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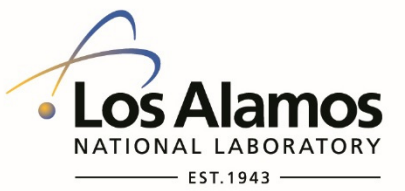
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Summary Report of Laboratory Testing to Establish the Effectiveness of Proposed Treatment Methods for Unremediated and Remediated Nitrate Salt Waste Streams



Prepared by Kurt Anast and David J. Funk

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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). 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 zeolite addition currently planned for implementation at the Waste Characterization, Reduction, and Repackaging Facility. During the course of this work, we established the need to evaluate and demonstrate the effectiveness of the proposed remedy for debris material, if required. The evaluation determined that Wypalls absorbed with saturated nitrate salt solutions exhibit the ignitability characteristic (all other expected debris is not classified as ignitable). Follow-on studies will be developed to demonstrate the effectiveness of stabilization for ignitable Wypall debris. 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). As a result, additional nitrate salt solutions (those exhibiting the oxidizer characteristic) will be tested to demonstrate the effectiveness of the 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 containers, and put into storage at LANL until such time as a final disposition path was identified. In 2012, the remediation path for the nitrate salt waste was identified 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 are 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 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 29 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 and unremediated 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, waste treatment of both RNS and UNS waste must be conducted 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 the prevalence of cementation as an immobilization method for similar wastes at numerous facilities around the U.S. Department of Energy complex, including at LANL. The results of the treatment study will be used with other testing to provide 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 initial 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 test methods used and Appendixes F through L 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. Additional characterization and treatment testing activities were conducted on-site at LANL and are discussed below and in Appendix K.

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. Thirteen RNS drums are estimated to contain over 50 volume-percent debris, and 23 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 be identified using real-time radiography (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 in the POC.

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

- 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

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, and blending the nitrated salts or solutions with sWheat kitty litter, zeolite, cement, water, or Waste Lock 770. The effectiveness for 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 includes the following areas of focus:

- Preparation of surrogate salt known as WB8 identified in the analysis by Wesibrod 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 K of this report.
- Preparation of surrogate UNS solution utilizing saturated nitrate solutions derived from Reference 4 and neutralized with Spilfyter 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.
- 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 found in Section 7.1

4.0 TEST MATERIALS

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

4.1 Surrogate Nitrated Salt – WB8

Nitrated 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 through 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: the ratio of sWheat scoop kitty litter to the nitrate salt and 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 verified 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(NO3)3 * 9 H20	2145	2.145	4.21
Ca(NO3)2 * 4 H2O	8530	8.530	16.73
Cr(NO3)3 * 9H2O	105	0.105	0.21
Fe(NO3)3 * 9H2O	3258	3.258	6.39
Mg(NO3)2 * 6H2O	23939	23.939	46.94
NaNO3	5307	5.307	10.41
Pb(NO3)2	1884	1.884	3.69
(COOH)2*2H20	1936	1.936	3.80
K2CO3	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 being neutralized with Kolorsafe Spilfyter 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(NO3)3 * 9 H20	2774.2	46.238
Ca(NO3)2 * 4 H2O	280.2	4.670
Cr(NO3)3 * 9H2O	20.6	0.342
Fe(NO3)3 * 9H2O	198.4	3.306
H2O-HNO3-Al-Ca-Cr-Fe-Mg-Ni	213.8	3.563
Mg(NO3)2 * 6H2O	1336.2	22.270
HNO3	21.2	0.354
NaNO3	164.6	2.742
Ni(NO3)2 * 6H2O	0.80	0.013
Pb(NO3)2	198.8	3.314
(COOH)2 * 2H20	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:

- 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.
- The weighed portion of reagent is transferred to a container for mixing.
- The salt formulation is then dissolved into water using 0.30 g of water per gram of salt.
- If the salts do not all dissolve, water is added in 10-mL increments until nearly all the salts are dissolved (about 2% remain).

4.4 sWheat Kitty Litter

The cat litter sWheat Scoop Original (sWheat) is made from wheat and is available at retail stores 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.

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

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 UN O.1 Test: Test for Oxidizing Solids

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 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 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: 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.

6.0 RNS WASTE BLEND TESTS

6.1 Surrogate RNS Waste Blends to Simulate RNS 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:

- The appropriate volume of sWheat Scoop kitty litter is transferred to the mixing container (4-L Nalgene bottle).
- The appropriate volume of WB8 salt or control salt is measured and added to the mixing container and mixed manually.
- 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
RNS Surrogate Waste & Test Results

	Blend Compositions			Test Results		
	KNO3 (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	NA*	NA	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	NA	NA	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

*NA = 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). We note 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 Discussion of RNS 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. 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 RNS 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 RNS 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 include volume ratios of 1:0, 1:1, 1:3, and 1:4 RNS waste to salt 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 evaluation tests were performed.

Table 4
Blending Recipes for RNS Surrogates

	RNS Surrogate Waste Composition			Zeolite Blend Recipe (S/S = salt/sWheat)		Test Results			
Blend #	KNO3 (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	NA*	3:1	NA: Salt	NA: Salt	Not Division 5.1	No water added
Blend 10	0	50	1:0	NA	3:1	NA: Salt	NA: Salt	Not Division 5.1	No water added
Blend 11	0	50	1:1	NA	3:1	Nonflammable	Not self-heating	Not Division 5.1	No water added
Blend 12	0	50	1:3	NA	3:1	Nonflammable	Not self-heating	Not Division 5.1	No water added
Blend 13	0	50	1:4	NA	3:1	Nonflammable	Not self-heating	Not Division 5.1	No water added
Blend 14	0	50	1:1	1:1	3:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 15	0	50	1:3	1:1	3:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 16	0	50	1:4	1:1	3:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 17	0	50	1:1	1:1	2:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 18	0	50	1:3	1:1	2:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 19	0	50	1:4	1:1	2:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 20	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	2:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 22	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	3:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids
Blend 24	0	50	1:0.5	0.5:1	2:1	Nonflammable	Not self-heating	Not Division 5.1	No free liquids

*NA = Not applicable.

The addition of water before the addition of zeolite is expected to be beneficial to the blending process as well as to 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 RNS waste to salt with water added at ratios of 0.5:1 and 1:1, and zeolite to RNS ratios addition of 3:1 and 2:1).

Blends 14 through 24 represent those where 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 each 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 is 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 Discussion of Zeolite Blending Test Results

As noted in Table 4, the addition of zeolite in ratios of 2:1 or greater was effective at 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 (our 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 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.

6.3 Cementation of RNS 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.

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 into 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 to 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 (the SwRI January 26, 2016, results report).

Table 5
Cement Recipes and Reactivity Test Results for Cementation Tests

	RNS Surrogate Waste Composition[a]				Cement Formulation			Test Results		
Cement Mix Number	KNO3 (g)	WB 8 (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	NA[c]	373	495	0.75:1	Nonflammable	Not self-heating	Not Div 5.1
Cmnt 7	0	130	0	NA	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] NA = Not applicable.

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 Discussion of Cementation Results

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

6.4 UNS Surrogate Solution Blends with sWheat to Simulate RNS Waste (UNS Blends 1–18)

Blending UNS Surrogate Solution with zeolite was assessed for effectiveness. UNS Surrogate Solution represents the solution found in UNS drums. 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. We have included testing using Waste Lock 770 to establish the effectiveness of adding zeolite for these materials to eliminate the ignitability and corrosivity.

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. The mixture set for 1 d. After resting for 1 d, the salt/sWheat mix was mixed 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 4 are included in Appendix L (March 29, 2016, SwRI test report).

Table 6
UNS Surrogate Solution Blend Recipes and Test Results

Blend ID	UNS Blend Formulation					Test Results				
	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 Test Method 9095B
UNS Blend 1	50	0	0	0	0	NA: Solution	NA:Solution	NA: Solution	Not Div 5.1	NA: Solution
UNS Blend 2	50	50	0	0	0	Nonflammable	DOT Packing Grp III	Not Div 5.1	NA	No free liquids
UNS Blend 3	50	150	0	0	0	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids
UNS Blend 4	50*	50	0	0	0	Nonflammable	DOT Packing Grp III	Not Div 5.1	NA	No free liquids
UNS Blend 5	50*	150	0	0	0	Nonflammable	DOT Packing Grp III	Not Div 5.1	NA	No free liquids
UNS Blend 6	50	50	0	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids
UNS Blend 7	50	150	0	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids
UNS Blend 8	50*	50	0	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids
UNS Blend 9	50*	150	0	0.5:1	3:1	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids
UNS Blend 10	50	50	0	0.5:1	2:1	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids
UNS Blend 11	50	150	0	0.5:1	2:1	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids
UNS Blend 12	50*	50	0	0.5:1	2:1	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids
UNS Blend 13	50*	150	0	0.5:1	2:1	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids
UNS Blend 14	50	0	3.12	0	0	NA: Solution	NA: Solution	NA: Solution	Not Div 5.1	NA: Solution
UNS Blend 16	50	0	3.12	0	3:1	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids
UNS Blend 18	50	0	3.12	0	2:1	Nonflammable	Not self-heating	Not Div 5.1	NA	No free liquids

Notes: DOT = U.S. Department of Transportation. NA = Not applicable.

* pH-adjusted solution (Spilfyter Kolorsafe).

6.4.1 Discussion of UNS Liquid Surrogate Testing

As Table 6 indicates, almost all of the liquid surrogate/sWheat mixtures exhibited the characteristic of ignitability through failure of the 1050 test and are classified as self-heating solids. In reviewing the data, we are concerned that UNS Blend 2 yielded a suspect result and will be re-run at a later date (the material expanded significantly but likely did not exceed 200 °C, a criterion of the 1050 test). However, we note that the addition of the Spilfyter Kolorsafe led to materials that yielded temperatures in excess of 700 °C in the 1050 test, demonstrating the increased chemical reactivity of the salt 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, we note that the surrogate solutions did not exhibit the characteristic of ignitability as oxidizers. While many of the nitrate salts are not oxidizers in solution (e.g., $CaNO_3$ [Reference 9]), the ratio of zeolite to liquid is greater than the original remedy proposed by the Difficult Waste Team[10] and should be effective. However, we will conduct additional tests with oxidizing nitrate liquids to verify the effectiveness of the remedy.

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 for an oxidizer. 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 tested to see how they respond to SW-846 Test Methods 1030 and 1050. The debris waste evaluated included cardboard liner, plastic bags, rubber gloves, and Wypall rags.

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 SW-846 Test Methods 1030 and 1050. Samples of the cardboard liner, plastic, and rubber glove were soaked and then allowed to drain for 1 h, after which they were submitted for testing. The Wypall rags were soaked, squeezed to remove excess moisture, and then submitted for testing.

Test results for the debris soaked in UNS Surrogate Solution are presented in Table 7.

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 WB8 salt-to-sWheat surrogate was impregnated onto the debris samples using a rolling pin. The surrogate RNS 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 were then submitted for SW-846 Test Methods 1030 and 1050 along with samples of untreated materials.

Test results for the debris impregnated with surrogate RNS material are presented in Table 7.

Table 7
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
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

Note: DOT = U.S. Department of Transportation.

Details of the preparation of the samples testing of debris surrogates can be found in Appendix J (March 11, 2016, SwRI test report).

7.3 Discussion of 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 might be considered ignitable (D001). The conditions the test materials were subjected to 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. This is an expected result because the rags are cellulose-based and are absorbent. The other materials are less absorbent and less cellulose-based materials.

Based upon these results, a process will be developed and evaluated to treat the Wypall rags to ensure they are not ignitable. This approach will utilize blending with water and zeolite to take advantage of the equipment and materials already intended to be used for the RNS waste. Additional testing will be planned to verify that this process is effective and the resulting product passes the reactivity tests. The other debris waste tested (plastic, cardboard liner, rubber gloves) will be not be considered D001 and will not be treated when encountered during remediation of the RNS drums.

8.0 CONCLUSIONS

Small scale, EPA SW-846 and UN DOT testing was conducted to (1) establish the characteristics of surrogates of nitrate salt mixtures and to ensure they bound the expected waste form and (2) 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 invokes water as a processing aid, was found to be effective at eliminating both characteristics of D001 and D002 for these materials. 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 through consultation 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^{o}) to the direction of airflow. Airflow parallel (0^{o}) 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

1. "Test Methods for Readily Combustible Solids. Burning Rate Test." (14.2.2.5). Recommendations on the Transport of Dangerous Goods. Fifth Revised Edition. United Nations, New York. 1988.

2. DOT Regulation. Appendix E to Part 173 of 49 CFR, Chapter 1 (12-31-91 Edition). pp. 597-598.

3. Flammability (solids). Method A.10. Official Journal of the European Communities. 9/19/84. No. L251/63.

4. "Validation of Ignitability Method For Solids" Foster Wheeler Enviresponse, Inc., Edison NJ., Submitted to the Office of Solid Waste, US EPA, February 1994.

5. Internal Report, (AMFA Report) North Carolina Department of Environmental Health and Natural Resources. (Bill Hamner)

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

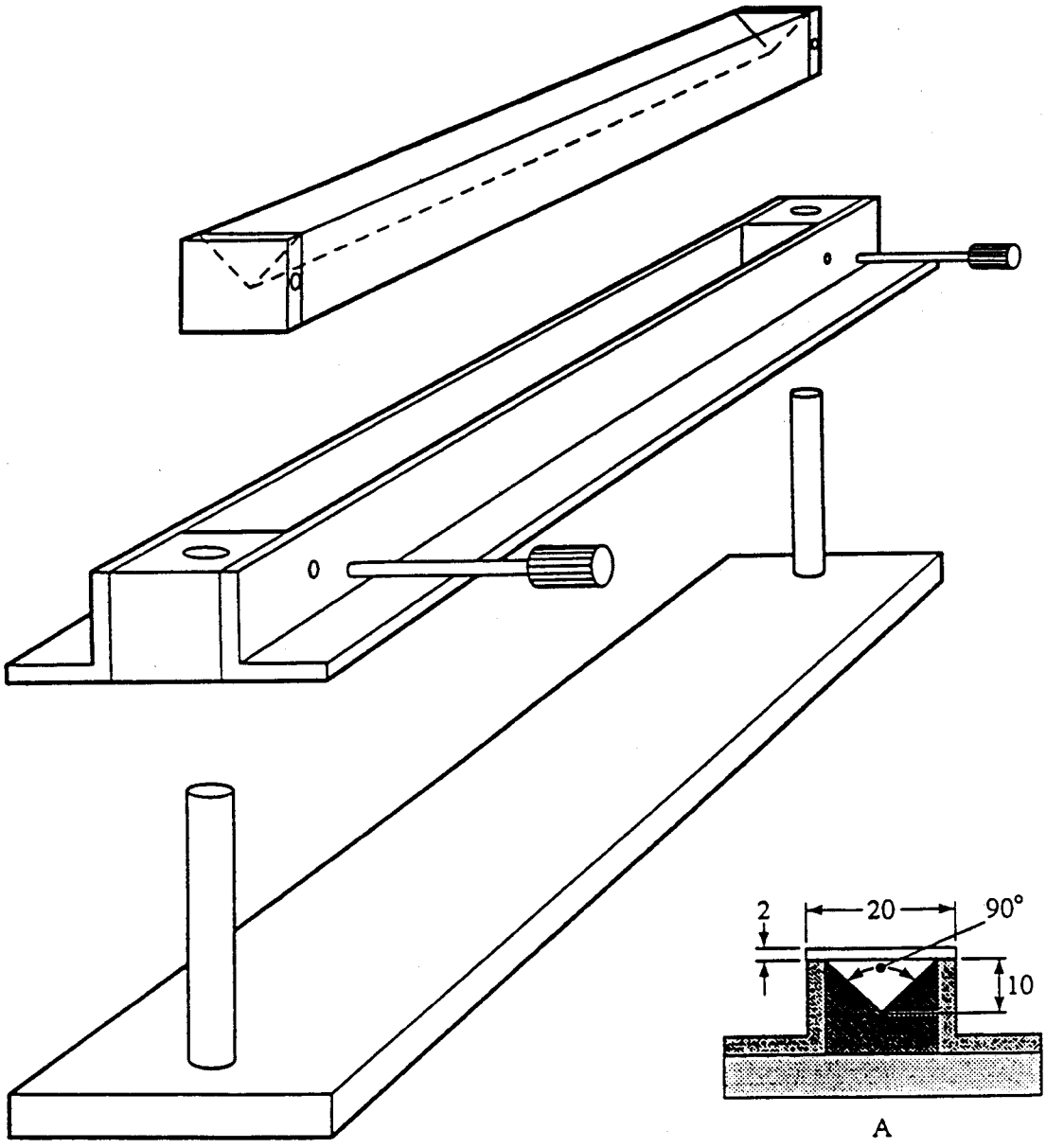
TABLE 3
COMPARISON OF BURN RATES

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

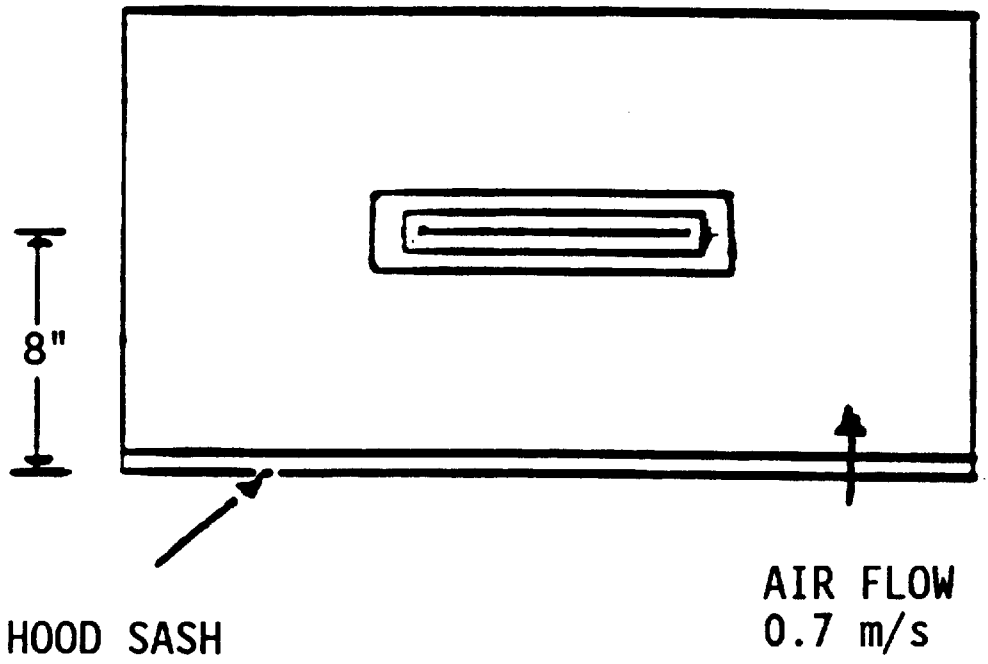
Powder Train Mold



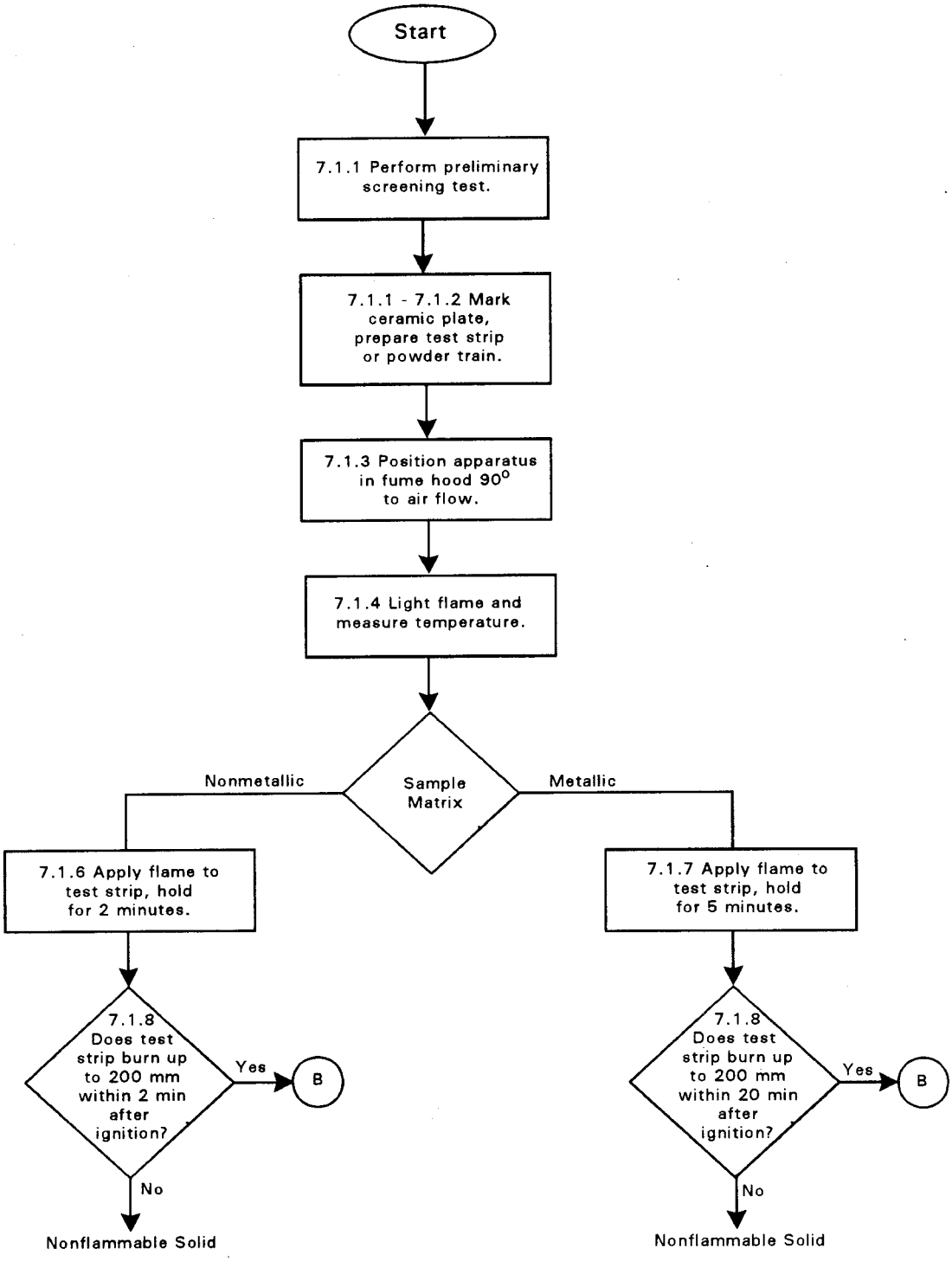
(A) Cross-section of 250 mm long mould

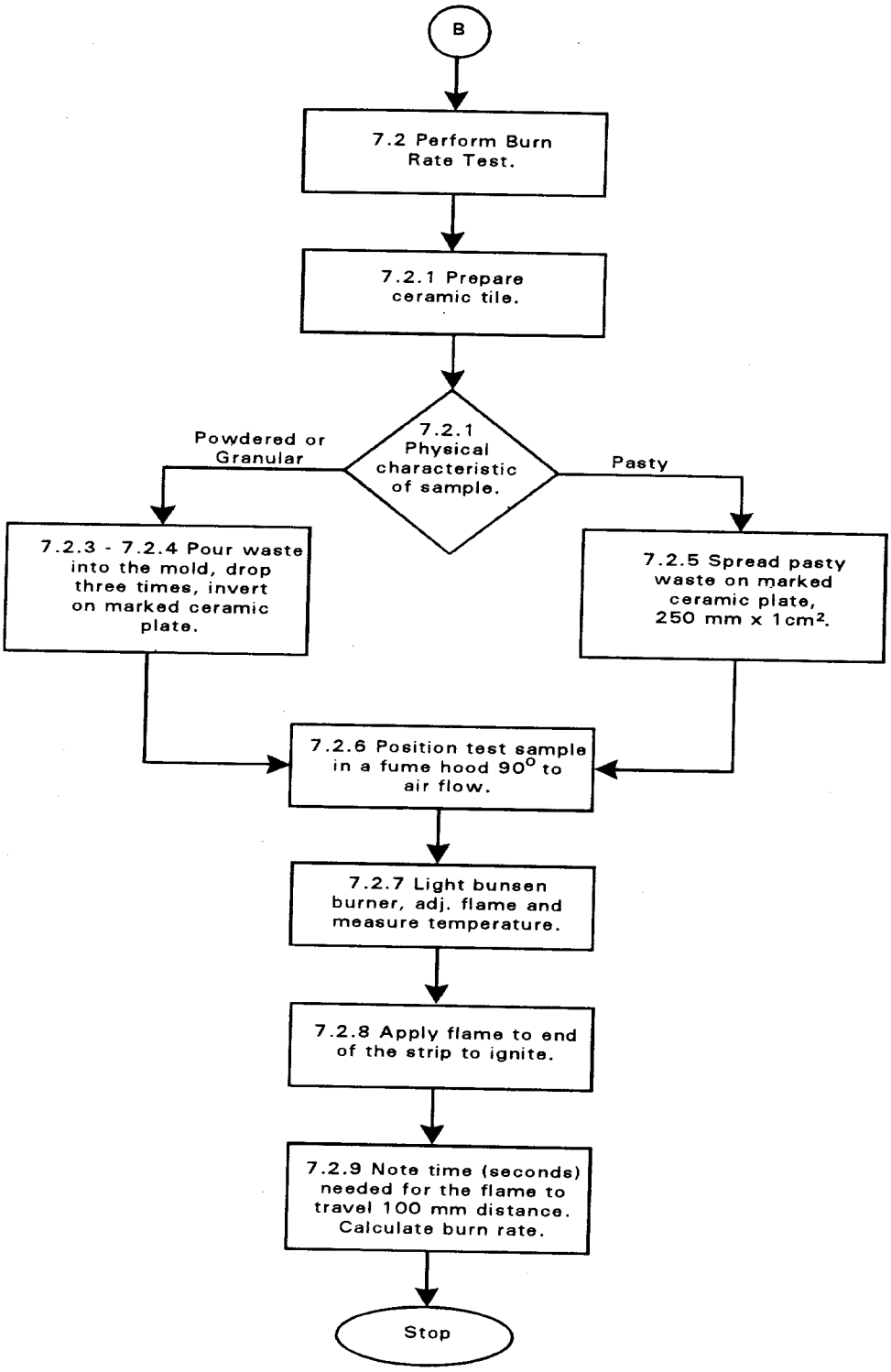
Figure 2

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.

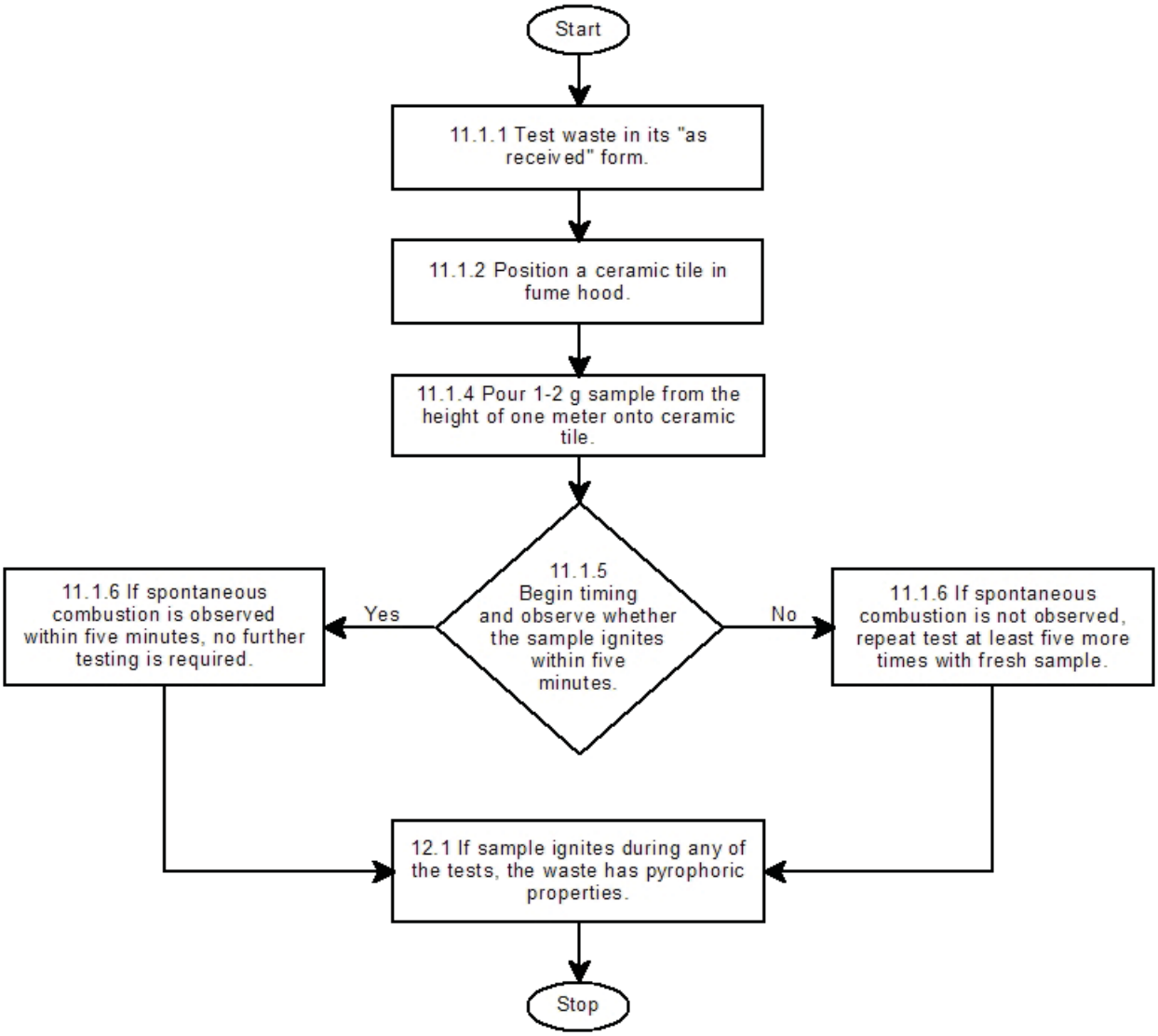
TABLE 6

DOT CLASSIFICATION OF SELF-HEATING SOLID WASTES

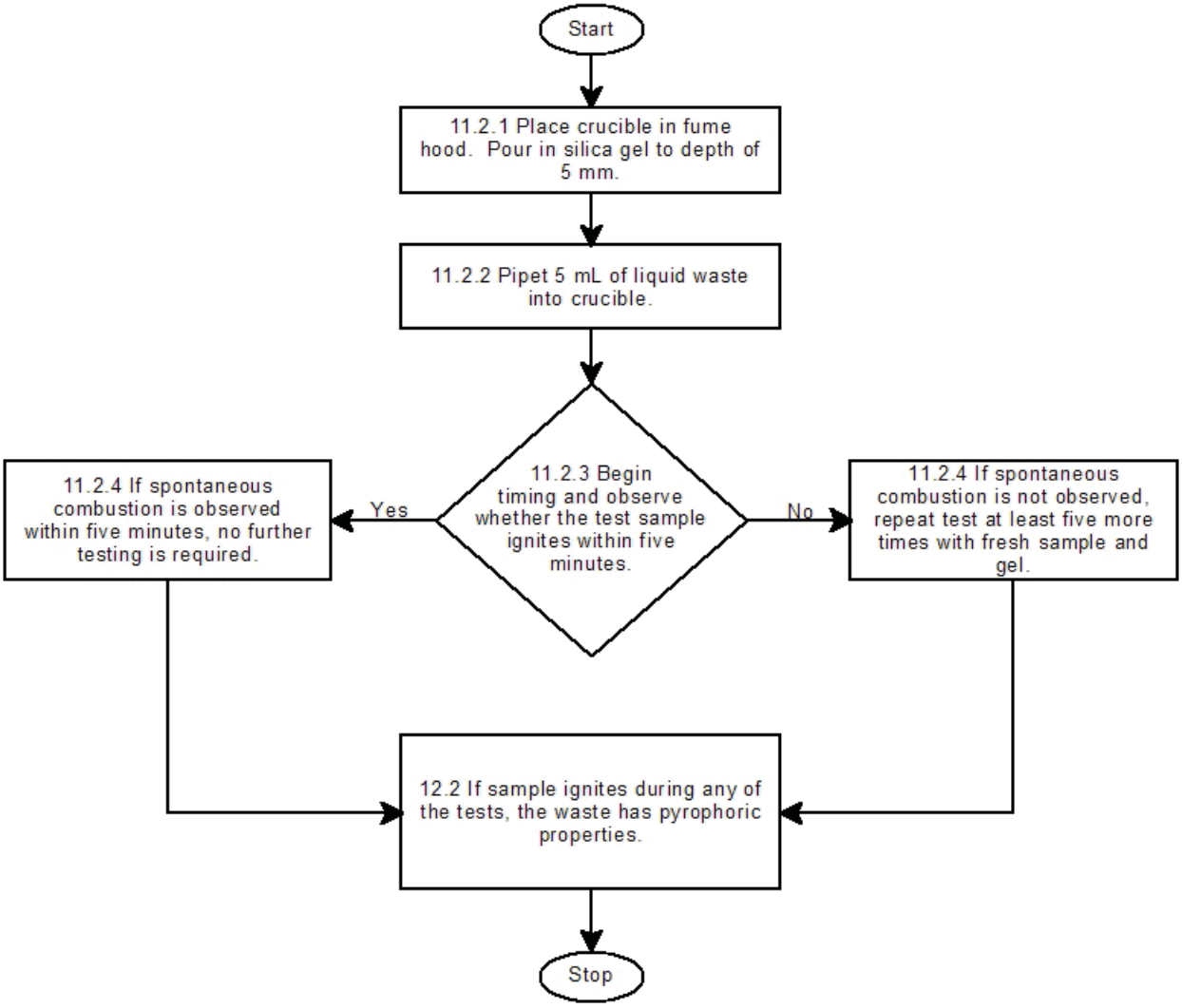
Results of Self-Heating Test	DOT Packing Group
Negative for the 100-mm cube test	Not a Self-Heating Waste
Positive for the 100-mm, but negative for the 25-mm cube test	III
Positive for both the 100-mm and 25-mm cube tests or positive for the 25-mm cube test, if tested alone	II

