCD Analysis Data Reporting Form

Client ID: Los Alamos National Laboratory
Case: R. Spies
SDG: 617476
Matrix: Gas
Sample Wt/Vol: NA
Extraction (SEPF/Cont/Sonc): NA
Instrument: GC02

Client Sample ID: Helium Blank
Project: 19869.01.00X
Date Received: NA
Date Extracted: NA
Date Analyzed: 07/14/17
Decanted (Y/N): N

Lab Sample ID: BLANK_14JUL17
Final Extraction Vol: NA
Dilution Factor: 1
pH: NA
Percent Dry: NA
Injection Volume: 50 µL

CAS No.	Compound	%
7782-44-7	Oxygen	1.00 U
7727-37-9	Nitrogen	1.00 U
124-38-9	Carbon Dioxide	1.00 U
630-08-0	Carbon Monoxide	1.00 U

DATA REPORTING QUALIFIERS

D This flag identifies a compound reported at a secondary dilution factor.
E This flag identifies compounds whose concentration exceed the calibration range.
J Indicates an estimated value.
U Indicates the compound was analyzed for but not detected at the reported concentration

SampleName BLANK_14JUL17

Client: Los Alamos National Laboratory

Project: 19869.01.00X

Method: Gas Analysis by GC-TCD

Client_ID Helium Blank

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 1:52:30 PM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

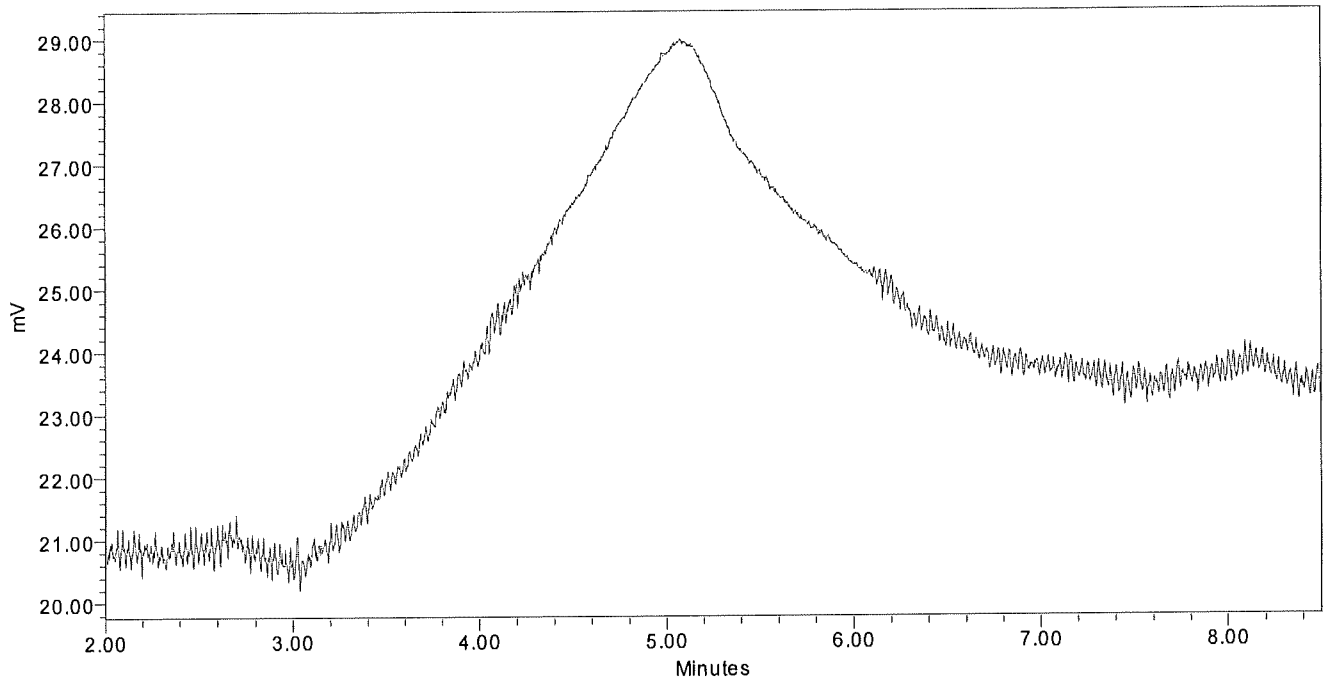
Project Folder GC02_2017

Detector: TCD

CYCLE 9

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.472			Missing	
2	Nitrogen	2.643			Missing	
3	Carbon Monoxide	3.382			Missing	
4	Carbon Dioxide	7.318			Missing	

Manual integrations are identified by lower case letters in the "Int Type" field.

010101

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Gas Analysis by GC/TCD
Standard Data

Southwest Research Institute

Method Gas Anaysis by GC-TCD Initial Calibration

Client: Los Alamos National Laboratory
SwRI Project: 19869.01.00X

System Name: GC02
GC Column: Carbosphere

ANALYTE	ADJ	RETENTION TIMES					Mean RT	RT Window	
		STD1	STD2	STD3	STD4	STD5		From	To
Hydrogen	Y	0.914	0.912	0.912	0.912	0.911	0.91	0.71	1.11

	INJECTION TIMES
	Group A
STD1	07/12/17 09:58:37
STD2	07/12/17 09:55:38
STD3	07/12/17 09:47:39
STD4	07/12/17 09:45:04
STD5	07/12/17 09:42:24

ADJ - If this column is 'Y' the Rentention Time window was adjusted, per method, to a reasonble size. This is done if the windows are small or zero.

Southwest Research Institute

Method Gas Anaysis by GC-TCD Initial Calibration

Client: Los Alamos National Laboratory
SwRI Project: 19869.01.00X

System Name: GC02
GC Column: Carbosphere

ANALYTE	CALIBRATION FACTORS					Mean Cal Factor	%RSD
	STD1	STD2	STD3	STD4	STD5		
Hydrogen	32988	32376	34567	31845	32226	32800	3.3

	INJECTION TIMES
	Group A
STD1	07/12/17 09:58:37
STD2	07/12/17 09:55:38
STD3	07/12/17 09:47:39
STD4	07/12/17 09:45:04
STD5	07/12/17 09:42:24

FORM VI-E

Southwest Research Institute

Method Gas Anaysis by GC-TCD Continuing Calibration

Client: Los Alamos National Laboratory
SwRI Project: 19869.01.00X
Continuing Cal ID(s): ICV GRPA STD3

System Name: GC02
GC Column: Carbosphere
Injection Times: 07/12/17 10:01:59

ANALYTE	Retention Time Window		RT	Nominal Amount	Calculated Amount	%D
	From	To				
Hydrogen	0.71	1.11	0.91	2.00	2.01	0.50

QC Limits: %D should be no greater than 30%

FORM VII

Southwest Research Institute

Gas Anaysis by GC-TCD Continuing Calibration

Client: Los Alamos National Laboratory
SwRI Project: 19869.01.00X
Continuing Cal ID(s): CCV01 GRPA STD3

System Name: GC02
GC Column: Carbosphere
Injection Times: 07/14/17 09:28:31

ANALYTE	Retention Time Window		RT	Nominal Amount	Calculated Amount	%D
	From	To				
Hydrogen	0.71	1.11	0.91	2.00	2.04	2.0

QC Limits: %D should be no greater than 30%

FORM VII

Southwest Research Institute

Gas Anaysis by GC-TCD Continuing Calibration

Client: Los Alamos National Laboratory
SwRI Project: 19869.01.00X
Continuing Cal ID(s): CCV02 GRPA STD3

System Name: GC02
GC Column: Carbosphere
Injection Times: 07/14/17 09:44:53

ANALYTE	Retention Time Window		RT	Nominal Amount	Calculated Amount	%D
	From	To				
Hydrogen	0.71	1.11	0.91	2.00	2.07	3.5

QC Limits: %D should be no greater than 30%

Southwest Research Institute

Method: Gas Anaysis by GC-TCD Analytical Sequence

Client: Los Alamos National Laboratory
Instrument ID: GC02
GC Column: Carbosphere

Project: 19869.01.00X
Case: R. Spies
SDG: 617476

The analytical sequence of performance evaluation mixtures, blanks, samples, and standards is given below:

	Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed
1	GRPA STD5	STD2017:38:01	07/12/17	09:42:24
2	GRPA STD4	STD2017:38:02	07/12/17	09:45:04
3	GRPA STD3	STD2017:38:03	07/12/17	09:47:39
4	GRPA STD2	STD2017:38:04	07/12/17	09:55:38
5	GRPA STD1	STD2017:38:05	07/12/17	09:58:37
6	ICV GRPA STD3	STD2017:38:06	07/12/17	10:01:59
7	CCV01 GRPA STD3	STD2017:38:07	07/14/17	09:28:31
8	Nitrogen Blank	BLANK_I4JUL17	07/14/17	09:32:11
9	617480	617727	07/14/17	09:37:28
10	617480 DUP	617727 DUP	07/14/17	09:41:41
11	CCV02 GRPA STD3	STD2017:38:07	07/14/17	09:44:53

ZZZZZ - These injections were not used to analyze this data

SampleName STD2017:38:01

Client: Los Alamos National Laboratory

Project: 19869.01.00X

Method: Gas Analysis by GC-TCD

Client_ID H2 @ 10 %

Column: Carbosphere

SDG: 617476

Dates Acquired 7/12/2017 9:42:24 AM CDT

System Name GC02_SYS

GC Conditions: 90°C Isothermal

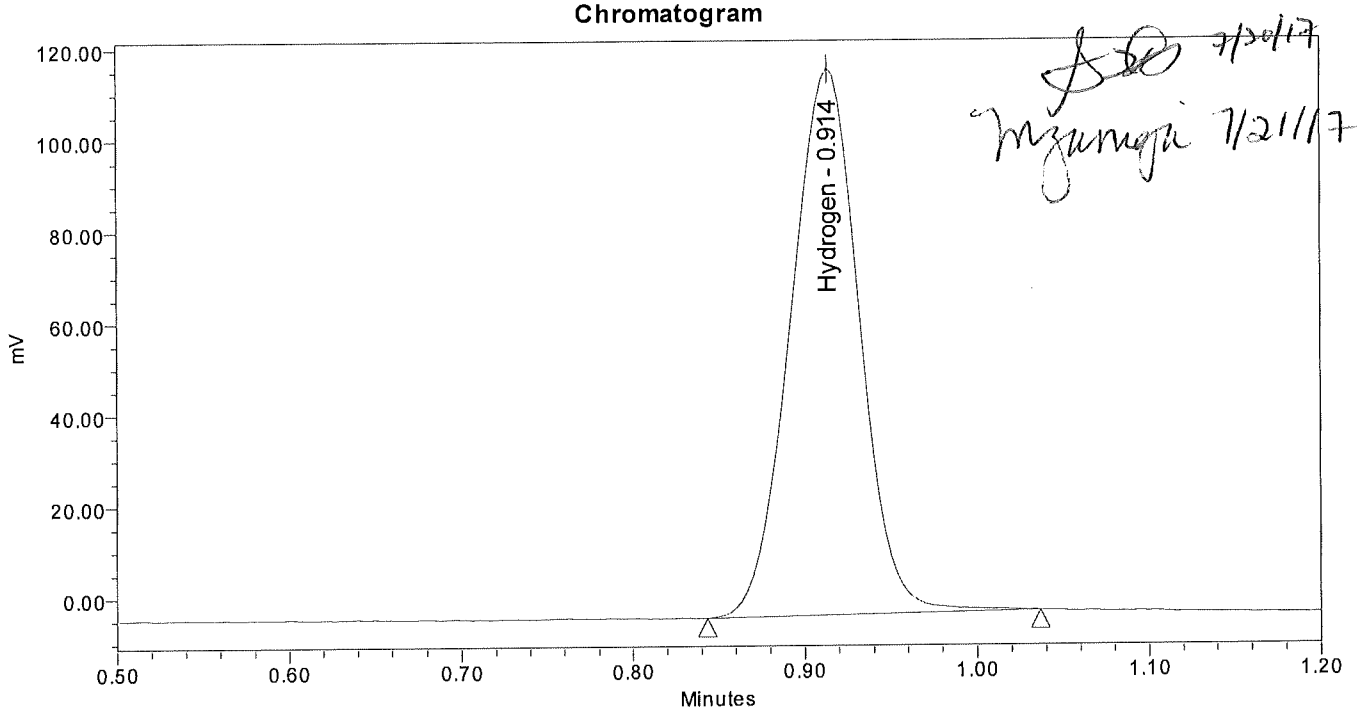
Project Folder GC02_2017

Detector: TCD

CYCLE 1

Injection Volume 50.00 uL

Chromatogram



7/20/17

Mzamagi 7/21/17

Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.914	329879	119668	BB	10.000

Manual integrations are identified by lower case letters in the "Int Type" field.

SampleName STD2017:38:02

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID H2 @ 5.0 %

Column: Carbosphere

SDG: 617476

Dates Acquired 7/12/2017 9:45:04 AM CDT

System Name GC02_SYS

GC Conditions: 90°C Isothermal

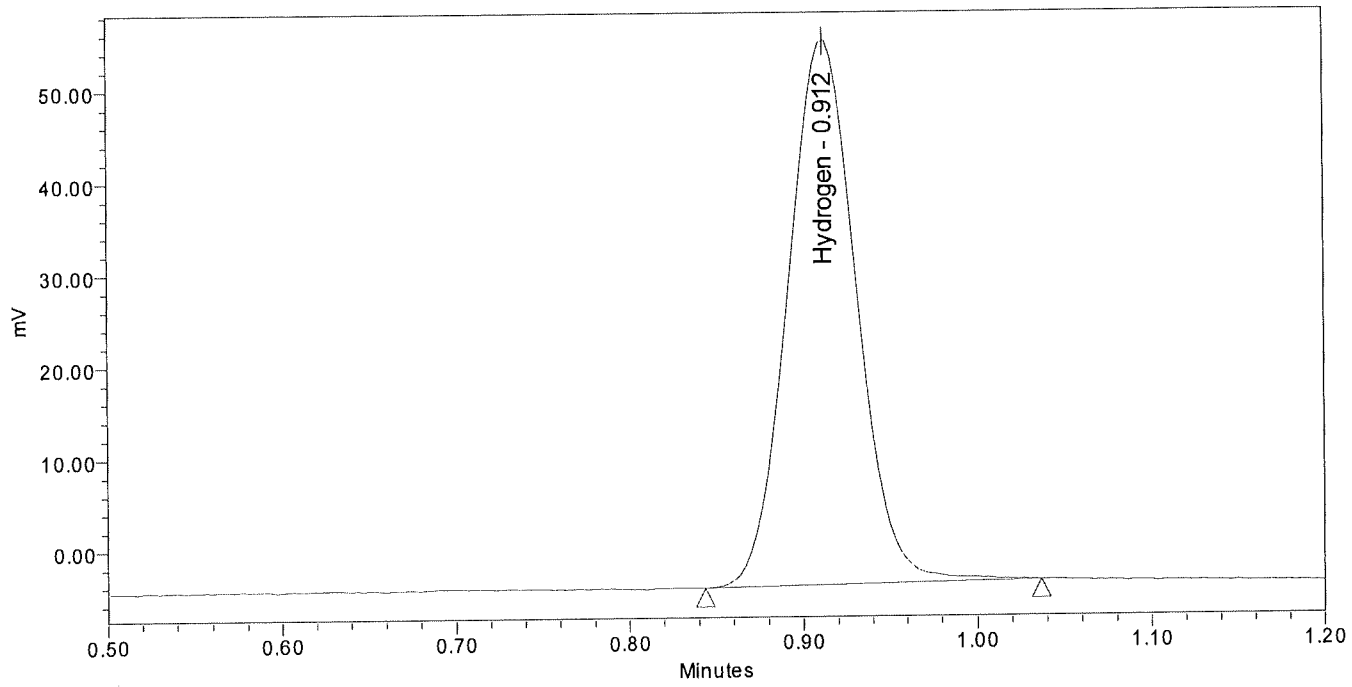
Project Folder GC02_2017

Detector: TCD

CYCLE 2

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.912	161879	59483	BB	5.000

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_H2_Carbospher

Processing Method H2_12JUL17

SampleName STD2017:38:03

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID H2 @ 2.0 %

Column: Carbosphere

SDG: 617476

Dates Acquired 7/12/2017 9:47:39 AM CDT

System Name GC02_SYS

GC Conditions: 90°C Isothermal

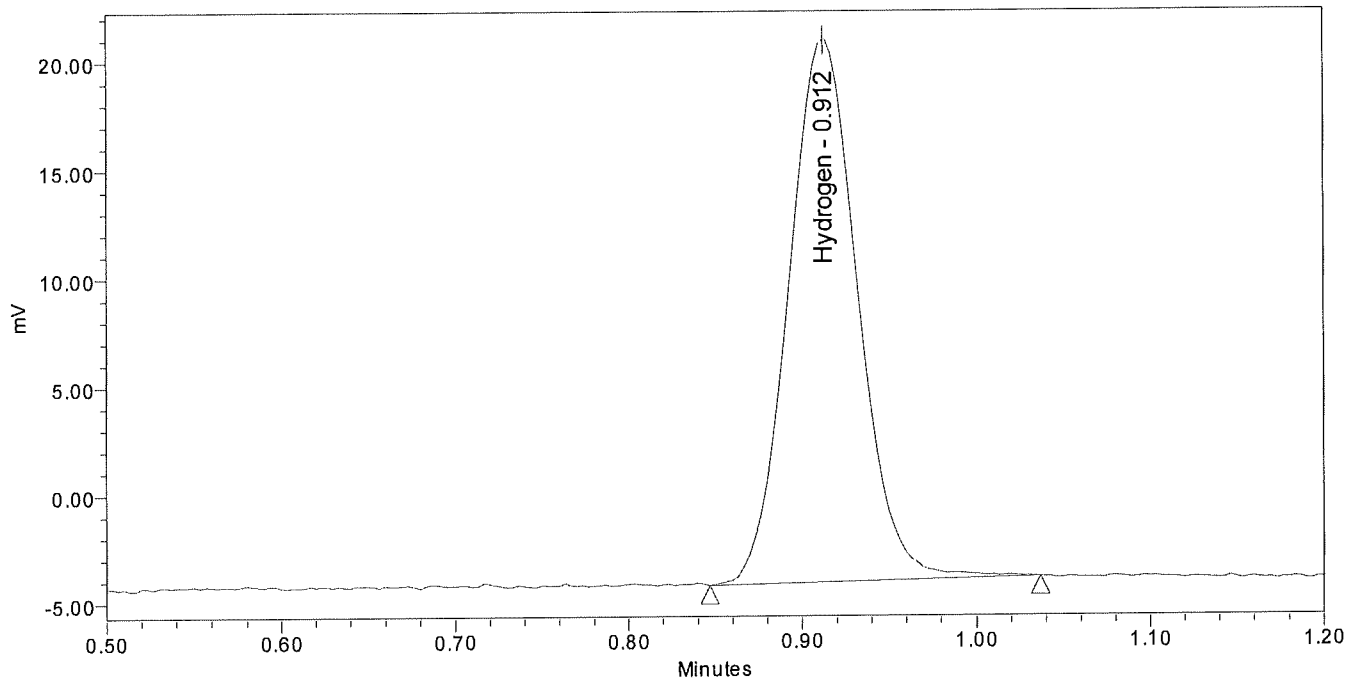
Project Folder GC02_2017

Detector: TCD

CYCLE 3

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.912	69133	25152	BB	2.000

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_H2_Carbospher

Processing Method H2_12JUL17

SampleName STD2017:38:04

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID H2 @ 1.0 %

Column: Carbosphere

SDG: 617476

Dates Acquired 7/12/2017 9:55:38 AM CDT

System Name GC02_SYS

GC Conditions: 90°C Isothermal

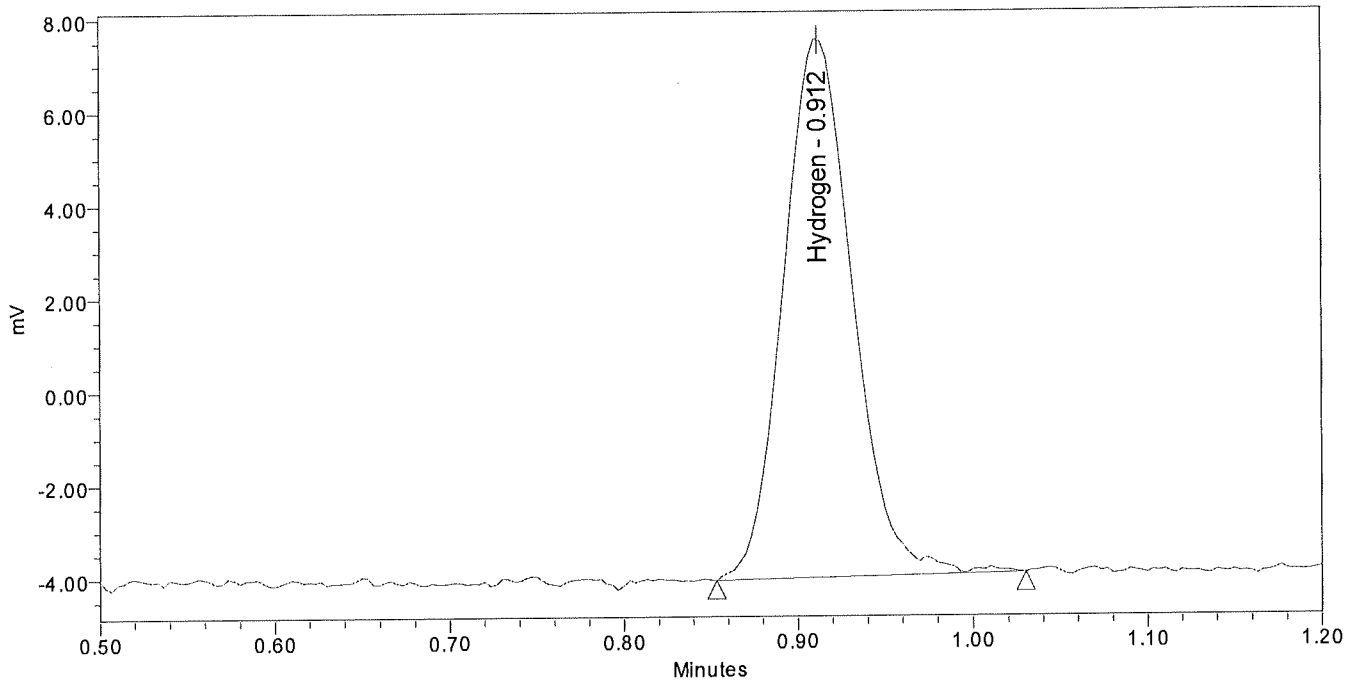
Project Folder GC02_2017

Detector: TCD

CYCLE 4

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.912	31845	11601	BB	1.000

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_H2_Carbospher

Processing Method H2_12JUL17

SampleName STD2017:38:05

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID H2 @ 0.5 %

Column: Carbosphere

SDG: 617476

Dates Acquired 7/12/2017 9:58:37 AM CDT

System Name GC02_SYS

GC Conditions: 90°C Isothermal

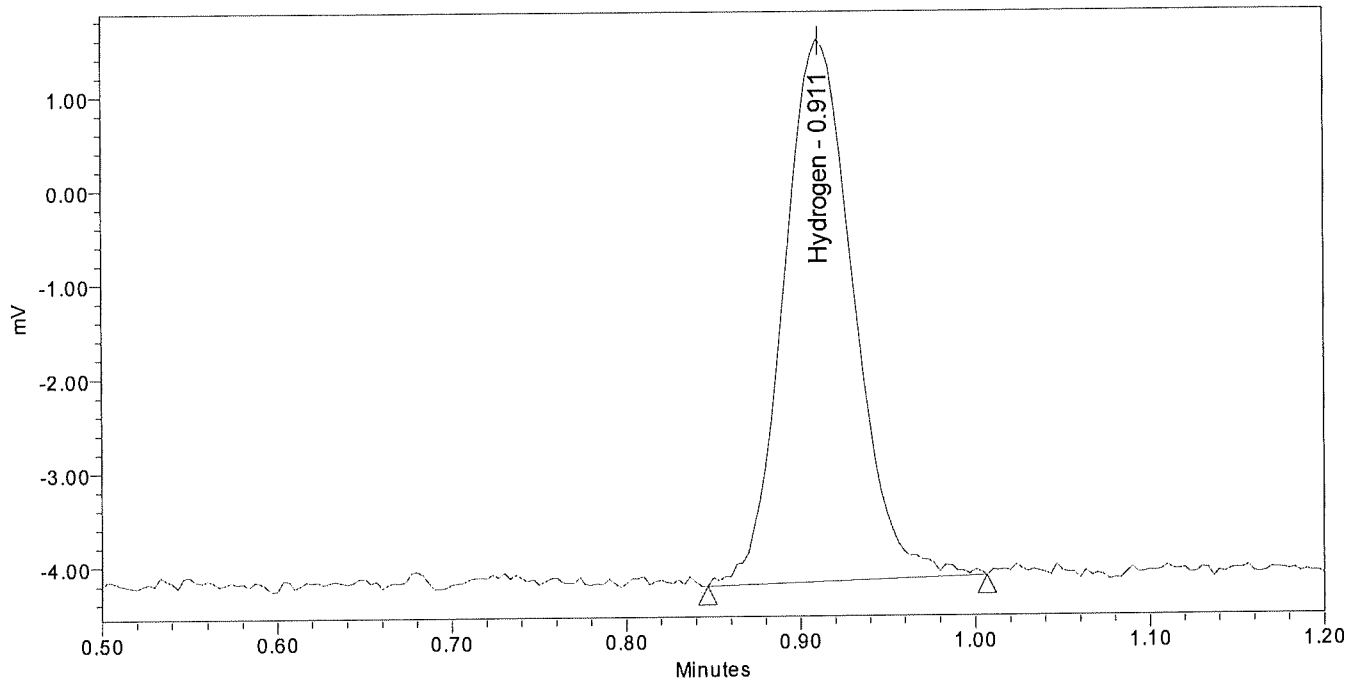
Project Folder GC02_2017

Detector: TCD

CYCLE 5

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.911	16113	5761	BB	0.500

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_H2_Carbospher

Processing Method H2_12JUL17

SampleName STD2017:38:06

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID ICV H2 @ 2.0 %

Column: Carbosphere

SDG: 617476

Dates Acquired 7/12/2017 10:01:59 AM CDT

System Name GC02_SYS

GC Conditions: 90°C Isothermal

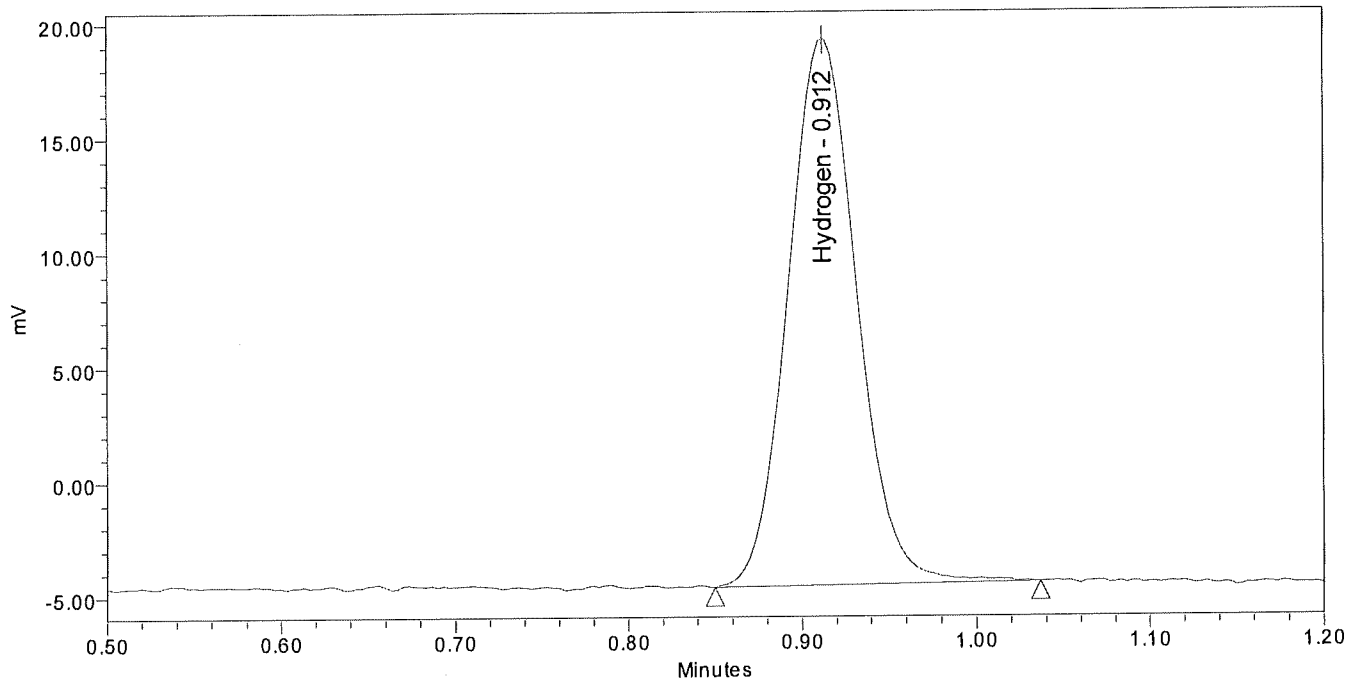
Project Folder GC02_2017

Detector: TCD

CYCLE 6

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.912	65764	23915	BB	2.005

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_H2_Carbospher

Processing Method H2_12JUL17

SampleName STD2017:38:07

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID CCV01 H2 @ 2.0 %

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 9:28:31 AM CDT

System Name GC02_SYS

GC Conditions: 90°C Isothermal

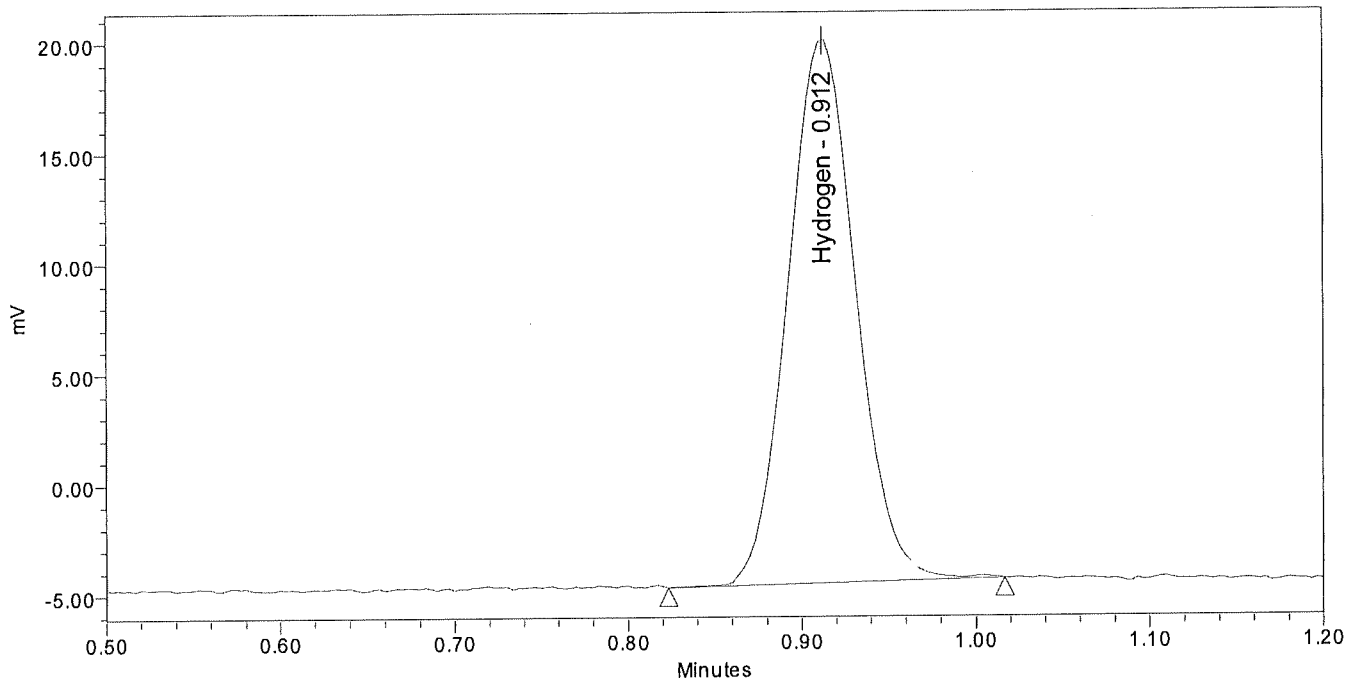
Project Folder GC02_2017

Detector: TCD

CYCLE 7

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.912	67021	24653	BB	2.043

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_H2_Carbospher

Processing Method H2_12JUL17

SampleName STD2017:38:07

Client: Los Alamos National Laboratory

Project: 19869.01.00X

Method: Gas Analysis by GC-TCD

Client_ID CCV02 H2 @ 2.0 %

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 9:44:53 AM CDT

System Name GC02_SYS

GC Conditions: 90°C Isothermal

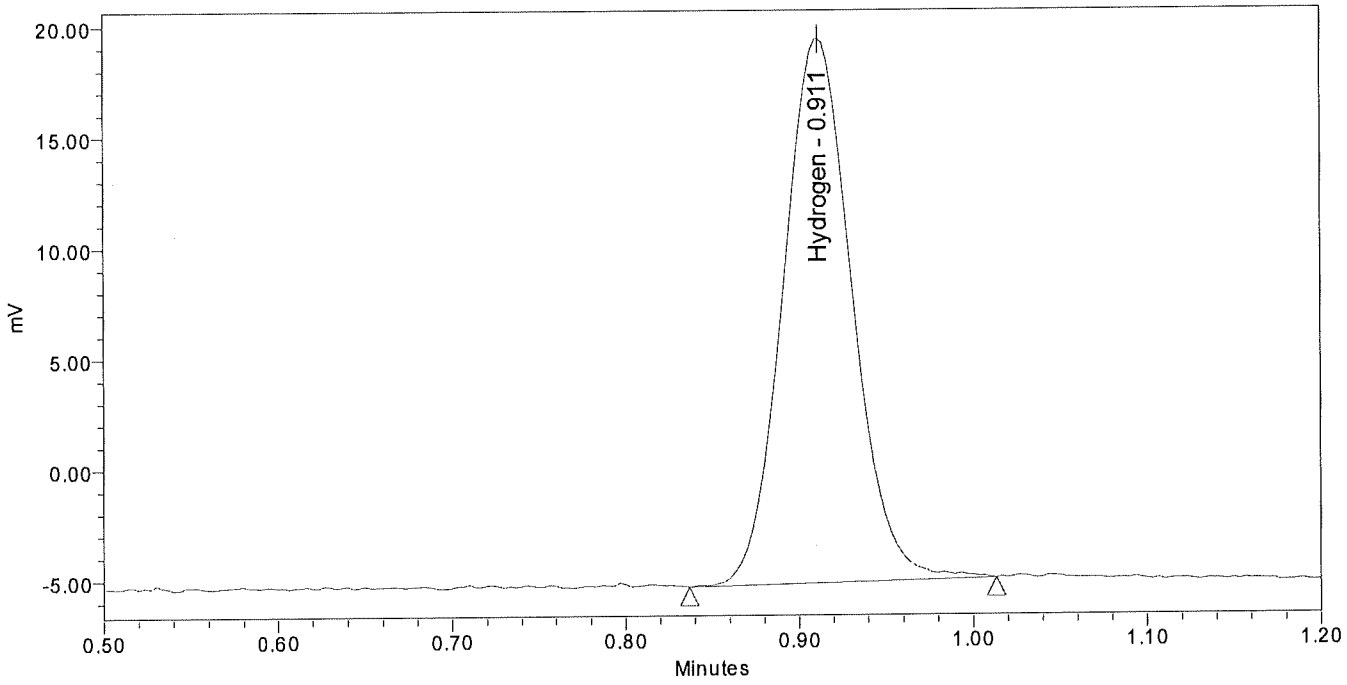
Project Folder GC02_2017

Detector: TCD

CYCLE 11

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Hydrogen	0.911	68022	24665	BB	2.074

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_H2_Carbospher

Processing Method H2_12JUL17

Southwest Research Institute

Method: Gas Anaysis by GC-TCD Initial Calibration

Client: Los Alamos National Laboratory
SwRI Project: 19869.01.00X

System Name: GC02
GC Column: Carbosphere

ANALYTE	ADJ	RETENTION TIMES						Mean RT	RT Window	
		STD1	STD2	STD3	STD4	STD5	STD6		From	To
Oxygen	Y	2.486	2.490	2.491				2.49	2.29	2.69
Nitrogen	Y	2.647		2.646	2.649	2.631	2.639	2.64	2.44	2.84
Carbon Dioxide	Y	7.328	7.326	7.338	7.321	7.307	7.305	7.32	7.12	7.52
Carbon Monoxide	Y	3.392	3.393	3.385				3.39	3.19	3.59

	INJECTION TIMES
	Group A
STD1	07/14/17 11:39:52
STD2	07/14/17 11:53:05
STD3	07/14/17 12:07:27
STD4	07/14/17 12:20:29
STD5	07/14/17 12:33:19
STD6	07/14/17 12:54:14

ADJ - If this column is 'Y' the Rentention Time window was adjusted, per method, to a reasonble size. This is done if the windows are small or zero.

Southwest Research Institute

Gas Anaysis by GC-TCD Initial Calibration

Client: Los Alamos National Laboratory
SwRI Project: 19869.01.00X

System Name: GC02
GC Column: Carbosphere

ANALYTE	CALIBRATION FACTORS						Mean Cal Factor	%RSD
	STD1	STD2	STD3	STD4	STD5	STD6		
Oxygen	49467	55173	51572				52071	5.5
Nitrogen	74089		118666	59443	62806	63982	75797	32.4
Carbon Dioxide	118534	105653	102945	118703	120835	121760	114738	7.2
Carbon Monoxide	59621	52952	43774				52116	15.3

	INJECTION TIMES
	Group A
STD1	07/14/17 11:39:52
STD2	07/14/17 11:53:05
STD3	07/14/17 12:07:27
STD4	07/14/17 12:20:29
STD5	07/14/17 12:33:19
STD6	07/14/17 12:54:14

FORM VI-E

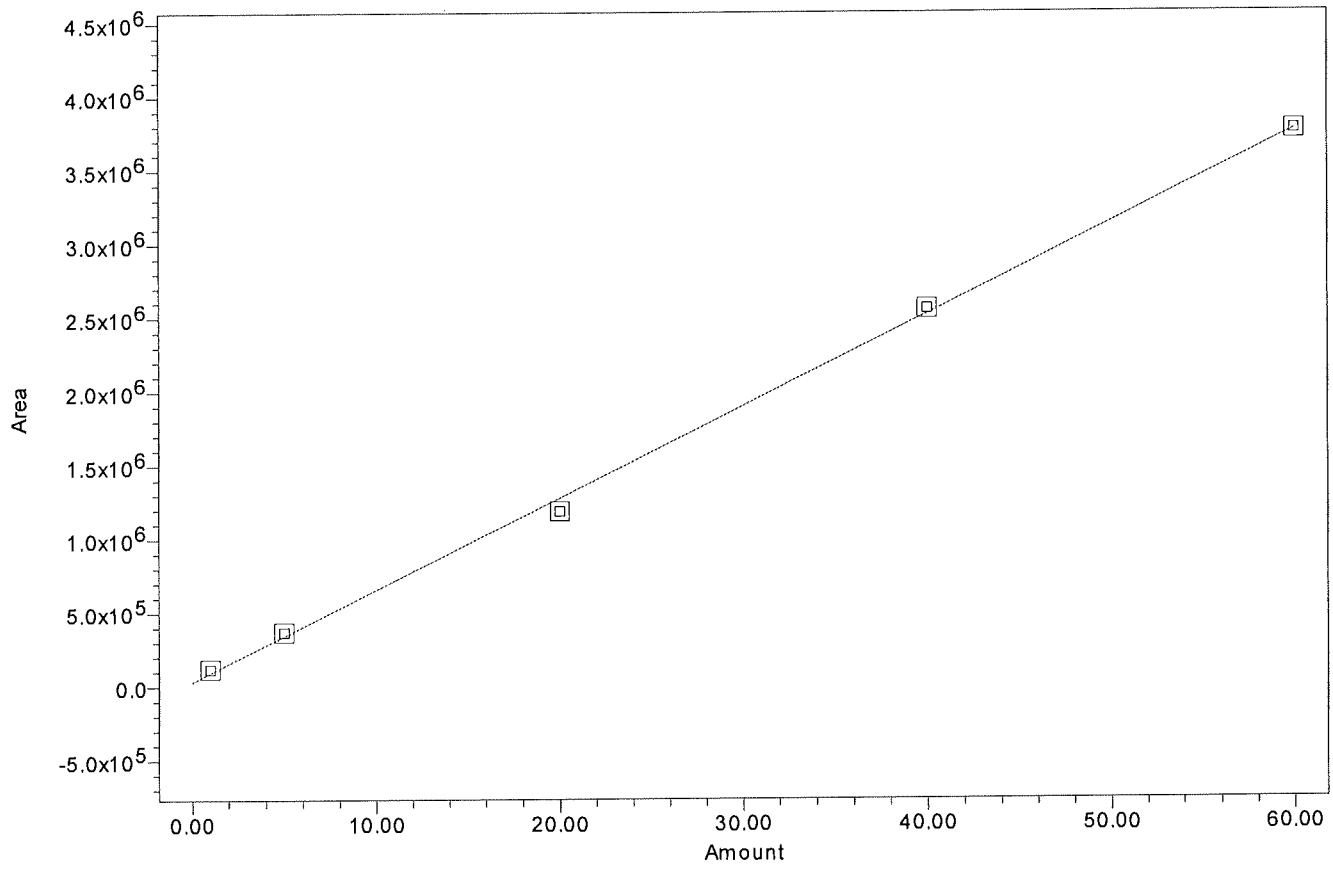
Empower 2 software

Untitled

Processing Method:	O2N2COCO2_14JUL17	Project Name:	GC02_2017
Processing Method ID:	2544	System:	GC02_SYS
Channel:	SATIN	Calibration ID:	2521
Proc. Chnl. Descr.:	****		
Date Calibrated:	07/14/17 1:12:52 PM CDT		

A 3.327564e+004
B 6.221604e+004
C 0.000000e+000
D 0.000000e+000
R^2 0.998896

Calibration Plot



Peak: Nitrogen

	Name	Level	X Value	Response	Calc. Value	% Deviation	Manual	Ignore
1	Nitrogen		1.000000	118665.731944	1.372477	37.248	No	No
2	Nitrogen		5.000000	370445.220000	5.419335	8.387	No	No
3	Nitrogen		20.000000	1188869.000000	18.573882	-7.131	No	No
4	Nitrogen		40.000000	2559262.800000	40.600257	1.501	No	No
5	Nitrogen		60.000000	3768356.400000	60.034049	0.057	No	No

Southwest Research Institute

Method: Gas Anaysis by GC-TCD Continuing Calibration

Client: Los Alamos National Laboratory
SwRI Project: 19869.01.00X
Continuing Cal ID(s): ICV01 GRPA STD3

System Name: GC02
GC Column: Carbosphere
Injection Times: 07/14/17 13:11:26

ANALYTE	Retention Time Window From	Retention Time Window To	RT	Nominal Amount	Calculated Amount	%D
Oxygen	2.29	2.69	2.47	NA	NA	NA
Nitrogen	2.44	2.84	2.62	NA	NA	NA
Carbon Dioxide	7.12	7.52	7.34	1	1.00	0
Carbon Monoxide	3.19	3.59	3.40	1	0.889	11

QC Limits: %D should be no greater than 30%

FORM VII

Southwest Research Institute

Method: Gas Anaysis by GC-TCD Continuing Calibration

Client: Los Alamos National Laboratory
SwRI Project: 19869.01.00X
Continuing Cal ID(s): ICV02 GRPA STD1

System Name: GC02
GC Column: Carbosphere
Injection Times: 07/14/17 13:37:55

ANALYTE	Retention Time Window From	Retention Time Window To	RT	Nominal Amount	Calculated Amount	%D
Oxygen	2.29	2.69	2.49	5.00	5.42	8.4
Nitrogen	2.44	2.84	2.66	5.00	5.60	12
Carbon Dioxide	7.12	7.52	7.33	5.00	5.86	17
Carbon Monoxide	3.19	3.59	3.38	NA	NA	NA

QC Limits: %D should be no greater than 30%

Southwest Research Institute

Method: Gas Anaysis by GC-TCD Continuing Calibration

Client: Los Alamos National Laboratory
SwRI Project: 19869.01.00X
Continuing Cal ID(s): CCV01 GRPA STD1

System Name: GC02
GC Column: Carbosphere
Injection Times: 07/14/17 14:30:59

ANALYTE	Retention Time Window		RT	Nominal Amount	Calculated Amount	%D
	From	To				
Oxygen	2.29	2.69	2.50	5.00	4.63	7.4
Nitrogen	2.44	2.84	2.66	5.00	4.80	4.0
Carbon Dioxide	7.12	7.52	7.33	5.00	5.27	5.4
Carbon Monoxide	3.19	3.59	3.40	5.00	5.79	16

QC Limits: %D should be no greater than 30%

FORM VII

Southwest Research Institute

Gas Anaysis by GC-TCD Analytical Sequence

Client: Los Alamos National Laboratory
Instrument ID: GC02
GC Column: Carbosphere

Project: 19869.01.00X
Case: R. Spies
SDG: 617476

The analytical sequence of performance evaluation mixtures, blanks, samples, and standards is given below:

	Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed
1	GRPA STD1	STD2017:39:01	07/14/17	11:39:52
2	GRPA STD2	STD2017:39:02	07/14/17	11:53:05
3	GRPA STD3	STD2017:39:03	07/14/17	12:07:27
4	GRPA STD4	STD2017:39:04	07/14/17	12:20:29
5	GRPA STD5	STD2017:39:05	07/14/17	12:33:19
6	GRPA STD6	STD2017:39:06	07/14/17	12:54:14
7	ICV01 GRPA STD3	STD2017:39:07	07/14/17	13:11:26
8	ICV02 GRPA STD1	STD2017:39:08	07/14/17	13:37:55
9	Helium Blank	BLANK_14JUL17	07/14/17	13:52:30
10	617480	617727	07/14/17	14:05:22
11	617480 DUP	617727 DUP	07/14/17	14:18:01
12	CCV01 GRPA STD1	STD2017:39:01	07/14/17	14:30:59

ZZZZZ - These injections were not used to analyze this data

SampleName STD2017:39:01

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID GRPA STD1

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 11:39:52 AM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

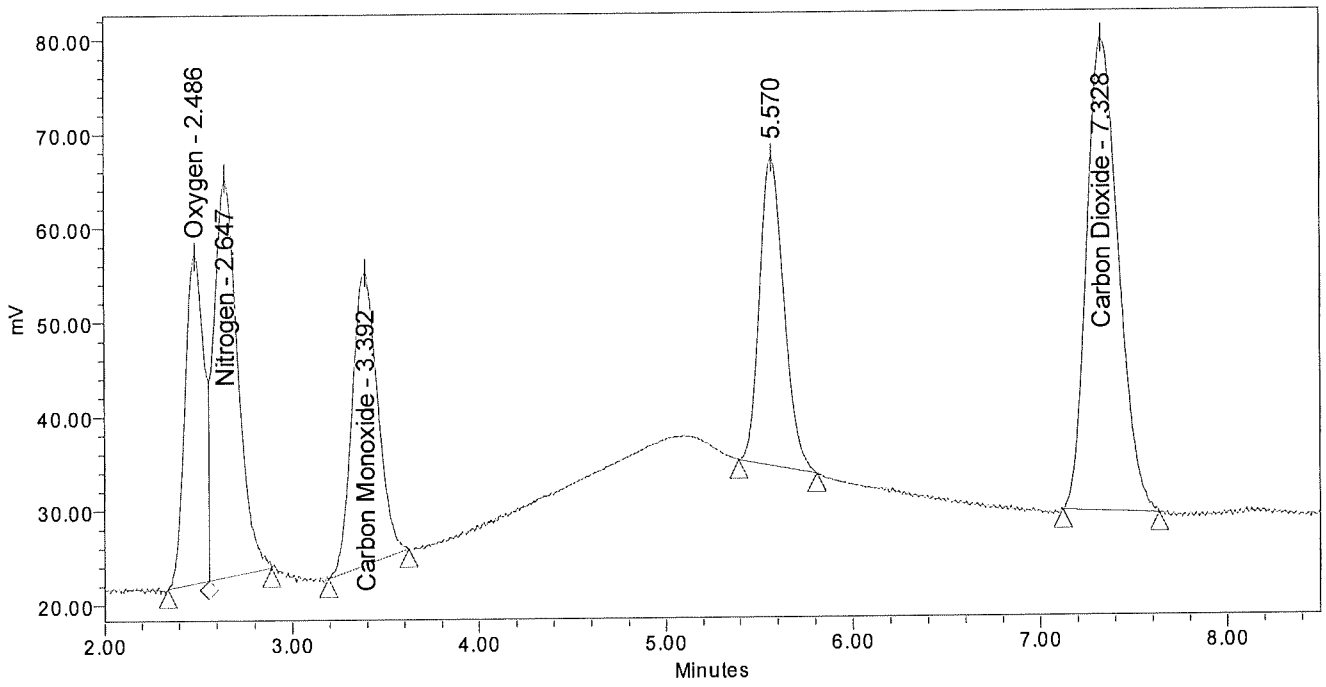
Project Folder GC02_2017

Detector: TCD

CYCLE 1

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.486	247337	34857	BV	5.000
2	Nitrogen	2.647	370445	42444	VB	5.000
3	Carbon Monoxide	3.392	298106	31058	BB	5.000
4	Carbon Dioxide	7.328	592672	50347	BB	5.000

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_O2N2COCO2_I

Processing Method O2N2COCO2_14JUL17

SampleName STD2017:39:02

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID GRPA STD2

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 11:53:05 AM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

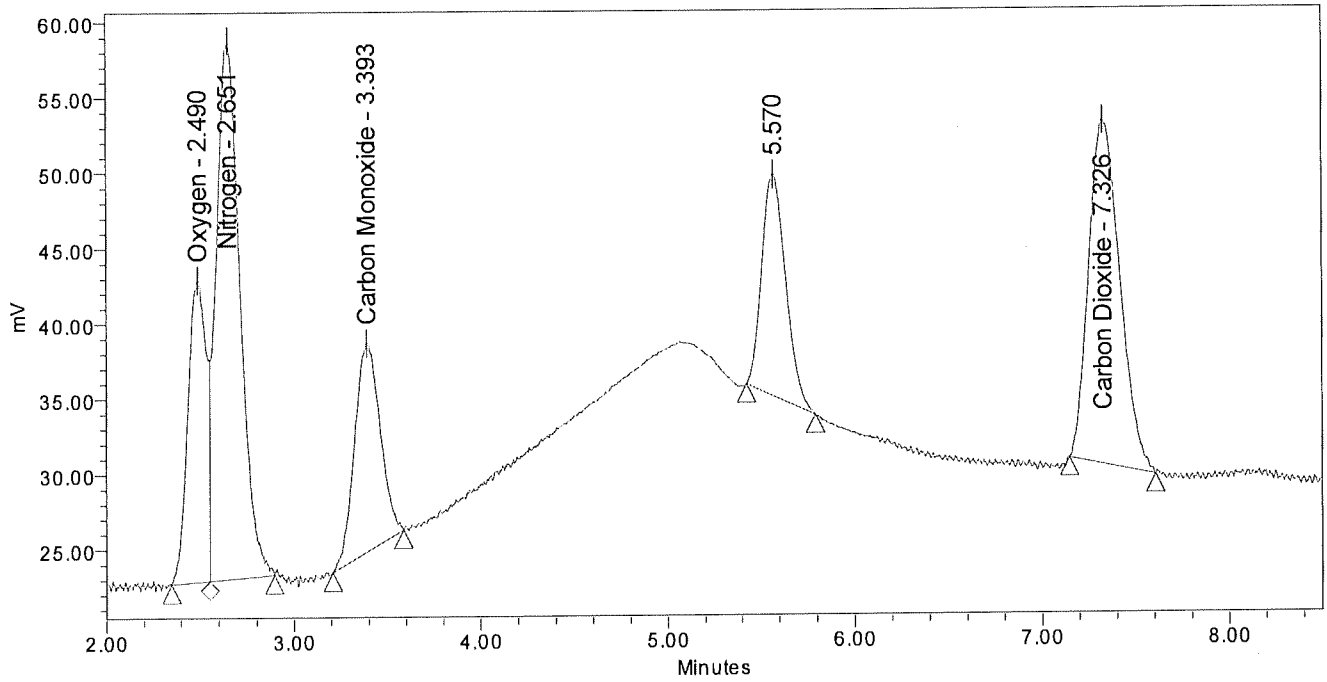
Project Folder GC02_2017

Detector: TCD

CYCLE 2

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.490	137933	20060	BV	2.500
2	Nitrogen	2.651	311916	35669	VB	
3	Carbon Monoxide	3.393	132381	13874	BB	2.500
4	Carbon Dioxide	7.326	264133	22872	BB	2.500

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_O2N2COCO2_

Processing Method O2N2COCO2_14JUL17

SampleName STD2017:39:03

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID GRPA STD3

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 12:07:27 PM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

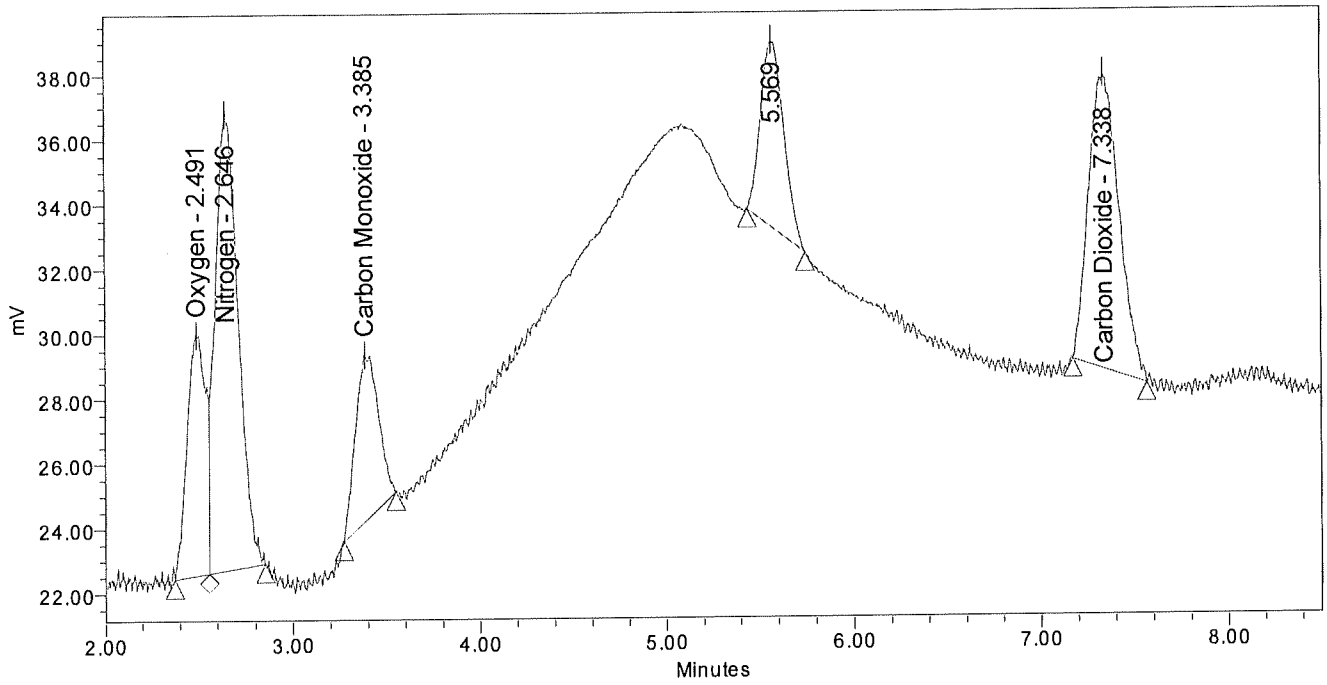
Project Folder GC02_2017

Detector: TCD

CYCLE 3

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.491	51572	7451	BV	1.000
2	Nitrogen	2.646	118666	14134	VB	1.000
3	Carbon Monoxide	3.385	43774	5170	BB	1.000
4	Carbon Dioxide	7.338	102945	9149	BB	1.000

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_O2N2COCO2_(

Processing Method O2N2COCO2_14JUL17

SampleName STD2017:39:04

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID GRPA STD4

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 12:20:29 PM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

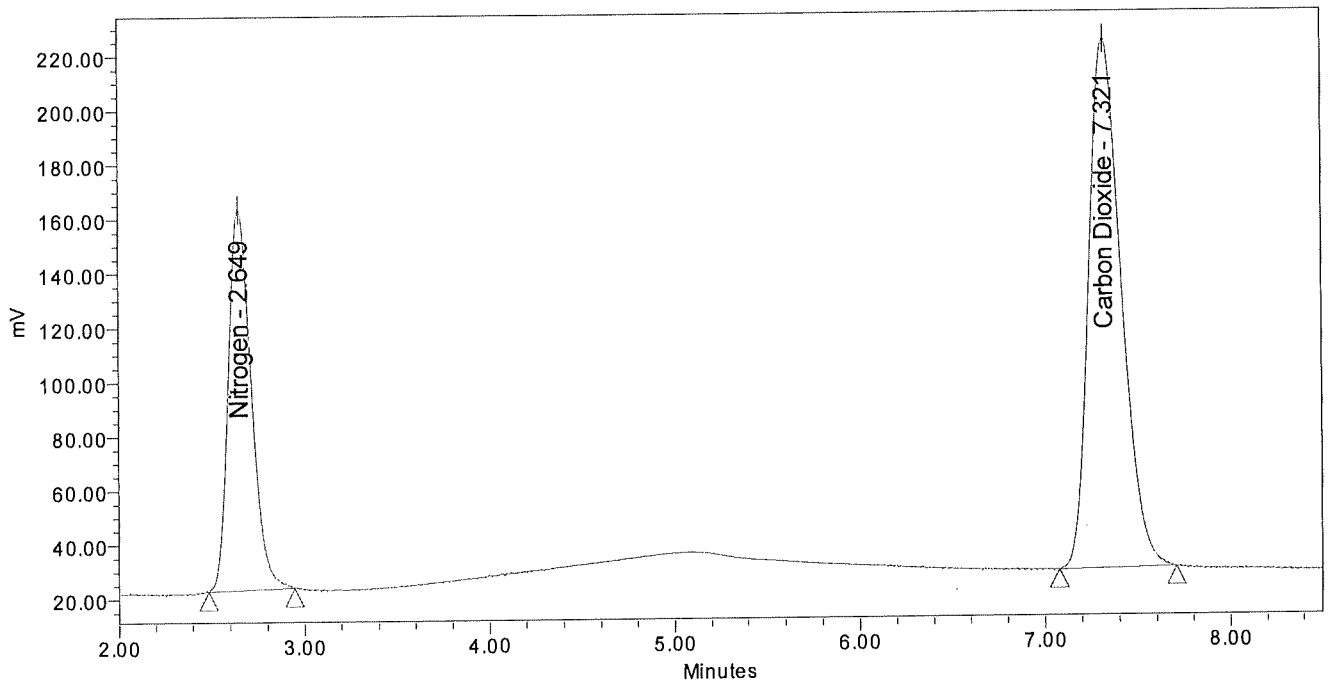
Project Folder GC02_2017

Detector: TCD

CYCLE 4

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.472			Missing	
2	Nitrogen	2.649	1188869	140301	BB	20.000
3	Carbon Monoxide	3.382			Missing	
4	Carbon Dioxide	7.321	2374052	195725	BB	20.000

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_O2N2COCO2_(

Processing Method O2N2COCO2_14JUL17

SampleName STD2017:39:05

Column: Carbosphere

Dates Acquired 7/14/2017 12:33:19 PM CDT

GC Conditions: 65C-2Mn-50C/Mn-200C

Detector: TCD

Injection Volume 50.00 uL

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID GRPA STD5

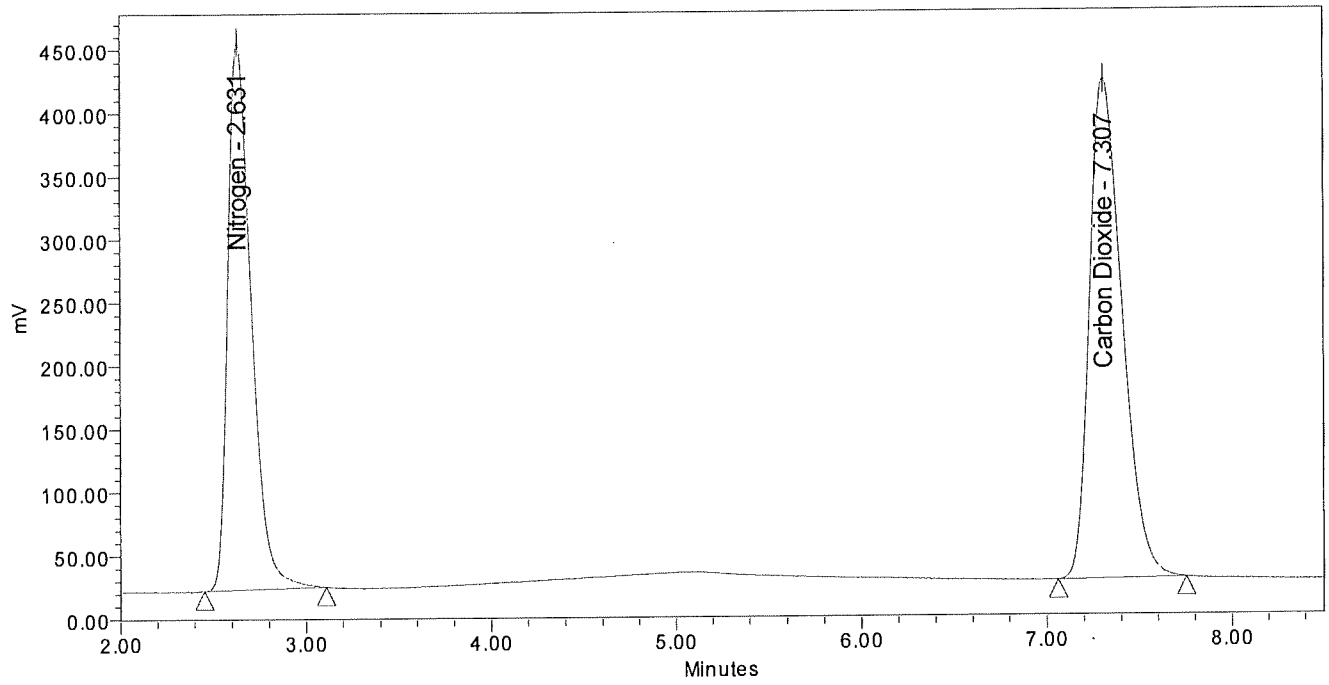
SDG: 617476

System Name GC02_SYS

Project Folder GC02_2017

CYCLE 5

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.472			Missing	
2	Nitrogen	2.631	3768356	433320	BB	60.000
3	Carbon Monoxide	3.382			Missing	
4	Carbon Dioxide	7.307	4833398	395511	BB	40.000

Manual integrations are identified by lower case letters in the "Int Type" field.

SampleName STD2017:39:06

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID GRPA STD6

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 12:54:14 PM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

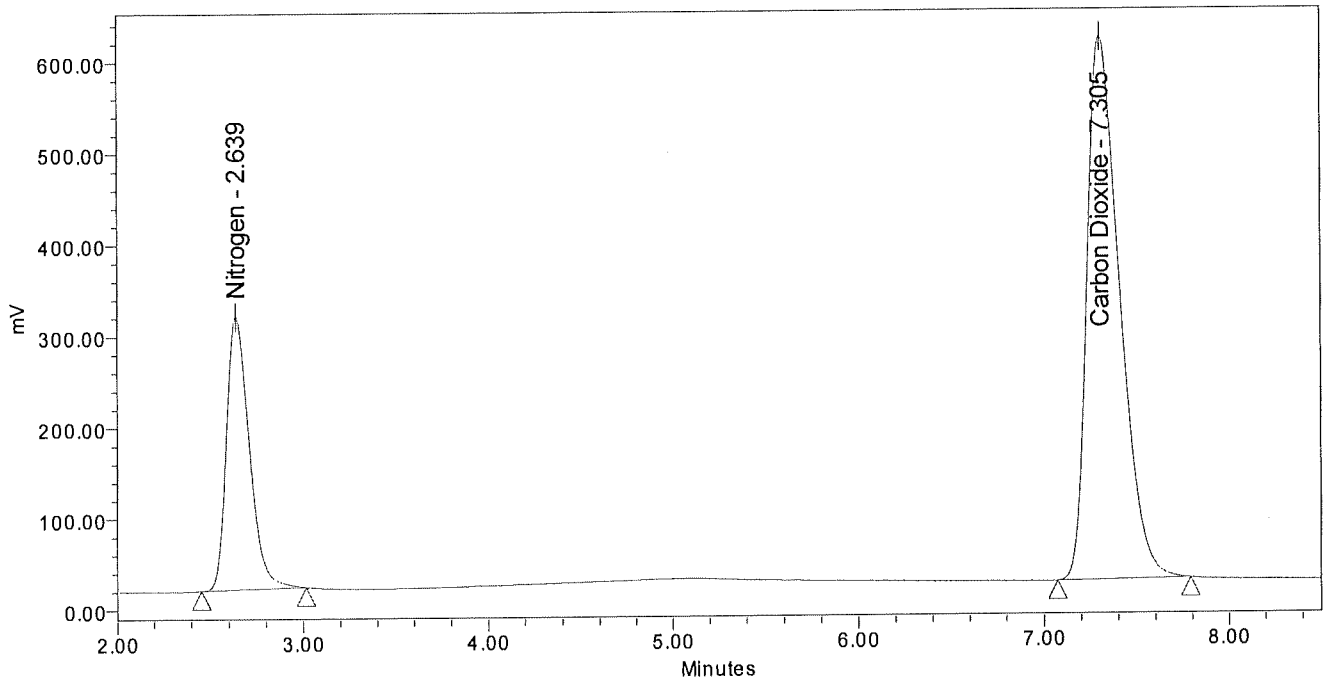
Project Folder GC02_2017

Detector: TCD

CYCLE 6

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.472			Missing	
2	Nitrogen	2.639	2559263	299596	BB	40.000
3	Carbon Monoxide	3.382			Missing	
4	Carbon Dioxide	7.305	7305588	596210	BB	60.000

Manual integrations are identified by lower case letters in the "Int Type" field.

SampleName STD2017:39:07

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID ICV01 GRPA STD3

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 1:11:26 PM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

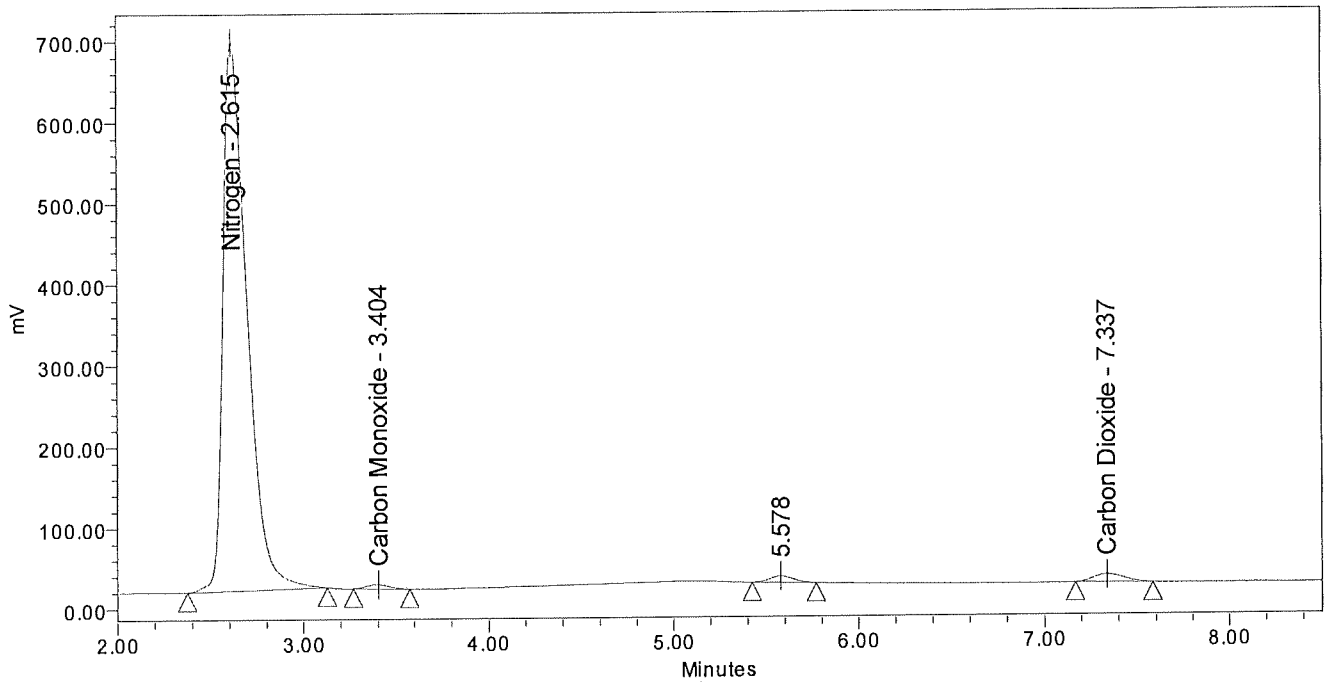
Project Folder GC02_2017

Detector: TCD

CYCLE 7

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.472			Missing	
2	Nitrogen	2.615	6044418	676715	BB	96.617
3	Carbon Monoxide	3.404	46318	5379	BB	0.889
4	Carbon Dioxide	7.337	114969	10120	BB	1.002

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_O2N2COCO2_(

Processing Method O2N2COCO2_14JUL17

SampleName STD2017:39:08

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID ICV02 GRPA STD1

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 1:37:55 PM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

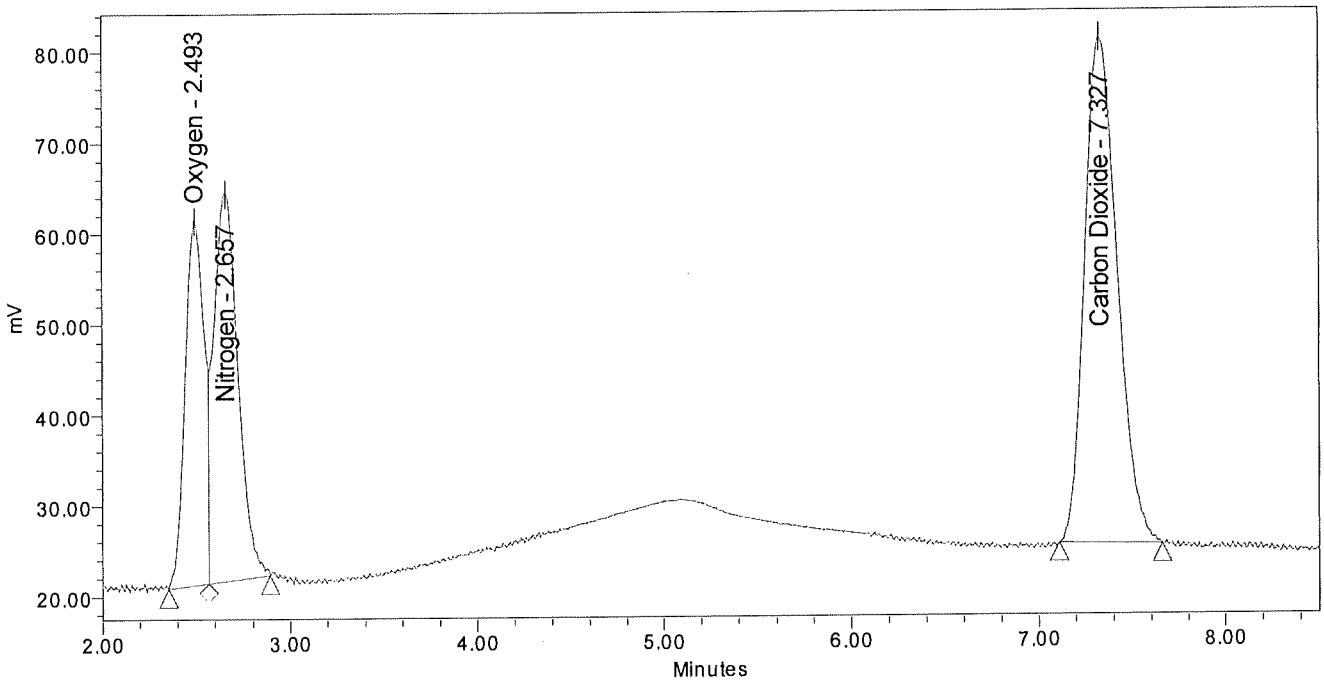
Project Folder GC02_2017

Detector: TCD

CYCLE 8

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.493	282263	40225	BV	5.421
2	Nitrogen	2.657	381445	42831	VB	5.596
3	Carbon Monoxide	3.382			Missing	
4	Carbon Dioxide	7.327	672472	55882	BB	5.861

Manual integrations are identified by lower case letters in the "Int Type" field.

Report Method Name LANL_O2N2COCO2_(

Processing Method O2N2COCO2_14JUL17

SampleName STD2017:39:01

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Method: Gas Analysis by GC-TCD

Client_ID CCV01 GRPA STD1

Column: Carbosphere

SDG: 617476

Dates Acquired 7/14/2017 2:30:59 PM CDT

System Name GC02_SYS

GC Conditions: 65C-2Mn-50C/Mn-200C

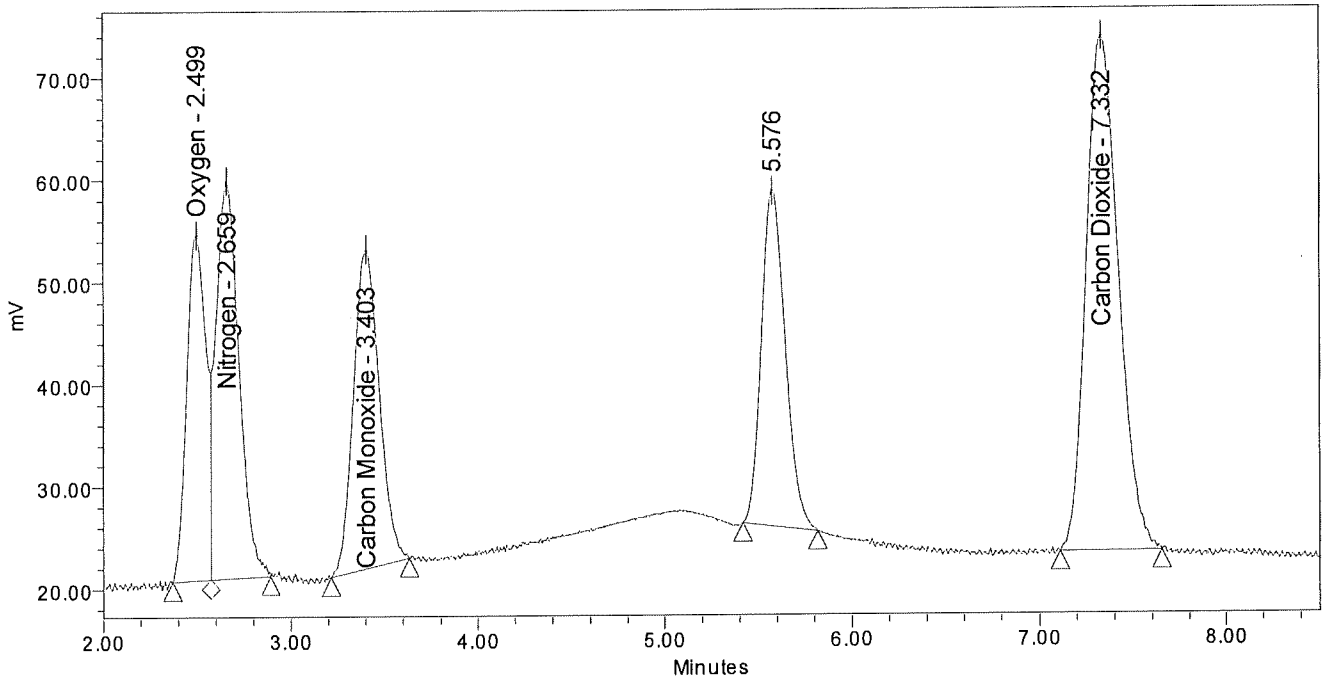
Project Folder GC02_2017

Detector: TCD

CYCLE 12

Injection Volume 50.00 uL

Chromatogram



Peak Results

	Name	RT	Area	Height	Int Type	Amount %
1	Oxygen	2.499	241211	33851	BV	4.632
2	Nitrogen	2.659	331675	38932	VB	4.796
3	Carbon Monoxide	3.403	301764	31220	BB	5.790
4	Carbon Dioxide	7.332	604443	50429	BB	5.268

Manual integrations are identified by lower case letters in the "Int Type" field.