TEST METHODS TO DETERMINE SUBSTANCES LIKELY TO SPONTANEOUSLY COMBUST

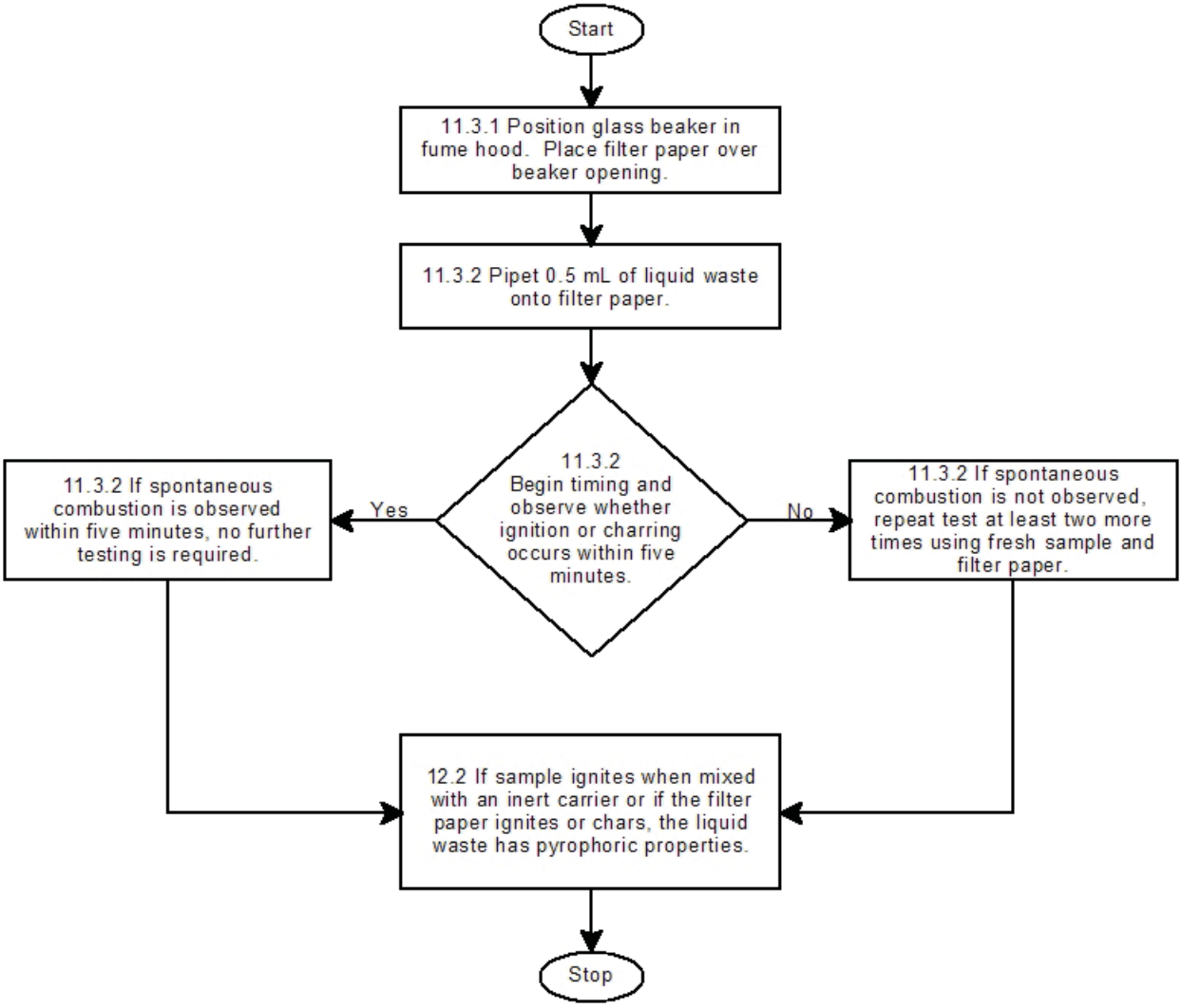
TEST METHOD A -- PYROPHORIC SOLIDS



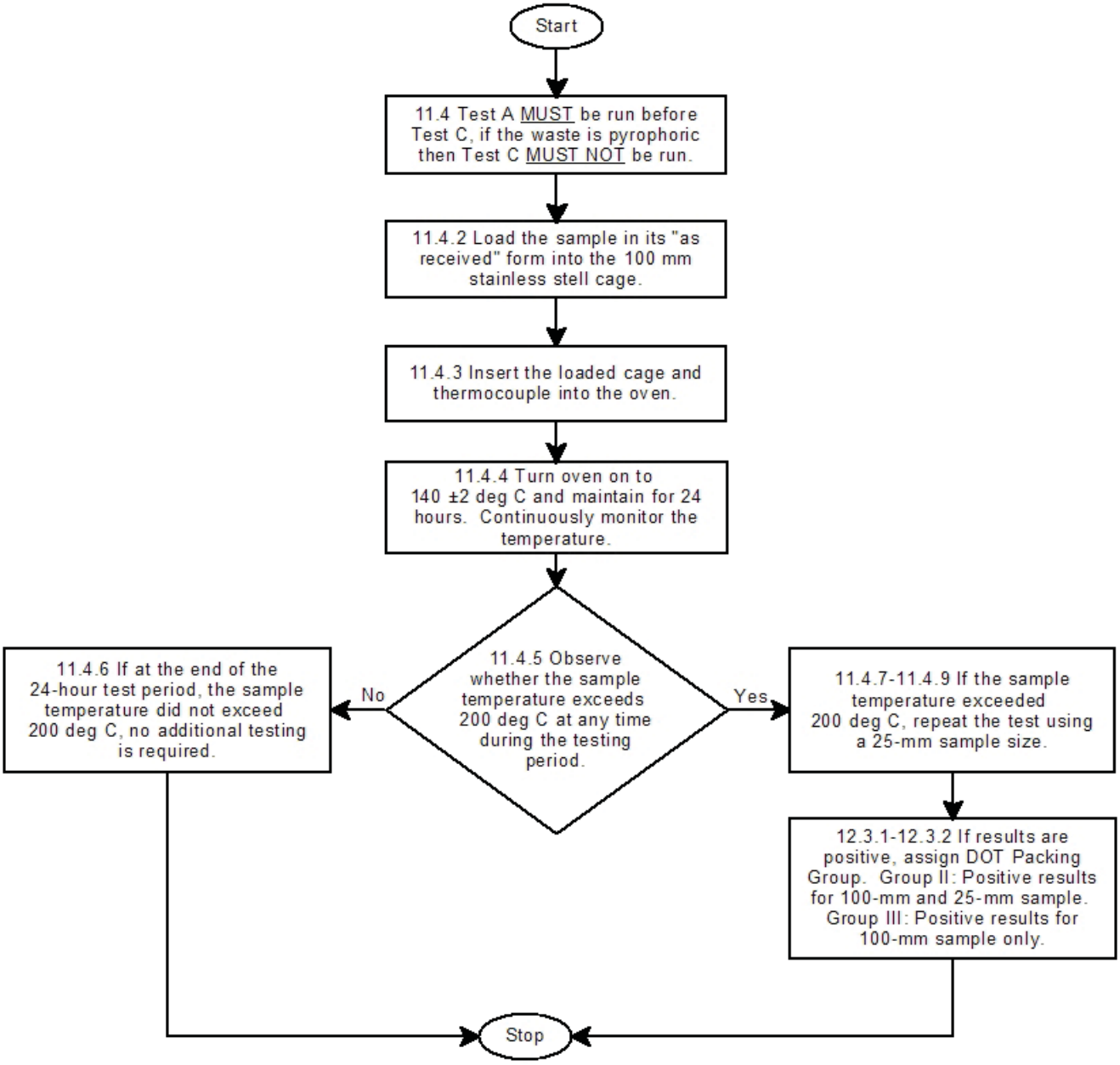
TEST METHOD B -- PYROPHORIC LIQUIDS, PORCELAIN CUP TEST



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

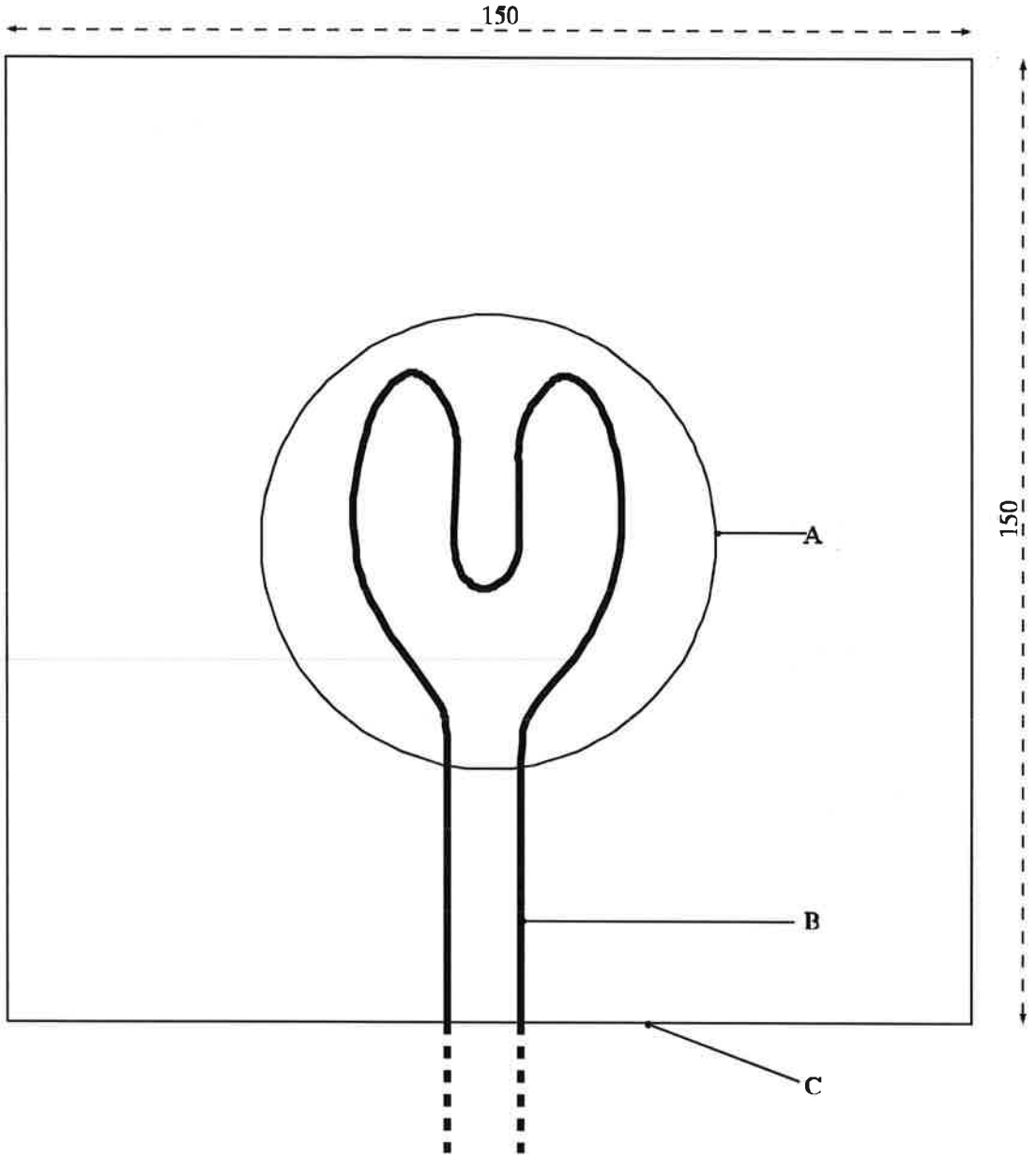
3:7 Potassium bromate/cellulose	100 s
2:3 Potassium bromate/cellulose	54 s
3:2 Potassium bromate/cellulose	4 s

[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*

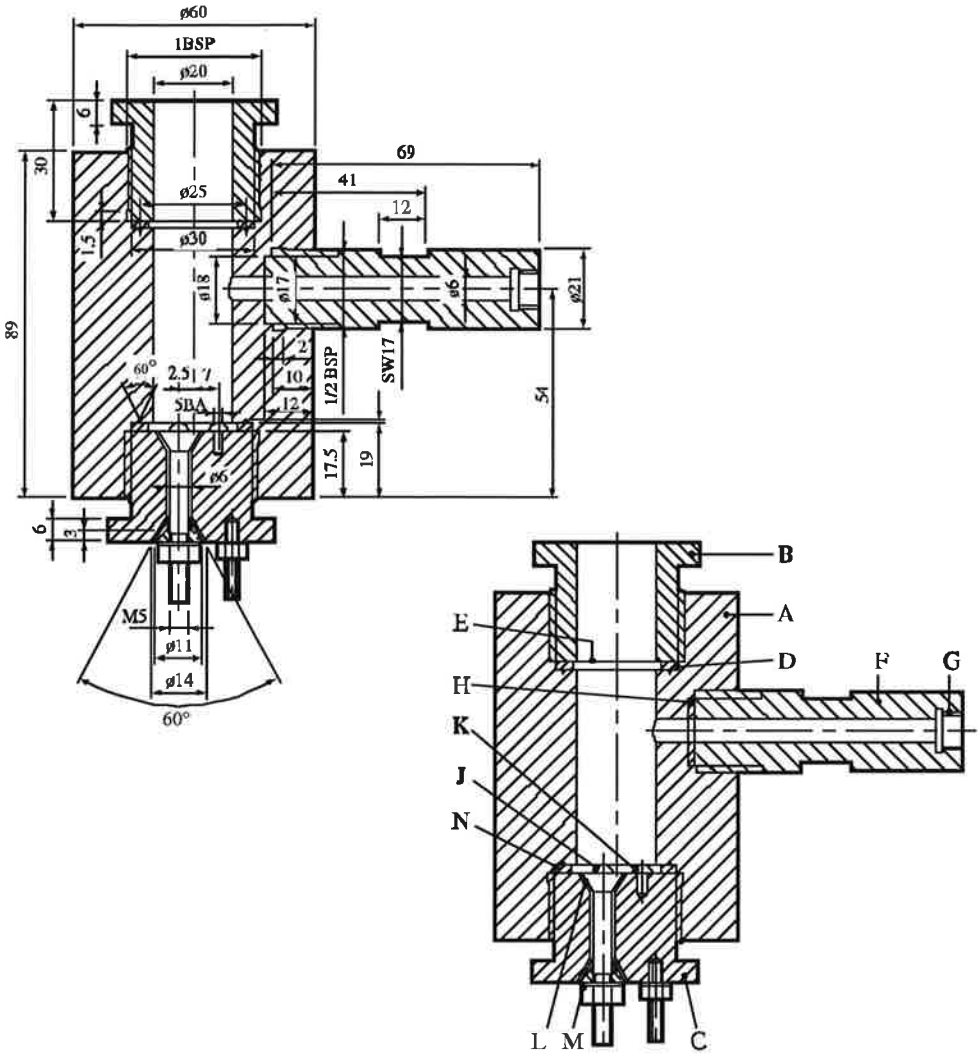
Substance	**Mean pressure rise time for a 1:1 mixture with cellulose (ms)**	**Results**
Ammonium dichromate, saturated aqueous solution	20 800	Not Div. 5.1
Calcium nitrate, saturated aqueous solution	6 700	Not Div. 5.1
Ferric nitrate, saturated aqueous solution	4 133	PG III
Lithium perchlorate, saturated 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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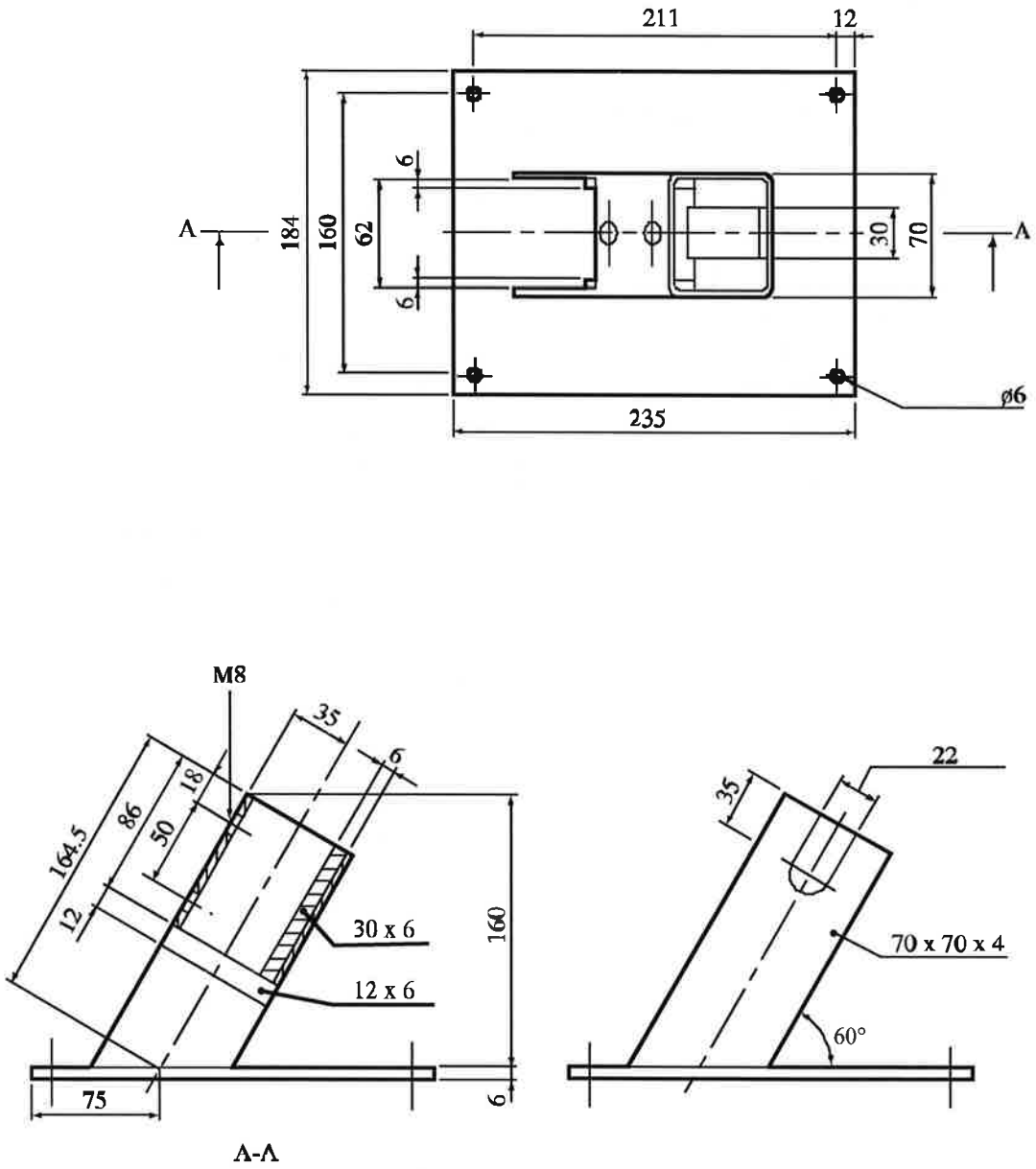
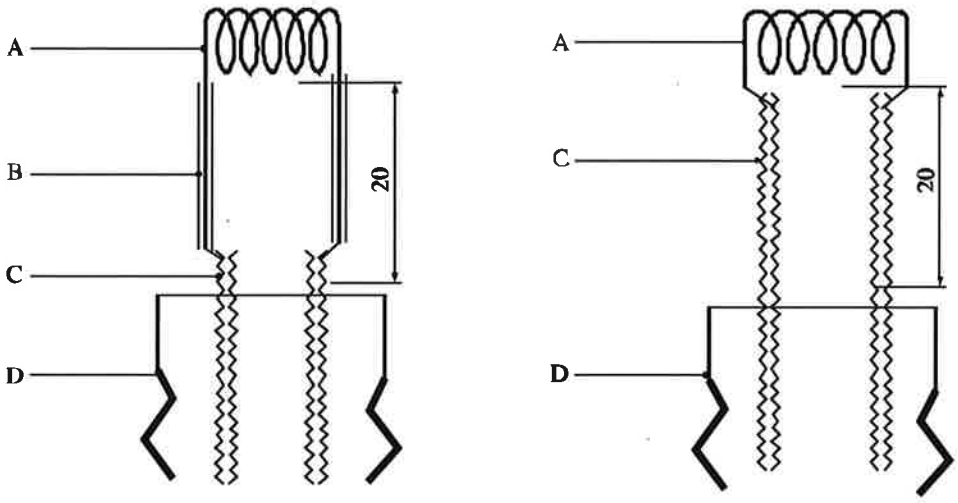


Figure 34.4.2.2: SUPPORT STAND

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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.

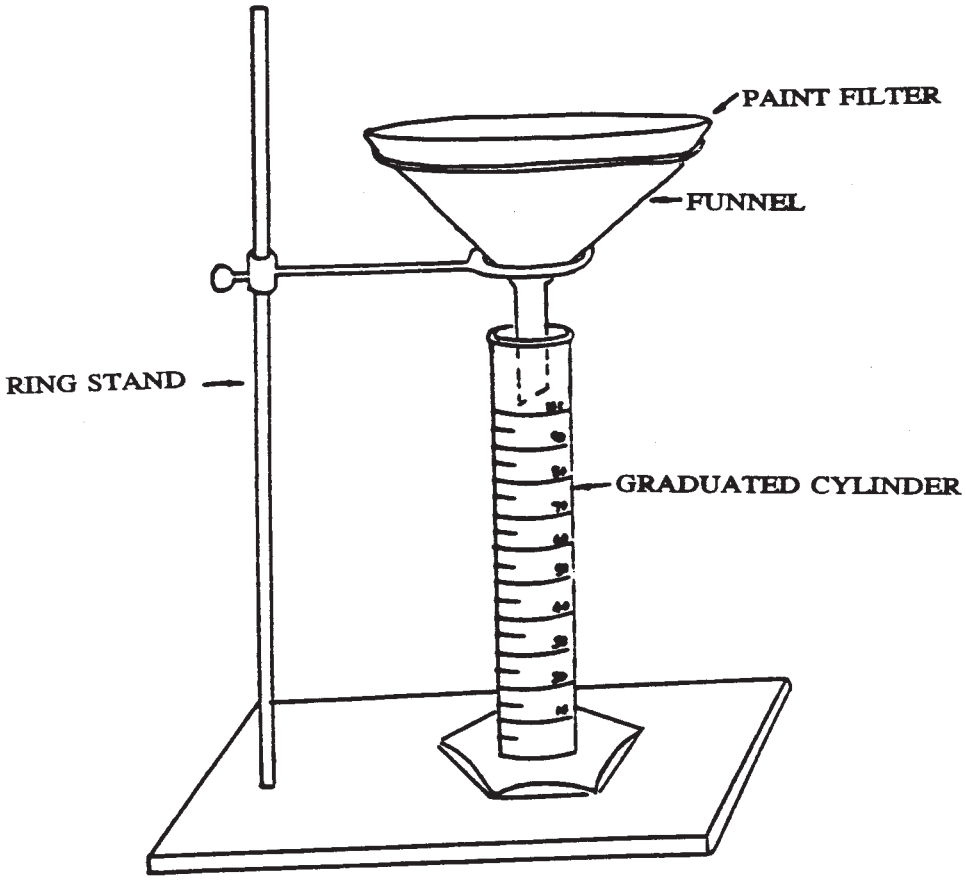
9.0 METHOD PERFORMANCE

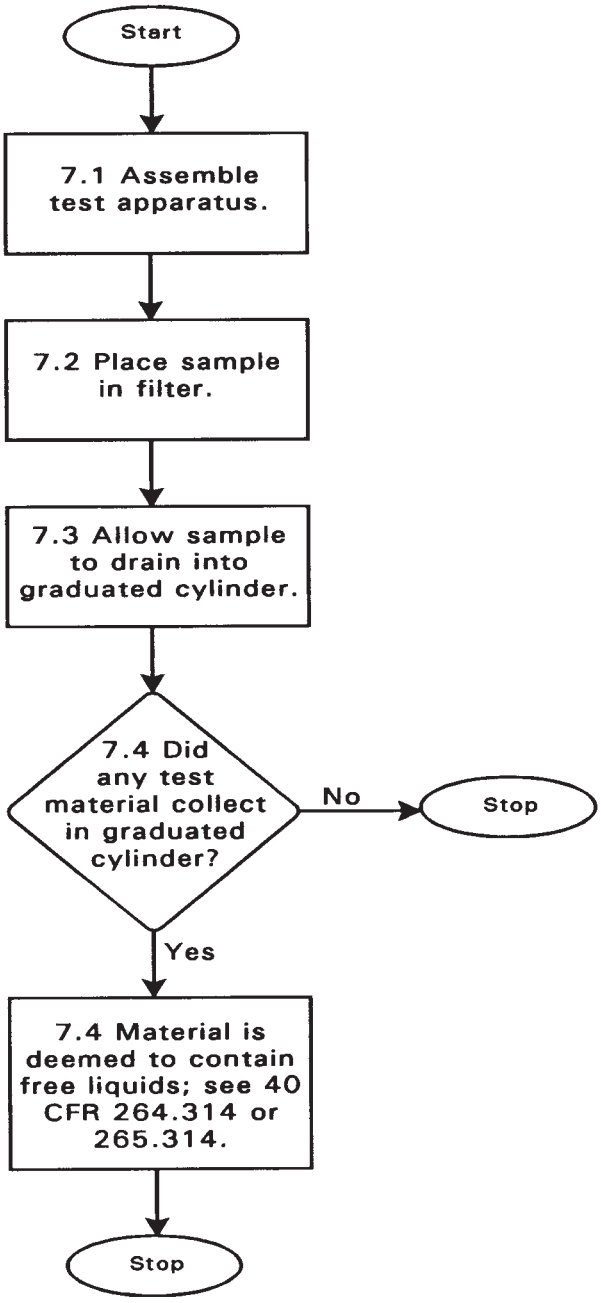
9.1 No data provided.

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

---

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.

Backgaround 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

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 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

Page Printed: 12/21/2015 15:29
ver: (7/18/2014)

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.

.



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

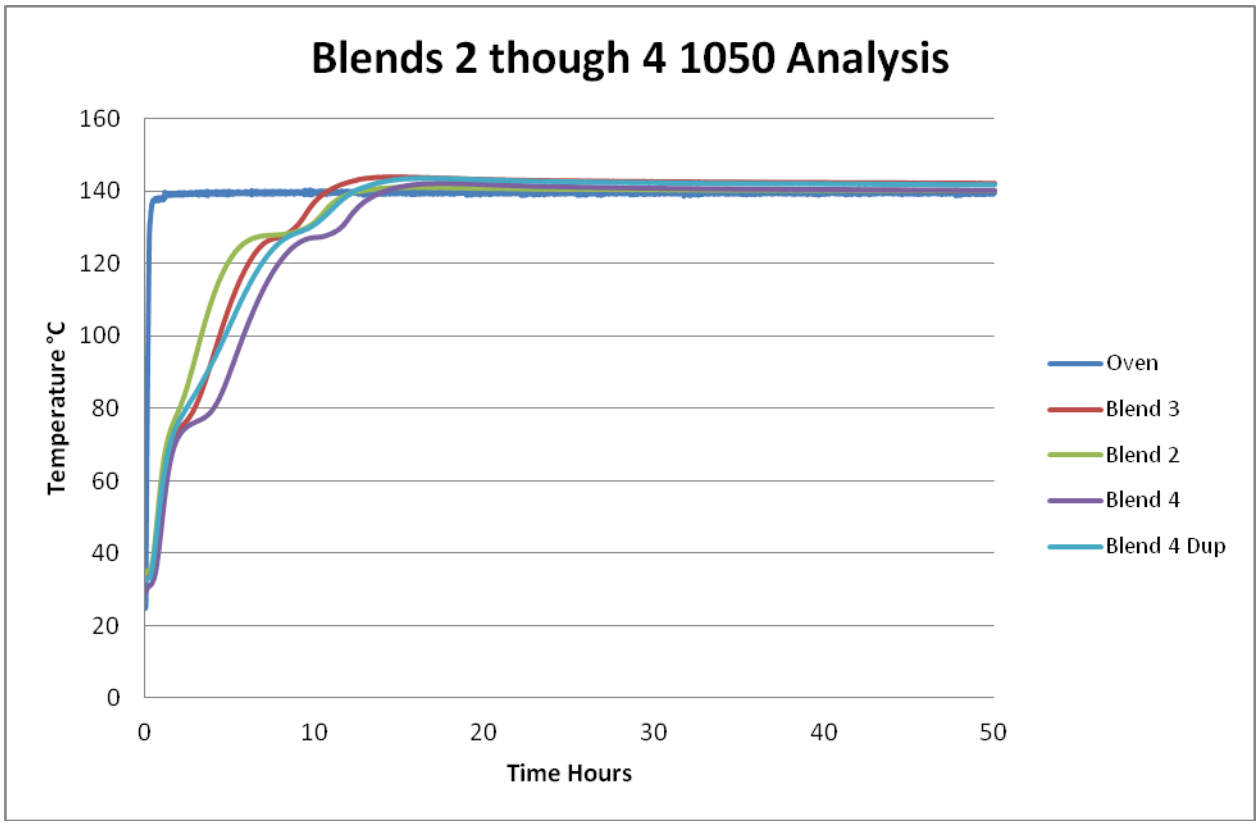


Figure 1. Method 1050 temperature graph for Blends 2, 3, 4 and 5 (100 mm cube). Blends were tested simultaneously with no events.

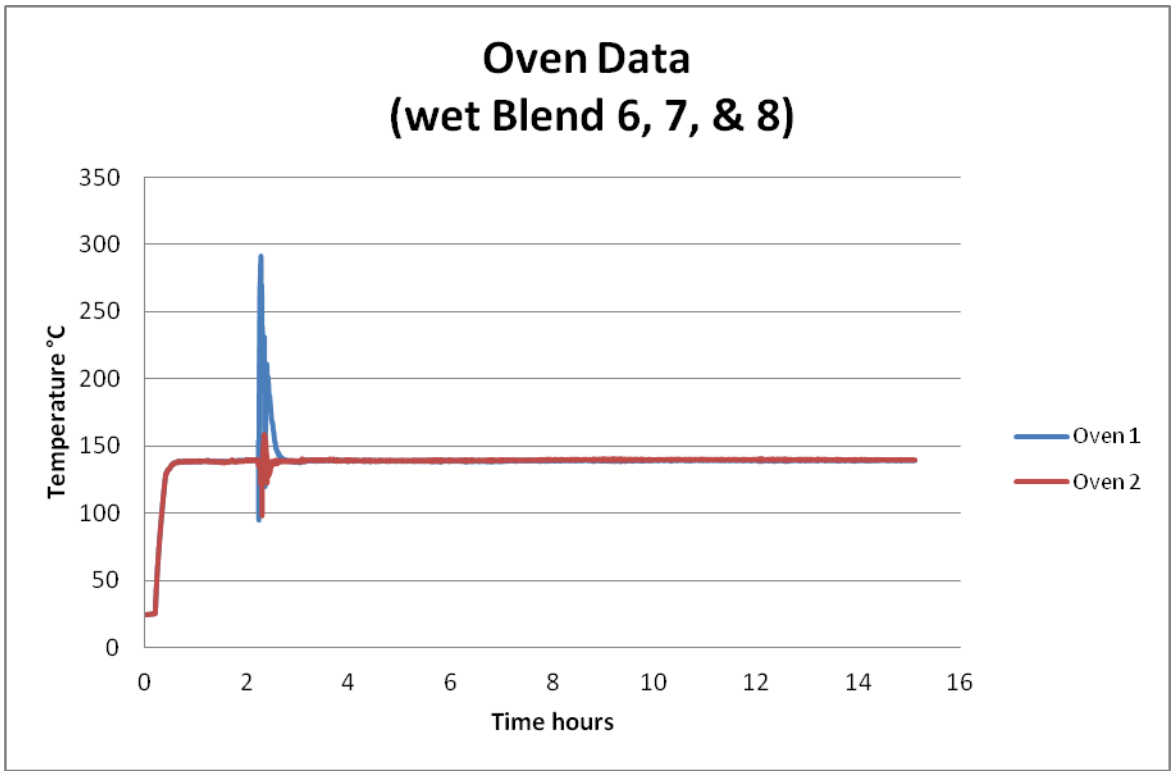


Figure 2. Method 1050 Graph of Oven temperature when (wet) Blends 6, 7 and 8 (100 mm cubes) were tested simultaneously. Note the temperature increase due to an even shortly after 2 hours.