010132

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Gas Analysis by GC/TCD
Logbook Pages

Work continued from Page

SWRI

191-01-WCS13 - Acid Reagent

188mL DI H_2O + 37mL phosphoric acid (# 77371)
5000-R exp 7/10/17

191-02-WCS13 TOC Reagent

25.0364 g sodium persulfate (# 77192) + 213mL DI H_2O +
9mL phosphoric acid (# 77371)
balance #135 exp 8/3/17 5000-R

191-03-WCS13 - 7M HNO_3 191-05-WCS13 191-06-WCS13

440.25mL HNO_3 (# 86640) to FV 1L with DI H_2O
EPP 5000-R exp 7/3/18

191-04-WCS13 ILNS surrogate solution balance #05

aluminum nitrate	1387.1 g	(# 69559, 69560, 69561) TBSAM 7/13/17
+ Calcium nitrate	140.131 g	(# 69601)
+ Chromium nitrate	~~8.400~~ 10.309 TBSAM 7/13/17	(# 66141)
+ Iron Nitrate	99.204 g	(# 63604)
+ Magnesium Nitrate	68.101 g	(# 69606)
+ Sodium nitrate	82.301 g	(# 70579)
+ Nickle nitrate	0.400 g	(# 65593)
+ Lead Nitrate	99.402 g	(# ~~70093~~) 72856 TBSAM 7/13/17
+ Oxalic acid	395.609 g	(# 69684)
+ 7M HNO_3	2400mL	until about 2% solids remained

191-07-WCS13 phthalate Reference std balance #135 ea daily

0.5062g potassium hydrogen phthalate (# 69625) to FV 50mL with DI H_2O; add 0.500g cetylpyridinyl (# 36479)

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Work continued to Page

SIGNATURE DATE 7/13/17

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 7/25/17

186 TITLE Anions Curve DX500 **PROJECT NO.** —

BOOK NO. B-0400-024

Work continued from Page

SWRI

186-01-IC10: 20 ppm = 20,000 ppb Anions

Component	Stock Conc. (mg/L)	Vol. Added (mL)	ID#	Exp. Date
Fluoride	1000	0.200	77992	01/30/18
Chloride	1000	0.200	77991	01/30/18
Nitrite-N	1000	0.200	75611	10/30/17
Bromide	1000	0.200	84127	03/30/18
Nitrate-N	1000	0.200	84128	03/30/18
Phosphate-P	1000	0.200	84130	03/30/18
Sulfate	1000	0.200	84131	03/30/18

To final volume 10 mL with DI H_2O

186-02-IC10: 15 ppm = 15,000 ppb Anions
3 mL 186-01-IC10 + 1 mL DI H_2O

186-03-IC10: 10 ppm = 10,000 ppb Anions
2 mL 186-01-IC10 + 2 mL DI H_2O

186-04-IC10: 5 ppm = 5,000 ppb Anions
2 mL 186-03-IC10 + 2 mL DI H_2O

186-05-IC10: 1 ppm = 1,000 ppb Anions
1 mL 186-04-IC10 + 4 mL DI H_2O

186-06-IC10: 0.5 ppm = 500 ppb Anions
2 mL 186-05-IC10 + 2 mL DI H_2O

186-07-IC10: 0.1 ppm = 100 ppb Anions
1 mL 186-06-IC10 + 4 mL DI H_2O

186-08-IC10: 0.05 ppm = 50 ppb Anions
2 mL 186-07-IC10 + 2 mL DI H_2O

186-09-IC10: 0 ppm
5 mL of DI H_2O

EP:
5000-M
1000-1
200-D

Juan Herrera 7/3/17

Work continued to Page

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SIGNATURE Juan Herrera DATE 7/3/17

DISCLOSED TO AND UNDERSTOOD BY | DATE | WITNESS | DATE 7/7/17

Work continued from Page

181-01-IC10: NO_2N @ 191 ppm

dissolve 47.1 mg of Sodium nitrite (# 676661) to final volume 50 mL w/ DI H2O.

$$\frac{47.1\ mg}{50\ mL} \times \frac{1000\ mL}{1\ L} \times \frac{149\ g/mol}{699\ g/mol} = 191\ mg/L$$

balance #135 Exp. date: 7/20/17

centrifuge #499

181-02-IC10: 10 ppm Anions LLC

Component	Stock Conc. (mg/L)	Vol. Added (mL)	ID#	Exp. Date
Fluoride	1000	0.100	77992	01/30/18
Chloride	1000	0.100	77991	01/30/18
Nitrite-N	1000	0.100	75611	10/30/17
Bromide	1000	0.100	84127	03/30/18
Nitrate-N	1000	0.100	84128	03/30/18
Phosphate-P	1000	0.100	84130	03/30/18
Sulfate	1000	0.100	84131	03/30/18

To final volume 10 mL with DI H_2O

For 0.200 ppm, dilute 100uL to final volume 5 mL with DI water

EP:
5000-M
1000-1
200-2

6/20/17

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Work continued to Page

SIGNATURE Judy Herrera DATE 6/20/17

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 7/11/17

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Balances and DI Water Verification Logs

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.: 17-0406-018

Balance Number	Asset Number	Manufacturer	Serial Number	Location	Number of Places	Maximum Weight
135	020014	Mettler Toledo	B338797310	Lab 47	4th 5th	220 g 81 g

Date	Operator	Std Wt. 200 g AN #011988 Tolerance: 199.9800-200.0200 g Recorded Wt. (g)	Std Wt. 2 g AN # 020641 Tolerance: 1.99980-2.00020 g Recorded Wt. (g)	Std Wt. 0.02 g AN # 012685 Tolerance: 0.01995-0.02005 g Recorded Wt. (g)
6-19-17	KE	199.9995	1.99999	0.0 1996
6-20-17	KE	199.9998	2.00000	0.0 1999
6-21-17	KE	199.9998	1.99997	0.01998
6-22-17	KE	199.9995	2.00001	0.02001
6/23/17	KE	199.9994	2.00001	0.02001
6/26/17	JCU	199.9993	1.99998	0.01997
6/27/17	JCU	199.9997	1.99999	0.01999
6/28/17	SAM	199.9999	1.99993	0.02002
6/29/17	SAM	199.9998	2.00004	0.02002
6/30/17	JCU	199.9997	2.00002	0.01999
7/3/17	SAM	199.9998	1.99999	0.01999
7/5/17	SAM	199.9996	1.99995	0.01999
7/6/17	SAM	199.9994	1.99996	0.01999
7/7/17	SAM	199.9998	1.99996	0.01999
7/8/17	SAM	199.9999	1.99995	0.01996
7/10/17	SAM	199.9998	2.00000	0.02001
7/11/17	JCU	199.9998	1.99996	0.01997
7/12/17	SAM	199.9996	1.99995	0.02000
7/13/17	SAM	199.9995	1.99999	0.02003
7/14/17	JCU	199.9996	1.99996	0.01999 9% Hi gain
7/17/17 (7/17 WBAM)	SAM	199.9997	1.99998	0.01996
7-18-17 (7/19/17 KE)	KE	199.9995	2.00000	0.01999

18 CI 7/18/17 JCU

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.# 16-0406-028

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
6-11-17.	JK	2000.01	1.999
6-12-17.	JK	2000.01	2.000
6-13-17.	JK	2000.02	2.000
6-14-17.	JK	2000.01	1.999
6-15-17	KE	2000.02	2.000
6-16-17	KE	2000.02	2.003
6-19-17	KE	2000.02	2.000
6-20-17	KE	2000.02	2.000
6-21-17	KE	2000.02	2.000
6-22-17	KE	2000.02	2.000
6-23-17	KE	2000.02	2.000
6-24-17.	JK	2000.02	1.999
6-26-17.	JK	2000.02	2.000
6-27-17	KE	2000.00	6-27-17 (NR) RE 2000 2.001
6-28-17	SD	2000.00	2.000
6-29-17.	JK	2000.00	1.999
6-30-17	KE	2000.00	2.001
7-3-17.	JK	2000.00	1.999
7-4-17.	JK	2000.00	2.000
7-5-17.	JK	2000.00	2.000
7-6-17.	JK	2000.00	2.000
7-7-17.	JK	2000.00	2.000

Comments:

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

Book I.D.# 16-0406-028

Balance Number	Asset Number	Manufacturer	Model Number	Location	Number of Places	Maximum Weight
05	009065	Mettler	PR 2003	Lab 47	3	2100 g

Date	Operator	Asset# 011992 Std Wt. 2000 g Tolerance: 1999.800-2000.200 g Recorded Wt. (g)	Asset# 011999 Std Wt. 2 g Tolerance: 1.996-2.004 g Recorded Wt. (g)
7-9-17.	JK	1999.99	2.000
7-10-17.	JK	2000.00	1.999
7-11-17	KE	2000.00	2.001
7/12/17	SD	2000.00	2.000
7-13-17	KE	2000.00	2.001
7-14-17.	JK	2000.00	2.000
7-15-17.	JK	2000.00	1.999
7-17-17	JK	2000.00	2.001
7-18-17	KE	2000.01	2.001
7-19-17	KE	2000.0	1.998
7/20/17	SAM	2000.00	1.997
7/21/17	SAM	2000.00	2.001
7-22-17	JK	2000.00	2.000
7-24-17	KE	2000.00	2.000
7-25-17.	JK	2000.00	1.999

Comments:

Southwest Research Institute®
Inorganic Laboratory Daily Pipette Verification Log

Lab Notebook ID: 17-0406-005 Book/Page: 24 00199

Mark appropriate box with a √ if a pipette is within Upper and Lower Level Tolerance Values

Date	Analyst	Balance #	Eppendorf #	True Value (mL)	Reading (g)	√
6/29/17	RSpies	135	1000-1	1.0	0.9917	✓
↓	↓	↓	↓	0.5	0.4940	✓
↓	↓	↓	↓	0.1	0.1000	✓
7/3/17	JAM	135	200-M	0.02	0.0203	✓
↓	↓	↓	↓	0.1	0.0998	✓
↓	↓	↓	↓	0.2	0.2005	✓
↓	↓	↓	1000-2	0.1	0.1006	✓
↓	↓	↓	↓	0.5	0.4947	✓
↓	↓	↓	↓	1.0	0.9900	✓
↓	↓	↓	5000-R	0.5	0.4982	✓
↓	↓	↓	↓	2.5	2.4825	✓
↓	↓	↓	↓	5.0	5.0182	✓
7/3/17	JAM	135	5000-M	5.0	5.0081	✓
↓	↓	↓	↓	2.5	2.4514	✓
↓	↓	↓	↓	0.5	0.5032	✓
↓	↓	↓	1000-1	1.0	0.9912	✓
↓	↓	↓	↓	0.5	0.4933	✓
↓	↓	↓	↓ TC 7/3/17 JAM	0.1	0.1007	✓
↓	↓	↓	200-2D	0.2	TC 7/3/17 JAM 0.1992008	✓
↓	↓	↓	↓	0.1	0.0984	✓
↓	↓	↓	↓	0.02	0.0201	✓

010141

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Inorganic Laboratory Daily Pipette Verification Log

Lab Notebook ID: 17-0406-005 Book/Page: 24 00193

Mark appropriate box with a √ if a pipette is within Upper and Lower Level Tolerance Values

Date	Analyst	Balance #	Eppendorf #	True Value (mL)	Reading (g)	√
6-18-17	AM	135	200-J	0.02	0.0201	✓
↓	↓	↓	↓	0.1	0.0996	✓
			↓	0.2	0.2000	✓
			1000-4	0.1	0.1015	✓
			↓	0.5	0.4986	✓
			↓	1.0	0.9972	✓
			5000-L	0.5	0.4993	✓
			↓	2.5	2.5032	✓
↓	↓	↓	↓	5.0	5.0076	✓
6/20/17	JCM	135	5000-M	5.0	4.9501	✓
↓	↓	↓	↓	2.5	2.4542	✓
			↓	0.5	0.5019	✓
			1000-1	1.0	0.9891	✓
			↓	0.5	0.4910	✓
			↓	0.1	0.1002	✓
			200-2	0.2	0.1986	✓
			↓	0.1	0.0988	✓
↓	↓	↓	↓	0.02	0.0200	✓
6/21/17	JCM	135	5000-M	5.0	4.9421	✓
↓	↓	↓	↓	2.5	2.4618	✓
↓	↓	↓	↓	0.5	0.4907	✓

Southwest Research Institute®

Inorganic Laboratory Daily Pipette Verification Log

Lab Notebook ID: 17-0406-005 Book/Page: 24 00199

Mark appropriate box with a √ if a pipette is within Upper and Lower Level Tolerance Values

Date	Analyst	Balance #	Eppendorf #	True Value (mL)	Reading (g)	√
6/29/17	RSpies	135	1000-1	1.0	0.9917	✓
↓	↓	↓	↓	0.5	0.4940	✓
↓	↓	↓	↓	0.1	0.1000	✓
7/3/17	JAM	135	200-M	0.02	0.0203	✓
↓	↓	↓	↓	0.1	0.0998	✓
↓	↓	↓	↓	0.2	0.2005	✓
↓	↓	↓	1000-2	0.1	0.1006	✓
↓	↓	↓	↓	0.5	0.4947	✓
↓	↓	↓	↓	1.0	0.9900	✓
↓	↓	↓	5000-R	0.5	0.4982	✓
↓	↓	↓	↓	2.5	2.4825	✓
↓	↓	↓	↓	5.0	5.0182	✓
7/3/17	JAM	135	5000-M	5.0	5.0081	✓
↓	↓	↓	↓	2.5	2.4514	✓
↓	↓	↓	↓	0.5	0.5032	✓
↓	↓	↓	1000-1	1.0	0.9912	✓
↓	↓	↓	↓	0.5	0.4933	✓
↓	↓	↓	↓ TC 7/3/17 JAM	0.1	0.1007	✓
↓	↓	↓	200-2D	0.2	0.1992008 TC 7/3/17 JAM	✓
↓	↓	↓	↓	0.1	0.0984	✓
↓	↓	↓	↓	0.02	0.0201	✓

010143

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Gas Analysis by GC/TCD
Injection Log

SWRI

7/19/17

METHOD: Gas Analysis by GC/TCD

BOOK # 15-0405-008

CLIENT: Los Alamos National Laboratory
Project: 19869.01.00X
GC Conditions: 90C Isothermal

Project Name GC02_2017
INSTR: GC02_SYS
Detector/GC Column: TCD/Carbosphere

	CYCLES	SampleName	Client_ID	Date Acquired	Sample Set Name	System Name
1	1	STD2017:38:01	H2 @ 10 %	07/12/17 9:42:24 AM CDT	H2_12JUL17	GC02_SYS
2	2	STD2017:38:02	H2 @ 5.0 %	07/12/17 9:45:04 AM CDT	H2_12JUL17	GC02_SYS
3	3	STD2017:38:03	H2 @ 2.0 %	07/12/17 9:47:39 AM CDT	H2_12JUL17	GC02_SYS
4	4	STD2017:38:04	H2 @ 1.0 %	07/12/17 9:55:38 AM CDT	H2_12JUL17	GC02_SYS
5	5	STD2017:38:05	H2 @ 0.5 %	07/12/17 9:58:37 AM CDT	H2_12JUL17	GC02_SYS
6	6	STD2017:38:06	ICV H2 @ 2.0 %	07/12/17 10:01:59 AM CDT	H2_12JUL17	GC02_SYS
7	7	STD2017:38:07	CCV01 H2 @ 2.0 %	07/14/17 9:28:31 AM CDT	H2_12JUL17	GC02_SYS
8	8	BLANK_14JUL17	Nitrogen Blank	07/14/17 9:32:11 AM CDT	H2_12JUL17	GC02_SYS
9	9	617727	617480	07/14/17 9:37:28 AM CDT	H2_12JUL17	GC02_SYS
10	10	617727 DUP	617480 DUP	07/14/17 9:41:41 AM CDT	H2_12JUL17	GC02_SYS
11	11	STD2017:38:07	CCV02 H2 @ 2.0 %	07/14/17 9:44:53 AM CDT	H2_12JUL17	GC02_SYS

Analyst: 7/19/17

Reviewed by: 7/19/17

Witnessed & Understood by me,	Date	Invented by:	Date
		Recorded by:	

SWRI

7/19/17

METHOD: Gas Analysis by GC/TCD

BOOK # 15-0405-008

CLIENT: Los Alamos National Laboratory

Project Name GC02_2017

Project: 19869.01.00X

INSTR: GC02_SYS

GC Conditions: 65C-3mn-50C/mn- 200C

Detector/GC Column: TCD/Carbosphere

	CYCLES	SampleName	Client_ID	Date Acquired	Sample Set Name	System Name
1	1	STD2017:39:01	GRPA STD1	07/14/17 11:39:52 AM CDT	O2N2_COCO2_14JUL17	GC02_SYS
2	2	STD2017:39:02	GRPA STD2	07/14/17 11:53:05 AM CDT	O2N2_COCO2_14JUL17	GC02_SYS
3	3	STD2017:39:03	GRPA STD3	07/14/17 12:07:27 PM CDT	O2N2_COCO2_14JUL17	GC02_SYS
4	4	STD2017:39:04	GRPA STD4	07/14/17 12:20:29 PM CDT	O2N2_COCO2_14JUL17	GC02_SYS
5	5	STD2017:39:05	GRPA STD5	07/14/17 12:33:19 PM CDT	O2N2_COCO2_14JUL17	GC02_SYS
6	6	STD2017:39:06	GRPA STD6	07/14/17 12:54:14 PM CDT	O2N2_COCO2_14JUL17	GC02_SYS
7	7	STD2017:39:07	ICV01 GRPA STD3	07/14/17 1:11:26 PM CDT	O2N2_COCO2_14JUL17	GC02_SYS
8	8	STD2017:39:08	ICV02 GRPA STD1	07/14/17 1:37:55 PM CDT	O2N2_COCO2_14JUL17	GC02_SYS
9	9	BLANK_14JUL17	Helium Blank	07/14/17 1:52:30 PM CDT	O2N2_COCO2_14JUL17	GC02_SYS
10	10	617727	617480	07/14/17 2:05:22 PM CDT	O2N2_COCO2_14JUL17	GC02_SYS
11	11	617727DUP	617480 DUP 7/19/17	07/14/17 2:18:01 PM CDT	O2N2_COCO2_14JUL17	GC02_SYS
12	12	STD2017:39:01	CCV01 GRPA STD1	07/14/17 2:30:59 PM CDT	O2N2_COCO2_14JUL17	GC02_SYS

Analyst: 7/19/17

Reviewed by: 7/19/17

essed & Understood by me,	Date	Invented by:	Date
		Recorded by:	

010146

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170713-5
SwRI SRR: 59998, 60031
SDG: 617476
VTSR: 06.20.2017, 07.14.2017

Standard Preparation and Certificate of Analysis

Title: LANL H2 Standards
Client: LANL
Project#: 19869.01.00X
Task Orders: 170713-5

Made by JQZ on 07/12/17

STD2017:38:01 H2 GAS STD1 (10%) EXP: End of Day
Added 100mLs of H2# to a FEV of 1000mLs N2*. (900mLs N2)

STD2017:38:02 H2 GAS STD2 (5%) EXP: End of Day
Added 50mLs of H2# to a FEV of 1000mLs N2**. (950mLs N2)

STD2017:38:03 H2 GAS STD3 (2%) EXP: End of Day
Added 20mLs of H2# to a FEV of 1000mLs N2**. (980mLs N2)

STD2017:38:04 H2 GAS STD4 (1%) EXP: End of Day
Added 10mLs of of H2# to a FEV of 1000mLs N2**. (990mLs N2)

STD2017:38:05 H2 GAS STD5 (0.5%) EXP: End of Day
Added 5mLs of of of H2# to a FEV of 1000mLs N2**. (995mLs N2)

Made on 07/12/17 by MZ

STD2017:38:06 H2 GAS ICV (2%) EXP: End of Day
Added 20mLs of H2# to a FEV of 1000mLs N2**. (980mLs N2)

Made on 07/14/17 by JQZ

STD2017:38:07 H2 GAS CCV (2%) EXP: End of Day
Added 20mLs of H2# to a FEV of 1000mLs N2**. (980mLs N2)

H2#: Hydrogen: Airgas, UHP Grade; 99.999%; Lot#52-400570309-1)
N2**: Nitrogen: Airgas, UHP Grade; 99.995+%

Title: LANL O2, N2, CO, & CO2 Standards
Client: LANL
Project#: 19869.01.00X
Task Orders: 170713-5

Made by JQZ on 07/14/17

STD2017:39:01 STD1 O2=5%, N2=5%, CO=5%, CO2=5%
(Scott Specialty Gases: Mix 01-04-234; LOT# 121PLU4SPC03L; Exp 09/18/2017)

STD2017:39:02 STD2 O2=2.5%, N2=2.5%, CO=2.5%, CO2=2.5% EXP: END of DAY
Added 200mLs STD2017:39:01 to a FVOL of 400mLs HE* (200 mLs HE).

STD2017:39:03 STD3 O2=1.0%, N2=1.0%, CO=1.0%, CO2=1.0% EXP: END of DAY
Added 100mLs STD2017:39:01 to a FVOL of 500mLs HE* (400 mLs HE).

STD2017:39:04 STD4 N2=20%, CO2=20% EXP: END of DAY
Added 200mLs N2 @ 99.999% (Airgas UHP, Lot#123-400945284-1) and 200mLs of CO2 @99.8 (Air Liquide/Scott Specialty Gases; Lot# 163PLU4SPC06L; EXP 07/18/17) to a FVOL of 1000mLs HE*.(600 mLs HE).

STD2017:39:05 STD5 N2=60%, CO2=40% EXP: END of DAY
Added 600mLs N2 @ 99.999% (Airgas UHP, Lot#123-400945284-1) and 400mLs of CO2 @99.8 (Air Liquide/Scott Specialty Gases; Lot# 163PLU4SPC06L; EXP 07/18/17) to a FVOL of 1000mLs.

STD2017:39:06 STD6 N2=40%, CO2=60% EXP: END of DAY
Added 400mLs N2 @ 99.999% (Airgas UHP, Lot#123-400945284-1) and 600mLs of CO2 @99.8 (Air Liquide/Scott Specialty Gases; Lot# 163PLU4SPC06L; EXP 07/18/17) to a FVOL of 1000mLs.

STD2017:39:07 ICV01 CO=1%, CO2=1%
(SUPELCO: CAT# 22561; LOT# 120PLU4SPC03L; Exp 07/28/2017)

Made on 07/14/17 by MZ

STD2017:39:08 ICV02 O2=5%, N2=5%, CO2=5% EXP: End of Day
Added 50mLs of Oxygen @ 99.6% (AirLiquide/Scotty; Lot# 403-223017; EXP 12/22/2018), 50mLs N2 @ 99.999% (Airgas UHP, Lot#123-400945284-1) and 50mLs of CO2 @99.8 (Air Liquide/Scott Specialty Gases; Lot# 322PLU3SPC03L; EXP 07/18/17) to a FVOL of 1000mLs HE*.(850 mLs HE).

HE* - Airgas UHP Helium

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott™

Rec'd 9/23/14

Shipped From:
6141 EASTON ROAD, BLDG 1 PO BOX 310
PLUMSTEADVILLE PA 18949-0310
Phone: 800-331-4953 Fax: 215-766-7226

CERTIFICATE OF ANALYSIS

SOUTHWEST RESEARCH INSTITUTE
DIRECT - JENNY ZHANG
9503 W. COMMERCE
DIVISION 01, BLDG 70
SAN ANTONIO TX 78284
US

DOCUMENT#:56868811 -003
PO#: G39337E
ITEM #: T234-14
DATE: 18Sep2014

ANALYTICAL ACCURACY: +/-02%
PRODUCT EXPIRATION: 18Sep2017

LOT # : 121PLU4SPC03L

COMPONENT	REQUESTED GAS CONC MOLES	ANALYSIS (MOLES)
CARBON DIOXIDE	5. %	5.0 %
CARBON MONOXIDE	5. %	5.0 %
HYDROGEN	4. %	4.0 %
METHANE	4. %	4.0 %
NITROGEN	5. %	5.0 %
OXYGEN	5. %	5.0 %
HELIUM	BALANCE	BALANCE

MANUFACTURED DATE: 18Sep2014

SCOTTY SIZE: 14

APPROVED BY: _____
DAN TRAVISANO

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott™

Rec'd 9/9/14 $02

6141 EASTON ROAD, BLDG 1 PO BOX 310
Shipped From: PLUMSTEADVILLE PA 18949-0310
Phone: 800-331-4953 Fax: 215-766-7226

CERTIFICATE OF ANALYSIS

SIGMA-ALDRICH
P443247
595 NORTH HARRISON ROAD
BELLEFONTE PA 16823
US

DOCUMENT#:56293400 -001
PO#: P443247
ITEM #: T218-14
CUST ITEM #: 22561
DATE: 28Jul2014

ANALYTICAL ACCURACY: +/-05%
PRODUCT EXPIRATION: 28Jul2017

LOT # : 120PLU4SPC03L

COMPONENT	REQUESTED GAS CONC MOLES		ANALYSIS (MOLES)	
CARBON DIOXIDE	1.	%	1.0	%
CARBON MONOXIDE	1.	%	1.0	%
HYDROGEN	1.	%	1.0	%
METHANE	1.	%	1.0	%
OXYGEN	1.	%	1.03	%
NITROGEN		BALANCE		BALANCE

MANUFACTURED DATE: 28Jul2014

SCOTTY SIZE: 14

APPROVED BY: L
DAN TRAVISANO

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott™

Rec'd 7/23/14 for

6141 EASTON ROAD, BLDG 1 PO BOX 310
Shipped From: PLUMSTEADVILLE PA 18949-0310
Phone: 800-331-4953 Fax: 215-766-7226

CERTIFICATE OF ANALYSIS

SOUTHWEST RESEARCH INSTITUTE
J STEVEN EVANS
9503 W. COMMERCE STREET
SHIP & REC BLDG 242
SAN ANTONIO TX 78227
US

DOCUMENT#:56145327 -001
PO#: G39032E
ITEM #: T105-14
DATE: 18Jul2014

PRODUCT EXPIRATION: 18Jul2017

LOT # : 163PLU4SPC06L

PURE MATERIAL: CARBON DIOXIDE CAS# 124-38-9

GRADE: BONE DRY

PURITY: 99.8%

MANUFACTURED DATE: 18Jul2014 SCOTTY SIZE: 14

APPROVED BY: _____
DAN TRAVISANO

Airgas
an Air Liquide company

010152

Airgas USA, LLC
616 Miller Cut-Off Road
La Porte, TX 77571
Airgas.com

CERTIFICATE OF BATCH ANALYSIS

Grade of Product: ULTRA HIGH PURITY-PURE

Part Number:	HY UHPC63	Reference Number:	52-400570309-1
Cylinder Analyzed:	HK1000136	Cylinder Volume:	1566.0 CF
Laboratory:	190 - Laporte (SAP) - TX	Cylinder Pressure:	2400 PSIG
Analysis Date:	Jul 09, 2015	Valve Outlet:	350
Lot Number:	52-400570309-1		

Expiration Date: Jul 09, 2023

ANALYTICAL RESULTS

Component	Requested Purity	Certified Concentration
HYDROGEN	99.999 %	99.999 %
CO + CO2	< 1.0 PPM	0.2 PPM
Oxygen	< 1.0 PPM	0.2 PPM
Moisture	< 2.0 PPM	0.6 PPM
Nitrogen	< 5.0 PPM	< 2.0 PPM
THC	< 0.5 PPM	0.1 PPM

Cylinders in Batch:

1879025Y, 23474A, 5003447Y, HK1000136, T413371, TW05-925119

Impurities verified against analytical standards traceable to NIST by weight and/or analysis.

Signature on file

Approved for Release

010153

Airgas
an Air Liquide company

Airgas Gulf Coast region
Airgas USA, LLC
335 N WW White Rd
San Antonio, TX 78219
Airgas.com

CERTIFICATE OF BATCH ANALYSIS

Grade of Product: ULTRA HIGH PURITY-PURE

Part Number:	NI UHPC63BA	Reference Number:	123-400945284-1
Cylinder Analyzed:	4788856Y	Cylinder Volume:	1824.0 CF
Laboratory:	190 - San Antonio (WWW) (SAP) - TX	Cylinder Pressure:	2640 PSIG
Analysis Date:	Jun 29, 2017	Valve Outlet:	580
Lot Number:	123-400945284-1		

ANALYTICAL RESULTS

Component	Requested Purity	Certified Concentration
NITROGEN	99.999 %	99.999 %
CO + CO2	< 1 PPM	.28 PPM
Moisture	< 1 PPM	.706 PPM
Oxygen	< 1 PPM	.57 PPM
THC	< 0.5 PPM	.09 PPM

Cylinders in Batch:

4788856Y, 4953776Y, 4953795Y, 4953833Y, 6J-A-5040

Impurities verified against analytical standards traceable to NIST by weight and/or analysis.

Signature on file

Approved for Release

ACCREDITED
Reference Materials Producer
Cert #2495.01

SPEXertificate®

Certificate of Reference Material

ACCREDITED
Chemical Testing
Cert #2495.02

Catalog Number: AS-NO2N9-2Y **Lot No.** 4-10NO2N-2Y

Description: 1000 µg/mL Nitrite-Nitrogen

Matrix: H_2O

This **Ion Chromatography** Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for ion chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1004 µg/mL ±5 µg/mL

Certified Value is Traceable to: 0416†

* - indicates NIST SRM † - indicates SPEX CertiPrep CRM (when NIST SRM is not available) ‡ - prepared gravimetrically

The CRM is prepared gravimetrically using high purity Sodium Nitrite, Lot# 0613A. The certified value listed is the average of values obtained by classical wet assay and ion chromatography analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1005 µg/mL

Method: Titration with $KMNO_4$ that was standardized against Sodium Oxalate NIST SRM 8040.

Instrumental Analysis by Ion Chromatography: 1002 µg/mL

Uncertified Properties

Trace Ionic Impurities in the Actual Solution via IC Analysis:

Element	µg/mL	Element	µg/mL
Br^-	<0.2	NO_3^-	<35
Cl^-	<0.2	$PO4^{-3}$	<0.2
F^-	<0.03	$SO4^{-2}$	<0.4

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32867 and others. This CRM is guaranteed stable and accurate to +/- 0.5% of the certified value. This includes uncertainty components due to preparation, homogeneity by the most precise method, and short-term and long-term stability. This guarantee is valid for a period of one year from the date of certification only when the material is unopened and stored under ambient laboratory conditions.

Date of Certification: OCT 2016 Certifying Officer:

SwRI Chem ID: 75611
SwRI Chem ID: 75611
SwRI Chem ID: 75611

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Report of Certification

This Certified Reference Material (CRM) has been prepared and certified under an ISO 9001:2008, ISO 17025:2005, and ISO Guide 34:2009 quality system consistent with the following guides:

- ISO 9001: Quality management systems – Requirements – certified by UL-DQS
- ISO 17025: General requirements for the competence of testing and calibration laboratories – accredited by A2LA
- ISO Guide 34: General requirements for the competence of reference material producers – accredited by A2LA
- ISO Guide 31: Reference Materials – Contents of certificates and labels
- ISO Guide 35: Reference Materials – General & Statistical Principals for Certification
- Guide To The Expression Of Uncertainty In Measurement 1997
- EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition
- ASTM Guide D6362-98
- NIST Technical Note 1297
- ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers
- ISO/REMCO N280

Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9001:2008, ISO 17025:2005, and ISO Guide 34:2009 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further assistance, please contact the Sales Support Department at crmsales@spexcsp.com.

Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles (where appropriate), and Class A/calibrated volumetrics have been used in all preparations.

Homogeneity:

The homogeneity of the CRM has been confirmed by procedures consistent with ISO 17025:2005, ISO Guide 34:2009, and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed to prove homogeneity in accordance with our internal procedure 4600-HOMOGEN-1A. Since the product is highly homogeneous, any sample size taken for analysis would be within the uncertainty budget. This is consistent with the intended use of the CRM.

Statistical Estimator and Confidence Limits:

The certified value 'X' listed on the reverse of this document is at the 95% level of confidence and can be expressed as:

- $X = x \pm U$ where X = certified value, U = expanded uncertainty, x = property value
- $U = ku_c$ where $k = 2$ is the coverage factor at the 95% confidence level
- u_c is obtained by combining the individual element standard uncertainty components u_i, and $u_c = \sqrt{\sum u_i^2}$

Certification Traveler Report:

All certified values reported were derived from the Traveler Report (SPEX CertiPrep's traceability documentation) identified by the lot number of this CRM. During the stated period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution. For further assistance, please contact the Sales Support Department at crmsales@spexcsp.com.

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Accredited to 17025 & Guide 34 ISO Certified to 9001

SwRI Chem ID: 75611
SwRI Chem ID: 75611
SwRI Chem ID: 75611

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Reference Materials Producer
Cert #2495.01

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Certificate of Reference Material

ILAC-MRA ACCREDITED
Chemical Testing
Cert #2495.02

Catalog Number: AS-NO3N9-2Y **Lot No.** 4-34NO3N-2Y

Description: 1000 µg/mL Nitrate-Nitrogen

Matrix: H_2O

This **Ion Chromatography** Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for ion chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1001 µg/mL ±5 µg/mL

Certified Value is Traceable to: 3185*

* - indicates NIST SRM † - indicates SPEX CertiPrep CRM (when NIST SRM is not available) ‡ - prepared gravimetrically

The CRM is prepared gravimetrically using high purity Sodium Nitrate, Lot# 0514A. The certified value listed is the average of values obtained by classical wet assay and ion chromatography analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 996 µg/mL

Method: Precipitate using Nitron Acetate. Filter, dry and weigh as C20H16N4HNO3

Instrumental Analysis by Ion Chromatography: 1005 µg/mL

Uncertified Properties

Trace Ionic Impurities in the Actual Solution via IC Analysis:

Element	µg/mL	Element	µg/mL
Br^-	<0.1	NO_2^-	<0.1
Cl^-	<0.05	$PO4^{-3}$	<0.1
F^-	<0.03	$SO4^{-2}$	<0.05

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32867 and others. This CRM is guaranteed stable and accurate to +/- 0.5% of the certified value. This includes uncertainty components due to preparation, homogeneity by the most precise method, and short-term and long-term stability. This guarantee is valid for a period of one year from the date of certification only when the material is unopened and stored under ambient laboratory conditions.

Date of Certification: **MAR 2017** Certifying Officer:

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SwRI Chem ID: 84128
SwRI Chem ID: 84128
SwRI Chem ID: 84128

Report of Certification

This Certified Reference Material (CRM) has been prepared and certified under an ISO 9001:2008, ISO 17025:2005, and ISO Guide 34:2009 quality system consistent with the following guides:

- ISO 9001: Quality management systems – Requirements – certified by UL-DQS
- ISO 17025: General requirements for the competence of testing and calibration laboratories – accredited by A2LA
- ISO Guide 34: General requirements for the competence of reference material producers – accredited by A2LA
- ISO Guide 31: Reference Materials – Contents of certificates and labels
- ISO Guide 35: Reference Materials – General & Statistical Principals for Certification
- Guide To The Expression Of Uncertainty In Measurement 1997
- EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition
- ASTM Guide D6362-98
- NIST Technical Note 1297
- ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers
- ISO/REMCO N280

Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9001:2008, ISO 17025:2005, and ISO Guide 34:2009 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further assistance, please contact the Sales Support Department at crmsales@spexcsp.com.

Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles (where appropriate), and Class A/calibrated volumetrics have been used in all preparations.

Homogeneity:

The homogeneity of the CRM has been confirmed by procedures consistent with ISO 17025:2005, ISO Guide 34:2009, and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed to prove homogeneity in accordance with our internal procedure 4600-HOMOGEN-1A. Since the product is highly homogeneous, any sample size taken for analysis would be within the uncertainty budget. This is consistent with the intended use of the CRM.

Statistical Estimator and Confidence Limits:

The certified value 'X' listed on the reverse of this document is at the 95% level of confidence and can be expressed as:

- $X = x \pm U$ where X = certified value, U = expanded uncertainty, x = property value
- $U = ku_c$ where $k = 2$ is the coverage factor at the 95% confidence level
- u_c is obtained by combining the individual element standard uncertainty components u_i, and $u_c = \sqrt{\sum u_i^2}$

Certification Traveler Report:

All certified values reported were derived from the Traveler Report (SPEX CertiPrep's traceability documentation) identified by the lot number of this CRM. During the stated period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution. For further assistance, please contact the Sales Support Department at crmsales@spexcsp.com.

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Accredited to 17025 & Guide 34 ISO Certified to 9001

SwRI Chem ID: 84128
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Certificate of Reference Material

ACCREDITED
Chemical Testing
Cert #2495.02

Catalog Number: ICMIX2-100 **Lot No.** 1-72PWY

Description: IC Instrument Check Standard 2

Matrix: H_2O

This **Ion Chromatography** Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for Ion Chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

The CRM is prepared from high purity single element concentrates of individual elements using Class A laboratory ware to give precise concentrations.

Instrumental Analysis by Ion Chromatography:

Analyte	Labeled	Certified	Uncertainty	SRM	Analyte	Labeled	Certified	Uncertainty	SRM
HPO_4^{-2}	600 µg/mL	596 µg/mL	±3 µg/mL	0716D†	SO_4^{-2}	400 µg/mL	394 µg/mL	±2 µg/mL	3181*
Br^-	400 µg/mL	406 µg/mL	±2 µg/mL	3184*	Cl^-	200 µg/mL	200 µg/mL	±1 µg/mL	3182*
NO_3^-	400 µg/mL	395 µg/mL	±2 µg/mL	3185*	F^-	100 µg/mL	101 µg/mL	±0.5 µg/mL	1019A†

* - indicates NIST SRM † - indicates SPEX CertiPrep CRM (when NIST SRM is not available) ‡ - prepared gravimetrically

SPEX CertiPrep Reference Multi: Lot# IC11-97JKS

Balances are calibrated regularly with weight sets traceable to NIST#s 32856, 32867 and others. This CRM is guaranteed stable and accurate to ±0.5% of the certified (measured) value. This includes uncertainty components due to preparation, measurement, homogeneity, and short-term and long-term stability. No measured concentration of any individual component exceeds ±2% of the labeled value. This guarantee is valid for a period of one year from the date of certification only when the material is unopened and stored under ambient laboratory conditions.

Date of Certification: **MAR 2017** Certifying Officer:

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SwRI Chem ID: 84129
SwRI Chem ID: 84129
SwRI Chem ID: 84129

Report of Certification

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- ISO Guide 34: General requirements for the competence of reference material producers – accredited by A2LA
- ISO Guide 31: Reference Materials – Contents of certificates and labels
- ISO Guide 35: Reference Materials – General & Statistical Principals for Certification
- Guide To The Expression Of Uncertainty In Measurement 1997
- EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition
- ASTM Guide D6362-98
- NIST Technical Note 1297
- ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers
- ISO/REMCO N280

Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9001:2008, ISO 17025:2005, and ISO Guide 34:2009 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further assistance, please contact the Sales Support Department at crmsales@spexcsp.com.

Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles (where appropriate), and Class A/calibrated volumetrics have been used in all preparations.

Homogeneity:

The homogeneity of the CRM has been confirmed by procedures consistent with ISO 17025:2005, ISO Guide 34:2009, and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed to prove homogeneity in accordance with our internal procedure 4600-HOMOGEN-1A. Since the product is highly homogeneous, any sample size taken for analysis would be within the uncertainty budget. This is consistent with the intended use of the CRM.

Statistical Estimator and Confidence Limits:

The certified value 'X' listed on the reverse of this document is at the 95% level of confidence and can be expressed as:

- $X = x \pm U$ where X = certified value, U = expanded uncertainty, x = property value
- $U = ku_c$ where $k = 2$ is the coverage factor at the 95% confidence level
- u_c is obtained by combining the individual element standard uncertainty components u_i, and $u_c = \sqrt{\Sigma u_i^2}$

Certification Traveler Report:

All certified values reported were derived from the Traveler Report (SPEX CertiPrep's traceability documentation) identified by the lot number of this CRM. During the stated period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution. For further assistance, please contact the Sales Support Department at crmsales@spexcsp.com.

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SwRI Chem ID: 84129
SwRI Chem ID: 84129
SwRI Chem ID: 84129

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	61226
Asset Number:	020014	Calibrated:	10/10/2016
Description:	BALANCE	Calibration Due:	10/10/2017
Manufacturer:	METTLER	Data Type:	FOUND / LEFT
Model Number:	XS205DU	Temp./RH:	70 °F / 44 %
Serial Number:	B338797310	Work Order #	403142842
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001704	TROEMNER	1 G	WEIGHT CLASS 1	12/10/2016
001705	TROEMNER	2 G	WEIGHT CLASS 1	6/30/2017
001706	RICE LAKE	2 G	WEIGHT CLASS 1	7/7/2017
001707	TROEMNER	5 G	WEIGHT CLASS 1	8/3/2017
001708	RICE LAKE	10 G	WEIGHT CLASS 1	7/14/2017
001709	TROEMNER	20 G	WEIGHT CLASS 1	8/3/2017
001710	TROEMNER	20 G	WEIGHT CLASS 1	8/3/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute

Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

001711	TROEMNER	50 G	WEIGHT CLASS 1	6/30/2017
001712	TROEMNER	100 G	WEIGHT CLASS 1	8/3/2017
001713	RICE LAKE	200 G	WEIGHT CLASS 1	7/14/2017

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142842	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	10-Oct-16
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Reference	100					
Left Front		100.0000	0.0000	0.0006	Pass	0%
Left Rear		99.9999	-0.0001		Pass	17%
Right Rear		100.0000	0.0000		Pass	0%
Right Front		99.9998	-0.0002		Pass	33%
Repeatability						
< 81 g Range						
1	80	79.99999				
2		79.99998				
3		79.99999				
4		79.99998				
5		79.99998				
6		79.99999				
7		80.00000				
8		79.99998				
9		80.00000				
10		79.99998				
Std Deviation		0.000008		0.00008	Pass	10%
< 220 g Range						
1	200	200.0000				
2		200.0000				
3		200.0001				
4		200.0001				
5		200.0000				
6		200.0002				
7		200.0002				
8		200.0002				
9		200.0001				
10		200.0002				
Std Deviation		0.00009		0.00020	Pass	45%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	0.00000	0.00000	0.00	0.40	0.07	Pass	0%
	7.99999	7.99999	0.00			Pass	0%
	16.00000	16.00000	0.00			Pass	0%
	23.99999	24.00004	0.05			Pass	13%
	32.00000	32.00005	0.05			Pass	13%
	39.99992	40.00002	0.10			Pass	25%
	47.99991	47.99995	0.04			Pass	10%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142842	Mfr:	Mettler	Technician:	RRV
Asset No.:	020014	Model:	XS205DU	Type Data:	Found-left
Serial No.:	B338797310	Type:	Balance	Cal Date:	10-Oct-16

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing (Cont)	grams	grams	milligrams	milligrams	milligrams		
< 81 g Range	55.99994	55.99998	0.04	0.40	0.07	Pass	10%
	64.00000	64.00002	0.02			Pass	5%
	71.99994	71.99995	0.01			Pass	3%
	79.99995	79.99995	0.00			Pass	0%
Direct Weighing	0.0000	0.0000	0.0	0.4	0.21	Pass	0%
< 220 g Range	20.0000	19.9999	-0.1			Pass	25%
	39.9999	39.9999	0.0			Pass	0%
	60.0000	59.9999	-0.1			Pass	25%
	80.0000	80.0000	0.0			Pass	0%
	100.0000	99.9999	-0.1			Pass	25%
	119.9999	119.9999	0.0			Pass	0%
	139.9999	139.9999	0.0			Pass	0%
	159.9999	159.9998	-0.1			Pass	25%
	179.9999	179.9998	-0.1			Pass	25%
	200.0002	200.0000	-0.2			Pass	50%

END OF REPORT

010164

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Customer:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	76370
Company Name:	SWRI	Calibrated:	6/26/2017
Address:	9503 W COMMERCE	Calibration Due:	6/26/2018
City:	SAN ANTONIO State: TX Zip Code:78227	Data Type:	FOUND / LEFT
Description:	BALANCE	Temp./RH:	71 °F / 56 %
Manufacturer:	METTLER	Work Order #	403148632
Model Number:	PR2003DR		
Asset Number:	009065 Serial Number: 1120351000		
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001711	TROEMNER	50 G	WEIGHT CLASS 1	6/26/2018
001712	TROEMNER	100 G	WEIGHT CLASS 1	8/3/2017
001713	RICE LAKE	200 G	WEIGHT CLASS 1	7/14/2017
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/9/2018
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/7/2017
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/6/2018
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/6/2018

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403148632	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	26-Jun-17
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Left Front	200	200.000	0.000	0.006	Pass	0%
Left Rear		200.001	0.001		Pass	17%
Right Rear		200.000	0.000		Pass	0%
Right Front		200.000	0.000		Pass	0%
Repeatability						
500 gram Range						
1	200	200.001				
2		200.000				
3		200.001				
4		200.001				
5		200.001				
6		200.000				
7		200.000				
8		200.000				
9		200.001				
10		200.000				
Std Deviation		0.0005		0.0020	Pass	25%
2000 gram Range						
1	1000	1000.00				
2		1000.00				
3		1000.00				
4		1000.00				
5		1000.00				
6		1000.00				
7		1000.00				
8		1000.00				
9		1000.00				
10		1000.00				
Std Deviation		0.000		0.006	Pass	0%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
500 gram Range	0.000	0.000	0.000	0.004	0.0012	Pass	0%
	50.000	50.000	0.000			Pass	0%
	100.000	100.001	0.001			Pass	25%
	150.000	150.001	0.001			Pass	25%
	200.000	200.001	0.001			Pass	25%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403148632	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	26-Jun-17

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing *(cont.)*	grams	grams	grams	grams	grams		
500 gram Range	250.000	250.001	0.001	0.004	0.0012	Pass	25%
	300.000	300.001	0.001			Pass	25%
	350.000	350.002	0.002			Pass	50%
	400.000	400.002	0.002			Pass	50%
	450.000	450.001	0.001			Pass	25%
	500.000	500.000	0.000			Pass	0%
Direct Weighing	0.00	0.00	0.00	0.01	0.012	Pass	0%
2000 gram Range	200.00	200.00	0.00			Pass	0%
	400.00	400.00	0.00			Pass	0%
	600.00	600.00	0.00			Pass	0%
	800.00	800.00	0.00			Pass	0%
	1000.00	1000.00	0.00			Pass	0%
	1200.00	1200.00	0.00			Pass	0%
	1400.00	1400.00	0.00			Pass	0%
	1600.00	1600.00	0.00			Pass	0%
	1800.00	1800.00	0.00			Pass	0%
	2000.00	2000.00	0.00			Pass	0%

END OF REPORT

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

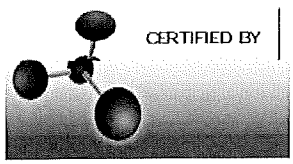
Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0090918

This is to certify that units of the lot number below were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	A200	**Quality Test / Release Date**	2/7/2017
Lot Number	168290		
Description	NITRIC ACID, CERTIFIED ACS		
Country of Origin	United States	* **Suggested Retest Date**	Feb-2022
Chemical Origin	Inorganic-non animal		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	CLEAR, COLORLESS FREE FROM SUSPENDED MATTER
ALUMINUM	ppm	<= 0.2	<0.100
ARSENIC (As)	ppm	<= 0.004	<0.0040
ASSAY	w/w %	Inclusive Between 68.0 - 70.0	69.4
BORON (B)	ppm	<= 0.1	<0.050
CALCIUM (Ca)	ppm	<= 0.2	<0.200
CHLORIDE	ppm	<= 0.08	<0.080
CHROMIUM (Cr)	ppm	<= 0.1	<0.050
COLOR	APHA	<= 10	5
COPPER (Cu)	ppm	<= 0.05	<0.050
GOLD (Au)	ppm	<= 0.3	<0.010
HEAVY METALS (as Pb)	ppm	<= 0.2	<0.20
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
IRON (Fe)	ppm	<= 0.2	<0.200
LEAD (Pb)	ppm	<= 0.1	<0.050
MAGNESIUM (Mg)	ppm	<= 0.3	<0.050
NICKEL (Ni)	ppm	<= 0.05	<0.050
PHOSPHATE (PO4)	ppm	<= 0.2	<0.20
POTASSIUM (K)	ppm	<= 0.3	<0.300
RESIDUE AFTER IGNITION	ppm	<= 2	<2
SODIUM (Na)	ppm	<= 0.3	<0.300
SULFATE (SO4)	ppm	<= 0.5	<0.5
TIN (Sn)	ppm	<= 0.3	<0.050
TITANIUM (Ti)	ppm	<= 0.3	<0.050
ZINC (Zn)	ppm	<= 0.3	<0.050

SwRI Chem ID: 86640



CERTIFIED BY

Teresa Bailey-Wyche

Quality Assurance Specialist - Certificate of Analysis BPF

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 86640

SwRI Chem ID: 86640

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

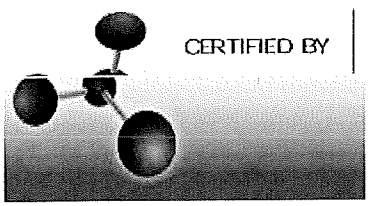
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69559
SwRI Chem ID: 69559
SwRI Chem ID: 69559

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

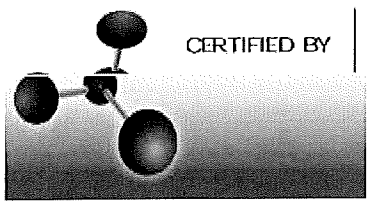
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005



Elgin E. Hans

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69560
SwRI Chem ID: 69560
SwRI Chem ID: 69560

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

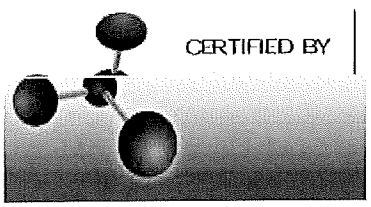
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005

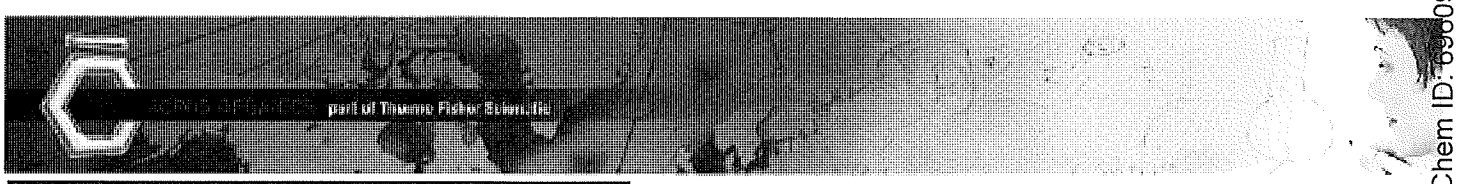


Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69561
SwRI Chem ID: 69561
SwRI Chem ID: 69561



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

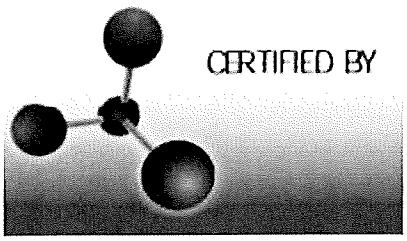
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Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69609
SwRI Chem ID: 69609
SwRI Chem ID: 69609

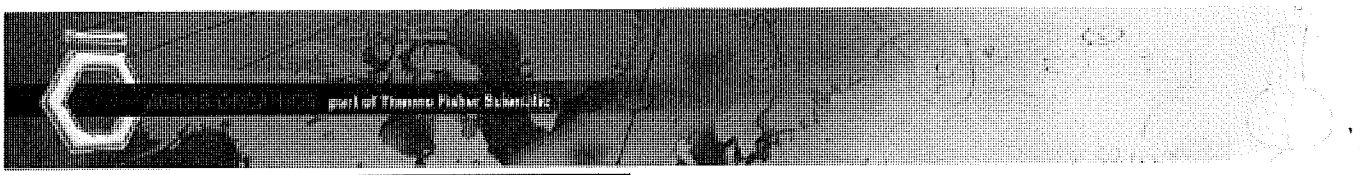


CERTIFIED BY

L. Van den Broek, QA Manager Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69609
SwRI Chem ID: 69609
SwRI Chem ID: 69609



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

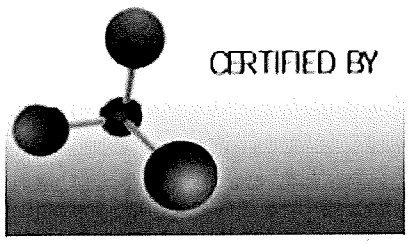
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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm
Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)

SwRI Chem ID: 66141
SwRI Chem ID: 66141
SwRI Chem ID: 66141



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 14 January 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 66141
SwRI Chem ID: 66141
SwRI Chem ID: 66141

SwRI Chem ID: 63604

SIGMA-ALDRICH®

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

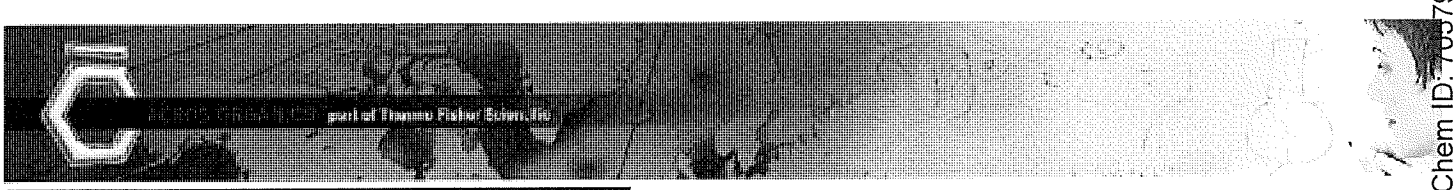
Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 63604

SwRI Chem ID: 63604



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

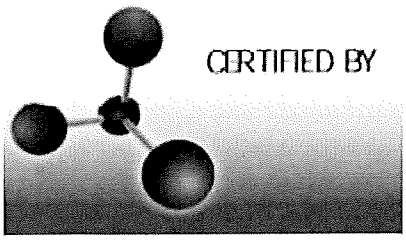
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Catalog Number	42434	**Quality Test / Release Date**	23 December 2015
Lot Number	A0367952	**Suggested Retest Date**	December 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5 % at 25°C)	5.7 (5 % at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 70579
SwRI Chem ID: 70579
SwRI Chem ID: 70579



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 20 May 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 70579

SwRI Chem ID: 70579

SwRI Chem ID: 70579

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Certificate of Analysis

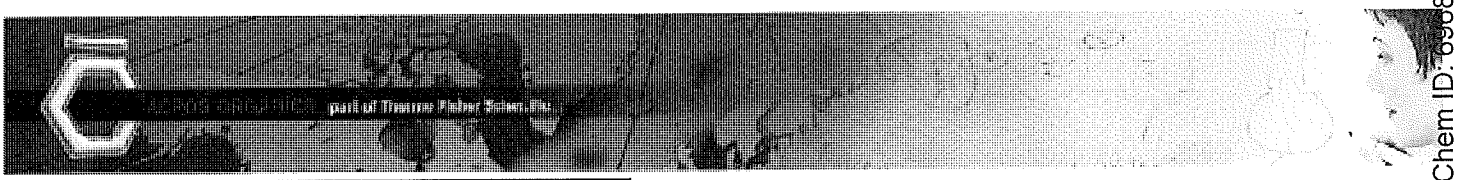
Product Name:	NICKEL(II) NITRATE HEXAHYDRATE purum p.a., crystallized, >= 97.0 % KT
Product Number:	72253
Batch Number:	BCBP4160V
Brand:	Sigma-Aldrich
CAS Number:	13478-00-7
Formula:	$Ni(NO_3)_2 \bullet 6H_2O$
Formula Weight:	290.79
Quality Release Date:	26 JAN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	BLUE-GREEN TO DEEP BLUE-GREEN	BLUE-GREEN
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	97.0 - 103.0 %	97.0 %
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
CADMIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
COBALT (ICP)	≤ 500 MG/KG	< 500 MG/KG
COPPER (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 50 MG/KG	< 50 MG/KG
POTASSIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
SODIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
LEAD (ICP)	≤ 50 MG/KG	< 50 MG/KG
ZINC (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 50 MG/KG	< 50 MG/KG

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65593
SwRI Chem ID: 65593
SwRI Chem ID: 65593



ACROS ORGANICS

Version	0
Molecular weight	126.04
Molecular formula	C2 H2 O4 . 2 H2 O
CAS No	6153-56-6
Linear formula	HO2CCO2H.2H2O
Flash point (°C)	

Certificate of Analysis

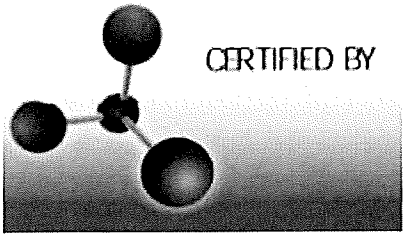
This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	42315	**Quality Test / Release Date**	10 December 2014
Lot Number	A0354614	**Suggested Retest Date**	December 2019
Description	Oxalic acid dihydrate,99.5+%,ACS reagent		
Country of Origin	SPAIN		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystals
Infrared spectrometry	authentic	authentic
Assay Titrimetry	99.5 to 102.5 %	99.9 %
Heavy metals (as Pb)	=<5 ppm	=<2.5 ppm
Residue after ignition	=<0.01 %	0.004 %
Nitrogen compounds (as N)	=<0.001 %	=<0.001 %
Trace analysis	Type: Cl measure =< 20 ppm	Type: Cl measure < 5 ppm
Trace analysis	Type: SO4 measure =< 50 ppm	Type: SO4 measure < 20 ppm
Trace analysis	Type: Ca measure =< 10 ppm	Type: Ca measure < 1 ppm
Trace analysis	Type: Fe measure =< 2 ppm	Type: Fe measure < 2 ppm
Insoluble matter	=<0.005 %	=<0.005 %
Substance darkened by H2SO4	passes test	passes test

SwRI Chem ID: 69684
SwRI Chem ID: 69684
SwRI Chem ID: 69684



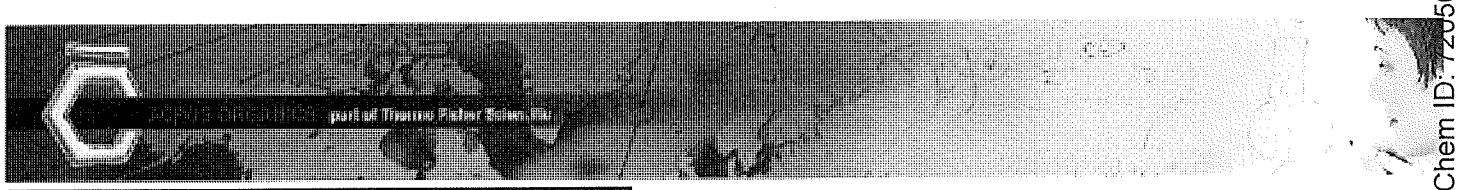
CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 27 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69684
SwRI Chem ID: 69684
SwRI Chem ID: 69684



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

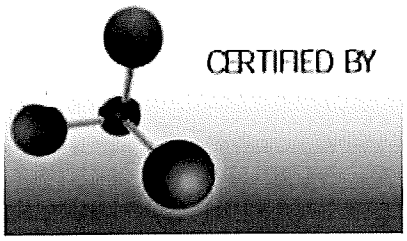
Certificate of Analysis

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Catalog Number	21156	**Quality Test / Release Date**	8 January 2016
Lot Number	A0368564	**Suggested Retest Date**	January 2018
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 1 July 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 72056
SwRI Chem ID: 72056
SwRI Chem ID: 72056

010182

Chemical Information Sheet

#67661

Sodium Nitrite

Grade:	Analytical
Type:	Commercial Stock
CAS:	7632-00-0
Lot:	MKBW3738V
Received:	02/29/2016
Expiration:	08/01/2017
Location:	- No Data -
Current Lab:	Lab 26 Bldg 70
Original Amount:	500 g
Amount Remaining:	500
Supplier:	Sigma-Aldrich
Concentration:	102.3 %
Project:	- No Data -
PO Number:	J47642MM
Internal Lab ID:	- No Data -
Density:	- No Data -
Storage Requirement:	Ambient
Measuring Device ID:	- No Data -
Date Disposed:	- No Data -
Notes:	PN 237213

Component Table

Compound	Conc/Activity	CAS

SwRI Chem ID: 67661

SIGMA-ALDRICH®

sigma-aldrich.com

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Sodium nitrite - ACS reagent, ≥97.0%

$NaNO_2$

Product Number:	**237213**
Batch Number:	**MKBW3738V**
Brand:	SIAL
CAS Number:	7632-00-0
MDL Number:	MFCD00011118
Formula:	NNaO2
Formula Weight:	69.00 g/mol
Quality Release Date:	04 SEP 2015
Recommended Retest Date:	AUG 2017

Test	Specification	Result
Appearance (Color) White to Off-White to Pale Yellow	Conforms to Requirements	White
Appearance (Form) Crystals and/or Crystalline Powder	Conforms to Requirements	Crystals
X-Ray Diffraction	Conforms to Structure	Conforms
Titration by KMNO4 % NaNO2	≥ 97.0 %	102.3 %
Insoluble Matter C= 10%, H2O	≤ 0.01 %	0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Chloride Content	≤ 0.005 %	< 0.005 %
Iron (Fe)	≤ 0.001 %	< 0.001 %
Heavy Metal as Lead	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Meets ACS Requirements 10th Edition	Current ACS Specification	Conforms
Recommended Retest Period 2 Years	----------	----------

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 67661

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3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 237213
Batch Number: MKBW3738V

Michael Grady, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 67661

SwRI Chem ID: 67661

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

Appendix V
SwRI Test Report, September 8, 2017

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

September 08, 2017

Los Alamos National Laboratory
TA-3 SM-271 Drop Point 02U
Los Alamos, New Mexico 87545

Attn: Kurt Anast

Subject:		
	SwRI Project Number:	19869.01.00X
	SDG:	619429
	SwRI Task Order Number:	170824-1
	SwRI Sample Receipt Number:	60216
	Samples Received:	08.04.2017
	Analysis:	Various

Dear Mr. Anast,

Please find the enclosed results for the samples generated by the lab on the above referenced date, for the plywood and celotex material. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Principal Scientist

APPROVED:

for Michael J. Dammann
Director

RPS: jz

Cc: Nita Patel, Los Alamos National Laboratory

Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170824-1
SwRI SRR: 60216
SDG: 619429
VTSR: 08.04.2017

Chain-of-Custody
&
Sample Receipt Paperwork

Total Page Count: 010001
Fraction: Various Pages: 010122

FW: LANL Samples

Moken, James A.

Mon 8/28/2017 7:53 AM

To: Ramirez, Daniel <daniel.ramirez@swri.org>; Garcia, David <david.garcia@swri.org>;

Danny or David,

Can I get four more samples added to SRR# 60216. They belong to the sample LANL project as below.

Client ID's

1) Plywood + UNS
2) Plywood + WB8
3) Celotex + UNS
4) Celotex + WB8

Thanks.

Jamie

From: Moken, James A.
Sent: Thursday, August 10, 2017 5:47 PM
To: Ramirez, Daniel <daniel.ramirez@swri.org>; Garcia, David <david.garcia@swri.org>
Cc: Spies, Radonna S. <radonna.spies@swri.org>
Subject: LANL Samples

Danny or David,

I received two sample from LANL for more of the kitty litter testing. Can I get two samples ID's and an SRR generated for them.

Client: LANL
Project: 19869.01.00X

Client ID's

1) Plywood
2) Celotex

You can just bring me the ID's since I have the samples in the lab. I will be receiving more of the same material next week since I did not receive enough. They will not need new ID's and should probably just make their way to the stockroom like these ones did. If you have any questions please let me know. Thanks.

Jamie

Client: LANL **Project # 19869.01.00X**
SRR # 60216
VTSR: 08/04/17
SwRI

Ramirez, Daniel

From: Moken, James A.
Sent: Thursday, August 10, 2017 5:47 PM
To: Ramirez, Daniel; Garcia, David
Cc: Spies, Radonna S.
Subject: LANL Samples

Danny or David,

I received two sample from LANL for more of the kitty litter testing. Can I get two samples ID's and an SRR generated for them.

Client: LANL
Project: 19869.01.00X

Client ID's

1) Plywood
2) Celotex

You can just bring me the ID's since I have the samples in the lab. I will be receiving more of the same material next week since I did not receive enough. They will not need new ID's and should probably just make their way to the stockroom like these ones did. If you have any questions please let me know. Thanks.

Jamie

Client: LANL Project # 19869.01.00X
SRR # 60216
VTSR: 08/04/17
Sample(s) received intact.

Southwest Research Institute

Laboratory Task Order

TO #: 170824-1 Revision: 1

Project(s): 19869.01.00X
Manager(s): DAMMANN, MIKE
To Client: 09/01/17

SDG: 619429

SRR #'s: 60216
Client(s): Los Alamos National Laboratory

Instructions

See instructions in Ignitability (D001) Evaluation of Celotex and Plywood word document for instructions on how to process samples.

In section 3.1Effect of UNS Liquid on Celotex and Plywood: D001 it says to dry the sample. After discussing with the client it was determined that the samples would be dried to a constant weight.

Documents Related to this task order: 226942[COC for SRR 60216], 226943[Paperwork for SRR 60216], 227963[Additional COC for SRR 60216], 227964[Additional Paperwork for SRR 60216]

Deliverables --> Hard Copy: no EDD: no PDF: -YES-

Test: COMB_1050
Section: WETCHEM

Holding: 180 days from CED

SW846 1050 Test A & C Spontaneous Combustion

Cnt: 6

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
619429		1	Celotex	Celotex	NO DATA	NO DATA
619430		1	Plywood	Plywood	NO DATA	NO DATA
620105		1	Plywood	Plywood + UNS	NO DATA	NO DATA
620106		1	Plywood	Plywood + WB8	NO DATA	NO DATA
620107		1	Celotex	Celotex + UNS	NO DATA	NO DATA
620108		1	Celotex	Celotex + WB8	NO DATA	NO DATA

Test: IGNIT_1030
Section: WETCHEM

Holding: 180 days from CED

SW 846 Method 1030 Ignitability of solids

Cnt: 6

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
619429		1	Celotex	Celotex	NO DATA	NO DATA
619430		1	Plywood	Plywood	NO DATA	NO DATA
620105		1	Plywood	Plywood + UNS	NO DATA	NO DATA
620106		1	Plywood	Plywood + WB8	NO DATA	NO DATA
620107		1	Celotex	Celotex + UNS	NO DATA	NO DATA
620108		1	Celotex	Celotex + WB8	NO DATA	NO DATA

Sample Receipt

Southwest Research Institute

Project: 19869.01.00X
Case #: Aspen
Client: Los Alamos National Laboratory

Sample Receipt Number: 60216
Revision: 2

This Receipt was Revised 08/28/2017

VTSR: 08/04/17

Time: 10:50:00

Manager: DAMMANN, MIKE
Logged in by: DRAMIREZ
Creation Date: 08/11/17

Notes

Box was delivered to SwRI Shipping & Receiving Warehouse. Div. 01 employees picked up the box from Receiving and took custody. SRR created from email received from the Lab. Sample was delivered intact, brown box, no ice.

Fed Ex #:
7124 2824 5718

Test requirements located on applicable Task Order.

See chain of custody as part of the SRR system for more information.

Phases:
001 - admin
006 - metals/radchem
007 - drg
REVISION 1 & 2, DRmz 08/28/17: Per email received on 08/28/17, 4 additional samples added to the SRR (Plywood + UNS, Plywood + WB8, Celotex + UNS, Celotex + WB8).

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
619429	Celotex		Celotex	1	
620107	Celotex + UNS		Celotex	1	
620108	Celotex + WB8		Celotex	1	
619430	Plywood		Plywood	1	
620105	Plywood + UNS		Plywood	1	
620106	Plywood + WB8		Plywood	1	

Containers: 6

Samples: 6

These documents are associated with this receipt: 227963[Additional COC for SRR 60216], 227964[Additional Paperwork for SRR 60216], 226942[COC for SRR 60216], 226943[Paperwork for SRR 60216]

Thermometer: N/A
Temperature: N/A

Page Printed: 09/08/2017 16:51
ver: (4/10/2017)

60216 Los Alamos National Laborato

Southwest Research Institute

Traffic Report

Sample Custodian Signature: DRM2 for Rev. 1

1. Custody Seal — Present
2. Chain of Custody — Not Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC N/A
4. SMO Forms — Not Present

Client: Los Alamos National Laboratory

Project: 19869.01.00X

Case: Aspen / SDG: SEE TO

Sample Receipt: 60216

Airbill: 7124 2824 5718

Custody Seal #(s):

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
08/04/17	10:50:00	None	Celotex	N/A	619429	YES	Intact
08/04/17	10:50:00	None	Plywood	N/A	619430	YES	Intact
08/04/17	10:50:00	Email	Plywood + UNS	N/A	620105	YES	Intact
08/04/17	10:50:00	Email	Plywood + WB8	N/A	620106	YES	Intact
08/04/17	10:50:00	Email	Celotex + UNS	N/A	620107	YES	Intact
08/04/17	10:50:00	Email	Celotex + WB8	N/A	620108	YES	Intact

SAMPLE LOG-IN SHEET

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): DANNY RAMIREZ	Log-in Date: 08/11/2017
Received By (Signature): DRmz for Rev. 1	
Case Number: Aspen	Sample Delivery Group No.: SEE TO	SAS Number: N/A
Remarks: 19869.01.00X		

1. Custody Seal(s)	Present/Absent* Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	Present/Absent*	
4. Traffic Reports or Packing Lists	Present/Absent*	
5. Airbill	Airbill/Sticker Present/Absent*	
6. Airbill No.	7124 2824 5718	
7. Sample Tags	Present/Absent*	N/A
Sample Tag Numbers	Listed/Not listed on Chain of Custody	N/A
8. Sample Condition	Intact/Broken*/ Leaking	
9. Cooler Temperature	N/AC	
10. Does Information on custody records, traffic reports, and sample tags agree?	Yes/No*	
11. Date Received at Lab	08/04/2017	
12. Time Received	10:50:00	

Sample Transfer	
Fraction: WC	Fraction:
Area #: B70	Area #:
By: DANNY RAMIREZ	By:
On: 08/04/2017	On:

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Celotex	N/A	619429	Intact
Plywood	N/A	619430	Intact
Plywood + UNS	N/A	620105	Intact
Plywood + WB8	N/A	620106	Intact
Celotex + UNS	N/A	620107	Intact
Celotex + WB8	N/A	620108	Intact

* Contact SMO and attach record of resolution

Reviewed By: J. Ramirez for Executive	Logbook No.: Sample Receipt (60216)
Date: 8-28-17	Logbook Page No.: 9902

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170824-1
SwRI SRR: 60216
SDG: 619429
VTSR: 08.04.2017

Case Narrative

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170824-1

WETCHEM ANALYSIS

Initial sample preparation

This report encompasses the preparation and analysis of the solid waste presented in Table 1, which also contains the methods performed on each piece of material. All tests were performed in duplicate if the initial run passed test specifications. The solid waste samples were prepared in three separate ways; as received, being impregnated with RNS salt surrogate (WB8), and by being soaked in UNS liquid and then dried. The samples receiving the WB8 treatment were initially submerged in the salt surrogate for several minutes. They were then removed from the WB8 and a rolling pin was used to try and impregnate the debris material with the WB8 (image 1 & 2). The samples were then shaken off and submitted for analysis. The samples receiving UNS treatment were submerged into the UNS liquid for two hours prior to being removed and allowed to drain for one hour (image 3). The debris was then placed into an oven at 55°C to dry to a constant weight prior to analysis (image 4). Samples took between two to three days to dry out with the exception of the 25mm Celotex + UNS samples which took only a little over 12 hours to dry. After soaking and drying in the UNS solution, it was noted that the Celotex became more brittle and darkened (image 5). The material uptake of the UNS and WB8 surrogates by the debris can be found in Table 2 and 3 respectively.

Table 1. Solid Waste analysis table

Surrogate ID	**Times made**	**Methods**	
		1030	**1050**
Celotex	1	1	1
Celotex + UNS	1	2	3
Celotex + WB8	1	2	2
Plywood	1	1	1
Plywood +UNS	1	2	2
Plywood + WB8	1	2	2

Table 2. Weight of UNS treated samples

Sample ID	Test	Material wgt (g)	Material wgt + UNS solution (g)	Material wgt + dried (g)	Dried UNS absorbed (g)
Celotex + UNS	1050	270.963	336.441	289.931	18.968
Celotex + UNS Dup	1050	272.037	371.472	312.173	40.136
Celotex + UNS*	1030	26.432	36.443	29.675	3.243
Plywood + UNS	1050	475.672	580.77	506.47	30.798
Plywood + UNS Dup	1050	485.476	582.44	497.99	12.514
Plywood + UNS*	1030	28.724	36.754	30.492	1.768
Celotex + UNS 25mm	1050	4.105	6.049	4.676	0.571
Celotex + UNS 25mm Dup	1050	4.041	6.166	4.681	0.640

* Both strips measured at the same time rather than independently.

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170824-1

Table 3. Weight of WB8 (RNS) treated samples.

Sample ID	Test	Material wgt (g)	Material wgt + WB8 (g)	WB8 impregnated onto sample (g)
Celotex + WB8	1050	271.061	352.205	81.144
Celotex + WB8 Dup	1050	271.810	341.704	69.894
Celotex + WB8	1030	14.417	26.612	12.195
Celotex + WB8 Dup	1030	12.970	25.611	12.641
Plywood + WB8	1050	503.51	609.92	106.41
Plywood + WB8 Dup	1050	512.66	605.74	93.08
Plywood + WB8	1030	15.444	19.331	3.887
Plywood + WB8 Dup	1030	17.823	21.921	4.098

SW-846 1030: Ignitability of Solids

In this test, an ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within 2 minutes. If the material combustion propagates, the burning time was measured over a distance of 100 mm and the rate of burning would be determined. The solid waste was cut into a 250 mm length strip that was placed atop a ceramic tile with marks at the 80 and 180 mm in from the end of the strip. The ceramic tile was placed about 8 inches in a hood with the sash lowered to give airflow of about 0.7 m/sec. One end of the strip was exposed to the end of an acetylene torch with a temperature greater than 1000°C. The torch was held there for 2 minutes and if the sample began to burn down the strip the time taken to get from the 80 to 180 mm mark was measured to determine the burn rate.

The plywood sample, as received, just charred and burned where the torch was applied whereas the Celotex sample burned and propagated about 30 mm across the sample test zone (Image 6 & 7). The samples treated with UNS solution burned within the burn zone but did not propagate across the sample (Image 8 & 9). They had very similar appearance to the debris as received. The samples treated with WB8 salt surrogate had burning in the burn zone with the salts boiling and forming a layer on the outside of the sample (Image 10 & 11). Under the laboratory conditions, all the samples are classified as nonflammable.

SW-846 1050: Spontaneous combustion and self heating

Since none of the samples exhibited characteristics of Method A, they were tested by Method C. In this test, a 100-mm sample cube is exposed to a test temperature of 140°C ± 2°C for a minimum of 24 hours to determine whether it undergoes spontaneous ignition or a rise in sample temperature to over 200 ^{o}C within the 24 hours. If the results of the preliminary 100mm test are positive, a second test using a 25-mm sample cube is conducted to further classify the waste as specified in Table 4.

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170824-1

Table 4. Method 1050 Waste Classification

Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm , but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm test, if tested alone	II

The filled cube was placed into an oven with one thermocouple measuring the oven temp and up to three thermocouples inserted into each sample to measure its temperature during the analysis. Lids were placed onto the top of the test cubes and tungsten weights were placed on top of those samples believed to potentially have an event in order to keep the thermocouples and lids from coming off the sample. Once the thermocouples were in place, the oven was ramped to 140°C ± 2°C and held for 24 hours. Temperatures of the oven and sample were collected every 10 seconds and plotted to determine if the sample temperature exceeded 200°C during the time of testing. At the conclusion of the test, the oven was turned off and allowed to cool before removing the sample. The oven and sample temperature graphs are located in Attachment A.

All of the plywood debris samples followed a similar pattern of coming up to temperature between 5 and 8 hours into the analysis and would remain there for the remainder of the testing period. The WB8 and UNS treated samples would reach a maximum temperature of 143°C which is still well below the 200°C limit. After analysis the WB8 treated samples appeared covered in a layer of bubbled up dried salt solution where as the UNS treated samples were dried, cracked, and covered in areas of dried UNS solution (images 12 & 13). Towards the 19 hour mark of the plywood UNS duplicate analysis run, the oven thermocouple began to have issues that caused reading to be in the 137ºC range which is outside the 140±2ºC range. At this point in the test the sample had a stabilized temperature and this was not believed to be an issue. All of the plywood samples were deemed to be "not a self heating waste" under laboratory conditions.

The Celotex samples showed self-heating when the WB8 and UNS surrogates were added to it. During the WB8 testing, the sample temperature of the initial run rose up to 160ºC and the duplicate rose to 146ºC. When removed from the oven the samples had dried bubble up salts on the exterior of the sample with slight charring marks on the interior region (Image 14). This shows the possible potential of the sample to self-heat. During the UNS testing, the sample temperature of the initial run rose to 151ºC and the duplicate did self heat causing the temperature to reach 683ºC. The sample from the first run was very brittle and had formed distinct cracks across the sample where as the second run produced a sample that was charred and ash (image 15 & 16). Due to this self heating, the UNS treated Celotex was analyzed in the 25mm cube. During this testing the sample temperature reached a maximum of 145ºC. When the sample was removed from the oven it was a darkened brown to black in color and was slightly more brittle then when it was placed in the oven (Image 17). From the laboratory testing, the Celotex as is and with the WB8 surrogate salt are considered to be "not as self heating waste". The Celotex + UNS sample is considered to be a "DOT packing group III".

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SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170824-1



Image 1: Impregnating WB8 into the Celotex samples.



Image 2: Impregnating the WB8 material into the plywood.

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170824-1

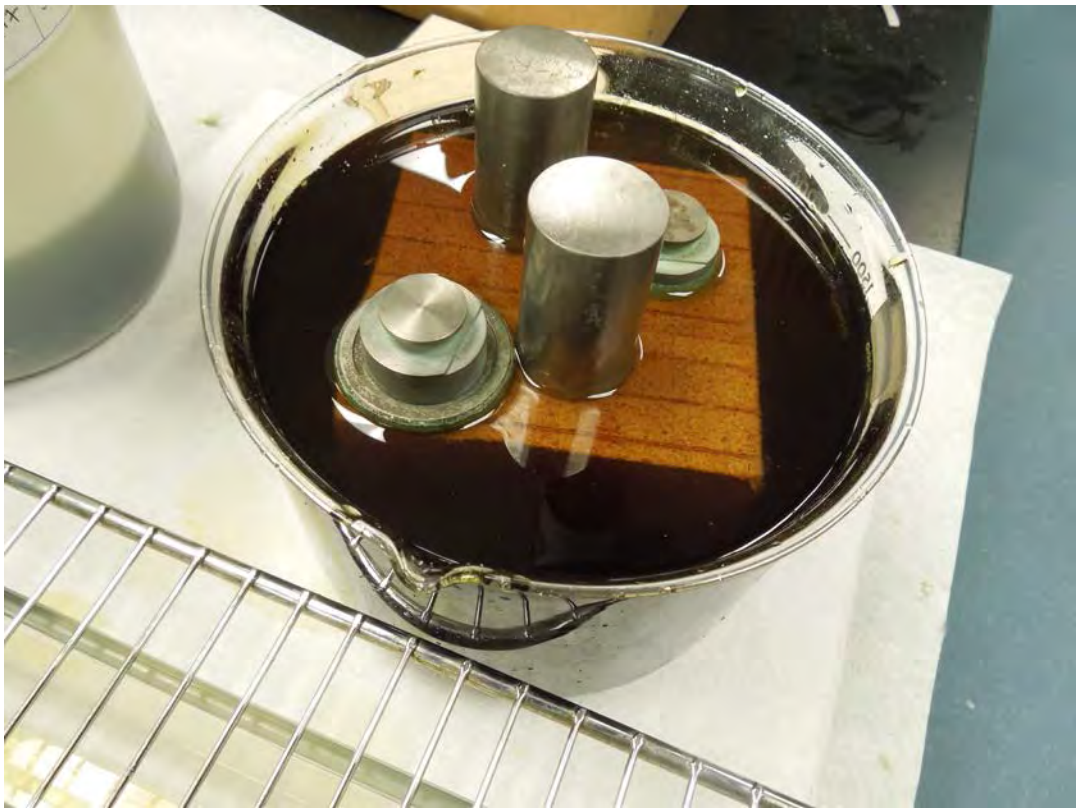


Image 3: Soaking of the debris in UNS salt solution.



Image 4: Debris material draining and drying after UNS solution treatment.

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SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170824-1

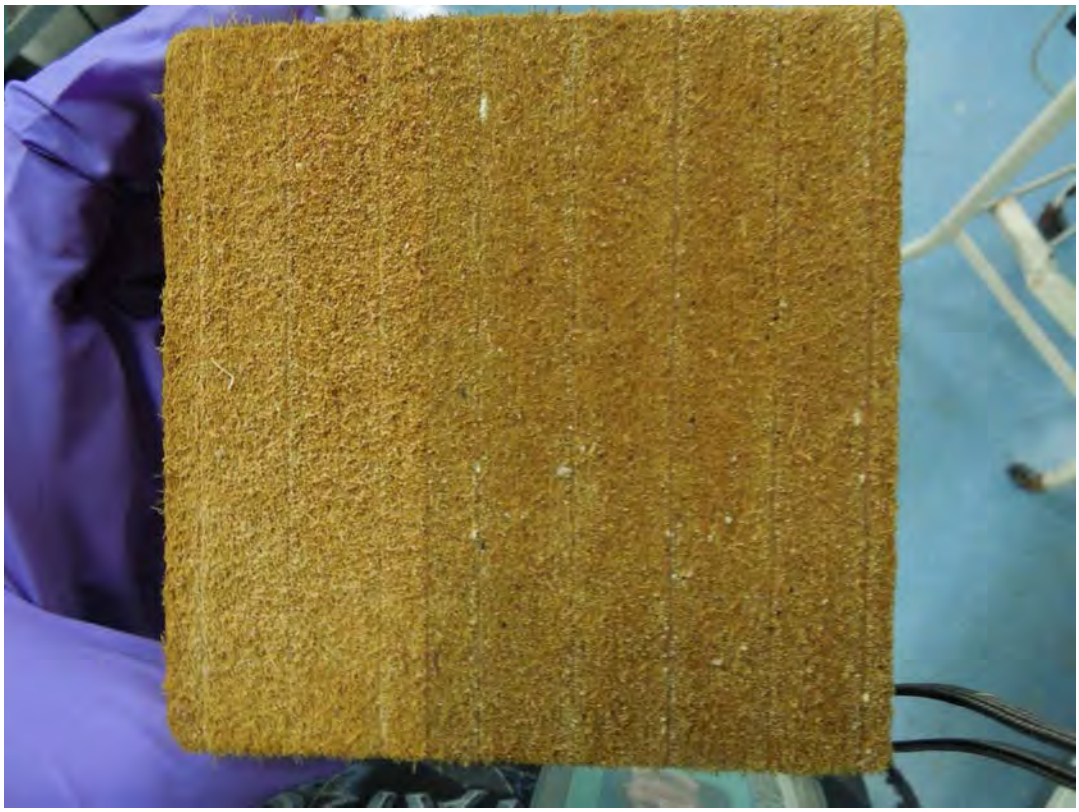


Image 5: Celotex after being treated with UNS solution and dried.



Image 6: SW-846 1030 performed on the plywood as received.

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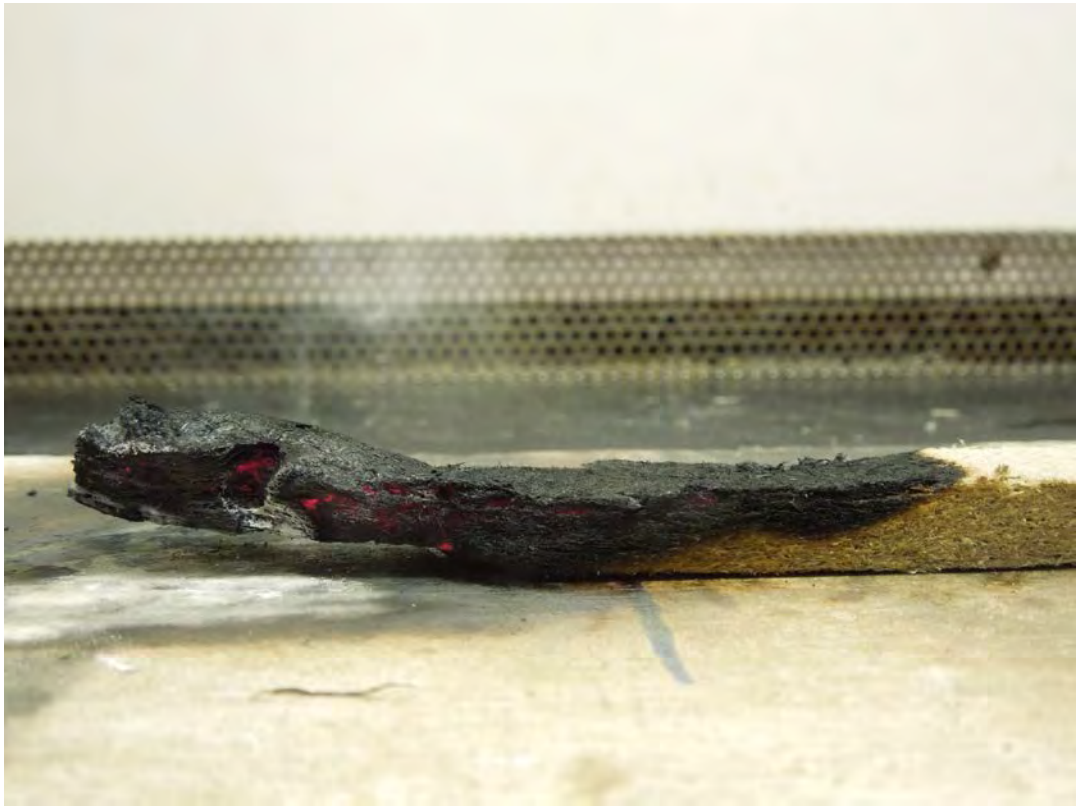


Image 7: SW-846 1030 performed on the Celotex as received.



Image 8: SW-846 1030 performed on the plywood treated with UNS solution.

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Image 9: SW-846 1030 performed on the Celotex treated with UNS solution.



Image 10: SW-846 1030 performed on the plywood treated with WB8 surrogate salt.

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Image 11: SW-846 1030 performed on the Celotex treated with WB8 surrogate salt.



Image 12: SW-846 1050 performed on plywood treated with WB8 surrogate salt.

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SwRI Task Order Number(s): 170824-1



Image 13: SW-846 1050 performed on plywood treated with UNS salt solution.

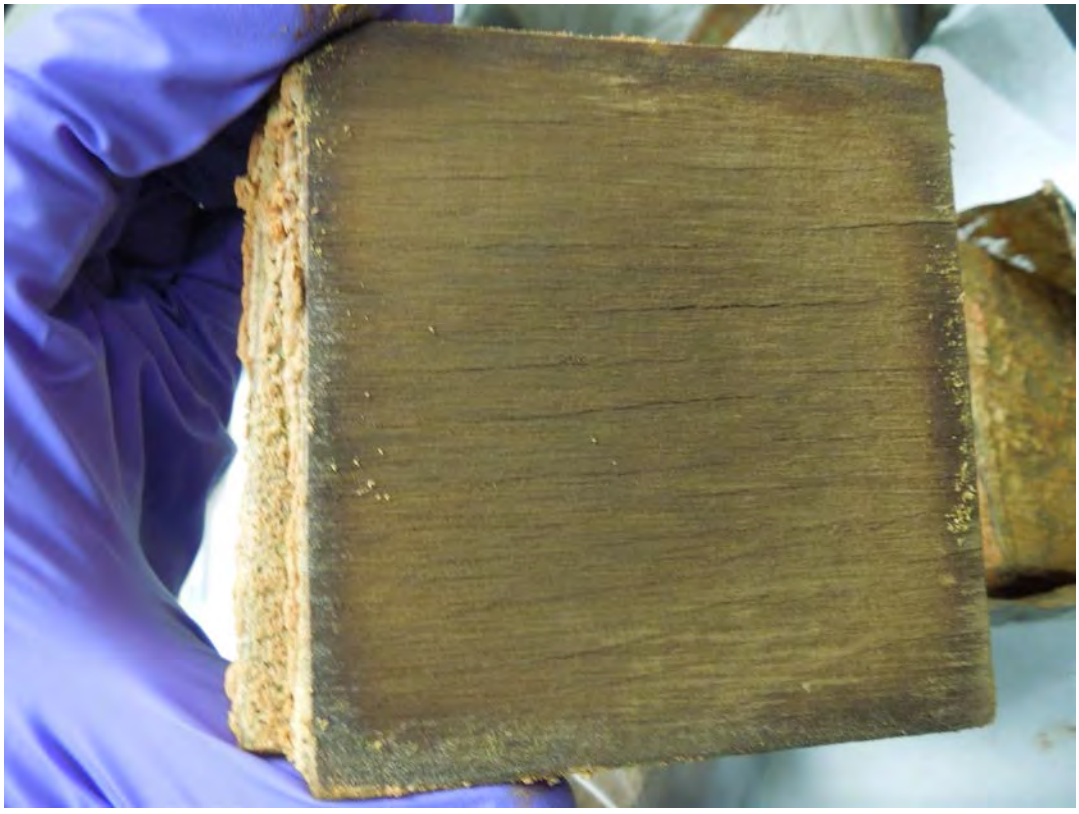


Image 14: SW-846 1050 performed on Celotex treated with WB8 surrogate salt.

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170824-1

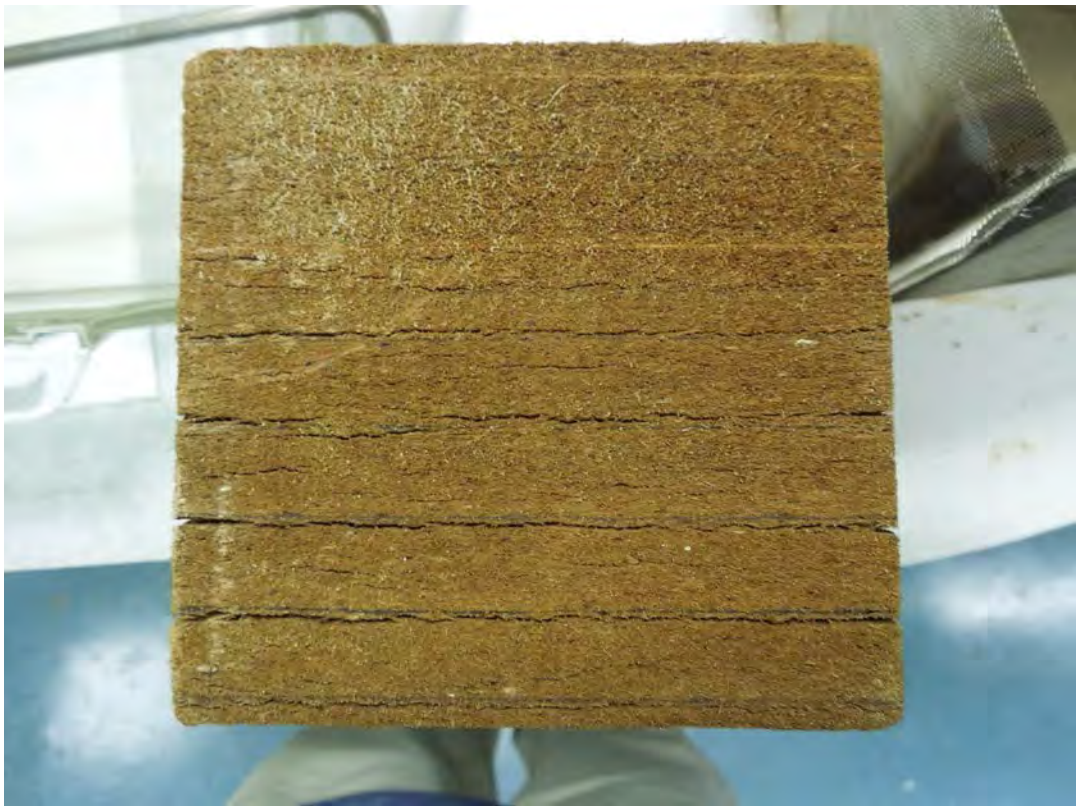


Image 15: SW-846 1050 performed on Celotex treated with UNS solution initial run.



Image 16: SW-846 1050 performed on Celotex treated with UNS solution duplicate run.

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SwRI Task Order Number(s): 170824-1



Image 17: SW-846 1050 performed on Celotex treated with UNS solution 25 mm cube.

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RDaniels — 9/6/17

Principal Scientist **Date**

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
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SwRI TASK ORDER: 170824-1
SwRI SRR: 60216
SDG: 619429
VTSR: 08.04.2017

Attachment A
Method 1050 Graphs

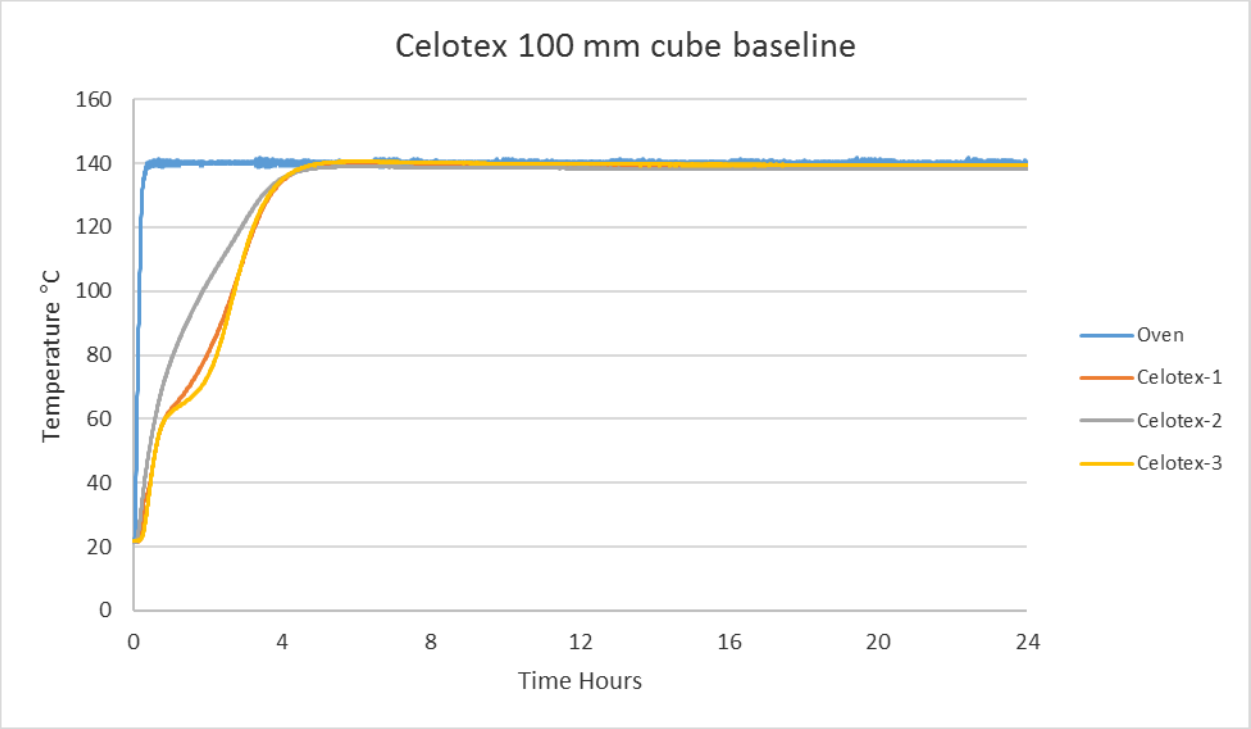


Figure 1. Method 1050 – Celotex Baseline (100mm cube).

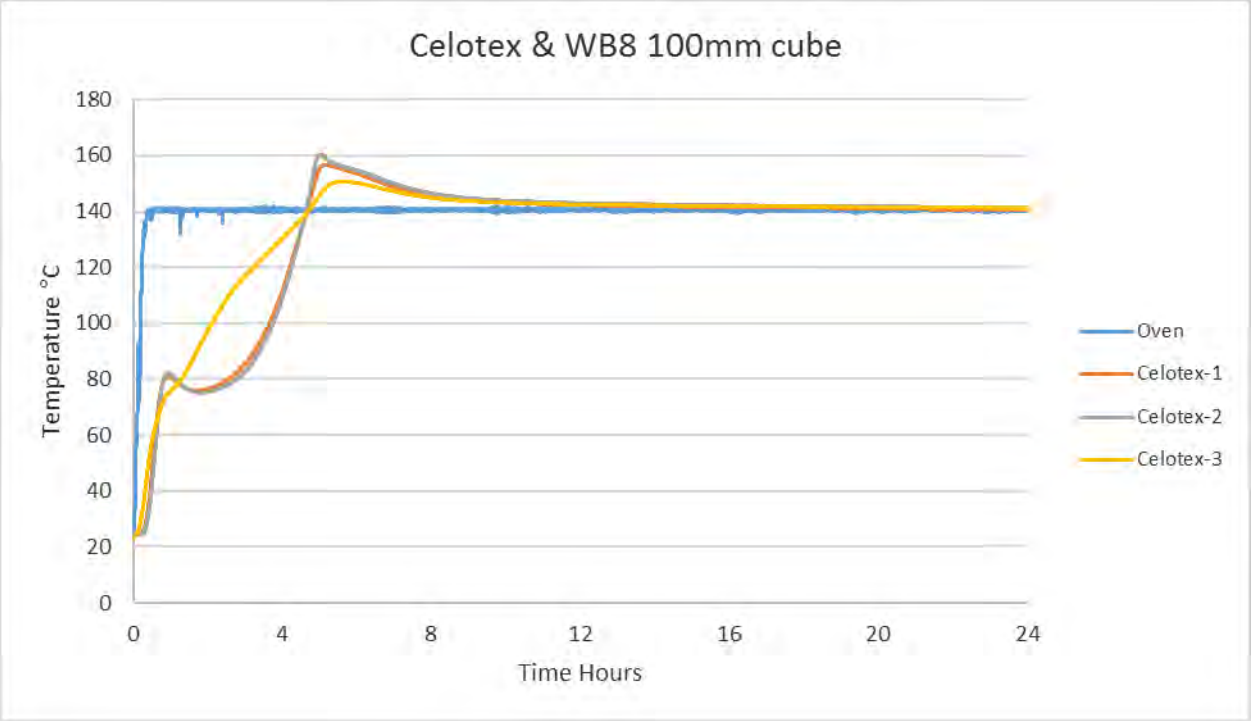


Figure 2. Method 1050 – Celotex and WB8 (100mm cube).

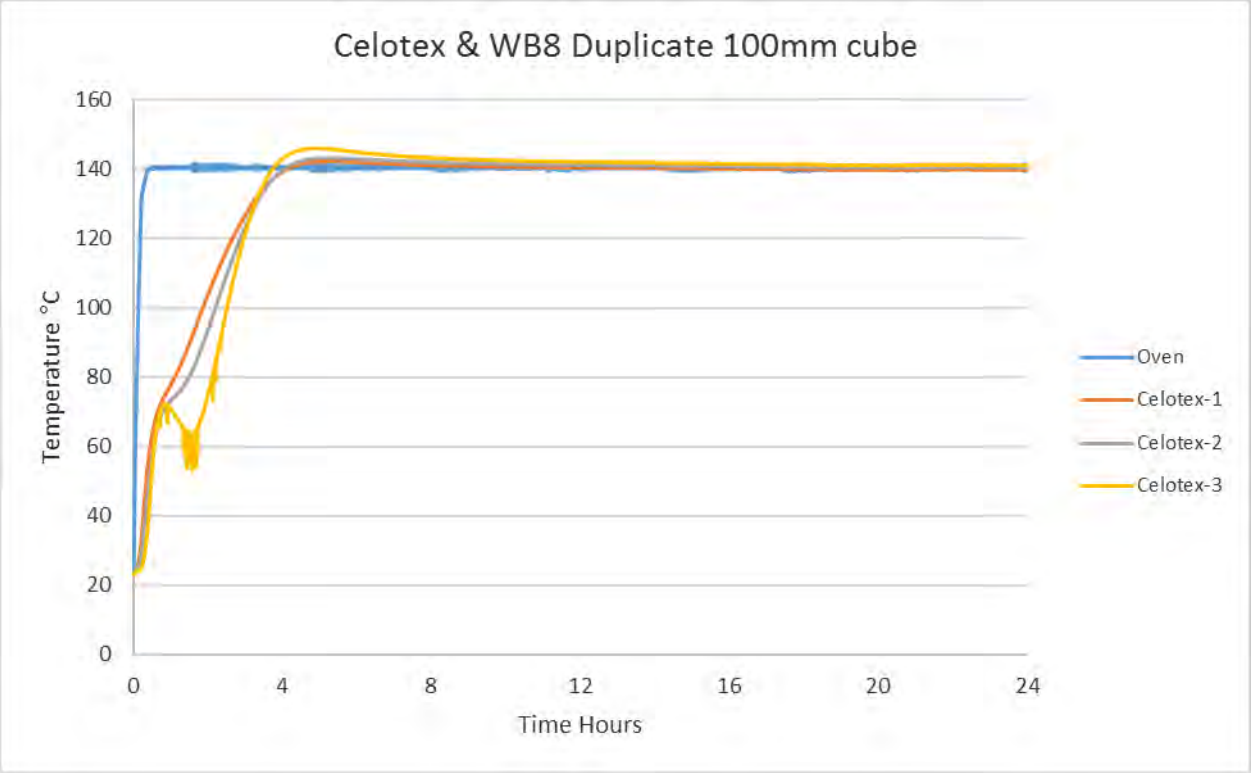


Figure 3. Method 1050 – Celotex and WB8 duplicate (100mm cube).

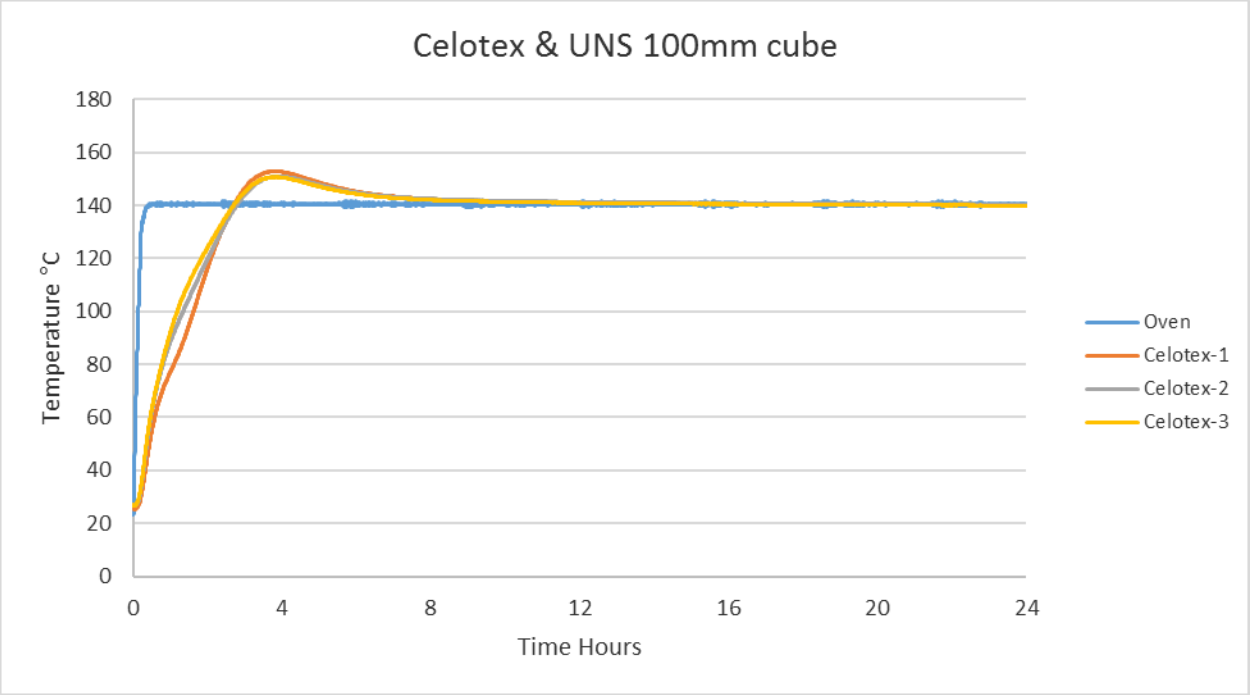


Figure 4. Method 1050 – Celotex and UNS (100mm cube).

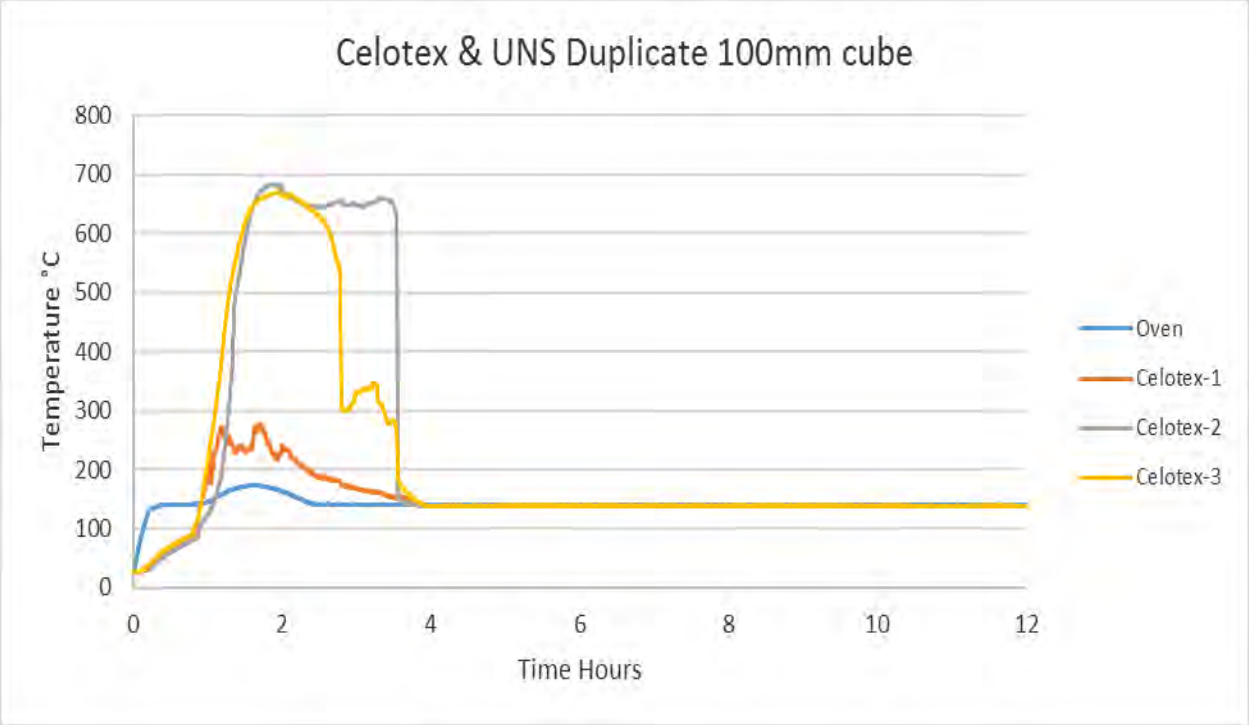


Figure 5. Method 1050 – Celotex and UNS duplicate run with event (100mm cube).

.

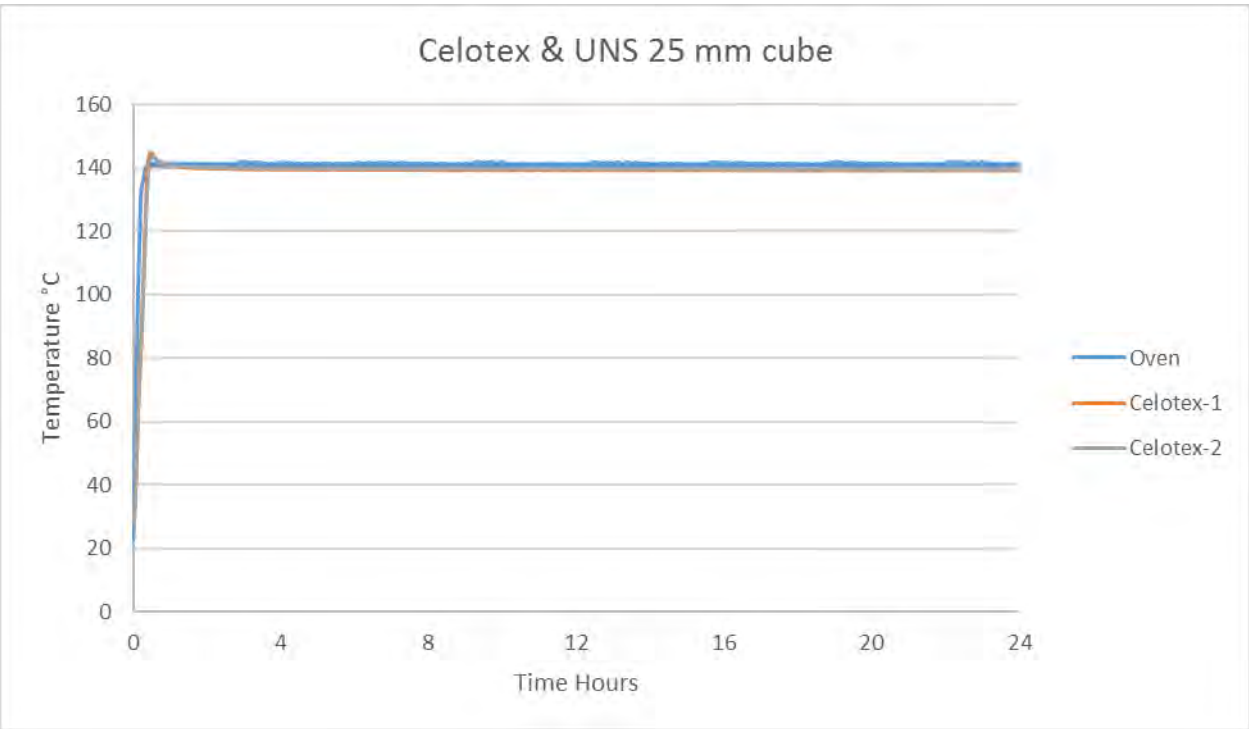


Figure 6. Method 1050 – Celotex and UNS sample and duplicate (25mm cube).

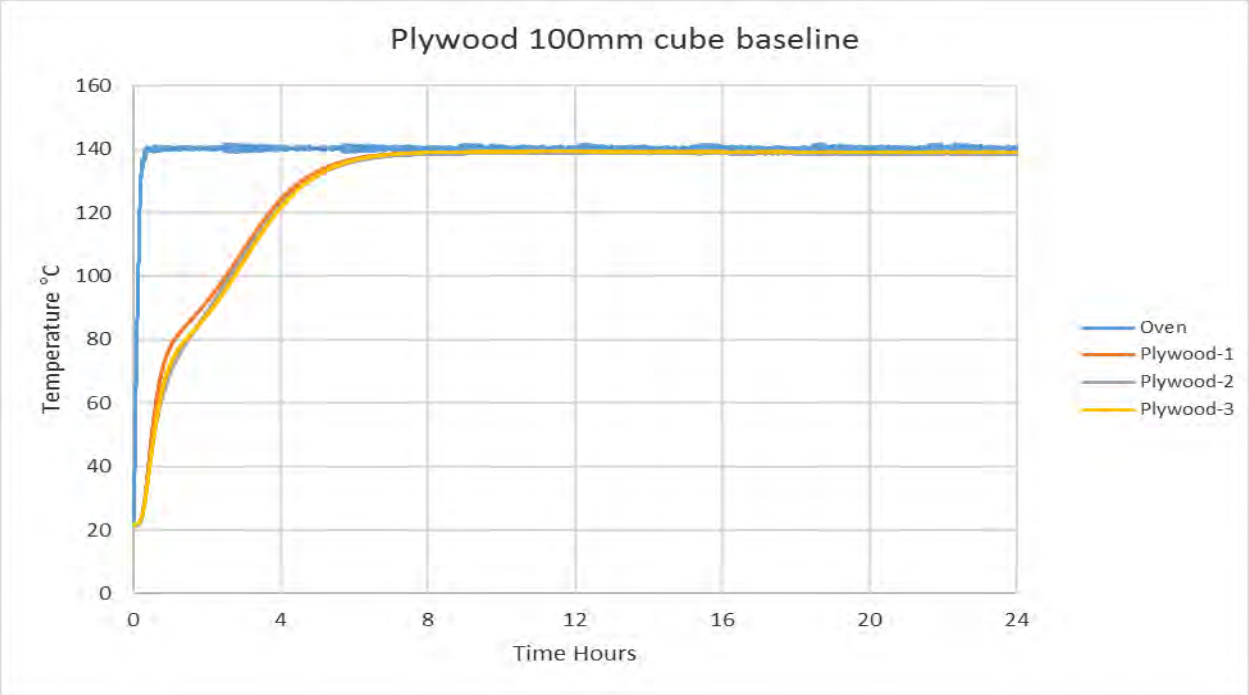


Figure 7. Method 1050 – Plywood Baseline (100mm cube).



Figure 8. Method 1050 – Plywood and WB8 (100mm cube).

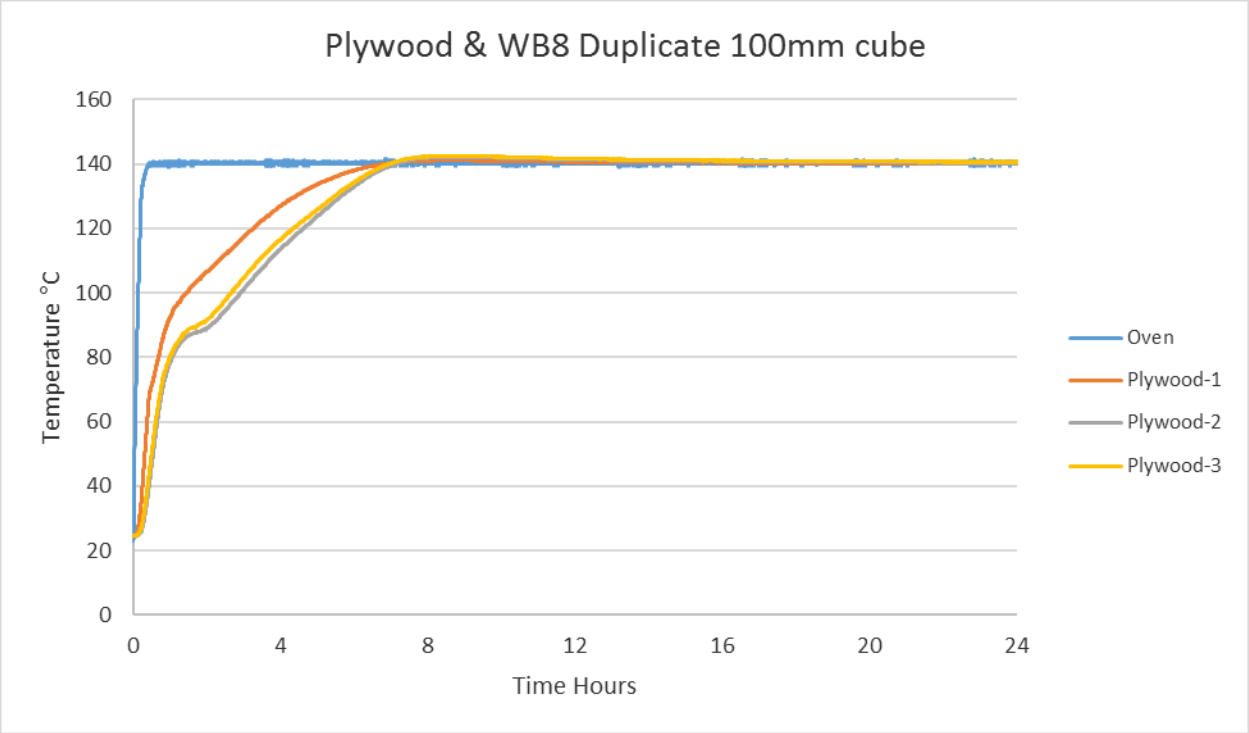


Figure 9. Method 1050 – Plywood and WB8 duplicate (100mm cube).

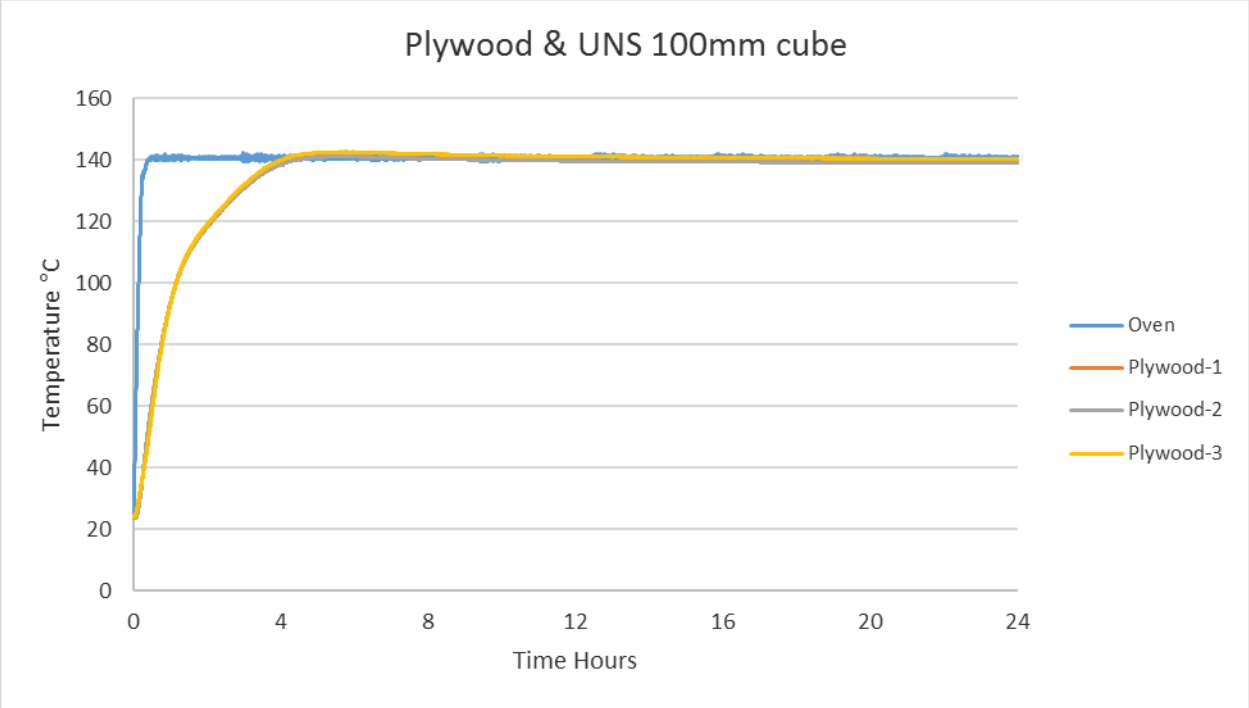


Figure 10. Method 1050 – Plywood and UNS (100mm cube).

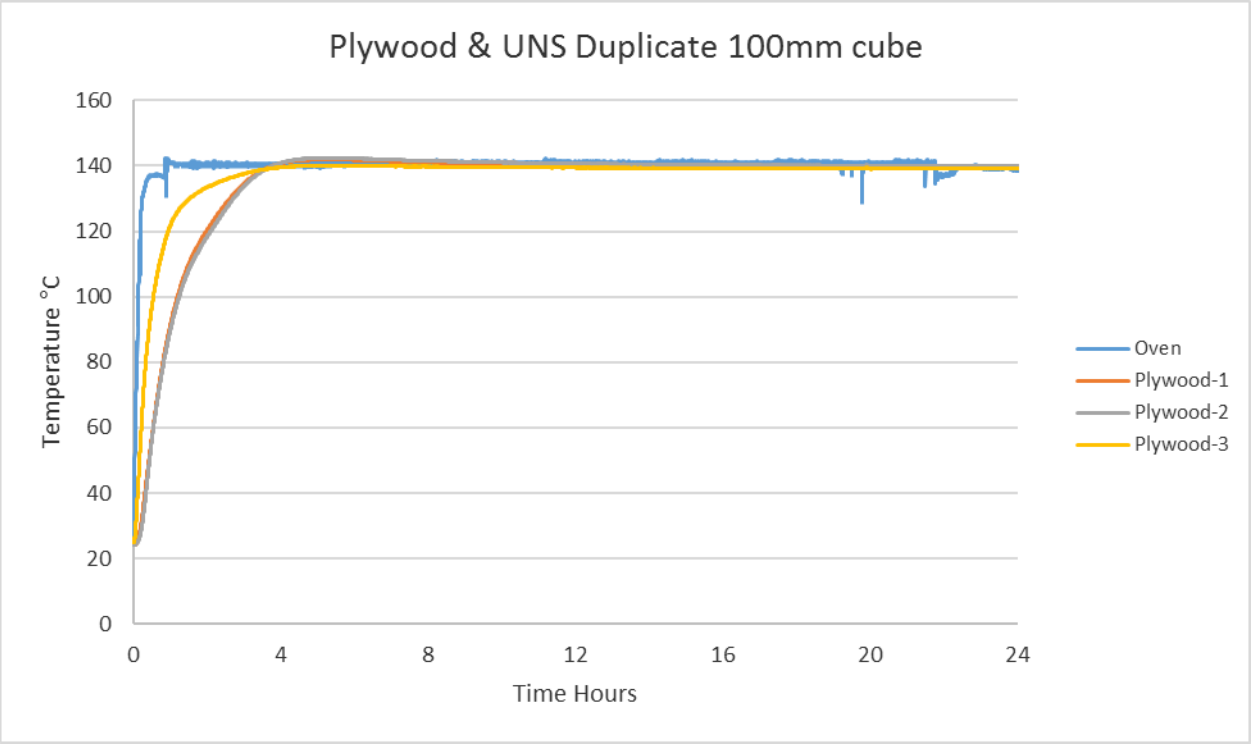


Figure 11. Method 1050 – Plywood and UNS duplicate (100mm cube).

SOUTHWEST RESEARCH INSTITUTE
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SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170824-1
SwRI SRR: 60216
SDG: 619429
VTSR: 08.04.2017

Sample Data Sheets

SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1030

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Solid

Task Order #: 170824-1

SRR #: 60216

Sample ID	SwRI System ID	Method 1030 *Ignitability of Solids Results*	Date Analyzed
Celotex	619429	Nonflammable	08/24/17
Plywood	619430	Nonflammable	08/24/17
Plywood + UNS	620105	Nonflammable	08/24/17
Plywood + WB8	620106	Nonflammable	08/24/17
Celotex + UNS	620107	Nonflammable	08/24/17
Celotex + WB8	620108	Nonflammable	08/24/17

* Note: The Ignitability designation is based on the criteria and conditions of the test

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SOUTHWEST RESEARCH INSTITUTE

SW 846 Method 1050

SAMPLE DATA SHEET

Lab Name: Southwest Research Institute

Client: Los Alamos National Laboratory

Lab Code: SwRI

Project No.: 19869.01.00X

Matrix: Solid

Task Order #: 170824-1

SRR #: 60216

Sample ID	SwRI System ID	SW 846 Method 1050 *Test Method to Determine Substances Likey to Spontaneously Combust* (Method C) Results	Date Analyzed
Celotex	619429	Not a self-heating waste	08/11/17
Plywood	619430	Not a self-heating waste	08/13/17
Plywood + UNS	620105	Not a self-heating waste	08/22/17, 08/30/17
Plywood + WB8	620106	Not a self-heating waste	08/18/17, 08/25/17
Celotex + UNS	620107	DOT Packing Group III	08/21/17, 08/28/17, 08/31/17
Celotex + WB8	620108	Not a self-heating waste	08/17/17, 08/23/17

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CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170824-1
SwRI SRR: 60216
SDG: 619429
VTSR: 08.04.2017

Preparation Logbook Pages

010032

Book I.D. 16-0406-001

Book/ Page : 13 00102

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1050 Project# 19864.01.006

Client: LANL TO# 1708241

LCS Info: NA TV= NA Balance#: NA

Notes: thermocouples calibration meter

023439 024074 012017

024075 024076

Sample ID / Temp °C	Channel 1		Channel 2	Channel 3	
0	0.1	0.2	0.2	0.2	8/28/17 ? 8/30/17 - UNS and ply used pans samples had dry salt buildup on the exterior but no event occured not self heating
50	50.3	50.2	50.3	50.2	
100	100.3	100.2	100.2	100.3	
150	150.3	150.3	150.3	150.2	
200	200.3	200.2	200.3	200.2	
8/11/17 ? 8/13/17	baseline test for celotex and plywood. NO reaction occured and little change to sample noted. not self heating				
8/14/17 ? 8/23/17	celotex and UOBS runs, samples had bubbled salt buildup on exterior of sample and a darkened brown/black inside, but no event occured. not self heating				
8/23/17 ? 8/25/17	plywood and UOBS runs, sample had a salt buildup on the exterior and slightly scorched inside no reaction, no self heating				
8/21/17 ? 8/25/17	UNS and celotex runs. 1st run sample became brittle and had cracks down the sample, also darkened. Duplicate run had one event 30 minutes in an hour into analysis causing sample to burn. 2.5mm				

Calculation: cube test performed on 8/31/17. no crust occured on test test but sample darkened and became brittle. DOT packing group III

Analyst Signature: Date: 8/11/17

Reviewed by: Date: 9/6/17

010033

Book I.D. 16-0406-001 Book/ Page : 13 00103

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: 1030 1050 / weights Project# 19869.01.006

Client: LANL TO# 170824-1

LCS Info: TV= Balance#: 05

Notes: Oven #33 55°C

WBB solution - 126-03-WCS12

WNS solution - 128-03-WCS17

Sample ID	~~Sample WBS~~ WBB+ sample wgt (g)	WBB+ sample (g)			
celotex	271.061	352.205	8/14/17		
1050 celotex dup	271.810	341.704	8/23/17		
plywood	503.51	609.92	8/18/17		
plywood Dup	512.66	605.74	8/25/17		
	Sample (g)	WNS+ sample (g)	dry wgt (1)	dry wgt (2)	
celotex	270.963	336.441	290.079	289.931	in 8/18/17 13:47 out 8/20/17 6:45 in 8:00 out 6:45 8/21/17
celotex dup	272.037	371.472	315.343 2 readings 8/28/17	312.173	in 8/25/17 16:00 out 8/27/17 6: in 9:00 out 13:02
1050 plywood	475.672	580.77	506.84	506.47	in 8/18/17 13:47 out 8/20/17 6:45 in 16:00 out 6:45 8/21/17
plywood Dup	485.476	582.44	498.24	497.99	in 8/25/17 16:00 out 8/28/17 6:45 in 9:00 out 8/30/17 7:00
celotex	26.432	36.443	30.014	29.675	in 8/18/17 13:47 out 8/21/17 6:45
1030 plywood	28.724	36.754	31.184	30.492	in 8/22/17 16:00 out 8/24/17 6:30
celotex	4.105	6.049	4.680	4.676	in 8/30/17 7:00pm
1050 25mm celotex dup	4.041	6.106	4.686	4.681	out 8/31/17 6:30
	Sample wgt (g)	WBB+ sample (g)			in 8/31/17 15:50
celotex	14.417	26.612			out 8/31/17 18:00
celotex dup	12.970	25.611			
1030 plywood	15.444	19.331	8/24/17		
plywood dup	17.823	21.921			

Calculation:

Analyst Signature: Date: 8/14/17

Reviewed by: Date: 9/6/17

010034

Book I.D. 16-0406-001 Book/ Page : 13 00104

Southwest Research Institute®
Logbook: Physical Testing

Analysis / Method: Ignitability 1030 Project# 19869.01.006

Client: LANL TO# 170824-1

LCS Info: excelsior wood (W1753) TV= 72.2mm/sec Balance#: MA

Notes: Hood 42 70-19 flow 0.69m/sec

torch >1000°c timer # 022921

thermocouple # 024076 test performed @ room temp 22.8°C

meter # 022939

Sample ID	burn	burn time (s)	rate mm/sec		
LCS	Yes	13.93	7.18mm/sec		
plywood	Yes	Sample did not burn past the burn zone. Sample charred and blackened.			
celotex	Yes	Propagated out of the burn zone but only made it about 30mm across the sample.			
plywood/UNS	Yes	Sample did not burn past the burn zone. Charred and blackened			
plywood/UNS dup	Yes	Same as original run			
celotex/UNS	Yes	Sample did not burn past the burn zone. Sample charred and blackened			
celotex/UNS dup	Yes	Same as original run			
plywood/WB8	Yes	Boiled and made a layer of salts. Did not burn past burn zone.			
plywood/WB8 dup	Yes	Same as original burn			
celotex/WB8	Yes	Boiled and made a layer of salts. Did not burn past burn zone. Charred and blackened			
celotex/WB8 Dup	Yes	Same as original run			

Calculation:

Analyst Signature: Date: 8/24/17

Reviewed by: Date: 9/6/17

128 TITLE Los Alamos

PROJECT NO. 21592.01.006
BOOK NO. 15-0406-052

Work continued from Page

SWRI

128-01-WCS12 Ni-B Zeo-1

600mL (124-04-WCS12) to 1200mL zeolite

let sit for 24 hr prior to analysis 5/15/16 10:10

128-02-WCS12 Ni-B Zeo-2

600mL (124-04-WCS12) to 1800mL zeolite

128-03-WCS12 LANS solution

8322.851 g aluminum nitrate nonahydrate (# 69597-69592, 69573-69571, 69591-69586) +
840.695 g calcium nitrate (# 69606, 69607) +
61.562 g chromium nitrate (# 66141, 63857) +
595.084 g Iron(III) nitrate (# 63607, 65582) +
400.600 g magnesium nitrate (# 69603, 69604) +

~~Sodium nitrate~~ TCS AM 5/16/16

493.5682 g sodium nitrate (# 69611) +
596.525 g lead nitrate (# 65951, 69629, 69623 +
2373.849 g oxalic acid (# 69684) +
2.310 g nickle nitrate (# 65593) +

63.727 g nitric acid (# 67843)
6500.17 g DI H2O

balance #89

Work continued to Page

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SIGNATURE [signature] DATE 5/15/16

DISCLOSED TO AND UNDERSTOOD BY M. Gradoville DATE WITNESS DATE 5/25/16

126 TITLE Kitty litter

PROJECT NO. 21542101.006
BOOK NO. 15-0406-052

Work continued from Page

SWRI

Sod NH A-2001 126-01-WCS12 (2:1)

600mL (124-03-WCS12) to 1200mL zeolite (made crackling noises when setting)

126-02-WCS12 Sod NH-A-2002 (3:1) Wet zeolite set for 24hr

600mL (124-03-WCS12) to 1800mL zeolite

126-03-WCS12 WB8

✓	743.801 (TS&M 5/13/14)	g	Aluminum nitrate (#65579)+
✓	2957.067	g	calcium nitrate (#65736)+(#63614)+(65735)+(#69600)
✓	36.405 (TS&M 5/13/14)	g	chromium nitrate (#63857)+
	1129.441	g	iron nitrate (#65381)+(63604) (TS&M 5/13/14) A
✓	8298.857	g	magnesium nitrate (#65737)+69602
✓	1839.762	g	sodium nitrate (#69610, 69611)+
✓	653.127	g	lead nitrate (#66142, 65951)+

✓	Oxalic acid	671.146 g	(#69684)+
✓	potassium carbonate	350.133 g	(#63914, 69660)+ B
	water	1000.148 g	

balance #89

Work continued to Page

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SIGNATURE [signature] DATE 5/13/16

DISCLOSED TO AND UNDERSTOOD BY M. Gabrillan DATE WITNESS DATE 5/25/14

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170824-1
SwRI SRR: 60216
SDG: 619429
VTSR: 08.04.2017

Certificates of Calibration

010038

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Customer:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	76370
Company Name:	SWRI	Calibrated:	6/26/2017
Address:	9503 W COMMERCE	Calibration Due:	6/26/2018
City:	SAN ANTONIO State: TX Zip Code:78227	Data Type:	FOUND / LEFT
Description:	BALANCE	Temp./RH:	71 °F / 56 %
Manufacturer:	METTLER	Work Order #	403148632
Model Number:	PR2003DR		
Asset Number:	009065 Serial Number: 1120351000		
Calibration Procedure:	BALANCES & SCALES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
001711	TROEMNER	50 G	WEIGHT CLASS 1	6/26/2018
001712	TROEMNER	100 G	WEIGHT CLASS 1	8/3/2017
001713	RICE LAKE	200 G	WEIGHT CLASS 1	7/14/2017
001714	TROEMNER	200 G	WEIGHT CLASS 1	1/9/2018
001715	RICE LAKE	500 G	WEIGHT CLASS S	7/7/2017
001716	RICE LAKE	1 KG	WEIGHT CLASS 1	4/6/2018
001717	RICE LAKE	2 KG	WEIGHT CLASS 1	4/6/2018

Authorized Signatory

Calibrated By: RRV
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403148632	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	26-Jun-17
Remarks:					

Function/Range	Applied	TI Reading	Difference	± Limit	Result	% Limit
Corner Load	grams	grams	grams	grams		
Left Front	200	200.000	0.000	0.006	Pass	0%
Left Rear		200.001	0.001		Pass	17%
Right Rear		200.000	0.000		Pass	0%
Right Front		200.000	0.000		Pass	0%
Repeatability						
500 gram Range						
1	200	200.001				
2		200.000				
3		200.001				
4		200.001				
5		200.001				
6		200.000				
7		200.000				
8		200.000				
9		200.001				
10		200.000				
Std Deviation		0.0005		0.0020	Pass	25%
2000 gram Range						
1	1000	1000.00				
2		1000.00				
3		1000.00				
4		1000.00				
5		1000.00				
6		1000.00				
7		1000.00				
8		1000.00				
9		1000.00				
10		1000.00				
Std Deviation		0.000		0.006	Pass	0%

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing	grams	grams	grams	grams	grams		
500 gram Range	0.000	0.000	0.000	0.004	0.0012	Pass	0%
	50.000	50.000	0.000			Pass	0%
	100.000	100.001	0.001			Pass	25%
	150.000	150.001	0.001			Pass	25%
	200.000	200.001	0.001			Pass	25%

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403148632	Mfr:	Mettler	Technician:	RRV
Asset No.:	009065	Model:	PR2003DR	Type Data:	Found-left
Serial No.:	1120351000	Type:	Balance	Cal Date:	26-Jun-17

Function/Range	Applied	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Direct Weighing *(cont.)*	grams	grams	grams	grams	grams		
500 gram Range	250.000	250.001	0.001	0.004	0.0012	Pass	25%
	300.000	300.001	0.001			Pass	25%
	350.000	350.002	0.002			Pass	50%
	400.000	400.002	0.002			Pass	50%
	450.000	450.001	0.001			Pass	25%
	500.000	500.000	0.000			Pass	0%
Direct Weighing	0.00	0.00	0.00	0.01	0.012	Pass	0%
2000 gram Range	200.00	200.00	0.00			Pass	0%
	400.00	400.00	0.00			Pass	0%
	600.00	600.00	0.00			Pass	0%
	800.00	800.00	0.00			Pass	0%
	1000.00	1000.00	0.00			Pass	0%
	1200.00	1200.00	0.00			Pass	0%
	1400.00	1400.00	0.00			Pass	0%
	1600.00	1600.00	0.00			Pass	0%
	1800.00	1800.00	0.00			Pass	0%
	2000.00	2000.00	0.00			Pass	0%

END OF REPORT

010041

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	60136
Asset Number:	023439	Calibrated:	9/20/2016
Description:	THERMOCOUPLE TYPE K	Calibration Due:	9/20/2017
Manufacturer:	UNKNOWN	Data Type:	FOUND / LEFT
Model Number:	TYPE K	Temp./RH:	76 °F / 52 %
Serial Number:	D0T19	Work Order #	403142360
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 ° TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	12/9/2016
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/3/2016
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	6/13/2017
013908	HART SCIENTIFIC	5628	SPRT	2/24/2017
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/3/2016

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403142360	Mfr:	Unknown	Technician:	Mark Romero
Asset No.:	023439	Model:	Type K	Type Data:	Found-left
Serial No.:	D0T19	Type:	Thermocouple	Cal Date:	20-Sep-16
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.9	-38.4	1.5	2.2	0.5	Pass	68%
	99.7	99.0	-0.7	2.2	0.5	Pass	32%
	500.5	503.1	2.6	3.8	1.3	Pass	69%
	752.3	754.5	2.2	5.6	1.3	Pass	39%
	1005.3	1003.0	-2.3	7.5	1.3	Pass	31%

END OF REPORT

010043

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Customer:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	77829
Company Name:	SWRI	Calibrated:	7/24/2017
Address:	9503 W COMMERCE	Calibration Due:	7/24/2018
City:	SAN ANTONIO State: TX Zip Code:78227	Data Type:	FOUND / LEFT
Description:	THERMOCOUPLE TYPE K	Temp./RH:	75.8 °F / 59 %
Manufacturer:	DIGI-SENSE	Work Order #	403149153
Model Number:	08516-96		
Asset Number:	024075 Serial Number: 24075		
Calibration Procedure:	TEMPERATURE PROBES		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	11/23/2017
010281	HART SCIENTIFIC	5628	SPRT	5/2/2018
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/7/2017
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	7/13/2018
013908	HART SCIENTIFIC	5628	SPRT	3/1/2018
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/7/2017

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403149153	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	024075	Model:	08516-96	Type Data:	Found-left
Serial No.:	24075	Type:	Thermocouple Type K	Cal Date:	24-Jul-17

Remarks: a reading exceeded 70% of limits. No adjustment possible.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.9	-38.3	1.6	2.2	0.5	Pass	73%
	200.5	200.6	0.1	2.2	0.5	Pass	5%
	396.7	397.6	0.9	3.0	1.3	Pass	30%
	749.7	750.9	1.2	5.6	1.3	Pass	21%
	1002.2	1000.5	-1.7	7.5	1.3	Pass	23%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Customer:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	77830
Company Name:	SWRI	Calibrated:	7/24/2017
Address:	9503 W COMMERCE	Calibration Due:	7/24/2018
City:	SAN ANTONIO State: TX Zip Code:78227	Data Type:	FOUND / LEFT
Description:	THERMOCOUPLE TYPE K	Temp./RH:	75.8 °F / 59 %
Manufacturer:	DIGI-SENSE	Work Order #	403149152
Model Number:	08516-96		
Asset Number:	024074 Serial Number: 24074		
Calibration Procedure:	TEMPERATURE PROBES		

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Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	11/23/2017
010281	HART SCIENTIFIC	5628	SPRT	5/2/2018
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/7/2017
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	7/13/2018
013908	HART SCIENTIFIC	5628	SPRT	3/1/2018
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/7/2017

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403149152	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	024074	Model:	08516-96	Type Data:	Found-left
Serial No.:	24074	Type:	Thermocouple Type K	Cal Date:	24-Jul-17

Remarks: a reading exceeded 70% of limits. No adjustment possible.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.9	-38.1	1.8	2.2	0.5	Pass	82%
	200.5	200.8	0.3	2.2	0.5	Pass	14%
	396.7	398.0	1.3	3.0	1.3	Pass	44%
	749.7	750.9	1.2	5.6	1.3	Pass	21%
	1002.2	999.8	-2.4	7.5	1.3	Pass	32%

END OF REPORT

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Customer:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	77828
Company Name:	SWRI	Calibrated:	7/24/2017
Address:	9503 W COMMERCE	Calibration Due:	7/24/2018
City:	SAN ANTONIO State: TX Zip Code:78227	Data Type:	FOUND / LEFT
Description:	THERMOCOUPLE TYPE K	Temp./RH:	75.8 °F / 59 %
Manufacturer:	DIGI-SENSE	Work Order #	403149154
Model Number:	08516-96		
Asset Number:	024076 Serial Number: 24076		
Calibration Procedure:	TEMPERATURE PROBES		

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Remarks:
CAL -40 °C TO 1000 °C

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009137	HART SCIENTIFIC	1575	SUPER THERMOMETER	11/23/2017
010281	HART SCIENTIFIC	5628	SPRT	5/2/2018
010814	HART SCIENTIFIC	1529	TEMPERATURE METER	11/7/2017
013617	HART SCIENTIFIC	5650	THERMOCOUPLE PROBE TYPE S	7/13/2018
013908	HART SCIENTIFIC	5628	SPRT	3/1/2018
015240	HART SCIENTIFIC	2566	THERMOCOUPLE SCANNER, 12-(	11/7/2017

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403149154	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	024076	Model:	08516-96	Type Data:	Found-left
Serial No.:	24076	Type:	Thermocouple Type K	Cal Date:	24-Jul-17
Remarks: a reading exceeded 70% of limits. No adjustment possible.					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Temperature	°C	°C	°C	°C	°C		
	-39.9	-38.1	1.8	2.2	0.5	Pass	82%
	200.5	200.7	0.2	2.2	0.5	Pass	9%
	396.7	397.8	1.1	3.0	1.3	Pass	37%
	749.7	750.4	0.7	5.6	1.3	Pass	12%
	1002.2	1000.6	-1.6	7.5	1.3	Pass	21%

END OF REPORT

010049

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	68159
Asset Number:	012017	Calibrated:	2/20/2017
Description:	CALIBRATOR, TEMPERATURE	Calibration Due:	2/20/2018
Manufacturer:	FLUKE	Data Type:	FOUND / LEFT
Model Number:	724	Temp./RH:	72.7°F / 41 %
Serial Number:	8776066	Work Order #	403145514
Calibration Procedure:	FLUKE 724, 725, 726		

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Remarks:
Ohm source not calibrated below 240 Ohms per customer.

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
011729	FLUKE	8508A-01	MULTIMETER, REFERENCE	2/7/2018
021436	FLUKE	5522A	MULTI-PRODUCT CALIBRATOR	11/2/2017

Authorized Signatory

Calibrated By: COM
Metrology Technician

010050

Southwest Research Institute
Calibration Laboratory
Measurement Report.

Work Order:	403145514	Mfr:	Fluke	Technician:	COM
Asset No:	012017	Model:	724	Type Data:	Found-left
Serial No:	8776066	Type:	Calibrator	Cal Date:	20-Feb-17

Remarks: Ohm source not calibrated below 240 Ohms per customer.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
V DC Measure	V	V	V	V	V		
Upper Display	0	0.000	0.000	0.002	0.0012	Pass	0%
	15	15.001	0.001	0.005	0.0013	Pass	20%
	30	30.002	0.002	0.008	0.0013	Pass	25%
mV DC Measure	mV	mV	mV	mV	mV		
Lower Display	0	0.00	0.00	0.02	0.012	Pass	0%
	50	49.99	-0.01	0.03	0.013	Pass	33%
	89	88.99	-0.01	0.04	0.013	Pass	25%
V DC Measure	V	V	V	V	V		
Lower Display	0	0.000	0.000	0.002	0.0012	Pass	0%
	10	9.999	-0.001	0.004	0.0013	Pass	25%
	20	19.998	-0.002	0.006	0.0013	Pass	33%
mA DC Measure	mA	mA	mA	mA	mA		
Upper Display	4	4.001	0.001	0.003	0.0014	Pass	33%
	12	12.003	0.003	0.005	0.0020	Pass	60%
	24	24.004	0.004	0.007	0.0033	Pass	57%
Resistance	Ω	Ω	Ω	Ω	Ω		
4-Wire Measure	15	14.98	-0.02	0.10	0.01	Pass	20%
Lower Display	350	349.99	-0.01	0.10	0.036	Pass	10%
	500	500.0	0.0	0.5	0.10	Pass	0%
	1500	1500.0	0.0	0.5	0.12	Pass	0%
	3200	3200.1	0.1	1.0	0.20	Pass	10%
3-Wire RTD	Ω	Ω	Ω	Ω	Ω		
Lower Display	350	349.97	-0.03	0.20	0.036	Pass	15%
Type J TC Measure	°C	°C	°C	°C	°C		
Lower Display	0	0.0	0.0	0.7	0.22	Pass	0%
Type J TC Source	°C	°C	°C	°C	°C		
Lower Display	0	-0.03	-0.03	0.70	0.17	Pass	4%
mV DC Source	mV	mV	mV	mV	mV		
Lower Display	0	-0.002	-0.002	0.020	0.0004	Pass	10%
	45	44.999	-0.001	0.030	0.002	Pass	4%
	100	99.999	-0.001	0.040	0.002	Pass	3%

Southwest Research Institute
Calibration Laboratory
Measurement Report.

Work Order:	403145514	Mfr:	Fluke	Technician:	COM
Asset No:	012017	Model:	724	Type Data:	Found-left
Serial No:	8776066	Type:	Calibrator	Cal Date:	20-Feb-17

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
V DC Source	V	V	V	V	V		
Lower Display	0	0.0000	0.0000	0.0020	0.00001	Pass	1%
	5	4.9999	-0.0001	0.0030	0.00006	Pass	2%
	10	9.9999	-0.0001	0.0040	0.00006	Pass	3%
Resistance Source	Ω	Ω	Ω	Ω	Ω		
Lower Display	15	n/a	#VALUE!	0.100	0.006	######	######
	360	360.067	0.067	0.100	0.006	Pass	67%
	500	500.11	0.11	0.50	0.04	Pass	22%
	1500	1500.12	0.12	0.50	0.04	Pass	24%
	3200	3200.17	0.17	1.00	0.07	Pass	17%

END OF REPORT

010052

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	69553
Asset Number:	022939	Calibrated:	3/13/2017
Description:	DIGITAL THERMOMETER	Calibration Due:	3/13/2018
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	20250-02	Temp./RH:	77.5°F / 38 %
Serial Number:	150709148	Work Order #	403145800
Calibration Procedure:	DIGITAL THERMOMETERS-MO		

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Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
017979	FLUKE	525B	CALIBRATOR, TEMPERATURE/PF	9/20/2017

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403145800	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022939	Model:	20250-02	Type Data:	Found-left
Serial No.:	150709148	Type:	Temperature Meter	Cal Date:	13-Mar-17

Remarks: Due to resolution of the unit, limits are rounded up.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
T1	°F	°F	°F	°F	°F		
Type K	-300.0	-298.5	1.5	5.1	0.8	Pass	29%
	390.0	392.2	2.2	3.8	0.6	Pass	58%
	1075	1077	2	7	0.3	Pass	29%
	1760	1764	4	11	0.3	Pass	36%
	2450	2452	2	14	1.0	Pass	14%
	°C	°C	°C	°C	°C		
	-150.0	-149.2	0.8	2.7	0.5	Pass	30%
	210.0	211.0	1.0	2.1	0.3	Pass	48%
	575.0	576.5	1.5	3.9	0.3	Pass	38%
	940.0	941.8	1.8	5.7	0.3	Pass	32%
	1350	1351	1	8	1.0	Pass	13%
T2	°F	°F	°F	°F	°F		
Type K	-300.0	-298.6	1.4	5.1	0.8	Pass	27%
	390.0	391.0	1.0	3.8	0.6	Pass	26%
	1075	1075	0	7	1.0	Pass	0%
	1760	1761	1	11	1.0	Pass	9%
	2450	2451	1	14	1.0	Pass	7%
	°C	°C	°C	°C	°C		
	-150.0	-149.4	0.6	2.7	0.5	Pass	22%
	210.0	210.5	0.5	2.1	0.3	Pass	24%
	575.0	575.6	0.6	3.9	0.3	Pass	15%
	940.0	940.4	0.4	5.7	0.3	Pass	7%
	1350	1350	0	8	1.0	Pass	0%

END OF REPORT

010054

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	69553
Asset Number:	022939	Calibrated:	3/13/2017
Description:	DIGITAL THERMOMETER	Calibration Due:	3/13/2018
Manufacturer:	DIGI-SENSE	Data Type:	FOUND / LEFT
Model Number:	20250-02	Temp./RH:	77.5°F / 38 %
Serial Number:	150709148	Work Order #	403145800
Calibration Procedure:	DIGITAL THERMOMETERS-MO		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
017979	FLUKE	525B	CALIBRATOR, TEMPERATURE/PF	9/20/2017

Authorized Signatory

Calibrated By: MAR
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403145800	Mfr:	Digi-Sense	Technician:	Mark Romero
Asset No.:	022939	Model:	20250-02	Type Data:	Found-left
Serial No.:	150709148	Type:	Temperature Meter	Cal Date:	13-Mar-17

Remarks: Due to resolution of the unit, limits are rounded up.

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
T1	°F	°F	°F	°F	°F		
Type K	-300.0	-298.5	1.5	5.1	0.8	Pass	29%
	390.0	392.2	2.2	3.8	0.6	Pass	58%
	1075	1077	2	7	0.3	Pass	29%
	1760	1764	4	11	0.3	Pass	36%
	2450	2452	2	14	1.0	Pass	14%
	°C	°C	°C	°C	°C		
	-150.0	-149.2	0.8	2.7	0.5	Pass	30%
	210.0	211.0	1.0	2.1	0.3	Pass	48%
	575.0	576.5	1.5	3.9	0.3	Pass	38%
	940.0	941.8	1.8	5.7	0.3	Pass	32%
	1350	1351	1	8	1.0	Pass	13%
T2	°F	°F	°F	°F	°F		
Type K	-300.0	-298.6	1.4	5.1	0.8	Pass	27%
	390.0	391.0	1.0	3.8	0.6	Pass	26%
	1075	1075	0	7	1.0	Pass	0%
	1760	1761	1	11	1.0	Pass	9%
	2450	2451	1	14	1.0	Pass	7%
	°C	°C	°C	°C	°C		
	-150.0	-149.4	0.6	2.7	0.5	Pass	22%
	210.0	210.5	0.5	2.1	0.3	Pass	24%
	575.0	575.6	0.6	3.9	0.3	Pass	15%
	940.0	940.4	0.4	5.7	0.3	Pass	7%
	1350	1350	0	8	1.0	Pass	0%

END OF REPORT

010056

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
Certificate # 3759.01

Cost Center:	01 CHEMISTRY & CHEMICAL ENGINEERING	Certificate Number:	67887
Asset Number:	022921	Calibrated:	2/14/2017
Description:	TIMER	Calibration Due:	2/14/2018
Manufacturer:	FISHER SCIENTIFIC	Data Type:	FOUND / LEFT
Model Number:	14-649-55	Temp./RH:	72.7°F / 42 %
Serial Number:	80494146	Work Order #	403145404
Calibration Procedure:	STOPWATCHES & TIMERS		

This certificate documents traceability to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other national metrology institute. The laboratory quality system is compliant to ISO/IEC 17025 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of ISO 9001-2008. This certificate shall not be reproduced, except in full, without written approval of Southwest Research Institute Calibration Laboratory and shall not be used to claim product endorsement by SwRI® or any agency of the U.S. Government.

Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability. Date due for recalibration is determined by the customer and does not imply the instrument will remain within limits, as any number of factors may cause an out of tolerance condition before this date.

Data type shall be interpreted as follows: Found-left - data recorded and no adjustment or repair was performed. As-left - data recorded after adjustment or repair was performed. As-found data are reviewed and the customer notified when the as-found results are other than pass and/or greater than 70 percent of the test limit. Pass? or Fail? indicate the measured value, plus or minus the expanded uncertainty, overlap the test limit and it is not possible to state Pass or Fail with a 95% confidence level. No statement of compliance with manufacturer or other specification is made or implied by this certificate. The customer has sole responsibility for determination of in/out-of-tolerance or compliance/noncompliance for the intended use of the instrument.

Measurement uncertainties are calculated in accordance with the methods described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM) as an expanded uncertainty with a coverage factor of k = 2 to approximately a 95% level of confidence. See Remarks or attached Measurement Report with the same Work Order number for data.

Remarks:

Standards Used To Calibrate Equipment

Asset	Manufacturer	Model	Description	Cal. Due Date
009759	FLUKE	910R	RUBIDIUM GPS FREQUENCY STA	7/15/2017

Authorized Signatory

Calibrated By: CER
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	403145404	Mfr:	Fisher Scientific	Technician:	CER
Asset No.:	022921	Model:	14-649-55	Type Data:	Found/Left
Serial No.:	80494146	Type:	Timer	Cal Date:	14-Feb-17
Remarks:					

Function/Range	Test Point	TI Reading	Difference	± Limit	± Uncertainty	Result	% Limit
Time Interval	Seconds	Seconds	Seconds	Seconds	Seconds		
	11580	11579	-1	2	1	Pass	50%
	13440	13439	-1	2	1	Pass	50%

END OF REPORT

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170824-1
SwRI SRR: 60216
SDG: 619429
VTSR: 08.04.2017

Certificates of Analysis for Chemicals

SIGMA-ALDRICH®
3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBQ1780V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	10 JUN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	WHITE	WHITE
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	98.0 - 102.0 %	99.6 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
ACS SPECIFICATIONS	MEETS REQUIREMENTS OF ACS 10TH ED	CORRESPONDS TO ACS (10TH ED.)
REMARKS ON ACS	INSOLUBLE MATTER ≤ 0.005 % HEAVY METALS (AS PB) ≤ 0.001 %	INSOLUBLE MATTER < 0.005 % HEAVY METALS (AS PB) < 0.001 %
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 20 MG/KG	< 20 MG/KG
POTASSIUM (ICP)	≤ 20 MG/KG	< 20 MG/KG
MAGNESIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 10 MG/KG	< 10 MG/KG

Claudia Geitner

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65579
SwRI Chem ID: 65579
SwRI Chem ID: 65579

SwRI Chem ID: 65736

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate - ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

SwRI Chem ID: 65736

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

SwRI Chem ID: 65736

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SwRI Chem ID: 65736

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Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 65736

SwRI Chem ID: 65736

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SwRI Chem ID: 63614

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Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate - ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

SwRI Chem ID: 63614

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

SwRI Chem ID: 63614

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SwRI Chem ID: 63614

SwRI Chem ID: 63614

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Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 63614

SwRI Chem ID: 63614

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SwRI Chem ID: 65735

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Certificate of Analysis

Product Name:
Calcium nitrate tetrahydrate – ACS reagent, 99%

$Ca(NO_3)_2 \cdot 4H_2O$

Product Number:	**237124**
Batch Number:	**MKBP5435V**
Brand:	SIAL
CAS Number:	13477-34-4
MDL Number:	MFCD00149604
Formula:	CaN2O6 · 4H2O
Formula Weight:	236.15 g/mol
Quality Release Date:	25 JUN 2013
Recommended Retest Date:	MAY 2016

SwRI Chem ID: 65735

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Granular Powder or Crystals or Flakes	Conforms to Requirements	Crystals
Complexometric EDTA	99.0 - 103.0 %	100.0 %
X-Ray Diffraction	Conforms to Structure	Conforms
pH c = 5%, Water, 25 Deg C	5.0 - 7.0	5.3
Insoluble matter c = 10%, Water	≤ 0.005 %	0.001 %
Chloride Content	≤ 0.005 %	< 0.005 %
Nitrite	≤ 0.001 %	< 0.001 %
Sulfate (SO4)	≤ 0.002 %	< 0.002 %
Barium	≤ 0.005 %	< 0.001 %
Heavy Metals as Pb	≤ 5.0 ppm	< 4.7 ppm
Iron (Fe)	≤ 5.0 ppm	< 0.4 ppm
Magnesium (Mg)	≤ 0.05 %	< 0.01 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.01 %	< 0.01 %
Strontium (Sr)	≤ 0.05 %	0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

SwRI Chem ID: 65735

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65735

SwRI Chem ID: 65735

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Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

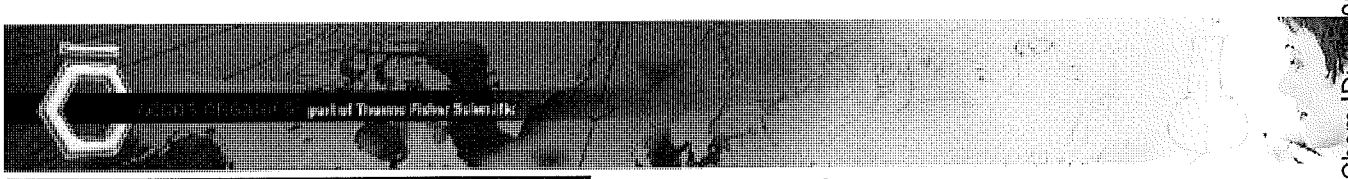
Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 65735

SwRI Chem ID: 65735

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ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

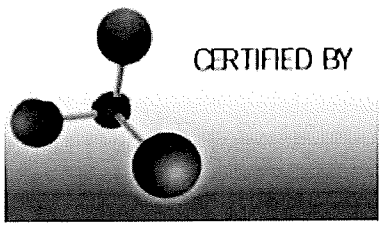
This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608

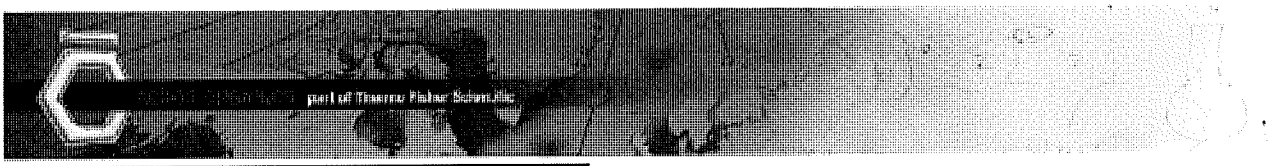


CERTIFIED BY

L. Van den Broek, QA Manager Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608



SwRI Chem ID: 63857

ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

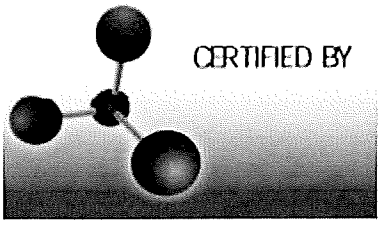
Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	dark purple to black crystalline chunks	black crystalline chunks
Titration Iodometric	>=98.5 %	101.9 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Trace analysis	Type: Ca measure =< 50 PPM	Type: Ca measure 5 PPM
Trace analysis	Type: Cd measure =< 10 PPM	Type: Cd measure 3 PPM
Trace analysis	Type: Co measure =< 10 PPM	Type: Co measure 5 PPM
Trace analysis	Type: Cu measure =< 10 PPM	Type: Cu measure 7 PPM
Trace analysis	Type: Fe measure =< 200 PPM	Type: Fe measure 178 PPM
Trace analysis	Type: Mg measure =< 50 PPM	Type: Mg measure 6 PPM
Trace analysis	Type: Mn measure =< 10 PPM	Type: Mn measure 7 PPM
Trace analysis	Type: Na measure =< 50 PPM	Type: Na measure 17 PPM
Trace analysis	Type: Ni measure =< 50 PPM	Type: Ni measure 8 PPM
Trace analysis	Type: Pb measure =< 20 PPM	Type: Pb measure 4 PPM
Trace analysis	Type: Sr measure =< 50 PPM	Type: Sr measure 11 PPM
Trace analysis	Type: Zn measure =< 10 PPM	Type: Zn measure 4 PPM
Trace analysis	Type: Cl measure =< 20 PPM	Type: Cl measure =< 20 PPM
Trace analysis	Type: SO4 measure =< 50 PPM	Type: SO4 measure =< 50 PPM
Trace analysis	Type: NH4 measure =< 10 PPM	Type: NH4 measure =< 10 PPM
Subst not pptd by NH4OH	=<0.2 % (as SO4)	=<0.0077 % (as SO4)

SwRI Chem ID: 63857

SwRI Chem ID: 63857



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L. Van den Broek, QA Manager Issued: 28 October 2015

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SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857

SwRI Chem ID: 65581

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Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBW6908V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	16 OCT 2015

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Michael Grady, Manager
Quality Control
Milwaukee, WI US

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SwRI Chem ID: 65581

SwRI Chem ID: 65581

SwRI Chem ID: 63604

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Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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SwRI Chem ID: 63604

SwRI Chem ID: 63604

SwRI Chem ID: 65737

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Certificate of Analysis

Product Name:
Magnesium nitrate hexahydrate – ACS reagent, 99%

$Mg(NO_3)_2 \cdot 6H_2O$

Product Number:	**237175**
Batch Number:	**MKBX1623V**
Brand:	SIAL
CAS Number:	13446-18-9
MDL Number:	MFCD00149779
Formula:	MgN2O6 · 6H2O
Formula Weight:	256.41 g/mol
Quality Release Date:	10 DEC 2015

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Chips or Crystals	Conforms to Requirements	Crystals
X-Ray Diffraction	Conforms to Structure	Conforms
Complexometric EDTA	98.0 - 102.0 %	99.8 %
Insoluble Matter C= 10%, H2O	≤ 0.005 %	< 0.005 %
Barium	≤ 0.005 %	< 0.005 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Chloride Content	≤ 0.001 %	< 0.001 %
Iron (Fe)	≤ 5 ppm	< 5 ppm
Heavy Metals as Pb	≤ 5 ppm	< 1 ppm
Potassium (K)	≤ 0.005 %	< 0.005 %
Manganese (Mn)	≤ 5 ppm	< 5 ppm
Sodium (Na)	≤ 0.005 %	< 0.005 %
Ammonia (NH4)	≤ 0.003 %	< 0.003 %
pH C= 5%, H2O @ 25 Deg C	5.0 - 8.2	5.0
Phosphate (PO4)	≤ 5 ppm	< 5 ppm
Strontium (Sr)	≤ 0.005 %	< 0.005 %
Sulfate (SO4)	≤ 0.005 %	< 0.005 %

SwRI Chem ID: 65737

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SwRI Chem ID: 65737

SwRI Chem ID: 65737

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Certificate of Analysis

Product Number: 237175
Batch Number: MKBX1623V

Test	Specification	Result
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

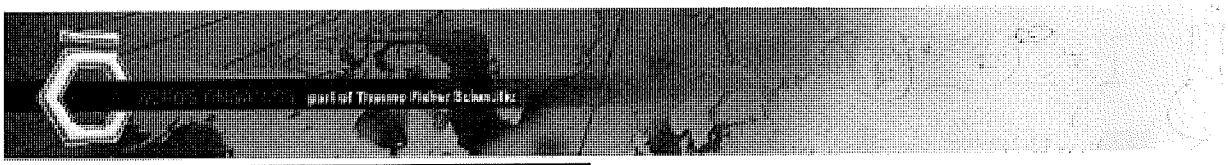
Michael Grady, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 65737

SwRI Chem ID: 65737

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SwRI Chem ID: 69602



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

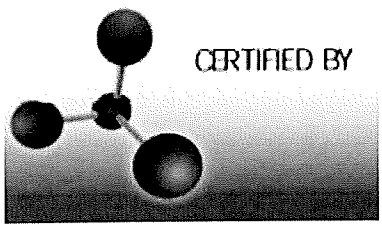
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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



L. Van den Broek, QA Manager

Issued: 25 April 2016

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SwRI Chem ID: 69602

SwRI Chem ID: 69602



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

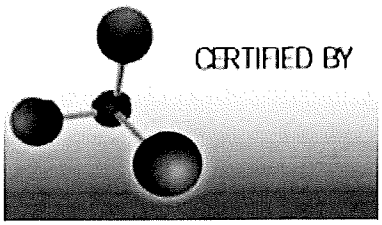
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Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69610
SwRI Chem ID: 69610
SwRI Chem ID: 69610



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L. Van den Broek, QA Manager

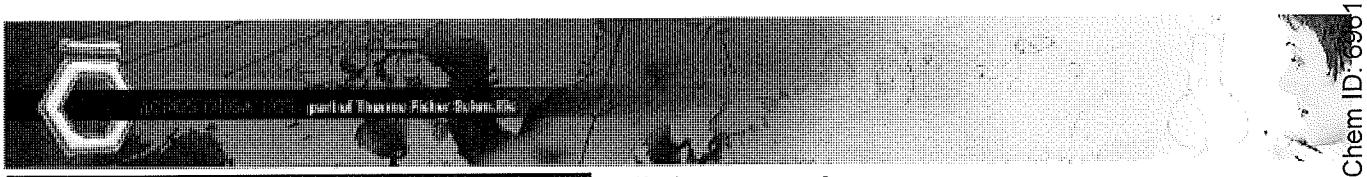
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SwRI Chem ID: 69610

SwRI Chem ID: 69610

SwRI Chem ID: 69610



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

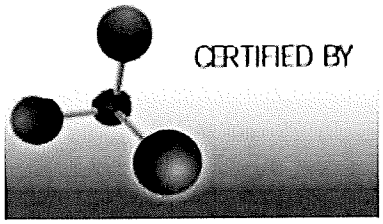
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Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69611
SwRI Chem ID: 69611
SwRI Chem ID: 69611



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SwRI Chem ID: 69611

SwRI Chem ID: 69611

SwRI Chem ID: 69611

SwRI Chem ID: 66142

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

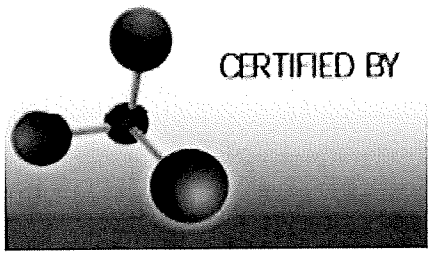
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



L. Van den Broek, QA Manager

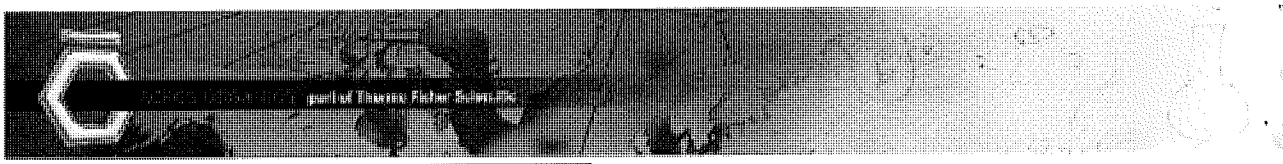
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SwRI Chem ID: 66142

SwRI Chem ID: 66142

SwRI Chem ID: 65951



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

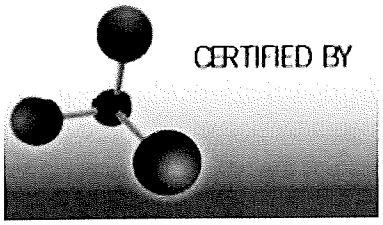
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 7 January 2016

Acros Organics
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SwRI Chem ID: 65951

SwRI Chem ID: 65951



ACROS ORGANICS

Version	0
Molecular weight	126.04
Molecular formula	C2 H2 O4 . 2 H2 O
CAS No	6153-56-6
Linear formula	HO2CCO2H.2H2O
Flash point (°C)	

Certificate of Analysis

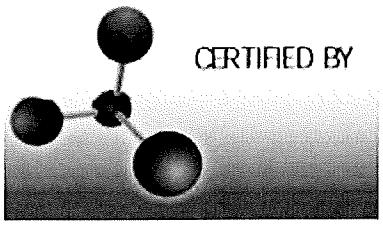
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Catalog Number	42315	**Quality Test / Release Date**	10 December 2014
Lot Number	A0354614	**Suggested Retest Date**	December 2019
Description	Oxalic acid dihydrate,99.5+%,ACS reagent		
Country of Origin	SPAIN		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystals
Infrared spectrometry	authentic	authentic
Assay Titrimetry	99.5 to 102.5 %	99.9 %
Heavy metals (as Pb)	=<5 ppm	=<2.5 ppm
Residue after ignition	=<0.01 %	0.004 %
Nitrogen compounds (as N)	=<0.001 %	=<0.001 %
Trace analysis	Type: Cl measure =< 20 ppm	Type: Cl measure < 5 ppm
Trace analysis	Type: SO4 measure =< 50 ppm	Type: SO4 measure < 20 ppm
Trace analysis	Type: Ca measure =< 10 ppm	Type: Ca measure < 1 ppm
Trace analysis	Type: Fe measure =< 2 ppm	Type: Fe measure < 2 ppm
Insoluble matter	=<0.005 %	=<0.005 %
Substance darkened by H2SO4	passes test	passes test

SwRI Chem ID: 69684
SwRI Chem ID: 69684
SwRI Chem ID: 69684



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 27 April 2016

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SwRI Chem ID: 69684
SwRI Chem ID: 69684
SwRI Chem ID: 69684

SwRI Chem ID: 63914

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Certificate of Analysis

Product Name:
Potassium carbonate - ACS reagent, ≥99.0%

K_2CO_3

Product Number:	**209619**
Batch Number:	**SLBM3461V**
Brand:	SIAL
CAS Number:	584-08-7
MDL Number:	MFCD00011382
Formula:	CK2O3
Formula Weight:	138.21 g/mol
Quality Release Date:	28 JAN 2015
Recommended Retest Date:	JAN 2018

Test	Specification	Result
Assay	≥ 99.0 %	99.8 %
Insoluble Matter < or = 0.01%	Pass	Pass
Chloride (Cl) < or = 0.003%	Pass	Pass
Phosphate (PO4) < or = 0.001%	Pass	Pass
Silica < or = 0.005%	Pass	Pass
Sulfur coumpounds < or = 0.004%	Pass	Pass
Calcium < or = 0.005%	Pass	Pass
Magnesium < or = 0.002%	Pass	Pass
Sodium < or = 0.02%	Pass	Pass
Iron (Fe) < or = 5 ppm	Pass	Pass
Heavy Metals (as Lead)	< = 5 ppm	< 5 ppm

SwRI Chem ID: 63914

SwRI Chem ID: 63914

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SwRI Chem ID: 63914

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Certificate of Analysis

Product Number: 209619
Batch Number: SLBM3461V

Rodney Burbach, Manager
Analytical Services
St. Louis, Missouri US

SwRI Chem ID: 63914

SwRI Chem ID: 63914

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

Fisher Scientific

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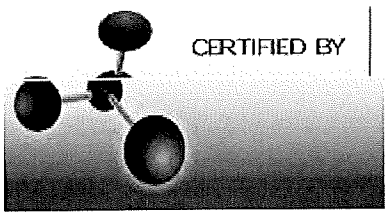
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	P208	**Quality Test / Release Date**	3/2/2016
Lot Number	161550		
Description	POTASSIUM CARBONATE, ANHYDROUS, A.C.S.		
Country of Origin	India	*** Suggested Retest Date**	Mar-2021
Chemical Origin	Inorganic-non animal		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	White granular powder
ASSAY	%	>= 99.0	99.6
CALCIUM	%	<= 0.005	0.003
CHLORIDE	%	<= 0.003	<0.0030
HEAVY METALS (as Pb)	ppm	<= 5	<5.0
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.01	<0.010
IRON (Fe)	ppm	<= 5	<5.0
MAGNESIUM	%	<= 0.002	<0.0020
PHOSPHATE (PO4)	%	<= 0.001	<0.0010
SILICA (SiO2)	%	<= 0.005	<0.005
SODIUM (Na)	%	<= 0.02	0.002
SULFUR COMPOUNDS	%	<= 0.004	<0.0040



Quality Control Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69660
SwRI Chem ID: 69660
SwRI Chem ID: 69660

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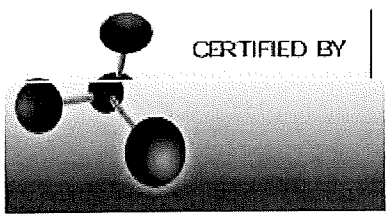
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69597
SwRI Chem ID: 69597
SwRI Chem ID: 69597

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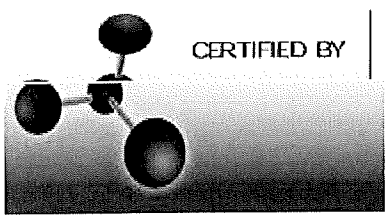
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69596
SwRI Chem ID: 69596
SwRI Chem ID: 69596

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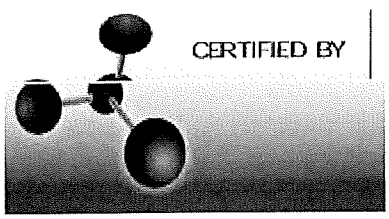
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Catalog Number	A586	Quality Test / Release Date	3/10/2015
Lot Number	151052		
Description	ALUMINUM NITRATE, A.C.S.		
Country of Origin	India	* Suggested Retest Date	Mar-2020

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69595
SwRI Chem ID: 69595
SwRI Chem ID: 69595

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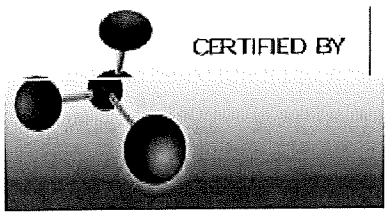
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69594
SwRI Chem ID: 69594
SwRI Chem ID: 69594

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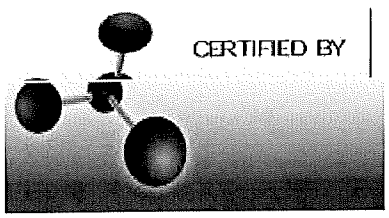
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SwRI Chem ID: 69593

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69593



Elyse E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69593

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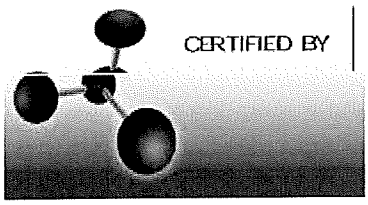
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69592
SwRI Chem ID: 69592
SwRI Chem ID: 69592

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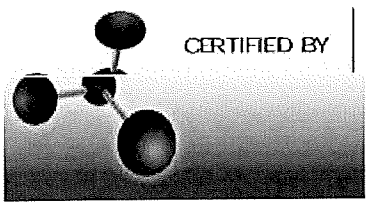
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69573
SwRI Chem ID: 69573
SwRI Chem ID: 69573

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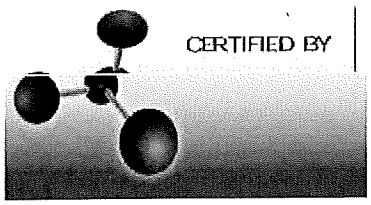
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005



Elyse E. Hess

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69572
SwRI Chem ID: 69572
SwRI Chem ID: 69572

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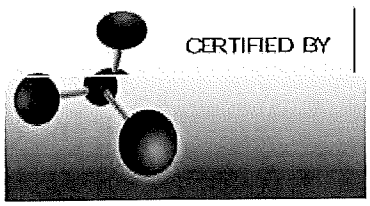
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/25/2015**
Lot Number	**151702**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Colorless crystals
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	0.002
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	<0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0015
SODIUM (Na)	%	<= 0.005	0.0024
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hau

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69571
SwRI Chem ID: 69571
SwRI Chem ID: 69571

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

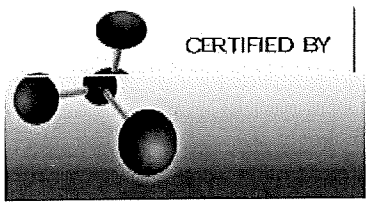
Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Edgar E. Hans

Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69591
SwRI Chem ID: 69591
SwRI Chem ID: 69591

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

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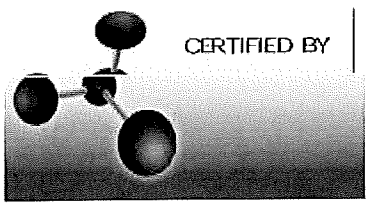
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

SwRI Chem ID: 69590

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69590



Elyse E. Hess

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69590

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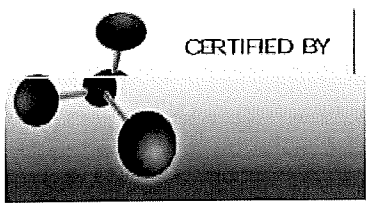
Certificate of Analysis

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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005



Lab Manager Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as a extension of this catalog number listed above. If there are any questions with this certificate, please call Chemical Services at (800) 227-6701.
*Based on suggested storage condition.