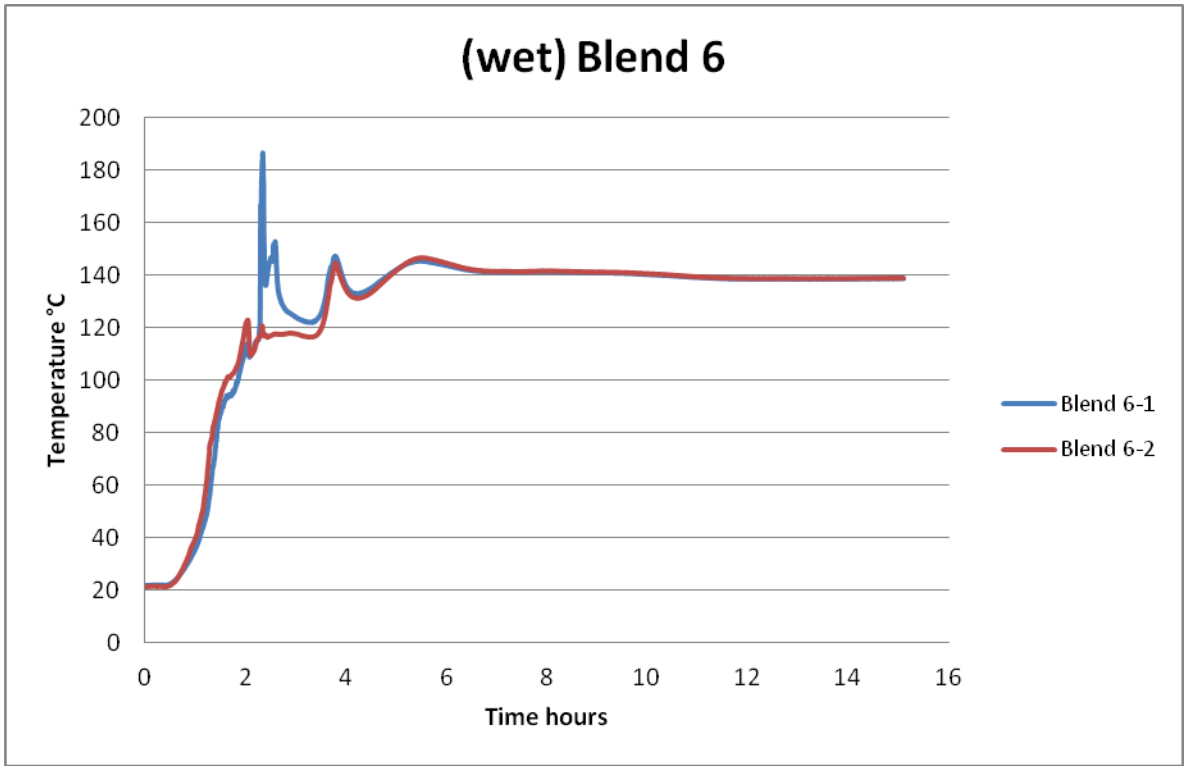


Figure 3. Method 1050 – Temperature of (wet) Blends 6 (100 mm cube) when tested simultaneously with Blend 7 & 8. Note the temperature increase due to an even shortly hour 2.

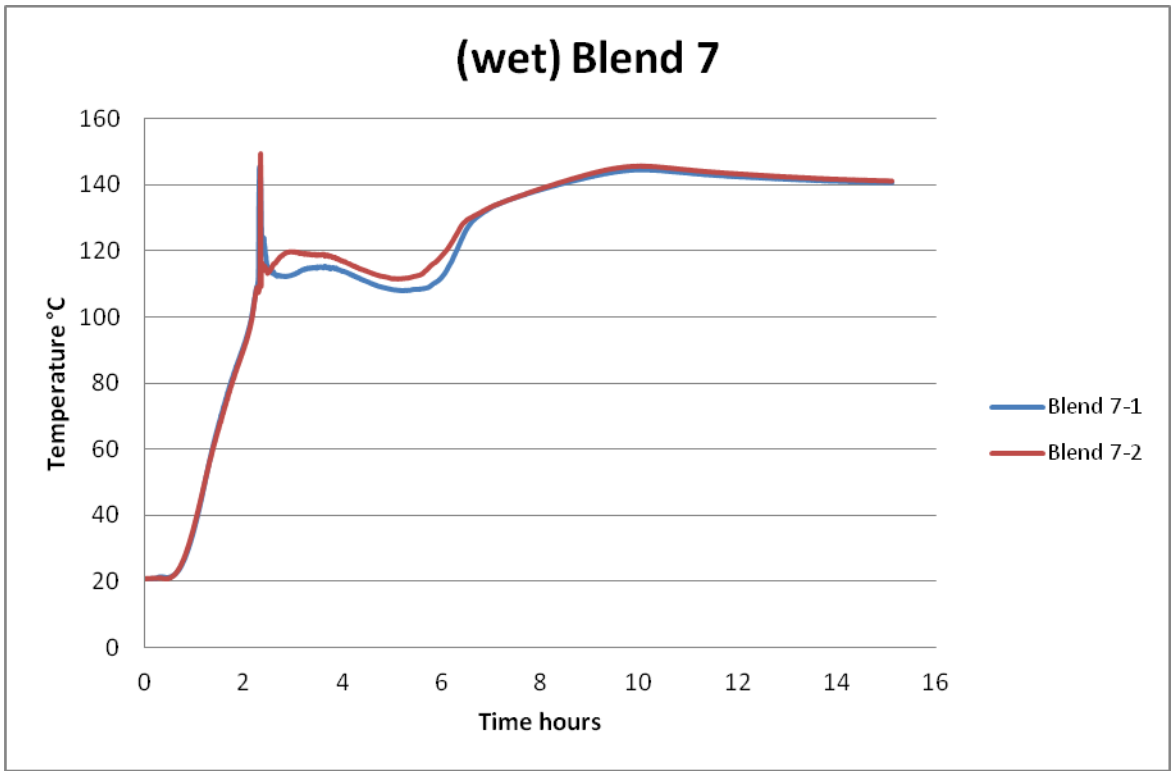


Figure 4. Method 1050 – Temperature of (wet) Blends 7 (100 mm cube) when tested simultaneously with Blend 6 & 8. Note the temperature increase due to an even shortly hour 2.

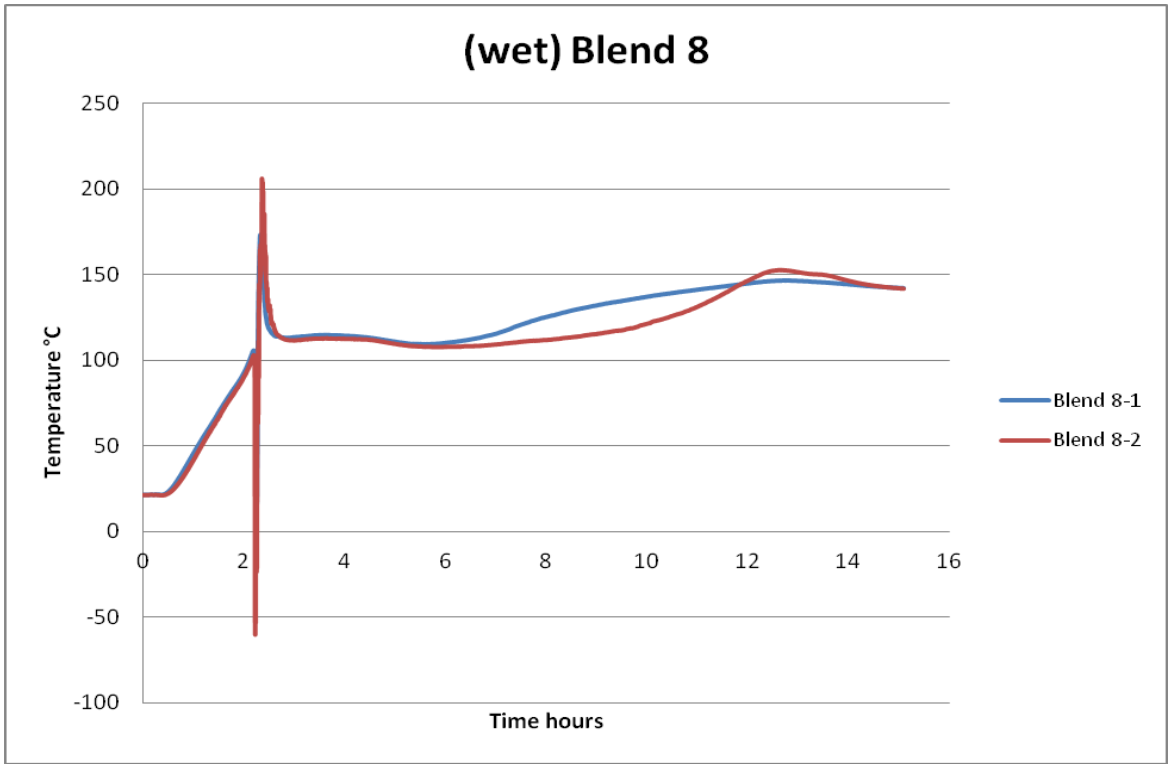


Figure 5. Method 1050 – Temperature of (wet) Blend 8 (100 mm cube) when tested simultaneously with Blend 6 & 7. Note the temperature increase due to an even shortly hour 2.

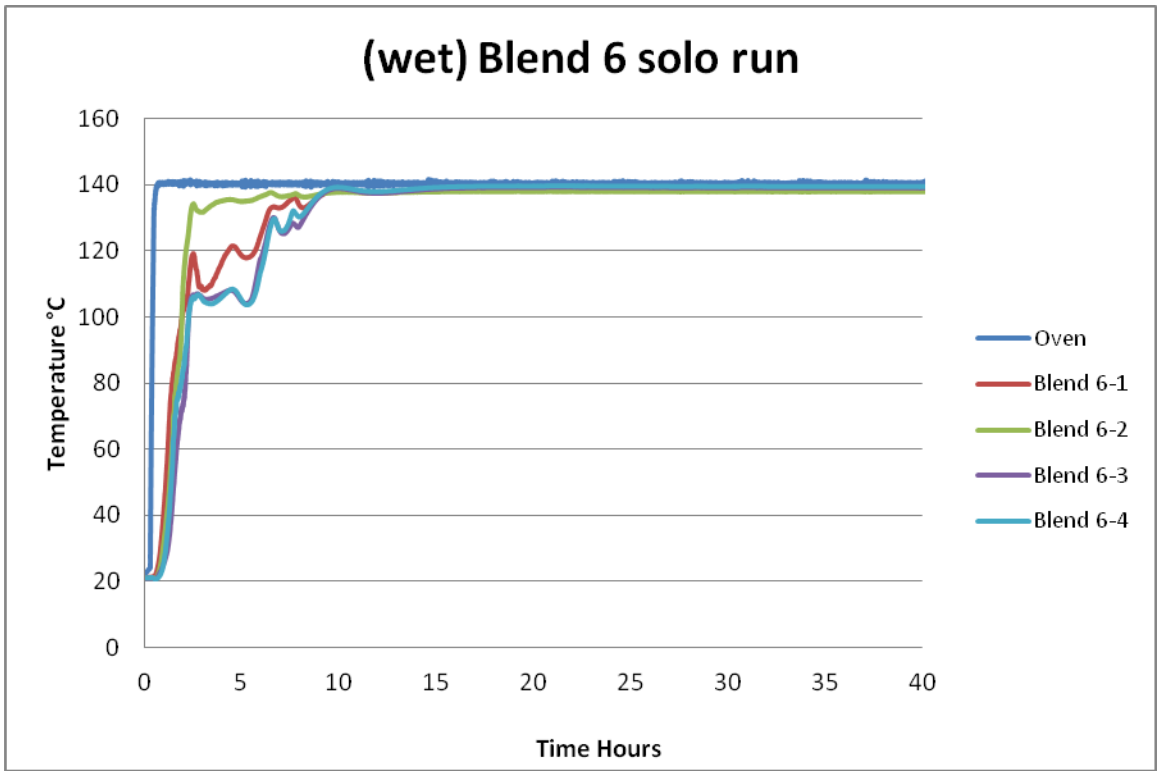


Figure 6. Method 1050 – Temperature of (wet) Blend 6 (100 mm cube) – individual test

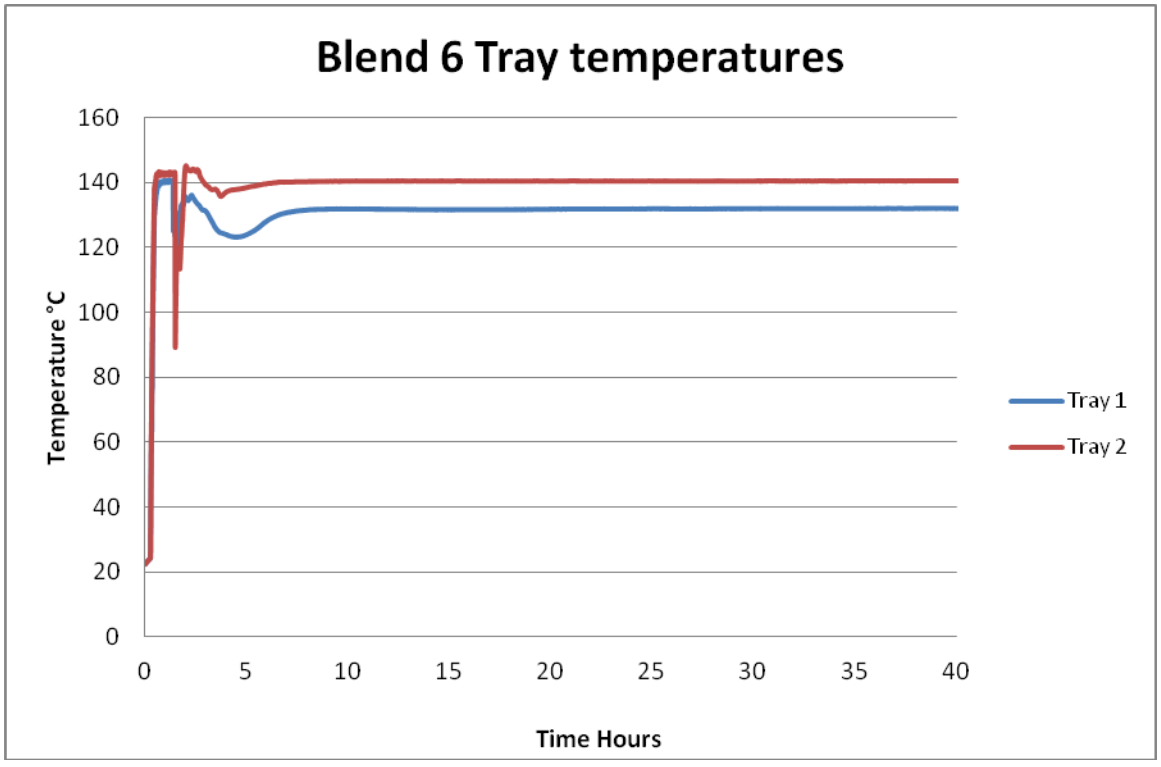


Figure 7. Method 1050 – Temperature of tray probes under the (wet) Blend 6 when tested individually. Note the temperature decrease at approximately 2 hr that signifies when the sample expanded out of the cube.

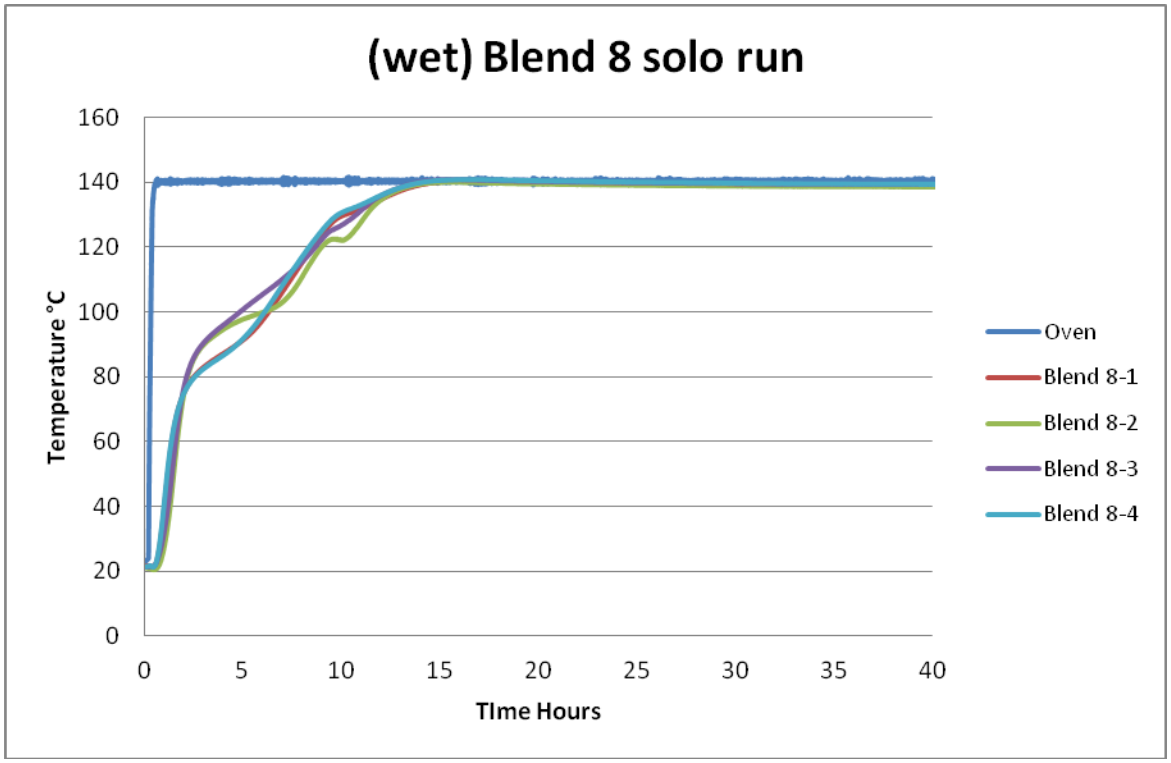


Figure 8. Method 1050 – Temperature of (wet) Blends 8 (100 mm cube) – individual test

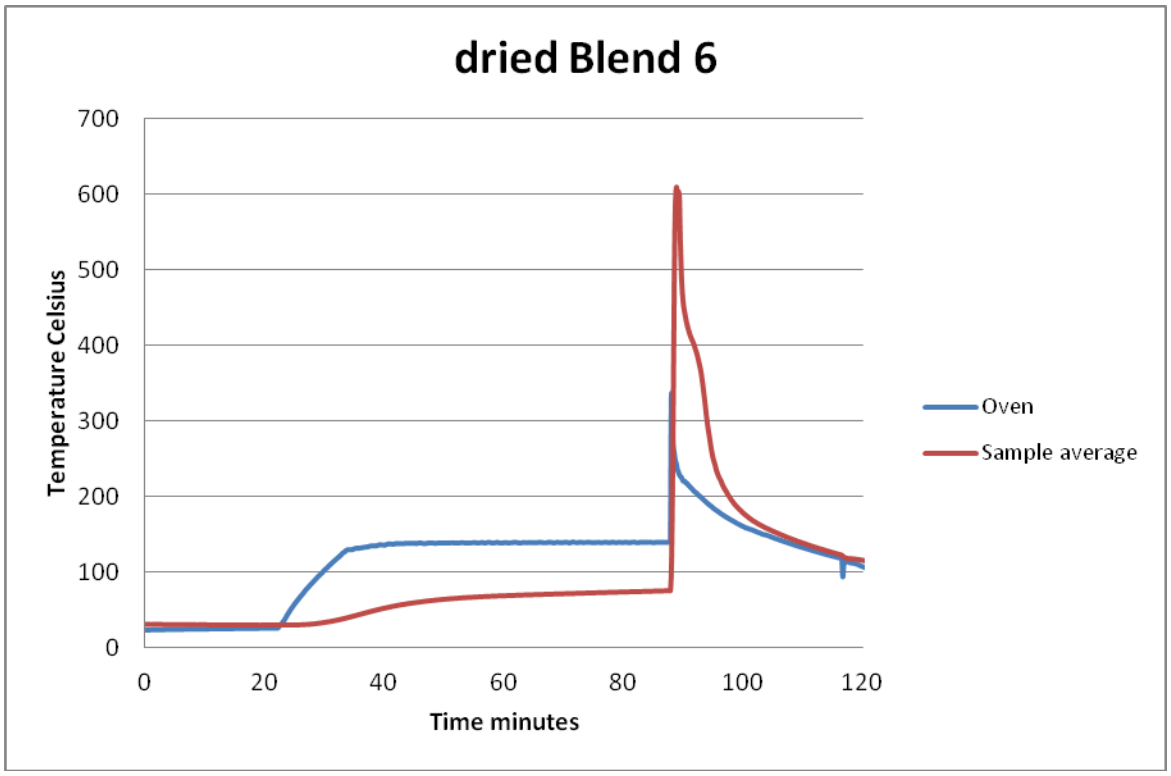


Figure 9. Method 1050 – Temperature of (dried) Blend 6 (100 mm cube). A significant event occurred when the sample reached 76° C

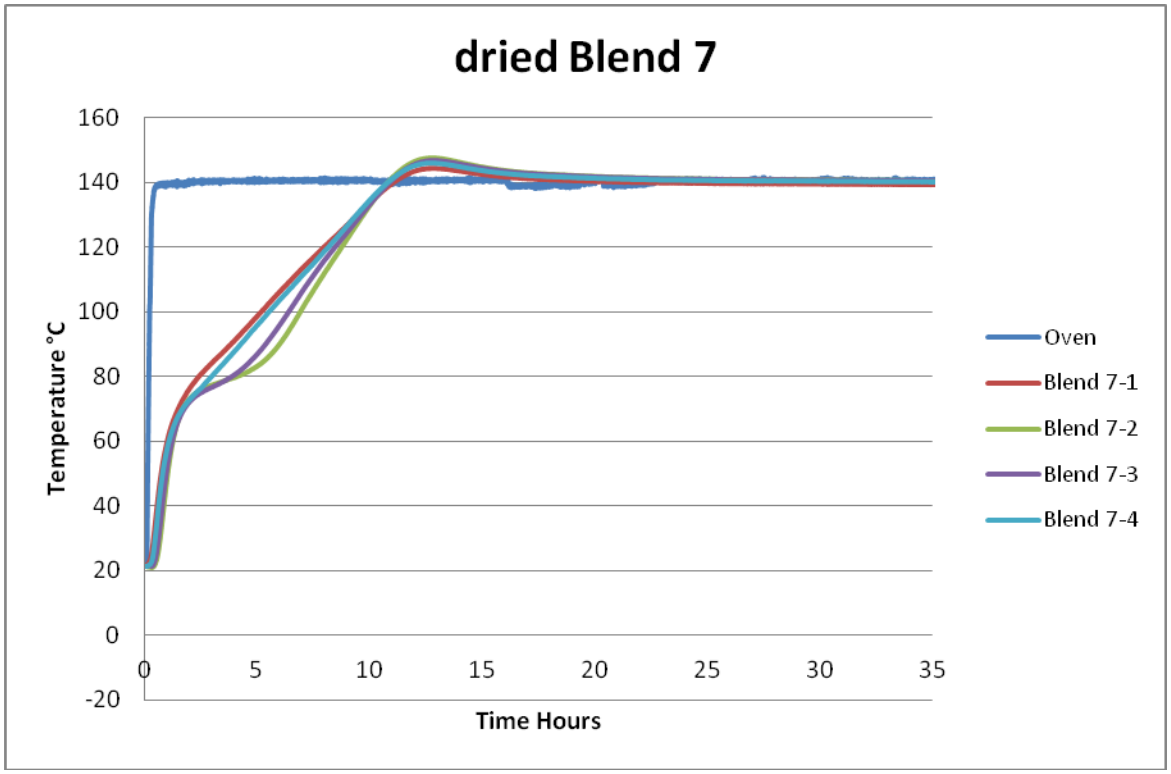


Figure 10. Method 1050 – Temperature of (dried) Blend 7 (100 mm cube)

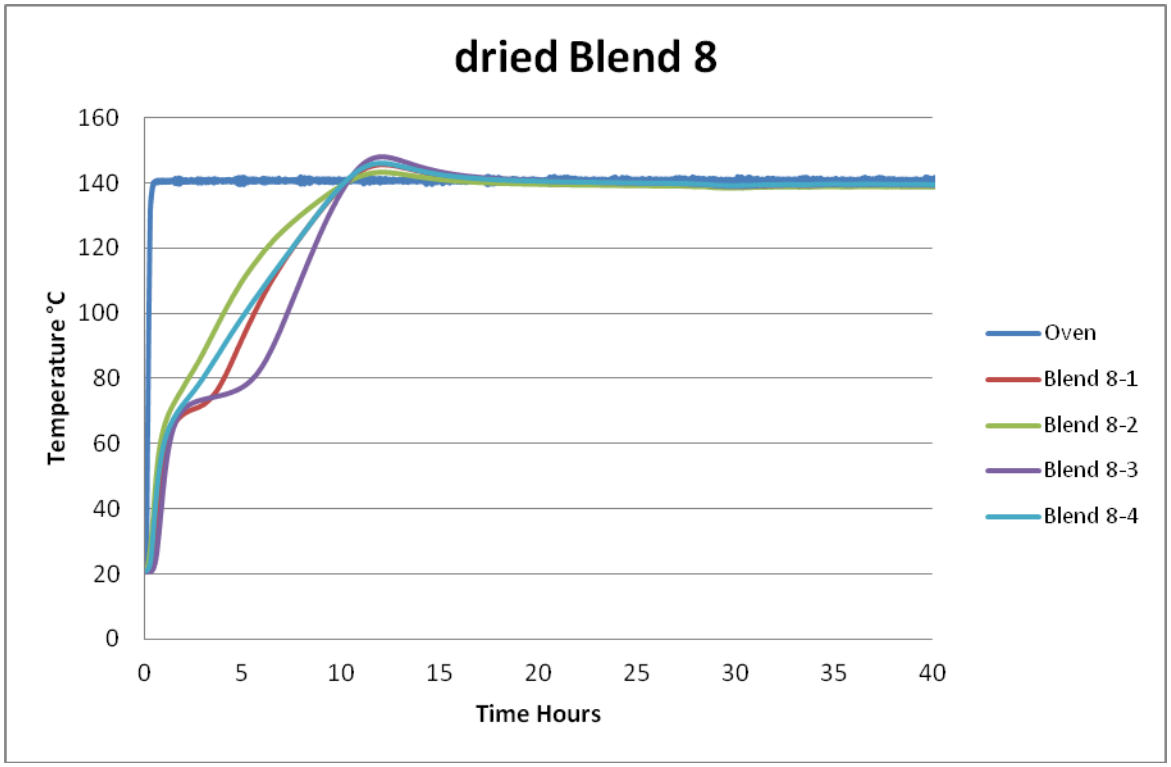


Figure 11. Method 1050 – Temperature of (dried) Blend 8 (100 mm cube)

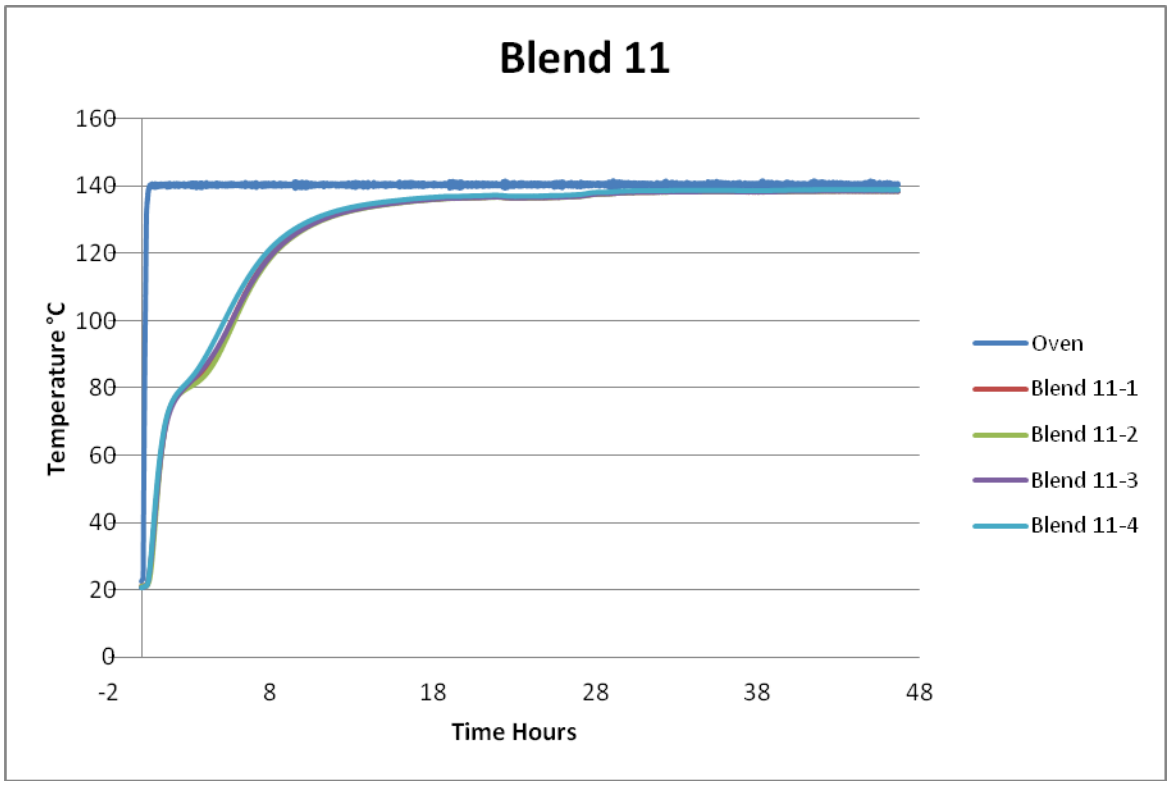


Figure 12. Method 1050 – Temperature of Blend 11 (100 mm cube)

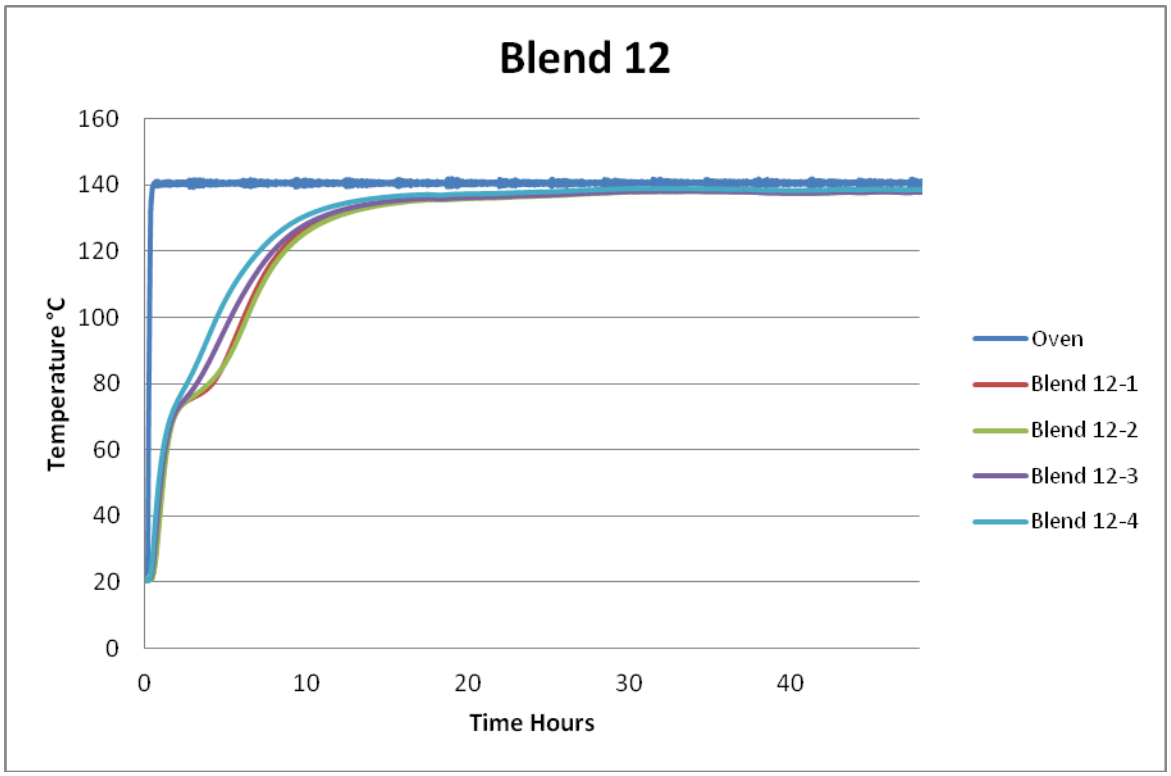


Figure 13. Method 1050 – Temperature of Blend 12 (100 mm cube)