SwRI Chem ID: 69589
SwRI Chem ID: 69589
SwRI Chem ID: 69589

Fisher Scientific

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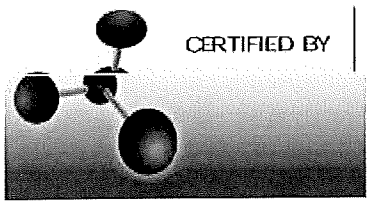
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

SwRI Chem ID: 69588

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69588



Lab Manager Fair Lawn

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SwRI Chem ID: 69588

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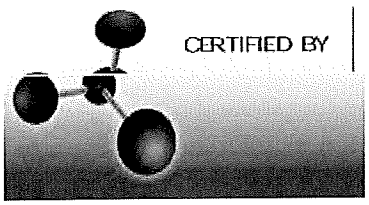
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Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

SwRI Chem ID: 69587

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69587



Elyse E. Hess

Lab Manager Fair Lawn

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SwRI Chem ID: 69587

Fisher Scientific

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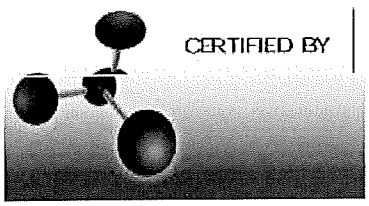
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SwRI Chem ID: 69586

Catalog Number	**A586**	**Quality Test / Release Date**	**3/10/2015**
Lot Number	**151052**		
Description	**ALUMINUM NITRATE, A.C.S.**		
Country of Origin	**India**	*** Suggested Retest Date**	**Mar-2020**

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	COLOLRESS CRYSTALS
ASSAY	%	Inclusive Between 98.0 - 102.0	99.2
CALCIUM (Ca)	%	<= 0.005	0.0010
CHLORIDE	%	<= 0.001	<0.0010
HEAVY METALS (as Pb)	%	<= 0.001	<0.0010
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
INSOLUBLE MATTER	%	<= 0.005	<0.005
IRON (Fe)	%	<= 0.002	<0.0020
MAGNESIUM (Mg)	%	<= 0.001	0.0010
PH 5% SOLUTION @ 25 DEG C		Inclusive Between 2.5 - 3.5	3.0
POTASSIUM (K)	%	<= 0.002	0.0020
SODIUM (Na)	%	<= 0.005	0.0020
SULFATE (SO4)	%	<= 0.005	<0.005

SwRI Chem ID: 69586

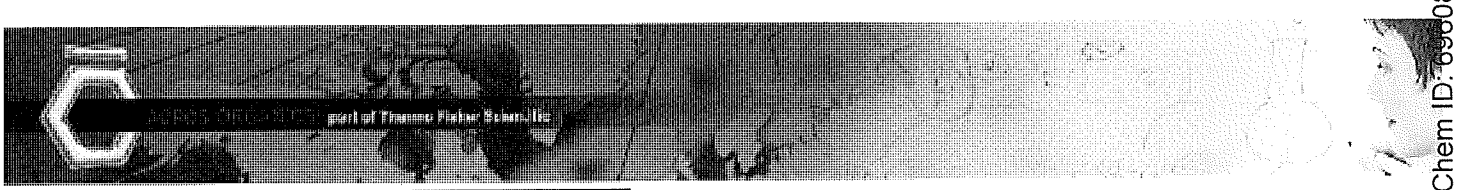


Edgar E. Hau

Lab Manager Fair Lawn

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*Based on suggested storage condition.

SwRI Chem ID: 69586



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

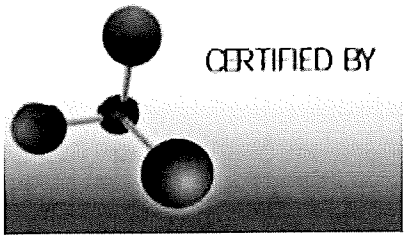
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Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69608
SwRI Chem ID: 69608
SwRI Chem ID: 69608



CERTIFIED BY

L. Van den Broek, QA Manager

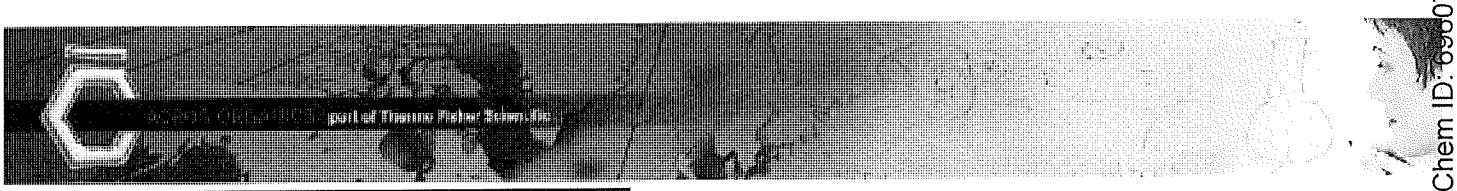
Issued: 25 April 2016

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69608

SwRI Chem ID: 69608

SwRI Chem ID: 69608



ACROS ORGANICS

Version	0
Molecular weight	236.15
Molecular formula	Ca N2 O6 . 4 H2 O
CAS No	13477-34-4
Linear formula	Ca(NO3)2.4H2O
Flash point (°C)	

Certificate of Analysis

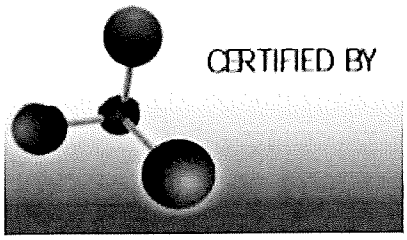
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Catalog Number	42353	**Quality Test / Release Date**	27 January 2016
Lot Number	A0369187	**Suggested Retest Date**	January 2021
Description	Calcium nitrate tetrahydrate,99+%,ACS reagent		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration Complexometric	99.0 to 103.0 %	100.6 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
pH	5.0 to 7.0 (5 % at 25°C)	5.9 (5 % at 25°C)
Insoluble matter	=<0.005 %	=<0.005 %
Chloride (Cl)	=<50 ppm	=<50 ppm
Sulfate (SO4)	=<20 ppm	1 ppm
Barium (Ba)	=<50 ppm	=<5 ppm
Iron (Fe)	=<5 ppm	=<5 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)
Magnesium (Mg)	=<500 ppm	9 ppm
Potassium (K)	=<50 ppm	20 ppm
Sodium (Na)	=<100 ppm	4 ppm
Strontium (Sr)	=<500 ppm	2 ppm

SwRI Chem ID: 69607
SwRI Chem ID: 69607
SwRI Chem ID: 69607



CERTIFIED BY

L. Van den Broek, QA Manager

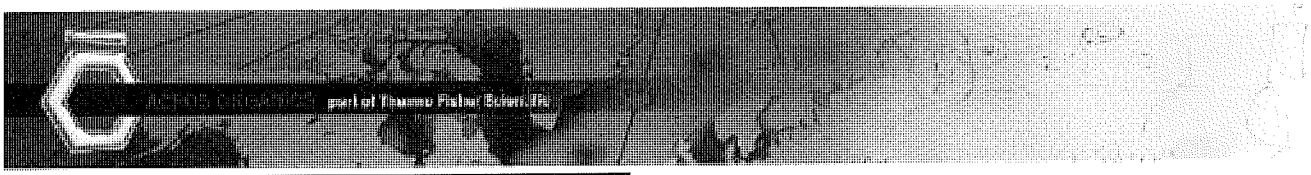
Issued: 25 April 2016

Acros Organics
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Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69607

SwRI Chem ID: 69607

SwRI Chem ID: 69607



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

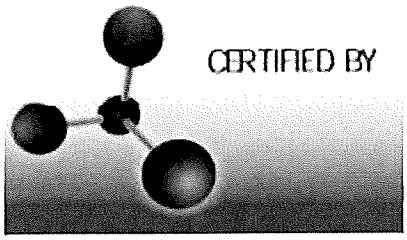
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Catalog Number	21920	**Quality Test / Release Date**	8 May 2015
Lot Number	A0359678	**Suggested Retest Date**	May 2020
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 ppm	2 ppm
Copper (Cu)	=<10 ppm	2.3 ppm
Iron (Fe)	=<200 ppm	158 ppm
Magnesium (Mg)	=<50 ppm	12 ppm
Manganese (Mn)	=<10 ppm	1 ppm
Sodium (Na)	=<50 ppm	12 ppm
Nickel (Ni)	=<50 ppm	18 ppm
Lead (Pb)	=<20 ppm	4 ppm
Strontium (Sr)	=<50 ppm	6.2 ppm
Zinc (Zn)	=<10 ppm	4.5 ppm
Chloride (Cl)	=<20 ppm	=<20 ppm
Sulfate (SO4)	=<50 ppm	=<50 ppm
Ammonium (NH4)	=<10 ppm	=<10 ppm
Subst not pptd by NH4OH	=<0.2 % (as SO4)	0.085 % (as SO4)

SwRI Chem ID: 66141
SwRI Chem ID: 66141
SwRI Chem ID: 66141

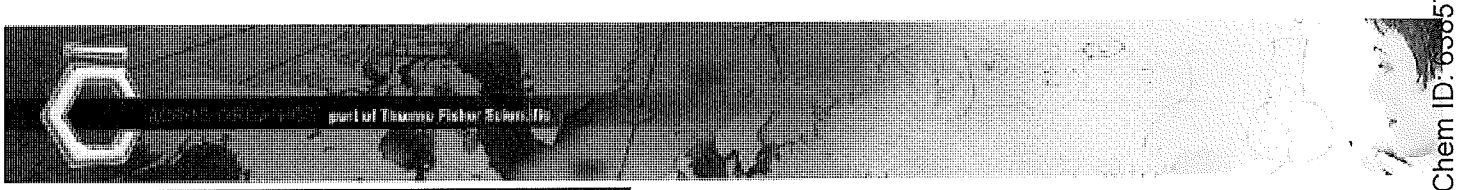


CERTIFIED BY

L. Van den Broek, QA Manager Issued: 14 January 2016

Acros Organics
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SwRI Chem ID: 66141
SwRI Chem ID: 66141
SwRI Chem ID: 66141



ACROS ORGANICS

Version	0
Molecular weight	400.14
Molecular formula	Cr N3 O9 . 9 H2 O
CAS No	7789-02-8
Linear formula	Cr(NO3)3.9H2O
Flash point (°C)	

Certificate of Analysis

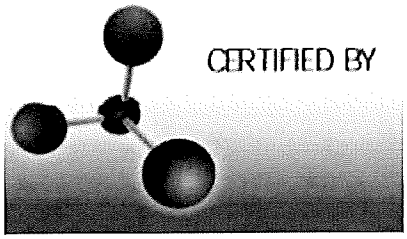
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Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	dark purple to black crystalline chunks	black crystalline chunks
Titration Iodometric	>=98.5 %	101.9 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Trace analysis	Type: Ca measure =< 50 PPM	Type: Ca measure 5 PPM
Trace analysis	Type: Cd measure =< 10 PPM	Type: Cd measure 3 PPM
Trace analysis	Type: Co measure =< 10 PPM	Type: Co measure 5 PPM
Trace analysis	Type: Cu measure =< 10 PPM	Type: Cu measure 7 PPM
Trace analysis	Type: Fe measure =< 200 PPM	Type: Fe measure 178 PPM
Trace analysis	Type: Mg measure =< 50 PPM	Type: Mg measure 6 PPM
Trace analysis	Type: Mn measure =< 10 PPM	Type: Mn measure 7 PPM
Trace analysis	Type: Na measure =< 50 PPM	Type: Na measure 17 PPM
Trace analysis	Type: Ni measure =< 50 PPM	Type: Ni measure 8 PPM
Trace analysis	Type: Pb measure =< 20 PPM	Type: Pb measure 4 PPM
Trace analysis	Type: Sr measure =< 50 PPM	Type: Sr measure 11 PPM
Trace analysis	Type: Zn measure =< 10 PPM	Type: Zn measure 4 PPM
Trace analysis	Type: Cl measure =< 20 PPM	Type: Cl measure =< 20 PPM
Trace analysis	Type: SO4 measure =< 50 PPM	Type: SO4 measure =< 50 PPM
Trace analysis	Type: NH4 measure =< 10 PPM	Type: NH4 measure =< 10 PPM
Subst not pptd by NH4OH	=<0.2 % (as SO4)	=<0.0077 % (as SO4)

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857



CERTIFIED BY

L. Van den Broek, QA Manager Issued: 28 October 2015

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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 63857

SwRI Chem ID: 63857

SwRI Chem ID: 63857

SwRI Chem ID: 63604

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBT4080V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	09 DEC 2014

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	100.0 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	0.003 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Ali Ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 63604

SwRI Chem ID: 63604

SwRI Chem ID: 65582

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

Product Number:	**216828**
Batch Number:	**MKBW6908V**
Brand:	SIAL
CAS Number:	7782-61-8
MDL Number:	MFCD00149708
Formula:	FeN3O9 · 9H2O
Formula Weight:	404.00 g/mol
Quality Release Date:	16 OCT 2015

Test	Specification	Result
Appearance (Color) Off-White to Pale Purple	Conforms to Requirements	Off-White
Appearance (Form) Moist Crystals	Conforms to Requirements	Crystals
Infrared Spectrum	Conforms to Structure	Conforms
Titration by Na2S2O3	98.0 - 101.0 %	98.9 %
Insoluble Matter c = 10 %; Dilute HNO3	≤ 0.005 %	< 0.005 %
Chloride (Cl)	≤ 5 ppm	< 5 ppm
Sulfate (SO4)	≤ 0.01 %	< 0.01 %
Calcium (Ca)	≤ 0.01 %	< 0.01 %
Magnesium (Mg)	≤ 0.005 %	< 0.001 %
Potassium (K)	≤ 0.005 %	< 0.001 %
Sodium (Na)	≤ 0.05 %	< 0.01 %
Meets ACS Requirements Tenth Edition	Current ACS Specification	Conforms

Michael Grady, Manager
Quality Control
Milwaukee, WI US

Sigma-Aldrich warrants, that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current Specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65582

SwRI Chem ID: 65582



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

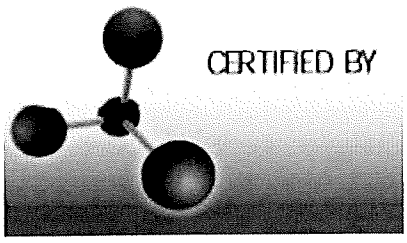
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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %

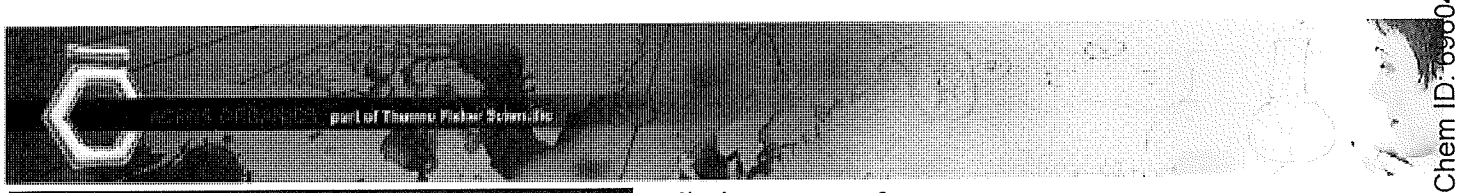


L. Van den Broek, QA Manager

Issued: 25 April 2016

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SwRI Chem ID: 69603
SwRI Chem ID: 69603
SwRI Chem ID: 69603



ACROS ORGANICS

Version	0
Molecular weight	256.40
Molecular formula	Mg N2 O6 . 6 H2 O
CAS No	13446-18-9
Linear formula	Mg(NO3)2.6H2O
Flash point (°C)	93.3

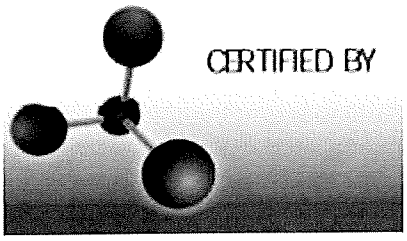
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Catalog Number	44754	**Quality Test / Release Date**	13 November 2014
Lot Number	A0353513	**Suggested Retest Date**	November 2019
Description	Magnesium nitrate hexahydrate,extra pure		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystals	white crystals
Titration Complexometric	98 to 102 %	100.3 %
pH	5 to 8.2 (5%,aq. soln.)	6 (5%,aq. soln.)
Heavy metals (as Pb)	=<0.001 %	=<0.0005 %
Chloride (Cl)	=<0.001 %	=<0.001 %
Iron (Fe)	=<0.001 %	=<0.0005 %
Sulfate (SO4)	=<0.005 %	=<0.005 %



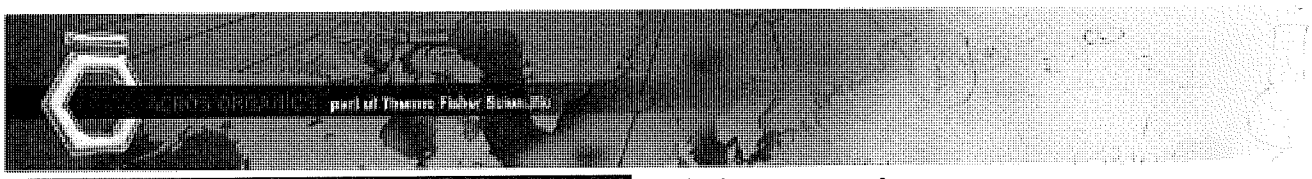
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SwRI Chem ID: 69604
SwRI Chem ID: 69604
SwRI Chem ID: 69604



ACROS ORGANICS

Version	0
Molecular weight	84.99
Molecular formula	N Na O3
CAS No	7631-99-4
Linear formula	NaNO3
Flash point (°C)	

Certificate of Analysis

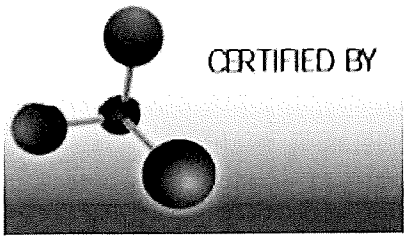
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Catalog Number	42434	**Quality Test / Release Date**	2 November 2015
Lot Number	A0365903	**Suggested Retest Date**	November 2020
Description	Sodium nitrate,99+%,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystals	Crystals
Titration after Ion exchange	>=99.0 %	100.2 %
Heavy metals (as Pb)	=<5 ppm	=<5 ppm
Insoluble matter	=<0.005 %	0.004 %
pH	5.5 to 8.3 (5% soln. at 25°C)	6.1 (5% soln. at 25°C)
Chloride (Cl)	=<10 ppm	7 ppm
Iodate (IO3)	=<5 ppm	ppm (none detected)
Phosphate (PO4)	=<5 ppm	=<5 ppm
Iron (Fe)	=<3 ppm	=<3 ppm
Sulfate (SO4)	=<30 ppm	10 ppm
Calcium (Ca)	=<50 ppm	1.4 ppm
Magnesium (Mg)	=<20 ppm	8 ppm
Nitrite (NO2)	=<10 ppm	ppm (none detected)

SwRI Chem ID: 69611
SwRI Chem ID: 69611
SwRI Chem ID: 69611



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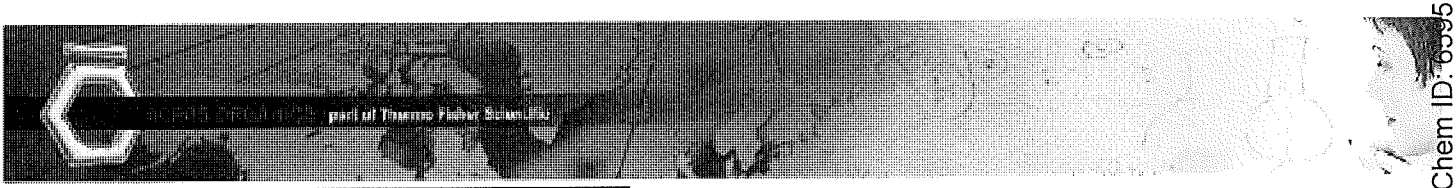
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SwRI Chem ID: 69611

SwRI Chem ID: 69611

SwRI Chem ID: 69611



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

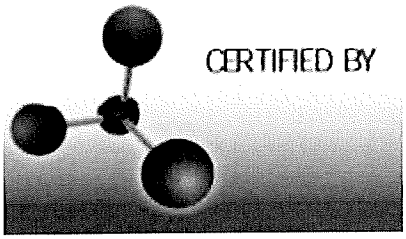
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



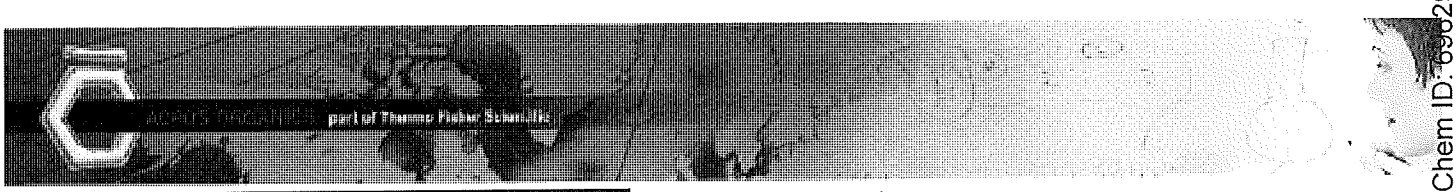
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Issued: 7 January 2016

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SwRI Chem ID: 65951
SwRI Chem ID: 65951
SwRI Chem ID: 65951



SwRI Chem ID: 69629

ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

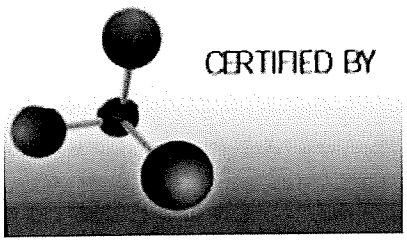
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



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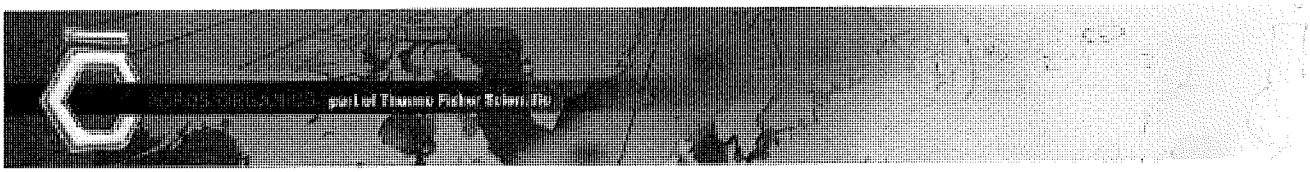
L. Van den Broek, QA Manager

Issued: 26 April 2016

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1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

SwRI Chem ID: 69629

SwRI Chem ID: 69629



ACROS ORGANICS

Version	0
Molecular weight	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

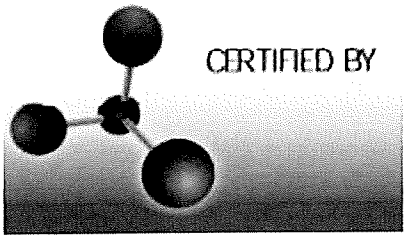
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Catalog Number	21156	**Quality Test / Release Date**	29 September 2015
Lot Number	A0364649	**Suggested Retest Date**	September 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance (Color)	White	White
Appearance (Form)	Crystalline powder	Crystalline powder
Titration Complexometric	>=99 %	99.9 %
Chloride (Cl)	=<10 ppm	=<10 ppm
Iron (Fe)	=<5 ppm	3.2 ppm



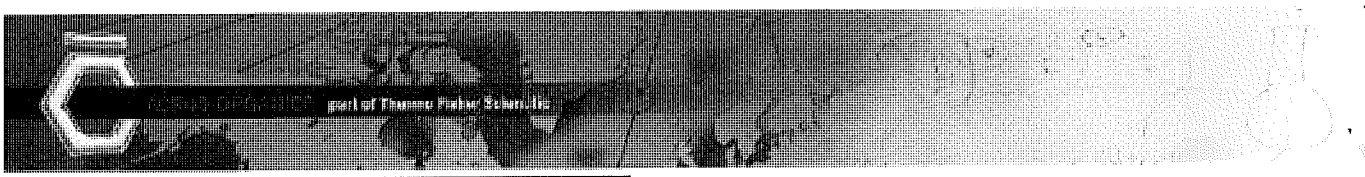
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L. Van den Broek, QA Manager

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SwRI Chem ID: 69628
SwRI Chem ID: 69628
SwRI Chem ID: 69628



ACROS ORGANICS

Version	0
Molecular weight	126.04
Molecular formula	C2 H2 O4 . 2 H2 O
CAS No	6153-56-6
Linear formula	HO2CCO2H.2H2O
Flash point (°C)	

Certificate of Analysis

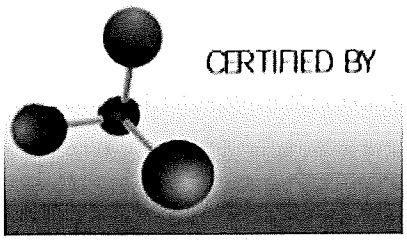
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Catalog Number	42315	**Quality Test / Release Date**	10 December 2014
Lot Number	A0354614	**Suggested Retest Date**	December 2019
Description	Oxalic acid dihydrate,99.5+%,ACS reagent		
Country of Origin	SPAIN		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	white crystalline powder	white crystals
Infrared spectrometry	authentic	authentic
Assay Titrimetry	99.5 to 102.5 %	99.9 %
Heavy metals (as Pb)	=<5 ppm	=<2.5 ppm
Residue after ignition	=<0.01 %	0.004 %
Nitrogen compounds (as N)	=<0.001 %	=<0.001 %
Trace analysis	Type: Cl measure =< 20 ppm	Type: Cl measure < 5 ppm
Trace analysis	Type: SO4 measure =< 50 ppm	Type: SO4 measure < 20 ppm
Trace analysis	Type: Ca measure =< 10 ppm	Type: Ca measure < 1 ppm
Trace analysis	Type: Fe measure =< 2 ppm	Type: Fe measure < 2 ppm
Insoluble matter	=<0.005 %	=<0.005 %
Substance darkened by H2SO4	passes test	passes test

SwRI Chem ID: 69684
SwRI Chem ID: 69684
SwRI Chem ID: 69684



CERTIFIED BY

L. Van den Broek, QA Manager

Issued: 27 April 2016

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SwRI Chem ID: 69684

SwRI Chem ID: 69684

SwRI Chem ID: 69684

SIGMA-ALDRICH®

3050 Spruce Street, Saint Louis, MO 63103 USA
Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:	NICKEL(II) NITRATE HEXAHYDRATE purum p.a., crystallized, >= 97.0 % KT
Product Number:	72253
Batch Number:	BCBP4160V
Brand:	Sigma-Aldrich
CAS Number:	13478-00-7
Formula:	$Ni(NO_3)_2 \bullet 6H_2O$
Formula Weight:	290.79
Quality Release Date:	26 JAN 2015

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	BLUE-GREEN TO DEEP BLUE-GREEN	BLUE-GREEN
APPEARANCE (FORM)	CRYSTALS	CRYSTALS
TITRATION (KT) EDTA 0.1M	97.0 - 103.0 %	97.0 %
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
CADMIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
COBALT (ICP)	≤ 500 MG/KG	< 500 MG/KG
COPPER (ICP)	≤ 50 MG/KG	< 50 MG/KG
IRON (ICP)	≤ 50 MG/KG	< 50 MG/KG
POTASSIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
SODIUM (ICP)	≤ 100 MG/KG	< 100 MG/KG
LEAD (ICP)	≤ 50 MG/KG	< 50 MG/KG
ZINC (ICP)	≤ 50 MG/KG	< 50 MG/KG
TOTAL SULFUR AS SO4 (ICP)	≤ 50 MG/KG	< 50 MG/KG
CHLORIDE (CL)	≤ 50 MG/KG	< 50 MG/KG

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

Sigma-Aldrich warrants that at the time of the quality release or subsequent retest date this product conformed to the information contained in this publication. The current specification sheet may be available at Sigma-Aldrich.com. For further inquiries, please contact Technical Service. Purchaser must determine the suitability of the product for its particular use. See reverse side of invoice or packing slip for additional terms and conditions of sale.

SwRI Chem ID: 65593
SwRI Chem ID: 65593
SwRI Chem ID: 65593

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

This is to certify that units of the above mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	**A509**	**Mfg. Date**	11/4/2015
Lot Number	**1115100**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

BSE/TSE Comment:	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.

Result Name	Units	Specifications	Test Value
.Expiry Date	mm/dd/yyyy	2 yrs	11/04/2017
Assay (HNO3, w/w)	% by w/w	67 - 70	69
Color	APHA	<= 10	< 7
Aluminum (Al)	ppb	<= 1	< 0.5
Antimony (Sb)	ppb	<= 0.5	< 0.1
Arsenic (As)	ppb	<= 0.5	< 0.1
Barium (Ba)	ppb	<= 0.1	< 0.1
Beryllium (Be)	ppb	<= 0.1	< 0.1
Bismuth (Bi)	ppb	<= 0.1	< 0.1
Boron (B)	ppb	<= 1	< 0.5
Cadmium (Cd)	ppb	<= 0.5	< 0.1
Calcium (Ca)	ppb	<= 1	< 0.5
Cerium (Ce)	ppb	<= 0.1	< 0.1
Cesium (Cs)	ppb	<= 0.1	< 0.1
Chromium (Cr)	ppb	<= 1	< 0.5
Cobalt (Co)	ppb	<= 0.5	< 0.1
Copper (Cu)	ppb	<= 0.5	< 0.2
Dysprosium (Dy)	ppb	<= 0.1	< 0.1
Erbium (Er)	ppb	<= 0.1	< 0.1
Europium (Eu)	ppb	<= 0.1	< 0.1
Gadolinium (Gd)	ppb	<= 0.1	< 0.1
Gallium (Ga)	ppb	<= 0.1	< 0.1
Germanium (Ge)	ppb	<= 0.1	< 0.1
Gold (Au)	ppb	<= 0.1	< 0.1
Hafnium (Hf)	ppb	<= 0.1	< 0.1
Holmium (Ho)	ppb	<= 0.1	< 0.1
Indium (In)	ppb	<= 0.1	< 0.1
Iron (Fe)	ppb	<= 1	< 0.5
Lanthanum (La)	ppb	<= 0.1	< 0.1
Lead (Pb)	ppb	<= 0.1	< 0.1
Lithium (Li)	ppb	<= 0.1	< 0.1

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Lutetium (Lu)	ppb	<= 0.1	< 0.1
Magnesium (Mg)	ppb	<= 1	< 0.2
Manganese (Mn)	ppb	<= 0.1	< 0.1
Mercury (Hg)	ppb	<= 0.1	< 0.02
Molybdenum (Mo)	ppb	<= 0.1	< 0.1
Neodymium (Nd)	ppb	<= 0.1	< 0.1
Nickel (Ni)	ppb	<= 0.5	< 0.5
Niobium (Nb)	ppb	<= 0.1	< 0.1
Palladium (Pd)	ppb	<= 0.5	< 0.1
Platinum (Pt)	ppb	<= 0.5	< 0.1
Potassium (K)	ppb	<= 1	< 0.2
Praseodymium (Pr)	ppb	<= 0.1	< 0.1
Rhenium (Re)	ppb	<= 0.1	< 0.1
Rhodium (Rh)	ppb	<= 0.5	< 0.1
Rubidium (Rb)	ppb	<= 0.1	< 0.1
Ruthenium (Ru)	ppb	<= 0.5	< 0.1
Samarium (Sm)	ppb	<= 0.1	< 0.1
Scandium (Sc)	ppb	<= 0.1	< 0.1
Selenium (Se)	ppb	<= 1	< 0.1
Silver (Ag)	ppb	<= 0.1	< 0.1
Sodium (Na)	ppb	<= 1	< 0.3
Strontium (Sr)	ppb	<= 0.1	< 0.1
Tantalum (Ta)	ppb	Information Only	< 0.1
Tellurium (Te)	ppb	<= 0.1	< 0.1
Terbium (Tb)	ppb	<= 0.1	< 0.1
Thallium (Tl)	ppb	<= 0.1	< 0.1
Thorium (Th)	ppb	<= 0.1	< 0.1
Thulium (Tm)	ppb	<= 0.1	< 0.1
Tin (Sn)	ppb	<= 0.5	< 0.1
Titanium (Ti)	ppb	<= 0.5	< 0.1
Tungsten (W)	ppb	<= 0.1	< 0.1
Uranium (U)	ppb	<= 0.1	< 0.1
Vanadium (V)	ppb	<= 0.5	< 0.1
Ytterbium (Yb)	ppb	<= 0.1	< 0.1
Yttrium (Y)	ppb	<= 0.1	< 0.1
Zinc (Zn)	ppb	<= 0.5	< 0.2
Zirconium (Zr)	ppb	<= 0.1	< 0.1
Chloride (Cl-)	ppm	<= 0.2	< 0.2
Total Phosphorus (P)	ppm	<= 0.01	< 0.01
Total Sulfur (S)	ppm	<= 0.3	< 0.3

CERTIFIED BY

Edgar E Hess
Lab Manager Fair Lawn

Joel Boland
Lab Manager BPF

Note: The data listed is valid for all package sizes of this lot of product, expressed as an extension of the catalog number listed above. If there are any questions with this certificate, please call Chemical Services at 1-800 227-6701.

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Appendix W

M7-16-6042, Rev 1 - Results from First Round of Remediated Nitrate Salt Surrogate Formulation and Testing, February 22, 2016

Los Alamos
NATIONAL LABORATORY
memorandum

M-7: High Explosive Science and Technology

To/MS: David J. Funk, ADEP, djf@lanl.gov
From/MS: Geoffrey Brown, M-7, geoffb@lanl.gov
Phone/Fax: 7-6718/7-0500
Symbol: M7-16-6042, Rev 1
Date: February 22, 2016

SUBJECT: Results from First Round of Remediated Nitrate Salt Surrogate Formulation and Testing

Contributors: Geoff Brown, Phil Leonard, Ernie Hartline, Mary Sandstrom, Hongzhao Tian, Jose Archuleta, Gabe Avilucea (M-7)

Introduction

High Explosives Science and Technology (M-7) completed the first round of formulation and testing of Remediated Nitrate Salt (RNS) surrogates in early February, 2016. This report summarizes the results of the work and also includes additional documentation required under test plan PLAN-TA9-2443 Rev A, "Remediated Nitrate Salt (RNS) Surrogate Formulation and Testing Standard Procedure", released July 25, 2015. All formulation and testing was carried out according to PLAN-TA9-2443 Rev A.

Materials

The materials used to formulate the RNS surrogates are listed in the table below. All chemicals were ordered through IESL-approved vendors using the Oracle iProcurement system. The Certificates of Analysis and packing slips for each item were scanned and documented in memorandum M7-15-6033, "Starting Materials Available for RNS Surrogate Formulation."

Reviewed and determined to be UNCLASSIFIED.

This review does not constitute clearance for public release.

Derivative Classifier: Geoffrey W. Brown, M-7

Date: February 22, 2016

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Table 1. Materials used for formulating RNS surrogates

Material	Lot Number
Aluminum nitrate nonahydrate	142299
Calcium nitrate tetrahydrate	144946
Chromium nitrate nonahydrate	F04Y024
Iron nitrate nonahydrate	A0355097
Water, LCMS grade	145280
Magnesium nitrate	147856
Sodium nitrate	144821
Lead nitrate	143996
Oxalic acid	143866 and 145400
Potassium carbonate	145088

SWheat pet litter was obtained commercially by LANL Environmental Programs and a 20 lb bag was supplied to M-7 per PLAN-TA9-2443 Rev A.

Formulation

The base RNS surrogate component is designated SFWB-8 and consists of the mixture listed in Table 2.

Table 2. SFWB-8 composition

Material	Weight %
$Al(NO_3)_3 * 9\ H_20$	3.20
$Ca(NO_3)_2 * 4\ H_2O$	12.72
$Cr(NO_3)_3 * 9H_2O$	0.16
$Fe(NO_3)_3 * 9H_2O$	4.86
$Mg(NO_3)_2 * 6H_2O$	35.69
$NaNO_3$	7.91
$(COOH)_2 * 2H_20$	2.89
K_2CO_3	1.51
Water	4.31

The final RNS surrogate formulations consist of SFWB-8 with lead nitrate and Swheat pet litter in the weight ratios shown in Table 3.

In the discussions below, the samples will be designated with a shorthand notation of the form SFWB8-XX-Y, where XX is the SWheat percentage and Y is the Pb percentage. For example, SFWB8-15-1 is the mixture made using SFWB-8 with 15% SWheat and 1% Pb.

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Table 3. RNS surrogate formulation matrix. Weight percent values shown.

	Increasing Swheat ->		
Increasing Lead ->	4% $Pb(NO_3)_2$ 15% Swheat 81% WB-8	4% $Pb(NO_3)_2$ 25% Swheat 71% WB-8	4% $Pb(NO_3)_2$ 35% Swheat 61% WB-8
	2% $Pb(NO_3)_2$ 15% Swheat 83% WB-8	2% $Pb(NO_3)_2$ 25% Swheat 73% WB-8	2% $Pb(NO_3)_2$ 35% Swheat 63% WB-8
	1% $Pb(NO_3)_2$ 15% Swheat 84% WB-8	1% $Pb(NO_3)_2$ 25% Swheat 74% WB-8	1% $Pb(NO_3)_2$ 35% Swheat 64% WB-8

Formulation nominally followed section 4.2 of PLAN-TA9-2443 Rev A with modifications noted in laboratory notebook pages documented in Appendix A of this report. These modifications were required due to formulation details including granulation, reactivity, swelling and gas evolution. The modifications did not change the work scope or significantly change the processes.

The modifications included

- Weights were recorded to +/- 10 mg precision due to the granularity of some materials.
- Oxalic acid and potassium carbonate would not fully dissolve in the allotted water for all recipes – they were instead stirred until the aqueous mixture was homogeneous.
- Mixtures were heated in glass containers covered with watch glasses instead of vials sealed with plastic lids – reactivity and gas evolution precluded holding in plastic and fully sealing the container while heating.

Testing

Details of all test methods are outlined in PLAN-TA9-2443 Rev A, Attachment B. The results of the tests are documented in M-7 Analytical Laboratory number 52219 (M-7-AC-52219). For tests carried out with the aid of control or analysis software, Software Quality Management documentation is included in Appendix B. Laboratory notebook pages for Differential Scanning Calorimetry and Sensitivity testing are included in Appendix C. Additional calorimetry notebook pages are in Appendix D.

Differential Scanning Calorimetry (DSC) Testing

The DSC data for all samples generally exhibit weak exotherms in the 100 °C to 150 °C range with endotherms scattered irreproducibly throughout the temperature scans. These features likely arise from the expected reactivity of the mixtures, loss of moisture, possibly melting of different components, and phase transitions associated with some of the salts. The replicate data sets for each mixture do not show high reproducibility. This variability is indicative of the inhomogeneity of these mixtures on the size scale of DSC samples. The DSC pans can only accommodate 1 mg to 3 mg of sample, however, as noted

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above, components of the formulations are being weighed at the +/- 10 mg level due to granulation. The grinding step in the formulation does reduce the size of the components somewhat, but after the mixture is complete it is still visually grainy and would understandably lead to highly variable DSC features for the instrument in M-7.

DSC data from all of the internal PETN standards appeared as expected. The temperature verification using the indium standard was always within tolerance. The indium enthalpy did fall out of tolerance on some runs. After SME discussion per PLAN-TA9-2443, this was determined not to be a problem since the exothermic peaks in all of the data were weak and broad and irreproducible. In addition, the failure of the indium enthalpy verification can be directly attributed to the corrosive nature of the samples. As each run is carried out, the cell picks up some contamination that leads to offsets in the measured enthalpy of a reacting sample. It can be reset by recalibrating the cell but, based on the nature of the data obtained, doing so before every run would unnecessarily consume time and supplies.

The variability of the DSC data due to the inhomogeneity of these multi-component mixtures makes it impossible to draw useful conclusions about the reactivity of the formulations since it obscures any trends. It does not seem useful to continue acquiring DSC data for the second and third passes through the formulation matrix.

Vacuum Thermal Stability (VTS) Testing

VTS testing was only carried out for a few of the initial formulations and was then discontinued since it was not producing any useful information while consuming significant testing time and resources. The issue arose from residual moisture in the formulations and moisture generated by heating nitrate salts that pushes the VTS sample cells to their maximum pressure limit within one or two hours in each case, causing the test to stop and all samples to show off-scale results. This is not useful for assessing the relative reactivity of the different formulations and so the test was discontinued.

Drop Weight Impact (DWI) Testing

No RNS surrogates showed any impact sensitivity. Each one showed 15 consecutive No-Go responses when the test weight was dropped from 320 cm. Note that all internal standards showed expected behavior.

Friction Testing

No RNS surrogates showed any friction sensitivity. Each one showed 15 consecutive No-Go responses with the largest weight at the full extent of the lever arm. Note that all internal standards showed expected behavior.

Electrostatic Discharge (ESD) Testing

The RNS surrogates showed some spark sensitivity but there was no trend with SWheat content or Pb content. Spark sensitivity is not unexpected in samples that have a volatile fraction. In the ESD sample holder, the sample is confined and any reactive gases are trapped until the probe needle discharges

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through the holder, causing the volatile head space to react. Note that all internal standards showed expected behavior.

Automatic Pressure Tracking Adiabatic Calorimetry (APTAC) Testing

APTAC testing measures the self-heating and associated kinetic parameters as the sample is heated adiabatically and step-wise in 2 °C increments. Notebook pages from the testing are documented below in Appendix D. Those pages also include the temperature and pressure verifications and instrument verification runs with di-tert butyl peroxide (DTBP) in toluene. Verifications were carried out before and after running the formulations in the test matrix. The CoA's for the toluene and the DTBP, obtained from IESL vendors are also included in Appendix A.

Notebook pages do not reflect a change in the data analysis relative to the description in PLAN-TA9-2443 Rev A. All data analysis is carried out in vendor-supplied software and the test plan was written before the new instrument was installed. The new instrument was supplied with upgraded software from the vendor. That software carries out the same analysis as the previous package but includes more automation and has different steps and commands. The temperature of the onset of self-heating and the kinetic parameters are determined through the software analysis.

Table 4 shows the temperatures of onset of self-heating for all 9 formulations. The onset is defined as the temperature at which the sample self-heating rate exceeded 0.02 °C/min. The basic trend is that the increasing SWheat content generally leads to higher onset temperatures for a given Pb concentration. The dependence on Pb is more complicated and is better observed in the heat flow plots.

Table 4. Temperatures of onset of self-heating for all 9 formulations in Table 2.

	15 % SWheat	**25 % SWheat**	**35 % SWheat**
4% Pb	42 °C	56 °C	64
2 % Pb	48 °C	56 °C	60
1% Pb	52 °C	52 °C	58

Figure 1 shows the heat flow traces for all 9 formulations in the matrix in Table 2. The traces have been offset in time so that 0 minutes is the point at which self-heating was first detected. In this way it is possible to see not only the different onset temperatures but also the different rates at which self-heating progressed for each sample.

Examination of Figure 1 reveals that the thermal traces for most mixtures exhibit regions with different slopes. In those cases there will be different reactions dominating at different times either due to full consumption of some reactants or the effect of different kinetic parameters. This is not surprising given the multicomponent nature of the mixtures. It is reasonable to assume that a general set of identical reactions is occurring in all of the mixtures at various times and with various levels of heat generation. In

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the mixtures that appear to be closer to a single smooth exothermic event, these reactions would overlap – the heat from one driving the next as the material thermally runs away.

Figure 1 shows some trends that vary with Pb concentration and SWheat concentration. Examining the onset of self-heating by the y-intercepts, a general trend already noted is that lower SWheat content leads to lower self-heating onset temperatures. This suggests that the SWheat is reducing the low temperature reactivity of the formulations. If this first reaction is viewed as a fuel-oxidizer reaction, then the trend with SWheat content suggests that the stoichiometric mixture composition lies at or below 15% SWheat and that the 25% and 35% mixtures are fuel rich. There is no trend in the onset temperatures with Pb concentration suggesting that the initial reactions are not influenced by Pb but by other components present in higher percentages or having stronger catalytic properties.

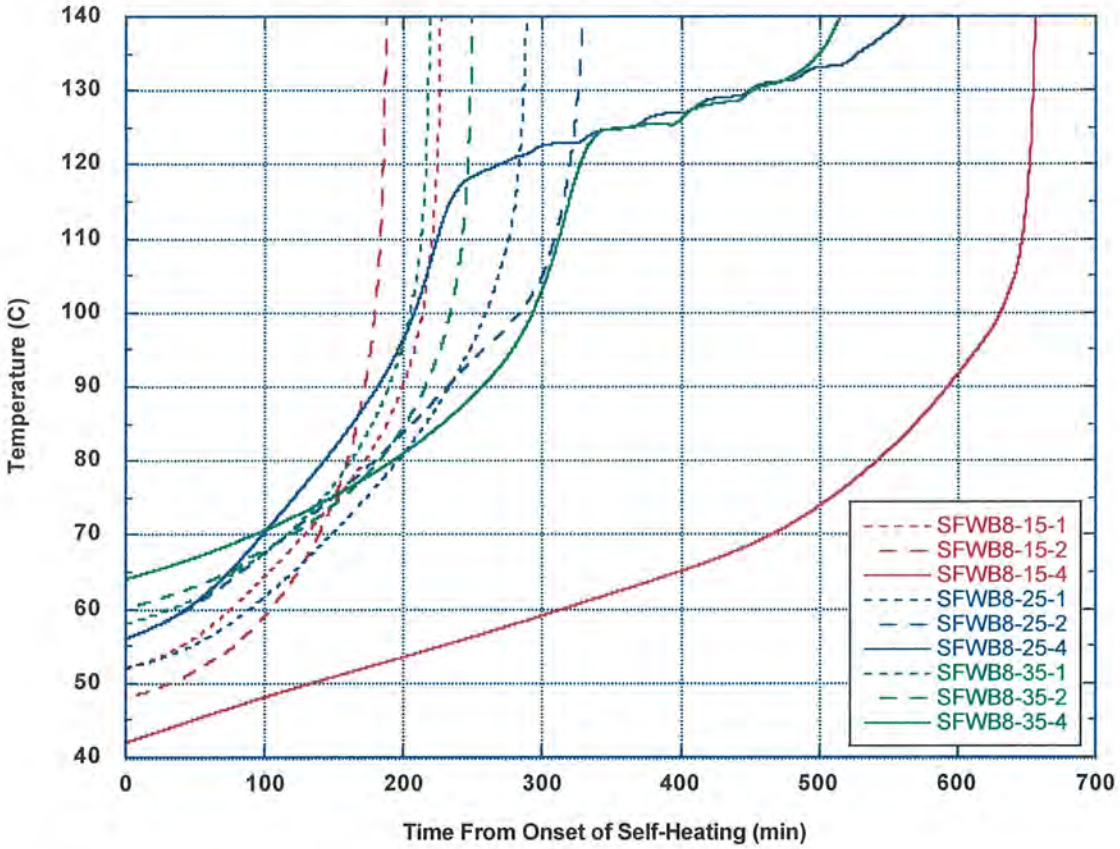


Figure 1. APTAC temperature vs time plots for all RNS mixtures

A trend that is visible regarding Pb is that the 4% mixtures take almost twice as long as the other mixtures to reach their highest temperatures. For the 25% and 35% mixtures with 4% Pb, completion of initial reactions is visible, followed by an extra incubation time present before later reactions ensue. The APTAC heat-wait-search steps during the incubation time are visible in both of the cases mentioned. These results suggest that the overall catalytic effect of Pb in these mixtures is low and perhaps only significant in a subset of the reactions that underlie the full exothermic behavior.

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Figure 2 shows the pressure traces associated with each heat flow trace in Figure 1. The curves have been offset in time in the same way as those of Figure 1. In these curves the contribution from a number of different reactions is obvious as multiple dips, peaks, and slopes. In all cases, the most vigorous pressure generation corresponds to the fastest heat generation in Figure 1. Note that this does not necessarily imply that any of the reactions are pressure-dependent. There is no way to determine whether the increase in pressure is driving the increase in temperature or whether it is the result of increased generation of gaseous products or simply due to the ideal gas law.

Interestingly, the 4% Pb mixtures with 15% and 25% SWheat show a reduction in pressure over a long timescale after self-heating begins. This likely indicates consumption of starting oxygen. This effect probably occurs in all formulations but due to the more rapid heat generation in the other compositions, the pressure remains positive.

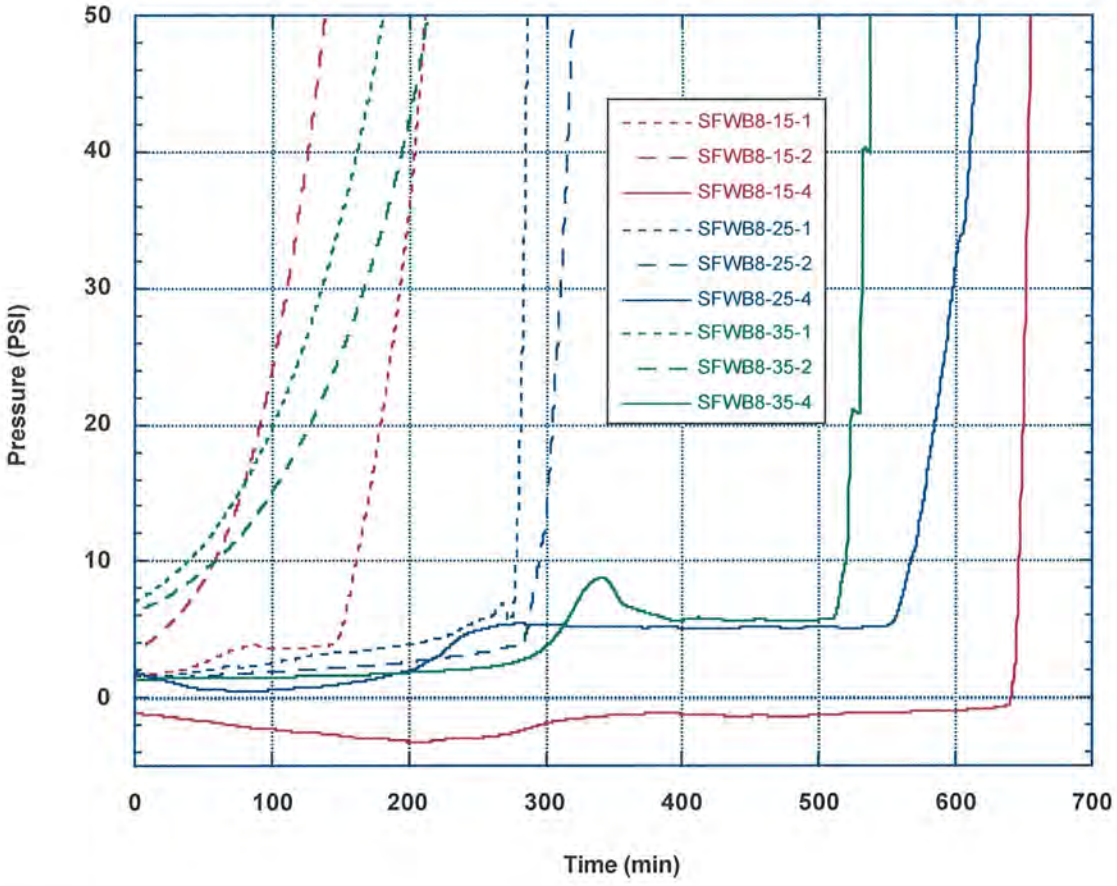


Figure 2. APTAC pressure vs time plots for all RNS mixtures

Each initial self-heating segment from the APTAC runs was analyzed with vendor-supplied software to determine kinetic parameters. This was not a robust analysis for two reasons. First, all of the available models that can be fit to the data assume single reactions, but all of the data sets show slope changes or other features indicative of multiple reactions. Second, most of the initial self-heating segments drove the

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APTAC instrument to shut down due to a temperature, temperature rate, or pressurization rate limit being exceeded. As a result, these data sets do not include the heat generated through full completion of the reaction under adiabatic conditions, violating an assumption used for kinetic analysis.

In order to provide some estimates of the relative kinetics of the different compositions, all data sets were fit to a first order Arrhenius model with endpoints adjusted so that the resulting parameters best fit a maximal portion of the data set. This approach is obviously somewhat subjective but does provide some relative comparison. The results of this approach are shown in Table 5.

Table 5. Arrhenius kinetic parameters for the initial self-heating segments of the RNS surrogate formulations. "A" is the pre-exponential factor in log(1/s) and "E_a" is the activation energy in kJ/mol.

SFWB8-15-4 A = 2.3 E_a = 47	SFWB8-25-4 A = 5.4 E_a = 62	SFWB8-35-4 A = 8.3 E_a = 85
SFWB8-15-2 A = 9.4 E_a = 93	SFWB8-25-2 A = 12.1 E_a = 116	SFWB8-35-2 A = 8.5 E_a = 88
SFWB8-15-1 A = 11.9 E_a = 113	SFWB8-25-1 A = 11.2 E_a = 110	SFWB8-35-1 A = 11 E_a = 107

Table 5 generally shows the pre-exponential and activation energy decreasing as the Pb concentration is increased. The center cell corresponding to 25% SWheat with 2% Pb does not fit this trend. The dependence on the SWheat concentration is more complicated. Again with the exception of the center cell, the bottom two rows show kinetic parameters decreasing with increasing SWheat. The top row, corresponding to 4% Pb, shows the opposite trend.

Summary

Nine RNS surrogate formulations were analyzed per PLAN-TA9-2443, Rev A as a first pass through the test matrix. Sensitivity testing showed all formulations were insensitive to impact and friction. Most were sensitive to spark but this is due to volatile fractions trapped in the headspace of the sample holder. DSC results were not reproducible due to the small sample size required and showed no discernible trends. APTAC testing did reveal some trends with Pb and SWheat concentration and kinetic parameters were determined from the data.

Contents of Appendices

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Appendix A: Notebook Pages Generated for Formulation and Testing

Formulation notes for SFWB8-15-1 and SFWB8-35-1 ..... A1
Formulation notes for SFWB8-15-2 ..... A3
Formulation notes for SFWB8-35-2 ..... A4
Formulation notes for SFWB8-15-4 ..... A5
Formulation notes for SFWB8-35-4 ..... A7
Formulation notes for SFWB8-25-1 and SFWB8-25-2 ..... A9
Formulation notes for SFWB8-25-4 ..... A12

Appendix B: Software Quality Management Documentation

SQM forms for instrument control and analysis software B1-B12

Appendix C: Notebook Pages Generated for DSC and Sensitivity Testing

DSC notebook pages C1-C6
Sensitivity testing notebook pages C7-C18

Appendix D: Notebook Pages Generated for APTAC Testing

DTBP APTAC instrument verification (9-16-15 and 9-17-15) D1
Note that for this experiment, the lot numbers of the DTBP and toluene were not recorded but it has been verified that the materials used were
DTBP: Lot A0339376, ChemDB barcode 1352757
Toluene: Lot 152579, ChemDB barcode 1352363
APTAC Temperature and Pressure Verification D2
APTAC notebook pages for all SFWB8 testing D3
DTBP APTAC instrument verification D12
Maximum self-heat rate was slightly low due to noisy mixture and not instrument issue. Determined not to be significant issue. Other parameters passed
Receipt paperwork and CoAs for DTBP and toluene D13

GB:mq

Cy: MDO DCRM file, P942

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PROJECT NAME APTAC Formulation NOTEBOOK Page

Formulation SFWB 8-15-1

Performed to TP 2443

15 % Swheat Salt mixture 1% Pb

Barcode	LOT#	Material	grams	actual	wt %
1338365	142295	Al(NO3)3 * 9 H2O	1.106	1.109	3.69
1338372	144946	Ca(NO3)2 * 4 H2O	4.399	4.402	14.66
1337445	F044024	Cr(NO3)3 * 9H2O	0.054	0.052	0.18
1338089	A0355097	Fe(NO3)3 * 9H2O	1.680	1.685	5.60
1338420	147856	Mg(NO3)2 * 6H2O	12.344	12.340	41.15
1338361	144821	NaNO3	2.737	2.733	9.12
1338408	143446	Pb(NO3)2	0.236	0.233	0.79
1338411	143866	(COOH)2*2H20	0.999	1.005	3.33
1339403	145088	K2CO3	0.505	0.507	1.68
NA		Swheat	4.500	4.501	15.00
1336164	145280	Water	1.443	1.450	4.81

From Procedure given in § 4.2

Balance Used PN: 1220845

4.2.1	Measure Salts as per table above
4.2.2	Transfer Salts to mortar
4.2.3	Grind nitrate Salts time:
4.2.4	Weigh Swheat Scoop
4.2.5	Transfer Swheat Scoop to Mortar
4.2.6	Grind Swheat Scoop Time:
4.2.7	Measure Oxalic acid and potassium Carbonate
4.2.8	Measure water into glass beaker
4.2.9	Add Oxalic acid and K_2CO_3 to water in beaker and c (Potassium Oxalate precipitate)
4.2.10	Add Oxalate soln to Nitrate Salts and Mix t
4.2.11	Add Swheat Scoop to wetted nitrate mix. Time
4.2.12-B	Transfer to Labelled Container

SIGNATURE _____ DATE 1/

READ AND UNDERSTOOD _____ DATE _____

122

PROJECT NAME _____ NOTEBOOK NO. _____

Continued from 121

1.2.14 Heat sample vials on Hotplate Temp: 60.3
Set at 60°C Time started 12:36
Product swelled to 2x volume

2.15 Allow sample to stand open overnight

1.2.16 Submit sample
Submitted SFWBB-35-1

SIGNATURE _____ DATE _____ 20__
READ AND UNDERSTOOD DATE 20

Continued from 121

Heat Sample Pellet on Hotplate. Temp: 60.3
Set at 60°C Time started 12:36
Product swelled to 2x volume
Allow sample to stand open overnight

Submit Sample
Submitted SFWB8-35-1

deletion 15-2

4.2.11 Gold
ad
4.2.12 Temp
4.2.13 L
4.2.14 Hea
Tim
4.2.15 Rem
4.2.16 S

5-2 1-11-16

arcode	LOT	Material	grams	actual	wt %
38365	142299	Al(NO3)3 * 9 H20	1.095	1.090	3.650
38372	144946	Ca(NO3)2 * 4 H2O	4.354	4.351	14.510
337445	F047024	Cr(NO3)3 * 9H2O	0.054	0.056	0.180
38089	A0355097	Fe(NO3)3 * 9H2O	1.663	1.659	5.540
338420	147856	Mg(NO3)2 * 6H2O	12.219	12.225	40.730
338361	144821	NaNO3	2.709	2.710	9.030
38408	143996	Pb(NO3)2	0.471	0.475	1.570
338411	143866	(COOH)2*2H20	0.988	0.985	3.290
339403	145088	K2CO3	0.505	0.510	1.680
		Swheat	4.500	4.501	15.000
338164	145280	Water	1.443	1.449	4.810

Procedure Balance PN:

Weigh out nitrate salt as above
Transfer Salt to Mortar
Grind Salt Time: 705
Weigh Swheat scoop
Transfer Swheat Scoop to Mortar
Grind Swheat scoop Time: 655

PROJECT NAME WI PP formulation NOTEBOOK NO.

35% Swheat 2% Lead in Salt

35-2

Barcode	LOT	Material	grams	actual	wt %
1338365	142299	Al(NO3)3 * 9 H2O	0.837		2.790
1338372	144946	Ca(NO3)2 * 4 H2O	3.330		11.100
1337445	F04 Y024	Cr(NO3)3 * 9H2O	0.041		0.140
1338089	A0355097	Fe(NO3)3 * 9H2O	1.272		4.240
1338420	147856	Mg(NO3)2 * 6H2O	9.344		31.150
1338361	144821	NaNO3	2.072		6.900
1338408	143996	Pb(NO3)2	0.360		1.200
1338411	143866	(COOH)2*2H20	0.756		2.520
1339403	145088	K2CO3	0.386		1.290
		Swheat	10.500		35.000
1338164	145280	Water	1.104		3.680

From Plan 2443 Rev A

Procedure:

4.2.1 Weigh masses of nitrate salts as above
4.2.2 Transfer Salts to Ceramic Mortar
4.2.3 Grind nitrate salts together for ~60 s Time: 70s
4.2.4 Weigh Swheat Scoop
4.2.5 Transfer Swheat Scoop to mortar
4.2.6 Grind SWheat Scoop in mortar ~60s Time: 70s
4.2.7 Measure Oxalic acid + Potassium Carbonate
4.2.8 Measure Water into Beaker
4.2.9 Store Oxalic acid and KCO_3 in water ~60s
Precipitate formed
4.2.10 Add potassium Oxalate mixture to nitrate salts
4.2.11 Add Swheat Scoop to Wetted nitrate salt
4.2.12 Gauge glass Container with mixture and heat ~60°C for ~4 hr

heated 4.5 hr, 60.0°C

4.2.13 Label sampler
4.2.14 Heat Container
4.2.15 Remove Cap and allow to stand overnight
4.2.16 Submit material
Material Submitted "SFWBB-35-2"

SIGNATURE _____ DATE _____ 20
READ AND UNDERSTOOD _____ DATE _____ 20

PROJECT NAME W11F formulation Page A-5 NOTEBOOK NO.

Philip Leonard ~~11/30/15~~ → 12-7-15 to 12-8-15 pvL

Performed to Test Plan TA-9-2443

Formulation 15% Swheat Scoop Cat litter
4% Pb in Salt mix "UB8" from Test Plan

Column1	Column2	Column3	Column4	Column5	Column6
Barcode	Material	Lot# ~~142299~~	grams	Actual g	wt %
1338365	Al(NO3)3 * 9 H2O	142299	1.073	1.0718	3.57
1338372	Ca(NO3)2 * 4 H2O	144946	4.265	4.2618	14.22
1337445	Cr(NO3)3 * 9H2O	~~MFG~~ F044024	0.053	0.0544	0.17
1338089	Fe(NO3)3 * 9H2O	A0355097	1.629	1.632	5.43
1338420	Mg(NO3)2 * 6H2O	147856	11.970	11.9683	39.9
1338361	NaNO3	144821	2.654	2.6566	8.85
1338408	Pb(NO3)2	143996	0.942	0.9431	3.14
1338411	(COOH)2*2H2O	143866	0.968	0.9673	3.23
1339403	K2CO3	145088	0.505	0.5051	1.68
	Swheat		4.500	4.4973	15
1338164	Water 145280	~~145276~~ pvL	1.443	1.4498	4.81

Procedure

4.2.1 Masses of nitrate salts measured on Calibrated Balance
Balance #: 1220845 See actual amounts in Table above

4.2.2 Transfer to Ceramic Mortar

4.2.3 Grind nitrate salts Time: 85s

4.2.4 Weigh Swheat Scoop

4.2.5 Transfer to Second Mortar and grind Swheat Scoop (4.2.6)
Ground for 100s

4.2.6 Measure Oxalic acid and Potassium Carbonate

4.2.8 Measure Water into glass beaker

4.2.9 add Oxalic acid and Carbonate to Water in beaker and mix
The material did not completely dissolve

4.2.10 Add Oxalate ~~salt~~ and Carbonate mixture to Nitrate Salts
Mix for time: 70s

20 SIGNATURE DATE 12-7 20 12
20 READ AND UNDERSTOOD DATE 20

4.2.11 Add Subcoat Scoop to Wetted nitrate Salts and Mix
Time = 90s

4.2.12 Transfer to Containers

4.2.13 Label Samples (Name, Date, Time)
"12-7-15 SFWBB-15-4" Time = 11.9273

4.2.14 Heat Containers Temp Setting = 60°C
Surface Temp: 63C
Time = 11:31 End 3:36
Samples had Ejected lids

4.2.15 Remove Cap and let stand overnight
Cap removed + standing
12-8: Material still shows porosity from off-gassing

4.2.16 Submit Material
Material submitted on 2 vials in an antistatic bag
12-8-15

Wt-Tares #1 = 15.29g
#2 = 9.748g

SIGNATURE _____ DATE _____ 20
READ AND UNDERSTOOD _____ DATE _____ 20

4.2.11 Add Sufficient Scoop to Wetted Nitrate Salts and M
Time = 90s

4.2.12 Transfer to Containers

4.2.13 Label Samples (Name, Date, Time)
"12-7-15 SFWB8-15-4" Time = 11.927g

4.2.14 Heat Containers Temp Setting = 60°C
Surface Temp: 63C
Time = 11:31 End 3:36
Samples had Ejected 1-15

4.2.15 Remove Cap and let stand overnight
Cap removed + standing
12-8. Material still shows porosity from off-gassing

4.2.16 Submit Material
Material submitted on 2 vials in an outer bag
12-8-15

Wt-Tares #1 = 15.29g
#2 = 9.748g

SIGNATURE DATE
READ AND UNDERSTOOD DATE

4.2.15 Allow material to Stand w/o Cap
No Visual Change from after Heating Foaming min

4.2.16 → Submit material
Material Submitted 12-8-15 10.

NOTE 1) This material was heated with PE cap on pierced with a 21ga needle. Volume expansion 1.5x was observed but foaming appeared to be minimal. During heating the contents did not Eject their Caps as the previous samples did

SIGNATURE _____ DATE 12-8
READ AND UNDERSTOOD _____ DATE _____

PROJECT NAME

NOTEBO

4.2.15 Allow material to Stand u/o Cap
No Visual Change from after Heating Foaming m.n

4.2.16 → Submit material

Material Subm. Hed 12-8-15

NOTE 1) This material was heated w.th PE Cap. pe:rced w.th a 21ga needle. Volume expans.on 1.5x was observed but foam.ng appeared to be m.n.mal. Dur.ng heat.ng the contents d.d Eject their Caps as the previous samples did

SIGNATURE DATE 12-8
READ AND UNDERSTOOD DATE

4.2.11 Add Wheat Scoop to Wetted nitrate Salts an
Time: 10

4.2.12 transfer to Containers for heating
4.2.13 label Samples with name, Date, Time
Labelled SFWSS-25-2

4.2.14 Heat Containers Temp Setting = 60°C Time
Surface temp: ~~60~~ 58.5-59.0
Observations: interval expanded to 25 values
ejecting lid and partially cooling containers

4.2.15 Remove Cap and let Stand overnight
Ended 4:45

4.2.16 Submit material
Submitted 12-15 10 am

SIGNATURE DATE
READ AND UNDERSTOOD DATE

4.2.13 Samples will be labeled with their designated name, the date and time of prep and all appropriate hazard labels. Labelled SFWB8-25-1

4.2.14 The glass container is heated using a hotplate with a surface temperature of approximately 60 °C for 4 hours. In 12:35 End 4.45
Temp: 58.5 - 59.0
Material expanded significantly pushing lid up

4.2.15 The cap is removed and the material is allowed to stand overnight at room ten in a ventilation hood.

4.2.16 The material is submitted for testing. 10 am 12/15/15

SIGNATURE DATE
READ AND UNDERSTOOD DATE

Philip Leonard 11/30/15

Performed according to Test Plan TA-9-2443

Formulation: 25% Swheat Scoop Cut 1.Her
4% Pb in Salt mix "WBB" according to
formula Below from Test Plan Appendix

barcode	Material	Lot #	grams	wt %	Actual g
1338365	Al(NO3)3 * 9 H2O	142299	0.946	3.15	0.943
1338372	Ca(NO3)2 * 4 H2O	144946	3.7635	12.54	3.759
1337445	Cr(NO3)3 * 9H2O	F044024	0.046	0.15	0.047
1338089	Fe(NO3)3 * 9H2O	A0355097	1.4375	4.79	1.440
1338720	Mg(NO3)2 * 6H2O	147856	10.5615	35.2	10.562
1338361	NaNO3	144821	2.3415	7.8	2.340
1338408	Pb(NO3)2	143996	0.8315	2.77	0.830
1338411	(COOH)2*2H20	143864	0.854	2.85	0.852
1339403	K2CO3	145088	0.4455	1.48	0.441
NA	Swheat	NA	7.5	25	
1338164	Water	145280	1.273	4.24	1.273

Procedure as given in 4.2

4.2.1 Masses of nitrate salts measured on a Calibrated balance Balance #: 1220845, PN
For actual amounts see table above

4.2.2 Transfer material to Ceramic mortar

4.2.3 Grind Nitrate salts time = 65 s

4.2.4 Weigh Swheat Scoop

4.2.5 Transfer to a second mortar

4.2.6 Grind Swheat scoop time = 70 s

4.2.7 Measure Oxalic acid and Potassium Carbonate

4.2.8 Measure water into a glass beaker

20 SIGNATURE DATE 20
20 READ AND UNDERSTOOD DATE 20

104 PROJECT NAME _____ NOTEBOOK NO. _____

1.2.9 add Oxalic and Carbonate to water in Beaker and dissolve did not fully redissolve

.2.10 Add Oxalate solution from above to Nitrates and mix for time = 62s until Thoroughly mixed

2.11 add SS Heat Scoop To wetted nitrate and stir time = 66s

2.12 Transfer to Container

2.13 Label sampler with Name, Date, Time of preparation, and hazards
Labelled PuL-V-103 WIPP SFW 138-25-4
tare 17.294 w/ cap → 32.968 17.236 w cap → 27.163

2.14 heat glass Container Surface temp = 60°C Actual = 57.9
Started 11:21a height of sample in vial 2 = 17mm Vial 1 observed by 1:21 sample doubled from foamy expansion Heat off 3:48p

2.15 Remove Cap / lid and let Sample stand in hood ORJ
Cap removed drying 3:55pm

.16 Submit material
Request sent 10:40a Sampler # 140

130 area inspected by
Anna M Gamboa
191744 @ 1211 hours
area is neat and clean

SIGNATURE _____ DATE _____ 20
READ AND UNDERSTOOD DATE 20

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

SQM-PLAN- *To be completed by the Document Control Team.*	Rev.	Effective Date:

1. SOFTWARE INFORMATION

☐ New Software ☒ Existing Software

Complete a Form 2033, *Safety/Non-Safety Software Determination Categorization,* unless software is commercially controlled (non-safety) software. Examples of commercially controlled software that do not meet the reasonable probability criteria are personal productivity software such as MS PowerPoint, MS Outlook, Internet Explorer, and Mozilla Firefox.

Software Category:
- ☒ Non-Safety - Commercially Controlled
- ☐ Risk Significant: SRL # ☐ 1 ☐ 2 ☐ 3
- ☐ Safety: ☐ SSS ☐ SHADS ☐ SMACS
- ☐ Firmware
- ☒ Simple/Easily Understood
- ☐ Weapons

Software Name: Q Advantage / Thermal Advantage

Acronym: none — Software Version: 5.5.3

Software Type: ☒ COTS/Acquired ☐ Custom ☐ Other:

Software Description: Controls Differential Scanning Calorimeter

Software Owner: Mary Sandstrom — Z#: 138389 — Organization: M-7

Software Custodian: Mary Sandstrom — Z#: 138389 — Organization: M-7

Software Vendor: TA Instruments

Procurement Information ☒ N/A

PR#: — Number of Licenses: — Requestor:

PR Date: — Price: $ — Date of Receipt:

Charge Codes:

2. SOFTWARE EVALUATION*

Determinations based on risk associated with the software or impact of the software failure.

SQMP Type Required:
- ☐ Full (skip Section 3) – Required for Safety Software/Optional for Non-Safety
- ☒ FORM-JDIV-1005 (Section 3 of this form)

Baseline version exists: ☒ No ☐ Yes: Version #: 1.0

If existing software, is a Baseline Required?: ☒ No ☐ Yes Version #:

3. SOFTWARE QUALITY MANAGEMENT PLAN*

Determinations based on risk associated with the software or impact of the software failure.

Change Control:	☒ N/A ☐ FORM-JDIV-1004, *Software Problem Report/Change Request* ☐ Other:
Problem Reporting and Corrective Action:	☒ N/A ☐ FORM-JDIV-1004, *Software Problem Report/Change Request* ☐ Other:

** Form guidance for this section is attached to the form.*

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

Interface Control:	☒ N/A ☐ Describe:
Other:	N/A

TRAINING REQUIREMENTS:

a. User: ☒ None ☐ OJT #: ☐ Other:

Users:			
	N/A		
	Name	*Z#*	*Organization*

b. Owner/Custodian: ☒ None ☐ OJT #: ☐ Other:

4. APPROVALS

When approved, submit completed form and associated documentation to the SQA POC for retention as a Controlled Document/Record.

Software Owner: Mary M. Sandstrom	138389	M-7	Mary M Sandstrom	9/30/15
Name	*Z#*	*Organization*	*Signature*	*Date*
SE *(if app.)*: N/A				
Name	*Z#*	*Organization*	*Signature*	*Date*
RLM SHELDON A-LARSON	121882	M-7	Sheldon A. Larson	10/2/15
Name	*Z#*	*Organization*	*Signature*	*Date*

Attach completed Form 2033, *Safety/Non-Safety Software Determination Categorization,* if completed.

Attach as applicable:

- Baseline Documents
- Procurement Package
- Traceability Matrix
- Requirements Identification and Documentation
- Design Documents
- Statement Of Work
- Installation Verification and Validation

** Form guidance for this section is attached to the form.*

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

SQM-PLAN- *To be completed by the Document Control Team.*	Rev.	Effective Date:

1. SOFTWARE INFORMATION

☐ New Software ☒ Existing Software

Complete a Form 2033, *Safety/Non-Safety Software Determination Categorization,* unless software is commercially controlled (non-safety) software. Examples of commercially controlled software that do not meet the reasonable probability criteria are personal productivity software such as MS PowerPoint, MS Outlook, Internet Explorer, and Mozilla Firefox.

Software Category:
- ☒ Non-Safety - Commercially Controlled
- ☐ Risk Significant: SRL # ☐ 1 ☐ 2 ☐ 3
- ☐ Safety: ☐ SSS ☐ SHADS ☐ SMACS
- ☐ Firmware
- ☒ Simple/Easily Understood
- ☐ Weapons

Software Name: Universal Analysis 2000

Acronym: none — Software Version: 4.5A Build 54.5.0.5

Software Type: ☒ COTS/Acquired ☐ Custom ☐ Other:

Software Description: Analyzes data from the Differential Scanning Calorimeter

Software Owner: Mary Sandstrom — Z#: 138389 — Organization: M-7

Software Custodian: Mary Sandstrom — Z#: 138389 — Organization: M-7

Software Vendor: TA Instruments

Procurement Information ☒ N/A

PR#: — Number of Licenses: — Requestor:

PR Date: — Price: $ — Date of Receipt:

Charge Codes:

2. SOFTWARE EVALUATION*

Determinations based on risk associated with the software or impact of the software failure.

SQMP Type Required:
- ☐ Full (skip Section 3) – Required for Safety Software/Optional for Non-Safety
- ☒ FORM-JDIV-1005 (Section 3 of this form)

Baseline version exists: ☒ No ☐ Yes: Version #: 1.0

If existing software, is a Baseline Required?: ☒ No ☐ Yes Version #:

3. SOFTWARE QUALITY MANAGEMENT PLAN*

Determinations based on risk associated with the software or impact of the software failure.

Change Control:
- ☒ N/A
- ☐ FORM-JDIV-1004, *Software Problem Report/Change Request*
- ☐ Other:

** Form guidance for this section is attached to the form.*

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

Problem Reporting and Corrective Action:	☒ N/A ☐ FORM-JDIV-1004, *Software Problem Report/Change Request* ☐ Other:
Interface Control:	☒ N/A ☐ Describe:
Other:	N/A

TRAINING REQUIREMENTS:

a. User: ☒ None ☐ OJT #: ☐ Other:

Users:			
	N/A		
	Name	*Z#*	*Organization*

b. Owner/Custodian: ☒ None ☐ OJT #: ☐ Other:

4. APPROVALS

When approved, submit completed form and associated documentation to the SQA POC for retention as a Controlled Document/Record.

Software Owner: Mary M. Sandstrom	138389	M-7	Mary M. Sandstrom	9/30/15
Name	*Z#*	*Organization*	*Signature*	*Date*
SE *(if app.)*: N/A				
Name	*Z#*	*Organization*	*Signature*	*Date*
RLM SHELDON A. LARSON	121882	M-7	Sheldon A. Larson	10/2/15
Name	*Z#*	*Organization*	*Signature*	*Date*

Attach completed Form 2033, *Safety/Non-Safety Software Determination Categorization*, if completed.

Attach as applicable:

- Baseline Documents
- Procurement Package
- Traceability Matrix
- Requirements Identification and Documentation
- Design Documents
- Statement Of Work
- Installation Verification and Validation

** Form guidance for this section is attached to the form.*

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

SQM-PLAN- *To be completed by the Document Control Team.*	Rev.	Effective Date:

1. SOFTWARE INFORMATION

☐ New Software ☒ Existing Software

Complete a Form 2033, *Safety/Non-Safety Software Determination Categorization,* unless software is commercially controlled (non-safety) software. Examples of commercially controlled software that do not meet the reasonable probability criteria are personal productivity software such as MS PowerPoint, MS Outlook, Internet Explorer, and Mozilla Firefox.

Software Category:
- ☒ Non-Safety - Commercially Controlled
- ☐ Risk Significant: SRL # ☐ 1 ☐ 2 ☐ 3
- ☐ Safety: ☐ SSS ☐ SHADS ☐ SMACS
- ☐ Firmware
- ☒ Simple/Easily Understood
- ☐ Weapons

Software Name: APTAC

Acronym: none

Software Version: 1.5.36 RPV9

Software Type: ☒ COTS/Acquired ☐ Custom ☐ Other:

Software Description: Controls the APTAC instrument.

Software Owner: Ernie Hartline	Z#: 188218	Organization: M-7
Software Custodian: Ernie Hartline	Z#: 188218	Organization: M-7

Software Vendor: TIAX Inc.

Procurement Information ☒ N/A

PR#:	Number of Licenses:	Requestor:
PR Date:	Price: $	Date of Receipt:

Charge Codes:

2. SOFTWARE EVALUATION*

Determinations based on risk associated with the software or impact of the software failure.

SQMP Type Required:
- ☐ Full (skip Section 3) – Required for Safety Software/Optional for Non-Safety
- ☒ FORM-JDIV-1005 (Section 3 of this form)

Baseline version exists: ☒ No ☐ Yes: Version #: 1.0

If existing software, is a Baseline Required?: ☒ No ☐ Yes Version #:

3. SOFTWARE QUALITY MANAGEMENT PLAN*

Determinations based on risk associated with the software or impact of the software failure.

Change Control:	☒ N/A ☐ FORM-JDIV-1004, *Software Problem Report/Change Request* ☐ Other:
Problem Reporting and Corrective Action:	☒ N/A ☐ FORM-JDIV-1004, *Software Problem Report/Change Request* ☐ Other:

** Form guidance for this section is attached to the form.*

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

Interface Control:	☒ N/A ☐ Describe:
Other:	N/A

TRAINING REQUIREMENTS:

a. User: ☒ None ☐ OJT #: ☐ Other:

Users:			
	N/A		
	Name	*Z#*	*Organization*

b. Owner/Custodian: ☒ None ☐ OJT #: ☐ Other:

4. APPROVALS

When approved, submit completed form and associated documentation to the SQA POC for retention as a Controlled Document/Record.

Software Owner: Ernest Hoffman	188218	M-7	[signature]	10/1/15
Name	*Z#*	*Organization*	*Signature*	*Date*
SE *(if app.)*: N/A				
Name	*Z#*	*Organization*	*Signature*	*Date*
RLM SHELDON A. LARSON	121882	M-7	[signature]	10/2/15
Name	*Z#*	*Organization*	*Signature*	*Date*

Attach completed Form 2033, *Safety/Non-Safety Software Determination Categorization*, if completed.

Attach as applicable:

- Baseline Documents
- Procurement Package
- Traceability Matrix
- Requirements Identification and Documentation
- Design Documents
- Statement Of Work
- Installation Verification and Validation

** Form guidance for this section is attached to the form.*

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

SQM-PLAN-M7-5009 *To be completed by the Document Control Team.*	Rev. B	Effective Date:

1. SOFTWARE INFORMATION

☐ New Software ☒ Existing Software

Complete a Form 2033, *Safety/Non-Safety Software Determination Categorization,* unless software is commercially controlled (non-safety) software. Examples of commercially controlled software that do not meet the reasonable probability criteria are personal productivity software such as MS PowerPoint, MS Outlook, Internet Explorer, and Mozilla Firefox.

Software Category:
- ☒ Non-Safety - Commercially Controlled
- ☐ Risk Significant: SRL # ☐ 1 ☐ 2 ☐ 3
- ☐ Safety: ☐ SSS ☐ SHADS ☐ SMACS
- ☐ Firmware
- ☒ Simple/Easily Understood
- ☐ Weapons

Software Name: Proteus Thermal Analysis

Acronym: N/A

Software Version: 7.0.1 (01.10.2015)

Software Type: ☒ COTS/Acquired ☐ Custom ☐ Other:

Software Description: Analysis data from APTAC instrument.

Software Owner: Geoff Brown	Z#: 118813	Organization: M-7
Software Custodian: Geoff Brown	Z#:	Organization: M-7

Software Vendor: NETZSCH

Procurement Information ☒ N/A

PR#:	Number of Licenses:	Requestor:
PR Date:	Price: $	Date of Receipt:
Charge Codes:		

2. SOFTWARE EVALUATION*

Determinations based on risk associated with the software or impact of the software failure.

SQMP Type Required:
- ☐ Full (skip Section 3) – Required for Safety Software/Optional for Non-Safety
- ☒ FORM-JDIV-1005 (Section 3 of this form)

Baseline version exists: ☒ No ☐ Yes: Version #:

If existing software, is a Baseline Required?: ☒ No ☐ Yes Version #:

3. SOFTWARE QUALITY MANAGEMENT PLAN*

Determinations based on risk associated with the software or impact of the software failure.

Change Control:	☐ N/A ☐ FORM-JDIV-1004, *Software Problem Report/Change Request* ☒ Other: Track revisions in Division Inventory
Problem Reporting and Corrective Action:	☒ N/A ☐ FORM-JDIV-1004, *Software Problem Report/Change Request* ☐ Other:

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

Interface Control:	☒ N/A ☐ Describe:
Other:	

TRAINING REQUIREMENTS:

a. User: ☒ None ☐ OJT #: ☐ Other:

Users:			
	Name	*Z#*	*Organization*

b. Owner/Custodian: ☒ None ☐ OJT #: ☐ Other:

4. APPROVALS

When approved, submit completed form and associated documentation to the SQA POC for retention as a Controlled Document/Record.

Software Owner:	Geoff Brown	118813	M-7	Geoff W. Brown	12/18/15
	Name	*Z#*	*Organization*	*Signature*	*Date*
SE *(if app.)*:	N/A				
	Name	*Z#*	*Organization*	*Signature*	*Date*
RLM	K. Lewintz	114740	M-7	K Lewintz	12/18/15
	Name	*Z#*	*Organization*	*Signature*	*Date*

Attach completed Form 2033, *Safety/Non-Safety Software Determination Categorization*, if completed.

Attach as applicable:

- Baseline Documents
- Procurement Package
- Traceability Matrix
- Requirements Identification and Documentation
- Design Documents
- Statement Of Work
- Installation Verification and Validation

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

SQM-PLAN- *To be completed by the Document Control Team.*	Rev.	Effective Date:

1. SOFTWARE INFORMATION

☐ New Software ☒ Existing Software

Complete a Form 2033, *Safety/Non-Safety Software Determination Categorization,* unless software is commercially controlled (non-safety) software. Examples of commercially controlled software that do not meet the reasonable probability criteria are personal productivity software such as MS PowerPoint, MS Outlook, Internet Explorer, and Mozilla Firefox.

Software Category:
- ☒ Non-Safety - Commercially Controlled
- ☐ Risk Significant: SRL # ☐ 1 ☐ 2 ☐ 3
- ☐ Safety: ☐ SSS ☐ SHADS ☐ SMACS
- ☐ Firmware
- ☒ Simple/Easily Understood
- ☐ Weapons

Software Name: Winstab

Acronym: none — Software Version: 3.22 (3.22.2006.1021)

Software Type: ☒ COTS/Acquired ☐ Custom ☐ Other:

Software Description: Controls the Vacuum Thermal Stability instrument

Software Owner: Jose Archuleta	Z#: 079834	Organization: M-7
Software Custodian: Jose Archuleta	Z#: 079834	Organization: M-7

Software Vendor: OZM Research

Procurement Information ☒ N/A

PR#:	Number of Licenses:	Requestor:
PR Date:	Price: $	Date of Receipt:
Charge Codes:		

2. SOFTWARE EVALUATION*

Determinations based on risk associated with the software or impact of the software failure.

SQMP Type Required:
- ☐ Full (skip Section 3) – Required for Safety Software/Optional for Non-Safety
- ☒ FORM-JDIV-1005 (Section 3 of this form)

Baseline version exists: ☒ No ☐ Yes: Version #: 1.0

If existing software, is a Baseline Required?: ☒ No ☐ Yes Version #:

3. SOFTWARE QUALITY MANAGEMENT PLAN*

Determinations based on risk associated with the software or impact of the software failure.

Change Control:
- ☒ N/A
- ☐ FORM-JDIV-1004, *Software Problem Report/Change Request*
- ☐ Other:

** Form guidance for this section is attached to the form.*

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

Problem Reporting and Corrective Action:	☒ N/A ☐ FORM-JDIV-1004, *Software Problem Report/Change Request* ☐ Other:
Interface Control:	☒ N/A ☐ Describe:
Other:	N/A

TRAINING REQUIREMENTS:

a. User: ☒ None ☐ OJT #: ☐ Other:

Users:			
	N/A		
	Name	*Z#*	*Organization*

b. Owner/Custodian: ☒ None ☐ OJT #: ☐ Other:

4. APPROVALS

When approved, submit completed form and associated documentation to the SQA POC for retention as a Controlled Document/Record.

Software Owner: Jose G. Archuleta	079834	M-7	Jose G. Archuleta	9/30/15
Name	*Z#*	*Organization*	*Signature*	*Date*
SE *(if app.)*: N/A				
Name	*Z#*	*Organization*	*Signature*	*Date*
RLM SHELDON A. LARSON	121882	M-7	Sheldon A. Larson	10/2/15
Name	*Z#*	*Organization*	*Signature*	*Date*

Attach completed Form 2033, *Safety/Non-Safety Software Determination Categorization,* if completed.

Attach as applicable:

- Baseline Documents
- Procurement Package
- Traceability Matrix
- Requirements Identification and Documentation
- Design Documents
- Statement Of Work
- Installation Verification and Validation

** Form guidance for this section is attached to the form.*

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

SQM-PLAN- *To be completed by the Document Control Team.*	Rev.	Effective Date:

1. SOFTWARE INFORMATION

☐ New Software ☒ Existing Software

Complete a Form 2033, *Safety/Non-Safety Software Determination Categorization,* unless software is commercially controlled (non-safety) software. Examples of commercially controlled software that do not meet the reasonable probability criteria are personal productivity software such as MS PowerPoint, MS Outlook, Internet Explorer, and Mozilla Firefox.

Software Category:
- ☒ Non-Safety - Commercially Controlled
- ☐ Risk Significant: SRL # ☐ 1 ☐ 2 ☐ 3
- ☐ Safety: ☐ SSS ☐ SHADS ☐ SMACS
- ☐ Firmware
- ☒ Simple/Easily Understood
- ☐ Weapons

Software Name: SenTest

Acronym: none — Software Version: 1.0

Software Type: ☒ COTS/Acquired ☐ Custom ☐ Other:

Software Description: Statistical analysis software used in sensitivity testing.

Software Owner: Hongzhao Tian — Z#: 230045 — Organization: M-7

Software Custodian: Hongzhao Tian — Z#: 230045 — Organization: M-7

Software Vendor: Neyer

Procurement Information ☒ N/A

PR#: — Number of Licenses: — Requestor:

PR Date: — Price: $ — Date of Receipt:

Charge Codes:

2. SOFTWARE EVALUATION*

Determinations based on risk associated with the software or impact of the software failure.

SQMP Type Required:
- ☐ Full (skip Section 3) – Required for Safety Software/Optional for Non-Safety
- ☒ FORM-JDIV-1005 (Section 3 of this form)

Baseline version exists: ☒ No ☐ Yes: Version #: 1.0

If existing software, is a Baseline Required?: ☒ No ☐ Yes Version #:

3. SOFTWARE QUALITY MANAGEMENT PLAN*

Determinations based on risk associated with the software or impact of the software failure.

Change Control:	☒ N/A ☐ FORM-JDIV-1004, *Software Problem Report/Change Request* ☐ Other:
Problem Reporting and Corrective Action:	☒ N/A ☐ FORM-JDIV-1004, *Software Problem Report/Change Request* ☐ Other:

** Form guidance for this section is attached to the form.*

SOFTWARE EVALUATION/QUALITY MANAGEMENT PLAN (QMP)

Interface Control:	☒ N/A ☐ Describe:
Other:	N/A

TRAINING REQUIREMENTS:

a. User: ☒ None ☐ OJT #: ☐ Other:

Users:			
	N/A		
	Name	*Z#*	*Organization*

b. Owner/Custodian: ☒ None ☐ OJT #: ☐ Other:

4. APPROVALS

When approved, submit completed form and associated documentation to the SQA POC for retention as a Controlled Document/Record.

Software Owner:	Hongzhao Tian	230045	M-7	Hongzhao Tian	10/1/15
	Name	*Z#*	*Organization*	*Signature*	*Date*
SE *(if app.)*:	N/A				
	Name	*Z#*	*Organization*	*Signature*	*Date*
RLM	SHELDON A. LARSON	121882	M-7	Sheldon A. Larson	10/2/15
	Name	*Z#*	*Organization*	*Signature*	*Date*

Attach completed Form 2033, *Safety/Non-Safety Software Determination Categorization*, if completed.

Attach as applicable:

- Baseline Documents
- Procurement Package
- Traceability Matrix
- Requirements Identification and Documentation
- Design Documents
- Statement Of Work
- Installation Verification and Validation

** Form guidance for this section is attached to the form.*

Los Alamos National Laboratories

BALANCE CALIBRATION LOG

Page C-1

BOOK PAGE

Balance: **ID Number:**

Date	Initials	Calibration Weight	Actual Weight	Control Parameters	Maintenance and Adjustments
11/5/15	MMS	10 mg	10.002	10 ± 0.005	Troemner
↓	↓	100 mg	100.010	100 ± 0.100	SN 48411
↓	↓	2 mg	2.001	2 ± 0.005	File # 01797
11/10/15	MMS	10 mg	10.000 11/10/15 MMS 138886	10 ± 0.005	Troemner
↓	↓	100 mg	100.010	100 ± 0.100	SN 48411
↓	↓	2 mg	2.001	2 ± 0.005	File # 01797
12/1/15	MMS	10 mg	10.002	10 ± 0.005	Troemner
↓	↓	100 mg	100.010	100 ± 0.100	SN 48411
↓	↓	2 mg	2.001	2 ± 0.005	File # 01797
12/8/15	MMS	10 mg	9.999	10 ± 0.005	Troemner
↓	↓	100 mg	100.009	100 ± 0.100	SN 48411
↓	↓	2 mg	1.998	2 ± 0.005	File # 01797
12/18/15	MMS	10 mg	10.000	10 ± 0.005	Troemner
↓	↓	100 mg	100.009	100 ± 0.100	SN 48411
↓	↓	2 mg	2.000	2 ± 0.005	File # 01797
1/7/16	MMS	10 mg	9.999	10 ± 0.005	Troemner
↓	↓	100 mg	100.003	100 ± 0.100	SN 48411
↓	↓	2 mg	2.000	2 ± 0.005	File # 01797
1/13/16	MMS	10 mg	10.000	10 ± 0.005	Troemner
↓	↓	100 mg	100.001	100 ± 0.100	SN 48411
↓	↓	2 mg	1.998	2 ± 0.005	File # 01797
1/28/16	MMS	10 mg	10.001	10 ± 0.005	Troemner
↓	↓	100 mg	100.007	100 ± 0.100	SN 48411
↓	↓	2 mg	1.998	2 ± 0.005	File # 01797

Signature: Date: Title:

Witness: Date: Title:

TITLE DSC

12HHF 12/3/15

Continued from page

Purpose: Run DSC analysis on WIPP formulation.

Method: 10°C/min, 40→400°C in 50ml/min flow.

Instruments: TA Instruments Q2000, SN 1000-0477
Sartorius CPA-2P Microbalance, SN 25207183

Materials: ~~Hermand~~ was Hermetically sealing Al pans.
UHP N_2 gas

Reference pan: 58.461

Sample	pan wt	Sample wt
Indium Metal Lot# B087008	57.942	4.056 ~~0.4 mmol~~
Pan Blank	57.779	—
PETN 9401B	58.430	1.029
PWL-V-103 WIPP SFWB8-25-4-1	58.260	1.208
PWL-V-103 WIPP SFWB8-25-4-2	58.048	1.261
PWL-V-103 WIPP SFWB8-25-4-2	58.372	1.841
Indium Metal Lot# B087008	57.942	4.056
6) CompB (VLWM prep) (52220)	58.211	1.022
PBX 9502 88H-891-008	58.513	0.896
PBX 9501 HDL 89C-730-010	58.243	0.934
TNT Lot 22391	58.567	0.912
Polytek	58.478	0.805
Polytek + 9502	57.978	0.681/0.1636 1.317
Polytek + 9501	58.486	0.581/0.595 1.176
Polytek + TNT	58.024	0.459/~~0.484~~ 0.952 0.493

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Page C-3

TITLE DSC PROJECT December 8, 2015

Continued from page

Purpose: DSC on WIPP + Comparability

Method: 10°C/min 40→400°C ~~min~~ (450°C for 7A7B) in 50 ml/min UHP N2 gas.

Instrument: TA Instruments Q2000 DSC SN 1000-0477
Sartorius CPA 2P Microbalance SN 25207183

Materials - Numerically Sealing Al pans
pan lids for comparability ~~Sub~~ studies
UHP N2 gas

Reference 58.213

Sample	pan wt	Sample wt
Indium Std. (Lot B0870B)	58.427	5.329
Pan Blank	57.544	—
PETN 940/3	58.294	0.990
SFWB-15-4 12-7-15 (1)	58.455	1.198
SFWB-15-4 12-7-15 (2)	58.372	1.246
SFWB-15-4 12-7-15 (3)	58.521	1.350
~~Indium Std (Lot B0870B)~~		
SFWB-8-35-4 12-7-15 -(1)	57.963	1.502
SFWB-8-35-4 12-7-15 -(2)	58.508	1.459
SFWB-8-35-4 12-7-15 -(3)	58.339	1.322
Indium Std Lot B0870B	58.427	5.329

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SIGNATURE DATE

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December 18, 201

Continued from page

Purpose: Run DSC analysis on WIPP sample

Method. 10°C/min 40→400°C in 50 ml/min UHP N_2 gas

Instruments: TA Instruments Q2000 DSC, SN# 1000-0477
Sartorius CPA-2P Microbalance, SN# 25207183

Materials: Hermetically sealing Al pans
UHP N_2 gas.

Reference 58.259 (MMS, 2/18/15) 58.263
1.838 mg

Sample	Amount	Sample wt
Indium Standard Lot # B08T008	58.427	5.329
Pan Blank	58.188	-
PETN 9401 B	58.188	0.973
SFWB8-25-1 (1)	58.442	3.693
SFWB8-25-1 (2)	58.356	3.590
SFWB8-25-1 (3)	58.316	3.438
SFWB8-25-2 (1)	58.491	2.382
SFWB8-25-2 (2)	58.604	2.862
SFWB8-25-2 (3)	58.111	3.256
Indium Standard Lot # B08T008	58.427	5.329

Continued to page

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TITLE DSC **PROJECT** January 7, 2016

Continued from page

Purpose: Run routine DSC analysis for compatibility, WIPP, & NRR's

Method: 10°C/min, 40→400°C (450 for TATB) w/ 50 ml/min UHP N_2 gas

Instrument: TA Instruments Q2000 DSC - SN# 1000-0477
Sartorius CPA 2P Microbalance - SN# 25267183

Materials: Hermetically sealing Al pans w/ pinhole lids.
W/out pinhole lids for WIPP samples
UHP N_2 gas

Reference 58.344

Sample	pan wt		Sample wt
Indium Standard Lot # B08T0Q8	58.437		5.329
Pan Blank	58.123		—
PETN 9401-13	58.303	0.959	~~0.983~~
Vaseline	58.910		1.320
PETN + Vaseline	58.225		1.045
SFWB8-15-1 (1)	57.851		3.766
SFWB8-15-1 (2)	58.068		3.837
SFWB8-15-1 (3)	57.071		2.355
SFWB8-35-1 (1)	58.015		2.903
SFWB8-35-1 (2)	58.408		2.266
SFWB8-35-1 (3)	57.300		2.478
Indium Standard Lot # B08T008	58.437		5.329

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BOOK PAGE

TITLE PROJECT January 28, 2016

Continued from page

Purpose: Run DSC analysis of WIPP Samples

Method: 10°C/min in 50mL/min UHP N2 gas
40 → 400 °C

Instruments: TA Instruments Q2000 SN# 2000-1067
Sartorius CPA2P Microbalance SN# 25207183

Materials: Hermetically sealing Al pans UHP N2 gas

Reference: SS.003

Sample	pan wt	Sample wt
Indium Standard Lot # B08T008	57.445	12.312
Pan Blank	58.317	—
PETN 9401	58.268	0.918
~~Std~~ SFWB8-15-2 (1)	58.696	3.605
SFWB8-15-2 (2)	58.445	1.229
SFWB8-15-2 (3)	57.970	2.664
SFWB8-35-2 (1)	58.494	1.856
SFWB8-35-2 (2)	~~59.348~~ 59.240	3.690
SFWB8-35-2 (3)	~~58.209~~ 58.590	2.432
Indium Standard Lot # B08T008	57.445	12.312

Continued to page

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TITLE Lab 52219 PROJECT

Continued from page Start

12/2/15 PETN Standard

- Material: PETN 0601-02 L298
- Balance Book: ~~011-14~~ 011-14 (HT 230045 12/2/15)
- Room temperature: 20.5°C
  Relative Humidity: 32%
- ESD Test: 0.025 J

12/3/15 PETN standard

- Material: PETN 0601-02 L298
- Balance Book: 011-14
- Balance: Mettler Toledo File#: 037682 ID: 1129082227
  Certified: 7/21/15 Expires: 6/30/16
- Weight Set: Ainsworth Weight Set TFA: 01736 File#: 033587
  Certified: 2/14/14 Expires: 2/14/16
- Room Temperature: 20.0°C
  Relative Humidity: 32%
- Friction Test: F50 = 79.2N σ = 9.9N
- DWI Test: H50 = 9.3 cm σ = 2.7 cm

HT 230045 12/3/15

Continued to page Stop

SIGNATURE Hongzhou Jiang DATE 12/3/15

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PROPRIETARY INFORMATION BELONGING TO Los Alamos Research Laboratories

TITLE Lab: 52219; LIMS: 15120100| PROJECT WIPP

Continued from page Start

12/3/15

- Sample: PWL-V-103 WIPP SFWB 8-25-4

- Room Temperature: 20.0°C
  Relative Humidity: 32%

- ESD: Test1: 0.025 J
  Test2: 0.025 J
  Test3: 0.025 J

- FRI: Test1: F50 > 360N; σ = NA
  Test2: F50 > 360N; σ = NA
  Test3: F50 > 360N; σ = NA

12/4/15 (- continued)

- Sample: PWL-V-103 WIPP SFWB 8-25-4

- Room Temperature: 20.5°C
  Relative Humidity: 32%

- DWI: Test1: H50 > 320 cm; σ = NA
  Test2: H50 > 320 cm; σ = NA
  Test3: H50 > 320 cm; σ = NA

Note: This sample is lead-containing. All of the waste was collected into a plastic bag and put in the waste container in TA-9-21-120.

HT 230045 12/4/15

Continued to page Stop

SIGNATURE Hongmao Jiao

DATE 12/4/15

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PROPRIETARY INFORMATION BELONGING TO Los Alamos Research Laboratories

TITLE Lab 52219; LIMS 151208001 PROJECT WIPP

Continued from page Start

12/8/15

- Sample: SFWB-15-4 12-7-15 LIMS 151208001

- Room Temp: 21.0°C
  Relative Humidity: 32%

- ESD: Test1: 0.0625 J
  Test2: 0.0625 J
  Test3 0.0625 J

- FRI: Test1: F50 > 360N; σ = NA
  Test2: F50 > 360N, σ = NA
  Test3: F50 > 360N, σ = NA

12/9/15

- Sample: SFWB 8-35-4 12-7-15 LIMS#: 151208002
- Room Temp: 21.0°C
  Relative Humidity: 34%
- ESD: Test1 0.0625 J
  Test2 0.025 J
  Test3: 0.0625 J
- FRI: Test1: F50 > 360N; σ = NA
  Test2: F50 > 360N; σ = NA
  Test3 F50 > 360N: σ = NA

- Sample: SFWB-15-4 12-7-15 LIMS# 151208001
  Balance Book: 011-15
  Balance: Mettler Toledo File# 037682 ID: 1129082227
  Certified 7/21/15 Expires: 6/20/16
  Weight Set: Ainsworth Weight Set TFG# 01736 File # 033587
  Certified 2/14/14 Expires: 2/14/16

Continued to page ~~27~~ 26

SIGNATURE	DATE
Hongshao Jiao	12/9/15
DISCLOSED TO AND UNDERSTOOD BY: N/A	DATE: NA

PROPRIETARY INFORMATION BELONGING TO: Los Alamos Research Laboratories

TITLE Lab 52219; LIMS: 151208001 151208002 PROJECT WIPP

Continued from page 25

LIMS 151208001 { IMP Test 1: HSO > 320 cm σ = NA
Test 2: HSO > 320 cm σ = NA
Test 3: HSO > 320 cm σ = NA

12/10/15

- Sample: SFWB 8-35-4 12-7-15
Balance Book: 011-15
Balance: Mettler Toledo File# 037682 ID: 1129082227
Certified: 7/21/15 Expires: 6/20/16
Weight Set: Ainsworth weight set TFE: 01736 File# 033587
Certified: 2/14/14 Expires: 2/14/16
Room Temperature: 22°C
Relative Humidity: ~~35%~~ 33% (HT 230045 12/10/15)

IMP Test 1: HSO > 320 cm; σ = NA
Test 2: HSO > 320 cm; σ = NA
Test 3: HSO > 320 cm, σ = NA

HT 230045 12/10/15

Continued to page Stop

SIGNATURE Hongshan Jiao DATE 12/10/15

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Los Alamos National Laboratories

BALANCE CALIBRATION LOG

Page C-11

BOOK 011 PAGE 15

Balance: Mettler Toledo File# 037682 **ID Number:** 1129082227 Exp 6/20/16

Date	Initials	Calibration Weight	Actual Weight	Control Parameters	Maintenance and Adjustments
12/9/15	HT	200.0 mg	200.00 mg	200.0 ± 0.5 mg	Ainsworth File# 033587 Exp 2/1
		300.0 mg	299.95 mg	300.0 ± 0.5 mg	
12/10/15	HT	200.0 mg	200.00 mg	200.0 ± 0.5 mg	Ainsworth File# 033587
		300.0 mg	299.97 mg	300.0 ± 0.5 mg	Exp. 2/14/16

12/10/15 200.00 300.05 HT

Signature: Hongzhuo Tian Date: 12/10/15 Title: Tech IV

Witness: NA Date: NA Title: NA

TITLE Lab 52219; LIMS 151215001 151215002 PROJECT WIPP

Continued from page Start

12/17/15

Samples: 1. SFWB 8-25-1, LIMS# 151215001
2. SFWB 8-25-2, LIMS# 151215002

Room Temp: 19°C
Relative Humidity: 32%

ESD:
- SFWB 8-25-1
  - Test 1: 0.0625 J
  - Test 2: 0.0625 J
  - Test 3: 0.025 J
- SFWB 8-25-2
  - Test 1: 0.025 J
  - Test 2: 0.0625 J
  - Test 3: 0.0625 J

Friction
- SFWB 8-25-1
  - Test 1: FS0 > 360N; σ = NA
  - Test 2: FS0 > 360N; σ = NA
  - Test 3: FS0 > 360N; σ = NA
- SFWB 8-25-2
  - Test 1: FS0 > 360 ~~cm~~; σ = NA
  - Test 2: FS0 > 360 ~~cm~~; σ = NA
  - Test 3: FS0 > 360 ~~cm~~; σ = NA

(H1 290045 12/18/15)

12/18/15

Room Temp: 19°C
Relative Humidity: 32%
Balance Book: 01-16
Balance: Mettler Toledo File# 037682 ID: 1129082227
Certified: 7/21/15 Expires: 6/20/16
Weight Set: Ainsworth Weight Set TFG: 01736. File# 033587. Exp. 2/18/16

IMP
- SFWB 8-25-1
  - Test 1: H50 > 320 cm; σ = NA
  - Test 2: H50 > 320 cm; σ = NA
  - Test 3: H50 > 320 cm; σ = NA
- SFWB 8-25-2
  - Test 1: H50 > 320 cm; σ = NA
  - Test 2: H50 > 320 cm; σ = NA
  - Test 3: H50 > 320 cm; σ = NA

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SIGNATURE Hongzhou Jiao DATE 12/18/15

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BALANCE CALIBRATION LOG

Los Alamos National Laboratorie

Balance: Mettler Toledo File# 037682 **ID Number:** 1129082227 Exp. 6/20/16

Date	Initials	Calibration Weight	Actual Weight	Control Parameters	Maintenance and Adjustments
12/17/15	HT	200.0mg	199.99 mg	200.0 ±0.5mg	Ainsworth File# 033587
		300.0 mg	300.00 mg	300.0 ±0.5mg	Exp. 2/14/16
12/18/15	HT	200.0 mg	199.98 mg	200.0±0.5 mg	Ainsworth File# 033587
		300.0 mg	300.00 mg	300.0±0.5mg	Exp. 2/14/16

12/18/15
230045
HT

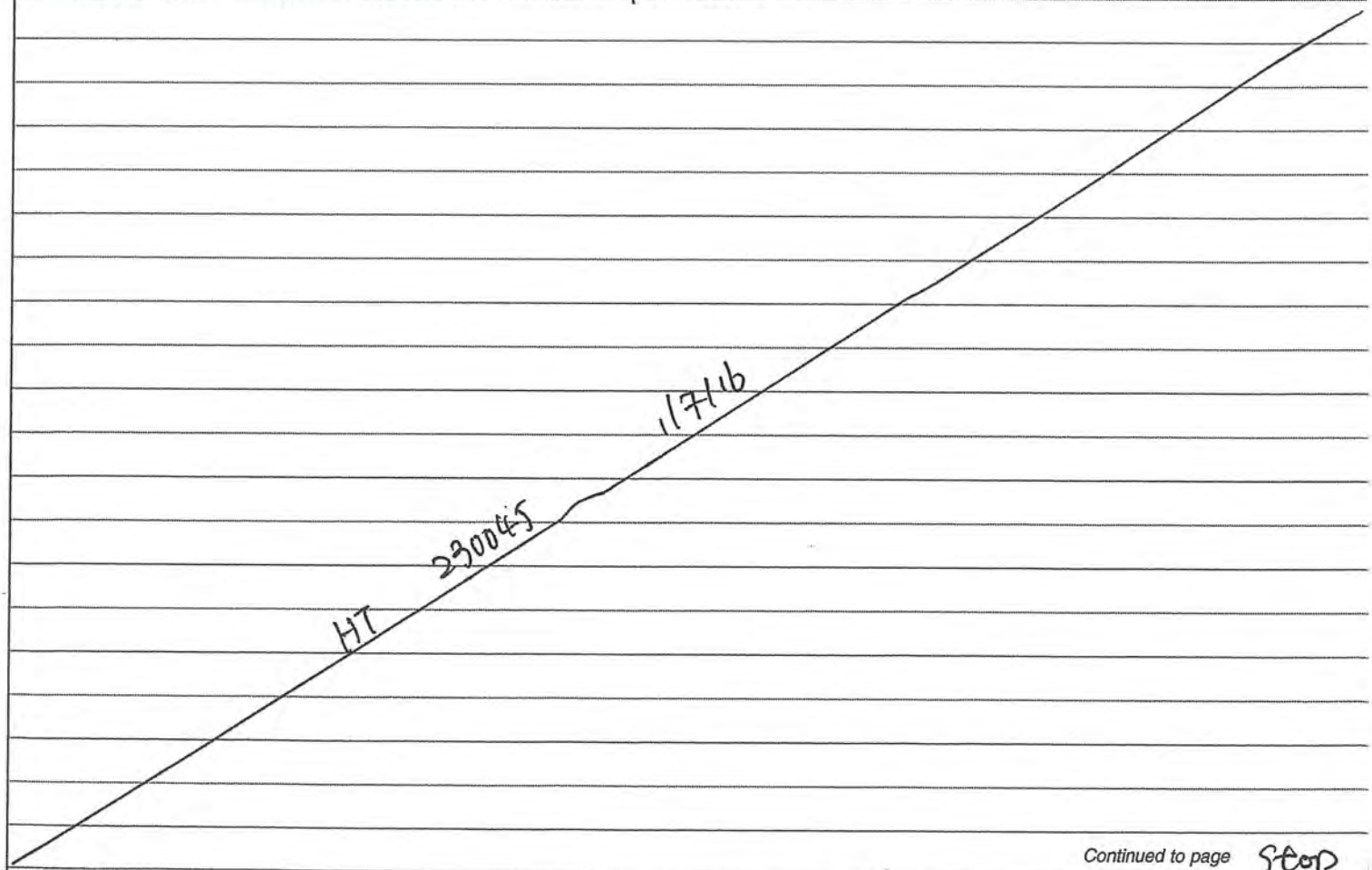
Signature: Hangzhuo Jiang Date: 12/18/15 Title: Tech IV

Witness: NA Date: NA Title: N/A

TITLE PETN Standard for Jan. 2016 PROJECT

Continued from page Start

- Material: PETN 0601-02 L298
- Balance: Mettler Toledo File #: 037682 ID: 1129082227
  Certified: 7/21/15 Expires: 6/20/16
- Weight Set: Ainsworth weight set TFG: 01736 File #: 033587
  Certified: 2/14/14 Expires: 2/14/16
- Balance Book: 011-17
- Room temp: 19.5°C
  Relative humidity: 31%
- ESD: 0.025 J
- FRI: Mu = 78.2 N σ = 17.3 N
- IMP: Mu = 10.9 cm σ = 1.2 cm



Continued to page Stop

SIGNATURE Hongzhou Tian

DATE 1/7/16

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DATE

PROPRIETARY INFORMATION BELONGING TO
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BOOK PAGE

TITLE Lab 52219, LIMS 160105009 160105010 PROJECT WIPP samples

Continued from page Start

- Samples: LIMS: 160105009 SFWB 8-15-1
  LIMS: 160105010 SFWB 8-35-1

01/06/16

- Room temp: 21°C
  Relative humidity: 33%

- ESD: SFWB 8-15-1
  - Test 1: 0.025 J
  - Test 2: 0.025 J
  - Test 3: 0.025 J

  SFWB 8-35-1
  - Test 1: 0.025 J
  - Test 2: 0.025 J
  - Test 3: 0.025 J

- FRI: SFWB 8-15-1
  - Test 1: F50 > 360 N, σ = NA
  - Test 2: F50 > 360 N, σ = NA
  - Test 3: F50 > 360 N, σ = NA

  SFWB 8-35-1
  - Test 1: F50 > 360 N, σ = NA
  - Test 2: F50 > 360 N, σ = NA
  - Test 3: F50 > 360 N, σ = NA

01/07/16

- Room Temp: 20°C
- Relative Humidity: 32%
- Balance book: 011-17
- Balance: Mettler Toledo File# 037682 ID: 1129082227 Exp. 6/29
- Weight set: Ainsworth weight set TFG#: 01736 File# 033587
  Exp. 2/19/16
- IMP: SFWB 8-15-1
  - Test 1: H50 > 320 cm, σ = NA
  - Test 2: H50 > 320 cm, σ = NA
  - Test 3: H50 > 320 cm, σ = NA

  SFWB 8-35-1
  - Test 1: H50 > 320 cm, σ = NA
  - Test 2: H50 > 320 cm, σ = NA
  - Test 3: H50 > 320 cm, σ = NA

Continued to page Stop

SIGNATURE Hongshen Tian DATE 1/7/16

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PROPRIETARY INFORMATION BELONGING TO Los Alamos Research Laboratories

Balance: Mettler Toledo File# 037682 ID Number: 1129082227 Exp. 6/20/16

Date	Initials	Calibration Weight	Actual Weight	Control Parameters	Maintenance and Adjustments
1/4/16	HT	200.0 mg	200.02	200.0 ± 0.5 mg	Ainsworth File # 033587
		300.0 mg	299.98	300.0 ± 0.5 mg	Exp. 2/14/16
1/5/16	HT	200.0 mg	199.98	200.0 ± 0.5 mg	Ainsworth File # 033587
		300.0 mg	299.97	300.0 ± 0.5 mg	Exp. 2/14/16
1/6/16	HT	200.0 mg	200.01	200.0 ± 0.5 mg	Ainsworth File # 033587
		300.0 mg	299.98	300.0 ± 0.5 mg	Exp 2/14/16
1/7/16	HT	200.0 mg	200.00	200.0 ± 0.5 mg	Ainsworth File# 033587
		300.0 mg	299.98	300.0 ± 0.5 mg	Exp. 2/14/16

1/7/16 2300645 HT

Signature: Hanghao Tian Date: 1/7/16 Title: Tech IV

Witness: N/A Date: N/A Title: N/A

TITLE Lab # 52219 PROJECT WIPP samples

Continued from page Stent

- Samples: LIMS: 160112001 SFWB 8-35-2
  160112002 SFWB 8-15-2

01/13/16

- Room temp: 19.0°C
  Relative humidity: 32%
- ESD: SFWB8-35-2 { Test1: 0.025 J
  Test2: 0.025 J
  Test3: 0.025 J
  SFWB 8-15-2 { Test1: 0.025 J
  Test2: 0.025 J
  Test3: 0.025 J

01/14/16

- Room Temp: 18°C
- Relative humidity: 31%
- Balance Book:
- Balance: Mettler Toledo File # 037682 ID: 1129082227
  Expire: 6/20/16
- Weight set: ~~Ainsworth~~ HT 230045 TFG02060 Heusser Neweigh, ASTM Class 1
  File # 040984 Exp. 5/31/17
- SFWB 8-35-2 { F50 > 360N σ = NA H50 ≥ 320cm σ = NA
  F50 > 360N σ = NA H50 > 320cm σ = NA
  F50 > 360N σ = NA H50 > 320cm σ = NA

  SFWB 8-15-2 { F50 > 360N σ = NA H50 > 320cm σ = NA
  F50 > 360N σ = NA H50 > 320cm σ = NA
  F50 > 360N σ = NA H50 > 320cm σ = NA

Continued to page Stop

SIGNATURE Hongzhao Tian DATE 01/14/16

DISCLOSED TO AND UNDERSTOOD BY NA DATE NA

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BALANCE CALIBRATION LOG

Los Alamos National Laboratorie

Balance: Mettler Toledo File# 037682 **ID Number:** 1129082227 Exp. 6/20/16

Date	Initials	Calibration Weight	Actual Weight	Control Parameters	Maintenance and Adjustments
1/12/16	HT	200.0 mg	199.99	200.0 ± 0.5 mg	Ainsworth File# 033587
		300.0 mg	299.97	300.0 ± 0.5 mg	Exp. 2/14/16
1/14/16	HT	200.0 mg	200.00	200.0 ± 0.5 mg	Heusser Neweigh Test. ASTM.
		500.0 mg	500.00	500.0 ± 0.5 mg	File# 040984 Exp 5/31/17

1/14/16 HT 230045

Signature: Huyphuo Tran Date: 1/14/16 Title: Tech IV

Witness: NA Date: NA Title: NA

TITLE

PROJECT

Continued from page

9/14/15 New APTAC delivered + installed. power Transformer inside was jared loose during shipping. Mike placed it back in place hard wired for 240V.

9/16/15 made 20% DTBP + Toluene in Bomb. 7g/35g. Standard Test. Bomb Vol 130mL, START Temp 95, Limit 265, Heat 5C/m, Cooldown 50 exotherm Threshold. 0.04 exotherm Limit. 250.00 Heat rate 2C/m.
9/17/15 STANDARD RUN Looked good.

1:55 Install complete Pressure initial settings in Kpa

		Transducer zero
Reaction vessel	15.0	44.1
Containment vessel	14.9	26.9
Simple Vent	14.9	22.3
Ishot vessel	~~18.0~~ 15.4	47.7

9/29/15 starting calibration with 10mL sample vessel.

Titanium. vessel 41.66g

	Transducer zero
Vessel = 0	29.1
Containment vessel = 0	12.
Simple Vent = 0	7.4
Ishot Vessel = 0	32.2

Continued to page

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PROPRIETARY INFORMATION BELONGING TO

TITLE WIPP PROJECT

Continued from page

11/3/15 Temperature Verification + Pressure verification
APTAC model: APTAC 264
SERIAL number: 002L0715-6060002447

Omega Handheld RTD Thermometer - Calibrated 7/27/15
model: 869C
SERIAL #: T-308219

Vessel Thermocouple + meter RTD connected To copper Block, wrapped with Heat Tape strip. Controlled with VARIAC.

Using calibrated omega pressure gauge: File: 104079

Temperature RTD (°C)	APTAC (°C)	Gauge (psi)	Reaction vessel APTAC (psi)
29.7	30	25	25
38	40	50	50
47.9	50	75	75
58.1	60	100	100
67.4	70	150	150
77.5	80	201	200
87.5	90	251	250
97.5	100	302	300
107.8	110	352	350
117.7	120	402	400
127.3	130	451.5	450
137.4	140	501.5	500
147.2	150		
157	160		

* Default Pressure parameters may need to be changed prior to Runs. If starting pressures are not zeroed APTAC will not run.

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SIGNATURE [signature] DATE 11/3/15

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TITLE WIPP

PROJECT

Continued from page

1/5/16

APTAC model: APTAC 264

SERIAL #: 002L0715-606002447

Sample vessel empty weight: 41.7084 g (10mL Titanium sample vessel)
Weight Taken on mettler Toledo scale TFG#02049, File#040858
model: XP504

WIPP sample: SFWB8-15-1 Lims#1601[illegible]5009

Weight Taken on mettler Toledo scale TFG#02049, File#040858
model: XP504

Sample weight: 4.0037 g
Lab wool on top: .0800 g

START Temp: 30C
Limit Temp: 250C
Temp increment: 2C
Cool Down Temp: 50C
mode: HWS

ExoTherm Threshold: 0.05C
ExoTherm Limit: 400C
Heat Rate: 2C/min,
min pressure: 0PSI

File name: LAB52195FWB8-15-1

Some Liquid Residue

Some plugging of system.

Continued to page

SIGNATURE

DATE 1/6/16

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Continued from page

1/12/16
APTAC model: APTAC 264
serial #: 002L0715-606002447

Sample vessel empty weight: 41.7056 g (10mL Titanium sample vessel)
weight Taken on mettler Toledo scale TFG# 02049, File # 040858
model: XP504

WIPP Sample: SFWB8-15-2 Lims#
weight Taken on mettler Toledo scale TFG# 02049, File # 040858
model: XP504

SAMPLE weight: 4.0039 g
glass Wool on top: 0.0830 g

START Temp: 30C — Exotherm Threshold: 0.05 C
Limit Temp: 250C — Exotherm Limit: 400C
Temp increase: 2 C — Heat Rate: 2C/min
cool Down Temp: 50C — Min. Pressure: 0 psi
mode: HWS

File Name: Lab 52219 SFWB8-15-2

Comments: 1.87g Residue some unreacted material

No plugging

Continued to page

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Continued from page

12/8/15

APTAC model : APTAC 264

SERIAL #: 002L0715-606002447

Sample vessel empty weight 41.7023 g (10 mL Titanium sample) vessel weight TAKEN on METTLER Toledo scale TFG# 02049, File# 040858 model: XP504

WIPP sample : SFWB-15-4

Weight TAKEN on METTLER Toledo SCALE TFG# 02049, File# 040858 model : XP504

Sample weight : 4.0023g

glass wool on Top : .0798g

START Temp : 30C

Limit Temp : 250 C

Temp increment : 2C

Cool down Temp : 50 C

mode ; HWS

Exotherm Threshold : 0.05C

Exotherm Limit : 400 C

heat RATE : 2C/min

min. PRESSURE : 0 psi

File NAME : LAB52219 SFWB-15-4

NOTE

Reaction vessel was very slow to vent, suspect some plugging of Lines. Rest of system vented but Reaction vessel slow from around 250 psi to 38 psi. Will not go below 38.7 pressure increase with system vented back to this pressure. attempting to Remove Reaction vessel. PRESSURE @ 39.5 psi placing shield in place before Loosening nut, on vessel, SMALL Amount of unreacted material in Reaction vessel. PRESSURE in false Reading due to Plugging during venting, flushed system with H_2O.

Continued to page

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BOOK PAGE

TITLE WIPP

PROJECT

Continued from page

12/16/15
APTAC model: APTAC 264
serial # 00210715-606002447

Sample vessel empty weight 41.6981g (10 mL Titanium Sample vessel)
Weight Taken on mettler Toledo scale TFG# 02049, F.L.# 040858
model: XP504

WIPP sample: SFWB8-25-1 Lims: 151215001
weight Taken on mettler Toledo scal TFG# 02049, F.L.# 040858
model: xp504

Sample weight: 4.0039 g
Glass wool on top: .0822 g

START Temp: 30C
Limit Temp: 250 C
Temp increment: 2C
cool Down Temp: 50C
mode: HWS

Exotherm Threshold: 0.05C
Exotherm Limit: 400C
Heat Rate: 2C/min
MIN PRESSURE: OPSI

file name: LAB522195FWB8-25-1

* System plugged again 525 psi Trapped in vessel @ the Transducer, Lines Removed & flushed to Remove debris.

Continued to page

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TITLE WIPP PROJECT

Continued from page

12/17/15

APTAC model: APTAC 264
Serial#: 002L0715-606002447

sample vessel empty weight: 41.7060 g (10mL TITANIUM SAMPLE VESSEL)
weight taken on mettler Toledo SCALE TFG# 02049, file# 040858
model; XP504

WIPP Sample: SFWB8-25-2 Lims# 15121502
weight taken on mettler Toledo SCALE TFG# 02049, File# 040858
model; XP504

SAMPLE weight: 4.0048 g
glass wool on top: .0822 g

START Temp: 30 C
LIMIT Temp: 250 C
Temp increment: 2 C
cool Down Temp: 50 C
mode: HWS

EXOTHERM THRESHOLD: 0.05 C
EXOTHERM LIMIT: 400 C
HEAT RATE: 2 C/min
min PRESSURE: 0 PSI

File Name: LAB 52219 SFWB8-25-2

Continued to page

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TITLE WIPP PROJECT

Continued from page

12/3/15
APTAC model: APTAC 264
Serial #: 002L0715-60600 2447

Sample vessel empty weight 41.7026g (10mL Titanium sample) vessel weight Taken on mettler Toledo scale TFG# 02049, file #040858 model: XP504

WIPP sample: SFWB8-25-4
weight TAKEN on mettler Toledo scale TFG# 02049, file# 040858 model: XP504

Sample Weight: 4.0062g
glass wool on top: .0822g

START Temp: 30C	Exotherm Threshold: 0.05C
Limit Temp: 250C	Exotherm Limit: 400C
Temp increment: 2C	heat RATE: 2C/min
Cool Down Temp: 50C	min pressure: 0psi

Mode: HWS

file name: LAB 52219 SFWB-25-4

NOTE
* When system was vented after the Run. Exposing it to AIR The Reaction vessel still showed signs of small Reactivity. Pressure in vessel increased back up To 8 To 9 psi. The Rest of The system was stable @ 0psi.

.77g of material Recovered from sample vessel. Excluding glass.

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Continued from page

1/7/16

APTAC model: APTAC264
Serial #: 002L0715-606002447

Sample vessel empty weight: 41.7098 g (10mL Titanium Sample Vessel)
Weight Taken on Mettler Toledo Scale TFG#02049, File# 040858
model: XP504

WIPP Sample: SFWB8-35-1 Lims# 160105010
Weight Taken on Mettler Toledo Scale TFG#02049, File# 040858
model: XP504

Sample weight: 4.0016 g
Glass wool on top: 0.0812 g

Start Temp: 30C — Exotherm Threshold: 0.05C
Limit Temp: 250C — Exotherm Limit: 400C
Temp increment: 2C — Heat Rate: 2C/min
Cool down Temp: 50C — min. Pressure: 0PSI.
mode: HWS

File name: LAB522195FWB8-35-1

Continued to page

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Continued from page

1/14/16
APTAC model: APTAC 264
Serial #: 002L0715-60600244 7

Sample Vessel empty weight: 41.7089 g (10mL Titanium sample vessel)
Weight Taken on Mettler Toledo scale TFG# 02049, File# 040858
model: xp 504

Wipp Sample: SFWB8-35-2 Lims: 160112001
Weight Taken on mettler Toledo scale TFG# 02049, File 040858
model: xP504

Sample weight: 4.0061 g
Glass wool on Top: .0824 g

Start Temp: 30C
Limit Temp: 250C
Temp Increment: 2C
Cool Down Temp: 50C
mode: HWS

Exotherm Threshold: 0.05 C
Exotherm Limit: 400C
Heat Rate: 2C/min.
min pressure: 0PSI

Filename: LA052219SFWB8-35-2

comments:

Continued to page

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TITLE WIPP

PROJECT

Continued from page

12/10/15

APTAC model: APTAC 264

serial #: 002L0715-606002447

Sample vessel empty weight 41.7062g (10mL Titanium sample vessel)

Weight Taken on mettler Toledo scale TFG#02049, file# 040858

model: xp504

WIPP Sample: SFWB 8-35-4, Lims: 151208002

weight Taken on mettler Toledo scale TFG#02049, file#040858

model: xp504

Sample weight: 4.0075 g

glass wool on Top: .0822 g

START Temp: 30C

Limit Temp: 250C

Temp increment: 2C

cool Down Temp: 50C

mode: HWS

ExoTherm Threshold: 0.05C

ExoTherm Limit: 400C

Heat Rate: 2C/min

min Pressure: 0PSI

file name: Lab52219 SFWB8-35-4

Continued to page

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TITLE

PROJECT

Continued from page

2/8/16 20% DTBP in Toluene

DTBP: Barcode: 1352757
Toluene Barcode: 1352363

Vessel WT: 53.87g NONUTOR graphite seal.

7g DTBP + 28g Toluene = 35g

START 95C
Limit 265C
Increment 5C
Cool down 50C
Exotherm Threshold 0.04
Exotherm Limit 250C
heat rate 2C
Level 270C
min pressure 101.5

Continued to page

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LOS ALAMOS NATIONAL LABORATORY

PTN #: 1673230 Chem log 09/03/2015
1352756
1352757

DROP PT: 09002901S RT: 4C

DELIVER TO: (118813)Brown, Geoffrey Wayne (

PHONE#: 505-667-6718

AC349932500 ACROS Organics N

VENDOR:

GOVERNMENT SCIENTIFIC SOURCE-P2650800

ORDER TYPE: STANDARD

ITEM#:

PART#: AC349932500

QTY: 2.0 Each STR LEV:

DESCRIPTION:

AC349932500 ACROS Organics No.:349932500

Di-tert-butyl peroxide99Application:Radical

PO#: 350508 , LN: 1, SHP: 1

Required: Chmlg QA ML4NOINSP

Lot A0339376



ACROS ORGANICS

Version	2
Molecular weight	146.23
Molecular formula	C8 H18 O2
CAS No	110-05-4
Linear formula	(CH3)3COOC(CH3)3
Flash point (°C)	6

Certificate of Analysis

This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for use in manufacturing, consumption or application of drugs, cosmetics, dialysis, parenteral or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	34993	**Quality Test / Release Date**	9 April 2015
Lot Number	A0339376	**Suggested Retest Date**	April 2016
Description	Di-tert-butyl peroxide,99%		
Country of Origin	NETHERLANDS		
Declaration of Origin	synthetic		

Origin Comment	

Result Name	Specifications	Test Value
Appearance	clear liquid	clear liquid
Infrared spectrometry	Authentic	Authentic
GC	>=98.5 %	99.7 %
Refractive index	1.3880 to 1.3900 (20°C, 589 nm)	1.3889 (20°C, 589 nm)
GC	=<0.1 % Tert-butyl hydroperoxide	0.04 % Tert-butyl hydroperoxide



L. Van den Broek, QA Manager

Issued: 4 September 2015

Acros Organics
ENA23, zone 1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Reagent Lane, Fair Lawn, NJ 07410,USA Fax 201-796-1329

PACKING SLIP

Government Scientific Source, Inc.
12351 Sunrise Valley Drive, Reston, Virginia 20191
*(800) 248-8030 * (703) 734-1805*
Fax (703) 734-1803

Shipment Number: 1301021
Shipment Date: 08/26/15

Bill To:

DOE / LOS ALAMOS NATIONAL LAB
DO NOT DROP SHIP
O
eCommerce, GSS will create the
Shipping Notice, Net 30 Days
LOS ALAMOS, NM 87545
United States

Customer ID LOS ALAMOS
Our Order No. **S836479**
SalesPerson ROSALIE GOMEZ

Ship To:

LANL for US DOE/NNSA
BROWN, GEOFFREY
350508
Bikini Atoll Road
SM-30 Warehouse
Los Alamos, NM 87545
United States

Tracking No. 425142 CHEM
P.O. Number **350508**
P.O. Date 08/18/15
Ship Via GSS

Supplier	Item No.	Description	Unit	Shipped	Ordered	Back Ordered
FISHER SCI	AC349932500	Di-tert-butyl Peroxide 250gr	Each		2	2
FISHER SCI	T324500	Toluene Certified Acs 500ml	Each	2	2	

152579 — B/C 1352363
Lot 152579 — B/C 1352364

PMR 11813
6/27/15

Fisher Scientific

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0064970

This is to certify that units of the lot number below were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not claim regulatory coverage under 21 CFR nor maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	**T324**	**Quality Test / Release Date 4/9/2015**	
Lot Number	**152579**		
Description	**TOLUENE, A.C.S.**		
Country of Origin	**United States**	*** Suggested Retest Date**	**Apr-2020**
Chemical Origin	**Organic - non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	CLEAR, COLORLESS LIQUID
ASSAY	%	>= 99.5	99.9
COLOR	APHA	<= 10	5
COPPER (Cu)	ppm	<= 0.1	<0.01
EVAPORATION RESIDUE	%	<= 0.001	<0.0001
HEAVY METALS (as Pb)	ppm	<= 0.1	<0.10
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
IRON (Fe)	ppm	<= 0.1	<0.01
NICKEL (Ni)	ppm	<= 0.1	<0.01
SUBSTANCES DARKENED BY H2SO4	PASS/FAIL	= PASS TEST	PASS TEST
SULFUR COMPOUNDS	%	<= 0.003	<0.0030
WATER (H2O)	%	<= 0.03	0.003



Edgar E. Hess

Lab Manager BPF

Appendix X
WX-7-AC-51933 Analytical Laboratory Report
May 31, 2014

WX-7 High Explosives Science & Technology

51933

Analytical Laboratory Report

Analytical Lab #: 51933

Requester: David Chavez **Group:** WX-7

Sample ID: Triethanolamine nitrate, Kolorsafe/5M HNO3/Swheat, Kolorsafe/1M HNO3/Swheat/NaNO

Tests Completed:			Analyst:
140528001			
	DSC	5/30/2014	SANDSTROM
	DWI - Neyer	5/31/2014	PRESTON
	ESD	5/31/2014	PRESTON
	FRICTION	5/31/2014	PRESTON
	VTS	5/31/2014	ARCHULETA
140528002			
	DSC	5/30/2014	SANDSTROM
	DWI - Neyer	5/31/2014	PRESTON
	ESD	5/31/2014	PRESTON
	FRICTION	5/31/2014	PRESTON
	VTS	5/31/2014	ARCHULETA
140528003			
	DSC	5/30/2014	SANDSTROM
	DWI - Neyer	5/31/2014	PRESTON
	ESD	5/31/2014	PRESTON
	FRICTION	5/31/2014	PRESTON
	VTS	5/31/2014	ARCHULETA

Analytical Lab #: 51933

Requester: David Chavez **Group:** WX-7

Sample ID: Kolorsafe/1M HNO3/Swheat/NaNO2

Tests Completed: **Analyst:**

This document deemed Unclassified by
Mary M. Sandstrom 5/31/14
(DC)

Validated: Shelda A. Jusa 6-2-14

Approved: Mary M. Sandstrom 5/31/14

Date Submitted: 5/28/2014

Date Completed: 5/31/2014

Los Alamos NATIONAL LABORATORY

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Los Alamos NATIONAL LABORATORY

memorandum

Weapons Experiments Division
WX-7: High Explosives Science & Technology

To/MS: Distribution
From/MS: Mary M. Sandstrom, WX-7
msandstrom@lanl.gov
Phone/Fax: 5-6813/Fax 7-0500
Symbol: WX-7-AC-14-040U
Date: June 2, 2014

Material Safety Release: Triethanolamine Nitrate, Kolor Safe/5M HNO3/Swheat, Kolor Safe/1M HNO3/Swheat

The following material and formulations, Triethanolamine Nitrate, Kolor Safe/5M HNO3/Swheat, Kolor Safe/1M HNO3/Swheat, submitted to WX-7 Analytical Chemistry on May 28, 2014, meet the safe handling requirements for secondary explosives as defined in P101-8, rev1, section 3.2.13.

NOTE: This memo documents the results of WX-7 high explosives safe handling and storage testing only and in no way certifies that this material meets all safety, compositional, or material requirements. All IWDs or other work control documents should be reviewed for suitability of this material for specific applications.

Lab Number 51933
Material Code **Triethanolamine Nitrate, Kolor Safe/5M HNO3/Swheat, Kolor Safe/1M HNO3/Swheat**
Manufacturer WX-7, Chavez

Test	Triethanolamine Nitrate	Kolor Safe/ 5M HNO3/ Swheat	Kolor Safe/ 1M HNO3/ Swheat	Reference
Impact (Type 12) H_{50} (cm)[a]	>320	>320	>320	PETN (RPS 3518) 12.9
Friction $Load_{50}$ (N)[b]	>360	>360	>360	PETN (RPS 3518) 84
Spark TIL (J)[c]	0.25	0.25	0.25	PETN (RPS 3518) .0625
DSC (10°C/min ramp in N_2 atmosphere)				
Onset of Decomposition (°C)	222	238	249	PETN (94-01B) 165
Peak Exotherm (°C)	270	272, 338	275, 331	PETN (94-01B) 206
Vacuum Stability (ml/g) (Gas evolved after 22hr @ 120 °C)	0.252	0.194	0.187	N/A

a. Drop height resulting in a "go" in 50% of samples obtained through a Neyer D-optimal testing method.
b. Force resulting in a "go" in 50% of samples obtained through a Neyer D-optimal testing method.
c. Threshold Initiation Level (3.4 % probability of reaction at specified energy level) based on a tape witness.

Distribution:
D, Chavez, WX-7, dechavez@lanl.gov
WX-7 Group Office
Cy: DCM file, MS P942

Reviewed:
Mary M. Sandstrom 6/2/14
M. Sandstrom I

Approved:
Sheldon A. Jason 6-2-14
WX-7 Group Office I

This document deemed Unclassified by
Mary M Sandstrom 6/4/14
(DC)

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EST. 1943

Sensitivity Testing Summary Memorandum

WX-7: High Explosives Science & Technology

From/MS: Daniel Preston, WX-7/ MS C920
Date: May 30, 2014
Lab#: 51933

Sample was tested as received.

ERL Type 12 IMPACT SENSITIVITY TESTING

The 50% drop height is determined using a 2.5 kg weight and the "*Neyer D-Optimal method.*"

SAMPLE, Date	Lab # / LIMs #	50% Height (cm)	σ (cm)
Triethanolamine nitrate, 5/30/2014	51933 / 140528001	>320	NA
Kolorsafe/5M HNO3/Swheat, 5/30/2014	51933 / 140528002	>320	NA
Kolorsafe/1M HNO3/Swheat/NaNO2, 5/30/2014	51933 / 140528003	>320	NA
PETN RPS 3518, 5/8/2014	NA	12.9	1.0

BAM FRICTION SENSITIVITY TESTING

The 50% load in N is determined using the "*Neyer D-Optimal method.*"

SAMPLE, Date	Lab # / LIMs #	50% Load (N)	σ (N)
Triethanolamine nitrate, 5/30/2014	51933 / 140528001	>360	NA
Kolorsafe/5M HNO3/Swheat, 5/30/2014	51933 / 140528002	>360	NA
Kolorsafe/1M HNO3/Swheat/NaNO2, 5/30/2014	51933 / 140528003	>360	NA
PETN RPS 3518, 5/8/2014	NA	84	12

ABL ELECTROSTATIC DISCHARGE (ESD) SENSITIVITY TESTING

SAMPLE, Date	Lab # / LIMs #	*TIL / **Screen (Joules)
Triethanolamine nitrate, 5/30/2014	51933 / 140528001	**0.25
Kolorsafe/5M HNO3/Swheat, 5/30/2014	51933 / 140528002	**0.25
Kolorsafe/1M HNO3/Swheat/NaNO2, 5/30/2014	51933 / 140528003	**0.25
PETN RPS 3518, 5/8/2014	NA	*0.0625