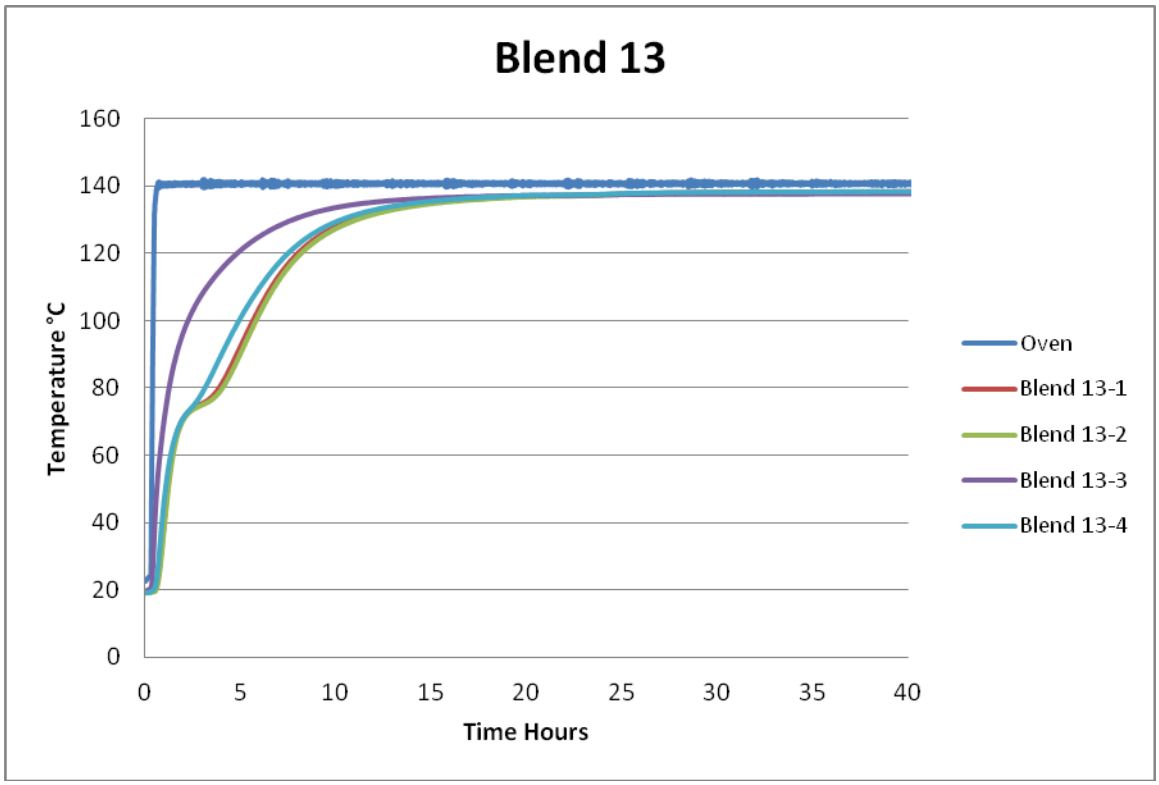


Figure 14. Method 1050 – Temperature of Blend 13 (100 mm cube)

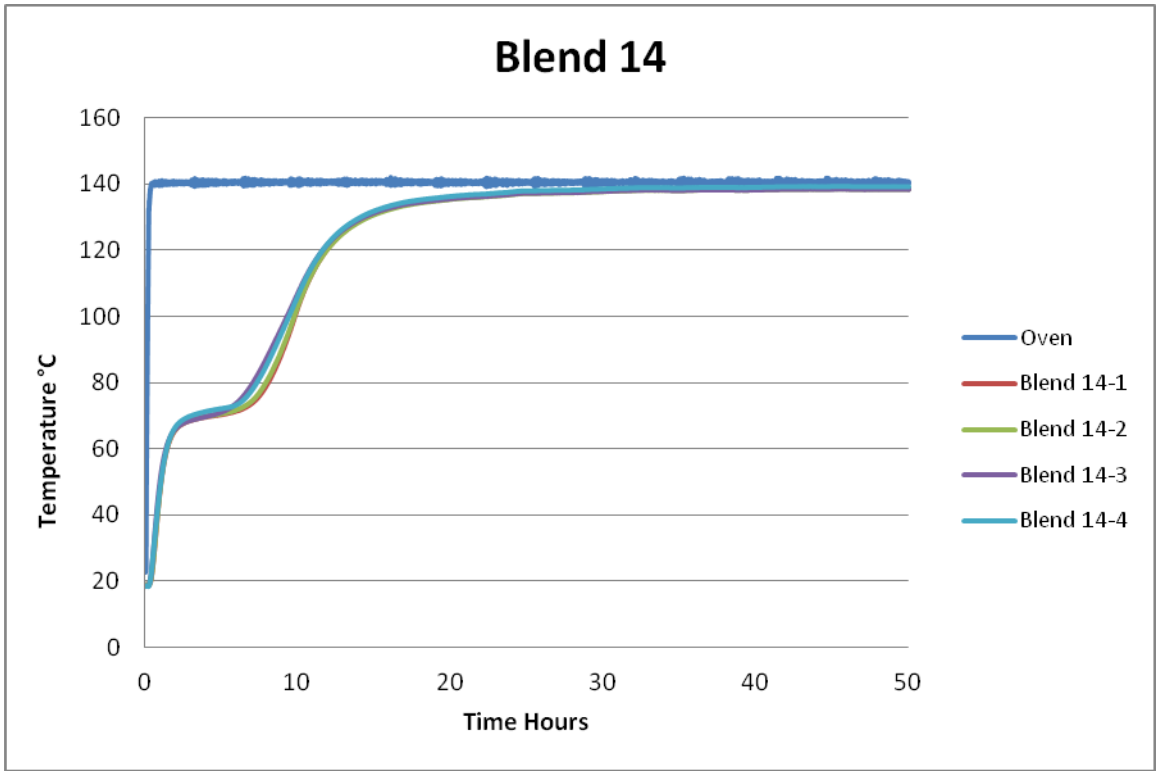


Figure 15. Method 1050 – Temperature of Blend 14 (100 mm cube)

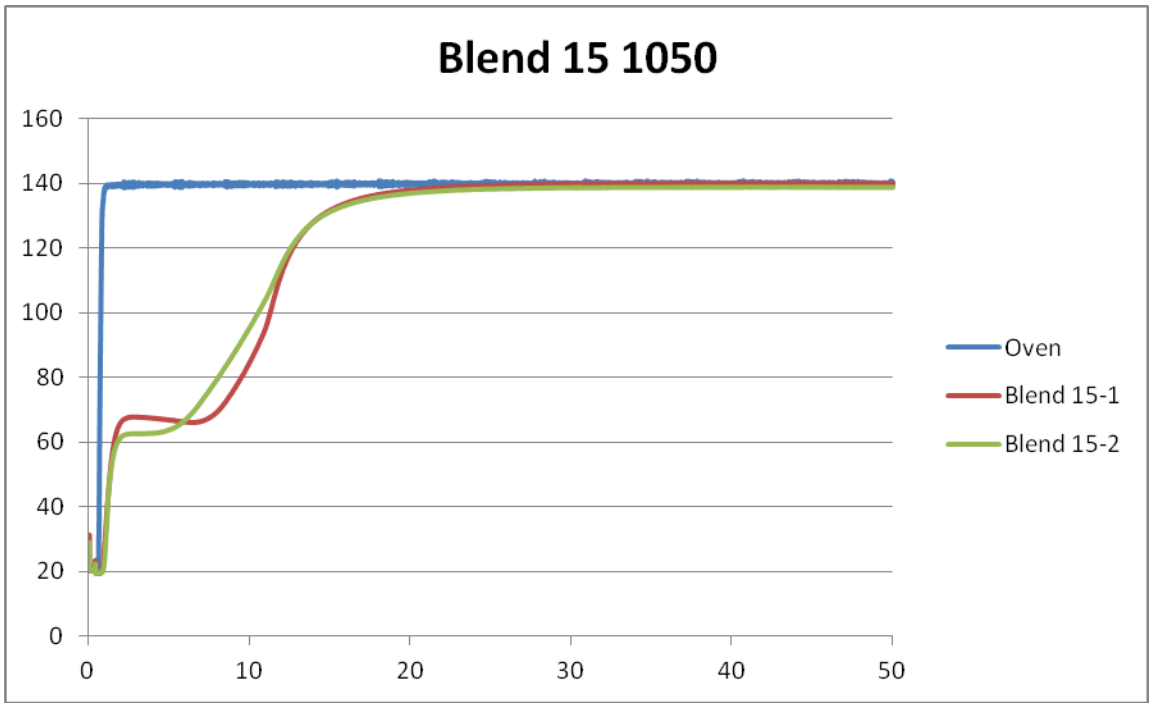


Figure 16. Method 1050 – Temperature of Blend 15 (100 mm cube) - tested concurrently with Blend 16.

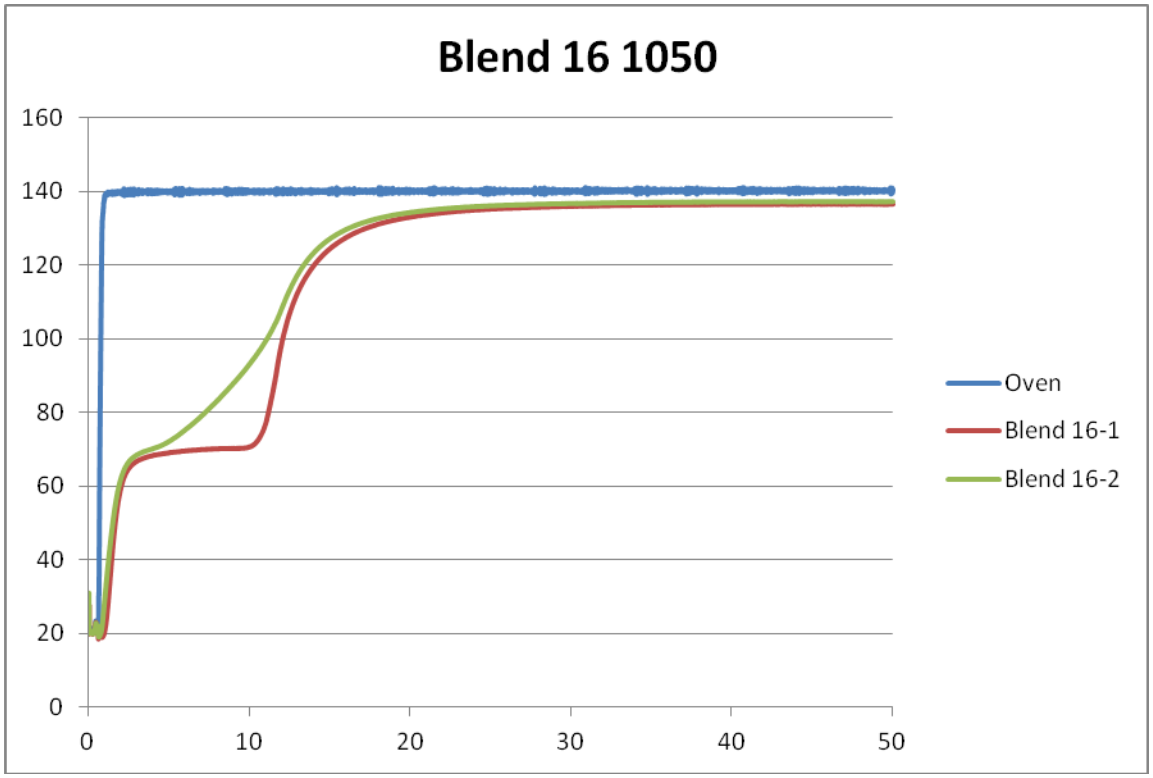


Figure 17. Method 1050 – Temperature of Blend 16 (100 mm cube) - tested concurrently with Blend 15.

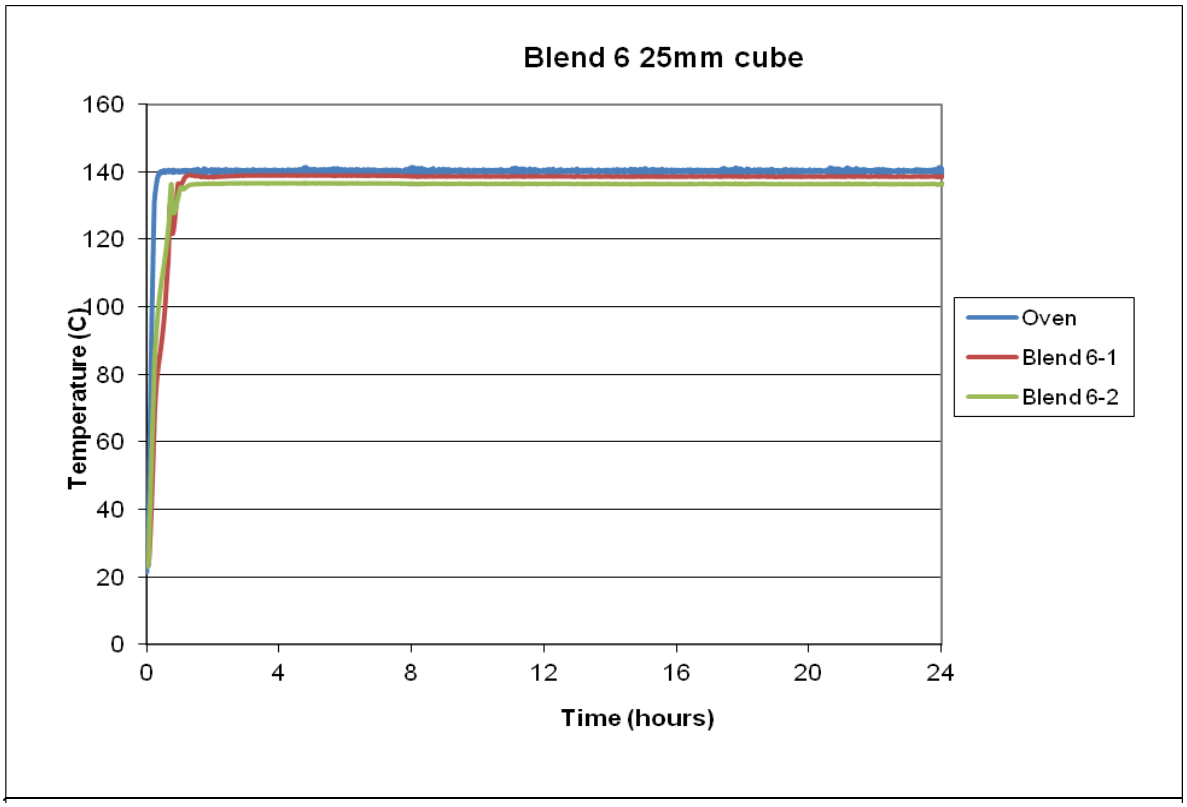


Figure 18. Method 1050 –Temperature of Blend 6 (25mm Cube)

"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

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: 63912

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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

SwRI Chem ID: 63912

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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

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

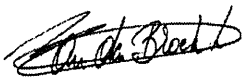
Appearance	white crystals
Assay Complexometry	99.0 to 103.0 %
Heavy metals (as Pb)	=<5 ppm
pH	5.0 to 7.0 (5% soln. at 25°C)
Insoluble matter	=<0.005 %
Trace analysis	Type: Cl measure =< 50 ppm
	Type: SO4 measure =< 20 ppm
	Type: Ba measure =< 50 ppm
	Type: Fe measure =< 5 ppm
	Type: NO2 measure =< 10 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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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: 36657

SwRI Chem ID: 36657

SwRI Chem ID: 36657

SwRI Chem ID: 61751

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	

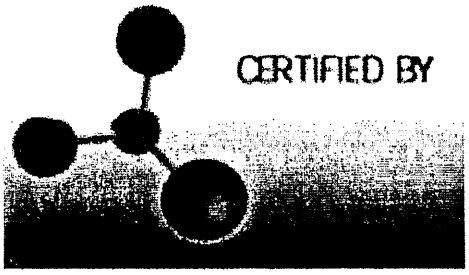
Result Name	Specifications	Test Value
Appearance (Color)	Dark purple to black	Dark purple
Appearance (Form)	Crystalline chunks	Crystalline chunks
Titration Iodometric	>=98.5 %	102.3 %
pH	2 to 3 (5% aq. soln.)	2.1 (5% aq. soln.)
Calcium (Ca)	=<50 ppm	21 ppm
Cadmium (Cd)	=<10 ppm	8 ppm
Cobalt (Co)	=<10 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

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
Email USA: techserv@sial.com
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

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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 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

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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)	

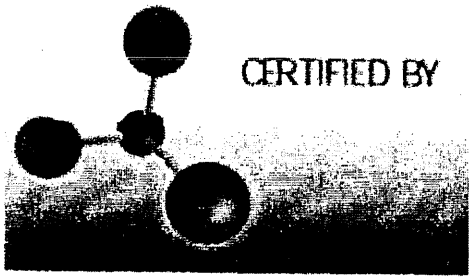
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Catalog Number	21156	**Quality Test / Release Date**	9 July 2015
Lot Number	A0349449	**Suggested Retest Date**	July 2017
Description	Lead(II) nitrate,99+%		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

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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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

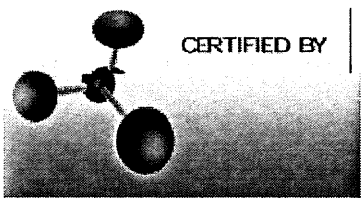
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Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by DNV Certificate number CERT-08052-2006-AQ-HOU-ANAB

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Catalog Number	**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
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201.796.1329 fax

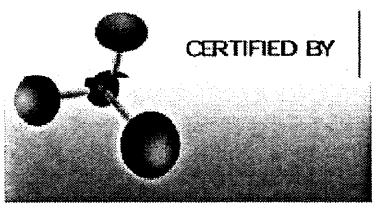
Certificate of Analysis

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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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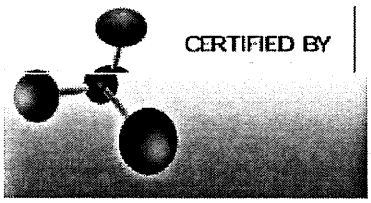
Certificate of Analysis

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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
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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:	**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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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: 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

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SwRI Chem ID: 62882

010116

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Website: www.sigmaaldrich.com
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

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SwRI Chem ID: 61137

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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

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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

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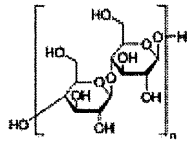
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3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
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

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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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SIGNATURE DATE 10/9/15

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 10/15/15

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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

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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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SIGNATURE [signature] DATE 10/29/15

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 10/30/15

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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

DISCLOSED TO AND UNDERSTOOD BY

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		

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	2/17/2015
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

010145

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

010147

Southwest Research Institute
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

010150

Southwest Research Institute
Calibration Certificate

ACCREDITED
Calibration Laboratory
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

010154

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		

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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:	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.

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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

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.

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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:	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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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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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

Southwest Research Institute
Calibration Certificate

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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.

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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:	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

Southwest Research Institute
Calibration Certificate

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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.

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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:	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

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.

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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:	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

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

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

010171

Southwest Research Institute
Calibration Certificate

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Calibration Laboratory
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

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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

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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

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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:	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.

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 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

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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:	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.

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:
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

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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.

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:
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: Wet Chem 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	

Page Printed: 01/26/2016 10:57
ver: (7/18/2014)

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

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

Page Printed: 01/26/2016 10:57
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	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

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

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. 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
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: Alex Reynolds	Logbook No.: Sample Receipt (56087)
Date: 12.21.15	Logbook Page No.: 9201 SEC 2 3 OF 4

FORM DC-1

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	Fraction	
Area #	Area #	
By	By	
On	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: INORG	Fraction:
Area #: 10 Sprgs	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:	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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SwRI Project Number: 21592.01.00X
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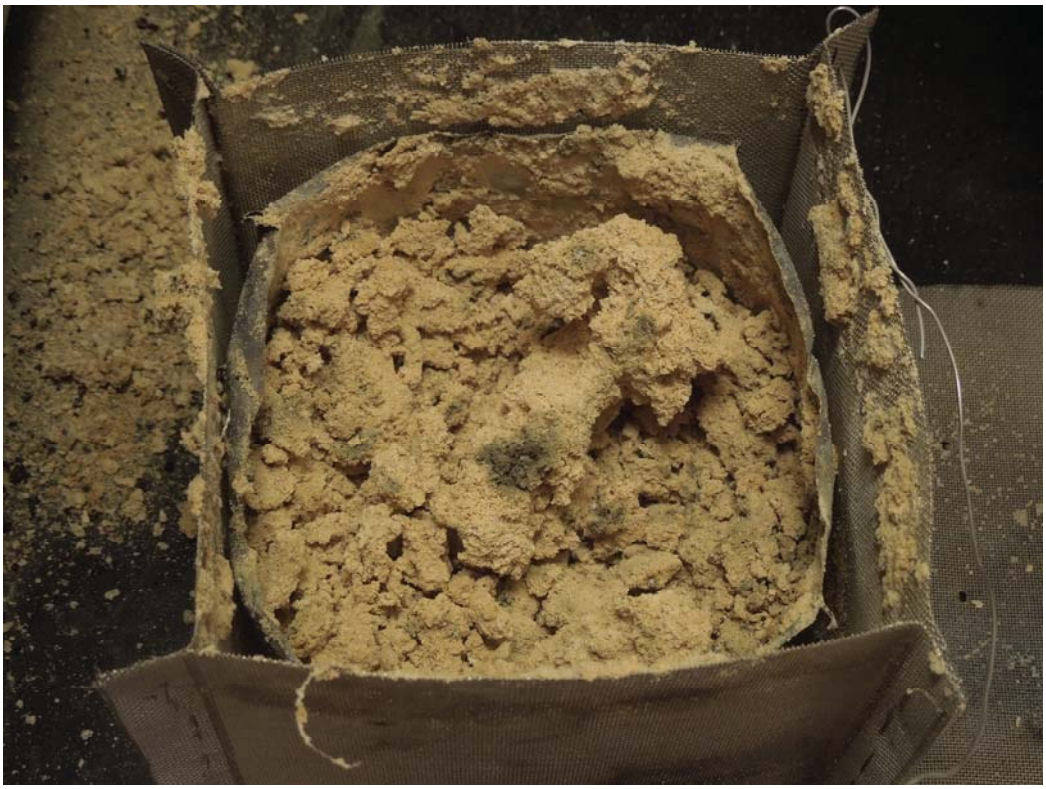


Image 9: Blend 25 after event in the hood.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 151222-14



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

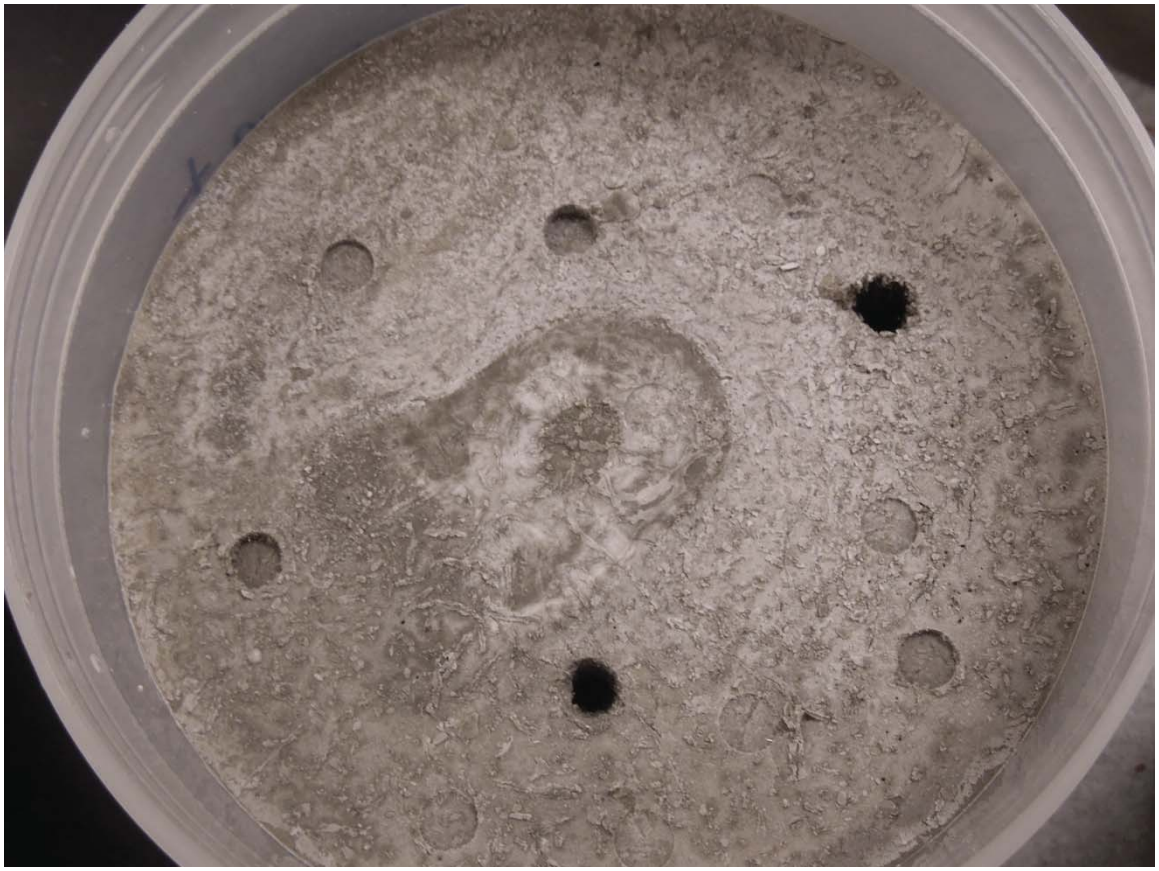


Image 7: Cement 6 Day 7



Image 8: Cement 6 Day 8

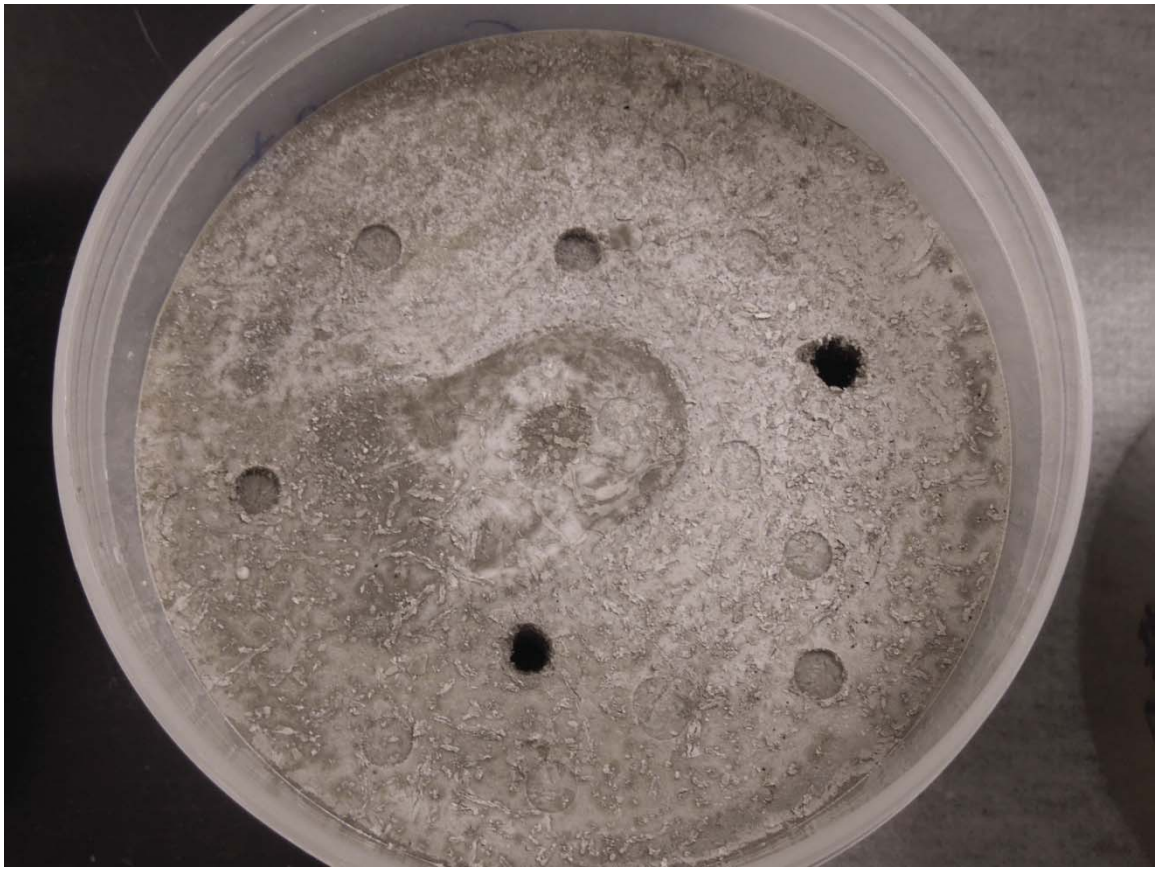


Image 9: Cement 6 Day 9

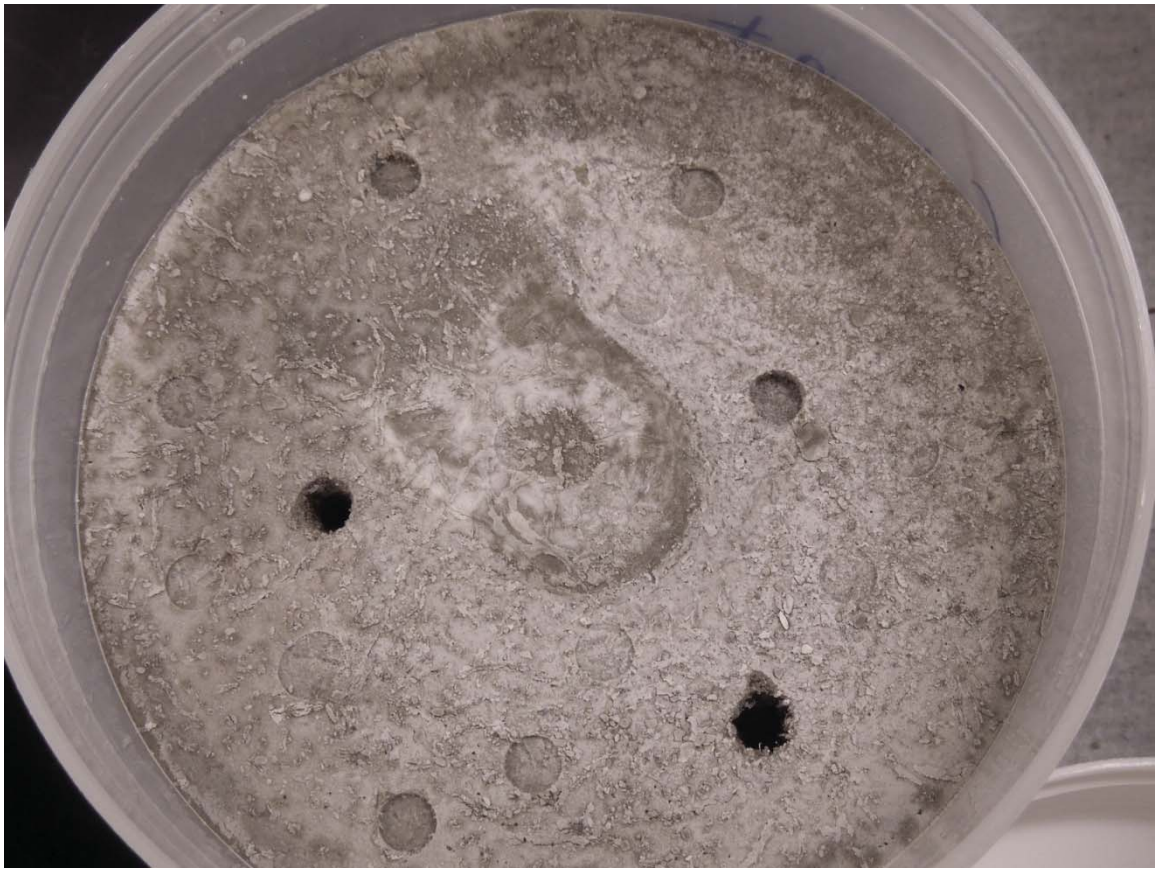


Image 10: Cement 6 Day 10



Image 11: Cement 7   Day 1



Image 12: Cement 7 Day 2



Image 13: Cement 7 Day 3

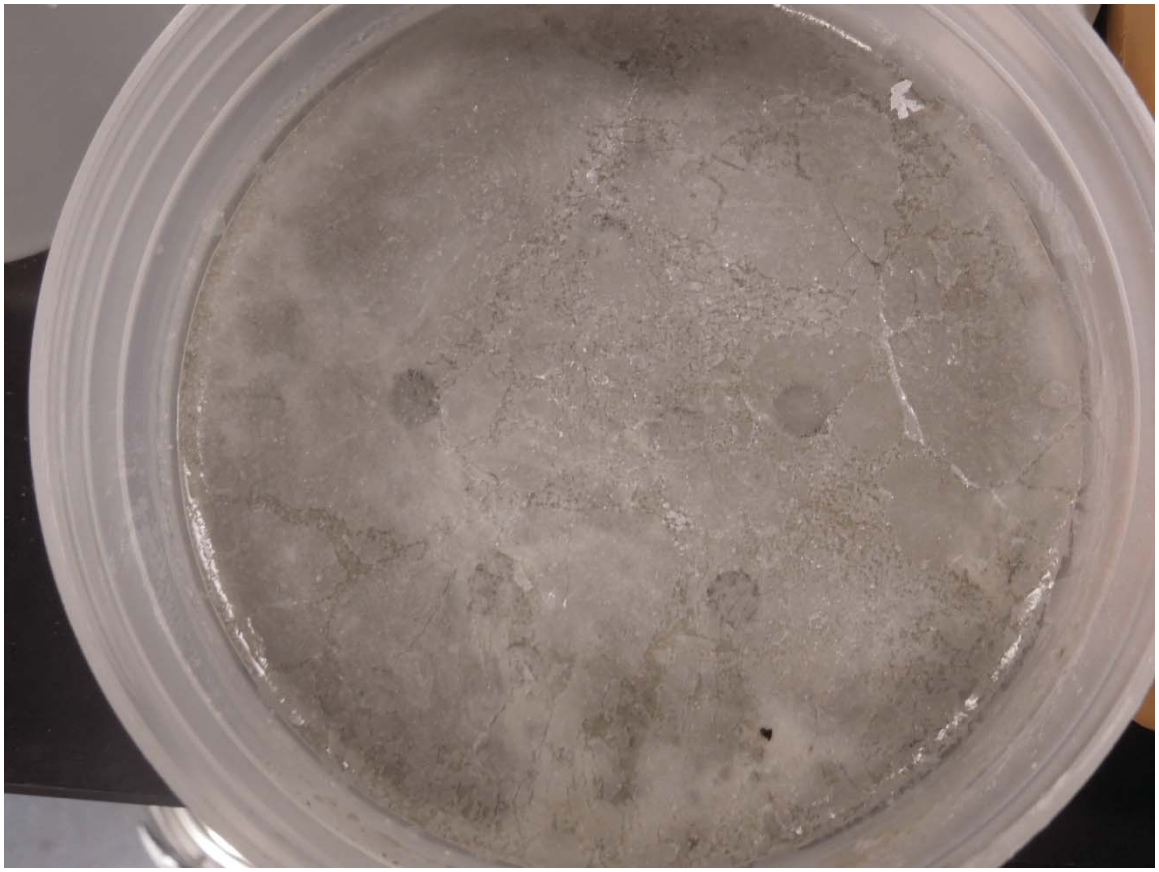


Image 14: Cement 7 Day 4

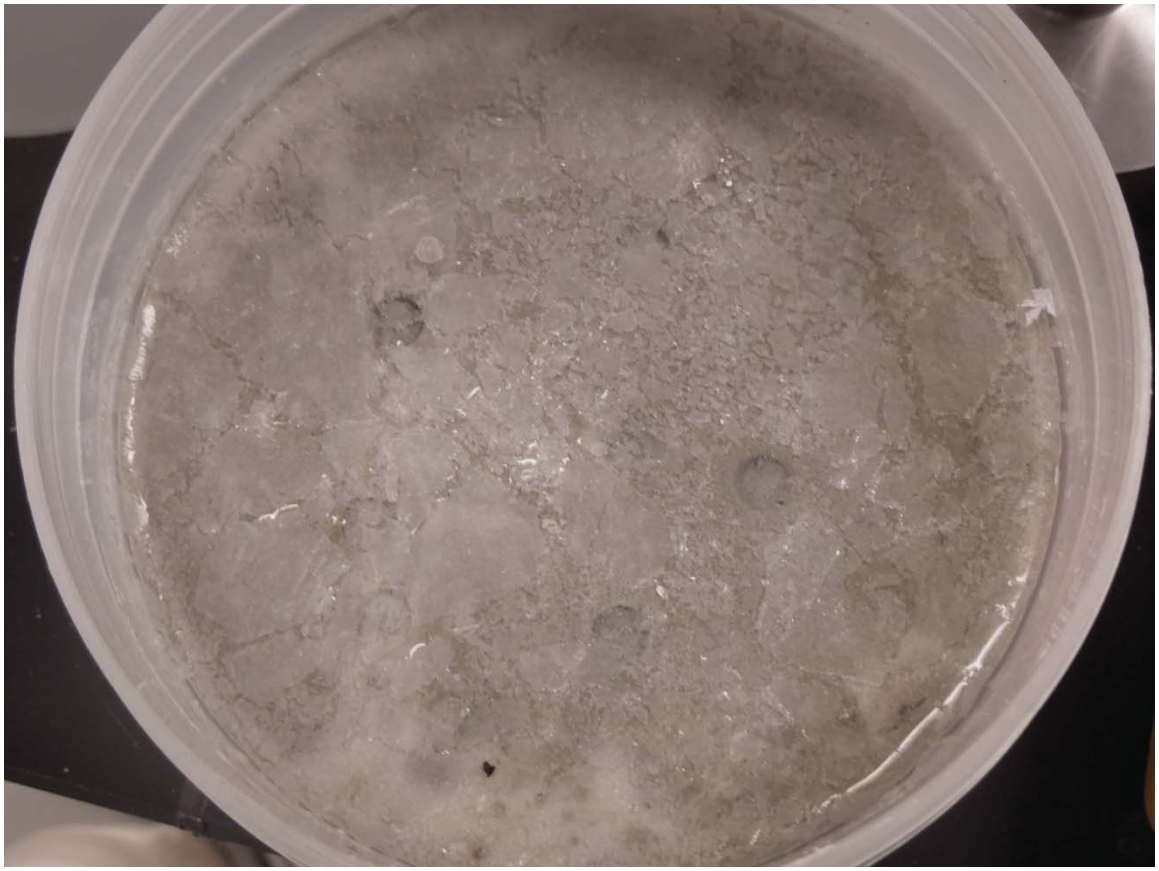


Image 15: Cement 7 Day 5



Image 16: Cement 7 Day 6



Image 17: Cement 7 Day 7

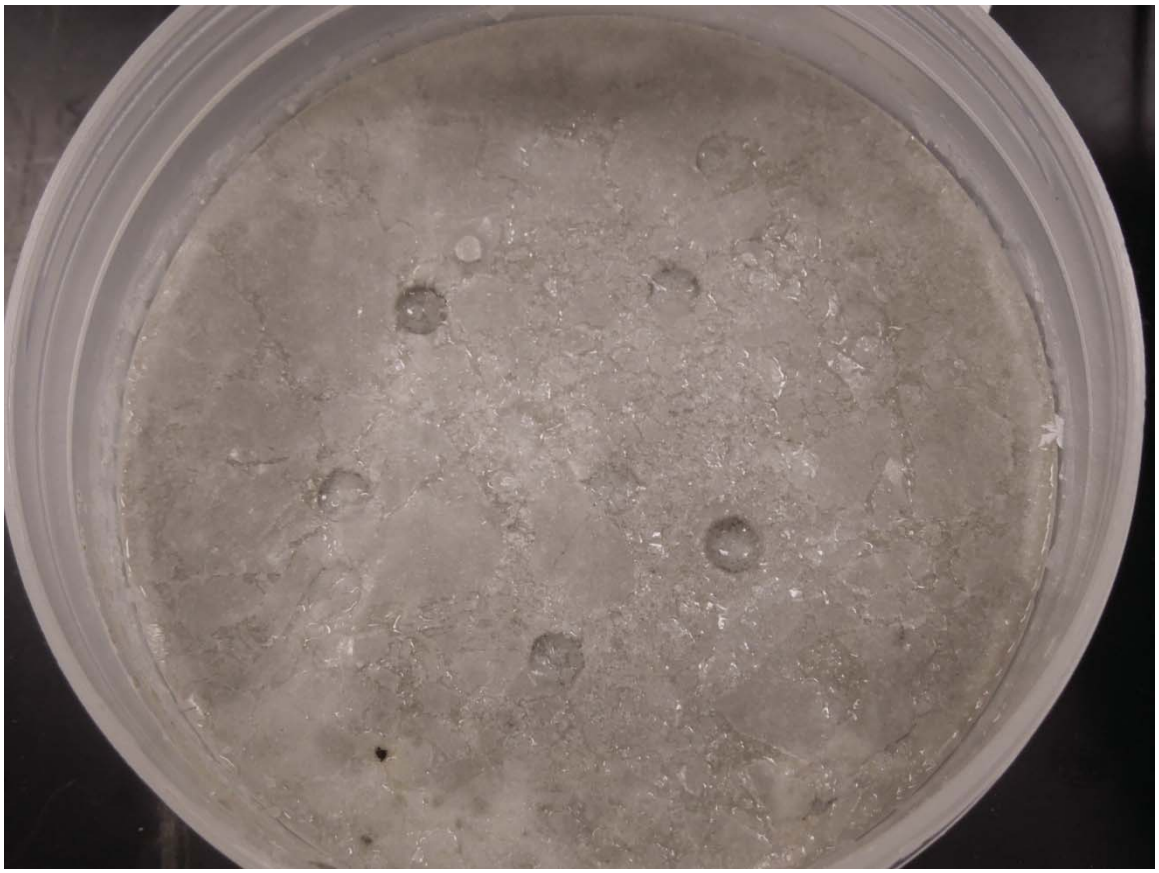


Image 18: Cement 7 Day 8

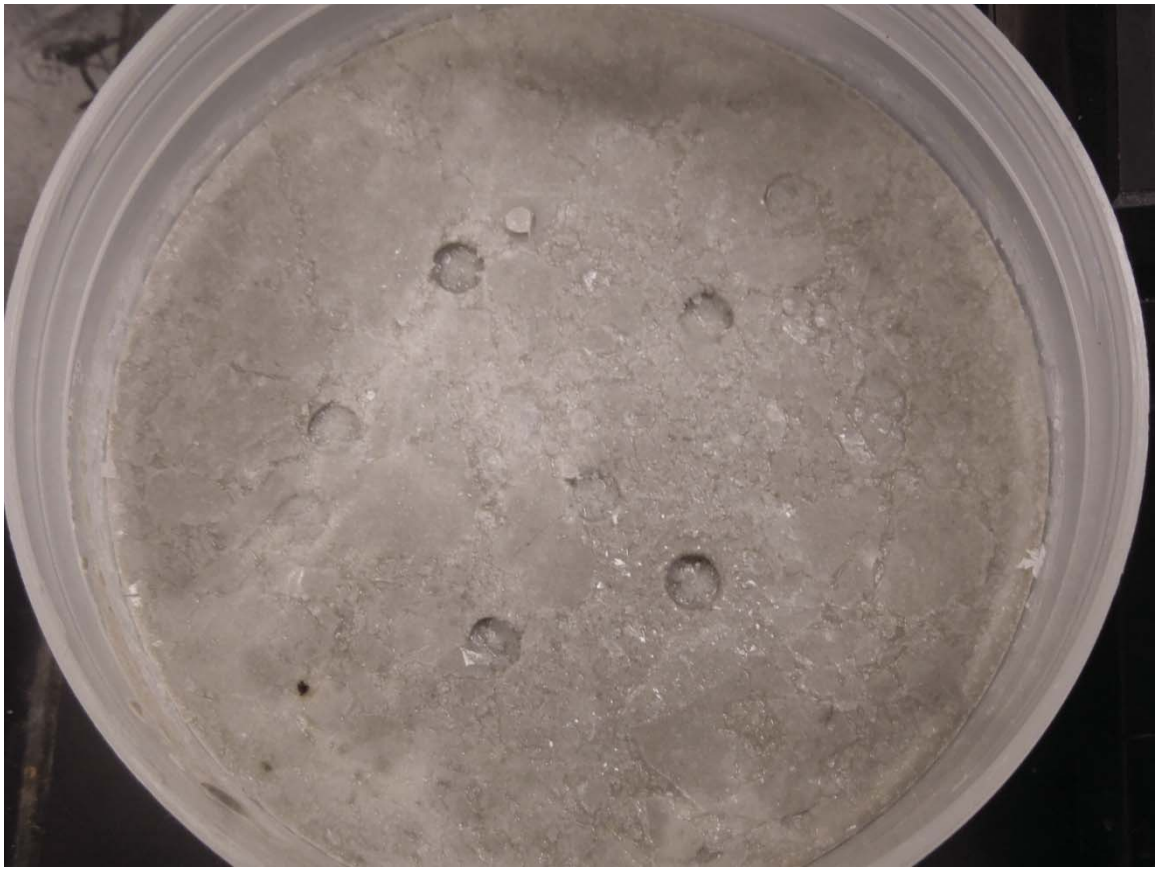


Image 19: Cement 7 Day 9



Image 20: Cement 7 Day 10

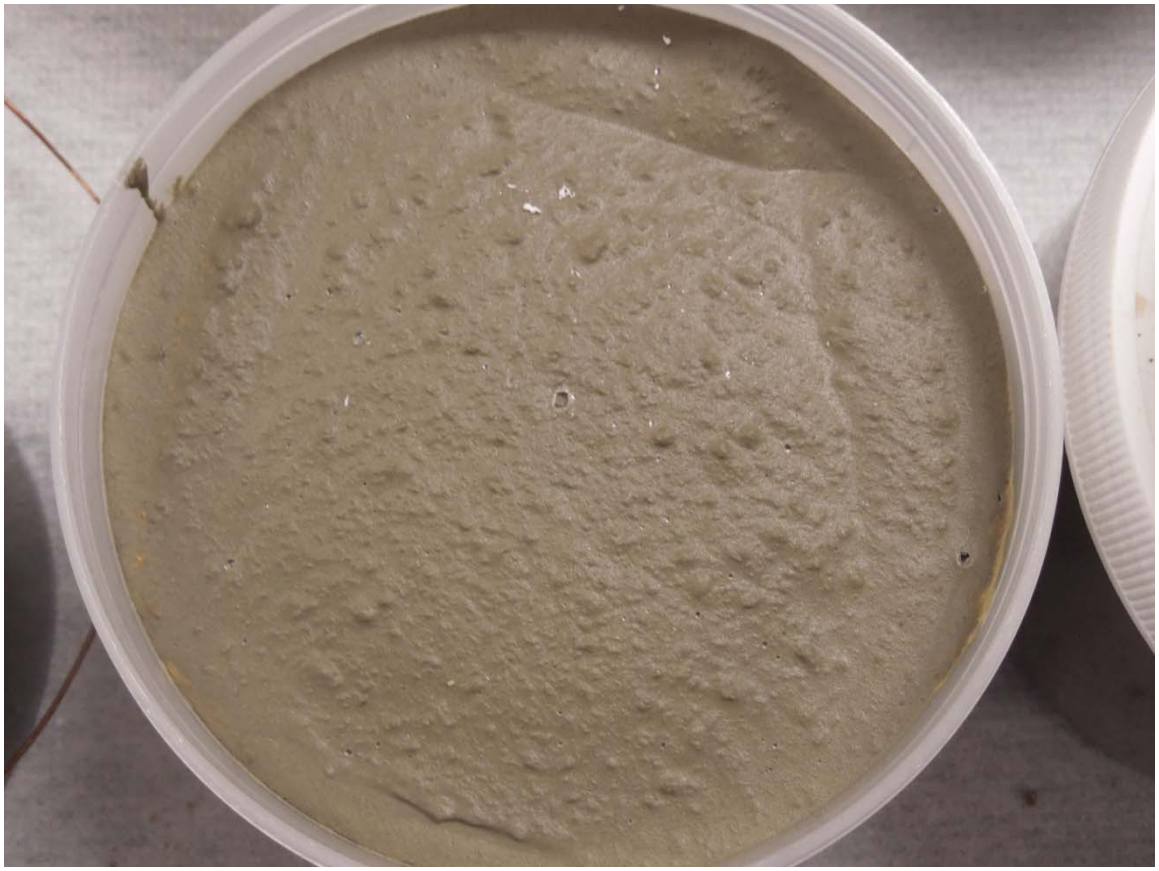


Image 21: Cement 8 Day 1



Image 22: Cement 8 Day 2

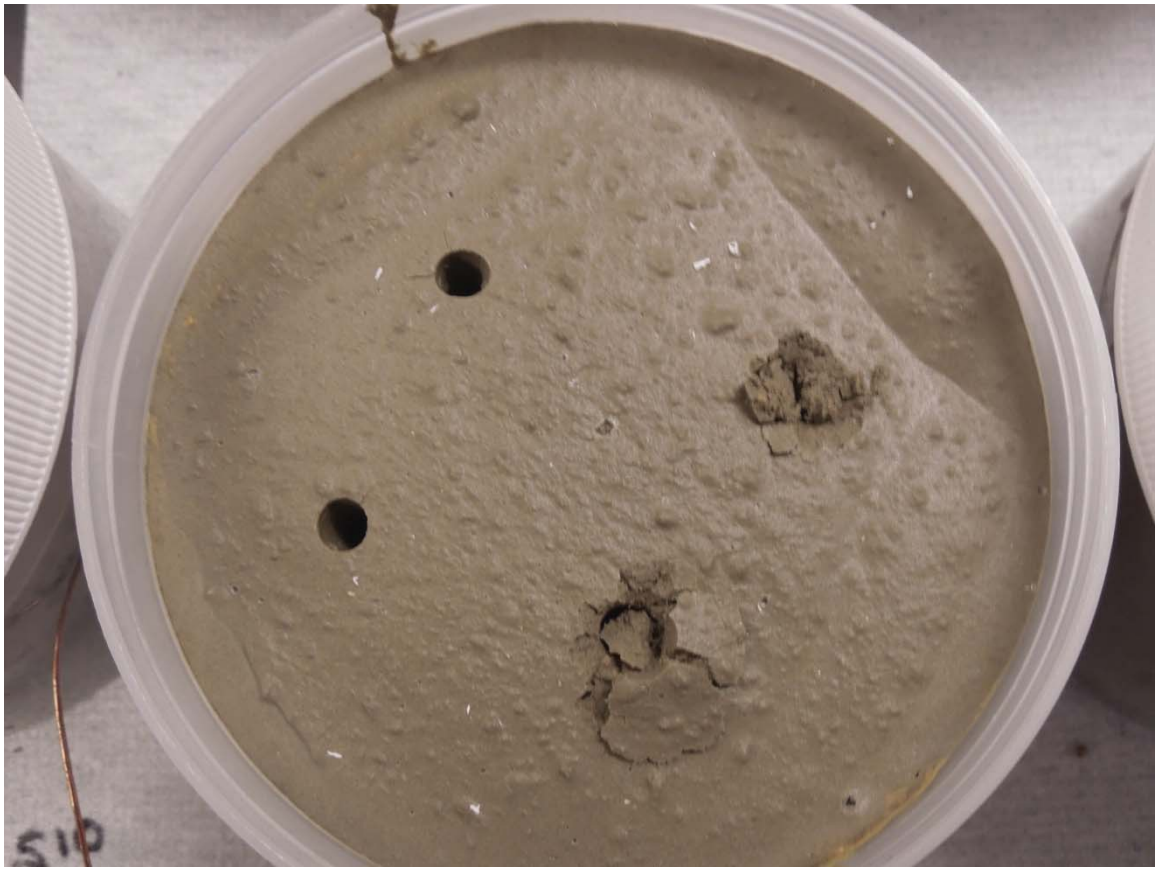


Image 23: Cement 8 Day 3



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

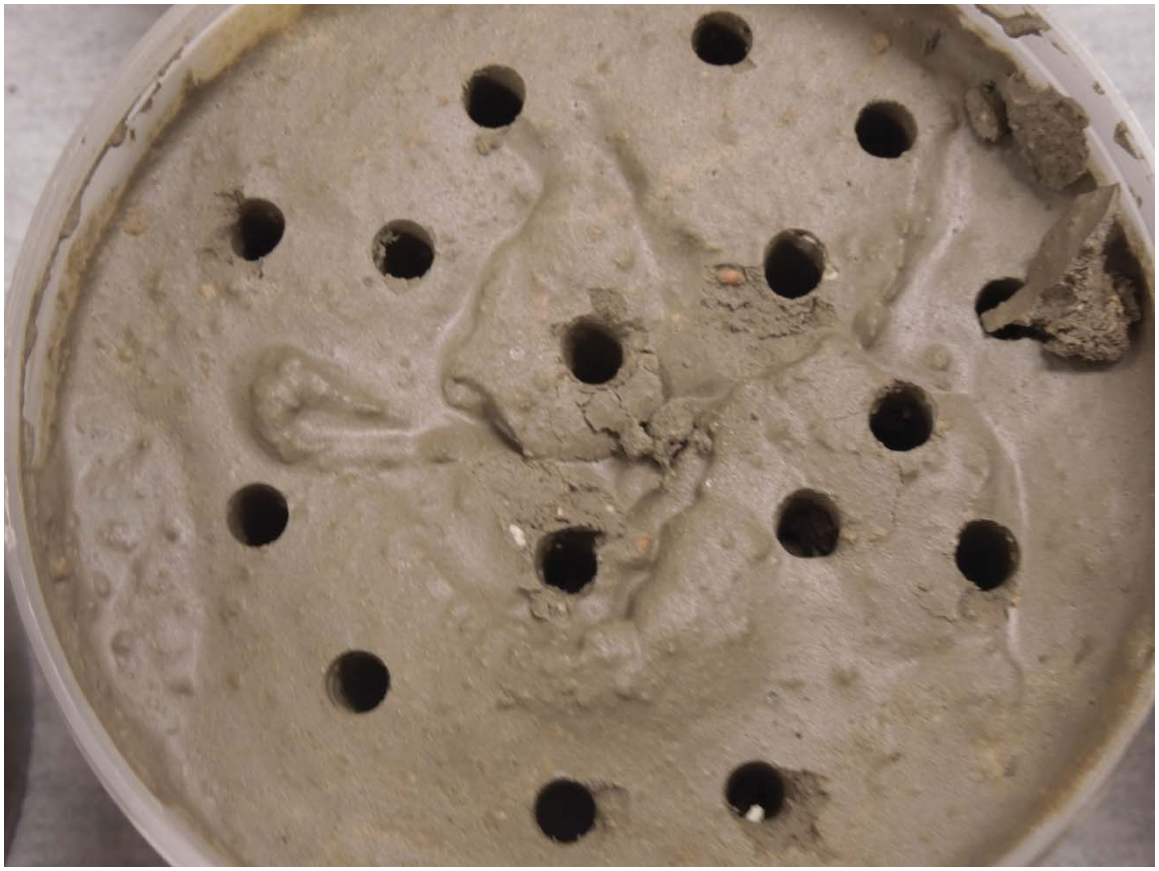


Image 39: Cement 9 Day 9



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

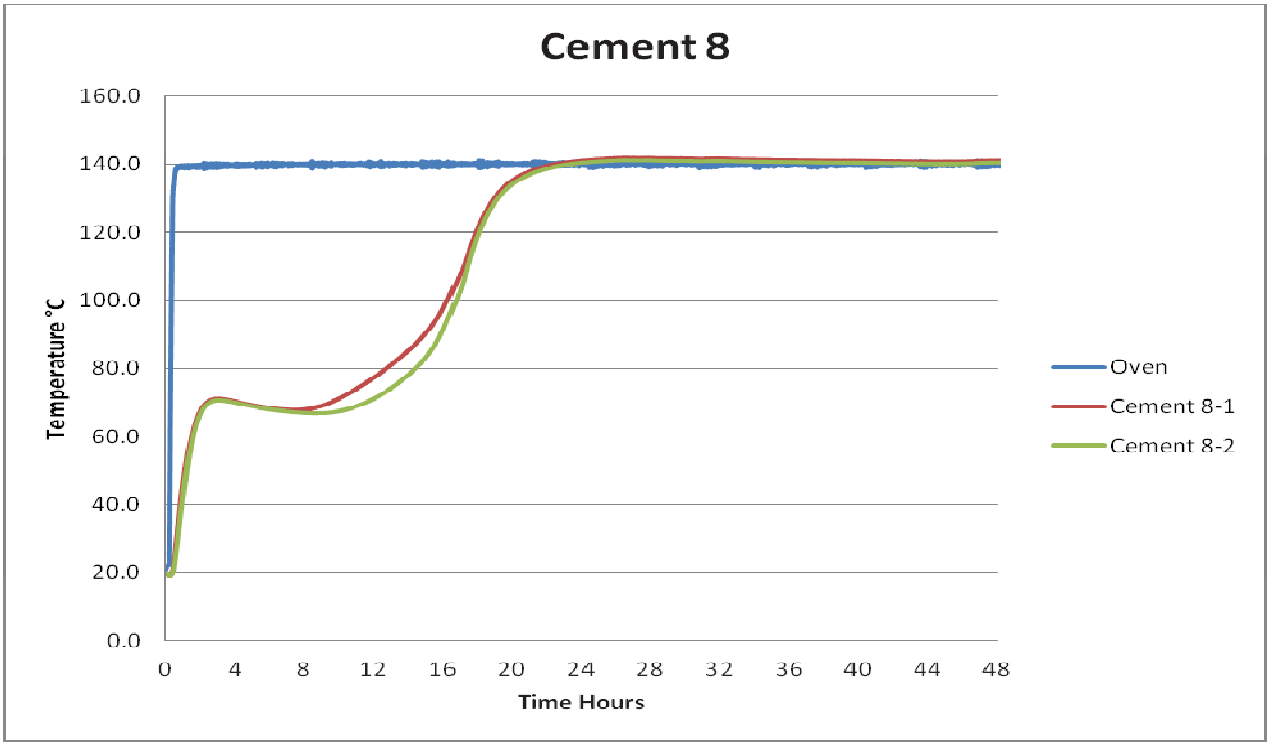


Figure 1. Method 1050 – Temperature of Cement 8 (100 mm cube) after ten days of setting and observations.

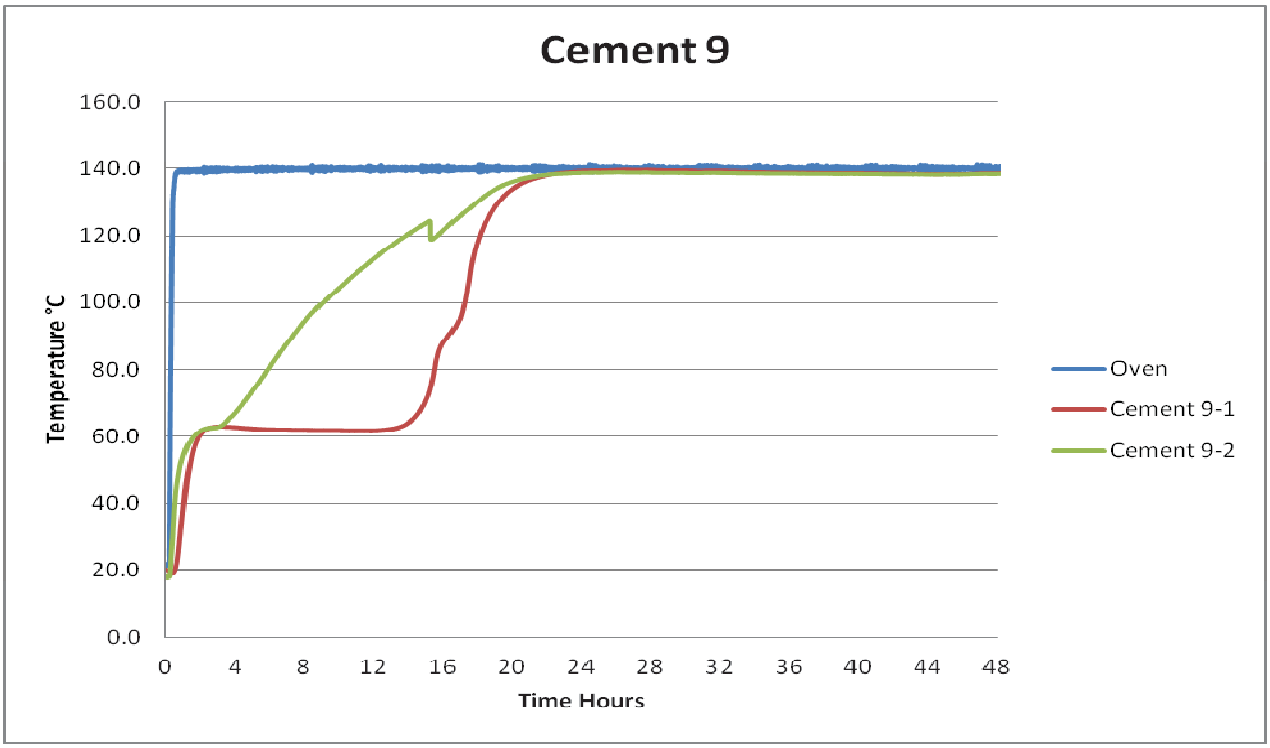


Figure 2. Method 1050 – Temperature of Cement 9 (100 mm cube) after ten days of setting and observations.

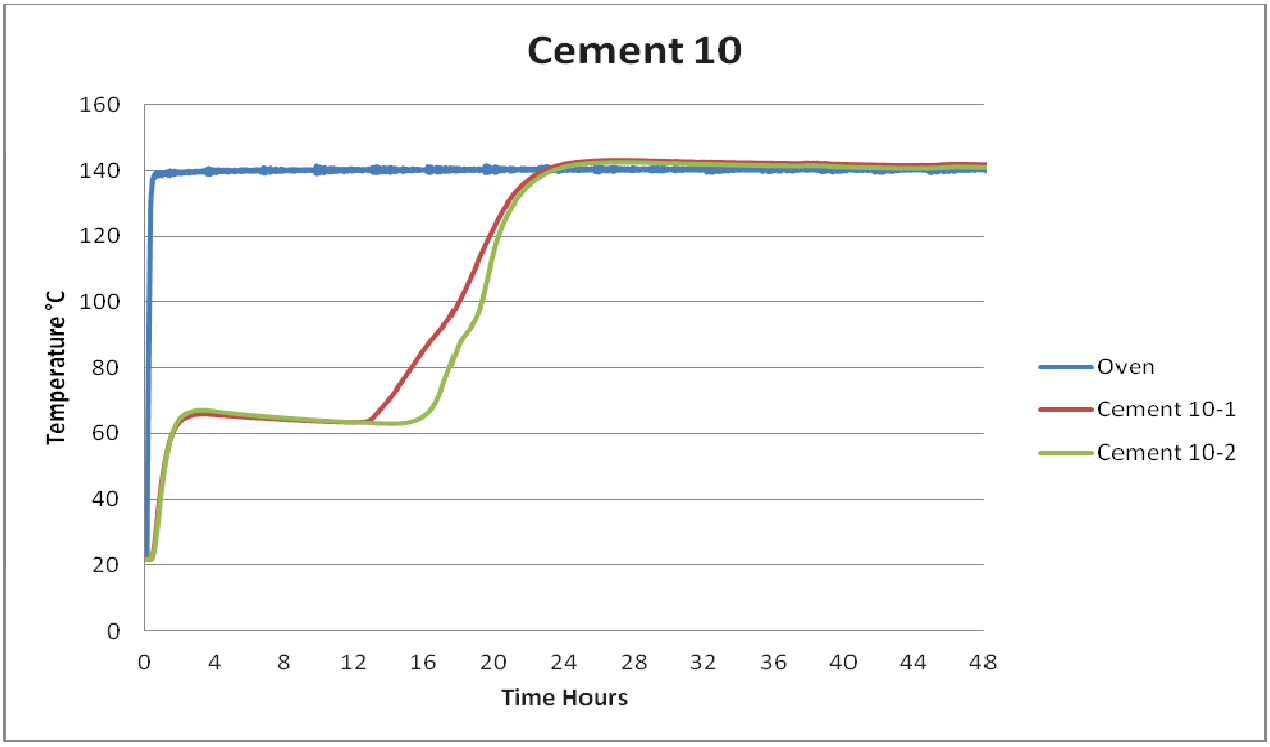


Figure 3. Method 1050 – Temperature of Cement 10 (100 mm cube) after ten days of setting and observations.