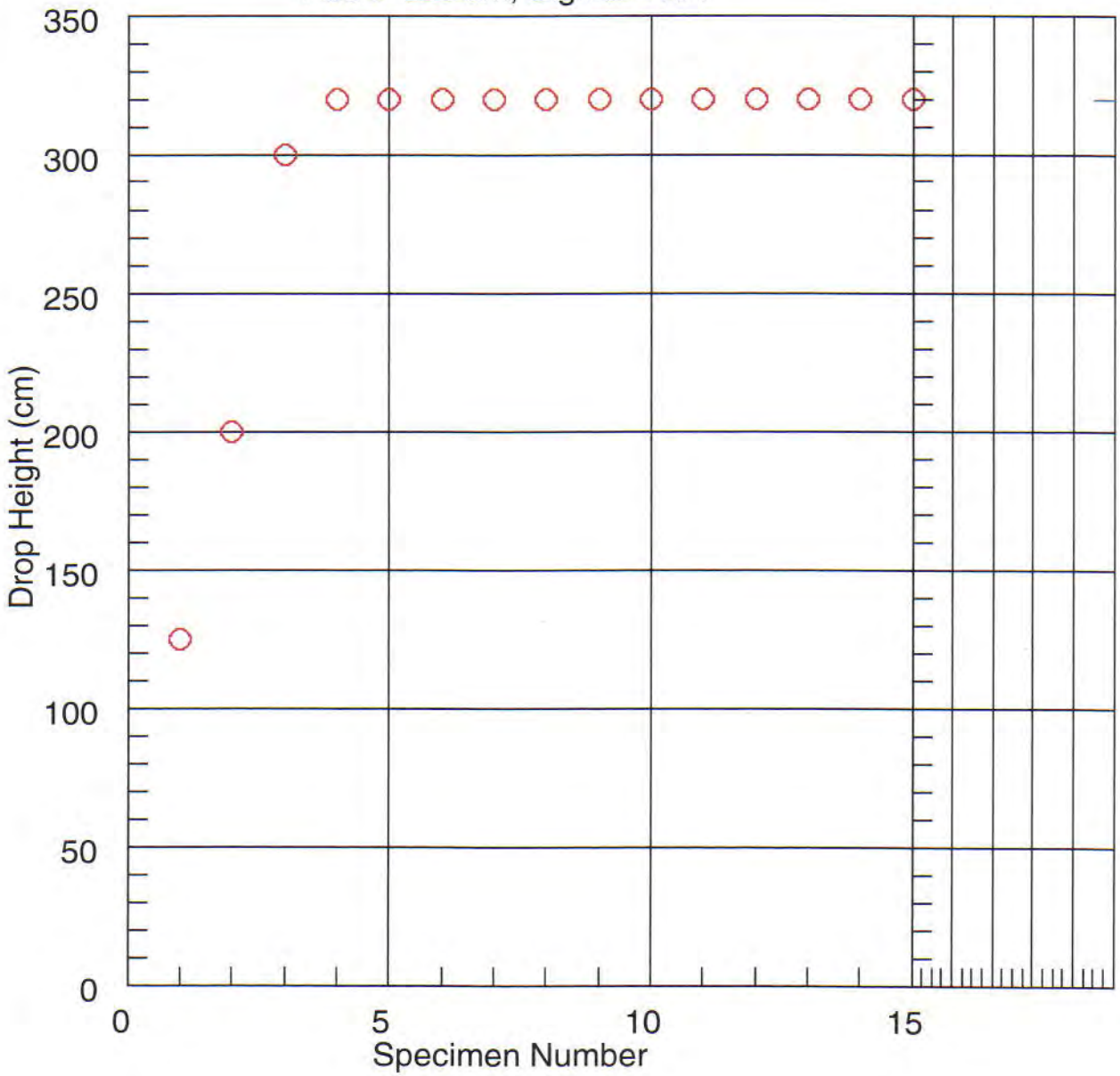
Distribution: WX-7 Analytical Lab

ERL Type 12 Impact Sensitivity: *Neyer D-Optimal Method*

Analytical Lab#: 51933, LIMS#: 140528001

Material: **Triethanolamine nitrate,** Date: **5/30/2014**

H50 > 320 cm, Sigma = NA



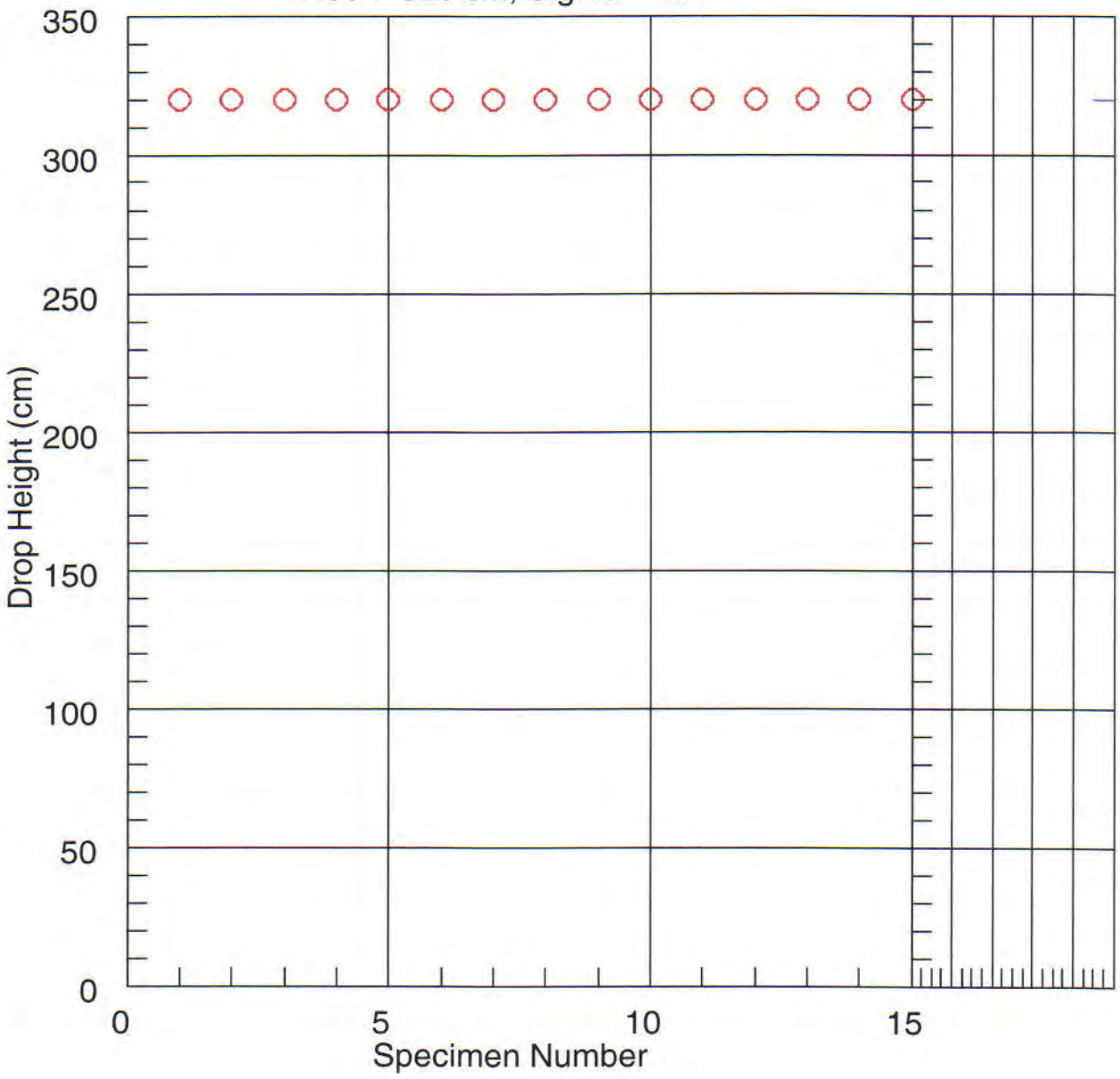
Operator: D. Preston

ERL Type 12 Impact Sensitivity: *Neyer D-Optimal Method*

Analytical Lab#: 51933, LIMS#: 140528002

Material: **Kolorsafe/5M HNO3/Swheat,** Date: **5/30/2014**

H50 > 320 cm, Sigma = NA



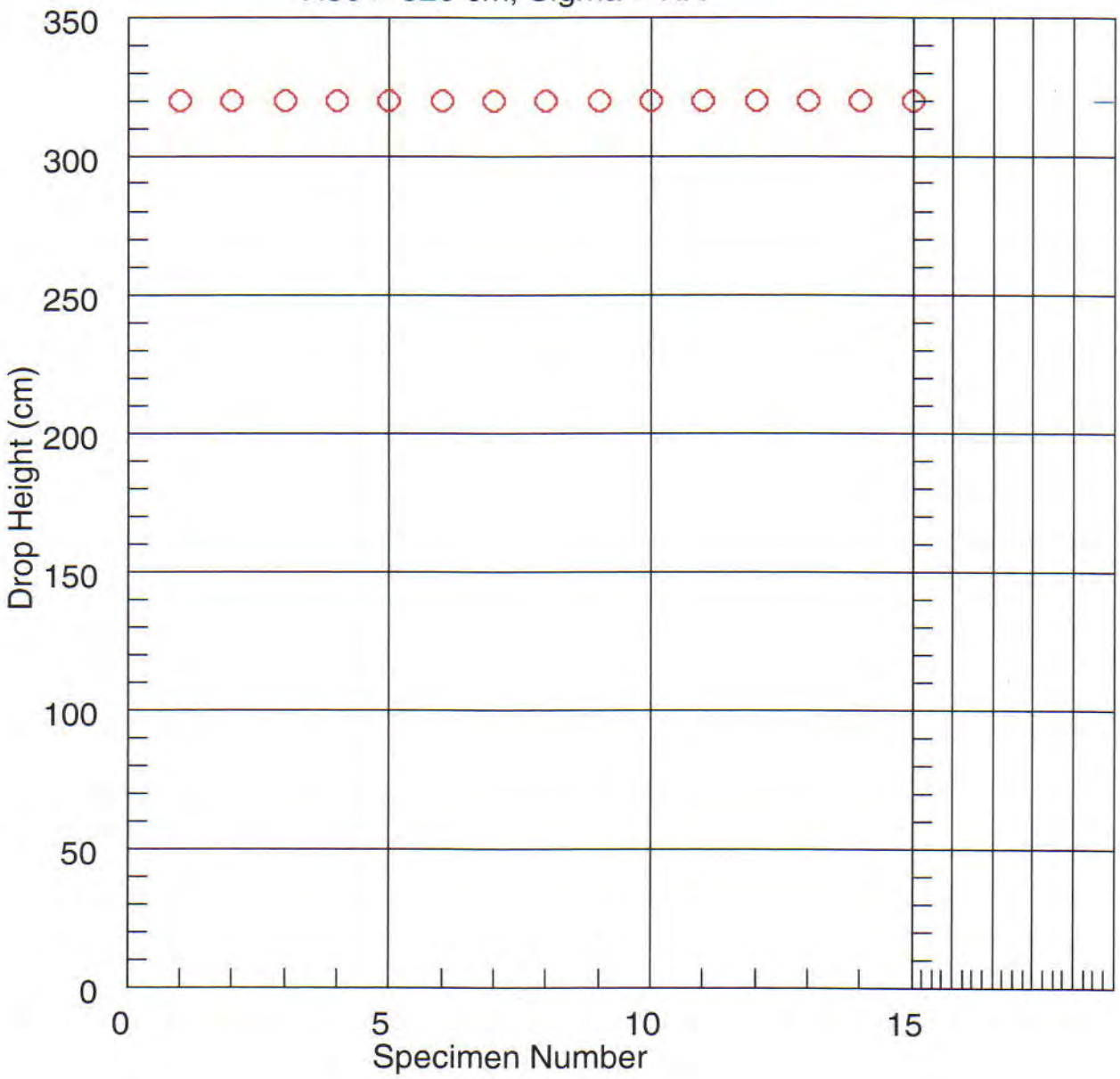
Operator: D. Preston

ERL Type 12 Impact Sensitivity: *Neyer D-Optimal Method*

Analytical Lab#: 51933, LIMS#: 140528003

Material: **Kolorsafe/1M HNO3/Swheat/NaNO2,** Date: **5/30/2014**

H50 > 320 cm, Sigma = NA



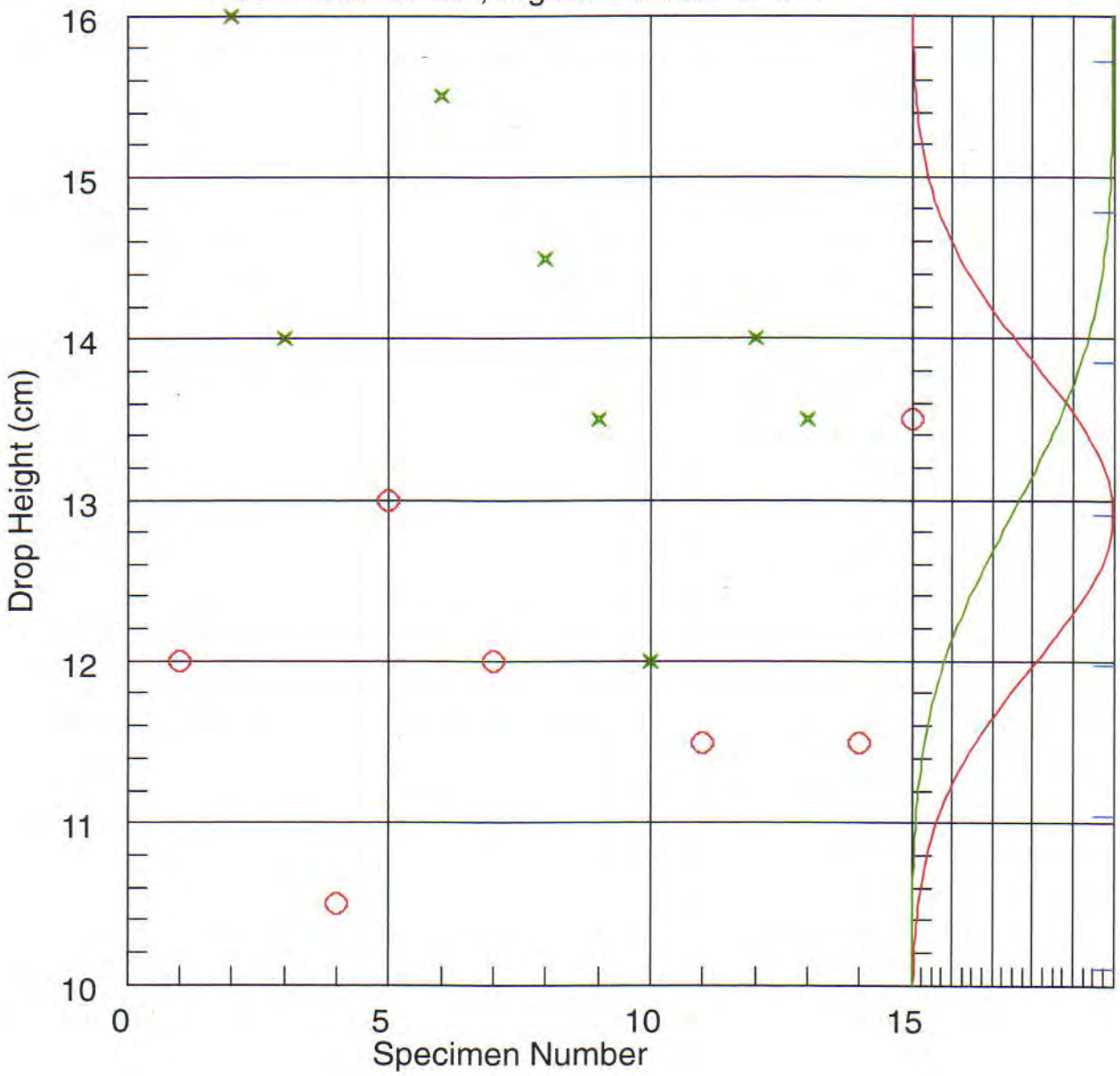
Operator: D. Preston

ERL Type 12 Impact Sensitivity: *Neyer D-Optimal Method*

Analytical Lab#: NA, LIMS#: NA

Material: **PETN RPS 3518,** Date: **5/08/2014**

H50 = 12.9137 cm, Sigma = 0.965707 cm



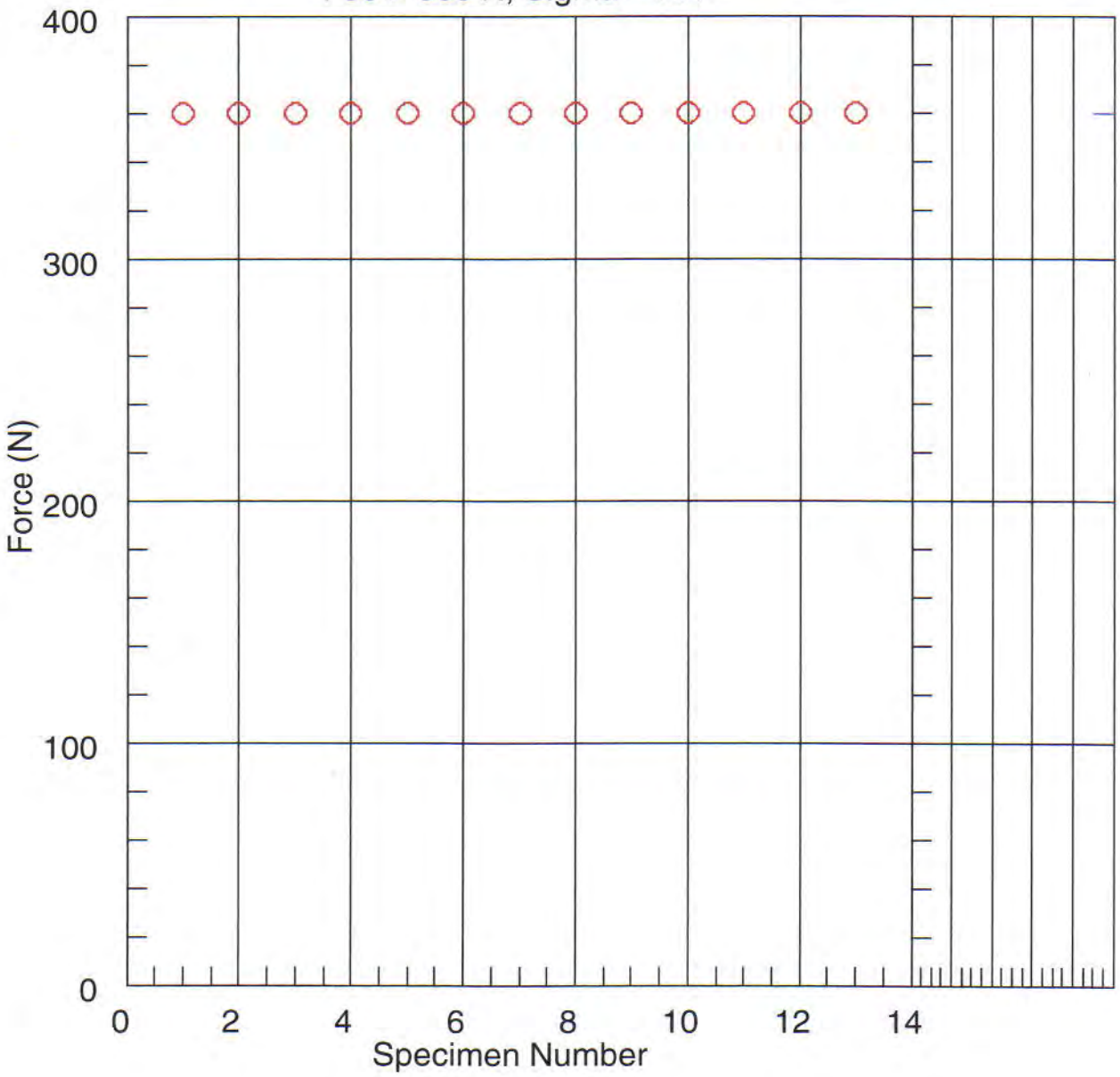
Operator: D. Preston

BAM Friction: *Neyer D-Optimal Method*

Analytical Lab#: 51933, LIMS#: 140528001

Material: **Triethanolamine nitrate,** Date: **5/30/2014**

F50 > 360 N, Sigma = NA



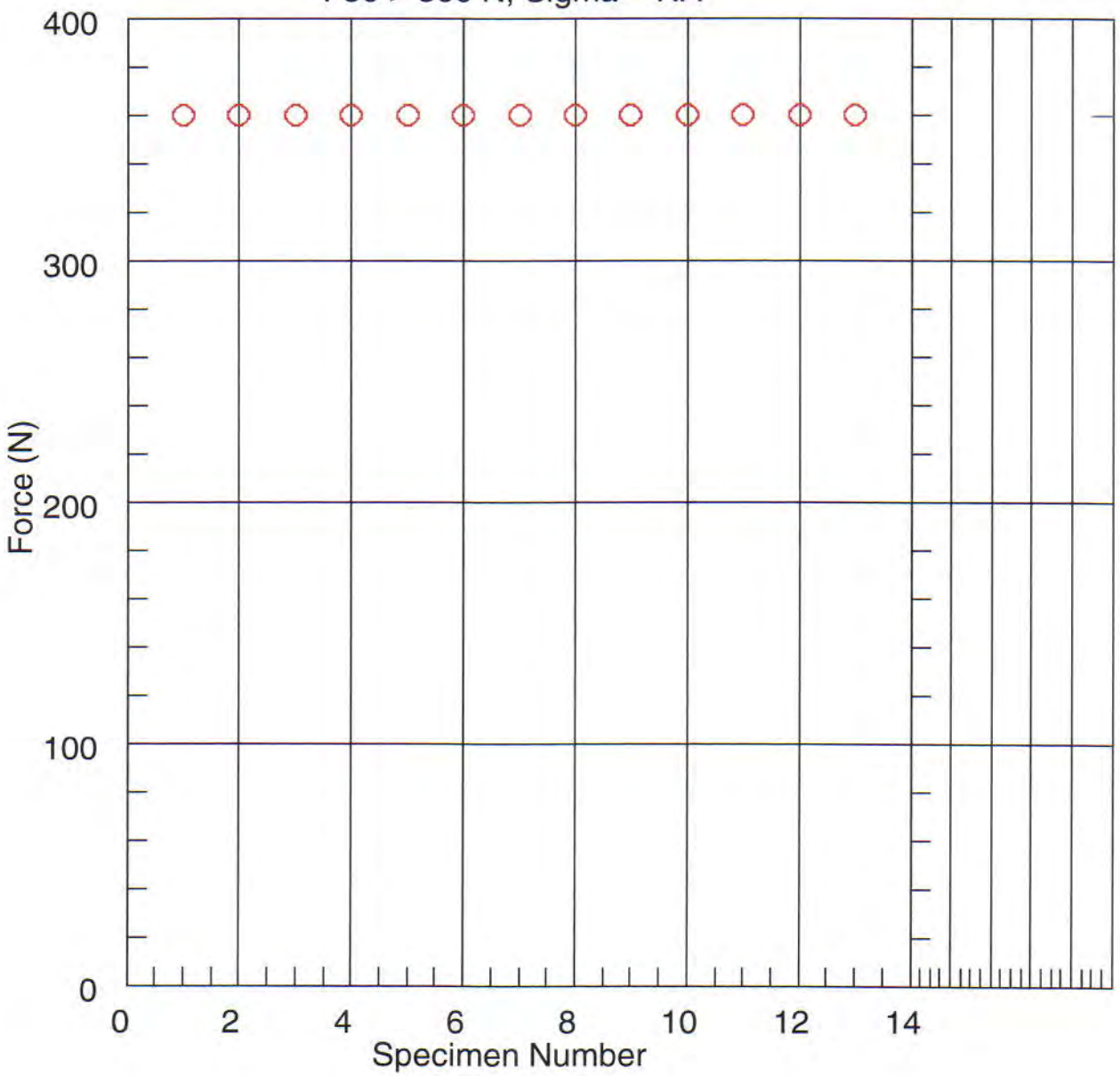
Operator: D. Preston

BAM Friction: *Neyer D-Optimal Method*

Analytical Lab#: 51933, LIMS#: 140528002

Material**: Kolorsafe/5M HNO3/Swheat,** Date: **5/30/2014**

F50 > 360 N, Sigma = NA



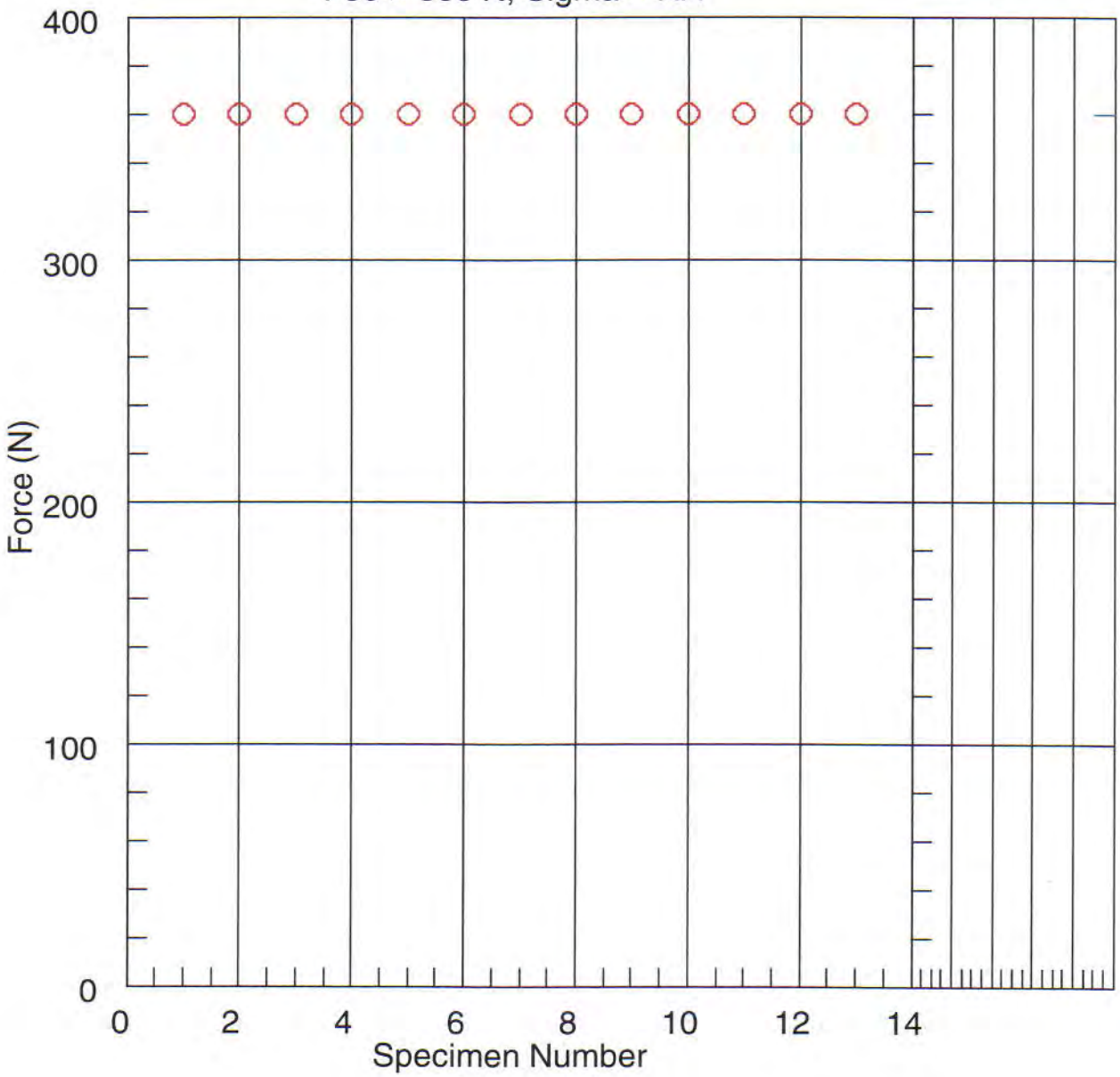
Operator: D. Preston

BAM Friction: *Neyer D-Optimal Method*

Analytical Lab#: 51933, LIMS#: 140528003

Material: **Kolorsafe/1M HNO3/Swheat/NaNO2,** Date: **5/30/2014**

F50 > 360 N, Sigma = NA



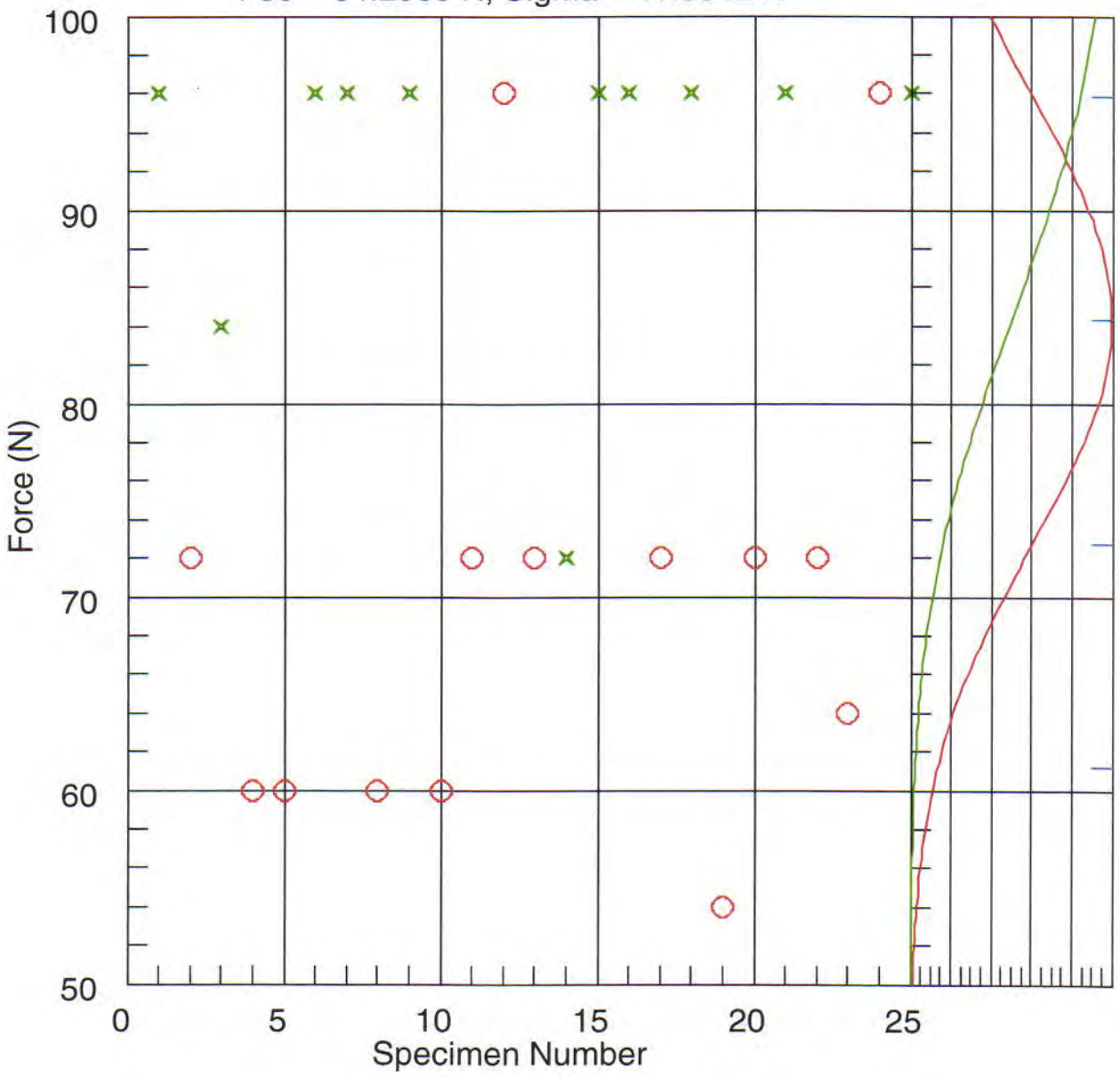
Operator: D. Preston

BAM Friction: *Neyer D-Optimal Method*

Analytical Lab#: NA, LIMS#: NA

Material: **PETN RPS 3518,** Date: **5/8/2014**

F50 = 84.2989 N, Sigma = 11.5312 N



Operator: D. Preston

ABL Electrostatic Discharge (ESD) Test Sheet

Analytical Lab No.: 51933
LIMS#: 140528001
Material : Triethanolamine nitrate
Date: 5/30/2014
Interlock Check: PASS

Operator: D. Preston

0/13 Rxn's @ 0.25J
0/0 Rxn's @ 0.125J
0/0 Rxn's @ 0.0625J
0/0 Rxn's @ 0.025J

Test Results

Discharge Level	1	2	3	4	5	6	7	8	9	10
0.25 Joules	N	N	N	N	N	N	N	N	N	N
0.125 Joules										
0.0625 Joules										
0.025 Joules										

Test Results (continued)

Discharge Level	11	12	13	14	15	16	17	18	19	20
0.25 Joules	N	N	N							
0.125 Joules										
0.0625 Joules										
0.025 Joules										

Type of Test

Screen Test: Energy level set to 0.25J (ten-times human electrostatic discharge) - Switch A set to position 5, Switch B set to position 1 - for 13 tests.

TIL (Threshold of Initiaiton Level): Standard energy level (Switch B set to position 1) at which 20 consecutive "no-go" tests are observed.

TIL (J):	-
SCREEN (J):	0.25

ABL Electrostatic Discharge (ESD) Test Sheet

Analytical Lab No.: 51933
LIMS#: 140528002
Material : Kolorsafe/5M HNO3/Sweat
Date: 5/30/2014
Interlock Check: PASS

Operator: D. Preston

0/13 Rxn's @ 0.25J
0/0 Rxn's @ 0.125J
0/0 Rxn's @ 0.0625J
0/0 Rxn's @ 0.025J

Test Results

Discharge Level	1	2	3	4	5	6	7	8	9	10
0.25 Joules	N	N	N	N	N	N	N	N	N	N
0.125 Joules										
0.0625 Joules										
0.025 Joules										

Test Results (continued)

Discharge Level	11	12	13	14	15	16	17	18	19	20
0.25 Joules	N	N	N							
0.125 Joules										
0.0625 Joules										
0.025 Joules										

Type of Test

Screen Test: Energy level set to 0.25J (ten-times human electrostatic discharge) - Switch A set to position 5, Switch B set to position 1 - for 13 tests.

TIL (Threshold of Initiaiton Level): Standard energy level (Switch B set to position 1) at which 20 consecutive "no-go" tests are observed.

TIL (J):	-
SCREEN (J):	0.25

ABL Electrostatic Discharge (ESD) Test Sheet

Analytical Lab No.: 51933
LIMS#: 140528003
Material : Kolorsafe/1M HNO3/Sweat/NaNO2
Date: 5/30/2014
Interlock Check: PASS

Operator: D. Preston

0/13 Rxn's @ 0.25J
0/0 Rxn's @ 0.125J
0/0 Rxn's @ 0.0625J
0/0 Rxn's @ 0.025J

Test Results

Discharge Level	1	2	3	4	5	6	7	8	9	10
0.25 Joules	N	N	N	N	N	N	N	N	N	N
0.125 Joules										
0.0625 Joules										
0.025 Joules										

Test Results (continued)

Discharge Level	11	12	13	14	15	16	17	18	19	20
0.25 Joules	N	N	N							
0.125 Joules										
0.0625 Joules										
0.025 Joules										

Type of Test

Screen Test: Energy level set to 0.25J (ten-times human electrostatic discharge) - Switch A set to position 5, Switch B set to position 1 - for 13 tests.

TIL (Threshold of Initiaiton Level): Standard energy level (Switch B set to position 1) at which 20 consecutive "no-go" tests are observed.

TIL (J):	-
SCREEN (J):	0.25

ABL Electrostatic Discharge (ESD) Test Sheet

Analytical Lab No.: NA
LIMS#: NA
Material : PETN RPS 3518
Date: 5/8/2014
Interlock Check: PASS

Operator: D. Preston

1/1 Rxn's @ 0.25J
1/1 Rxn's @ 0.125J
0/20 Rxn's @ 0.0625J
0/0 Rxn's @ 0.025J

Test Results

Discharge Level	1	2	3	4	5	6	7	8	9	10
0.25 Joules	E									
0.125 Joules	E									
0.0625 Joules	N	N	N	N	N	N	N	N	N	N
0.025 Joules										

Test Results (continued)

Discharge Level	11	12	13	14	15	16	17	18	19	20
0.25 Joules										
0.125 Joules										
0.0625 Joules	N	N	N	N	N	N	N	N	N	N
0.025 Joules										

Type of Test

Screen Test: Energy level set to 0.25J (ten-times human electrostatic discharge) - Switch A set to position 5, Switch B set to position 1 - for 13 tests.

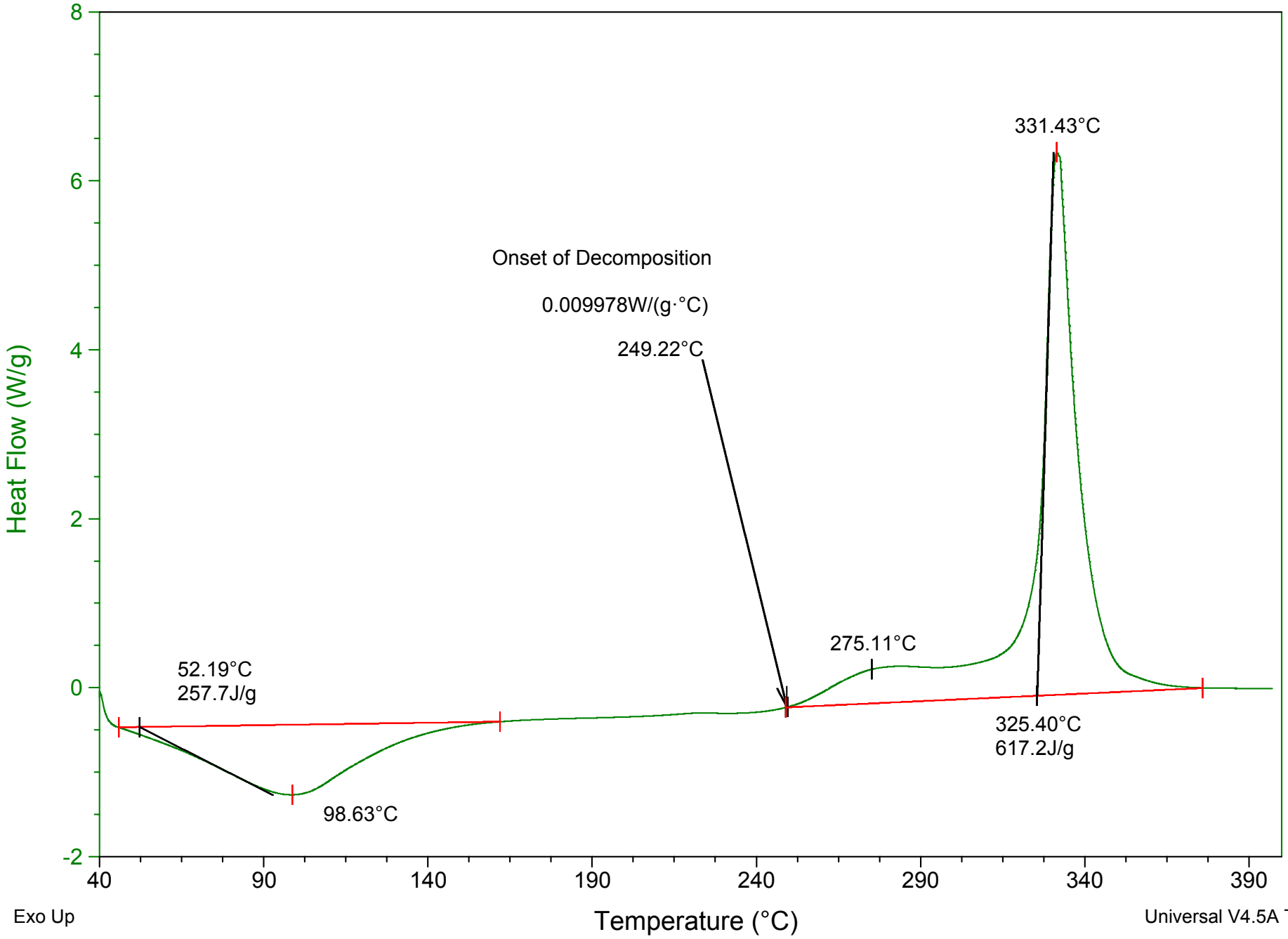
TIL (Threshold of Initiaiton Level): Standard energy level (Switch B set to position 1) at which 20 consecutive "no-go" tests are observed.

TIL (J):	0.0625
SCREEN (J):	-

Sample: Kolor Safe-1M HNO3-Swheat
Size: 0.8490 mg
Method: 10C Ramp

DSC

File: C:...\Kolor Safe-1M HNO3-Swheat.001
Operator: MMS
Run Date: 29-May-2014 17:41
Instrument: DSC Q2000 V24.10 Build 122

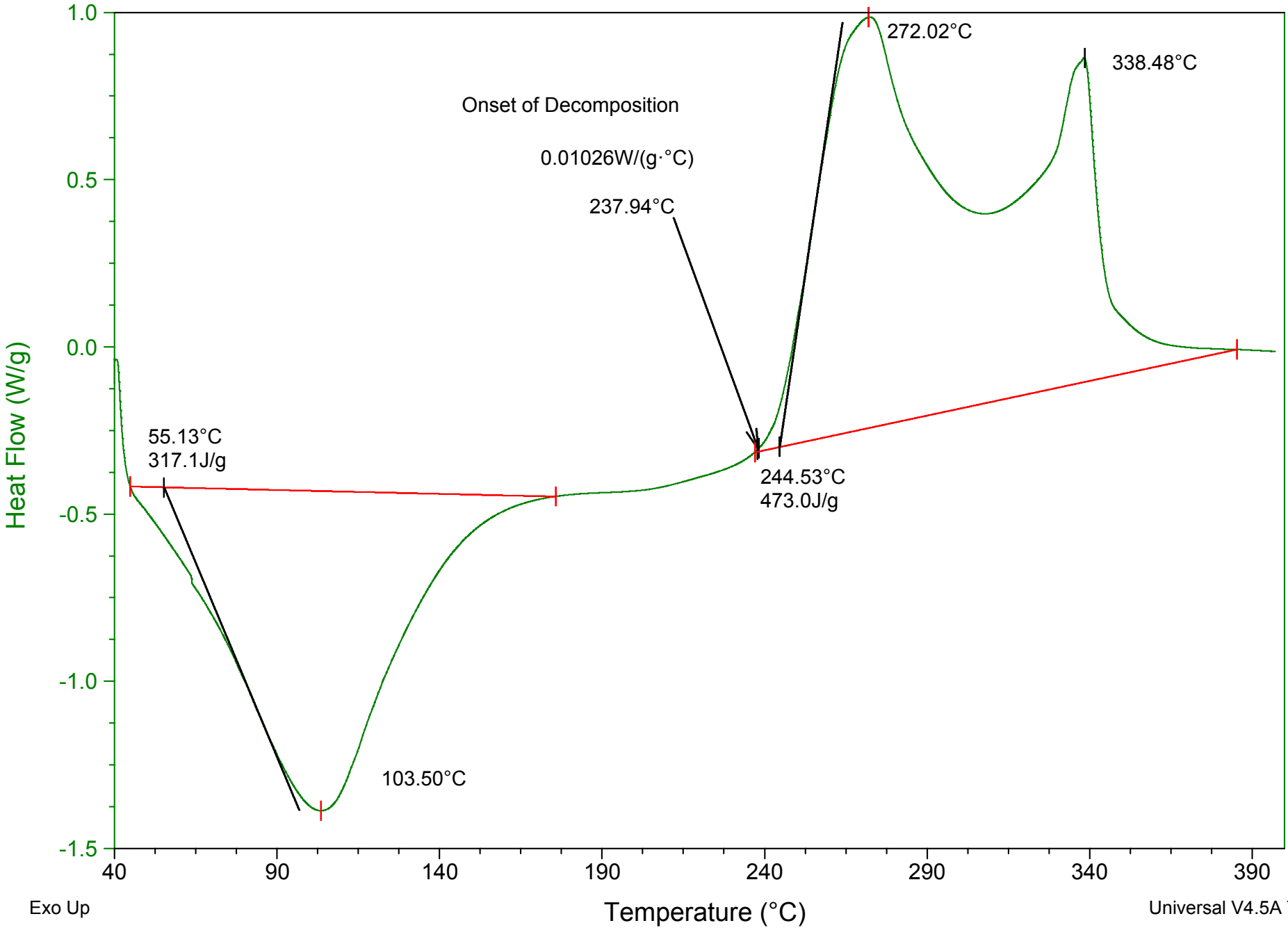


Universal V4.5A TA Instruments

Sample: Kolor Safe-5M HNO3-Swheat
Size: 0.9630 mg
Method: 10C Ramp

DSC

File: C:...\Kolor Safe-5M HNO3-Swheat.001
Operator: MMS
Run Date: 29-May-2014 16:50
Instrument: DSC Q2000 V24.10 Build 122

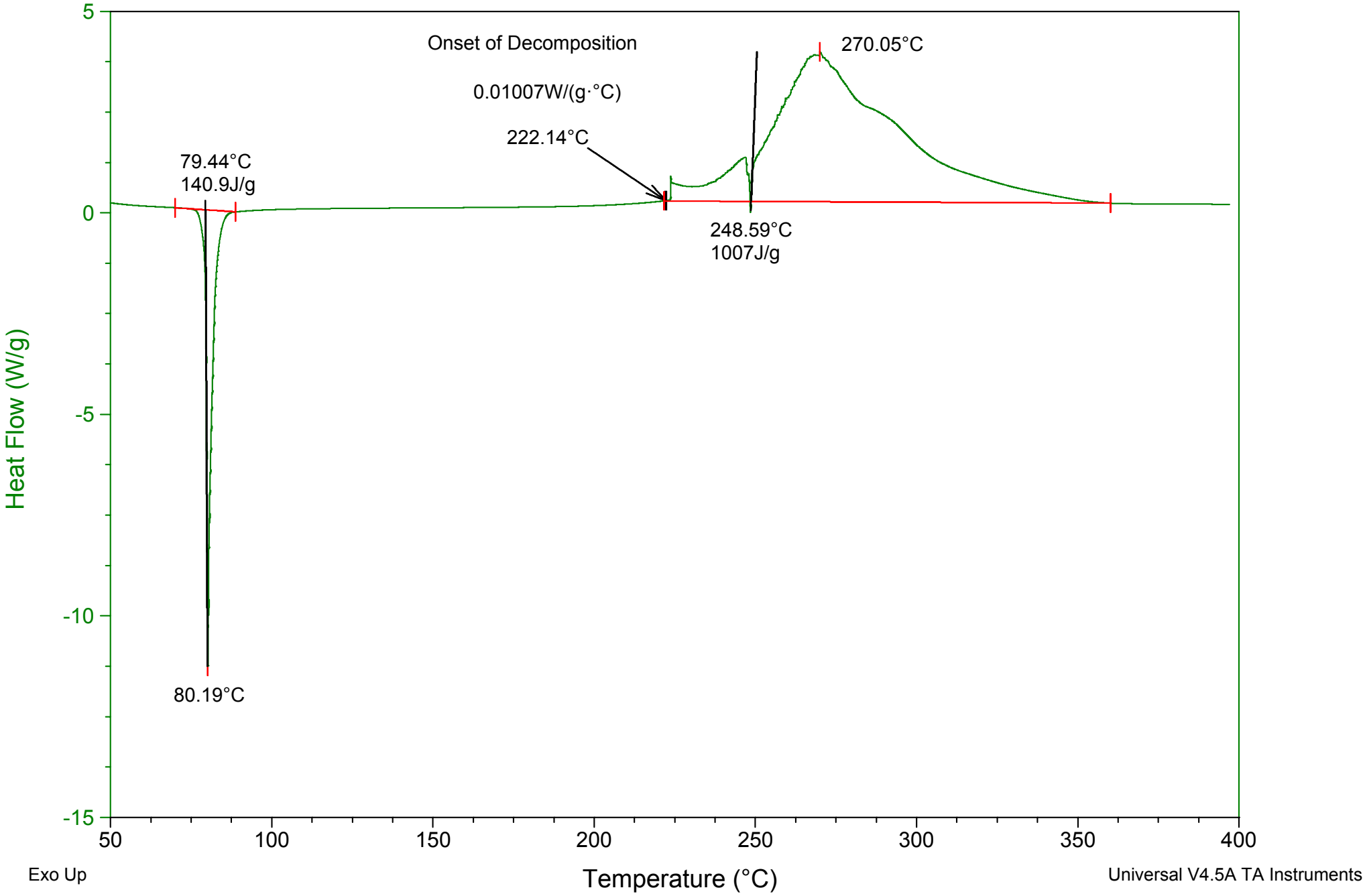


Universal V4.5A TA Instruments

Sample: Triethanolamine Nitrate
Size: 0.7400 mg
Method: 10C Ramp

DSC

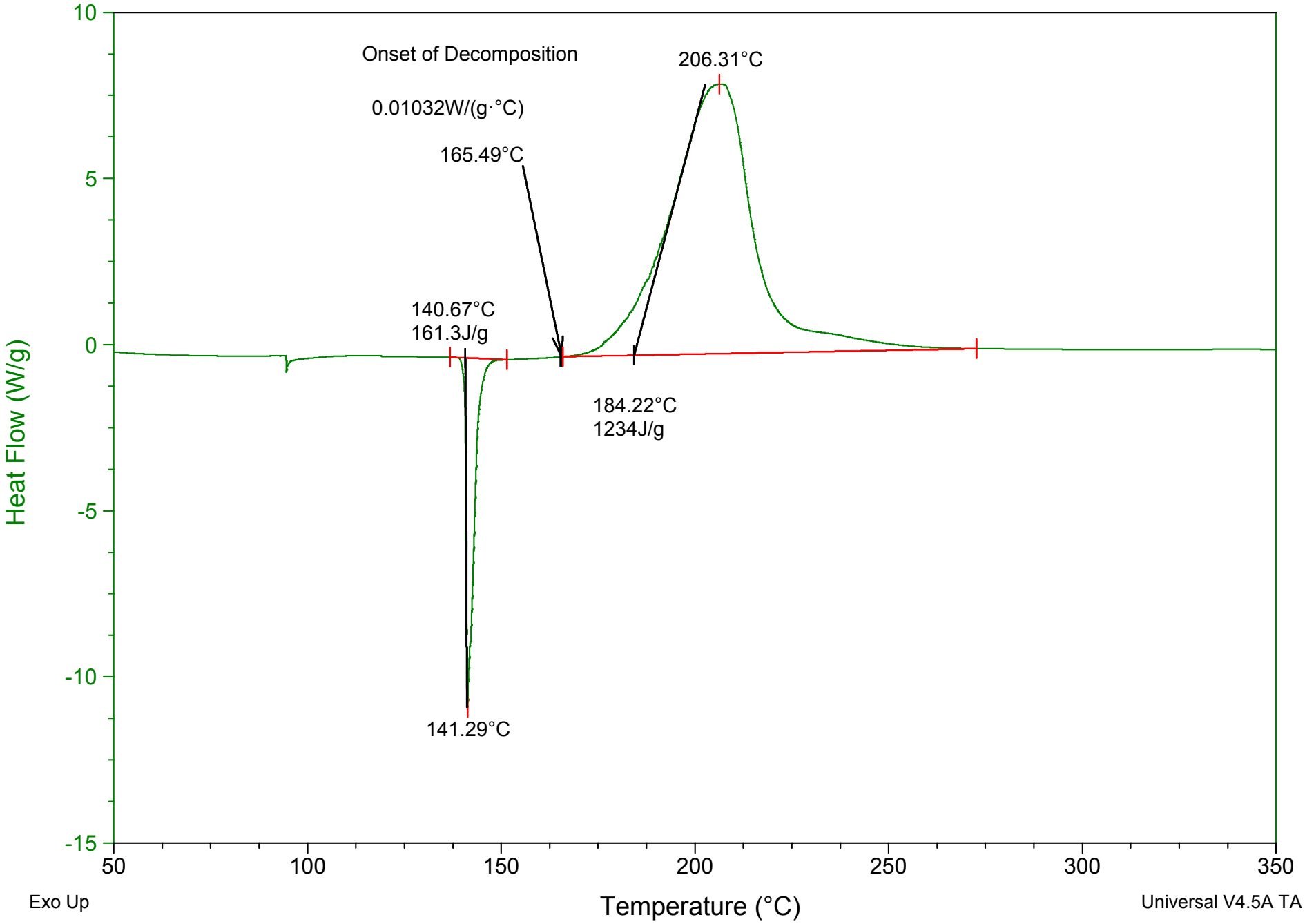
File: C:...\51933\Triethanolamine Nitrate.001
Operator: MMS
Run Date: 29-May-2014 16:00
Instrument: DSC Q2000 V24.10 Build 122



Sample: PETN 9401B
Size: 0.9290 mg
Method: 10C Ramp

DSC

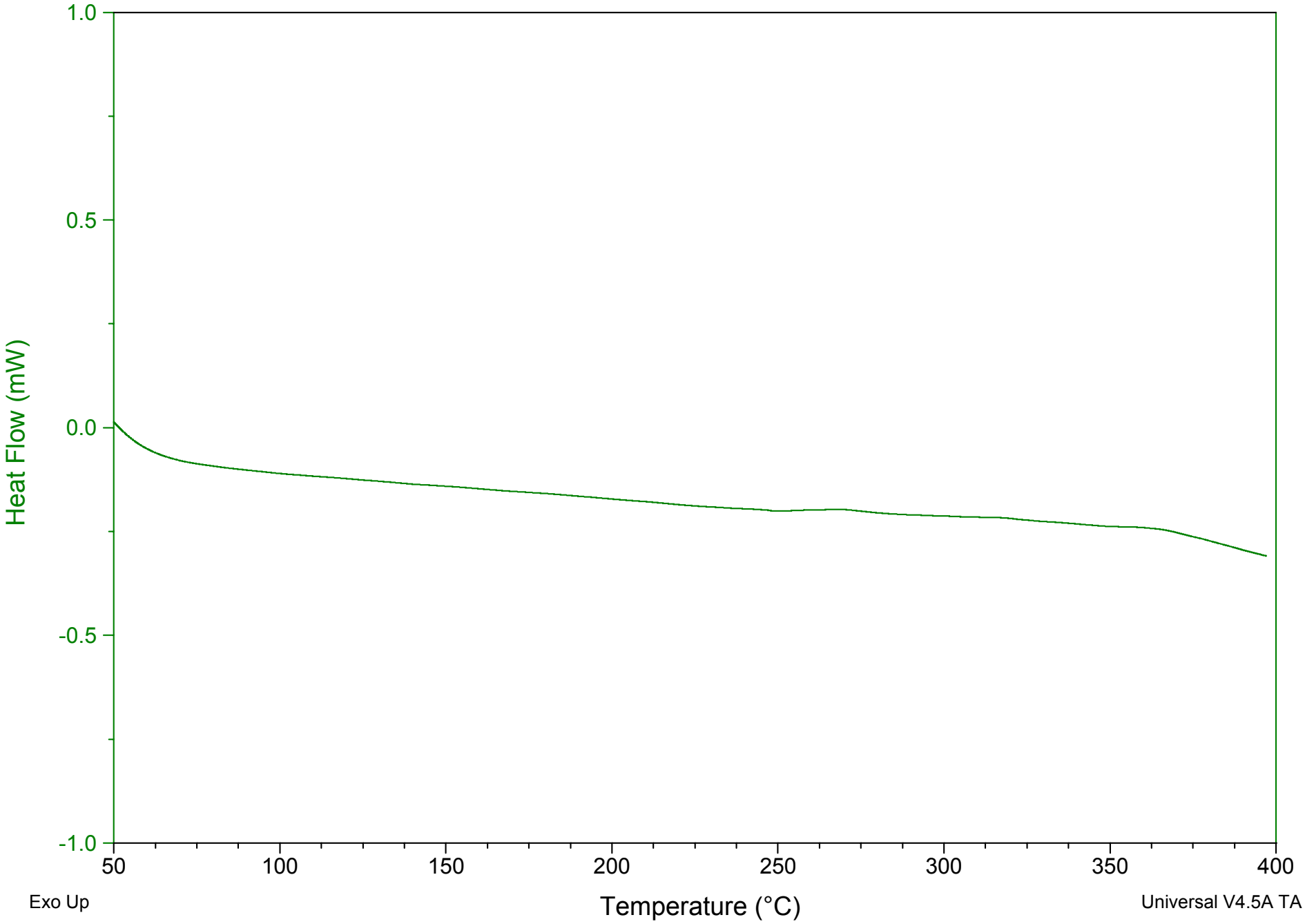
File: C:...\052914 Instrument Control.001
Operator: MMS
Run Date: 29-May-2014 15:10
Instrument: DSC Q2000 V24.10 Build 122



Sample: Pan Blank
Size: 0.0000 mg
Method: 10C Ramp

DSC

File: C:...\Pan Blanks\052912 Pan Blank.002
Operator: MMS
Run Date: 29-May-2014 14:17
Instrument: DSC Q2000 V24.10 Build 122



WX-7 SS-VTS Report

Lab# 51933 LIMS# 140528002 Kolorsafe/5M HNO3/Swheat

CrossOver: Stainless Steel Reaction Tube		**Temp.°C:**	120	**Date:**	5/31/14
SAMPLE Lab #	51933	**Sample Description:**		**Kolorsafe/5M HNO3/Swheat-; (SS-Tt#6/Td#6) (200mg)'**	**Test; 22 hrs.**
SAMPLE LIMS#	140528002				

SS-VTS Worksheet for Calculation Volume of Gas Evolution from Starting and Ending Pressure (corrected for Standard Temperature and Pressure (STP)

With Glass Liner

Tube #	6	**Formula for Volume Calculation**		
Transducer #	6	**Vstp=(Pf-Pi)(273.15k)(Vrt-Vs)/(101.325kPa)(Tc+273.15k)**		
Tube Calibration Volume	3.644			
			Where:	
			Pf = final pressure (kPa)	
Sample Weight (g)	0.2		Pi = initial pressure (kPa)	
Initial Pressure (kPa)	3.506		Vrt = reaction tube volume (cm3)	
Final Pressure (kPa)	5.25		Vs = sample volume (cm3)	
Standard Pressure (kPa)	101.325		Tc = Temperature of bath (centigrade)	
Standard Temperature (deg. centigrade)	273.15			
Sample Volume* (ml)	0.4 *			
Bath Temperature (deg. centigrade)	120			
	0.038793024			
Volume of Gas evolved (ml/g) @ STP	0.194			
		NA (ref.)	NA	ml/g @ 120° C (48 hrs)

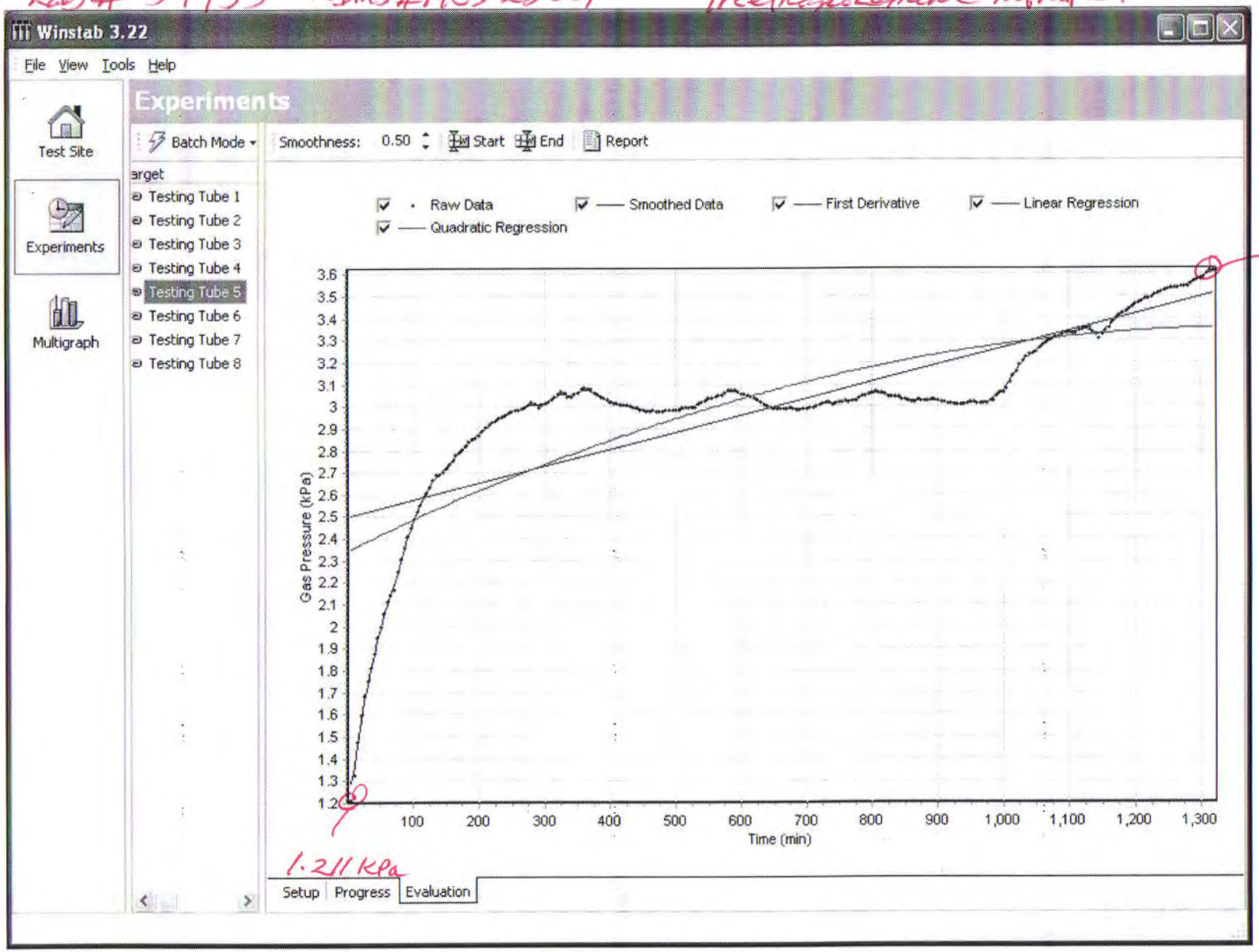
***estimated from visual of glass liner + sample.**

***Kolorsafe/5M HNO3/Swheat : As received

22 hrs @ 120°C

5-31-14

Lab # 5:1933 LIMS #140528001 Triethanolamine nitrate.



WX-7 SS-VTS Report

CrossOver: Stainless Steel Reaction Tube		**Temp.°C:**	**120**	**Date:**	5/31/14
SAMPLE Lab #	51933	**Sample Description:**		**Triethanolamine nitrate-; (SS-Tt#5/Td#5) (200mg)'**	**Test; 22 hrs.**
SAMPLE LIMS#	140528001				

SS-VTS Worksheet for Calculation Volume of Gas Evolution from Starting and Ending Pressure (corrected for Standard Temperature and Pressure (STP)

With Glass Liner

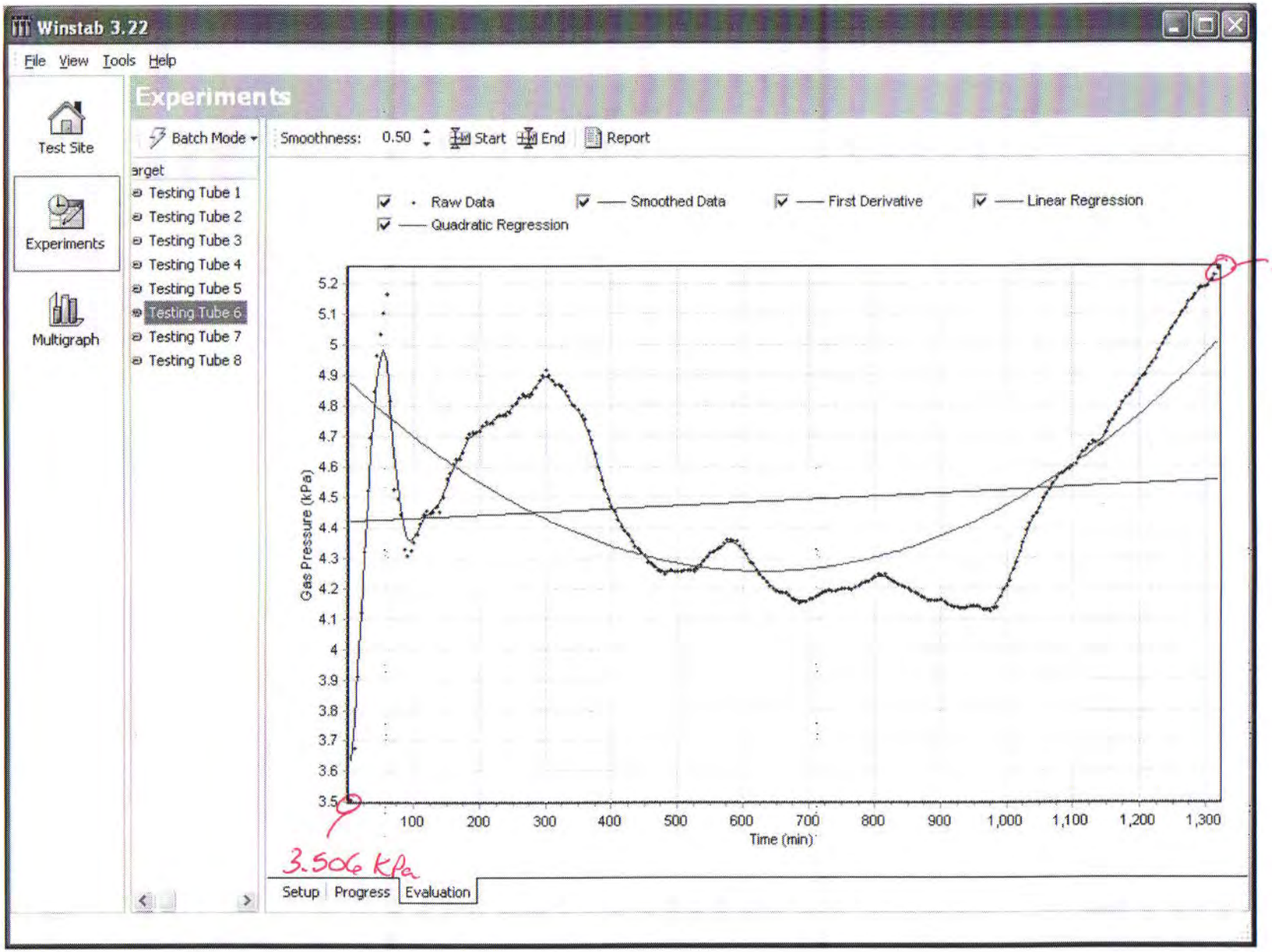
Tube #	5	**Formula for Volume Calculation**	
Transducer #	5	**Vstp=(Pf-Pi)(273.15k)(Vrt-Vs)/(101.325kPa)(Tc+273.15k)**	
Tube Calibration Volume	3.654		
		Where:	
		Pf = final pressure (kPa)	
Sample Weight (g)	0.2	Pi = initial pressure (kPa)	
Initial Pressure (kPa)	1.211	Vrt = reaction tube volume (cm3)	
Final Pressure (kPa)	3.614	Vs = sample volume (cm3)	
Standard Pressure (kPa)	101.325	Tc = Temperature of bath (centigrade)	
Standard Temperature (deg. centigrade)	273.15		
Sample Volume* (ml)	0.6 *		
Bath Temperature (deg. centigrade)	120		
	0.050320983		
Volume of Gas evolved (ml/g) @ STP	0.252		
		NA (ref.) NA	ml/g @ 120° C (48 hrs)

***estimated from visual of glass liner + sample.**

***Triethanolamine nitrate : As received

22hrs @ 120c

5-31-14



5.250kPa

3.506 kPa

WX-7 SS-VTS Report

Lab #51933 LIMS #140528003 Kolorsafe/1M HNO3/NaNO3/Swheat

CrossOver: Stainless Steel Reaction Tube		**Temp.°C:**	**120**	**Date:**	5/31/14
SAMPLE Lab #	51933	**Sample Description:**		**Kolorsafe/1M HNO3/NaNO3/Swheat-; (SS-Tt#7/Td#7) (200mg)'**	**Test; 22 hrs.**
SAMPLE LIMS#	140528003				

SS-VTS Worksheet for Calculation Volume of Gas Evolution from Starting and Ending Pressure (corrected for Standard Temperature and Pressure (STP)

With Glass Liner

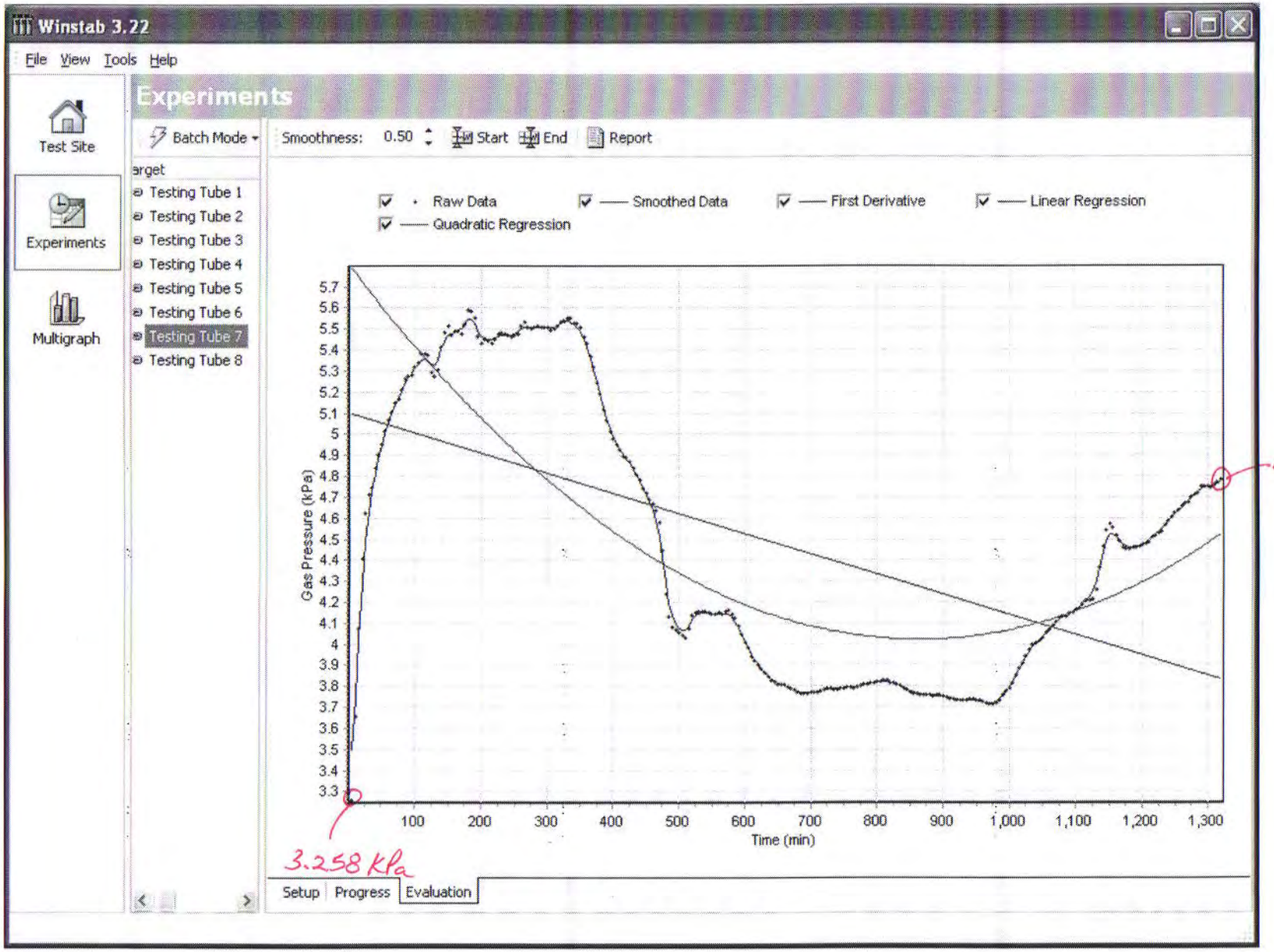
Tube #	7	**Formula for Volume Calculation**		
Transducer #	7	**Vstp=(Pf-Pi)(273.15k)(Vrt-Vs)/(101.325kPa)(Tc+273.15k)**		
Tube Calibration Volume	3.781			
			Where:	
			Pf = final pressure (kPa)	
Sample Weight (g)	0.2		Pi = initial pressure (kPa)	
Initial Pressure (kPa)	3.258		Vrt = reaction tube volume (cm3)	
Final Pressure (kPa)	4.781		Vs = sample volume (cm3)	
Standard Pressure (kPa)	101.325		Tc = Temperature of bath (centigrade)	
Standard Temperature (deg. centigrade)	273.15			
Sample Volume* (ml)	0.2 *			
Bath Temperature (deg. centigrade)	120			
	0.037396464			
Volume of Gas evolved (ml/g) @ STP	0.187			
		NA (ref.)	NA	ml/g @ 120° C (48 hrs)

***estimated from visual of glass liner + sample.**

***Kolorsafe/1M HNO3/NaNO3/Swheat : As received

22 hrs. @ 120°C

5-31-14



Appendix X
WX-7-AC-52528 Analytical Laboratory Report
May 5, 2017

M-7 High Explosives Science and Technology

Analytical Laboratory Report

Analytical Lab # 52528

52528

Requester: FUNK **Group:** ADEM

Sample ID: UNS solution + Kolorsafe / Swheat, (1:1) and (1:3)

Tests Completed	Date Completed	Analyst
170505001 – (1:1)		
DWI – Impact	05/05/2017	TIAN
BAM – Friction	05/05/2017	TIAN
ESD – Spark	05/05/2017	TIAN
170505002 – (1:3)		
DWI – Impact	05/05/2017	TIAN
BAM – Friction	05/05/2017	TIAN
ESD – Spark	05/05/2017	TIAN

This document deemed Unclassified by
5/5/17
(DC)

Validated: 5/5/17 Acting GL for K. Lintz

Approved: 5/5/17

Date Submitted: 05/05/2017
Date Competed: 05/05/2017

Los Alamos NATIONAL LABORATORY

Lab 52528 Sample Drying

Sample starting masses (g)		Petri dish masses (g)
UNS + Kolorsafe / Swheat (1:1)	6.623	35.7459
UNS + Kolorsafe / Swheat (1:3)	5.498	41.6436

Into 50 C oven at 14:07 on 5/4/17
Out of oven at 6:00 on 5/5/17 followed by 30 minute cool down

1st weighing sample masses (dish + sample in grams)		Sample alone (g)	Sample loss (g)	Cumulative Sample loss (% from initial)
UNS + Kolorsafe / Swheat (1:1)	40.3679	4.6220	2.0010	30.21
UNS + Kolorsafe / Swheat (1:3)	46.0682	4.4246	1.0734	19.52

Into 50 C oven at 6:40 am on 5/5/17
Out of oven at 7:42 am followed by 30 minute cool down

2nd weighing sample masses (dish + sample in grams)		Sample alone (g)	Sample loss (g)	Cumulative Sample loss (% from initial)
UNS + Kolorsafe / Swheat (1:1)	40.3269	4.5810	0.0410	30.83
UNS + Kolorsafe / Swheat (1:3)	46.0213	4.3777	0.0469	20.38

Into 50 C oven at 8:20 on 5/5/17
Out of oven at 9:20 followed by 30 minute cool down

3rd weighing sample masses (dish + sample in grams)		Sample alone (g)	Sample loss (g)	Cumulative Sample loss (% from initial)
UNS + Kolorsafe / Swheat (1:1)	40.3031	4.5572	0.0238	31.19
UNS + Kolorsafe / Swheat (1:3)	46.0100	4.3664	0.0113	20.58

Break up both samples (agglomerates and patties)

Re-weigh after breaking up samples		Sample alone (g)	Sample loss (g)	Cumulative Sample loss (% from initial)
UNS + Kolorsafe / Swheat (1:1)	40.3109	4.5650	-0.0078	31.07
UNS + Kolorsafe / Swheat (1:3)	46.0117	4.3681	-0.0017	20.55

Into 50 C oven at 10:10 am on 5/5/17
Out of oven at 11:12 am followed by 30 minute cool down

4th weighing sample masses (dish + sample in grams)		Sample alone (g)	Sample loss (g)	Cumulative Sample loss (% from initial)
UNS + Kolorsafe / Swheat (1:1)	40.2812	4.5353	0.0297	31.52
UNS + Kolorsafe / Swheat (1:3)	46.0006	4.3570	0.0111	20.75

Los Alamos NATIONAL LABORATORY EST.1943

From/MS: Hongzhao Tian, M-7 / MS C920
Date: 5/5/2017
Lab#: 52528

Sensitivity Testing Summary Memorandum

M-7: High Explosives Science & Technology

Sample was tested as received.

ERL Type 12 IMPACT SENSITIVITY TESTING

The 50% drop height is determined using a 2.5 kg weight and the "*Neyer D-Optimal method.*"

SAMPLE, Date	Lab # / LIMs #	50% Height (cm)	σ (cm)
UNS Solution + Kolorsafe / Swheat (1:1), 5/5/2017	52528/170505001	>320	NA
UNS Solution + Kolorsafe / Swheat (1:3), 5/5/2017	52528/170505002	>320	NA
PETN 0601-02 L-298, 4/4/2017	NA	8.9	0.7

BAM FRICTION SENSITIVITY TESTING

The 50% load in N is determined using the "*Neyer D-Optimal method.*"

SAMPLE, Date	Lab # / LIMs #	50% Load (N)	σ (N)
UNS Solution + Kolorsafe / Swheat (1:1), 5/5/2017	52528/170505001	>360	NA
UNS Solution + Kolorsafe / Swheat (1:3), 5/5/2017	52528/170505002	>360	NA
PETN 0601-02 L-298, 4/4/2017	NA	71.2	16.1

ABL ELECTROSTATIC DISCHARGE (ESD) SENSITIVITY TESTING

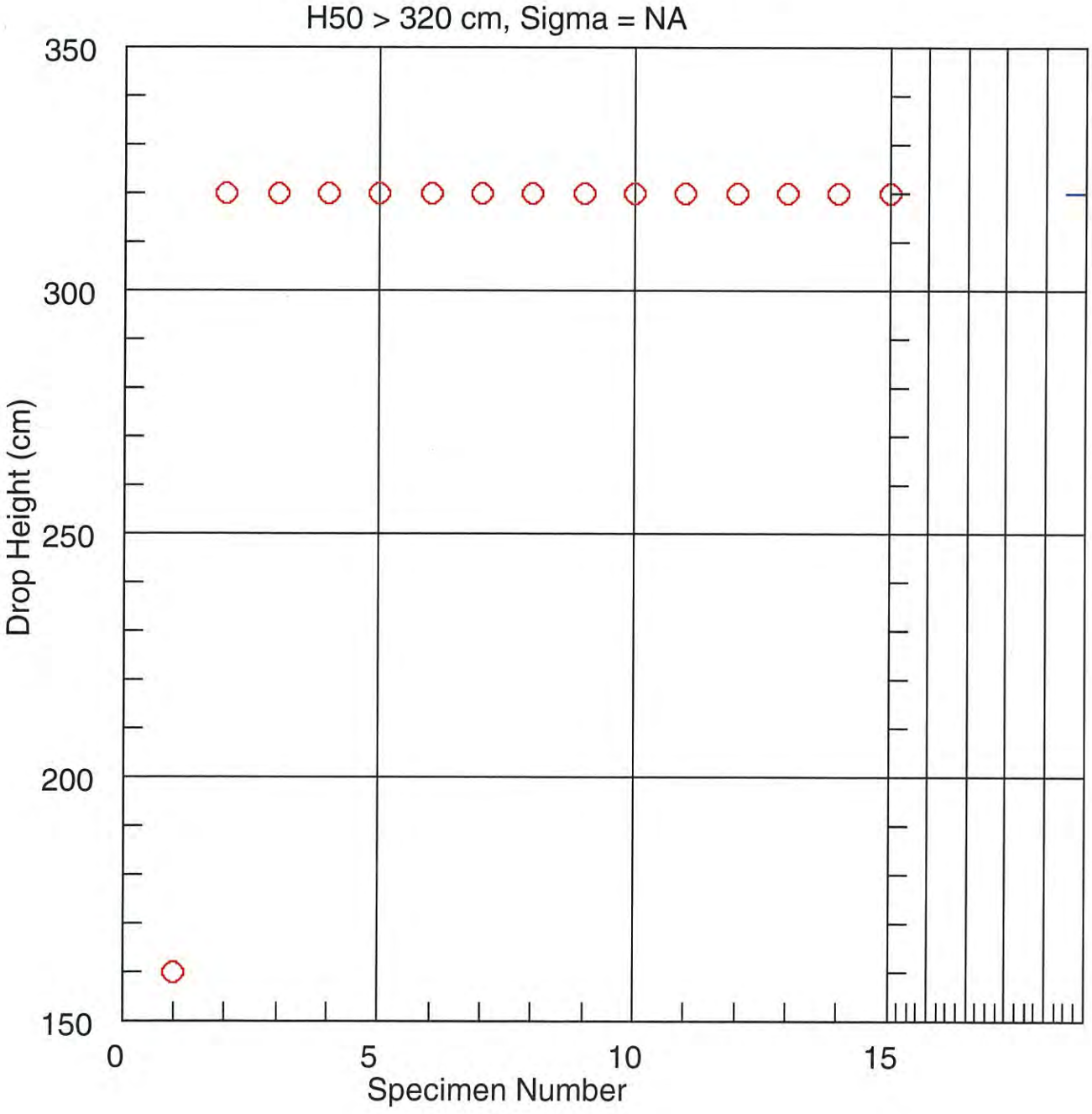
SAMPLE, Date	Lab # / LIMs #	*TIL / **Screen (Joules)
UNS Solution + Kolorsafe / Swheat (1:1), 5/5/2017	52528/170505001	*0.0625
UNS Solution + Kolorsafe / Swheat (1:3), 5/5/2017	52528/170505002	*0.0625
PETN 0601-02 L-298, 4/4/2017	NA	*0.025

Distribution: M-7 Analytical Lab

ERL Type 12 Impact Sensitivity: *Neyer D-Optimal Method*

Analytical Lab#: 52528, LIMS#: 170505001

Material**: UNS solution + Kolorsafe / Swheat (1:1),** Date: **05/05/2017**

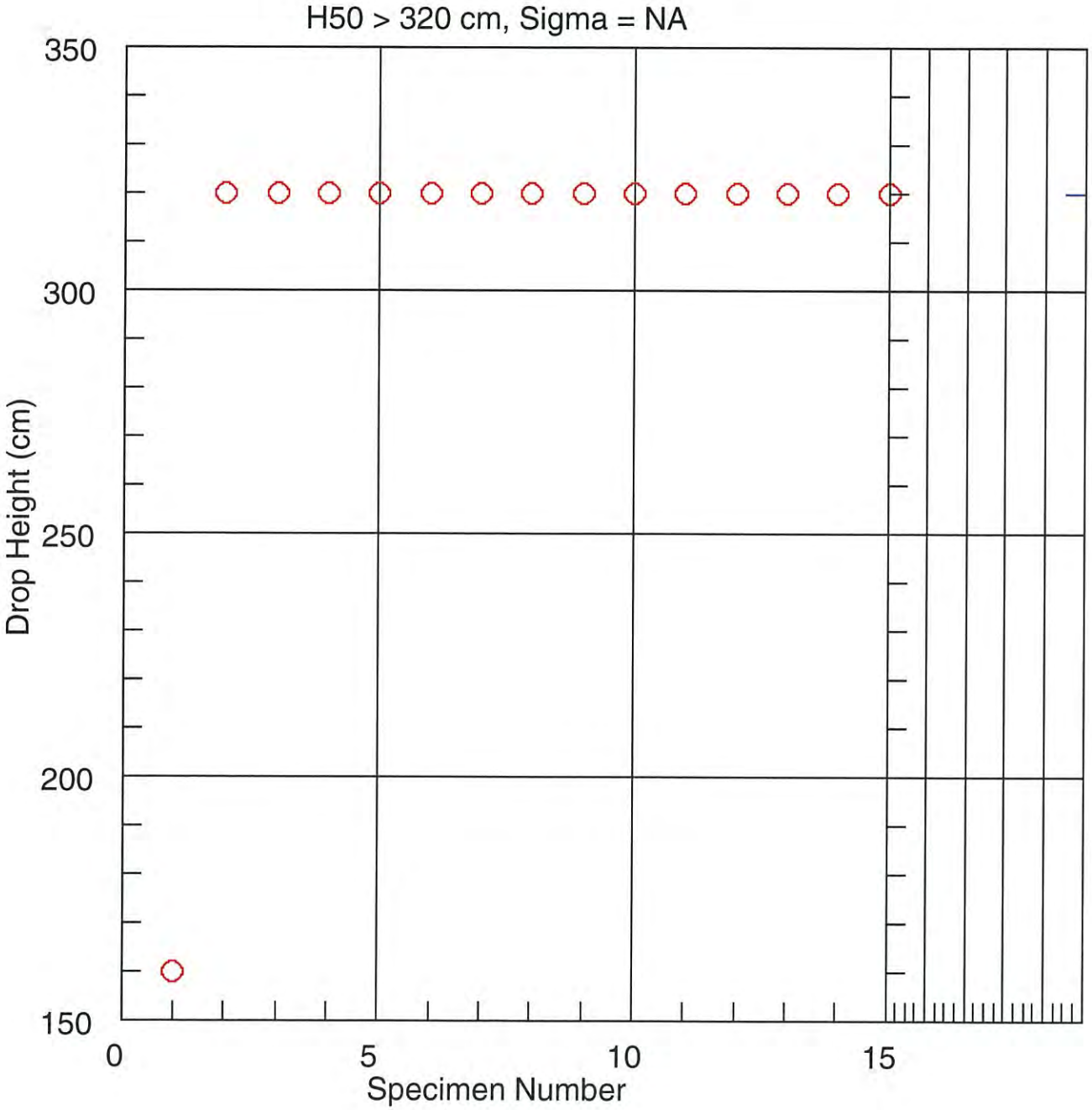


Operator: H. Tian

ERL Type 12 Impact Sensitivity: *Neyer D-Optimal Method*

Analytical Lab#: 52528, LIMS#: 170505002

Material**: UNS solution + Kolorsafe / Swheat (1:3),** Date: **05/05/2017**



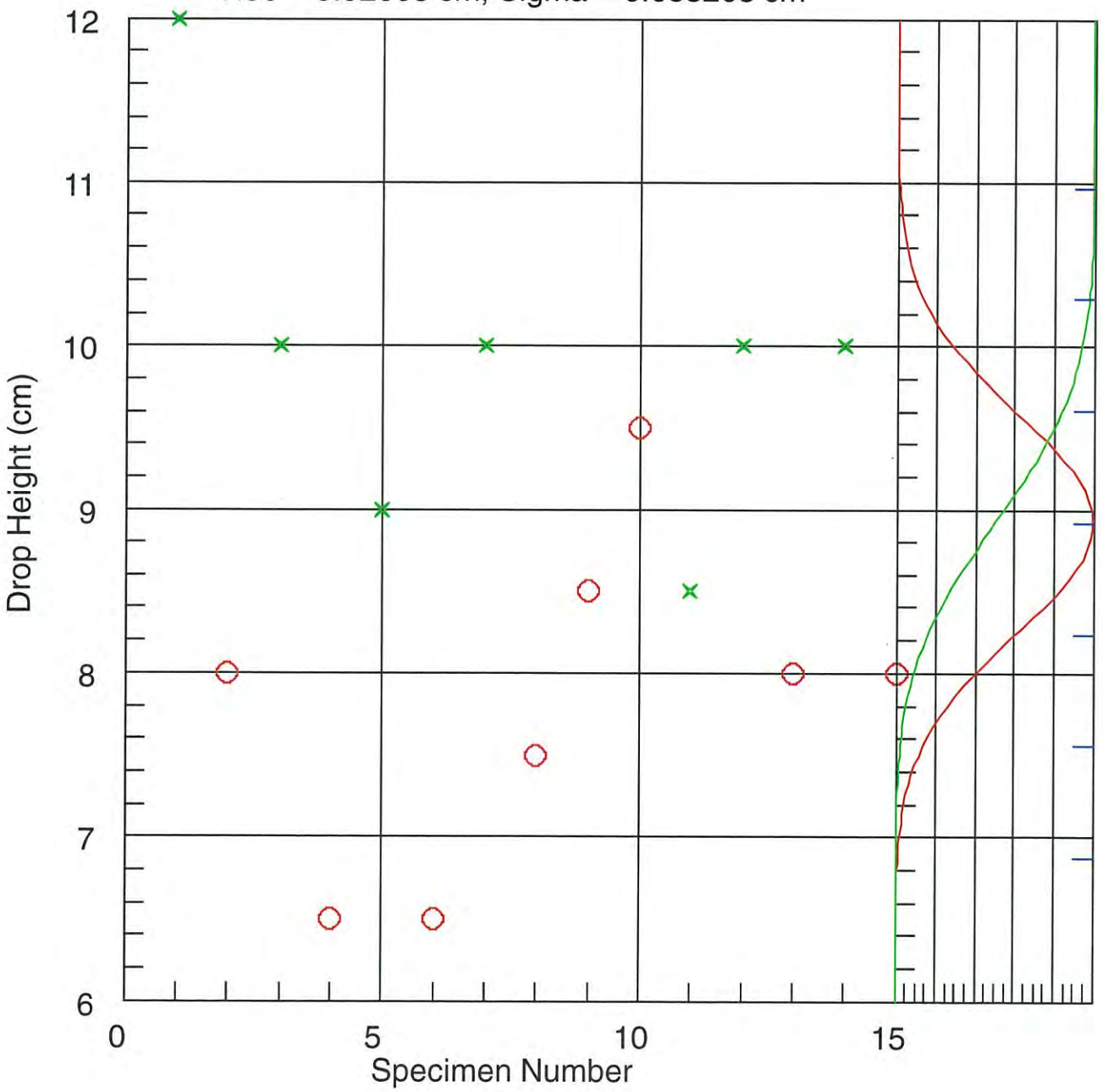
Operator: H. Tian

ERL Type 12 Impact Sensitivity: *Neyer D-Optimal Method*

Analytical Lab#: **NA**, LIMS#: **NA**

Material**: PETN0601-02 L298,** Date: **04/04/2017**

H50 = 8.92008 cm, Sigma = 0.683203 cm

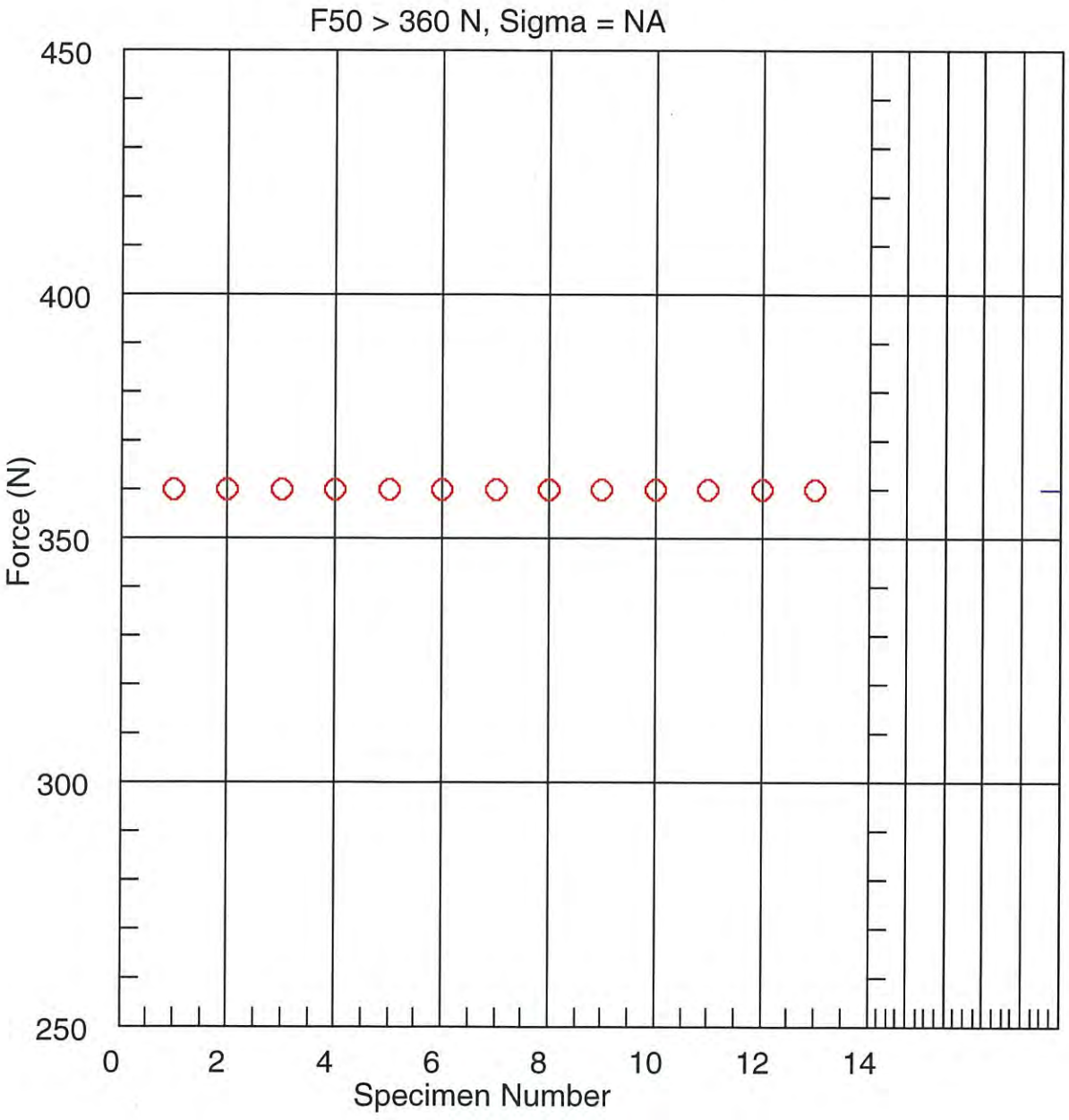


Operator: H. Tian

BAM Friction: *Neyer D-Optimal Method*

Analytical Lab#: 52528, LIMS#: 170505001

Material**: UNS solution + Kolorsafe / Swheat (1:1),** Date: **05/05/2017**

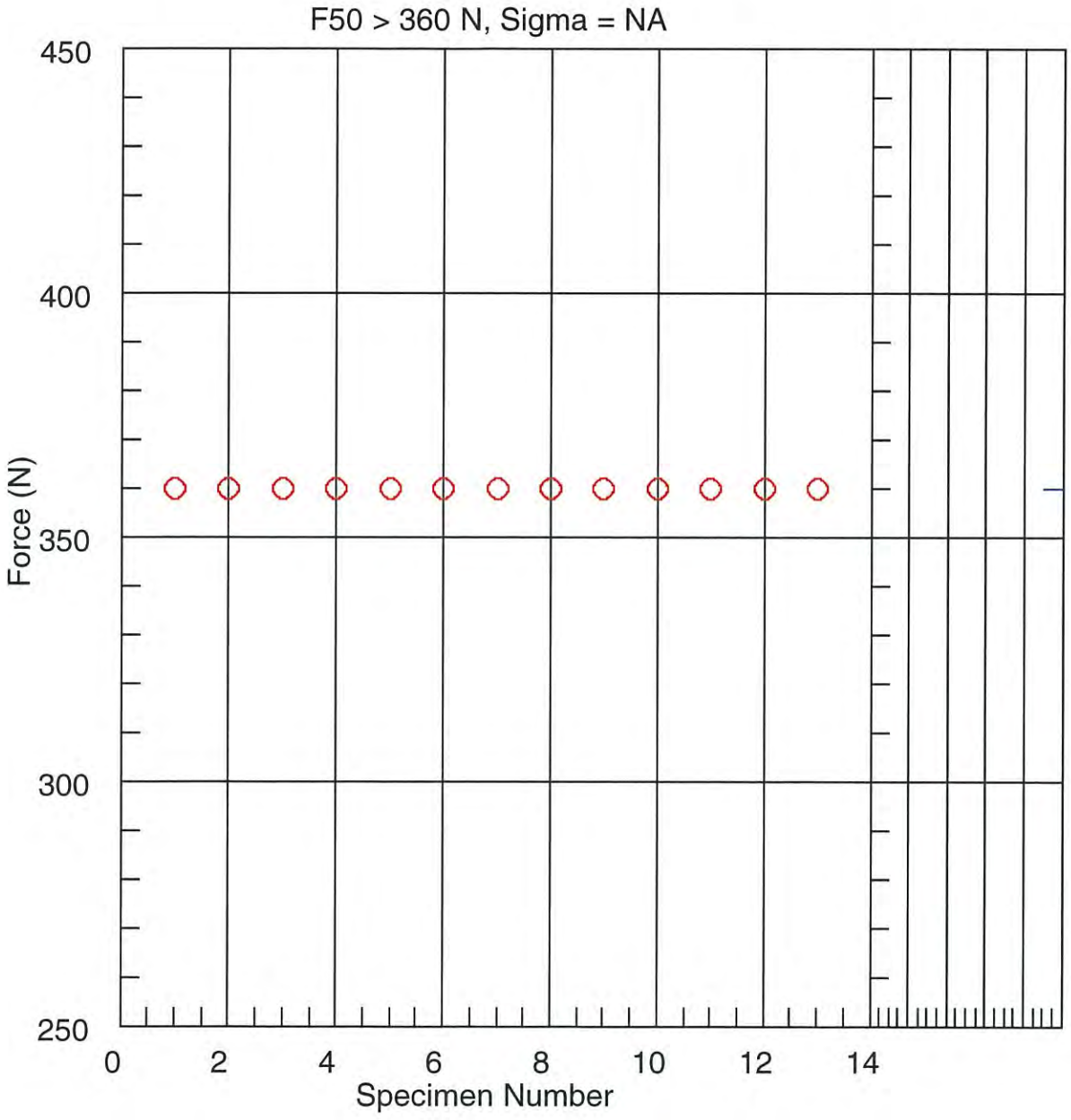


Operator: H. Tian

BAM Friction: *Neyer D-Optimal Method*

Analytical Lab#: 52528, LIMS#: 170505002

Material**: UNS solution + Kolorsafe / Swheat (1:3),** Date: **05/05/2017**



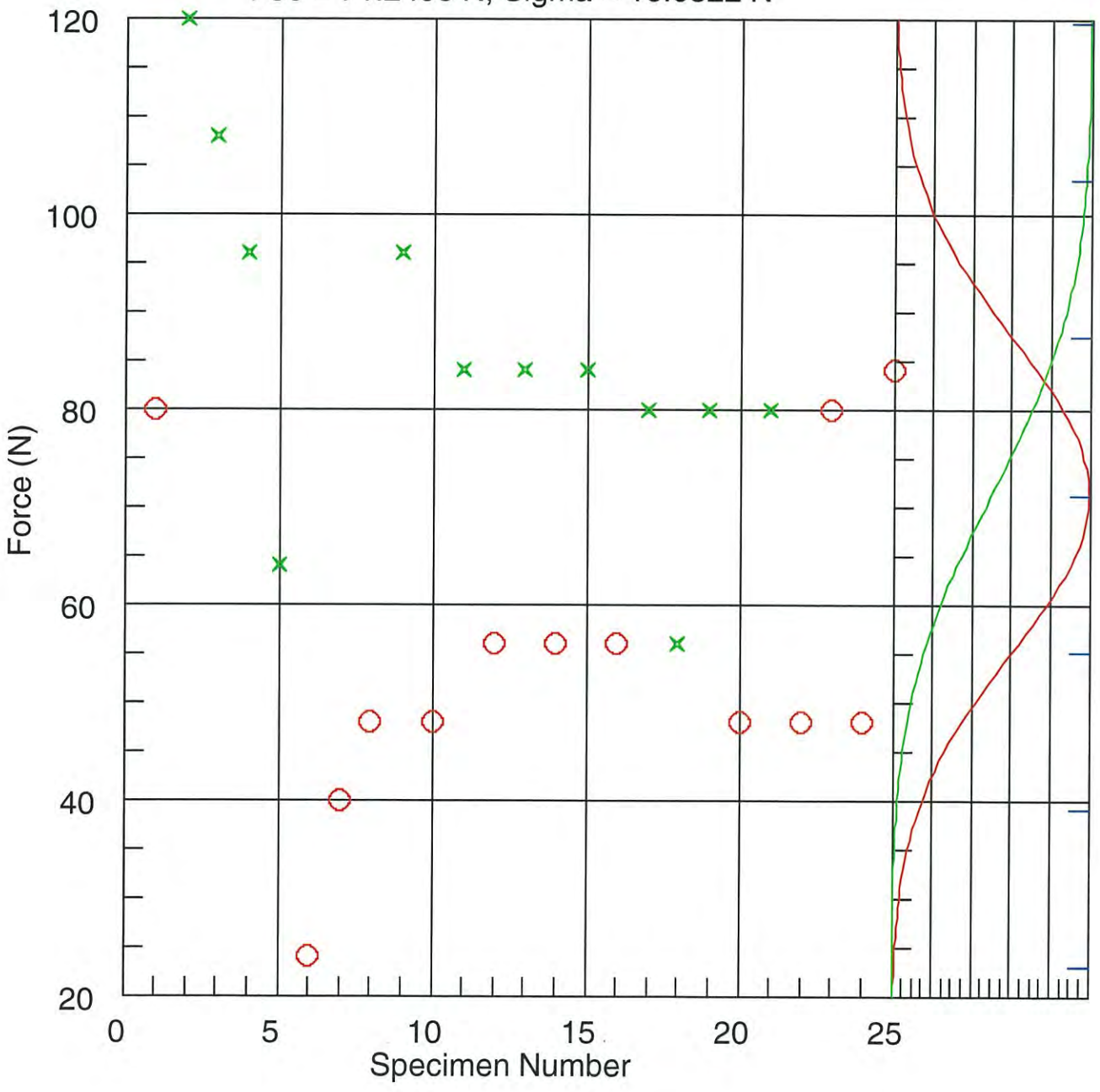
Operator: H. Tian

BAM Friction: *Neyer D-Optimal Method*

Analytical Lab#: **NA**, LIMS#: **NA**

Material**: PETN0601-02 L298,** Date: **04/04/2017**

F50 = 71.2498 N, Sigma = 16.0822 N



Operator: H. Tian

ABL Electrostatic Discharge (ESD) Test Sheet

Analytical Lab No.: 52528
LIMS#: 170505001
Material: UNS solution + Kolorsafe / Swheat (1:1)
Date: 5/5/2017
Interlock Check: PASS

Operator: H. Tian
Relative Humidity: 40%
Room Temperature: 21 C

1/1 Rxn's @ 0.25J
1/9 Rxn's @ 0.125J
0/20 Rxn's @ 0.0625J
0/0 Rxn's @ 0.025J

Test Results

Discharge Level	1	2	3	4	5	6	7	8	9	10
0.25 Joules	E									
0.125 Joules	N	N	N	N	N	N	N	N	E	
0.0625 Joules	N	N	N	N	N	N	N	N	N	N
0.025 Joules										

Test Results (continued)

Discharge Level	11	12	13	14	15	16	17	18	19	20
0.25 Joules										
0.125 Joules										
0.0625 Joules	N	N	N	N	N	N	N	N	N	N
0.025 Joules										

Type of Test

Screen Test: Energy level set to 0.25J (ten-times human electrostatic discharge) - Switch A set to position 5, Switch B set to position 1 - for 13 tests.