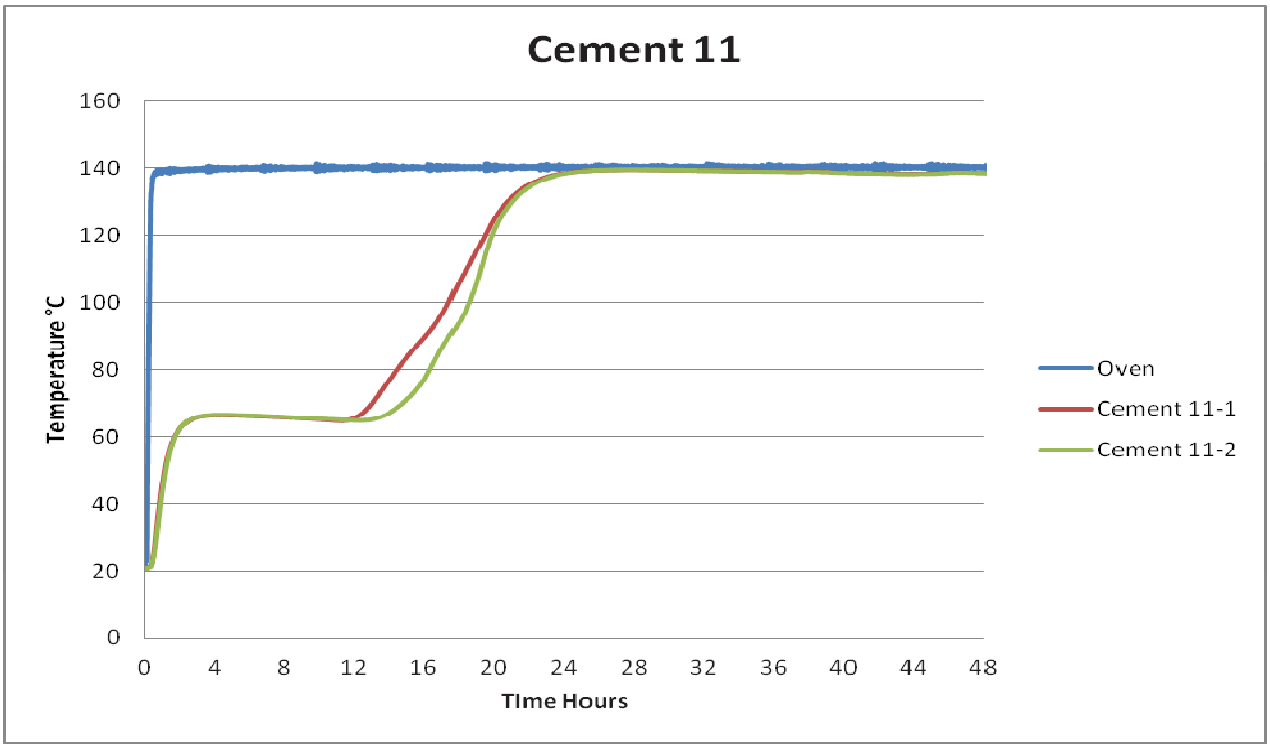


Figure 4. Method 1050 – Temperature of Cement 11 (100 mm cube) after ten days of setting and observations.

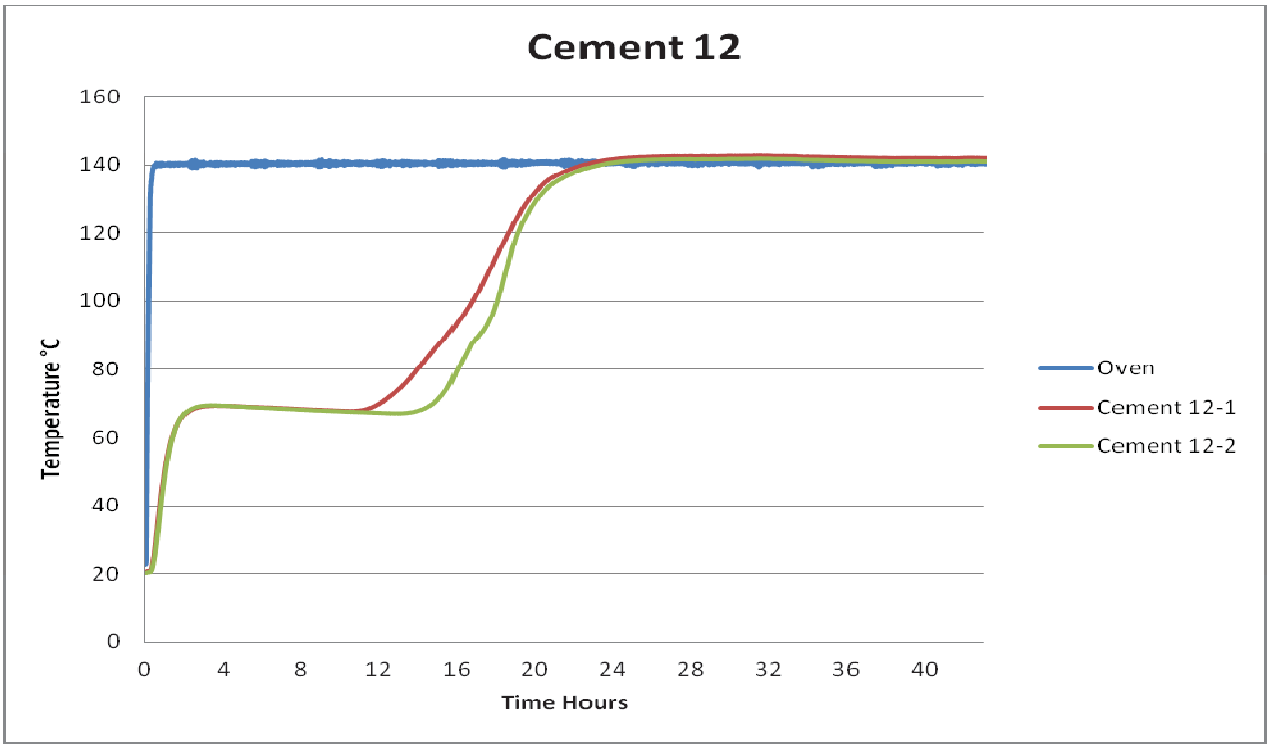


Figure 5. Method 1050 – Temperature of Cement 12 (100 mm cube) after ten days of setting and observations.

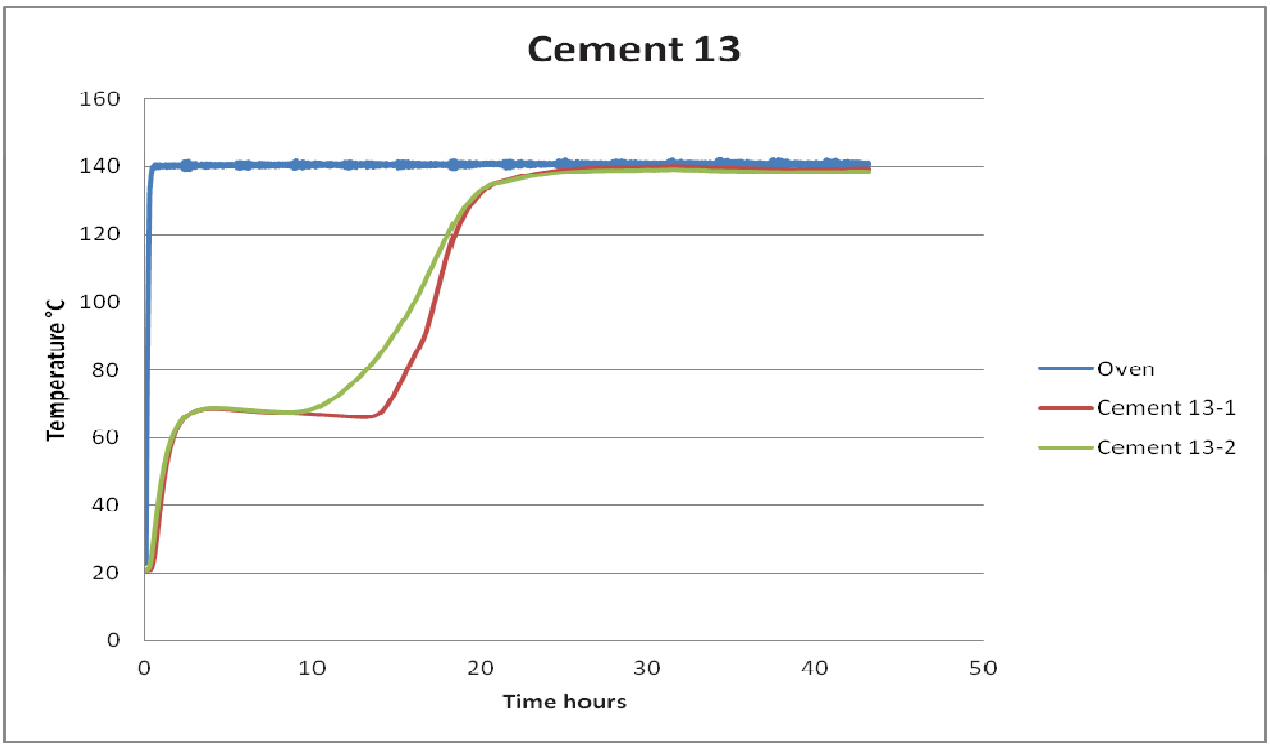


Figure 6. Method 1050 – Temperature of Cement 13 (100 mm cube) after ten days of setting and observations.

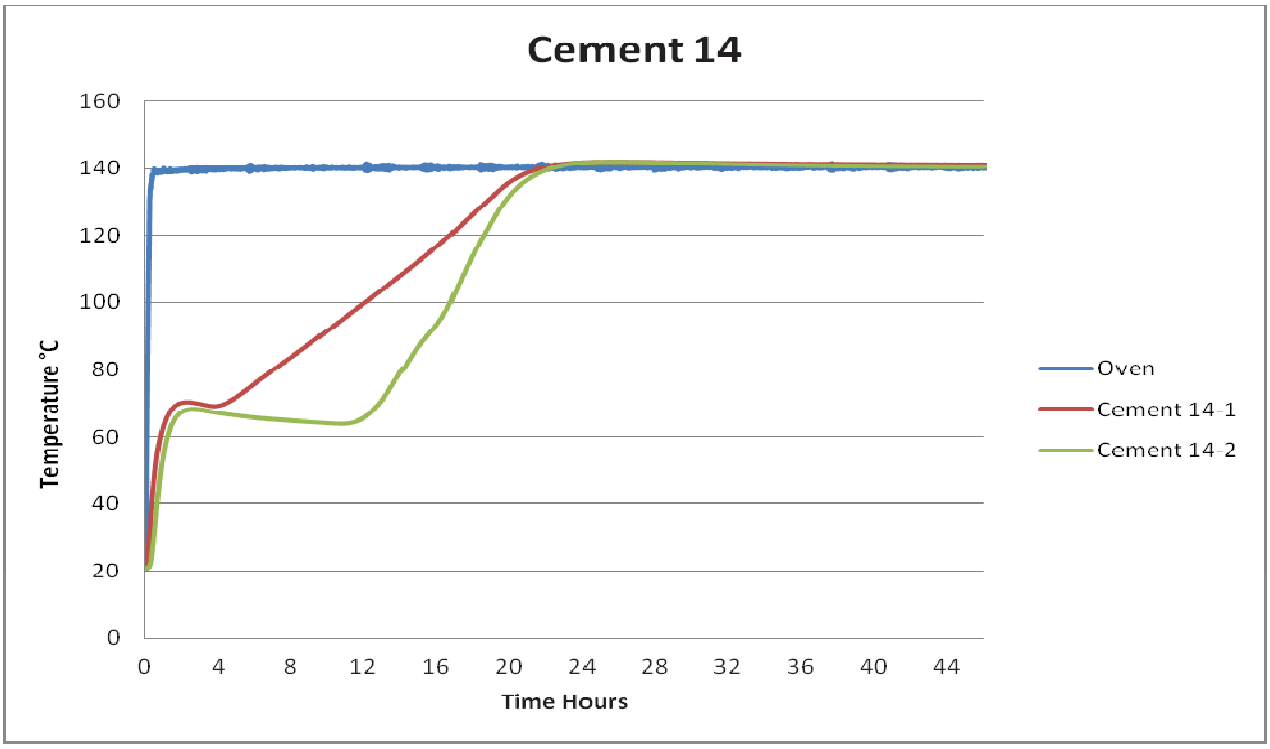


Figure 7. Method 1050 – Temperature of Cement 14 (100 mm cube) after ten days of setting and observations.

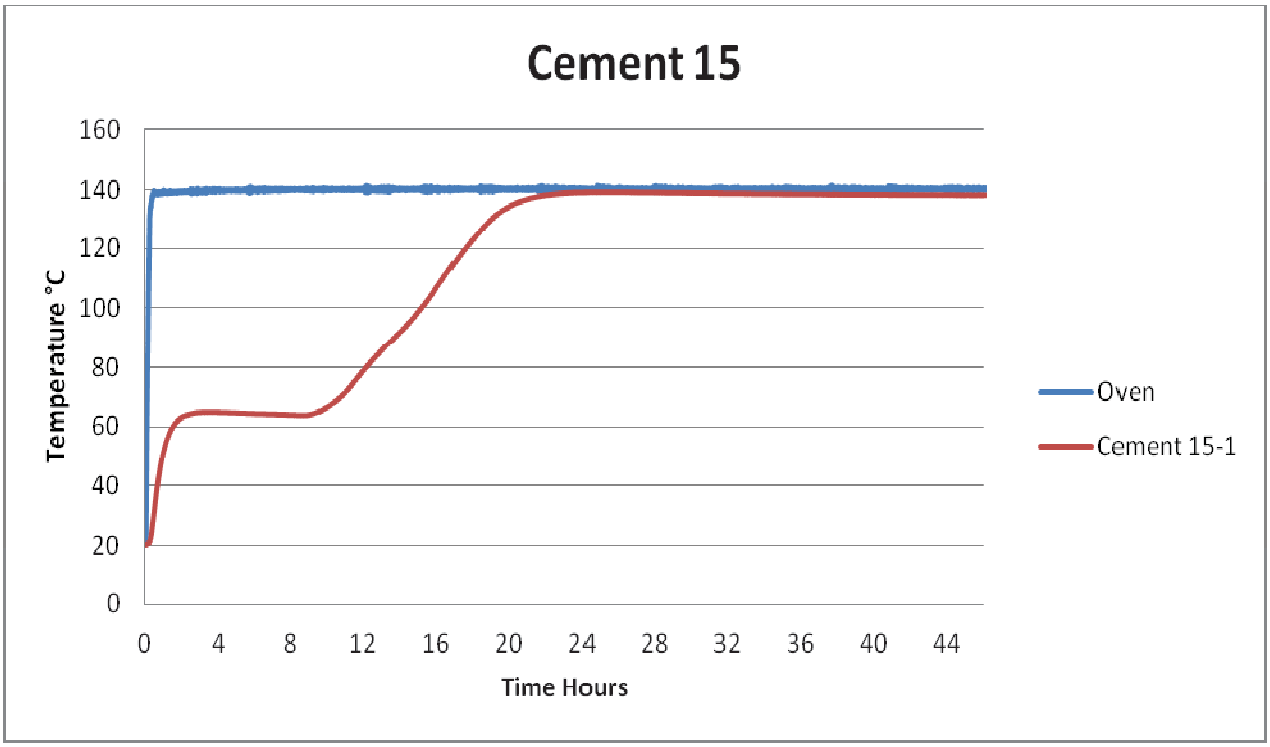


Figure 8. Method 1050 – Temperature of Cement 15 (100 mm cube) after ten days of setting and observations. One thermocouple came out of the sample during the analysis so only data from the one was used.

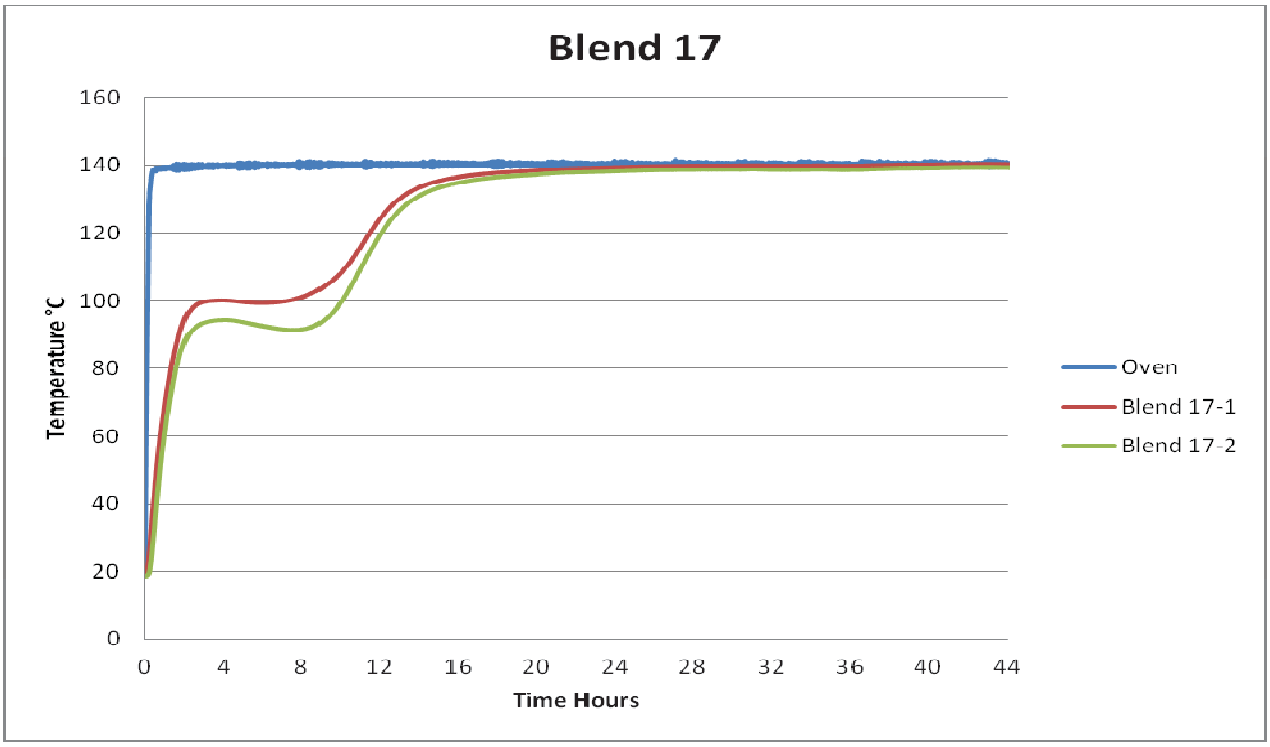


Figure 9. Method 1050 – Temperature of Blend 17 (100 mm cube)



Figure 10. Method 1050 – Temperature of Blend 18 (100 mm cube)



Figure 11. Method 1050 – Temperature of Blend 19 (100 mm cube)

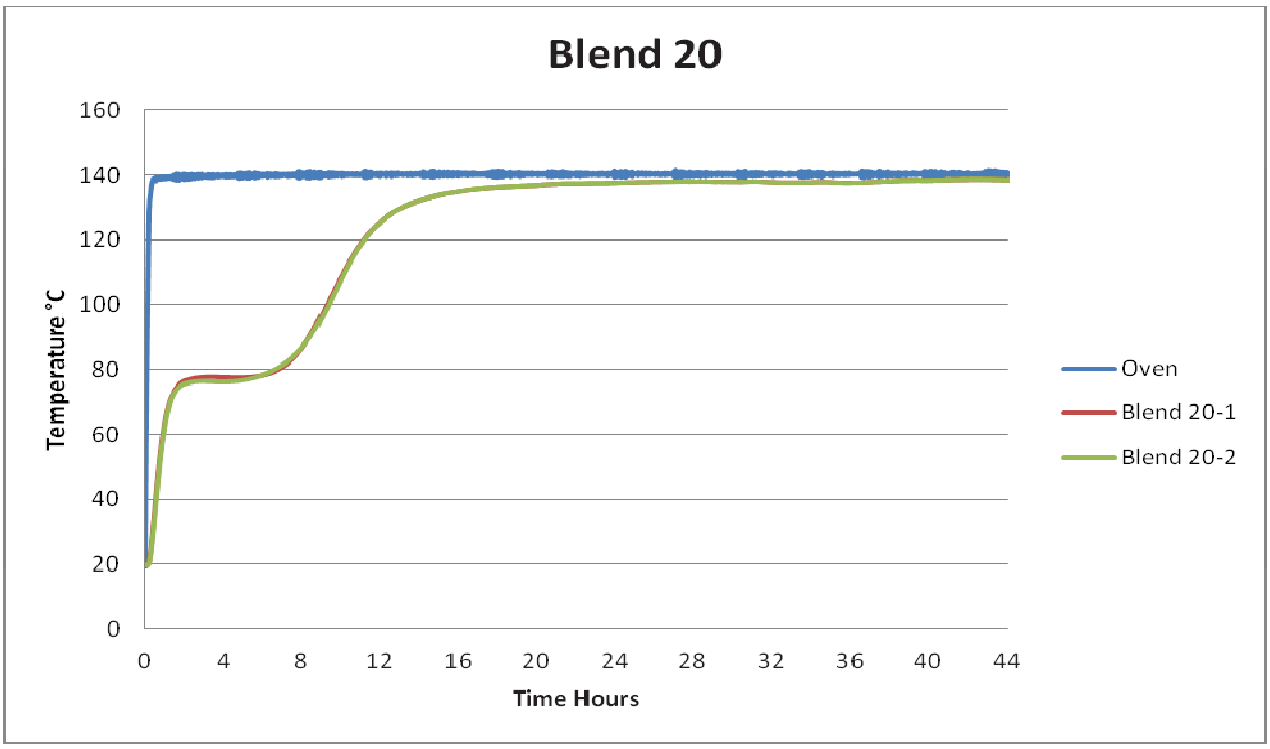


Figure 12. Method 1050 – Temperature of Blend 20 (100 mm cube)

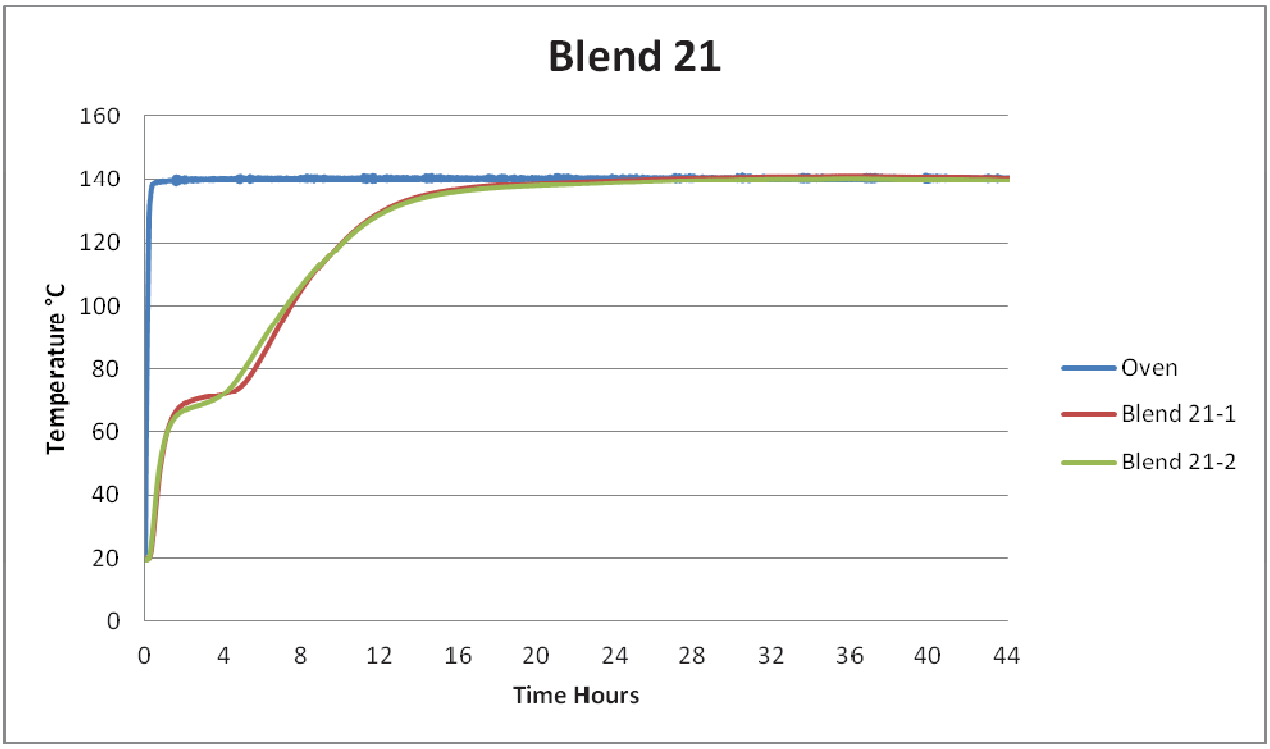


Figure 13. Method 1050 – Temperature of Blend 21 (100 mm cube)

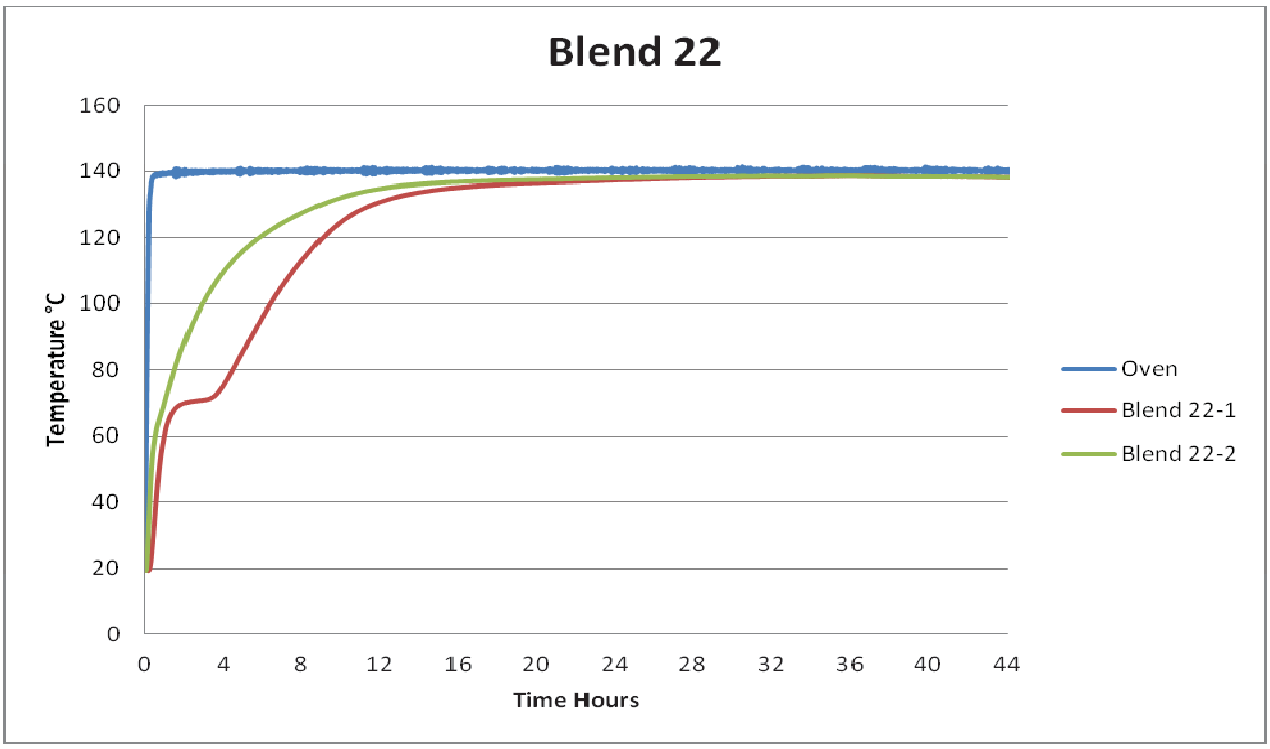


Figure 14. Method 1050 – Temperature of Blend 22 (100 mm cube)

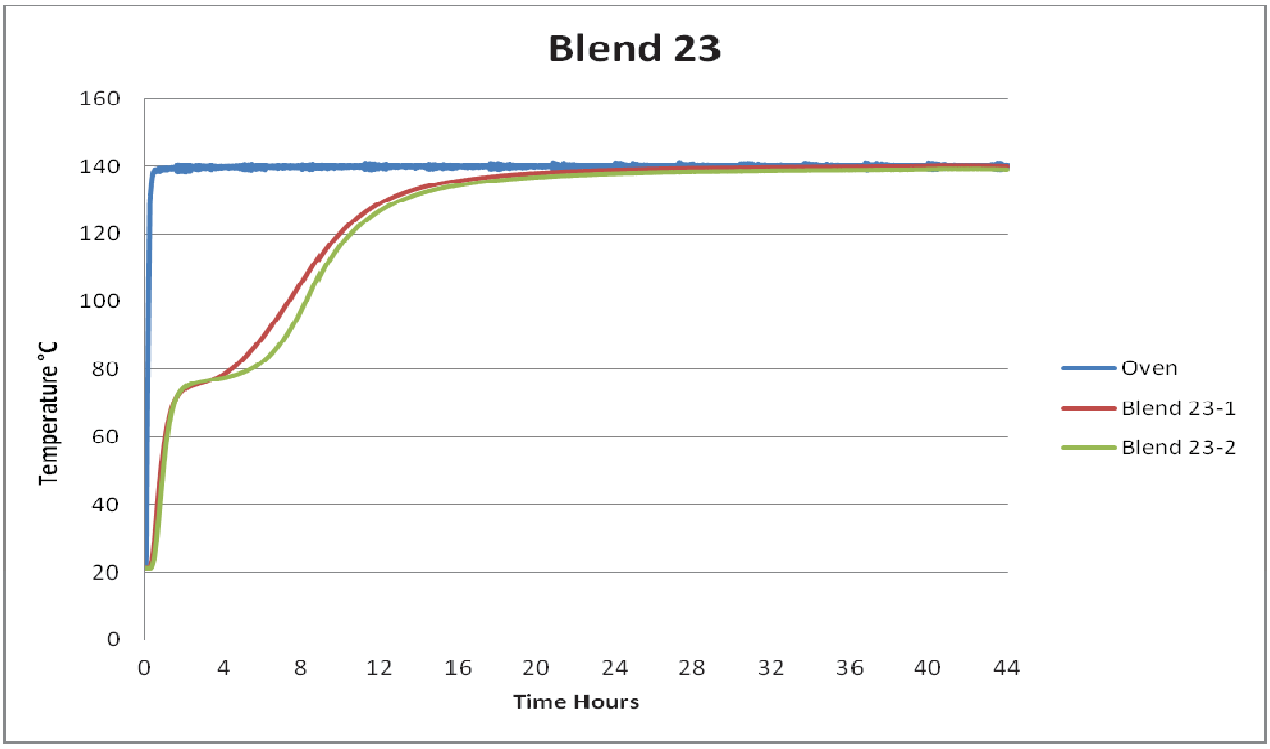


Figure 15. Method 1050 – Temperature of Blend 23 (100 mm cube)