TIL (Threshold of Initiaiton Level): Standard energy level (Switch B set to position 1) at which 20 consecutive "no-go" tests are observed.

TIL (J):	0.0625
SCREEN (J):	-

ABL Electrostatic Discharge (ESD) Test Sheet

Analytical Lab No.: 52528
LIMS#: 170505002
Material: UNS solution + Kolorsafe / Swheat (1:3)
Date: 5/5/2017
Interlock Check: PASS

Operator: H. Tian
Relative Humidity: 40%
Room Temperature: 21 C

1/4 Rxn's @ 0.25J
1/5 Rxn's @ 0.125J
0/20 Rxn's @ 0.0625J
0/0 Rxn's @ 0.025J

Test Results

Discharge Level	1	2	3	4	5	6	7	8	9	10
0.25 Joules	N	N	N	E						
0.125 Joules	N	N	N	N	E					
0.0625 Joules	N	N	N	N	N	N	N	N	N	N
0.025 Joules										

Test Results (continued)

Discharge Level	11	12	13	14	15	16	17	18	19	20
0.25 Joules										
0.125 Joules										
0.0625 Joules	N	N	N	N	N	N	N	N	N	N
0.025 Joules										

Type of Test

Screen Test: Energy level set to 0.25J (ten-times human electrostatic discharge) - Switch A set to position 5, Switch B set to position 1 - for 13 tests.

TIL (Threshold of Initiaiton Level): Standard energy level (Switch B set to position 1) at which 20 consecutive "no-go" tests are observed.

TIL (J):	0.0625
SCREEN (J):	-

ABL Electrostatic Discharge (ESD) Test Sheet

Analytical Lab No.: NA
LIMS#: NA
Material: PETN0601-02 L298
Date: 4/4/2017
Interlock Check: PASS

Operator: H. Tian
Relative Humidity: 39%
Room Temperature: 21 C

1/1 Rxn's @ 0.25J
1/1 Rxn's @ 0.125J
1/2 Rxn's @ 0.0625J
0/20 Rxn's @ 0.025J

Test Results

Discharge Level	1	2	3	4	5	6	7	8	9	10
0.25 Joules	E									
0.125 Joules	E									
0.0625 Joules	N	E								
0.025 Joules	N	N	N	N	N	N	N	N	N	N

Test Results (continued)

Discharge Level	11	12	13	14	15	16	17	18	19	20
0.25 Joules										
0.125 Joules										
0.0625 Joules										
0.025 Joules	N	N	N	N	N	N	N	N	N	N

Type of Test

Screen Test: Energy level set to 0.25J (ten-times human electrostatic discharge) - Switch A set to position 5, Switch B set to position 1 - for 13 tests.

TIL (Threshold of Initiaiton Level): Standard energy level (Switch B set to position 1) at which 20 consecutive "no-go" tests are observed.

TIL (J):	0.025
SCREEN (J):	-

Appendix Z

ADEM-17-0023, Evaluation of the Applicability of the D003 Characteristic (Reactivity) to Remediated Nitrate Salt Waste (RNS)

January 31, 2017

Los Alamos
NATIONAL LABORATORY
EST.1943

memorandum

AD Environmental Management

To: Mark Haagenstad, EPC-CP
From: Dave Funk, ADEM DJF
Phone: 505-667-9659
Symbol: ADEM-17-0023
Date: January 31, 2017

Subject: Evaluation of the Applicability of the D003 Characteristic (Reactivity) to Remediated Nitrate Salt Waste (RNS)

In accordance with the work scope under Section C.5.1.06 "CH-TRU Storage and Movement," LANS is responsible for storing all waste in a safe and compliant manner until the waste is disposed off-site or transferred for shipment to WIPP. In two instances, review panels have suggested that we evaluate the Remediated Nitrate Salt (RNS) waste for the RCRA hazardous waste characteristic D003, reactivity.[1,2]

To address this issue, we requested a review of the RNS waste for hazardous characteristics by the LANL Explosives Review Committee (ERC), who made the following recommendation:[3]

> "While it is the opinion of the Explosive Review Committee that D003 Reactivity does not apply to the RNS waste as there is no evidence to support such classification, the committee recommends certified testing of waste samples for confirmation. Specifically, it is difficult to assess the following characteristic in the absence of testing:
>
> (1) It is normally unstable and readily undergoes violent change without detonating.
>
> To evaluate this, we recommend that UN DOT Explosive Test Series 1c[4] (Time/Pressure test) be conducted: "the test is used to determine the effects of igniting the substance under confinement to determine if ignition leads to deflagration with explosive violence at pressures which can be attained with substances in normal commercial packages.""

Upon further internal ADEM review, we became concerned with another section of the D003 criteria, that states:

> (6) It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.

In additional discussions with our ERC, it is thought that this criteria does not apply, but would best be demonstrated through evaluation with the Koenen test,[4] which is used to evaluate the response of material to heating under confinement (UN DOT Explosive Test Series 1b)[5].

---

[1] POFMR 2015-087, "LANL Resource Conservation and Recovery Act (RCRA) Nitrate Salt Treatability Plan," Laureen Smith, Chair (2015).
[2] F. Pennebaker led Peer Review Team as documented in SRNL-MS-2016-00035 (2016).
[3] M7-15-6009, "Assessment of Nitrate Salt - Swheat Mixtures Waste Characteristics" (2015).
[4] Recommendations on the Transport of Dangerous Goods Manual of Tests and Critera, pp. 39-45, UnitedNations Publishing (New York and Geneva), Fifth Edition (2009).
[5] Emails from K. Laintz and P. Dickson (co-Chairs of the ERC) to D. Funk, April 11, 2016.

Thus, to support this analysis, an evaluation for the D003 characteristic was conducted. To accomplish this, LANS contracted with Fauske & Associates, LLC to conduct the UN DOT Explosive Test Series 1b (Koenen test) and 1c (Time/Pressure test) using the surrogates that had previously been demonstrated to exhibit the characteristic of ignitability.[6] Both tests were run in triplicate to eliminate potential outliers.

A matrix for the testing protocol was developed to evaluate mixtures that were derived from both solid (RNS – Table 1) and liquid (unremediated nitrate salt [UNS] – Table 2) salt surrogates[6]. For the RNS surrogates, ratios of sWheat to salt were chosen to maximize 1) chemical reactivity and 2) energy output. A 1:1.5 sWheat to salt ratio is stoichiometric (fuel:oxidizer) and is expected to yield maximum energy output. However, the RNS waste is expected to have ratios of sWheat:salt that vary between 1:1 and 3:1, based on the remediation process that was in place at the time the RNS waste was created. As a result, we also conducted testing with the 1:1 ratio, which has an expected lower thermal onset behavior then the 3:1 ratio material, based on the trends identified in [7].

The Koenen test protocol involves the rapid heating of a tube containing the material to be tested. One end of the tube is closed and the other has an orifice. If the tube fails structurally during the test (e.g. greater than two pieces), at an orifice size of 1 mm or greater, then the test result is positive, potentially indicating a reactive material. Our testing protocol specified that the most stringent Koenen test be run (1 mm orifice). Additional tests were identified to evaluate the effectiveness of the zeolite treatment, but would only be executed if the surrogate blends exhibited a positive response. For example, Blend 3 of Table 1 would only be run if Blend 1 failed the test, and Blend 5 would only be run if Blend 3 failed the test, etc.

Table 1 - Blending Recipes for RNS Surrogates & Testing

Blend ID	WB8 Salt (g)	sWheat:Salt Vol Ratio	Water : (S/S) Vol Ratio	Zeolite : (S/S) Vol Ratio	UN Series 1 type (b)	UN Series 1 type (c)	Testing Sequence
Baseline Testing							
Blend 1	50	1:1	NA	NA	X	X	1st
Blend 2	50	1:1.5	NA	NA	X	X	4th
Optional Testing							
Blend 3*	50	1:1	NA	2:1	X	X	Optional Testing
Blend 4*	50	1:1.5	NA	2:1	X	X	Optional Testing
Blend 5**	50	1:1	NA	3:1	X	X	Optional Testing
Blend 6**	50	1:1.5	NA	3:1	X	X	Optional Testing
Blend 7***	50	1:1	0.5:1	3:1	X	X	Optional Testing
Blend 8***	50	1:1.5	0.5:1	3:1	X	X	Optional Testing

S/S – sWheat/Salt
** Perform only if Blend 1 or 2 is positive*
*** Perform only if Blend 3 or 4 is positive*
**** Perform only if Blend 5 or 6 is positive*

[6] Anast, K. R., and Funk, D. J., "Summary Report of Laboratory Testing to Establish the Effectiveness of Proposed Treatment Methods for Unremediated and Remediated Nitrate Salt Waste Stream," LA-UR-16-22658.

[7] G. Brown, "PLAN-TA9-2443(U), Rev. B Remediated Nitrate Salt (RNS) Surrogate Formulation and Testing Standard Procedure," LA-UR-16-21746 and the results found in M7-16-6063, Memorandum, *Summary of Remediated Nitrate Salt Surrogate Formulation and Testing*, TO: David J. Funk,ADEP, FROM: Geoffrey Brown, M-7, dated May 3, 2016.

For the UNS blends, the prescribed remediation was to mix the sWheat with the liquid at a 3:1 ratio, though it is possible to absorb the liquids at ratios as low as 1:1 (sWheat:liquid), so the test matrix was chosen to span that range. In addition, to evaluate the effect of the Kolorsafe Spilfyter® neutralizer, the UNS solution was also neutralized prior to mixing with the sWheat (see Table 2). As with the RNS, additional tests were identified to evaluate the effectiveness of the zeolite treatment, but would only be executed if the surrogate blends had a positive result. For example, if UNS Blend 1 failed, then UNS Blend 5 would be run, if UNS Blend 5 failed, then UNS Blend 9 would be run, etc.

Finally, since four of the RNS containers had been processed with Wastelock 770®, for completeness, we also evaluated a surrogate derived from that product (UNS Blend 14). Due to the high ionic strength of the nitrate salt solution, the Wastelock did not "set" and the resulting product was primarily liquid. The Time Pressure tests were not conducted with the Wastelock surrogates, since the liquid would not be capable of ignition.

Table 2 - UNS Surrogate Solution Blending Recipes and Testing

Blend ID	UNS Sol (ml)	UNS Sol pH Adj. (ml)	sWheat (ml)	Waste Lock (ml)	Water: Waste Vol Ratio	Zeolite:Waste Vol Ratio	UN Series 1 type (b)	UN Series 1 type (c)	Testing Sequence
Baseline Testing									
UNS Blend 1	50	0	50	0	0	0	X	X	2nd
UNS Blend 2	50	0	150	0	0	0	X	X	5th
UNS Blend 3	0	50	50	0	0	0	X	X	3rd
UNS Blend 4	0	50	150	0	0	0	X	X	6th
Optional Testing									
UNS Blend 5*	50	0	50	0	0.5:1	2:1	X	X	Optional Testing
UNS Blend 6*	50	0	150	0	0.5:1	2:1	X	X	Optional Testing
UNS Blend 7*	0	50	50	0	0.5:1	2:1	X	X	Optional Testing
UNS Blend 8*	0	50	150	0	0.5:1	2:1	X	X	Optional Testing
UNS Blend 9**	50	0	50	0	0.5:1	3:1	X	X	Optional Testing
UNS Blend 10**	50	0	150	0	0.5:1	3:1	X	X	Optional Testing
UNS Blend 12**	0	50	50	0	0.5:1	3:1	X	X	Optional Testing
UNS Blend 13**	0	50	150	0	0.5:1	3:1	X	X	Optional Testing
UNS Blend 14	50	0	0	3.12	0	0	X	n/a	7th
UNS Blend 15***	50	0	0	3.12	0	2:1	X	n/a	Optional Testing
UNS Blend 16***	50	0	0	3.12	0	3:1	X	n/a	Optional Testing

** Perform only if UNS Blend 1, 2, 3 or 4 is positive*
*** Perform only if UNS Blend 5, 6, 7 or 8 is positive*
**** Perform only if UNS Blend 14 is positive*

The attached report[8] documents the testing and a tabular summary of the testing is provided below (Table 3). As can be seen from the table, all of the blends exhibited a negative response, with the exception of

[8] Report No.: FAI-2016-0793, "Koenen and Time/Pressure Testing on RNS and UNS Mixtures," Revision 1 (2016).

UNS Blend 2. In discussion with the contractor, the test results varied significantly in the Koenen test, and appeared to be dependent on whether or not the orifice plugged (see page 15 of Reference 8 as well as the Conclusions of the same report). We note that UNS Blend 2 exhibited a "Positive" result, which is surprising, since the fuel to oxidizer ratio is significantly greater then UNS Blend 1. In addition, UNS Blend 1 was found to be self-heating (1050 test) whereas UNS Blend 2 was not.[6] However, in reviewing the data, it was found that the tube failure for UNS Blend 2 occurred at 25, 33, and 39 seconds into the test (3 replicas are always run; and we speculate as to whether the larger quantity of sWheat contributed to 'earlier' plugging of the orifice; these were 3:1 (sWheat:liquid)). In reviewing the comments that were presented to the 39th session of the Sub-Committee of Experts on the Transport of Dangerous Goods related to the Koenen test, it was noted that, "meaningful comparisons of test results can only be made under conditions where the bursting pressure of the tube is roughly constant."[9] This results from the fact that the tube burst strength varies significantly as the steel heats, plummeting once the tube reaches temperature greater than 400 °C. Thus, it is concluded that the test results are only valid at times of ~25 s or less. Since the failures occurred at 33 and 39 seconds for two of the tests, where the tube has been significantly weakened, the results should have been determined to be "Negative." Given the prevalence for plugging, as well the fact that UNS Blend 2 was not found to be a self-heating solid, and the tube failures occurred after 25 s, we do not believe that the testing indicates a valid reactive solids test result for UNS Blend 2. For completeness, UNS Blend 6 was evaluated (consists of UNS Blend 2 mixed with zeolite in 1:2 UNS Blend 6:zeolite ratio) and yielded a negative result during Koenen testing.

Table 3. Summary of the Koenen and Time/Pressure Tests taken directly from Reference [8]. Section 2.2.1 can be found in Reference [8].

Mixture	Koenen Test Result†	Time/Pressure Test Results
RNS Blend 1	"D" – Negative	"—"
UNS Blend 1	"B" – Negative‡	"—"
UNS Blend 3	"A" – Negative	"—"
RNS Blend 2	"D" – Negative‡	"—"
UNS Blend 2	"F" – Positive	"—"
UNS Blend 4	"O" – Negative	"—"
UNS Blend 14	"C" – Negative	NR
UNS Blend 6	"O" – Negative	NR

† Descriptions of the various effects is provided in the Koenen Test Procedure in Section 2.2.1

‡ These samples initially showed a "positive" result. The testing was repeated after it was found that the heating rate was slightly faster than the specifications in the standard.

NR=Not requested by client

[9] UN/SCETDG/39/INF.53, "Comments on the Koenen Test," presented to the 39th session of the Sub-Committee of Experts on the Transport of Dangerous Goods, Geneva, Switzerland (2011).

Conclusion

We have conducted UN DOT Explosive Test Series 1b (Koenen test) and 1c (Time/Pressure test) using the surrogates that had previously been demonstrated to exhibit the characteristic of ignitability to evaluate whether D003 should be assigned as a hazardous characteristic to the RNS Waste. As a result of the testing, we have determined that D003 is not a characteristic of the RNS Waste.

DJF:as

Attachments: FAI-2016-0793 Koenen and Time/Pressure Testing on RNS and UNS Mixtures, Revision 0; prepared by Amy Paul and Paul Osterberg.

Copy:
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FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Report No.: FAI-2016-0793

Koenen and Time/Pressure Testing on RNS and UNS Mixtures

Revision 0

Project No.: LANL-Waste

Submitted to:

Los Alamos National Laboratory
Los Alamos, NM 87545

Prepared by:

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Amy Paul
Paul Osterberg
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August 2016

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LANL Approval

	Name	Signature	Date
Los Alamos National Laboratory			
Los Alamos National Laboratory			
Los Alamos National Laboratory			
Los Alamos National Laboratory			

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CALCULATION NOTE COVER SHEET

SECTION TO BE COMPLETED BY AUTHOR(S):

Calc-Note Number: FAI-2016-0793 Revision Number: 0

Title: Koenen and Time-Pressure Test Results

Project/Subject: Koenen and Time/Pressure Testing of Remediated and Unremediated Nitrate Salt Mixtures

Project Number or Shop Order: LANL-Waste

Purpose: To describe the test results of Koenen and Time/Pressure testing being performed for LANL.

Methods of Analysis*: Testing; See Section 3.0

Acceptance Criteria*: N/A

Results Summary: N/A

Does this document contain Proprietary Information? (Yes/No, if Yes whose information is it?) No

*Can be N/A and/or a reference to this information in the Design Analysis can be provided.

References of Resulting Reports, Letters, or Memoranda (Optional)

Author(s): Name (Print or Type)	Signature:	Responsibility:	Completion Date: (MM/DD/YYYY)
Amy Paul	Amy Paul	Introduction, Koenen Testing	08/08/2016
Paul Osterberg	Paul Osterberg	Time/Pressure Testing	08/08/2016

SECTION TO BE COMPLETED BY VERIFIER(S):

Verifier(s): Name (Print or Type)	Signature:	Responsibility:	Approval Date: (MM/DD/YYYY)
Paul Osterberg	Paul Osterberg	Introduction, Koenen Testing, entire report	08/08/2016
Amy Paul	Amy Paul	Time/Pressure Testing, entire report	08/08/2016

Each verifier signature confirms they have completed a separate 3-Pass Verification Checklist

SECTION TO BE COMPLETED BY EDITORIAL REVIEWER:

Reviewer Name: (Print or Type)	Signature:	Approval Date: (MM/DD/YYYY)
Ashok Ghose Dastidar	Ashok Dastidar	08/08/2016

SECTION TO BE COMPLETED BY RESPONSIBLE MANAGER:

Manager Name: (Print or Type)	Signature:	Approval Date: (MM/DD/YYYY)
Ashok Ghose Dastidar	Ashok Dastidar	08/08/2016

Responsibilities of authors/verifiers are documented ☒ Independence of verification is confirmed ☒

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a. 3-PASS VERIFICATION CHECKLIST

Verifier Name: Paul Osterberg Date: 08/05/2016 (MM/DD/YYYY)

Document Number & Rev.: FAI-2016-0793_Rev. 0

Method(s) of Verification: (attach pages as needed)
Design Review ☐ Independent Review or Alternate Calculations ☐ Testing ☐
3-Pass Method ☒ Other (specify) ☐

3-Pass Verification Review Topic	Yes	No	N/A
First Pass			
Were the general theme, scope of document and scope of review clear?	☒	☐	
Second Pass			
Do the references appear to be documented correctly? Is there enough information present to ensure the referenced document is retrievable? (Include FAI QAR number for FAI documents.)	☒	☐	
If applicable, do the acceptance criteria seem appropriate?	☐	☐	☒
Does the technical content of the calculation note make sense from a qualitative standpoint and are appropriate methods used?	☒	☐	
Third Pass			
Do the results and conclusions meet the acceptance criteria?	☐	☐	☒
Do the results and conclusions make sense and support the purpose of the calculation note?	☒	☐	
Has the technical content of the document been verified in adequate detail? Examples of technical content include inputs, models, techniques, output, hand calculations, results, tables, plots, units of measure, etc.	☒	☐	
Does the calculation note provide sufficient detail in a concise manner? Note that sufficient detail is enough information such that a qualified person could understand the analysis and replicate the results without consultation with the author.	☒	☐	
Are proprietary markings in place, as appropriate?	☒	☐	☐
Is the calculation note acceptable with respect to spelling, punctuation, and grammar?	☒	☐	
If applicable, are the references accurate? If applicable, do the references to other documents point to the latest revision? If not, are the reasons documented? Are the references retrievable?	☒	☐	☐
Are computer code names spelled correctly? If applicable, are numerals included in the official code name as appropriate?	☐	☐	☒
Has the documentation for which the verifier is responsible been read word-for-word?	☒	☐	

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Verifier Name: Amy Paul Date: 08/05/2016 (MM/DD/YYYY)

Document Number & Rev.: FAI-2016-0793_Rev. 0

Method(s) of Verification: (attach pages as needed) Design Review ☐ Independent Review or Alternate Calculations ☐ Testing ☐ 3-Pass Method ☒ Other (specify) ☐

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b. EDITORIAL REVIEW CHECKLIST

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4. Is the Record of Revision page filled in correctly including Revision, Date, and Description of Revisions, if applicable?	☒	☐	☐
5. Are the page numbers in the Table of Contents provided and correct?	☒	☐	☐
6. Are Acronyms defined in the document (either individually or on a separate page)?	☒	☐	☐
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8. Are the units of measure clearly identified and used throughout?	☒	☐	☐
9. Do all cross references to tables, figures, references, and sections point to an object of the given type?	☒	☐	☐
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12. Are all References listed referred to in the text and vice versa?	☐	☒	☐
13. Is the content of the Appendices consistent with what the document states it is?	☒	☐	☐
Calc Notes			
Body of Calc Notes			
14. Is all information in the cover page header block completed appropriately?	☒	☐	☐
15. Are the responsibilities of the author(s) and verifier(s) clearly documented? (e.g. by page numbers, section numbers, etc.)	☒	☐	☐
16. Is the report revision number on each page?	☒	☐	☐
17. Are Tables labeled consistently and do they include units of measure?	☒	☐	☐
18. Is background information and purpose of the calculation clearly stated in the appropriate section?	☐	☐	☒
19. If applicable, have the limits of applicability been listed?	☐	☐	☒
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21. Are the Acceptance Criteria listed in the appropriate section (if applicable)?	☐	☐	☒
22. Does the Calc Note include a discussion on the methodology used?	☒	☐	☐
23. If applicable, are references to the utility, plant, unit, and cycle correct with respect to spelling and consistency of use?	☐	☐	☒

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Body of Document			
24. Is the Summary/Conclusion consistent with the purpose stated and consistent with the results section?	☒	☐	☐
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33. If results are based on code development or modifications, is a source code listing or reference to a controlled location of the source code included? Alternately, if results are based on available software is the software in a controlled location?	☐	☐	☒
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Editorial Reviewer Comments (if needed):

c. RECORD OF REVISIONS

Rev.	Date (Month, Year)	CAPAL Issue ID (If Applicable)	Revision Description
A	July, 2016		Initial Draft for Customer Review
B	July, 2016		Added test duration and test dates.
0	August, 2016		Initial Issuance as Final Report. Added table defining mixtures.

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1.0 INTRODUCTION

Testing was performed to determine the effects of heating a mixture under confinement in addition to the effect of igniting a mixture under confinement. The testing was performed in accordance to *Recommendations on the Transport of Dangerous Goods Manual of Tests and Criteria* Test 1 (b): Koenen test using only a 1 mm orifice and UN Test 1 (c) (i): Time/pressure test (TPT).

These tests were performed on two different types of mixtures: Remediated Nitrate Salt (RNS) Surrogate Mixture and Unremediated Nitrate Salt (UNS) Solution Surrogate Mixture. A description of the mixtures and their compositions are provided in Tables 2-2 through Table 2-8 in Section 2.3. A summary of the Koenen and Time/Pressure Test results for the RNS and UNS mixtures are provided in Table 1-1.

Table 1-1: Test Results

Mixture	Koenen Test Result†	Time/Pressure Test Results
RNS Blend 1	~~D~~” - Negative	——”
UNS Blend 1	~~B~~” - Negative‡	——”
UNS Blend 3	~~A~~” - Negative	——”
RNS Blend 2	~~D~~” - Negative‡	——”
UNS Blend 2	~~F~~” - Positive	——”
UNS Blend 4	~~O~~” - Negative	——”

† Descriptions of the various effects is provided in the Koenen Test Procedure in Section 2.2.1

‡ These samples initially showed a ~~p~~ositive” result. The testing was repeated after it was found that the heating rate was slightly faster than the specifications in the standard.

The Koenen test results for these mixtures had a tendency to vary significantly from test to test. It is believed to be a result of the likelihood of whether or not the orifice would plug during the test. The TPT results produced a negative result for each of the samples meaning that these samples do not show a likelihood of deflagration.

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2.0 EXPERIMENTAL TEST METHODS AND VALIDATION

The Koenen and TPT testing performed is outlined in this section and follows the test plan under report FAI-2016-0648 rev.0.

2.1 TEST SETUP

2.1.1 KOENEN TEST SETUP

The test apparatus is composed of a four sided welded box to contain the potential explosion. Attached to the welded enclosure are four propane burners, one on each of the three sides and one on the bottom. Propane lines are run to each of the burners. Two rods run horizontally between the opposite walls. The non-reusable test tube and orifice assembly is suspended vertically from these rods. The tube will be fitted with an orifice plate with an opening of 1.0 mm. The test apparatus is depicted in Figure 2-1.



Figure 2-1: Koenen Test Apparatus

2.1.2 TIME/PRESSURE TEST SETUP

The Time/Pressure test apparatus, as shown in Figure 2-2, consists of a pressure vessel, firing plug, igniter, vent plug, and pressure transducer. The firing plug consists of two terminals, one grounded to the firing plug and one isolated from the firing plug. Attached to the firing plug terminals is an igniter. It will be attached to the terminals using screws. The vessel is charged with 5 g of sample. The sample is measured using an electronic mass balance. The pressure vessel and the vent plug have 20 mm openings; between the two pieces, a bursting disc (bursting

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pressure of approximately 2,200 kPa-g, or 320 psig) is placed before securing the vent plug in place.

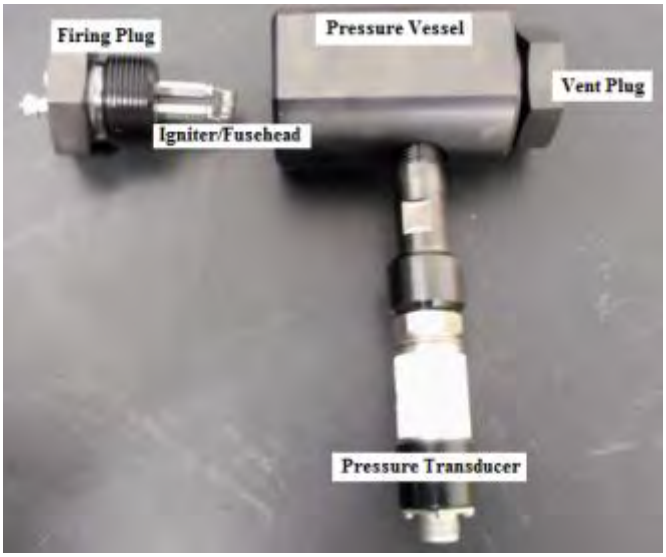


Figure 2-2: Time/Pressure Test Apparatus

After closing the pressure vessel with the firing and vent plugs, the vessel is placed on a support stand at an angle of 60 degrees from the horizontal. An ignition system is utilized to engage the igniter. The reading of the pressure transducer is recorded using a data acquisition system and computer.

2.2 TESTING PROCEDURE

2.2.1 KOENEN TEST PROCEDURE

Before testing the requested sample, the apparatus is calibrated by heating a tube containing dibutyl phthalate at a rate of 3.3±0.3K/s. The Koenen Calibration Form in Appendix A will be completed for each calibration and verification test. Verification will be done after completing the three trials for each Blend ID to confirm the heating rate of 3.3±0.3K/s.

The mass of the three new supplied metal tubes, that are approximately 24 mm in diameter and 75 mm long, is recorded. Each metal tube has one closed end and one open end. The sample is added to the tube. Liquids and gels are added to a height of 60 mm. For compressible samples, the entire cross section is tamped using an 80 N force and sample is added or discarded and re-tamped until 15 mm of empty space remains at the top of the tube. The mass of the tube and sample is recorded. The open end of the tube is then fitted with an assembly that holds the appropriate orifice plate in place. The tube and assembly is then suspended vertically by placing the collar on the two rods in the apparatus.

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Once the tube is in place in the apparatus, the room is evacuated. The operator then opens the propane tank and places the key in the control box and turns the key to the "ON" position. The burners are on and a timer is set for 5 minutes. The tube is heated by four propane burners located on three sides and at the bottom of the apparatus. The test is completed either when the tube ruptures or when the 5 minutes elapse, whichever comes first.

Once the trial is completed, the entire setup is allowed to cool for 10 minutes. The tube and remnants are carefully collected. Observations of the tube are reported, and the effects are classified and recorded as "O through "H" as follows:

- "O": Tube unchanged
- "A": Bottom of tube bulged out
- "B": Bottom of wall and of the tube bulged out
- "C": Bottom of tube split
- "D": Wall of tube split
- "E": Tube split into two fragments
- "F": Tube fragmenting into three or more mainly large pieces which in some cases may be connected with each other by a narrow strip
- "G": Tube fragmented into many mainly small pieces, closing device undamaged
- "H": Tube fragmented into many very small pieces, closing device bulged out or fragmented.

Any trial that results in "O" to "E" is regarded as "No Explosion," and "Negative" while the remaining effects are regarded as "Explosion" and "Positive."

The apparatus is thoroughly cleaned with Kimwipes®, acetone, and a wire bristle brush to remove any sample that may have been displaced during the test and to prepare the apparatus for the next test.

2.2.2 TIME/PRESSURE TEST PROCEDURE

Initially, the apparatus is cleaned of any debris from previous tests and an igniter is secured to the firing plug terminals. The firing plug is screwed in to the pressure vessel. The pressure vessel is secured vertically using a stand. Using a mass balance and glassware, 5 grams of sample is measured. While adding the sample, care was taken to not disturb the igniter. The sample is compressed gently within the pressure vessel if needed.

After adding the sample, a rupture disc is added to the top of the pressure vessel, followed by the vent plug. The pressure vessel is placed in the stand, which holds the vessel at a 60 degree angle.

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The igniter system is connected to the external terminals on the firing plug, and the pressure transducer is connected to the data acquisition system. The data acquisition system is started. At this point, the energy is applied to the igniter using the ignition system. If the rupture disc does not burst, care is taken during disassembly of the apparatus to ensure safe venting of any pressure build-up. After the test is completed, the apparatus is disassembled, cleaned and dried. The data is analyzed to determine the time for the pressure to rise from 690 kPa gauge to 2070 kPa gauge (100 psig to 300 psig). A total of 3 trials are performed, and the mean rise time is determined. The sample is considered "Positive" if the maximum pressure reached is greater than or equal to 2070 kPa gauge. The result is considered "Negative" if the maximum pressure reached in any one test is less than 2070 kPa gauge.

2.2.3 TIME PRESSURE TEST IGNITER VALIDATION TESTING

Since primed cambric is difficult to obtain, an alternative ignition source was required to be validated for use in these experiments. Initial testing was performed using pyrogen igniters; it was found that these igniters were not suitable as they were causing the rupture disc to fail prematurely. An alternate ignition source was used that consisted of a mixture of 70:30 lead oxide:silicon by weight. This ignition source was used extensively in TPT studies (Yosida, Wada, & Foster, 1995).

Validation tests were performed both on Guanidine Nitrate and Ammonium Nitrate. The results from 3 separate tests are summarized in Table 2-1.

Table 2-1: TPT Validation Test Results

Mixture	Maximum Pressure (kPa)	Time from 690 kPa to 2070 kPa (ms)	Result
Guanidine Nitrate	2806	636	"+"
	2793	165	"+"
	2705	150	"+"
Ammonium Nitrate	716	NA	"–"
	2198	671	"+"
	1717	NA	"–"

The results from the Guanidine Nitrate tests are consistent with the reported results in the *Recommendations on the Transport of Dangerous Goods Manual of Tests and Criteria* Test 1 (c) (i): Time/pressure test (TPT). The ammonium nitrate tests were used as a secondary check but cannot be used as a direct comparison of the results reported in the UN Test Manual because the material's size characteristics are different. The manual reports results for small or large prills

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and the ammonium nitrate used in these tests was a fine powder. The powder will burn more easily and rapidly than in prill form which was evidenced by the one –positive" result.

2.3 SAMPLE PREPARATION

The samples for the RNS and UNS mixtures were prepared as outlined in the Subcontract Agreement No. 390282 and subsequently in the test plan, FAI-2016-0648, Rev. 0. The sample preparation forms for each of the samples are provided in Appendix A. A summary of the actual composition for each of the mixtures is provided in Tables 2-2 through 2-8.

Table 2-2: WB8 Surrogate Mixtures for RNS Blends

Material	Desired Wt.%	RNS Blend 1 06/28/2016			RNS Blend 2 06/29/2016		
		Mass (grams)	Actual Wt.%	Difference Wt.%	Mass (grams)	Actual Wt.%	Difference Wt.%
Aluminum Nitrate Nonahydrate	4.21	8.417	4.208	0.002	16.8428	4.210	0.002
Calcium Nitrate Tetrahydrate	16.73	33.4649	16.731	0.001	66.9194	16.727	0.004
Chromium Nitrate Nonahydrate	0.21	0.4251	0.213	0.003	0.849	0.212	0.000
Iron (III) Nitrate Nonahydrate	6.39	12.7723	6.386	0.004	25.5573	6.388	0.003
Magnesium Nitrate Tetrahydrate	46.94	93.8829	46.937	0.003	187.7566	46.930	0.007
Sodium Nitrate	10.41	20.8122	10.405	0.005	41.6316	10.406	0.001
Lead (II) Nitrate	3.69	7.37	3.685	0.005	14.7661	3.691	0.006
Oxalic Acid Dihydrate	3.8	7.5924	3.796	0.004	15.2069	3.801	0.005
Potassium Carbonate	1.98	3.9665	1.983	0.003	7.913	1.978	0.005
Water	5.66	11.3152	5.657	0.003	22.6347	5.658	0.001
Total (grams)		200.0185			400.0774		

Table 2-3: WB8 Surrogate Mixtures with Swheat for RNS Blends

	RNS Blend 1 (06/28/2016)	RNS Blend 2 (06/29/2016)
WB8 Salt (mL)	130	200
Swheat (mL)	130	133
Volume Ratio Swheat:WB8 Salt	1:1	1:1.5

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Table 2-4: UNS Surrogate Solution Salt Mixtures

Material	Desired Wt.%	UNS Blend 1 and 2 06/29/2016			UNS Blend 1 and 2 07/19/2016		
		Mass (grams)	Actual Wt.%	Difference Wt.%	Mass (grams)	Actual Wt.%	Difference Wt.%
Aluminum Nitrate Nonahydrate	46.237	92.4688	46.233	0.004	46.2252	46.237	0.000
Calcium Nitrate Tetrahydrate	4.67	9.3446	4.672	0.002	4.6686	4.670	0.000
Chromium Nitrate Nonahydrate	0.342	0.6885	0.344	0.002	0.3441	0.344	0.002
Iron (III) Nitrate Nonahydrate	3.307	6.6182	3.309	0.002	3.3016	3.302	0.005
Water	3.397	6.8034	3.402	0.005	3.402	3.403	0.006
Magnesium Nitrate Tetrahydrate	22.27	44.5397	22.269	0.001	22.2753	22.281	0.011
68% Nitric Acid	0.52	1.036	0.518	0.002	0.5191	0.519	0.001
Sodium Nitrate	2.743	5.4779	2.739	0.004	2.7369	2.738	0.005
Nickel (II) Nitrate Hexahdyrate	0.013	0.0314	0.016	0.003	0.0158	0.016	0.003
Lead (II) Nitrate	3.314	6.6215	3.311	0.003	3.3038	3.305	0.009
Oxalic Acid Dihydrate	13.187	26.376	13.188	0.001	13.181	13.185	0.002
Additional Water		69.9769			34.9983		
Total (grams)		269.9829			134.9717		

Table 2-5: UNS Surrogate Solution Salt Mixtures with Swheat

	UNS Blend 1 (06/29/2016)	UNS Blend 1 (07/19/2016)	UNS Blend 2 (06/29/2016)
UNS Solution Salt (mL)	100	95	91
Swheat (mL)	100	95	273
Volume Ratio Swheat: UNS Solution Salt	1:1	1:1	3:1

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Table 2-6: UNS Surrogate Solution Salt Mixtures to be pH Adjusted

Material	Desired Wt.%	UNS Blend 3 and 4 06/30/2016		
		Mass (grams)	Actual Wt.%	Difference Wt.%
Aluminum Nitrate Nonahydrate	46.237	184.9453	46.284	0.047
Calcium Nitrate Tetrahydrate	4.67	18.6729	4.673	0.003
Chromium Nitrate Nonahydrate	0.342	1.3758	0.344	0.002
Iron (III) Nitrate Nonahydrate	3.307	13.2201	3.308	0.001
Water	3.397	13.2046	3.305	0.092
Magnesium Nitrate Tetrahydrate	22.27	89.0769	22.292	0.022
68% Nitric Acid	0.52	2.0726	0.519	0.001
Sodium Nitrate	2.743	10.9679	2.745	0.002
Nickel (II) Nitrate Hexahdyrate	0.013	0.0534	0.013	0.000
Lead (II) Nitrate	3.314	13.2604	3.319	0.005
Oxalic Acid Dihydrate	13.187	52.7385	13.198	0.011
Additional Water		140.0018		
Total (grams)		539.5902		

Table 2-7: UNS Surrogate Solution Salt Mixtures with Spilfyer Kolor Safe

	UNS Blend 3 and 4 (06/30/2016)
UNS Solution Salt (grams)	539.5902
Spilfyter Kolor Safe (grams)	1050.7687
pH after adjusting	6

Table 2-8: UNS Solution pH Adjusted with Swheat

	UNS Blend 3 (06/30/2016)	UNS Blend 4 (06/30/2016)
UNS pH Adjusted Solution (mL)	250	150
Swheat (mL)	250	450
Volume Ratio Swheat: UNS pH Adjust Solution Salt	1:1	3:1

Each of the materials procured for this testing were analyzed for chemical identity and purity. The results from the chemical analysis are provided in E.2 in Appendix E.

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2.4 KOENEN TUBE VERIFICATION

The Koenen tubes were tested to determine if they meet the specifications within the standard. The tubes passed except for the burst pressure test as it ruptured just below the lower tolerance. This does not have a major impact on the outcome of this test as the burst pressure is relatively close to the specifications. The Koenen tube specifications and results are summarized in Table 2-9. The tube composition analysis is provided in E.1 in Appendix E.

Table 2-9: Koenen Tube Characteristics Test Results

Characteristic Allowable Result	Characteristic Allowable Result	Result
Mass of Tube	26.5 ± 1.5 g	Pass, see Koenen Test forms in Appendix D
Length	75 ± 0.5 mm	75.31 mm, pass
Wall thickness, 20 mm from bottom	0.5 ± 0.05 mm	0.48 mm, pass
Burst Pressure	30 ± 3 MPa	25 to 26 MPa, fail
Carbon	0.06% (maximum)	0.025%, Pass
Manganese	0.50% (maximum)	0.27%, Pass
Phosphorus	0.020% (maximum)	0.019%, Pass
Sulfur	0.020% (maximum)	0.0071%, Pass
Aluminum	0.01% (minimum)	0.06%, Pass
Copper	0.20% (maximum)	0.0085%, Pass
Nickel	0.20% (maximum)	0.0052%, Pass
Chromium	0.15% (maximum)	0.018%, Pass
Molybdenum	0.06% (maximum)	0.0034%, Pass
Vanadium	0.008% (maximum)	0.0005%, Pass
Niobium	0.008% (maximum)	0.00006%, Pass
Titanium	0.025% (maximum)	0.00062%, Pass

2.5 DEVIATIONS FROM TEST PLAN

The test plan, FAI report FAI-2016-0648, Rev. 0, outlines the scope and procedures of this project. There are a few deviations from the test plan to be noted:

1. Calibration/verification of the pressure transducer and thermocouple
2. Koenen tubes were used despite bursting below pressure indicated in the test plan.

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The calibration/verification of the pressure transducers were stated to be performed before and after each test series. This calibration/verification procedure occurred less frequently throughout the testing campaign. The pressure transducer and thermocouple were found to be within tolerance when they were checked between the series so no further calibration actions were required.

The Koenen tubes were still used despite their burst pressure being just below the lower tolerance specified in the standard. This is because the burst pressure is still relatively close to the specifications and would not have a major impact on the outcome of these tests.

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3.0 EXPERIMENTAL TEST RESULTS

3.1 KOENEN TEST RESULTS

The Koenen results for the RNS and UNS mixtures are shown in Table 3-1. Post-test observations for each of the trials are provided in Appendix B. The details of each of the individual trials are provided in Appendix C.

Table 3-1: Koenen Test Results Summary

Mixture	Koenen Test Effect Result	Comments
RNS Blend 1	~~D~~" - Negative	
UNS Blend 1	~~B~~" – Negative	Initial result was ~~F~~"—Positive, but the heating rate was deemed to be too fast by 0.08 K/s.
UNS Blend 3	~~A~~" - Negative	
RNS Blend 2	~~D~~" - Negative	Initial result was ~~F~~"—Positive, but the heating rate was deemed to be too fast by 0.08 K/s.
UNS Blend 2	~~F~~" - Positive	
UNS Blend 4	~~O~~" - Negative	

For a few of the samples, the Koenen test results varied significantly from trial to trial. Repeat testing was performed on UNS Blend 1 and RNS Blend 2 after review of the calibration heating rate. The heating rate was a little faster than specified in the test method. Upon completion of the repeat tests, UNS Blend 1 changed from an ~~F~~"—Positive to a ~~B~~"—Negative. RNS Blend 2 changed from an ~~F~~"—Positive to ~~D~~"—Negative. The variability in some of these test result is believed to be a result of the likelihood of orifice blockage during the test. A complete list of the results from each individual test run is listed below in Table 3-2. The test performance date and duration of each test run is summarized in Table 3-3.

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Table 3-2: Koenen Heating Rate Test Results

Mixture	Pre-test Heating Rate (K/s)	Post-Test Heating Rate (K/s)	Trial 1	Trial 2	Trial 3
RNS Blend 1	3.23	3.47	C	C	D
UNS Blend 1† (Initial Series 1)	3.47	3.68	F	A	A
UNS Blend 3	3.20	3.14	A	A	A
RNS Blend 2† (Initial Series 1)	3.68	3.20	C	D	F
UNS Blend 2	3.14	3.44	F	F	F
UNS Blend 4	3.44	3.59	O	O	O
RNS Blend 2 (Repeat Series 2)	3.17	3.50	D	B	B
UNS Blend 1 (Repeat Series 2)	3.50	3.07	A	B	A

†After testing was completed, the verifications were found to be out of tolerance and testing was repeated.

Table 3-3: Koenen Test Dates and Duration

	Date of Test (MM/DD/YYYY)	Trial 1 (MM:SS/Results)	Trial 2 (MM:SS/Results)	Trial 3 (MM:SS/Results)
RNS Blend 1	06/29/2016	0:30/C	0:30/C	0:52/D
UNS Blend 1 (Initial Series 1)	06/30/2016	1:00/F	>5:00/A	>5:00/A
UNS Blend 3	07/01/2016	>5:00/A	>5:00/A	>5:00/A
RNS Blend 2 (Initial Series 1)	07/01/2016	>5:00/C	0:38/D	1:06/F
UNS Blend 2	07/02/2016	0:33/F	0:39/F	0:25/F
UNS Blend 4	07/02/2016	>5:00/O	>5:00/O	>5:00/O
RNS Blend 2 (Repeat Series 2)	07/15/2016	>5:00/D	>5:00/B	>5:00/B
UNS Blend 1 (Repeat Series 2)	07/21/2016	>5:00/A	>5:00/B	>5:00/A

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3.2 TIME/PRESSURE TEST RESULTS

The Time/Pressure Test results for the RNS and UNS mixtures are shown in Table 3-4. The TPT results produced a negative result for each of the samples meaning that these samples do not show a likelihood of deflagration. The detailed results are shown in Appendix D.

Table 3-4: TPT Results

Sample	Maximum Pressure (kPa)	Time for a Pressure Rise from 690 to 2070 kPa (ms)	Test Result
RNS Blend 1	< 2070	—	—”
UNS Blend 1	< 2070	—	—”
UNS Blend 3	< 2070	—	—”
RNS Blend 2	< 2070	—	—”
UNS Blend 2	< 2070	—	—”
UNS Blend 4	< 2070	—	—”

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4.0 QUALITY ASSURANCE

The testing services provided are considered to be safety-related and therefore will meet the requirements of the Westinghouse Electric Company Quality management System (QMS) and the lower tier, FAI's F3 Procedures, which are compliant with 10CFR50 Appendix B and FAI's ISO 9001 certification.

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5.0 CONCLUSIONS

The Koenen and Time/Pressure Tests were performed for UNS and RNS mixtures. A summary of the test results is provided in Table 5-1. The Koenen test results were not always repeatable and consistent for some of the mixtures. Although this could possibly be contributed to several factors, one of the main factors is whether or not the discharge orifice plugged during a trial. The TPT results produced a negative result for each of the samples meaning that these samples do not show a likelihood of deflagration.

Table 5-1: Summary of the Koenen and TPT Results

Mixture	Koenen Test Result	Time/Pressure Test Results
RNS Blend 1	―D" - Negative	―"
UNS Blend 1	―B" - Negative†	―"
UNS Blend 3	―A" - Negative	―"
RNS Blend 2	―D" - Negative†	―"
UNS Blend 2	―F" - Positive	―"
UNS Blend 4	―O" - Negative	―"

† These samples initially showed a ―positive" result. The testing was repeated after it was found that the heating rate was slightly faster than the specifications in the standard.

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6.0 REFERENCES

United Nations. (2009). *Recommendations of the Transport of Dangerous Goods: Manual of Tests and Criteria.* New York: United Nations.

"Test Plan: Koenen and Time/Pressure Baseline Testing for Los Alamos National Laboratory," FAI-2016-0648, Rev. 0. Fauske & Associates, Burr Ridge IL, June 2016. QAR 5.170.

Yosida, T., Wada, Y., & Foster, N. (1995). *Safety of Reactive Chemicals and Pyrotechnics.* Amsterdam: Elsevier.

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APPENDIX A: MIXTURE FORMS

A.1 RNS Blend 1 Mixture

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name: LANL - WASTE
Project Number: 5,170
Date: 06/28/2016
Relative Humidity: 36%
Prepared By: TOM JOHNSON
Scale ID: SCALE 8
Room Temp.: 26°C
Barometric Pressure: 996 mbar

Mixture ID: RNS BLEND 1

Chemical/FAI ID	Mass of Sample (g)	Final Mass of Pan (g)	Total Mass Added (g)
ALUMINUM NITRATE NONAHYDRATE FAI-LANL-WASTE-1	8.4184	0.0014	8.4170
CALCIUM NITRATE TETRAHYDRATE FAI-LANL-WASTE-2	33.4657	0.0008	33.4649
CHROMIUM (III) NITRATE NONAHYDRATE FAI-LANL-WASTE-3	0.4261	0.0010	0.4251
IRON (III) NITRATE NONAHYDRATE FAI-LANL-WASTE-4	12.7827	0.0104	12.7723
MAGNESIUM NITRATE HEXAHYDRATE FAI-LANL-WASTE-5	93.8905	0.0076	93.8829
SODIUM NITRATE FAI-LANL-WASTE-6	20.8306	0.0184	20.8122
LEAD (II) NITRATE FAI-LANL-WASTE-8	7.3960	0.0260	7.3700
WATER FAI-LANL-WASTE-14	11.3152	–	–
OXALIC ACID DIHYDRATE FAI-LANL-WASTE-9	7.6003	0.0079	7.5924
POTASSIUM CARBONATE FAI-LANL-WASTE-10	3.9813	0.0148	3.9665
~~SILVER NITRATE FAI-LANL-WASTE-12~~			

AJ 06/28

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A.2 RNS Blend 1 Mixture with Swheat

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name:	LANL - WASTE	Prepared By:	Tom Johnson
Project Number:	5.170	Scale ID:	—
Date:	06/28/2016	Room Temp.:	24.3°C
Relative Humidity:	36%	Barometric Pressure:	796 mbar

Mixture ID: RNS blend 1 with Swheat

Chemical/FAI ID	Mass of Sample (g) mL	Final Mass of Pan (g)	Total Mass Added (g)
RNS blend 1	130	—	130
Swheat 213	130	-	130
Sample added to oven at 5:22 pm at 60°C, 06/28/2016			
Sample removed from oven at 10:26 am, 06/29/2016			

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A.3 UNS Blend 1 and 2 Mixture

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name: LANL - WASTE
Prepared By: Amy Johnson
Project Number: 5170
Scale ID: SCALE 8
Date: 06/29/2016
Room Temp.: 24.5°C
Relative Humidity: 34%
Barometric Pressure: 795 mbar

Mixture ID: LANS BLEND 1+2

Chemical/FAI ID	Mass of Sample (g)	Final Mass of Pan (g)	Total Mass Added (g)
ALUMINUM NITRATE NONAHYDRATE FAI - LANL - WASTE - 1	92.4980	0.0302	92.4688
CALCIUM NITRATE TETRAHYDRATE FAI - LANL - WASTE - 2	9.3541	0.0095	9.3446
CHROMIUM NITRATE NONAHYDRATE FAI - LANL - WASTE - 3	0.6893	0.0008	0.6885
IRON (III) NITRATE NONAHYDRATE FAI - LANL - WASTE - 4	6.6203	0.0021	6.6182
MAGNESIUM NITRATE HEXAHYDRATE FAI - LANL - WASTE - 5	44.5565	0.0168	44.5397
SODIUM NITRATE FAI - LANL - WASTE - 6	5.4838	0.0059	5.4779
MILLERITE NITRATE HEXAHYDRATE FAI - LANL - WASTE - 7	0.0314	0.0000	0.0314
LEAD(II) NITRATE FAI - LANL - WASTE - 8	6.6218	0.0003	6.6215
OXALIC ACID DIHYDRATE FAI - LANL - WASTE - 9	26.3781	0.0021	26.3760
WATER FAI - LANL - WASTE - 14	6.8334	-	6.8334
70% NITRIC ACID FAI - LANL - WASTE - 15	1.0052	0.0022	1.0030
WATER FAI - LANL - WASTE - 14	70.0017	0.0258	69.9769

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A.4 UNS Blend 1 Mixture with Swheat

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name: LANL-WASTE
Project Number: 5,170
Date: 06/29/16
Relative Humidity: 36%
Prepared By: Tom Johnson
Scale ID: — FZM-50 GC 1
Room Temp.: 22.9 °C
Barometric Pressure: 944 mbar

Mixture ID: UNS Blend 1 with SWHEAT

Chemical/FAI ID	Mass of Sample ~~(g)~~ mL	Final Mass of Pan (g)	Total Mass Added (g) mL
UNS Blend 1@2	50	N/A	50
UNS Blend 1@2	50	N/A	50
SWheat 2/3	50	N/A	50
SWheat 2/3	50	N/A	50

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A.5 UNS Blend 3 and 4 Mixture with Kolor-Safe

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name: LANL-WASTE
Project Number: 5170
Date: 06/30/2016
Relative Humidity: 42%
Prepared By: TOM JOHNSON
Scale ID: SCALE 8
Room Temp.: 20.0°C
Barometric Pressure: 993

Mixture ID: UNS Blend 3&4 with KOLOR-SAFE

Chemical/FAI ID	Mass of Sample (g)	Final Mass of Pan (g)	Total Mass Added (g)
ALUMINUM NITRATE NONAHYDRATE FAI-LANL-WASTE-1	184.9637	0.0184	184.9453
CALCIUM NITRATE TETRAHYDRATE FAI-LANL-WASTE-2	18.6794	0.0065	18.6729
CHROMIUM (III) NITRATE NONAHYDRATE FAI-LANL-WASTE-3	1.3766	0.0008	1.3758
ZINC (II) NITRATE HEXAHYDRATE FAI-LANL-WASTE-4	13.2309	0.0108	13.2201
MAGNESIUM NITRATE HEXAHYDRATE FAI-LANL-WASTE-5	89.0803	0.0034	89.0769
SODIUM NITRATE FAI-LANL-WASTE-6	10.9692	0.0013	10.9679
NICKEL (II) NITRATE HEXAHYDRATE FAI-LANL-WASTE-7	0.0538	0.0004	0.0534
LEAD (II) NITRATE FAI-LANL-WASTE-8	13.2605	0.0001	13.2604
OXALIC ACID DIHYDRATE FAI-LANL-WASTE-9	52.7456	0.8971	51.7395
WATER FAI-LANL-WASTE-11	13.2646	—	13.2646
70% NITRIC ACID FAI-LANL-WASTE-15	2.0257	0.931	2.0126
WATER FAI-LANL-WASTE-14	140.0024	0.0006	140.0018
SPILFYTER KOLOR-SAFE ½	79.0788	0.1439	78.9349
SPILFYTER KOLOR-SAFE ½	84.5789	0.1611	84.4178
SPILFYTER KOLOR-SAFE ½	93.3313	0.1325	93.1988
SPILFYTER KOLOR-SAFE ½	97.8481	0.1013	97.7468
SPILFYTER KOLOR-SAFE ½	100.8430	0.1752	100.6678
SPILFYTER KOLOR-SAFE ½	82.4536	0.0441	82.4095
SPILFYTER KOLOR-SAFE ½	84.8525	0.0972	84.7953
SPILFYTER KOLOR-SAFE ½	91.7797	0.0949	91.6848
SPILFYTER KOLOR-SAFE ½	83.5547	0.0110	83.5437
SPILFYTER KOLOR-SAFE ½	85.6512	0.0305	85.6207
SPILFYTER KOLOR-SAFE ½	85.5487	0.1153	85.4334

- pH 0-1
- pH ~2.5

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A.5 UNS Blend 3 and 4 Mixture with Kolor-Safe Continued

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

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Chemical/FAI ID	Mass of Sample (g)	Final Mass of Pan (g)	Total Mass Added (g)
SAFETYGER KOLOR-SAFE 1/2	82.4400	0.1248	82.3152

pH = 6

Comments/Observations:

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A.6 UNS Blend 3 Mixture with Swheat

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name: LANL-WASTE
Project Number: 5170
Date: 06/30/16
Relative Humidity: 40%
Prepared By: Tom Johnson
Scale ID: - FLM-50 GC 1
Room Temp.: 21.8 °C
Barometric Pressure: 990 mbar

Mixture ID: UNS Blend 3 with SWHEAT

Chemical/FAI ID	Mass of Sample (gr) in g	Final Mass of Pan (gr)	Total Mass Added (gr) in g
UNS Blend 3+4 with Kolor-Safe	50	-	50
UNS Blend 3+4 with Kolor-Safe	50	-	50
UNS BLEND 3+4 with Kolor-SAFE	50	-	50
UNS BLEND 3+4 with Kolor-SAFE	50	-	50
UNS BLEND 3+4 with Kolor-SAFE	50	-	50
SWHEAT 2/3	50	-	50
SWHEAT 2/3	50	-	50
SWHEAT 2/3	50	-	50
SWHEAT 2/3	50	-	50
SWHEAT 2/3	50	-	50

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A.7 RNS Blend 2 Mixture

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name:	LANL-WASTE	Prepared By:	TOM JOHNSON
Project Number:	5.170	Scale ID:	SCALE 8
Date:	06/29/16	Room Temp.:	22.9°C
Relative Humidity:	36%	Barometric Pressure:	914 mbar

Mixture ID: RNS Blend 2

Chemical/FAI ID	Mass of Sample (g)	Final Mass of Pan (g)	Total Mass Added (g)
ALUMINUM NITRATE NONAHYDRATE FAI-LANL-WASTE-1	16.8553	0.0125	16.8428
CALCIUM NITRATE TETRAHYDRATE FAI-LANL-WASTE-2	66.9216	0.0022	66.9194
CHROMIUM (III) NITRATE NONAHYDRATE FAI-LANL-WASTE-3	0.8522	0.0032	0.8490
IRON (II) NITRATE NONAHYDRATE FAI-LANL-WASTE-4	25.5714	0.0141	25.5573
MAGNESIUM NITRATE HEXAHYDRATE FAI-LANL-WASTE-5	187.7624	0.0058	187.7566
SODIUM NITRATE FAI-LANL-WASTE-6	41.6630	~~0.00~~ 0.0314	41.6316
LEAD (II) NITRATE FAI-LANL-WASTE-8	14.7880	0.0019	14.7861
WATER FAI-LANL-WASTE-14	22.6347	—	22.6347
OXALIC ACID DIHYDRATE FAI-LANL-WASTE-9	15.2083	0.0014	15.2069
POTASSIUM CARBONATE FAI-LANL-WASTE-10	7.9254	0.0124	7.9130

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A.8 RNS Blend 2 Mixture with Swheat

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name: LANL-WASTE
Prepared By: Tom Johnson
Project Number: 5.170
Scale ID: — FLM-50 GC 1
Date: 06/29/16
Room Temp.: 22.9 °C
Relative Humidity: 36 %
Barometric Pressure: 993 mbar

Mixture ID: RNS Blend 2 with sWheat

133

Chemical/FAI ID	Mass of Sample ~~(g)~~ mL	Final Mass of Pan (g)	Total Mass Added ~~(g)~~ mL
RNS Blend 2	50	N/A	50
RNS Blend 2	50	N/A	50
RNS Blend 2	50	N/A	50
RNS Blend 2	50 mL	N/A	50
sWheat 2/3	50	N/A	50
sWheat 2/3	50	N/A	50
sWheat 2/3	33	N/A	33

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A.9 UNS Blend 2 Mixture with Swheat

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name: LANL-WASTE
Project Number: 5170
Date: 06/29/16
Relative Humidity: 36%
Prepared By: Tom Johnson
Scale ID: — FLM-50 Gr 1
Room Temp.: 22.9 C
Barometric Pressure: 994 mbar

Mixture ID: UNS Blend 2 with SWHEAT

273

Chemical/FAI ID	Mass of Sample (g)	Final Mass of Pan (g)	Total Mass Added (g)
UNS Blend 102	50	N/A	50
UNS Blend 102	41	N/A	41
sWheat 2/3	50	N/A	50
sWheat 2/3	50	N/A	50
sWheat 2/3	50	N/A	50
sWheat 2/3	50	N/A	50
sWheat 2/3	50	N/A	50
sWheat 2/3	23	N/A	23

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A.10 UNS Blend 4 Mixture with Swheat

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name: LANL-WASTE
Project Number: 5,170
Date: 06/30/16
Relative Humidity: 40 %
Prepared By: TOM JOHNSON
Scale ID: — FLM-50 GC 1
Room Temp.: 22.1 °C
Barometric Pressure: 981 mbar

Mixture ID: UNS Blend 4 with SWHEAT

Chemical/FAI ID	Mass of Sample (g)	Final Mass of Pan (g)	Total Mass Added (g)
UNS BLEND 3+4 WITH KOLORSAFE	50	—	50
UNS BLEND 3+4 WITH KOLORSAFE	50	—	50
UNS BLEND 3+4 WITH KOLORSAFE	50	—	50
SWHEAT 2/3	50	—	50
SWHEAT 2/3	50	—	50
SWHEAT 2/3	50	—	50
SWHEAT 2/3	50	—	50
SWHEAT 2/3	50	—	50
SWHEAT 2/3	50	—	50
SWHEAT 2/3	50	—	50
SWHEAT 2/3	50	—	50
SWHEAT 2/3	50	—	50

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A.11 UNS Blend 1 Mixture 2

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name:	LANL - Waste	Prepared By:	Amy Paul
Project Number:	QAP. 5.170	Scale ID:	Scale 8
Date:	07/19/2016	Room Temp.:	23.9 C
Relative Humidity:	50%	Barometric Pressure:	998 mbar

Mixture ID: UNS Blend 1 Repeat

Chemical/FAI ID	Mass of Sample (g)	Final Mass of Pan (g)	Total Mass Added (g)
Aluminum Nitrate Nonahydrate FAI-LANL-Waste-1	46.2454	0.0202	46.2252
Calcium Nitrate Tetrahydrate FAI-LANL-Waste-2	4.6771	0.0085	4.6686
Chromium Nitrate Nonahydrate FAI-LANL-Waste-3	0.3443	0.0002	0.3441
Iron(III) Nitrate Nonahydrate FAI-LANL-Waste-4	3.3105	0.0089	3.3016
Magnesium Nitrate Hexahydrate FAI-LANL-Waste-5	22.2781	0.0028	22.2753
Sodium Nitrate FAI-LANL-Waste-6	2.7429	0.0060	2.7369
Nickel(II) Nitrate Hexahydrate FAI-LANL-Waste-7	0.0159	0.0001	0.0158
Lead(II) Nitrate FAI-LANL-Waste-8	3.3100	0.0062	3.3038
Oxalic Acid Dihydrate FAI-LANL-Waste-9	13.1899	0.0089	13.1810
Water FAI-LANL-Waste-14	3.4170	—	3.4170
70% Nitric Acid FAI-LANL-Waste-15	0.5641	—	0.5041
Water FAI-LANL-Waste-14	35.0073	0.0090	34.9983

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A.12 UNS Blend 1 Mixture 2 with Swheat

FAUSKE & ASSOCIATES, LLC

Date: 6/29/2015
Revision: 0
Approved By:

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

Sample Preparation Form

Project Name:	LANL	Prepared By:	Amy Paul
Project Number:	LANL-Waste QAR 5.170	Scale ID:	Scale 8
Date:	07/19/2016	Room Temp.:	23.9°C
Relative Humidity:	50%	Barometric Pressure:	998 mbar

Mixture ID: UNS Blend with Swheat Repeat

Chemical/FAI ID	Mass of Sample ~~(g)~~ mL	Final Mass of Pan (g)	Total Mass Added ~~(g)~~ mL
UNS Blend 1 Repeat	50	N/A	50
UNS Blend 1 Repeat	45	N/A	45
Swheat 2/3	50	N/A	50
Swheat 2/3	45	N/A	45

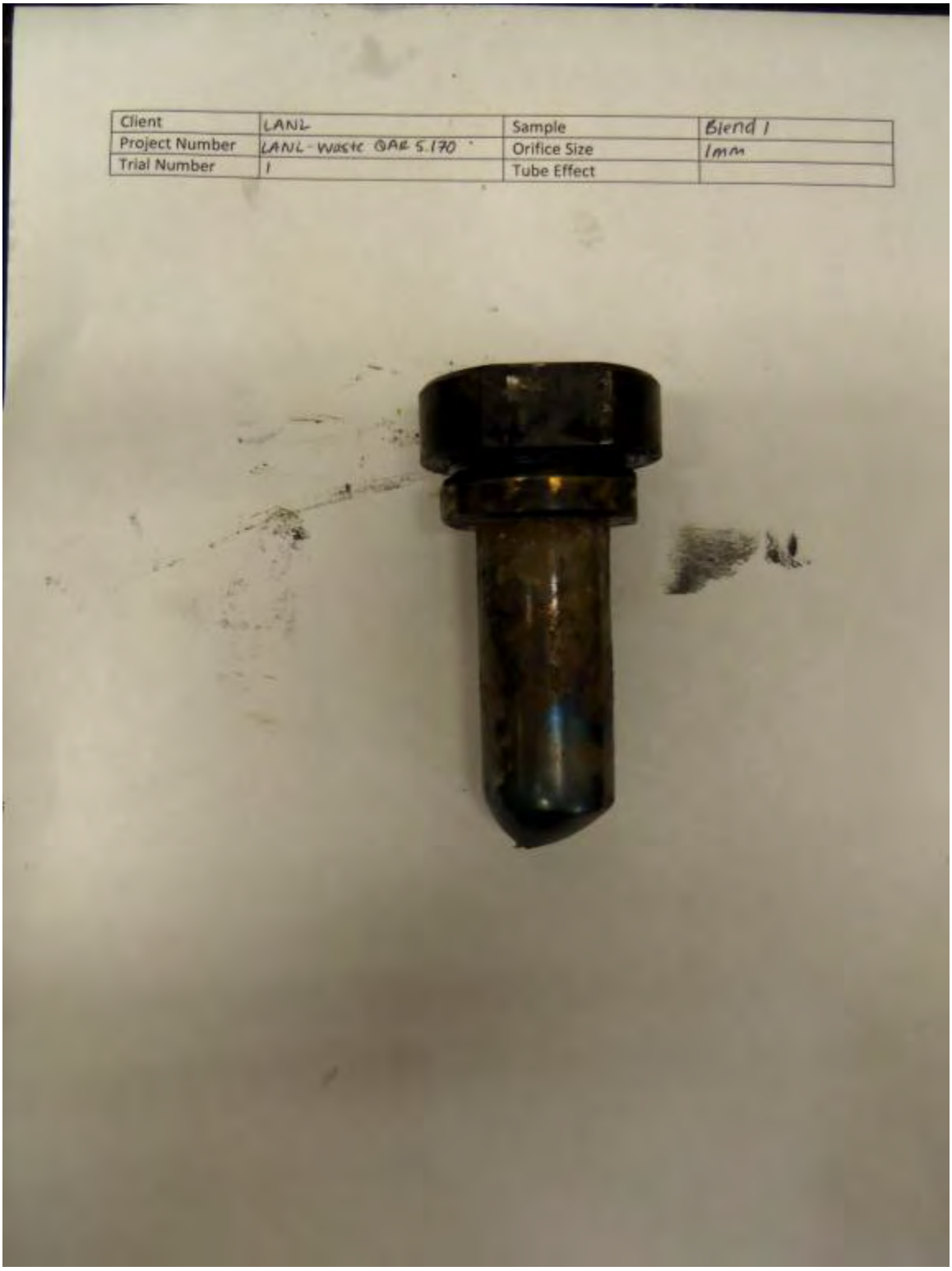
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APPENDIX B: KOENEN TEST IMAGES

B.1 Koenen Results RNS Blend 1 Trial 1



B.2 Koenen Results RNS Blend 1 Trial 2



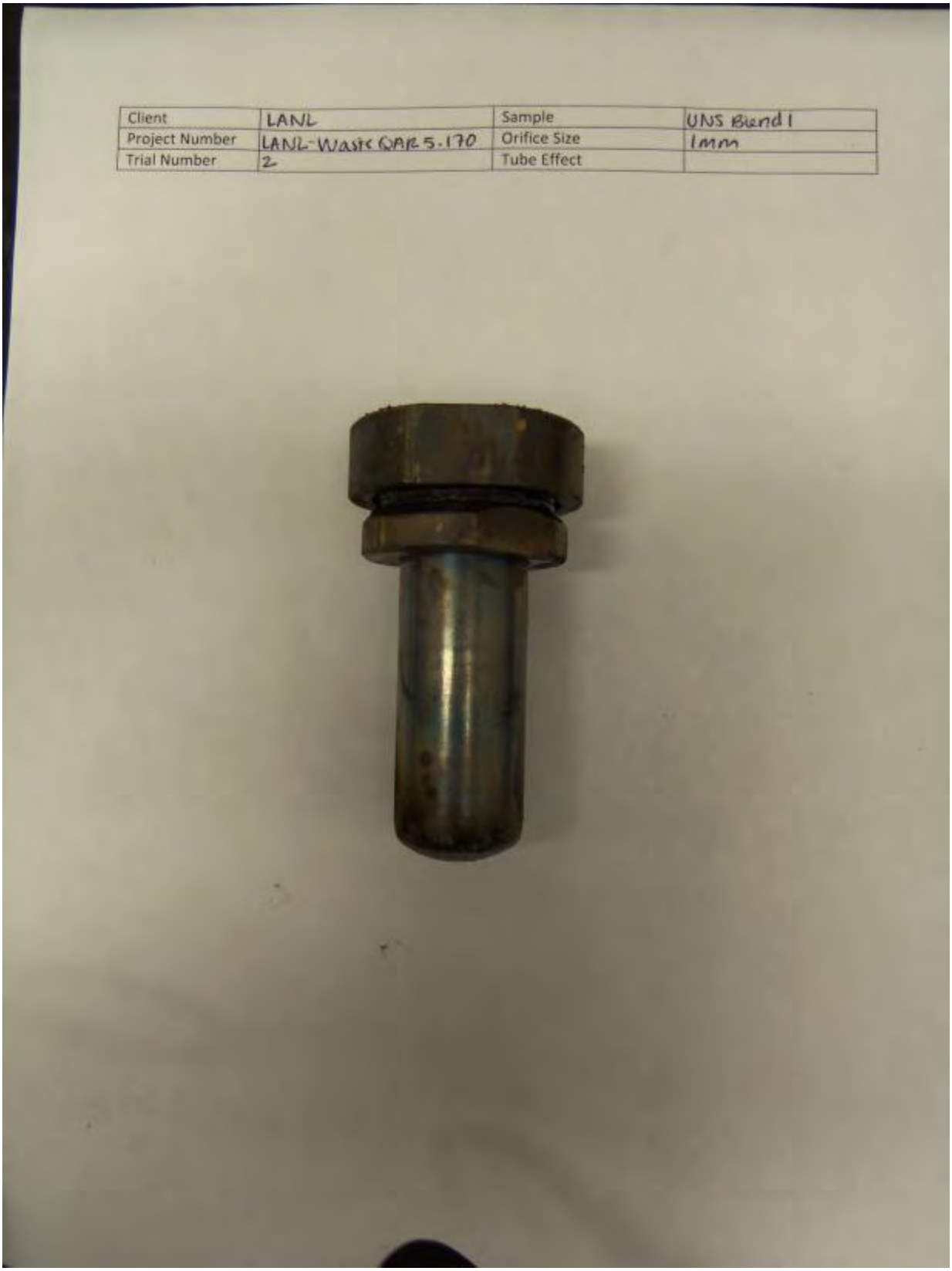
B.3 Koenen Results RNS Blend 1 Trial 3



B.4 Koenen Results UNS Blend 1 Trial 1(Initial)



B.5 Koenen Results UNS Blend 1 Trial 2(Initial)



B.6 Koenen Results UNS Blend 1 Trial 3(Initial)



B.7 Koenen Results UNS Blend 1 Trial 1(Repeat Series 2)



B.8 Koenen Results UNS Blend 1 Trial 2(Repeat Series 2)



B.9 Koenen Results UNS Blend 1 Trial 3(Repeat Series 2)



B.10 Koenen Results UNS Blend 3 Trial 1



B.11 Koenen Results UNS Blend 3 Trial 2



B.12 Koenen Results UNS Blend 3 Trial 3



B.13 Koenen Results RNS Blend 2 Trial 1(Initial)



B.14 Koenen Results RNS Blend 2 Trial 2(Initial)



B.15 Koenen Results RNS Blend 2 Trial 3(Initial)



B.16 Koenen Results RNS Blend 2 Trial 1(Repeat Series 2)



B.17 Koenen Results RNS Blend 2 Trial 2(Repeat Series 2)



B.18 Koenen Results RNS Blend 2 Trial 3(Repeat Series 2)



B.19 Koenen Results UNS Blend 2 Trial 1



B.20 Koenen Results UNS Blend 2 Trial 2



B.21 Koenen Results UNS Blend 2 Trial 3



B.22 Koenen Results UNS Blend 4 Trial 1



B.23 Koenen Results UNS Blend 4 Trial 2



B.24 Koenen Results UNS Blend 4 Trial 3



APPENDIX C: KOENEN TEST FORMS

C.1 RNS Blend 1

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

KOENEN TEST SHEET

TEST IDENTIFICATION

Client: LANL Sample: RNS Blend 1

Project No.: LANL-Waste QAR 5.170

Test Date: 06/29/16 Operator: Amy Paul

Apparatus ID: Koenen-1 Pressure Regulator ID:

TEST INFORMATION

Test Type: ☐ DOT/UN Classification ☐ Limiting Diameter ☒ Other: UN 1mm

Room Temp (°C): 23.2 Relative Humidity (%): 35 Barometric Pressure (mbar): 995

TEST DATA

Trial	Orifice Size (mm)	Empty Tube Mass (g)	Sample + Tube Mass (g)	Sample Net Mass (g)	Comments	Effect Type
1	1mm	26.39	65.20	38.81		C
2	1mm	26.61	63.27	36.66		C
3	1mm	26.44	65.42	38.98		D

Comments/Observations:

Revision # (Date)	Authorized by	Signature
Rev. 1 (2-9-2015)	Paul Osterberg	

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C.2 UNS Blend 1 (Initial)

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

KOENEN TEST SHEET

TEST IDENTIFICATION

Client: LANL Sample: UNS Blend 1

Project No.: LANL-WASTE QAP 5.170

Test Date: ~~06/29/16~~ 06/30/16 Operator: Amy Paul

Apparatus ID: koenen-1 Pressure Regulator ID:

TEST INFORMATION

Test Type: ☐ DOT/UN Classification ☐ Limiting Diameter ☒ Other: UN, 1mm

Room Temp (°C): 21.6 Relative Humidity (%): 40 Barometric Pressure (mbar): 991

TEST DATA

Trial	Orifice Size (mm)	Empty Tube Mass (g)	Sample + Tube Mass (g)	Sample Net Mass (g)	Comments	Effect Type
1	1mm	26.03	63.37	36.74		F
2	1mm	26.36	61.67	35.31		A
3	1mm	26.61	61.87	35.25		A

Comments/Observations:
Calibration/Verification post test was too fast by 0.08 K/sec.