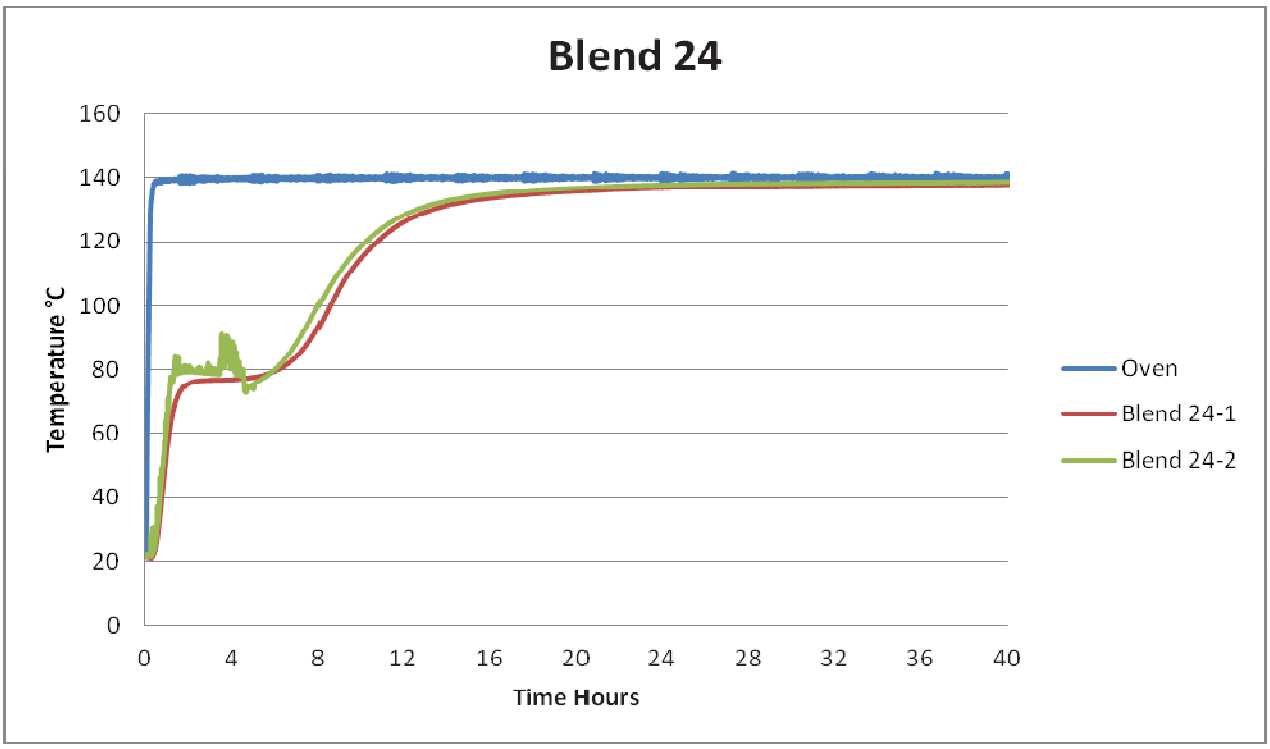


Figure 16. Method 1050 – Temperature of Blend 24 (100 mm cube)

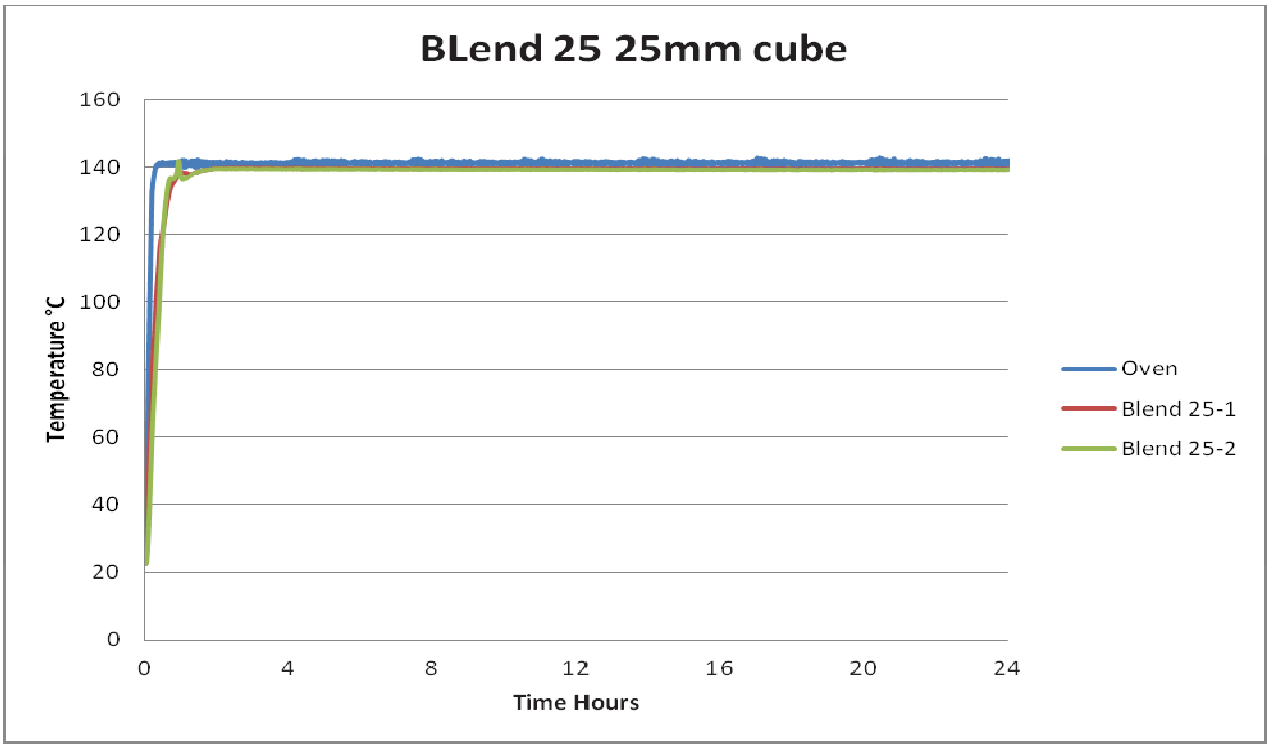


Figure 17. Method 1050 – Temperature of Blend 25 (25 mm cube). Since no event occurred sample was then analyzed in the 100 mm cube.

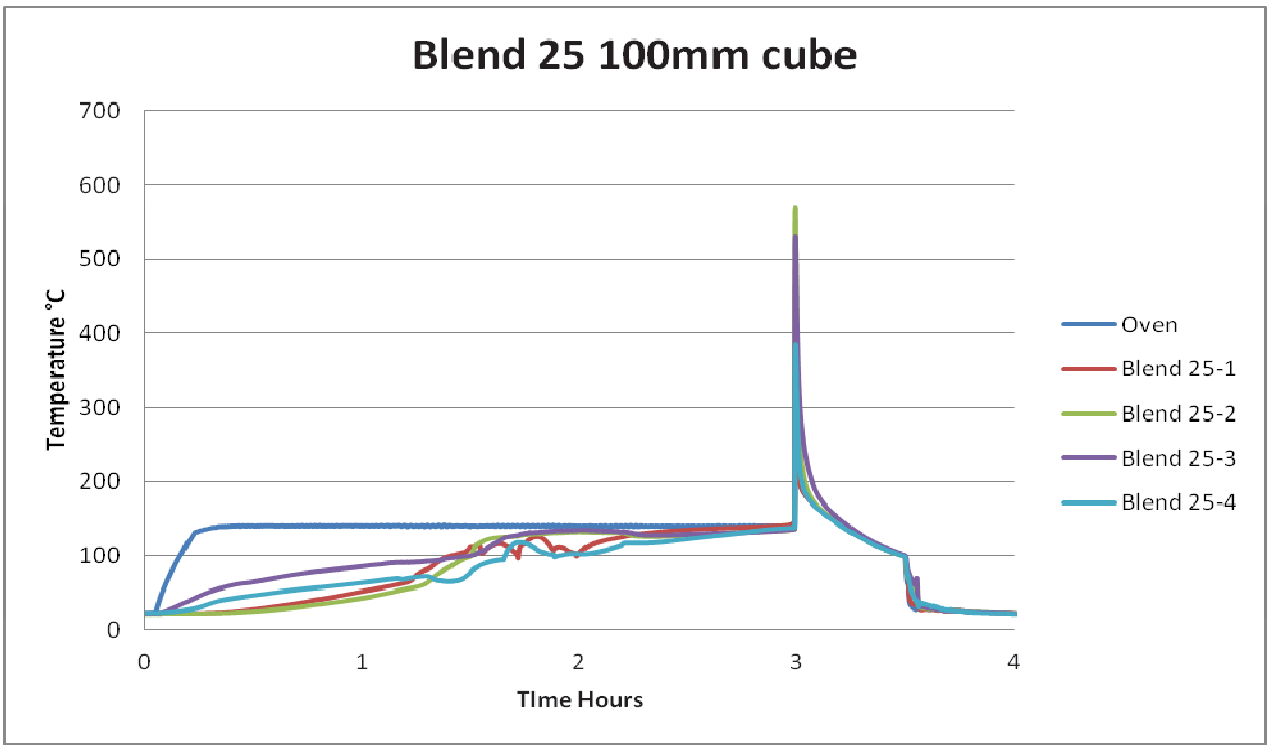


Figure 18. Method 1050 – Temperature of Blend 25 (100 mm cube). An event occurred at around 3 hours as the sample was just reaching 140°C. All sample and oven thermocouples exceeded 200°C.

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 #: 21592.01.006
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
4:1	2	24.0070	6.0142	>180 *	around wire
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
1:1	2	15.0036	15.0034	>180 *	around wire, no flame
1:1	3	15.0077	15.0054	718	+ 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. @ 65°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 3mins/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# le1128 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 lone 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 #: 21592.01.0006
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

Southwest Research Institute 010107

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	>180 *	No flames, charring only around wire, light smoke
4:1	2	24.6052	6.0058	>180 *	
4:1	3	24.0205	6.0188	>180 *	
4:1	4	24.0018	6.0061	>180 *	
4:1	5	24.6022	6.0033	>180 *	
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	24.6003	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# 61128 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	120.06	
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 (ef 12/21/15 mc)	Burning Time, sec	Comment
1:1	1	15.0155	~~6~~ 15.0018	181.20	flames + charring around around
1:1	2	15.0011	15.0034	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# 611128 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 11 (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

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 cut 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	100.22	
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 V

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 Grabalden Balance#: 135 Date: 12/23/15
Tested Samples: Monica Grabalden 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	24.6008	6.0019	>180 *	wire, light smoke
4:1	3	24.0035	6.0020	>180 *	↓
4:1	4	24.6041	6.0051	>180 *	↓
4:1	5	24.6011	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	15.6121	15.6047	180.38	smoke. flames didn't propagate
1:1	3	15.6101	15.6122	180.43	↓
1:1	4	15.0043	15.6017	180.26	↓
1:1	5	15.6037	15.6036	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# le5519 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	6.0002	>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 ~~if~~ WO initials mh left on for full 3min/180sec.

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	12.0075			
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 #: 21592.01.006
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: >4 hrs. @ 105°C
Variac Setting: 150 ± 7 W

Not Division 5.1

Southwest Research Institute 010120

Method: UN Oxidizer
Project #: Z1592.01.006
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 #: 21592.01.006
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 flam
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	>240	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 pow
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# L5519 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.

Not Division 5.1

Southwest Research Institute 010123

Method: UN 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~~ RE 11510 mg 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# 165519 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: Flame propagated after power turned off
1:1	1	15.0121	15.0057	7240	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

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 34 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# 6 5519 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: 12hrs 65°C
Cellulose: Inorg# 161704 Dried: 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
4:1	2	24.0651	6.0092	45.53	and smoldering. Timer stoped after major flame
4:1	3	24.0791	6.0269	62.44	and sparking subsided. Remaining sample after
4:1	4	24.0671	6.0203	47.37	analysis was ashlike
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 Moken Balance#: 88 Date: 1/14/16
Tested Samples: James Moken Timer ID: 80494M6 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# 151222-14

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 past burn point	propagation past burn	flame	time over 100mm	burn rate mm/sec
LCS	Yes	Yes	Yes	11.18	8.94
Cement #8	No	No	No		
Cement #30	No	No	No		
Cement #9	No	No	No		
Cement #10	No	No	No		
Cement #11	No	No	No	cement turned a drier 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: [signature] Date: 12/17/15

Reviewed by: [signature] Date: 1/20/16

Southwest Research Institute®
Logbook: Physical Testing

010131

Analysis / Method: 1030 Project# 21592.01.006

Client: LANL TO# 151222-H

LCS Info: excelstor 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 past burn point	Propagation past 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.	
Blend 24	NO	NO	NO	became white at the burn point	
Blend 25	NO	No	No	sample bubbled and oozed to the back of the plate	
UNS Blend #2	No	No	No	burned and nibbled 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 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: [signature] Date: 12/31/15

Reviewed by: J Rapues 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: 12/20/15 12/17/15 WO JAM

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:	14:47 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 occurred 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	1251 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	1-1-16 (Team 7116)	
(X) Data lost during "saving". Void.					
Calculation:					

Analyst Signature: Jana Mer 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
Blend 22 ✓ RE

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. 1/6/16

Work continued to Page

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 remaining 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 remaining 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 594.9 g mix and let sit 1 hr
10:00 - 11:00 added 360g NaOH pH 9.12 added remaining 90mL DI H_2O let sit and then added 1200 g cement. mixed and poured into plastic containers
balance #05

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DATE 12/31/16

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DATE

WITNESS

DATE 1/20/16

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SWRI

199-01-WC811 Cement #9 010140

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 1hr 10:00 - 11:00 added 72.8 g NaOH pH 8.99. added remaining 327.6 g DI H2O 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 1hr 10:00-11:00 added 106 g NaOH pH 9.11. added remaining 271 g DI H2O 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 1hr 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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SIGNATURE James Green DATE 12/3/16

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 1/20/16

200-01-WCS11 cement #13

WB8: Swheat 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: Swheat 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: Swheat 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

Work continued from Page

SWRI

010142

205-01-WC011 WB8

4.2963

TE SAM 12/10/15 ~~21.145~~ 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

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SIGNATURE DATE 12/10/15

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 1/20/16

1:3 WB8 : Sulfoxaflor - 206-01-WCS11

(205-01-WCS11)
400mL WB8 to 1200 mL Sulfoxaflor tray #11

1:4 WB8 : Sulfoxaflor 206-02-WCS11

(205-01-WCS11)
300mL WB8 to 1200mL Sulfoxaflor tray #6

placed on hotplates @ 60°C to dry
Starting at 15:30
12/10/15

1:1 WB8 : Sulfoxaflor

(205-01-WCS11)
400mL WB8 to 400mL Sulfoxaflor tray #12

JAM 12/13/15

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 let sit for 24 hrs. 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 24 hr. 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 12/16/15 9:00

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 to Page

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SIGNATURE

DATE 12/14/15

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DATE

WITNESS

DATE 1/20/16

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 F.V. 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 TEXAM 12/16/15 L2-5 01-WCS12 5 TEXAM 12/16/15
~~500~~ mL WB8 to ~~1000~~ mL solvent mixed and then placed on a hotplate @ 60°C for 4 days. 3 days 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 & granola.

SAM 1/20/16

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SIGNATURE James Grab DATE 12/16/15

DISCLOSED TO AND UNDERSTOOD BY D Davies 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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Work continued to Page

SIGNATURE

DATE 12/28/15

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE 1/20/16

Work continued from Page

010147

SWRI

18-01-WCS12 1:1 Swheat:Salt(WB38)

4 1/4/16 RSS PG 400mL WB38 (205-01-WC0011) + 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 ~~1/4/16~~ RSS 1/4/16
off hotplate 10:15am 1st 1/5/16 removed saran wrap and placed in forced air oven #35 @ 60°C ~~to~~ RSS 1/5/15 to dry a bit more.

Removed from oven @ 4:30pm 1/5/16 to make blends

18-02-WCS12
Blend 17

500mL of 1:1 swheat/WB38 (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/WB38 (18-01-WCS12) + ~~250mL~~ 250 RSS 1/5/16 DI mixed for 5min. Took 420mL of this + ~~mL~~ 1/5/16 mixed with 840mL zeolite. Hand mixed. @ 6PM let sit 24hrs.

* 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	18:30 TE JAM 12/14/15	12/2/15
		9.	264	264		"	"		
		10.	204	273		"	"		
10		11.	246	246	New bag ~~Sheet~~ 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 WB8 & Sunheat in a glass Pyrex tray.

2. Distribute evenly on tray ~~Wrap with Al foil~~ 12/1/15 Cover with Saran wraps 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

35

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SIGNATURE DATE 12/1/15

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 1/4/16

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	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 1732	DRmZ	✓	✓ 18.0	36926.7	✓
12/1/15 1811	DRmZ	✓	✓ 18.0	36930.8	✓
12/7/15 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 1802	DRmZ	✓	✓ 18.0	36979.4	✓
12/15/15 1836	DRmZ	✓	✓ 18.0	36982.3	✓
12/16/15 1832	DRmZ	✓	✓ 18.0	36989.5	✓
12/17/15 1812	DRmZ	✓	✓ 18.0 12/17 DRmZ	~~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

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 naught error.
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 changed
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	JCH	199.9994	1.99996	0.02001
11/25/15	KE	199.9998	1.99999	0.01999
11/28/15	SAM	199.9996	1.99999	0.02001
11/30/15	JCH	199.9996	1.99996	0.02001
12/1/15	SAM	199.9995	1.99992	0.02002
12/2/15	JCH	99.9996	2.00007	0.01998
12/3/15	SAM	199.9995	1.99998	0.01997
12/4/15	SAM	199.9995	1.99999	0.01998
12/5/15	SAM	200.0016	2.00000	0.02003
12/7/15	SAM	200.0016	2.00001	0.02001
12/8/15	SAM	199.9997	1.99998	0.01999
12-9-15	JK	199.9995	2.00003	0.01997
12/10/15	SAM	199.9998	1.99999	0.01999
12/11/15	SAM	199.9998	1.99995	0.01997
12/12/15	JCH	199.9999	1.99997	0.01999
12/13/15	JCH	199.9997	1.99999	0.02001
12/14/15	JCH	199.9997	1.99999	0.01997
12/15/15	MG	199.9999	2.00003	0.02000
12/16/15	SAM	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 SAM 199.9998 2.00009 0.02001
12/21/15 JCH 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 TESAM 12/28/15
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	TESAM 12/30/15 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 (ME) ~~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	1.99998 TESAM 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
Using 200g ID 015HZ

Southwest Research Institute®
Division 01, Building 70
Inorganic's Balance Verification Log

010154

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 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:

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

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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:	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

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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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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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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

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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.

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

010174

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		

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:	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

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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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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

010179

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		

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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
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

010180

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

010184

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

010186

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		

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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

010187

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

010189

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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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	10/1/2015

Approved By

Calibrated By: RRV
Metrology Technician

010191

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

010193

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

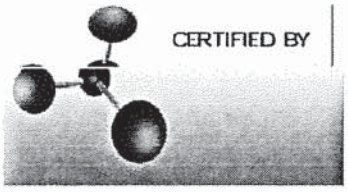
Certificate of Analysis

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

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



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: 61580

SwRI Chem ID: 62882

010197

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Outside USA: eurtechserv@sial.com

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.

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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

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SwRI Chem ID: 54983
SwRI Chem ID: 54983
SwRI Chem ID: 54983

SwRI Chem ID: 65583

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Website: www.sigmaaldrich.com
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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

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

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.

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

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

SwRI Chem ID: 63604

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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

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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SwRI Chem ID: 63604

SwRI Chem ID: 63604

Certificate of Analysis

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010204

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 DLV.16

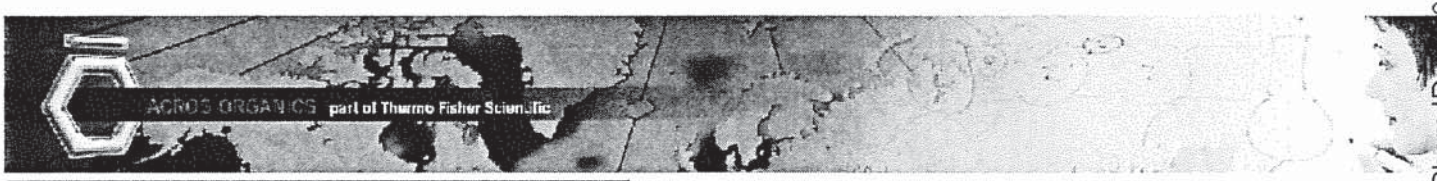
TEST	LOT 07030MH RESULTS
APPEARANCE	WHITE CRYSTALLINE POWDER
TITRATION	99.7% (WITH NAOH) *
ICP ASSAY	CONFIRMS SODIUM COMPONENT
INSOLUBLE MATTER	0.003% (20%, H2O) *
CALCIUM	0.003% *
CHLORIDE	0.0002% *
IRON	1 PPM *
HEAVY METALS	3 PPM (AS PB) *
IODATE	2 PPM *
MAGNESIUM	0.001% *
NITRITE	0.0005% *
PH	6.0 @ 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

SwRI Chem ID: 64108



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)	

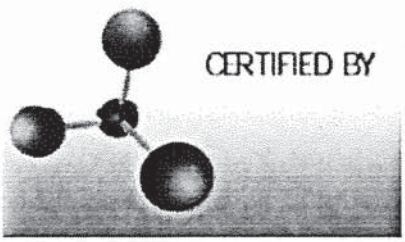
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Catalog Number	42385	**Quality Test / Release Date**	7 August 2014
Lot Number	A0350156	**Suggested Retest Date**	August 2019
Description	Lead(II) nitrate,ACS reagent		
Country of Origin	INDIA		
Declaration of Origin	synthetic		

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
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: 64108

SwRI Chem ID: 64108

SwRI Chem ID: 63608

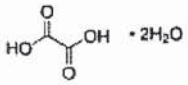
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Outside USA: eurtechserv@sial.com

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:	C2H2O4 · 2H2O
Formula Weight:	126.07 g/mol
Quality Release Date:	18 SEP 2014
Recommended Retest Date:	SEP 2019

SwRI Chem ID: 63608

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: 63608

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.

010207

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: 63608

Certificate of Analysis

Product Number: 247537
Batch Number: MKBS8637V

ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

SwRI Chem ID: 63608

SwRI Chem ID: 63608

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

010208

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:
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

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

010209

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: 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

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.

010210

SIGMA-ALDRICH®

sigma-aldrich.com

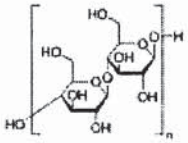
3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 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

SwRI Chem ID: 65519

SIGMA-ALDRICH®

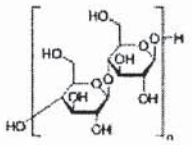
sigma-aldrich.com

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: 65519

SwRI Chem ID: 65519

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 H
SwRI Test Report, February 3, 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

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

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

010006

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

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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

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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

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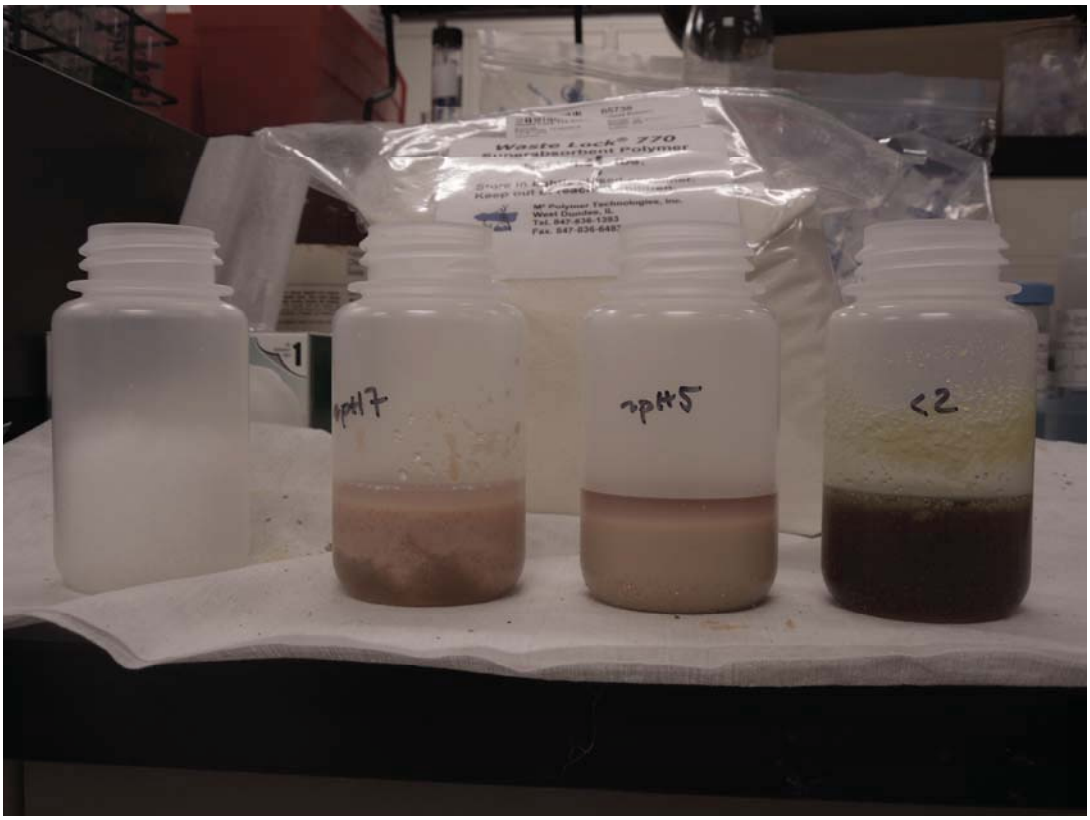


Image 1: UNS solutions with wastelock. Left was 50ml of water that was absorbed by the wastelock. The pH 5 and 7 UNS solutions had different volumes absorbed by the wastelock but free flowing liquid was still present in them. The <2 pH UNS solution had little to no absorption and the wastelock floated on the top surface.

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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.

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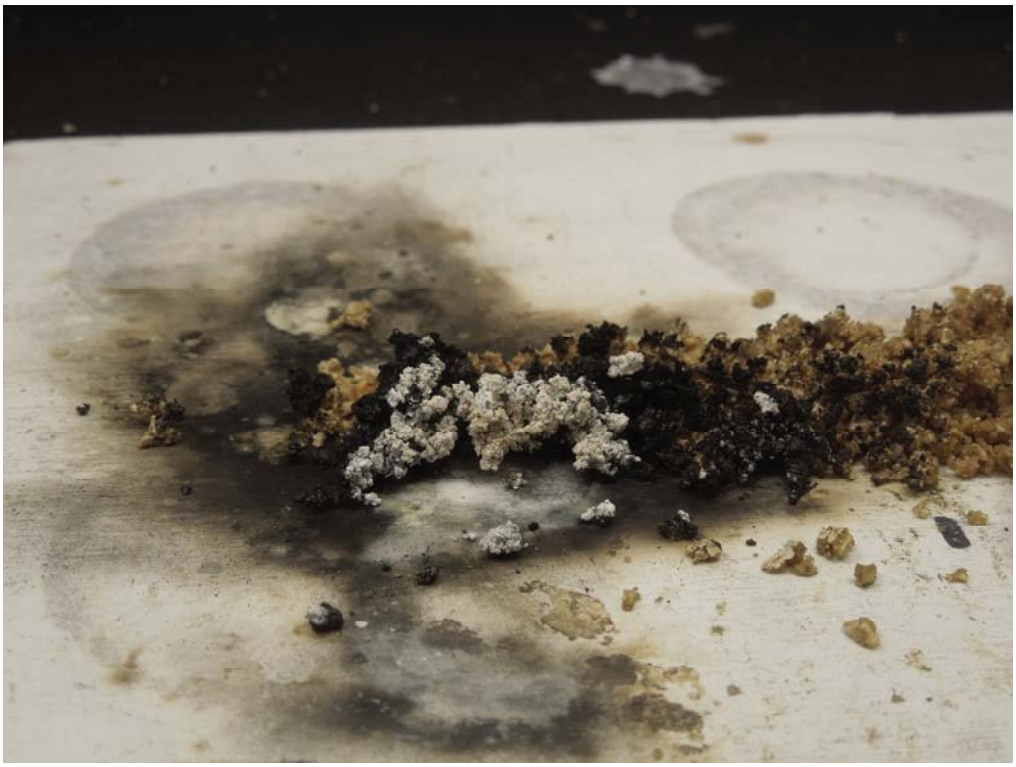


Image 4: (UNS Blend #3) Burn point and then the slight propagation of the flame past the point.



Image 5: (UNS Blend #4) Slight burning on the outside of the sample but very little past that.

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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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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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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.

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Image 12: (UNS Blend #2) 1050 25mm cube analysis showing the expanded sample during the analysis.

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Image 13: (UNS Blend #4) 1050 100mm cube analysis showing the inside of the oven coated in the black tarlike substance after analysis.

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Image 14: (UNS Blend #4) 1050 100mm cube analysis showing the inside of the oven coated in the black tarlike substance after analysis.

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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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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.

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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

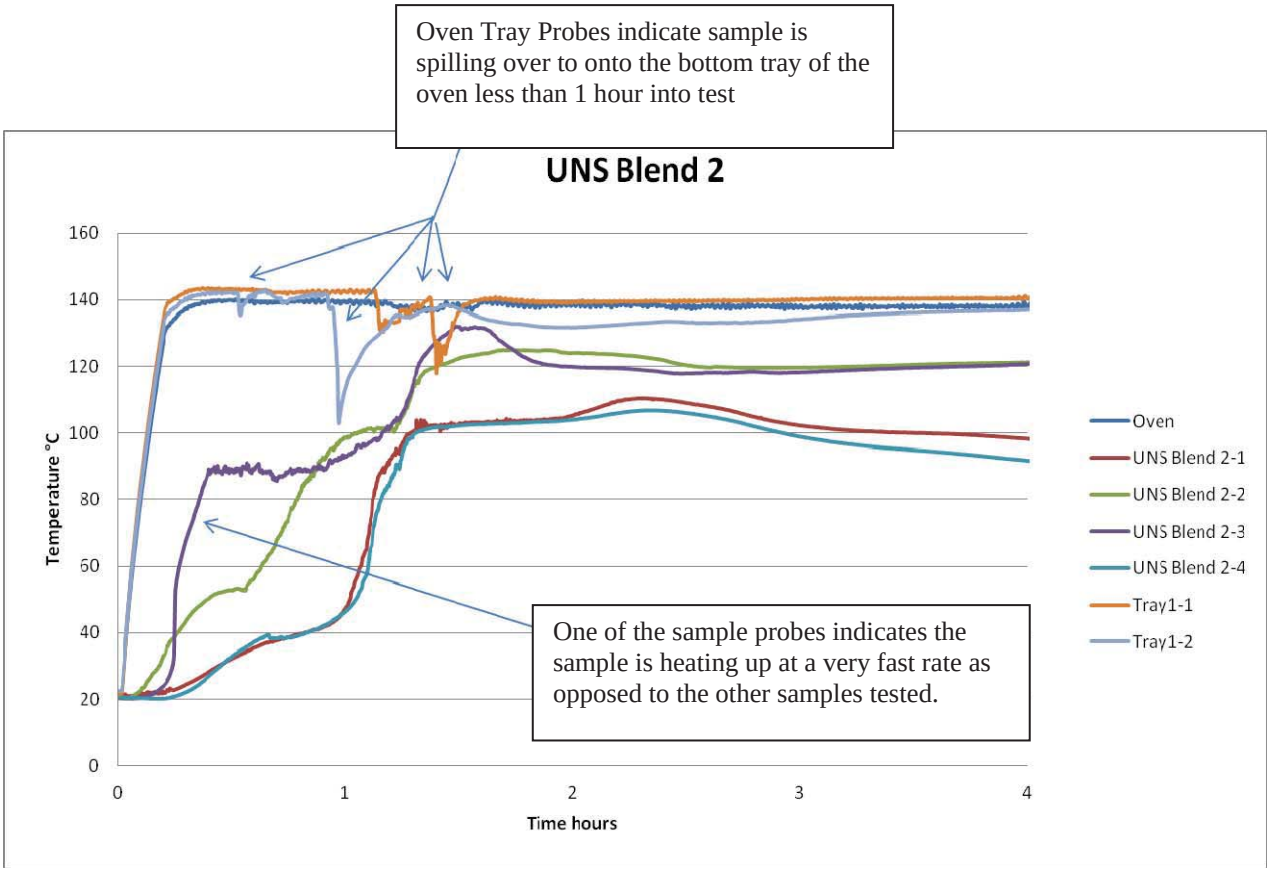


Figure 1. Method 1050 – UNS Blend 2 (100mm cube) event occuring during the first four hours of analysis.