Revision # (Date)	Authorized by	Signature
Rev. 1 (2-9-2015)	Paul Osterberg	

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C.3 UNS Blend 1 (Repeat Series 2)

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

KOENEN TEST SHEET

TEST IDENTIFICATION

Client: LANL Sample: UNS Blend 1 Repeat

Project No.: LANL-Waste QAL 5.170

Test Date: 07/21/2016 Operator: Amy Paul

Apparatus ID: Koenen-1 Pressure Regulator ID:

TEST INFORMATION

Test Type: ☐ DOT/UN Classification ☐ Limiting Diameter ☒ Other: UN, 1mm

Room Temp (°C): 24.9 Relative Humidity (%): 52 Barometric Pressure (mbar): 990

TEST DATA

Trial	Orifice Size (mm)	Empty Tube Mass (g)	Sample + Tube Mass (g)	Sample Net Mass (g)	Comments	Effect Type
1	1mm	26.49	56.21	29.72		A
2	1mm	26.32	56.60	30.28		B
3	1mm	26.49	61.31	34.82	left over sample from original mixture	A

Comments/Observations:

Revision # (Date)	Authorized by	Signature
Rev. 1 (2-9-2015)	Paul Osterberg	

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C.4 UNS Blend 3

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

KOENEN TEST SHEET

TEST IDENTIFICATION

Client: LANL Sample: UNS Blend 3

Project No.: LANL-Waste QAP-5.170

Test Date: 07/01/16 Operator: AmyPaw

Apparatus ID: Koenen-1 Pressure Regulator ID:

TEST INFORMATION

Test Type: ☐ DOT/UN Classification ☐ Limiting Diameter ☒ Other: UN, 1mm

Room Temp (°C): 21.5 Relative Humidity (%): 42 Barometric Pressure (mbar): 994

TEST DATA

Trial	Orifice Size (mm)	Empty Tube Mass (g)	Sample + Tube Mass (g)	Sample Net Mass (g)	Comments	Effect Type
1	1mm	26.21	61.16	34.95		A
2	1mm	26.07	61.46	35.39		A
3	1mm	26.28	60.93	34.65		A

Comments/Observations:

Revision # (Date)	Authorized by	Signature
Rev. 1 (2-9-2015)	Paul Osterberg	

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C.5 RNS Blend 2 (Initial)

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WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

KOENEN TEST SHEET

TEST IDENTIFICATION

Client: LANL Sample: RNS Blend 2

Project No.: LANL-Waste. QAE 5.170

Test Date: 07/01/16 Operator: AmyPaul

Apparatus ID: Koenen-1 Pressure Regulator ID:

TEST INFORMATION

Test Type: ☐ DOT/UN Classification ☐ Limiting Diameter ☒ Other: UN, 1mm

Room Temp (°C): 21.5 Relative Humidity (%): 42 Barometric Pressure (mbar): 994

TEST DATA

Trial	Orifice Size (mm)	Empty Tube Mass (g)	Sample + Tube Mass (g)	Sample Net Mass (g)	Comments	Effect Type
1	1mm	26.52	64.67	38.15		C
2	1mm	26.60	64.19	37.59		D
3	1mm	26.74	64.29	37.55		F

Comments/Observations:
verification pretest was too fast by 0.08 K/sec.

Revision # (Date)	Authorized by	Signature
Rev. 1 (2-9-2015)	Paul Osterberg	

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C.6 RNS Blend 2 (Repeat Series 2)

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WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

KOENEN TEST SHEET

TEST IDENTIFICATION

Client: LANL Sample: RNS Blend 2 (Repeat)

Project No.: LANL-Waste QAR 5.170

Test Date: 07/15/2016 Operator: Amy Paul

Apparatus ID: Koenen-1 Pressure Regulator ID:

TEST INFORMATION

Test Type: ☐ DOT/UN Classification ☐ Limiting Diameter ☒ Other: UN, 1mm

Room Temp (°C): 20.9 Relative Humidity (%): 46 Barometric Pressure (mbar): 991

TEST DATA

Trial	Orifice Size (mm)	Empty Tube Mass (g)	Sample + Tube Mass (g)	Sample Net Mass (g)	Comments	Effect Type
1	1mm	26.50	65.47	38.97		D
2	1mm	26.21	65.48	39.27		B
3	1mm	26.29	65.65	39.36		B

Comments/Observations:

Revision # (Date)	Authorized by	Signature
Rev. 1 (2-9-2015)	Paul Osterberg	

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C.7 UNS Blend 2

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

KOENEN TEST SHEET

TEST IDENTIFICATION

Client: LANL Sample: UNS Blend 2

Project No.: LANL-Waste QAP 5.17D

Test Date: 07/02/16 Operator: AmyPaul

Apparatus ID: Koenen-1 Pressure Regulator ID:

TEST INFORMATION

Test Type: ☐ DOT/UN Classification ☐ Limiting Diameter ☒ Other: UN, 1mm

Room Temp (°C): 21.0 Relative Humidity (%): 39 Barometric Pressure (mbar): 996

TEST DATA

Trial	Orifice Size (mm)	Empty Tube Mass (g)	Sample + Tube Mass (g)	Sample Net Mass (g)	Comments	Effect Type
1	1 mm	26.53	61.43	34.90		F
2	1 mm	26.29	61.67	35.38		F
3	1 mm	26.51	61.49	34.98		F

Comments/Observations:

Revision # (Date)	Authorized by	Signature
Rev. 1 (2-9-2015)	Paul Osterberg	

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C.8 UNS Blend 4

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

KOENEN TEST SHEET

TEST IDENTIFICATION

Client: LANL Sample: UNS Blend 4

Project No.: LANL - Waste QAR 5.170

Test Date: 07/02/16 Operator: Amy Paul

Apparatus ID: Koenen-1 Pressure Regulator ID:

TEST INFORMATION

Test Type: ☐ DOT/UN Classification ☐ Limiting Diameter ☒ Other: UN, 1mm

Room Temp (°C): 21.0 Relative Humidity (%): 39 Barometric Pressure (mbar): 997

TEST DATA

Trial	Orifice Size (mm)	Empty Tube Mass (g)	Sample + Tube Mass (g)	Sample Net Mass (g)	Comments	Effect Type
1	1 mm	26.50	57.45	30.95		0
2	1 mm	26.06	57.04	30.98		0
3	1 mm	26.62	57.79	31.17		0

Comments/Observations:

Revision # (Date)	Authorized by	Signature
Rev. 1 (2-9-2015)	Paul Osterberg	

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APPENDIX D: TIME/PRESSURE TEST FORMS

D.1 RNS Blend 1

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

TIME/PRESSURE TEST SHEET

TEST IDENTIFICATION

Client: LANL - WP5/6 Sample: RNS Blend 1 with SWHEAT

Project No.: LANL - WP5/6

Test Date: 07/12/2016 Operator: Tom Johnson

Apparatus ID: 4 gal Stirred Reactor-1 Pressure Transducer ID: TPT PT-1

DAQ ID: DAQ 21-59 Scale ID: Scale 8

TEST INFORMATION

Room Temp (°C): 21.6 Relative Humidity (%): 74 Barometric Pressure (mbar): 980

TEST DATA

Trial	Mass of sample (g)	Ruptured Disk (Y/N)	Maximum Pressure (kPa)	Comments
1	5.0093	N	357	1.0056 g 70/30 Pb_3O_4 + SiC
2	5.0131	N	464	1.0093 g 70/30 Pb_3O_4 + SiC
3	5.0252	N	412	1.0053 70 % Pb_3O_4 + 30% SiC

Comments/Observations:

Revision # (Date)	Authorized by	Signature
Rev. 1 (6-9-2016)	Paul Osterberg	

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D.2 UNS Blend 1

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

TIME/PRESSURE TEST SHEET

TEST IDENTIFICATION

Client:	LANL	Sample:	UNS Blend 1 with shrapnel
Project No.:	LANL-WASTE		
Test Date:	07/13/2016	Operator:	Tom Johnson
Apparatus ID:	Lynd Oxidizer Apparatus-1	Pressure Transducer ID:	TPT PT-1
DAQ ID:	00762159	Scale ID:	Scale 8

TEST INFORMATION

Room Temp (°C): 18.9 Relative Humidity (%): 70 Barometric Pressure (mbar): 987

TEST DATA

Trial	Mass of sample (g)	Ruptured Disk (Y/N)	Maximum Pressure (kPa)	Comments
1	4.9981	N	244	1.0185 g PuO_2/SS 70/30
2	4.9951	N	281	1.0179 g PuO_2/SS 70/30
3	5.0048	N	280	0.9917 g PuO_2/SS 70/30

Comments/Observations:
Sample container slightly bulged

Revision # (Date)	Authorized by	Signature
Rev. 1 (6-9-2016)	Paul Osterberg	

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D.3 UNS Blend 3

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

TIME/PRESSURE TEST SHEET

TEST IDENTIFICATION

Client:	LANL	Sample:	UNS Blend 3 with Sulfur
Project No.:	LANL- WASTE		
Test Date:	07/13/2016	Operator:	Tom Johnson
Apparatus ID:	Liquid Oxidizer Apparatus-1	Pressure Transducer ID:	TPT PT-1
DAQ ID:	D07C2159	Scale ID:	Scale B

TEST INFORMATION

Room Temp (°C): 20.5 Relative Humidity (%): 73 Barometric Pressure (mbar): 956

TEST DATA

Trial	Mass of sample (g)	Ruptured Disk (Y/N)	Maximum Pressure (kPa)	Comments
1	5.0067	N	402	1.0089 g PbO_2/S 70/30
2	5.0023	N	Did not fire	1.0099 g PbO_2/S 70/30
3	5.0044	N	271	0.9912 g PbO_2/S 70/30
4	5.0014	N	355	0.9978 g PbO_2/S 70/30

Comments/Observations:
Sample contained some free liquid before mixing

Revision # (Date)	Authorized by	Signature
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D.4 RNS Blend 2

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

TIME/PRESSURE TEST SHEET

TEST IDENTIFICATION

Client:	LANL	Sample:	RNS Blend 2 with solvent
Project No.:	LANL-WRAYE		
Test Date:	07/13/2016	Operator:	Tom Jensen
Apparatus ID:	Liquid Oxidizer Apparatus-1	Pressure Transducer ID:	TAY PT-1
DAQ ID:	0f7c2159	Scale ID:	Scale 8

TEST INFORMATION

Room Temp (°C): 21.2 Relative Humidity (%): 74 Barometric Pressure (mbar): 985

TEST DATA

Trial	Mass of sample (g)	Ruptured Disk (Y/N)	Maximum Pressure (kPa)	Comments
1	5.0089	N	544	0.9956 g Pb_3O_4/S; 7:33
2	5.0086	N	419	1.0261 g Pb_3O_4/S; 7:45
3	5.0014	N	233	1.0057 g Pb_3O_4/S; 7:57

Comments/Observations:

Revision # (Date)	Authorized by	Signature
Rev. 1 (6-9-2016)	Paul Osterberg	

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D.5 UNS Blend 2

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

TIME/PRESSURE TEST SHEET

TEST IDENTIFICATION

Client: LANL Sample: UNS Blend 2 with stainless

Project No.: LANL WASTE

Test Date: 07/14/2016 Operator: Tom Johnson

Apparatus ID: Large Oxidizer Apparatus-1 Pressure Transducer ID: TPT PT-1

DAQ ID: 007C215A Scale ID: Scale 8

TEST INFORMATION

Room Temp (°C): 20.3 Relative Humidity (%): 67 Barometric Pressure (mbar): 956

TEST DATA

Trial	Mass of sample (g)	Ruptured Disk (Y/N)	Maximum Pressure (kPa)	Comments
1	5.0080	N	378	1.0072 g PbO_2/S 74/30
2	4.9961	N	558	0.9995 g PbO_2/S 74/30
3	5.0075	N	349	1.0100 g PbO_2/S 74/30

Comments/Observations:

Revision # (Date)	Authorized by	Signature
Rev. 1 (6-9-2016)	Paul Osterberg	

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D.6 UNS Blend 4

FAUSKE & ASSOCIATES, LLC

WORLD LEADER IN NUCLEAR AND CHEMICAL PROCESS SAFETY

TIME/PRESSURE TEST SHEET

TEST IDENTIFICATION

Client: LANL Sample: UNS Blend 4 with solvent

Project No.: LANL-WASTE

Test Date: 07/14/2016 Operator: Tom Johnson

Apparatus ID: Liquid Oxidizer Apparatus-1 Pressure Transducer ID: TPT PT-1

DAQ ID: 0070159 Scale ID: Scale 8

TEST INFORMATION

Room Temp (°C): 285 Relative Humidity (%): 66 Barometric Pressure (mbar): 987

TEST DATA

Trial	Mass of sample (g)	Ruptured Disk (Y/N)	Maximum Pressure (kPa)	Comments
1	5.0054	N	340	1.0075 g PbO_2/SS 70/30
2	5.0062	N	317	1.0093 g PbO_2/SS 70/30
3	4.9976	N	330	1.0057 g PbO_2/SS 70/30

Comments/Observations:

Revision # (Date)	Authorized by	Signature
Rev. 1 (6-9-2016)	Paul Osterberg	

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APPENDIX E: MATERIAL ANALYSIS

E.1 KOENEN TUBE ANALYSIS

EAG
Evans Analytical Group

Fauske & Associates, LLC

Report Date: July 1, 2016
PO #:
Job #: S0GTZ018
Sample ID: S160622081
Sample: FAI-LANL-WASTE-16

Summary of Analytical Testing:

One stainless steel sample was submitted for certification to ASTM A1008 specifications. The material was analyzed by GDMS and IGA for composition. The sample was found to meet the specifications for all designations shown in Table 1 of ASTM Designation: A1008/A1008M-15. The following table summarizes the status of the material as tested:

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Attribute	Test Method	Test Result	Explanation for failure (if applicable)
Composition	GD-MS and IGA	Pass	-

Element	Specification	Test Result	Explanation for failure (if applicable)
C	< 0.10%	0.025%	
Mn	< 0.60%	0.27%	
P	< 0.025%	0.019%	
S	< 0.035%	0.0071%	
Al	Not Specified	0.06%	
Cu	< 0.20%	0.0085%	
Ni	< 0.20%	0.0052%	
Cr	< 0.15%	0.018%	
Mo	< 0.06%	0.0034%	
V	< 0.008%	0.0005%	
Nb	< 0.008%	0.00006%	
Ti	< 0.025%	0.00062%	

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EAG Evans Analytical Group
IGA
ANALYTICAL REPORT
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Customer: **Fauske & Associates, LLC**
16W070 83rd Street, Burr Ridge, IL 60521
P.O.#

Date: 27-Jun-16
Job # S0GTZ018
Customer ID: **Stainless Steel**
Sample ID: S160622081
FAI-LANL-WASTE-16
(Rev: 2015-06-27 09:13:40)

Element	Concentration [ppm wt]
C	250
N	-
O	-
S	-
H	-

C,S: determined by Combustion-IR
N,H: determined by IGF-TC
O: determined by IGF-TC/IR

ISO 17025
Testing Cert. #2797.03

K.OBRIEN (Analyst)
Reviewed by

Precision and bias typical of IGA measurements are discussed under ASTM E1019 and E1447.
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EAG Evans Analytical Group

GDMS
ANALYTICAL REPORT

Evans Analytical Group
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Liverpool, New York 13088

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Email info.ny@eag.com
www.eag.com

Customer: **Fauske & Associates, LLC**
16W070 83rd Street, Burr Ridge, IL 60521

P.O.#

Date: 24-Jun-16

Job # S0GTZ018

Customer ID: **Stainless Steel**

Sample ID: S160622081

FAI-LANL-WASTE-16

Element	Concentration [ppm wt]	Element	Concentration [ppm wt]
Li	-	Pd	-
Be	-	Ag	-
B	-	Cd	-
C	-	In	-
N	-	Sn	-
O	-	Sb	-
F	-	Te	-
Na	-	I	-
Mg	-	Cs	-
Al	600	Ba	-
Si	-	La	-
P	190	Ce	-
S	71	Pr	-
Cl	-	Nd	-
K	-	Sm	-
Ca	-	Eu	-
Sc	-	Gd	-
Ti	6.2	Tb	-
V	5	Dy	-
Cr	180	Ho	-
Mn	0.27 wt%	Er	-
Fe	Matrix	Tm	-
Co	-	Yb	-
Ni	52	Lu	-
Cu	85	Hf	-
Zn	-	Ta	-
Ga	-	W	-
Ge	-	Re	-
As	-	Os	-
Se	-	Ir	-
Br	-	Pt	-
Rb	-	Au	-
Sr	-	Hg	-
Y	-	Tl	-
Zr	-	Pb	-
Nb	0.6	Bi	-
Mo	34	Th	-
Ru	-	U	-
Rh	-		

ISO 17025

Testing Cert. #2797.03

4 of 4

B.CIARLEI (Analyst)

Analyzed according to WI F rev. 12/06/12

Reviewed by

Precision and bias typical of GDMS measurements are discussed under ASTM F1593
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E.2 CHEMICAL ANALYSIS SUMMARY

EAG
Evans Analytical Group

ISO 17025
Testing Cert. #2797.01

Materials Characterization Project Report: Rev. 1

17 Jun 2016

Job Number C0GTZ159

PO Number 4500696545, 4500696574

for

Amy Paul
Fauske & Associates, Inc.
16W070 83rd Street
Burr Ridge IL 60521
USA

Release Authorized By:

Greg Strossman, Ph.D.
Project Manager
(Tel. 408-530-3798; gstrossman@eag.com)

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Project Scope:

The purpose of this analysis was to confirm the identities and purities of thirteen materials. Additionally a fourteenth sample of analytical grade water was submitted for trace metals analysis. The samples are identified below.

This document is a revision of a previously released report. The revised report corrects a mislabeling of the samples in Table 1b.

Executive Summary:

Solids (FAI-LANL-Waste- 1 through 12): XRD phase analysis identified a single component consistent with the expected material; with the exception of FAI-LANL-Waste-10 where both hydrated and anhydrous forms of potassium carbonate were identified, and FAI-LANL-Waste-12 where two monoclinic phases of guanidinium (guanidine) nitrate were identified.

XRF found that the major elements comprising each compound accounted for >99.9wt% of the solid; except for FAI-LANL-Waste-10 where the major elements accounted for >97wt% and ~2.5wt% nitrogen was also found. All of the solids had various elements at trace levels that are identified in the data tables.

FAI-LANL-Waste-13: The sample was consistent with dibutyl phthalate with a measured purity of ~99.2%. Impurities included other phthalates, maleates, butyl esters, butyl tosylate.

FAI-LANL-Waste-14: Boron (B), Na, and Si were found in the water sample at concentrations between ~1-3 mg/L. Lithium (Li), Al, and K were found at concentrations <1 mg/L. No other elements were detected.

Samples:

FAI-LANL-Waste-1, Aluminum Nitrate Nonahydrate
FAI-LANL-Waste-2, Calcium Nitrate Tetrahydrate
FAI-LANL-Waste-3, Chromium Nitrate Nonahydrate
FAI-LANL-Waste-4, Iron Nitrate Nonahydrate
FAI-LANL-Waste-5, Magnesium Nitrate Hexahydrate
FAI-LANL-Waste-6, Sodium Nitrate
FAI-LANL-Waste-7, Nickel Nitrate Hexahydrate
FAI-LANL-Waste-8, Lead Nitrate
FAI-LANL-Waste-9, Oxalic Acid Dihydrate
FAI-LANL-Waste-10, Potassium Carbonate
FAI-LANL-Waste-11, Ammonium Nitrate
FAI-LANL-Waste-12, Guanidine Nitrate

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EAG Number C0GTZ159; Rev. 1
Amy Paul
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17 Jun 2016

FAI-LANL-Waste-13, Dibutyl Phthalate
FAI-LANL-Waste-14, Wafer

Technique1: XRF (FAI-LANL-Waste- 1 through 12)
Technique2: XRD (FAI-LANL-Waste- 1 through 12)
Technique3: GC-MS (FAI-LANL-Waste-13)
Technique4: ICP-MS (FAI-LANL-Waste-14)

Results:

1) Solids (FAI-LANL-Waste- 1 through 12): Table 1 (XRF) and Table 2 (XRD)

Table 1a. Sample Compositions from XRF: FAI-LANL-Waste- 1 through 6[a]

	FAI-LANL-Waste-1	FAI-LANL-Waste-2	FAI-LANL-Waste-3	FAI-LANL-Waste-4	FAI-LANL-Waste-5	FAI-LANL-Waste-6
N	(10.6)	(10.7)	(8.6)	(9.5)	(17.4)	(15.2)
O	(76.5)	(67.0)	(62.0)	(67.3)	(71.7)	(57.4)
Na	142	-	-	-	-	(27.4)
Mg	-	18	-	-	(10.9)	-
Al	(12.9)	13	18	202	7	10
Si	20	25	19	85	8	15
P	-	-	-	3	-	-
S	18	100	31	39	2	51
K	25	-	-	-	-	16
Ca	14	(22.2)	-	-	-	7
Ti	-	-	-	16	-	-
Cr	22	31	(29.3)	81	-	19
Mn	-	-	-	-	8	-
Fe[d]	50	22	58	(23.1)	9	16
Ni[d]	11	8	22	16	13	11
Ga	19	-	-	-	-	-
Sr	-	37	-	-	-	-
Major phase (wt%)[b]	99.97	99.98	99.99	99.96	99.99+	99.99

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Table 1b. Sample Compositions from XRF: FAI-LANL-Waste- 7 through 12[a]

	FAI-LANL-Waste-7	FAI-LANL-Waste-8	FAI-LANL-Waste-9	FAI-LANL-Waste-10	FAI-LANL-Waste-11	FAI-LANL-Waste-12
C	-	-	(27.1)	(9.9)	-	(12.7)
N	(8.2)	(15.9)	-	(2.5)	(38.0)	(52.3)
O	(51.2)	(41.6)	(72.9)	(39.1)	(62.0)	(35.0)
F	-	1130[c]	-	-	-	-
Na	-	532	32	114	-	36
Mg	-	84	-	-	-	27
Al	20	177	47	36	6	5
Si	26	235	56	25	13	17
P	-	26	7	5	0	14
S	14	-	174	485	17	20
Cl	19	69	-	581	-	-
K	-	106	106	(48.4)	-	3
Ca	-	654	11	11	-	10
Cr	45	151	11	-	9	7
Fe[d]	87	981	14	13	10	8
Co	49	-	-	-	-	-
Ni[d]	(40.6)	85	7	12	7	6
Cu	-	35	-	-	-	-
Rb	-	-	-	13	-	-
Ce	-	367	-	-	-	-
Pb	-	(42.0)	-	-	-	-
Major phase (wt%)[b]	**99.97**	**99.54**	**99.95**	**97.37**	**99.99**	**99.99**

[a] The results are normalized to 100% of the measured and detected elements. Note: 1.0 wt%=10,000ppm. Numbers in parentheses are in weight% (wt%). Other results are in parts per million (ppm).
[b] Represents the summed concentrations of the elements associated with the material.
[c] Fluorine may be present at or near the detection limit.
[d] Reported Fe and Ni concentrations below ~10ppm may be primarily attributable to the instrument background.

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Table 2: XRD Phase Identification and concentration from the ICDD/ICSD databases

Sample ID	Primary Phases	Concentration (wt %)
FAI-LANL-Waste-1 Aluminum Nitrate Nonahydrate	$Al(NO_3)_3 \bullet 9H_2O$ – aluminum nitrate nonahydrate Monoclinic, SG: $P2_1/c$ (14) PDF# [04-011-9934]	100.0 ± 5.0
FAI-LANL-Waste-2 Calcium Nitrate Tetrahydrate	$Ca(NO_3)_2 \bullet 4H_2O$ – calcium nitrate nonahydrate Monoclinic, SG: $P2_1/c$ (14) PDF# [98-001-1530]	100.0 ± 5.0
FAI-LANL-Waste-3 Chromium Nitrate Nonahydrate	$Cr(NO_3)_3 \bullet 9H_2O$ – chromium nitrate nonahydrate Monoclinic, SG: $P2_1/c$ (14) PDF# [04-016-0032]	100.0 ± 5.0
FAI-LANL-Waste-4 Iron Nitrate Nonahydrate	$Fe(NO_3)_3 \bullet 9H_2O$ – iron nitrate nonahydrate Monoclinic, SG: $P2_1/c$ (14) PDF# [04-010-6285]	100.0 ± 5.0
FAI-LANL-Waste-5 Magnesium Nitrate Hexahydrate	$Mg(NO_3)_2 \bullet 6H_2O$ – magnesium nitrate hexahydrate – nitromagnesite Monoclinic, SG: $P2_1/c$ (14) PDF# [00-014-0101]	100.0 ± 5.0
FAI-LANL-Waste-6 Sodium Nitrate	$Na(NO_3)$ – sodium nitrate – nitratine Hexagonal, SG: R-3c (167) PDF# [01-080-3762] Unknown minor phase	99.0 ± 5.0 <1.0% ± 5.0
FAI-LANL-Waste-7 Nickel Nitrate Hexahydrate	$Ni(NO_3)_2 \bullet 6H_2O$ – nickel nitrate hexahydrate Triclinic, SG: P-1 (2) PDF# [04-011-1578]	100.0 ± 5.0
FAI-LANL-Waste-8 Lead Nitrate	$Pb(NO_3)_2$ – lead nitrate Cubic, SG: Pa-3 (205) PDF# [04-007-4709]	100.0 ± 5.0

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FAI-LANL-Waste-9 Oxalic Acid Dihydrate	$(C_2O_4)H_2 \bullet 2H_2O$ – hydrogen oxalate hydrate Monoclinic, SG: $P2_1/n$ (14) PDF# [04-009-3739]	100.0 ± 5.0
FAI-LANL-Waste-10 Potassium Carbonate	$K_4(CO_3)_2 \bullet 3H_2O$ – potassium carbonate hydrate Monoclinic, SG: C2/c (15) PDF# [04-010-8931] $K_2(CO_3)$– potassium carbonate Monoclinic, SG: $P2_1/c$ (14) PDF# [04-014-3875]	69.6 ± 5.0 30.4 ± 5.0
FAI-LANL-Waste-11 Ammonium Nitrate	$(NH4)(NO_3)$ – ammonium nitrate - Gwihabaite Orthorhombic, SG: Pnmm (59) PDF# [01-085-1093]	100.0 ± 5.0
FAI-LANL-Waste-12 Guanidine Nitrate	$(CN_3H_8)(NO_3)$ – guanidinium nitrate Monoclinic, SG: C2 (5) PDF# [02-070-2827] $(CN_3H_8)(NO_3)$ – guanidinium nitrate Monoclinic, SG: Cm (8) PDF# [04-018-0575]	94.6 ± 5.0 5.4 ± 5.0

*Potassium carbonate is deliquescent and readily absorbs water from the air so the phase composition of the sample may have changed during data collection

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2) FAI-LANL-13, Dibutyl Phthalate: Table 3 (GC-MS)

Table 3. Major Volatiles

Retention Time (minutes)	Sample (% Area)*	Compound Identification
15.70	0.01	dodecamethylcyclohexasiloxane "D6"
16.79	0.07	butyl benzoate or an isomer
18.78	0.01	dibutyl maleate
19.06	0.00	unknown, similar to butylphthalide
20.55	0.03	possibly butyl 2-methylbenzenesulfonate
21.20	0.41	possibly butyl tosylate
22.48	0.01	possibly diisobutylphthalate
22.97	0.18	unknown phthalate, m/z = 278, 223, 205, 149
23.60	99.2	dibutyl phthalate
25.18	0.02	possibly bis(2-ethylhexyl)maleate
26.18	0.10	unknown phthalate, m/z = 223, 205, 149

*% Area calculations are based upon the area under the TIC, and no attempt is made to correct for response factors.

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17 Jun 2016

3) FAI-LANL-Waste-14, Water: Table 4 (ICP-MS)

Table 4. Trace Elements in Water

Element	Concentration [ug/L]	Element	Concentration [ug/L]
Li	2	In	< 1
Be	< 1	Sn	< 1
B	1.8 mg/L	Sb	< 1
Na	2.5 mg/L	Te	< 1
Mg	< 1	Cs	< 1
Al	7	Ba	< 1
Si	1.6 mg/L	La	< 1
P	< 10	Ce	< 1
K	80	Pr	< 1
Ca	< 10	Nd	< 1
Sc	< 1	Sm	< 1
Ti	< 1	Eu	< 1
V	< 1	Gd	< 1
Cr	< 1	Tb	< 1
Mn	< 1	Dy	< 1
Fe	< 10	Ho	< 1
Co	< 1	Er	< 1
Ni	< 1	Tm	< 1
Cu	< 1	Yb	< 1
Zn	< 1	Lu	< 1
Ga	< 1	Hf	< 1
Ge	< 1	Ta	< 1
As	< 1	W	< 1
Se	< 1	Re	< 1
Rb	< 1	Os	< 1
Sr	< 1	Ir	< 1
Y	< 1	Pt	< 1
Zr	< 1	Au	< 1
Nb	< 1	Hg	< 1
Mo	< 1	Tl	< 1
Ru	< 1	Pb	< 1
Rh	< 1	Bi	< 1
Pd	< 1	Th	< 1
Ag	< 1	U	< 1
Cd	< 1		

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Experimental

1) XRF

X-ray Fluorescence (XRF) is a non-destructive technique that can identify and quantify the elemental constituents of a sample using the secondary fluorescence signal produced by irradiation with high energy x-rays. This analysis utilized a wavelength dispersive spectrometer (WDXRF) that is capable of detecting elements from atomic number (Z) 4 (beryllium) through atomic number 92 (uranium) at concentrations from the low parts per million (ppm) range up to 100% by weight.

Analytical Parameters

Instrument	Rigaku Primus II WDXRF
X-ray source	Rhodium x-ray tube
Atmosphere	Helium Vacuum (FAI-LANL-Waste-5, 8, 10)
Analysis area	30mm diameter 20mm diameter (FAI-LANL-Waste-8)

Samples were pressed into dense pellets for analysis. Quantification was performed using the Fundamental Parameters (FP) standardless quantification software associated with the system. The fundamental parameters approach uses x-ray physics coupled with established sensitivity factors for pure elements. Relative accuracy by this method usually ranges from better than 5% up to ~30% for major elements. However, it should be noted that some materials can degrade during the course of an analysis and, in particular, hydrated materials may lose water. Light element (C, N, O) concentrations generally have the greatest error.

2) XRD

The as-received samples were prepared by lightly grinding in an agate mortar and pestle. The resulting powders were loaded into standard glass sample holders and placed immediately into the diffractometer. XRD data was collected by a coupled theta/2-theta scan on a Rigaku Ultima-III diffractometer equipped with copper X-ray tube with Ni beta filter, parafocusing optics, computer-controlled slits, and D/teX Ultra 1D strip detector.

The phase identification results compare the best matches between the background-subtracted experimental XRD data and the ICDD/ICSD diffraction database for each sample. The reference markers for each phase show where in two-theta the expected

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experimental peaks should be located and the height of the markers indicates the expected intensity of the experimental peaks, if the sample is fine-grained and randomly oriented. Note that XRD is sensitive to crystal structure but relatively insensitive to elemental or chemical state composition. Please note that not all of the reference patterns from the database extend the full two theta range of each pattern.

Whole pattern fitting was performed to determine phase concentrations in the sample. Whole pattern fitting is a subset of Rietveld Refinement that accounts for all intensity above the background curve. This technique requires that either the structure factors and atomic locations or the reference intensity ratio (a way of comparing the diffracting power of different phases) are known for all phases identified. During this process, structure factor (which relates to concentration), lattice parameters (which relate to peak position), peak width and peak shape are refined for each phase to minimize the R value – an estimate of the agreement between the model and the experimental data over the entire pattern.

3) GC-MS

The sample was analyzed by injection on the GCMS. Prior to sample analysis, an instrument blank was also analyzed. The sample was analyzed on a Hewlett-Packard 6890 Gas Chromatograph/ Hewlett-Packard 5973 Mass Spectrometer.

GC Column:	30 m X 0.25mm DB-5MS (J&W scientific) 0.25 µm film thickness
Flow Rate:	1.0 ml/min, constant flow mode
Detector:	Mass Selective Detector (MSD). The detector was started 3 minutes after the injection of the sample.
Injection Mode:	20:1 split, 1 µL injection
Injector temperature:	300 °C
Oven temperature:	
	1) 40 °C, hold for 5 min
	2) to 300 °C @ 10 °C/min
	3) hold for 5 min at 300 °C

The amounts listed in Table 3 were referenced to a known amount of external standard, and are semi-quantitative. No calibration curves were prepared and no attempt was made to correct for response factor differences between species that are structurally/functionally different. Typical reproducibility as determined by statistical process control of the measurement system is about 10% (at 95% confidence level, k ~ 2). Compound identities were determined with the help of the NIST mass spectral databases.

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http://www.eaglabs.com/main-survey.html?job=C0GTZ159

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Appendix:

XRF
http://www.eag.com/mc/x-ray-fluorescence.html

XRD
http://www.eag.com/mc/x-ray-diffraction.html

GC-MS
http://www.eag.com/mc/gas-chromatography-mass-spectrometry.html

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E.3 NITRIC ACID ANALYSIS SUMMARY

KINECTRICS

Analysis of Nitric Acid for Fauske and Associates

TEST REPORT

K-115400-RA-0001 Rev. 00

July 18, 2016

Prepared by:
Serena Krause
Project Manager
Kinectrics US, Inc.
Date: 18 July 2016

Reviewed by:
Jon Winebrenner
Test Engineer
Kinectrics US Inc.
Date: July 18, 2016

Reviewed by:
Robert J. Burns
Quality Assurance
Kinectrics, Inc.
Date: 22 July 2016

Approved by:
Garry Chapman, P.E.
KUS Director
Nuclear Parts & Qualification
Kinectrics Us, Inc.
Date: 1 August 2016

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REVISION HISTORY					
REV	DESCRIPTION	PREPARED BY	REVIEWED BY	ACCEPTED BY	ISSUE DATE
00	Initial Issue for approval	S.Krause	J.Winebrenner/ RJ Burns	G. Chapman	July 18, 2016

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Appendix A: ANALYTICAL AND ENVIRONMENTAL SERVICES REPORT 16-01940

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1. SCOPE

This report provides the results of testing of customer supplied Nitric Acid for analysis.

2. RESULTS

Appendix A provides the analytical chemistry report (Report 16-01940). In summary the Nitric Acid was sent to Kinectrics for concentration and identification. Nitrate concentration was 695,000ppm which is equal to 69.5% using the Ion Chromatography technique. Nitric Acid concentration was calculated from the Nitrate at 70.6%.

3. REFERENCES

3.1 General:

Faulkse and Associates Purchase Order # 4500696675

3.2 Codes and Standards:

10CFR50 Appendix B

10CFR Part 21

4. QUALITY ASSURANCE

4.1 General

All work was completed under Kinectrics' 10CFR50 Appendix B quality program.

There were no non-conformances or anomalies to report.

4.2 Supply

a) Receiving Inspection

Requirements were set in the component Flow Sheet, Appendix A of Inspection and Test Plan K-115400-ITP-0001.

Conforming components were labeled and retained in segregated storage.

b) In-process Inspection

Inspections were performed by qualified personnel.

c) Final Inspection

Inspection of items were performed as set out in the Flow Sheet Appendix A included in the aforementioned test plan.

d) Measuring and Testing Equipment

Measuring and testing was performed using calibrated equipment and is identified in Appendix A of this report.

4.3 Final Results

Final results are included in Appendix A of this report.

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APPENDIX A

ANALYTICAL AND ENVIRONMENTAL SERVICES REPORT 16-01940

Proprietary Property of Fauske & Associates, LLC*

Kinectrics Inc.
800 Kipling Avenue, Unit 2, KJ135
Toronto, Ontario, Canada
M8Z 5G5

Telephone 416.207.6000
Facsimile 416.207.5550
www.kinectrics.com

KINECTRICS

Analytical and Environmental Services Report: 16-01940

Serena Krause
Senior Engineer, Service Line Lead KUS TEL 513-247-9039
US Nuclear Programs
7251 East Kemper Rd, Cincinnati, Oh 45249

Printed - 16-Jul-2016
Logged - 05-Jul-2016
Approved - 15-Jul-2016
Page 1 of 2

Report Description -	GRAB WATER SAMPLE
Special Instructions -	10 CFR 50 APPENDIX B QUALITY PROGRAM

Approved by:

Andreas Rudolph, Ph.D.
Laboratory Manager
Phone - (416)207-6000 ext 6328 FAX - (416)207-5550
Email - andreas.rudolph@kinectrics.com

The following samples were submitted for analysis:

Sample #	Sample Name	Sample Location	Sampling Date
1	NITRIC ACID FAI-LANL-WASTE-15	KINECTRICS US	None

Sample #	Analyte	Result	Unit	RDL	Technique	Uncertainty	Test Date
1	Nitrate	695000	ppm	0.01	Ion Chromatography*		15-Jul-2016

Comments 15-Jul-2016

Nitrate concentration 695,000 ppm - 69.5 %

Nitric acid concentration calculated from nitrate 70.6 %

7-Jul-2016

Instrument used for IC Analysis:

Dionex ICS-2000 s/n 27101408

Calibrated before each use

Balance used:

Mettler PM4600 KIS 03558

Calibrated 27 August 2014

Calibration due date August 2016

Calibration verified before each use

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Appendix AA

Triclinic Labs, XRPD Measurements for Two Clinoptilolite Zeolites

April 10, 2017

Triclinic Labs

Data Summary

XRPD Measurements for Two Clinoptilolite Zeolites

KMI Zeolite Inc.

Prepared for Conrad Wagenaar.

Prepared by Simon Bates

April 10th, 2017

Report Number R2017116.02
Project#: 2017144



Author: _____ April 10th 2017

Simon Bates Ph.D. (Fellow) Date

Overview

Two clinoptilolite zeolite powder samples were received from KMI Zeolite Inc. for X-ray powder diffraction (XRPD) measurement under standard conditions. Each powder sample was mounted using a low background silicon sample holder. The powder was mounted to fill the holder and give a flat and level surface. Information concerning the samples are presented in Table 1.

Table 1. Samples and Materials as Provided

TCL#	Sample
TCL6397	clinoptilolite zeotile (KMI XRD 1)
TCL6398	clinoptilolite zeotile (KMI XRD 2)

X-ray Powder Diffraction (XRPD) Parameters

Instrument measurement parameters and resulting XRPD data are shown in Tables 2 and 3.

Table 2. XRPD Parameters for Rigaku SmartLab system

Parameters	Value
Geometry	Reflection B-B
X-ray Tube	copper
Monochromatization	beta-filter
Detector	D'teX PSD
Voltage (kV)	40.00
Current (mA)	44.00
Start Angle (2θ)	2.00
End Angle (2θ)	80.00
Step Size (2θ)	0.02
Scan Speed (2θ/min)	1.00
Slits (S0deg, S1deg, S3mm)	1/3, 4, 13
Measurement Type	symmetric θ:2θ
Sample Holder	Si low background
Sample Rotation (RPM)	50.00

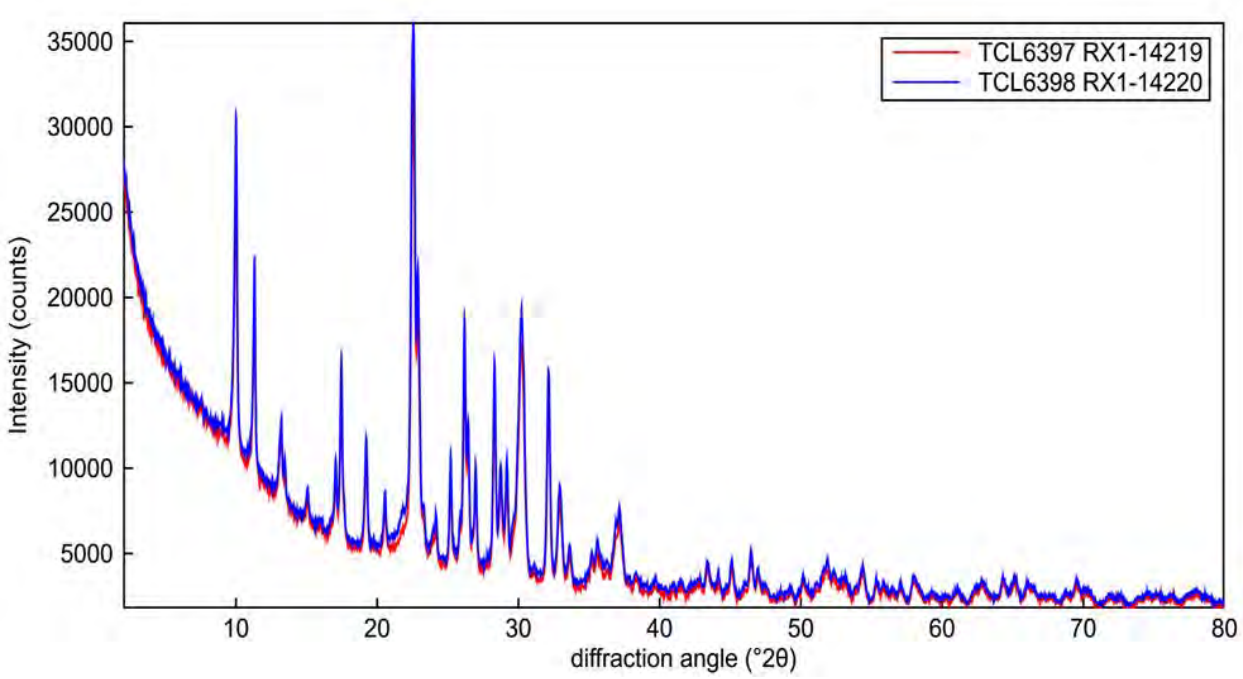
Table 3. XRPD Data Collected for General Powder Measurements

TCL#	Sample	XRPD#
TCL6397	clinoptilolite zeotile (KMI XRD 1)	RX1-14219
TCL6398	clinoptilolite zeotile (KMI XRD 2)	RX1-14219

Measurements

Data as measured displayed in Figure 1.

Figure 1: Measured XRPD data for both powder samples.



Visual inspection of the data indicates that both powder samples are essentially the same with respect to the X-ray powder diffraction response.

Analysis

Phase Identification

A crystalline peak search was performed for each data file and the resulting peak list matched against the COD crystal structure data base using the software MDI-Jade2010 (V 5.0.0). The crystalline phase identification results for each data file are presented in Figures 2 through 3. Clinoptilolite (PDF# 98-900-8264) was identified as being the only significant crystalline phase present for both samples.

Figure 2: Phase identification and WPF analysis for data set RX1-14219.

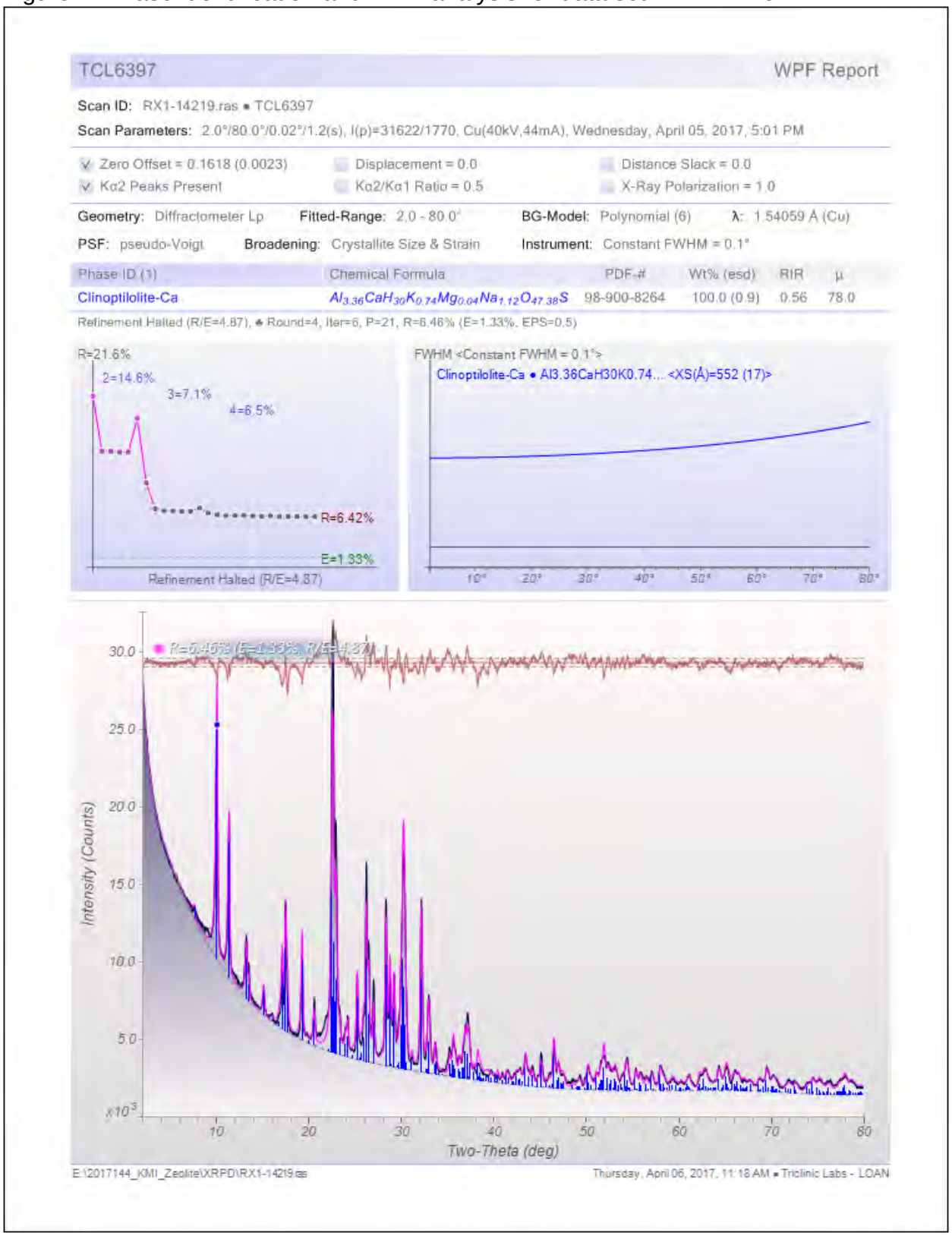
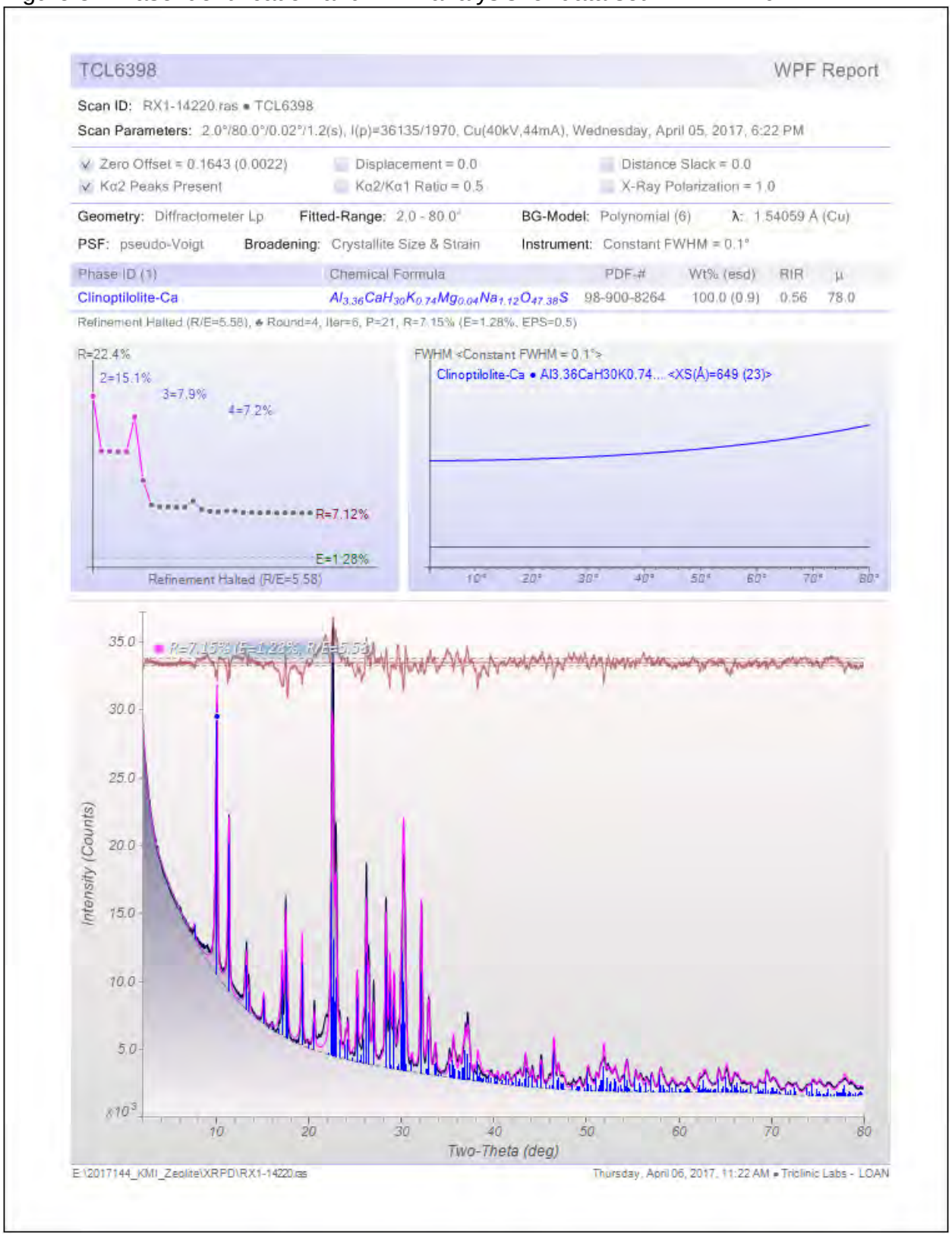


Figure 3: Phase identification and WPF analysis for data set RX1-14220.



Semi-Quantitative analysis

Phase identification returned clinoptilolite-Ca as the only candidate crystalline phase with all observed diffraction peaks associated with this phase. A previous X-ray diffraction study performed on similar clinoptilolite samples (LUCAS report to KMI Zeolite, 2010) had identified the presence of the mineral form Phlogopite as a minor phase along with clinoptilolite. An additional mineral phase that may appear along with the clinoptilolite-heulandite zeolites is Stilbite. To determine whether these mineral forms were present along with the clinoptilolite, a Rietveld semi-quantitative analysis was performed using Jade2010. For each Rietveld analysis, the crystalline minerals Clinoptilolite-Ca, Phlogopite and Stilbite-Ca were included within the starting model. The results of the Rietveld semi-quantitative analysis are presented in Figures 4 through 5.

For routine XRPD analysis, the detection limit for crystalline phases using Rietveld semi-quantitative analysis is generally around 1% w/w. For data sets RX1-14219 and RX1-14220, the Rietveld analysis returned quantitative values for both Phlogopite and Stilbite-Ca that were below detection limits. The semi-quantitative results are summarized in Table 4.

Table 4. Results of Rietveld semi-quantitative analysis

TCL#	Sample	XRPD#	Mineral phase	Quantity (w/w%)
TCL6397	KMI XRD 1	RX1-14219	clinoptilolite-Ca	99.8
			phlogopite	<< 1%
			stilbite-Ca	<< 1%
TCL6398	KMI XRD 2	RX1-14220	clinoptilolite-Ca	100
			phlogopite	<< 1%
			stilbite-Ca	<< 1%

Figure 4: Rietveld semi-quantitative WPF analysis for data set RX1-14219.

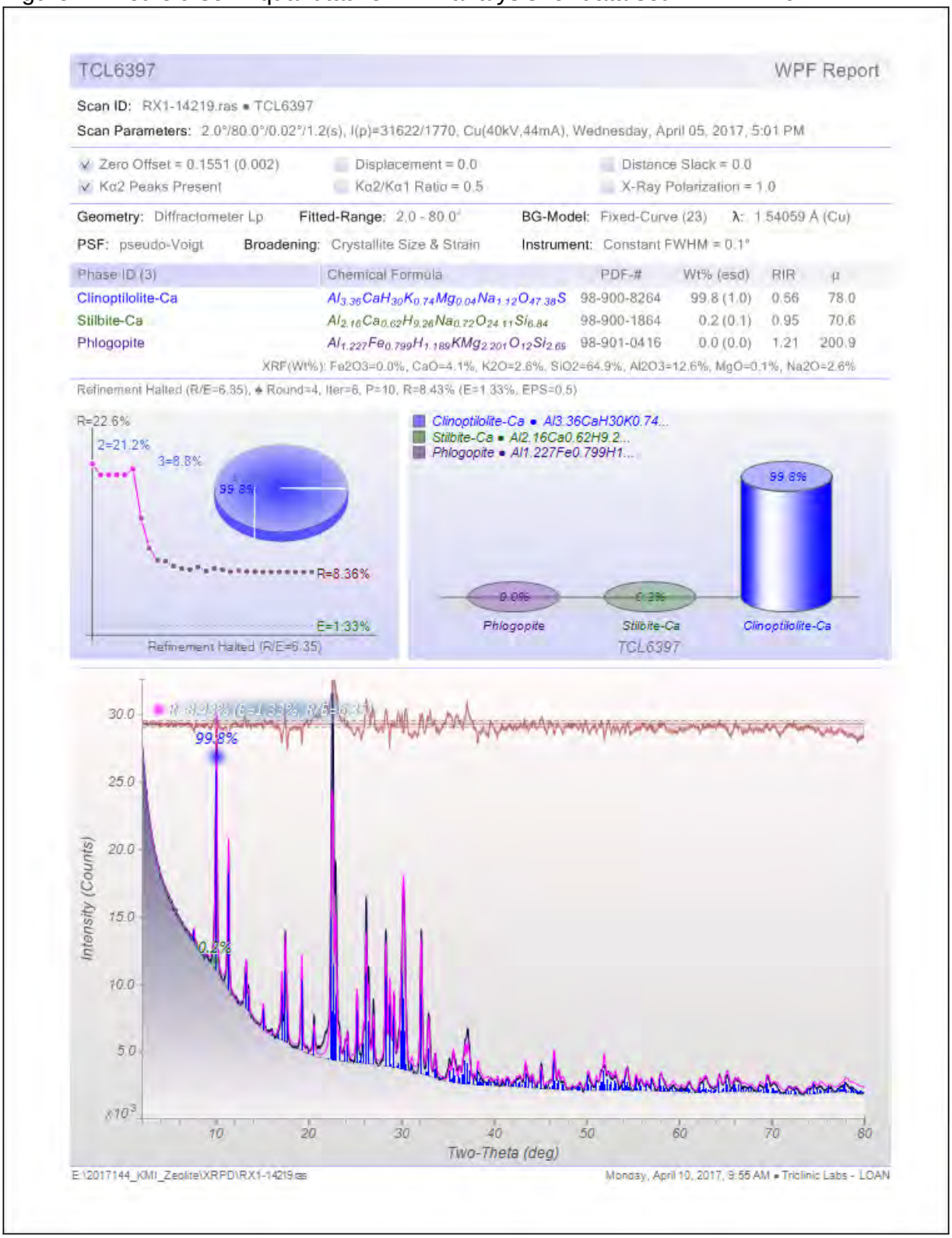
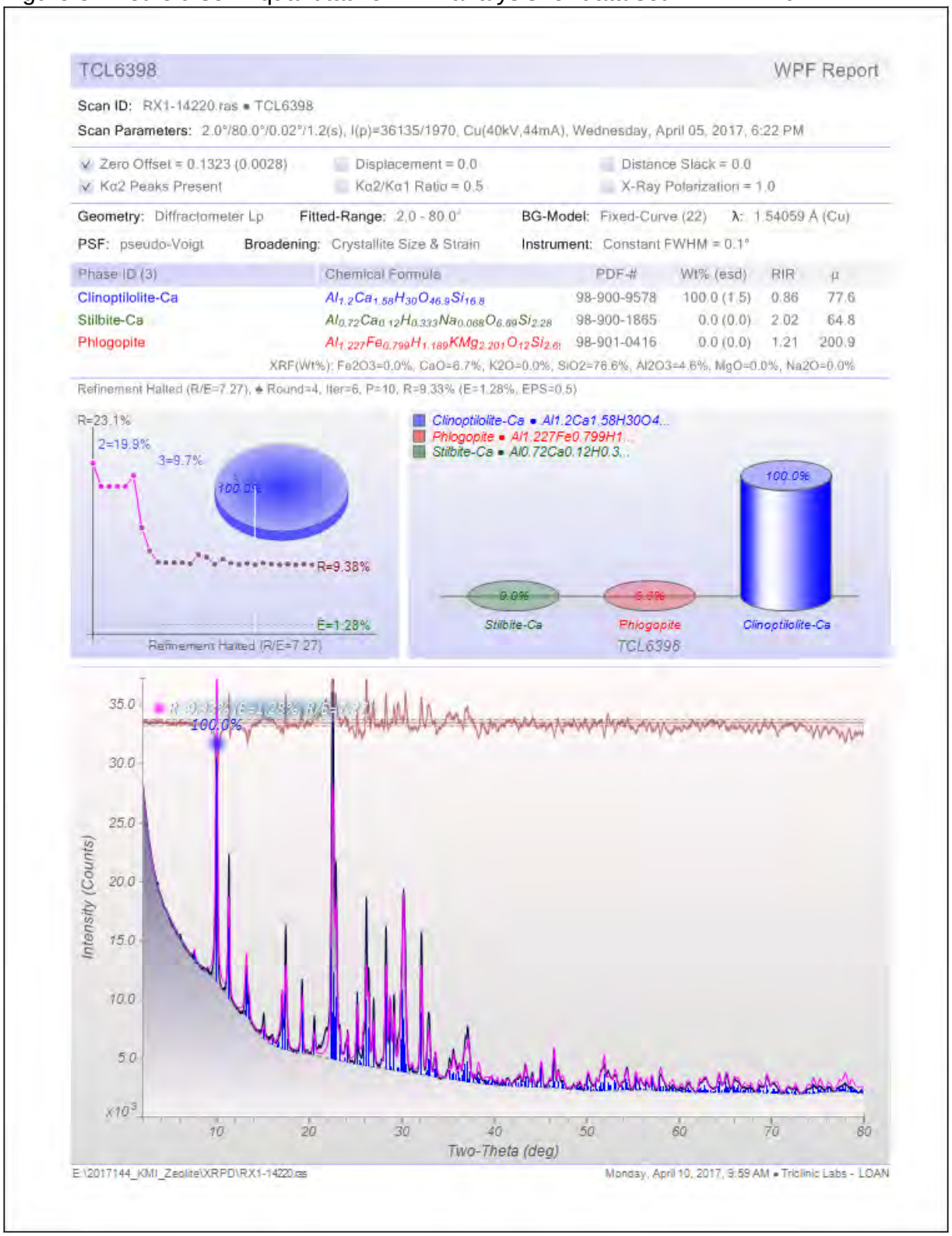


Figure 5: Rietveld semi-quantitative WPF analysis for data set RX1-14220.



Appendix AB

Nelson Laboratories Total Organic Carbon (TOC): Wet Oxidation Method Final Report

April 11, 2017

NELSON LABORATORIES

Sponsor:
Aeri Park
Triclinic Labs, Inc.
2660 Schuyler Ave., Ste. A
Lafayette, IN 47905

Total Organic Carbon (TOC): Wet Oxidation Method Final Report

Test Article:	KMI TOC 1 KMI TOC 2 KMI TOC 3
Purchase Order:	PO0004
Study Number:	956914-S01
Study Received Date:	05 Apr 2017
Test Procedure(s):	Standard Test Protocol (STP) Number: 801-STP0028 Rev 13

Summary: All test method acceptance criteria were met. Testing was performed in compliance with US FDA good manufacturing practice (GMP) regulations 21 CFR Parts 210, 211 and 820. The test article meets the USP requirements for purified water if the response for the test article is not greater than the corrected limit response. This limit would only apply to water test articles that are expected to comply with USP TOC requirements. Feed water, tap water, and cleaning validation test articles are examples of water that may not be expected to meet USP requirements.

TOC Method:	Heated Persulfate Oxidation
Corrected Limit Response:	0.511 parts per million (ppm)
Extraction Technique:	Sonication
Extraction Time:	30 minutes
Extraction Solvent(s):	USP Purified Water

Results: The limit of detection for TOC is 0.019 ppm.

TOC:

Test Article	TOC (ppm)	Average Blank TOC Value (ppm)	Net TOC (ppm)	Total TOC Content (µg C)	TOC Concentration (µg C/g)
1	0.550	<0.019	2.20	216	18.3
2	0.547	<0.019	2.19	210	21.1
3	0.531	<0.019	2.12	202	18.6

Test Article Weight(s) and Extraction Volume(s):

Test Article	Test Article Weight (g)	Extraction Volume (g)[a]
1	11.80	98.06
2	9.95	96.06
3	10.88	95.20

[a] It is assumed that 1 gram = 1 milliliter at 20°C.

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Study Director Brent T. Shelley, B.S.

11 Apr 2017
Study Completion Date

956914-S01

These results relate only to the test article listed in this report. Reports may not be reproduced except in their entirety. Subject to NL terms and conditions at www.nelsonlabs.com

Appendix AC

Calcium Nitrate Saturated Solution Salt Concentration @ 20 °C and Density Measurements

Calcium Nitrate Saturated Solution Salt Concentration @ 20 ºC

CRC Handbook of Physics, 97th Edition

AQUEOUS SOLUBILITY OF INORGANIC COMPOUNDS AT VARIOUS TEMPERATURES

The solubility of over 300 common inorganic compounds in water is tabulated here as a function of temperature. Solubility is defined as the concentration of the compound in a solution that is in equilibrium with a solid phase at the specified temperature. In this table the solid phase is generally the most stable crystalline phase at the temperature in question. An asterisk * on solubility values in adjacent columns indicates that the solid phase changes between those two temperatures (usually from one hydrated phase to another or from a hydrate to the anhydrous solid). In such cases the slope of the solubility vs. temperature curve may show a discontinuity.

All solubility values are expressed as mass percent of solute, $100 \times w_2$, where

$w_2 = m_2/(m_1 + m_2)$

and m_2 is the mass of solute and m_1 the mass of water. This quantity is related to other common measures of solubility as follows:

- Molarity: $c_2 = 1000\rho w_2/M_2$
- Molality: $m_2 = 1000w_2/M_2(1\text{-}w_2)$
- Mole fraction: $x_2 = (w_2/M_2)/\{(w_2/M_2) + (1\text{-}w_2)/M_1\}$
- Mass of solute per 100 g of H_2O: $r_2 = 100w_2/(1\text{-}w_2)$

Here M_2 is the molar mass of the solute and $M_1 = 18.015$ g/mol is the molar mass of water; ρ is the density of the solution in g cm^{-3}.

The data in the table have been derived from the references indicated; in many cases the data have been refitted or interpolated in order to present solubility at rounded values of temperature. Where available, values were taken from the IUPAC *Solubility Data Series* (Reference 1) or related papers in the *Journal of Physical and Chemical Reference Data* (References 2 to 5), which present carefully evaluated data.

Formula	Name	CAS Reg. No.	Mol wt.	0 ºC	10 ºC	20 ºC
Ca(NO3)2	Calcium nitrate	10124-37-5	164.087	50.1	53.1	56.7

Molarity @ 20 ºC $= 1000\rho w_2/M_2$

- $\rho = 1.561$
- $w_2 = 0.567$
- $M_2 = 164.09$

Molarity = 1000 x 1.561 x 0.567 /164.09

Molarity = 5.39 moles $Ca(NO_3)_2$ / liter of solution

g/ml = 5.39 moles $Ca(NO_3)_2$ * 164.09/1000

g/ml = 0. 884

Specific Gravity of Saturated Calcium Nitrate Solution

Nachurs Alpine Solutions, a company with its Quality Management System registered to ISO 9001:2008 standards, manufactures a 70% aqueous solution of calcium nitrate tetrahydrate [$Ca(NO_3)_2 \cdot 4H_2O$]; this solution is anhydrous 48.6% $Ca(NO_3)_2$ by mass. This 70% solution of the tetrahydrate typically has a specific gravity of 1.48, and is close to saturated, since at 20 °C the solubility of $Ca(NO_3)_2$ is reported to be 129 g of anhydrous $Ca(NO_3)_2$ in 100 g of water (56.3% by mass). To determine the specific gravity of a saturated solution of calcium nitrate, the following measurement was conducted in our R&D laboratories at our headquarters in Marion, Ohio.

Calcium nitrate tetrahydrate, 99+%, ACS reagent, Lot A0369187, was obtained from Acros Organics, and used as supplied. A saturated solution was prepared from this crystalline material with sufficient deionized water to dissolve about two-thirds of the solid; since the heat of solution is positive, the solution cools as it dissolves. To prevent supersaturation, the solution was maintained in a room slightly cooler than 20 °C for five hours until its specific gravity was measured. The measurement was performed with an Anton Paar DMA 4500 M density meter, at 20 °C, resulting in a specific gravity of 1.561 (water = 1.00 at 20 °C). The measurement was conducted according to the company's Standard Analytical Method 073, "Operating the Anton Paar DMA 4500 M Density Meter;" the instrument was calibrated 18 October 2016 by an Anton Paar service representative, and validation checks with distilled water are performed weekly to confirm the calibration.

The density of the tetrahydrate is reported on the Acros bottle as 1.8600. Combining 144.3 g of the 70% tetrahydrate solution and 84.7 g of tetrahydrate crystals can be envisioned; the 70% tetrahydrate solution is 70.1 g of anhydride and 74.2 g of water, while the solid tetrahydrate crystals can be considered to be 58.9 g of anhydride and 25.8 g of water. This mixture contains 129 g of anhydride and 100 g of water, matching the literature values for a solution saturated at 20 °C. Simple mixing of 63% of a solution with density 1.48 and 37% of a solution with density 1.86 would result in a solution with density 1.62, which is in reasonable agreement with the observed 1.561.

Please let me know if you have any questions or comments on this measurement, or if I can assist in any way.

Franklin Kroh

Franklin Kroh, PhD
krohf@nachurs-alpine.com

SOUTHWEST RESEARCH INSTITUTE®

6220 CULEBRA ROAD 78238-5166 • P.O. DRAWER 28510 78228-0510 • SAN ANTONIO, TEXAS, USA • (210) 684-5111 • WWW.SWRI.ORG

CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

April 21, 2017

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

Attn: David J. Funk

Subject:	Case:	2009-2010
	SwRI Project Number:	19869.01.00X
	SwRI Task Order Number:	170420-13
	SwRI Sample Receipt Number:	59571
	Samples Received:	04.20.2017
	Analysis:	Bulk Density by ASTM D5057

Dear Mr. Funk,

Please find the enclosed results for the one (01) overall liquid sample received on the above referenced date. Should you have any questions, please feel free to contact me at 210-522-3242, or at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Principal Scientist

APPROVED:

Michael J. Dammann
Director

RPS: mg
Encl

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170420-13
SwRI SRR: 59571
VTSR: 04/20/2017

BULK DENSITY BY ASTM D5057

Case Narrative

Total Page Count:
Fraction: Bulk Density Pages: 010001-010011

Client: Los Alamos National Laboratory
SwRI Project Number: 19869.01.006
SwRI Task Order Number(s): 170420-13

WETCHEM ANALYSIS

A saturated solution of calcium nitrate was prepared by adding approximately 210g of $Ca(NO_3)_2*4H_2O$ incrementally to 50 mL of deionized water until solids remained. The solution was adjusted to room temperature and shaking for 30 minutes. The sample was filtered with a 0.45um filter to remove any undissolved material prior to the density measurement. The density was determined at 22.4°C in duplicate. Both density measurements were 1.56 g/L. Deionized water was used as a laboratory control.

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."

R Spaw
Group Leader

4/21/17
Date

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170420-13
SwRI SRR: 59571
VTSR: 04/20/2017

BULK DENSITY BY ASTM D5057 ANALYSIS

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170420-13
SwRI SRR: 59571
VTSR: 04/20/2017

BULK DENSITY BY ASTM D5057

Sample Results

Bulk Den ASTM 5057 010005

Southwest Research Institute
San Antonio, Texas 78228

Batch: 20170420-A009 (Ver. 5)
Status: CONSUMED

Customer: Los Alamos National Laboratory
Task Order: 170420-13
SDG: 614471
Project: 19869.01.00X
Analysis Method: Bulk Density (TAP: 01-0406-164)
Analyte Test: Bulk Den ASTM 5057
Balance: Bal #135
Matrix: Liquid
Equipment: Thermocouple# 022943, Meter# 022940

		BD					
Sample Identification	Client Identification	Container Initial Wt (g)	Container & DI Wt (g)	Container & Samp Wt (g)	Bulk Density (g/mL)	RPD (%)	Rec (%)
LCSS ①	NA	20.3239	45.1918	45.1572	0.999		100
614472	Saturated calcium nitrate	20.7656	45.6751	59.6585	1.56		
614472D	Saturated calcium nitrate	26.3431	51.2594	65.3012	1.56	0.00	

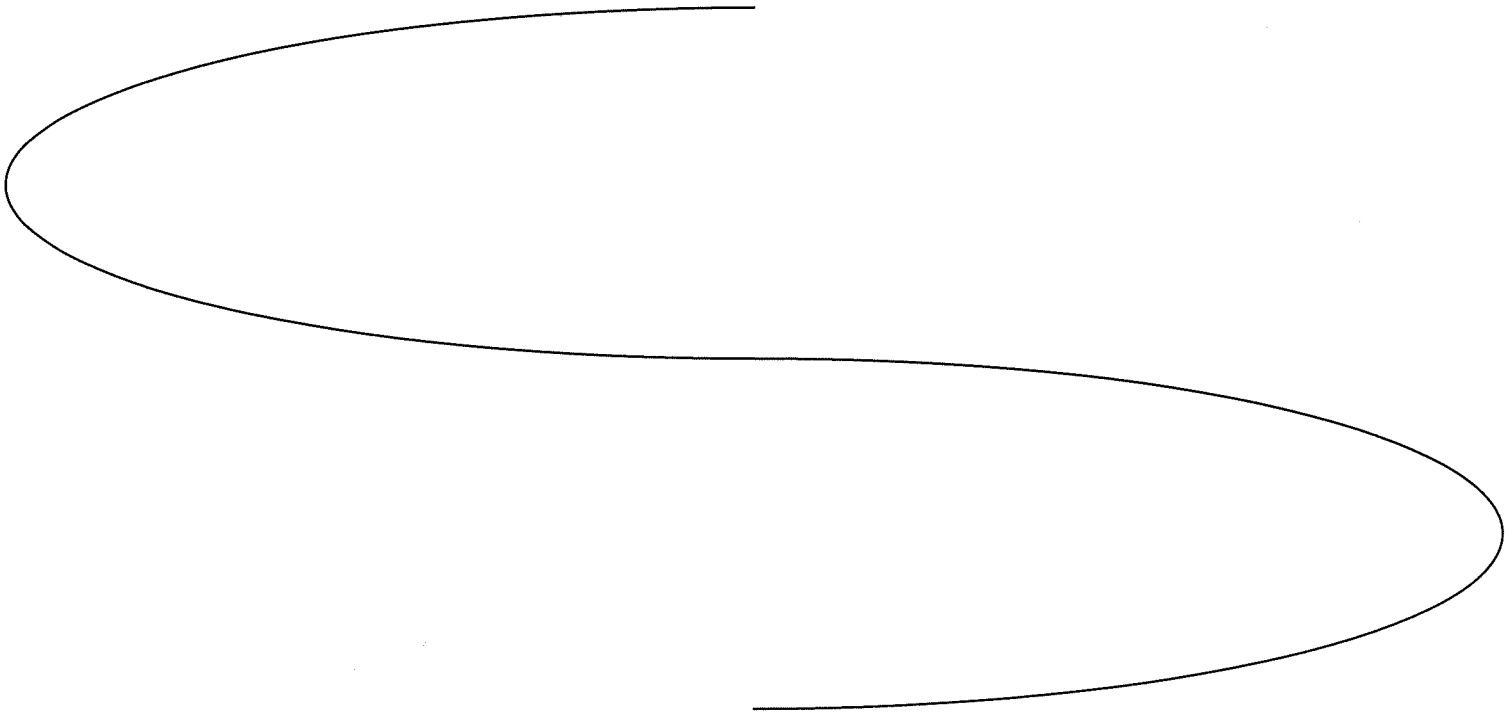
① spiked 25 mL of DI H2O Room Temp (Lot# UNDEFINED, Source: UNDEFINED, Exp: 04/21/2020) with BD at 0.998 g/ml

Comments:
LCS (DI H2O) Temp 22.9C

Sample Temp 22.4C

* 25 mL Class A Volumetric

Ca(NO3)2*4H2O saturated made by taking 209.7155g Ca(NO3)2*4H2O (#69609) to 50 mL DI H2O.
Adjusted to room temperature and shaken for 30 minutes. 17:10 - 17:40 4/20/17. (Tubes #484 used)
Sample filtered with a 1um TSS filter prior to analysis to remove any undisolved material.



U - Result is less than the SwRI Reporting Limit (RL)

Prepared by: MOKEN, JAMES Date: 04/20/2017

Reviewed by: SPIES, RADONNA Date: 04/20/2017

Program version(8/11/2011)

SOUTHWEST RESEARCH INSTITUTE
CLIENT: Los Alamos National Laboratory
SwRI PROJECT#: 19869.01.00X
SwRI TASK ORDER: 170420-13
SwRI SRR: 59571
VTSR: 04/20/2017

CHAIN-OF-CUSTODY & SAMPLE RECEIPT PAPERWORK

010007

General Sample Chain of Custody

Ver (8/25/2011)

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

SRR #:	59571	Thermometer:	N/A
Project	19869.01.00X	Temperature:	N/A
CASE:	2009-2010	Airbill #:	Email
Customer:	Los Alamos National Laboratory	Logged in by:	DXGARCIA
Samples Received:	Apr 20 2017 4:35PM	Logged in:	Apr 20 2017 4:43PM
Manager:	DAMMANN, MIKE		
Disposal Instructions:	Contact project manager for disposal authority.		

System ID	Customer ID	CED	Matrix	# Cont	Special Requirements	Sample Condition
614471	Calcium nitrate tetrahydrate		Liquid	1		Intact
614472	Saturated calcium nitrate		Liquid	1		Intact

Reliquished by (Print/Signature): Email	Date 04-20-2017	Time 16:35
Received by (Print/Signature): David Garcia David Garcia	Date 04-20-2017	Time 16:35
Reliquished by (Print/Signature):	Date	Time
Received by (Print/Signature):	Date	Time
Reliquished by (Print/Signature):	Date	Time

Southwest Research Institute

Laboratory Task Order

010008

TO #: 170420-13 Revision: 0

Project(s): 19869.01.00X
Manager(s): DAMMANN, MIKE
To Client:

SDG:

SRR #'s: 59571
Client(s): Los Alamos National Laboratory

Instructions

Deliverables --> Hard Copy: -YES- EDD: no PDF: no

Test: BD_D5057
Section: WETCHEM

Holding: 180 days from CED

Bulk Density by ASTM D5057

Cnt: 1

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
614472		1	Liquid	Saturated calcium nitrate	NO DATA	NO DATA

010009

Sample Receipt

Southwest Research Institute

Sample Receipt Number: 59571

VTSR: 04/20/17

Time: 16:35:00

Project: 19869.01.00X
Case #: 2009-2010
Client: Los Alamos National Laboratory

Manager: DAMMANN, MIKE
Logged in by: DXGARCIA
Creation Date: 04/20/17

Notes

Email was received to create an SRR for the following.

See Task Order for full requirements.

See chain of custody as part of the SRR system for more information.

Phases:
001 - admin
002 - extraction
005 - 8082
006 - metals/radchem
007 - drg

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
614471	Calcium nitrate tetrahydrate		Liquid	1	
614472	Saturated calcium nitrate		Liquid	1	

Containers: 2

Samples: 2

Thermometer: N/A
Temperature: N/A

Page Printed: 04/21/2017 12:09
ver: (4/10/2017)

59571 Los Alamos National Laborato

Sample Custodian Signature: David Lovier

Southwest Research Institute
Traffic Report

010010

1. Custody Seal	Not Present or Damaged
2. Chain of Custody	Present
3. Sample Tags	Not Present
Sample Tag Numbers	Not on COC
4. SMO Forms	Not Present

Client: Los Alamos National Laboratory
Project: 19869.01.00X
Case: 2009-2010 / SDG: _____
Sample Receipt: 59571
Airbill: Email

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
04/20/17	16:35:00	Email	Calcium nitrate tetrahydrate	N/A	614471	YES	Intact
04/20/17	16:35:00	Email	Saturated calcium nitrate	N/A	614472	YES	Intact

SAMPLE LOG-IN SHEET **010011**

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): DAVID GARCIA	Log-in Date: 04/20/2017
Received By (Signature): David Garcia	
Case Number: 2009-2010	Sample Delivery Group No.: N/A — SAS Number: N/A
Remarks: 19869.01.00X	

1. Custody Seal(s)	Present/(Absent*) Intact/Broken	
2. Custody Seal Nos.	N/A	
3. Chain-of Custody Records	(Present)/Absent*	
4. Traffic Reports or Packing Lists	Present/(Absent)	
5. Airbill	Airbill/Sticker (Present)/Absent*	
6. Airbill No.	Email	
7. Sample Tags	Present/(Absent)	
Sample Tag Numbers	Listed/(Not listed on Chain of Custody)	
8. Sample Condition	(Intact)/Broken*/Leaking	
9. Cooler Temperature	N/AC	
10. Does Information on custody records, traffic reports, and sample tags agree?	(Yes)/No*	
11. Date Received at Lab	04/20/2017	
12. Time Received	16:35:00	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Calcium nitrate tetrahydrate	N/A	614471	Intact
Saturated calcium nitrate	N/A	614472	Intact

Sample Transfer

Fraction: InORG	Fraction
Area #: R. Spies	Area #
By: DAVID GARCIA	By
On: 04/20/2017	On

* Contact SMO and attach record of resolution

Reviewed By: M. Dellinger	Logbook No.: Sample Receipt (59571)
Date: 4-21-2017	Logbook Page No.: 9796