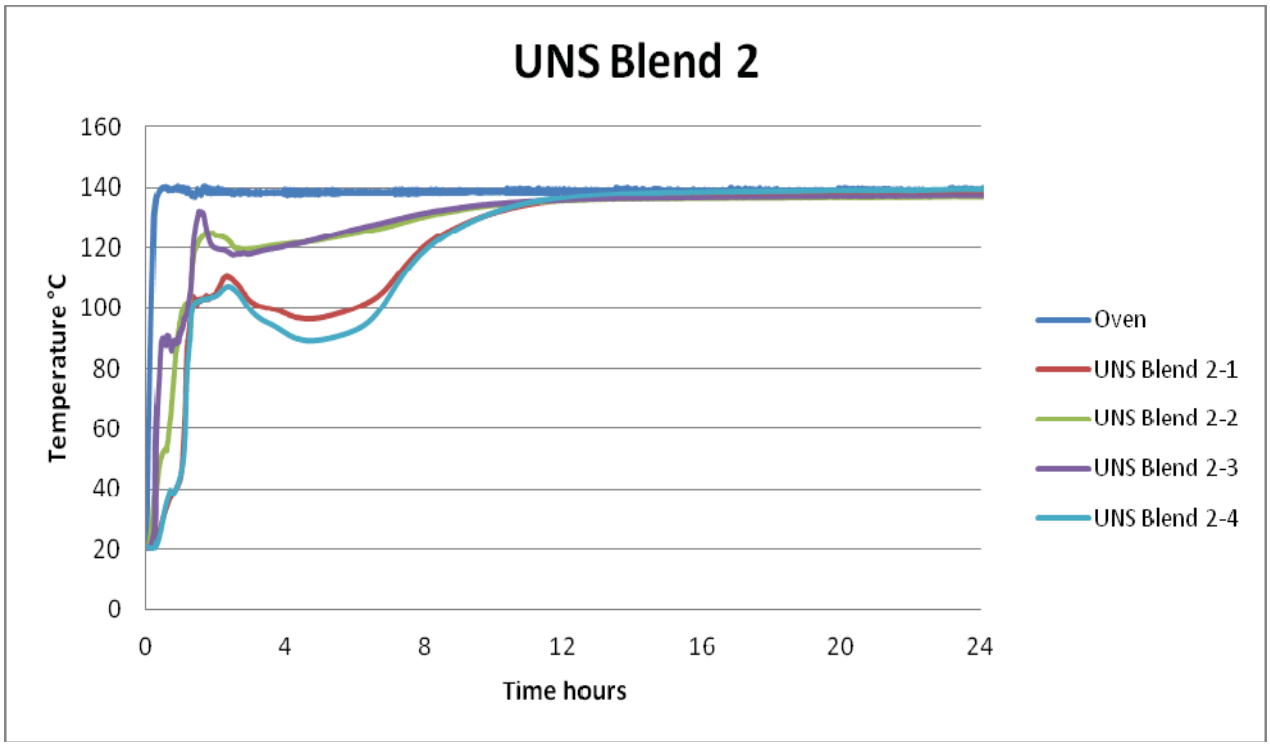


Figure 2. Method 1050 – Temperature of UNS Blend 2 (100mm cube) full run.

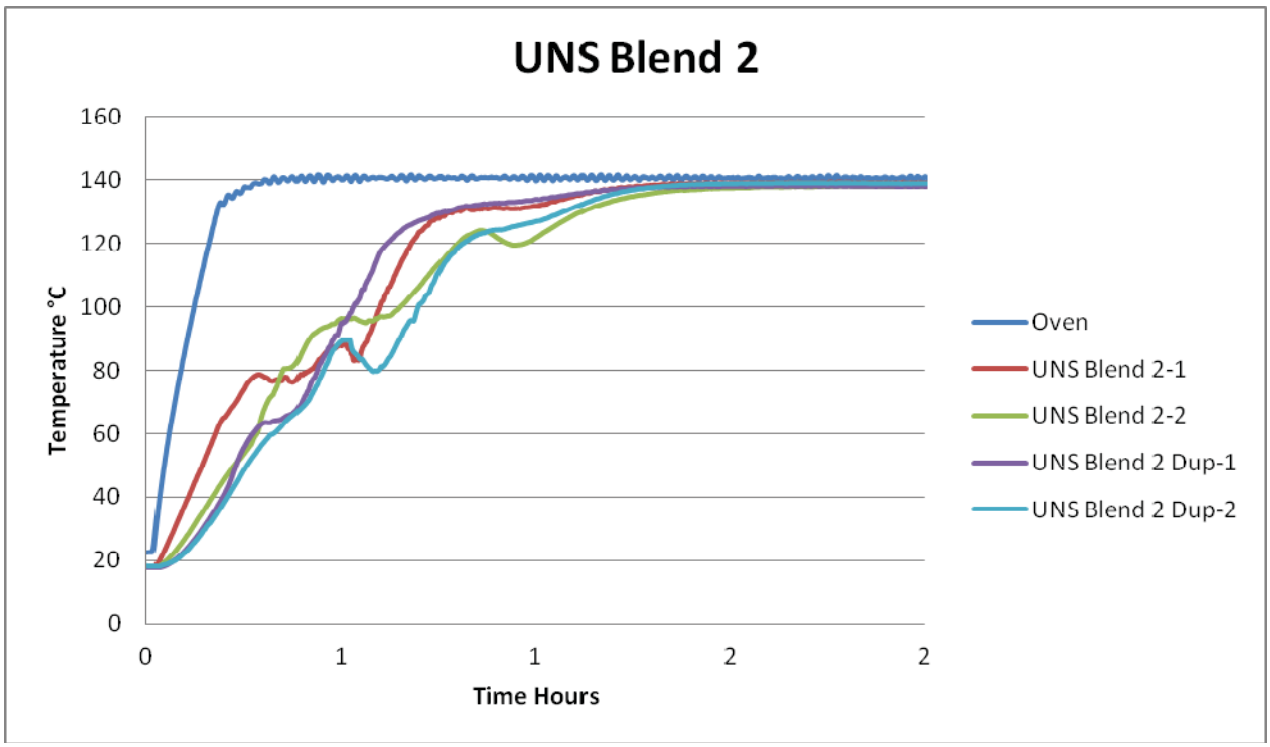


Figure 3. Method 1050 – Temperature of UNS Blend 2 (25mm cube) first two hours of the analysis show the sample heating and cooling as it expands out of the cubes.

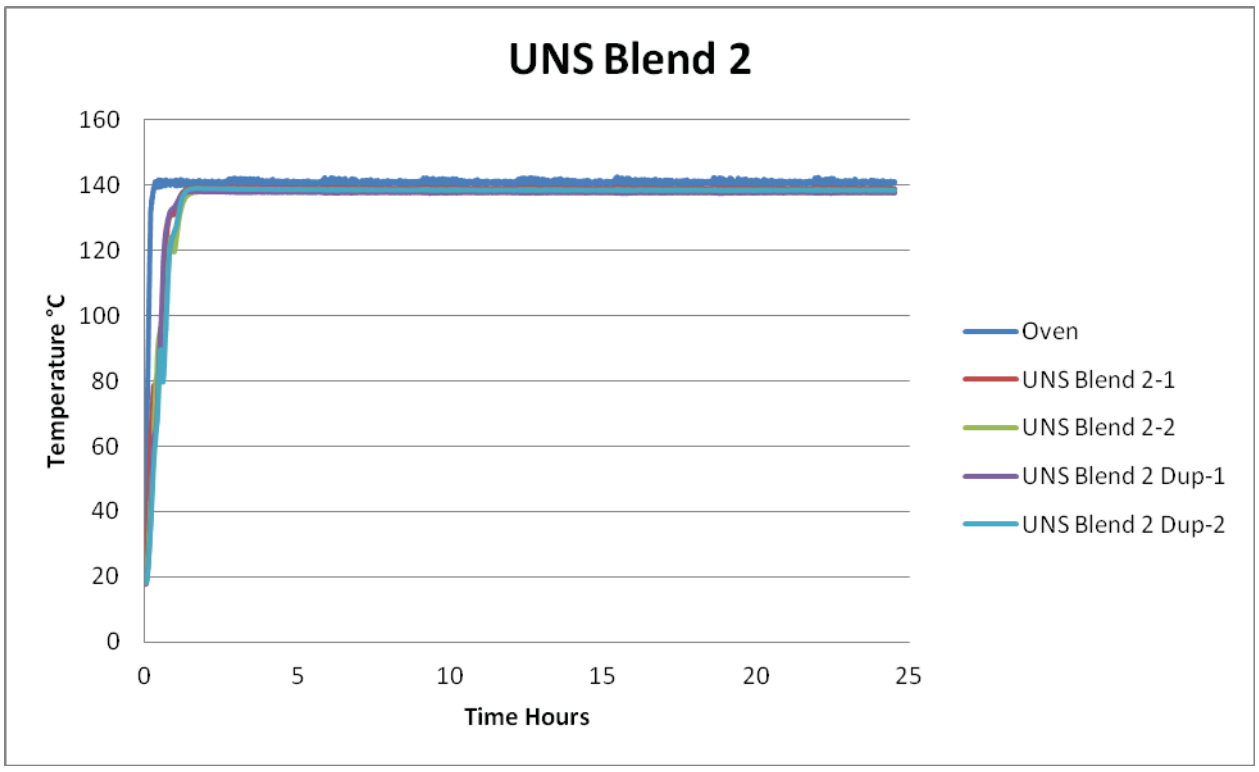


Figure 4. Method 1050 – Temperature of UNS Blend 2 (25mm cube) full run.

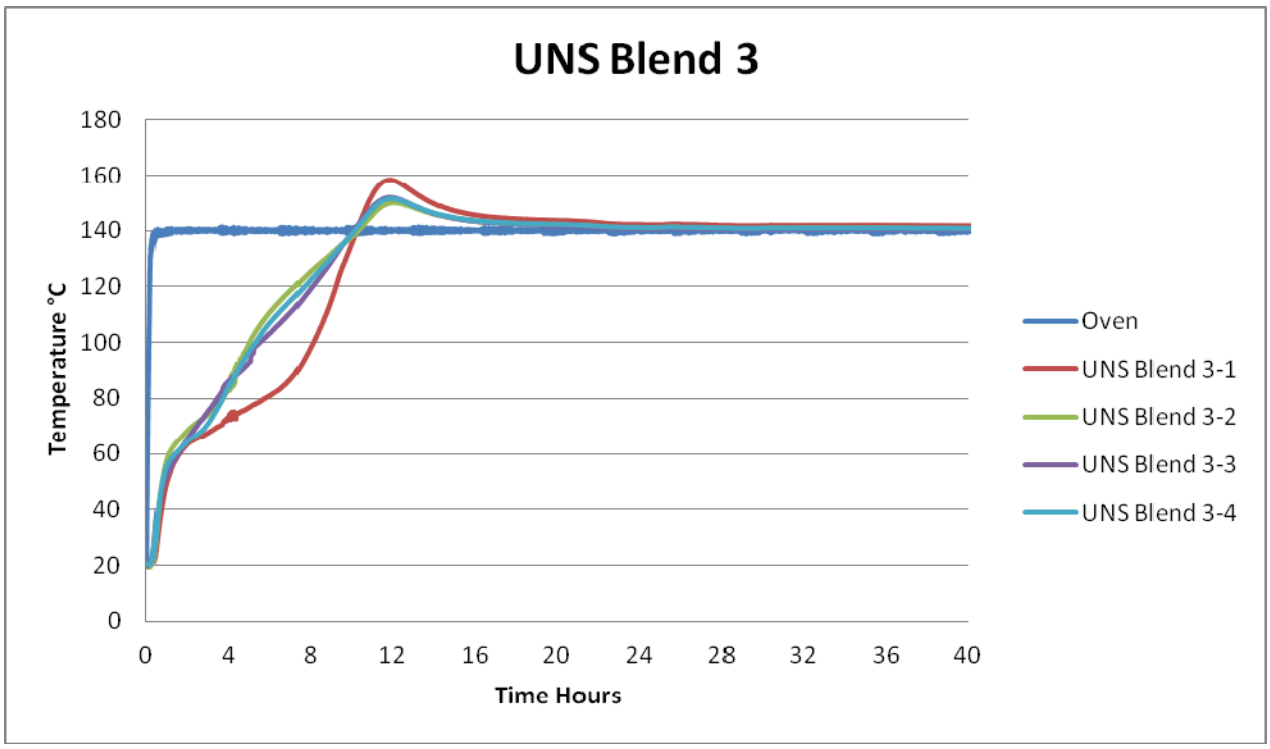


Figure 5. Method 1050 – Temperature of UNS Blend 3 (100 mm cube) slight self heating event occuring at hour 12.

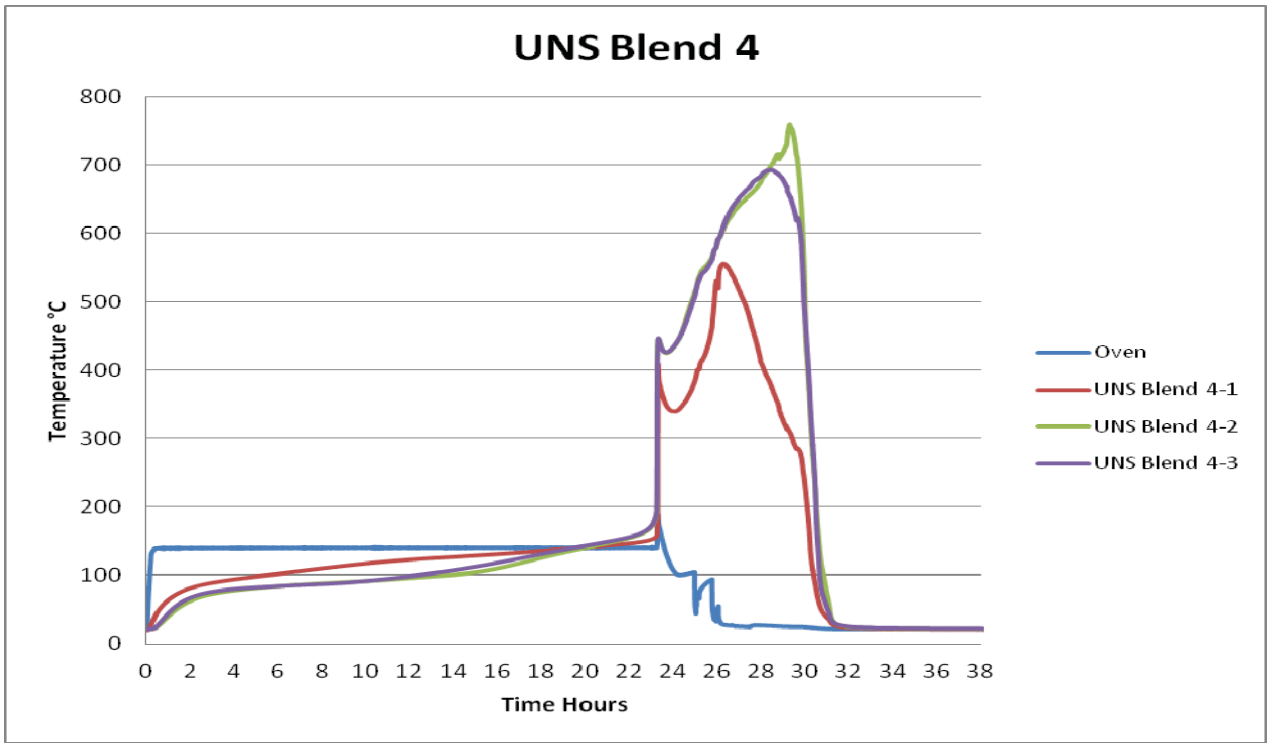


Figure 6. Method 1050 – Temperature of UNS Blend 4 (100mm cube) self heating event just before 24 hours and continuing for about 7 hours.

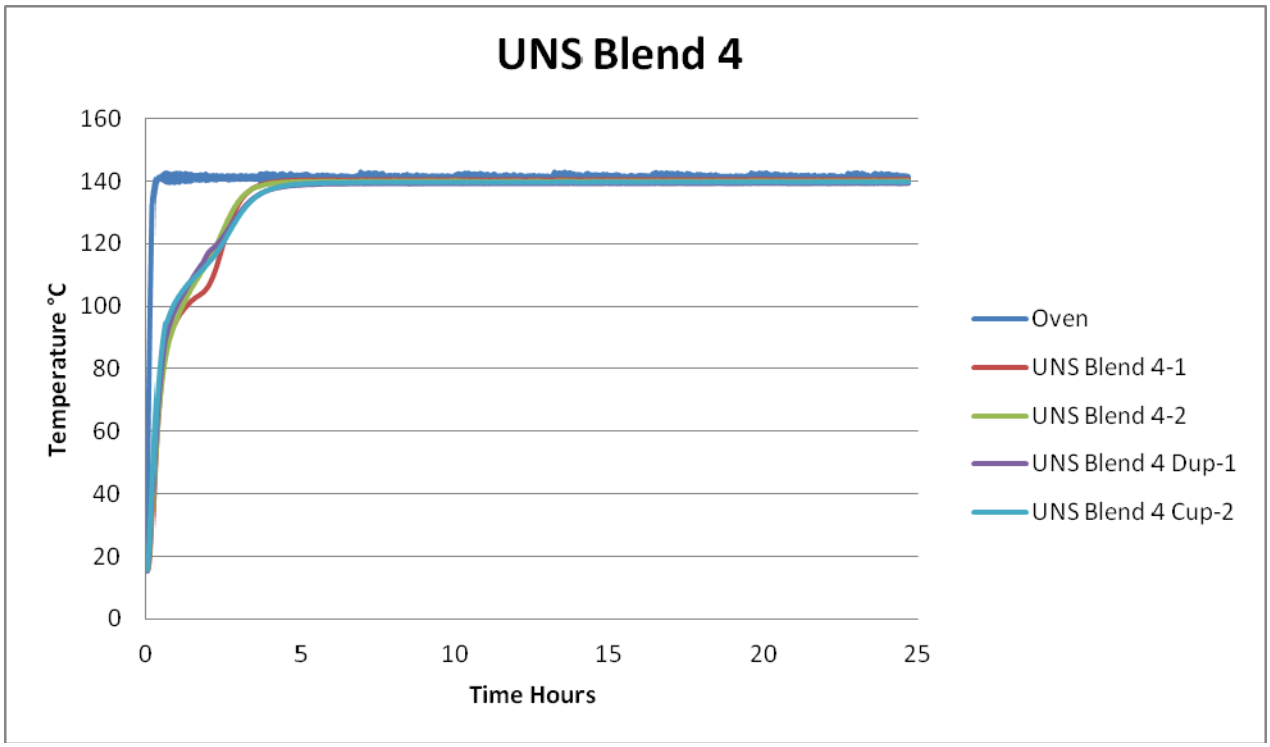


Figure 7. Method 1050 – Temperature of UNS Blend 4 (25mm cube)

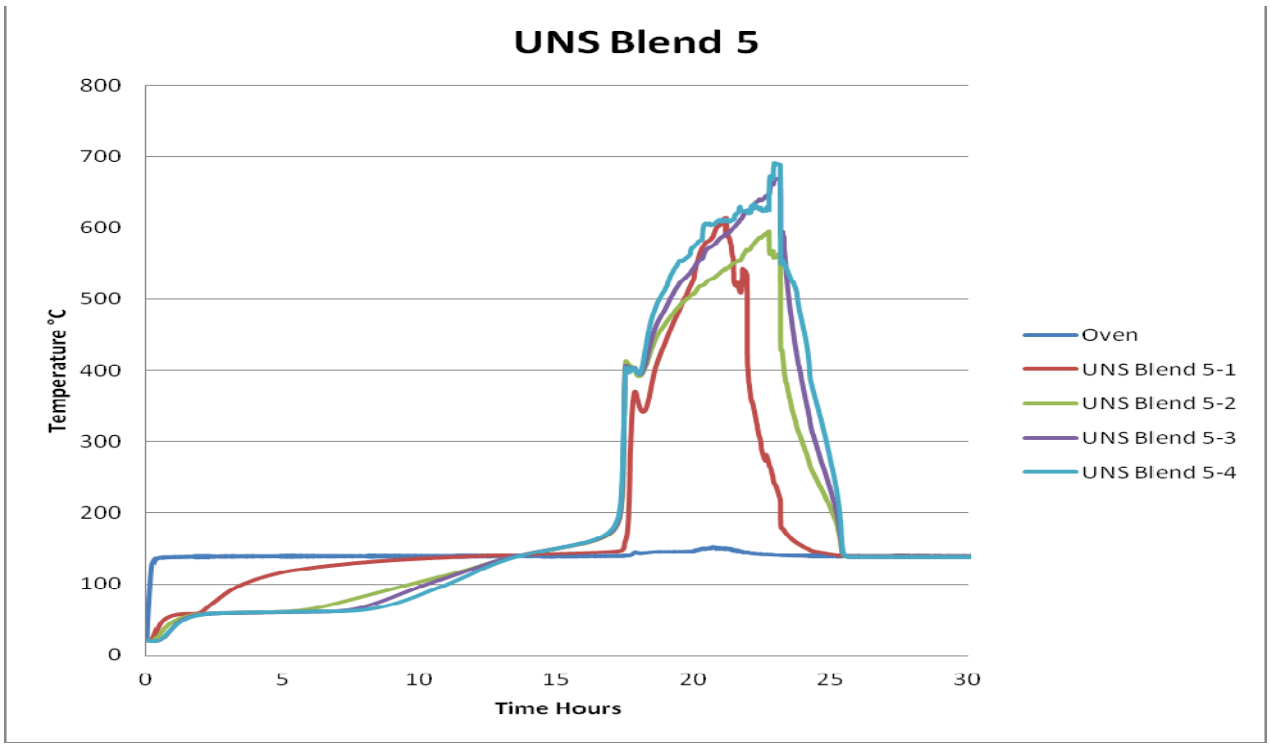


Figure 8. Method 1050 – Temperature of UNS Blend 5 (100 mm cube) with self heating event occuring at about 17 hours and continuing for another 9 hours.

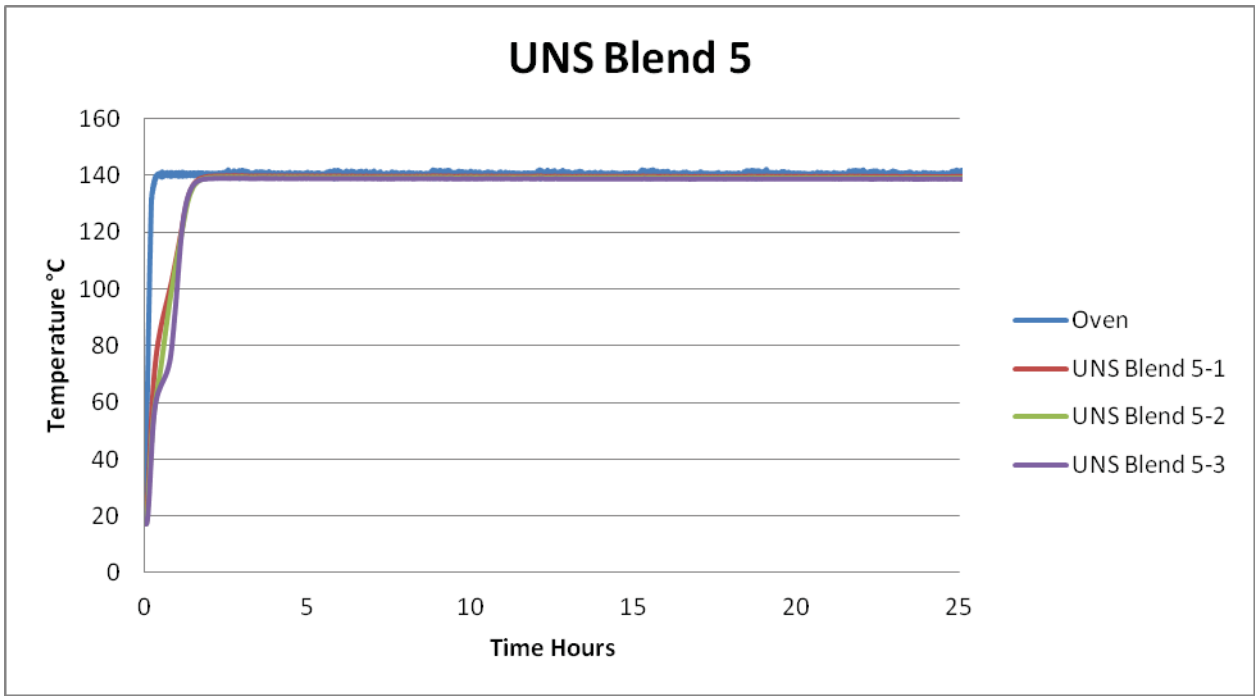


Figure 9. Method 1050 – Temperature of UNS Blend 5 (25 mm cube)

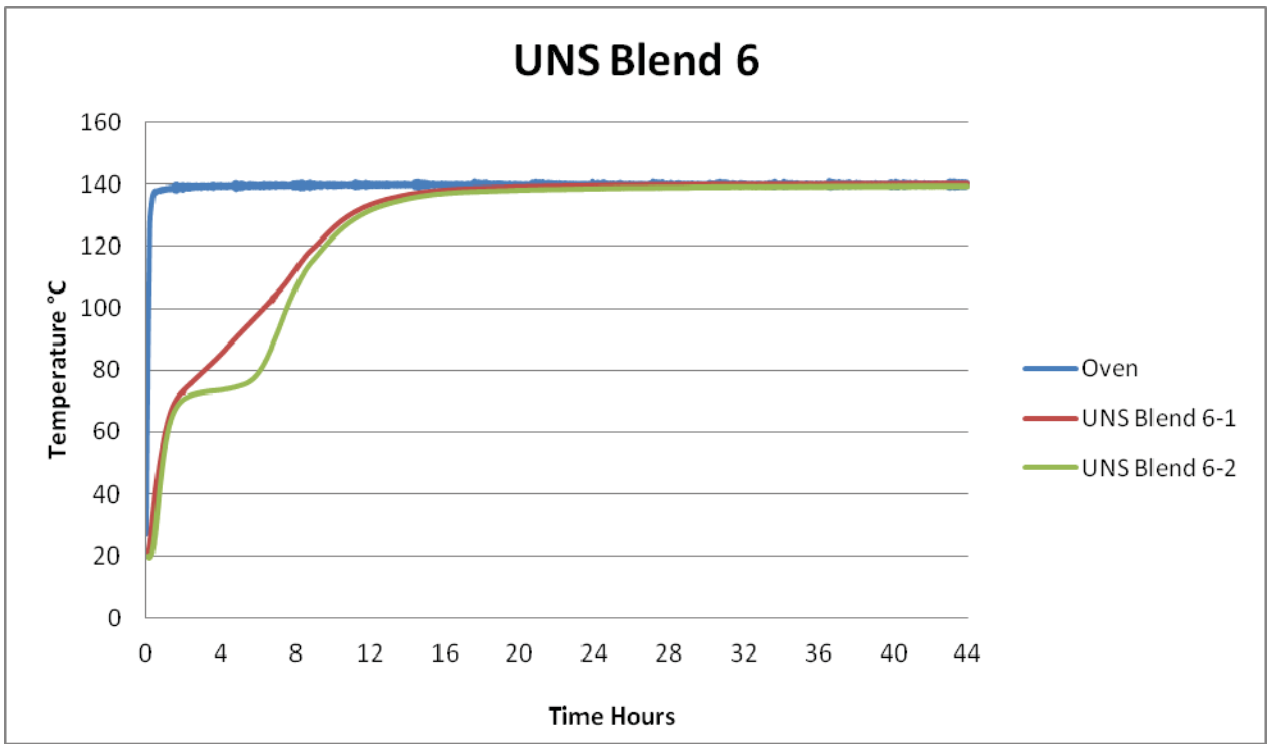


Figure 10. Method 1050 – Temperature of UNS Blend 6 (100 mm cube)

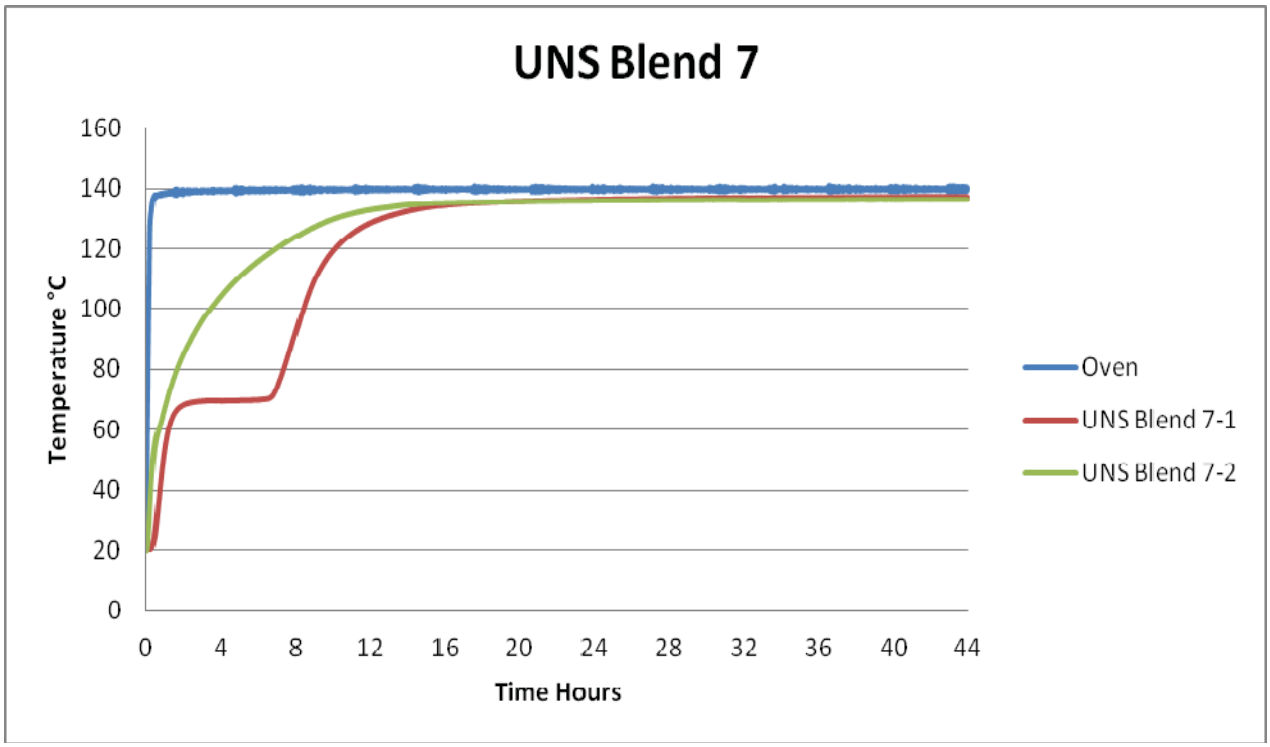


Figure 11. Method 1050 – Temperature of UNS Blend 7 (100 mm cube)

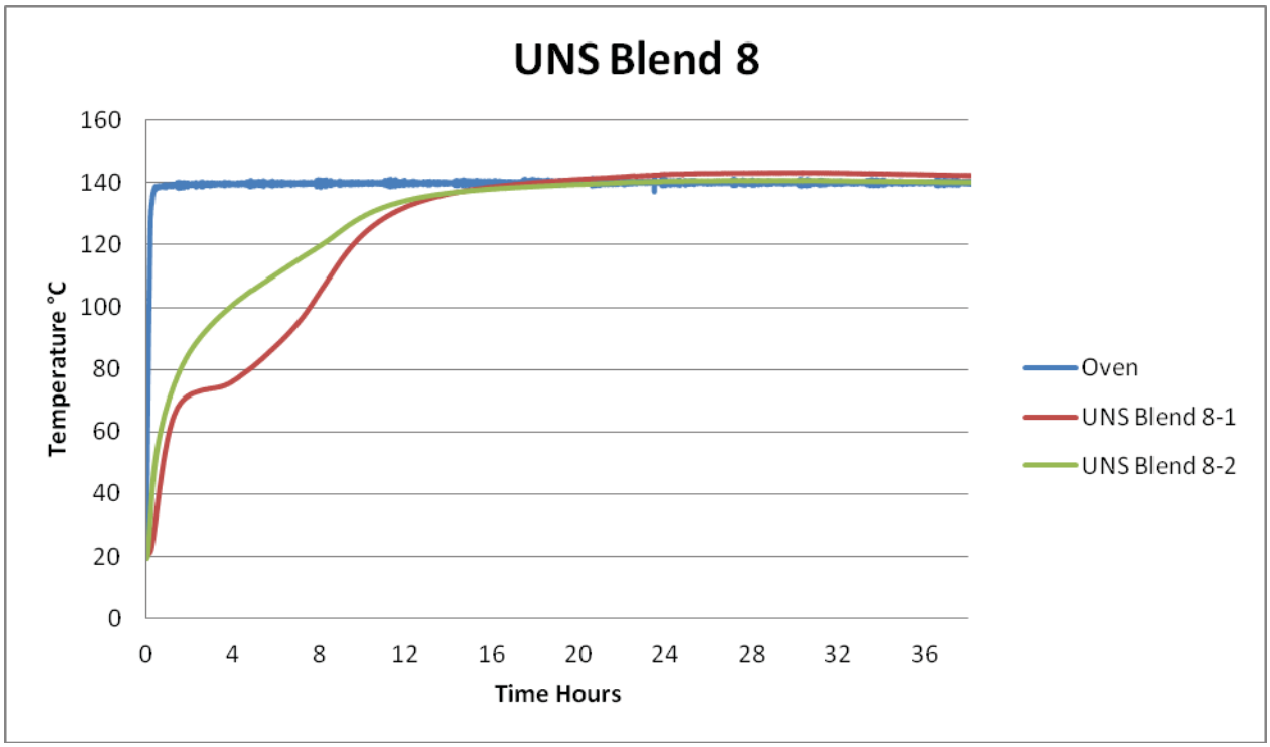


Figure 12. Method 1050 – Temperature of UNS Blend 8 (100 mm cube)

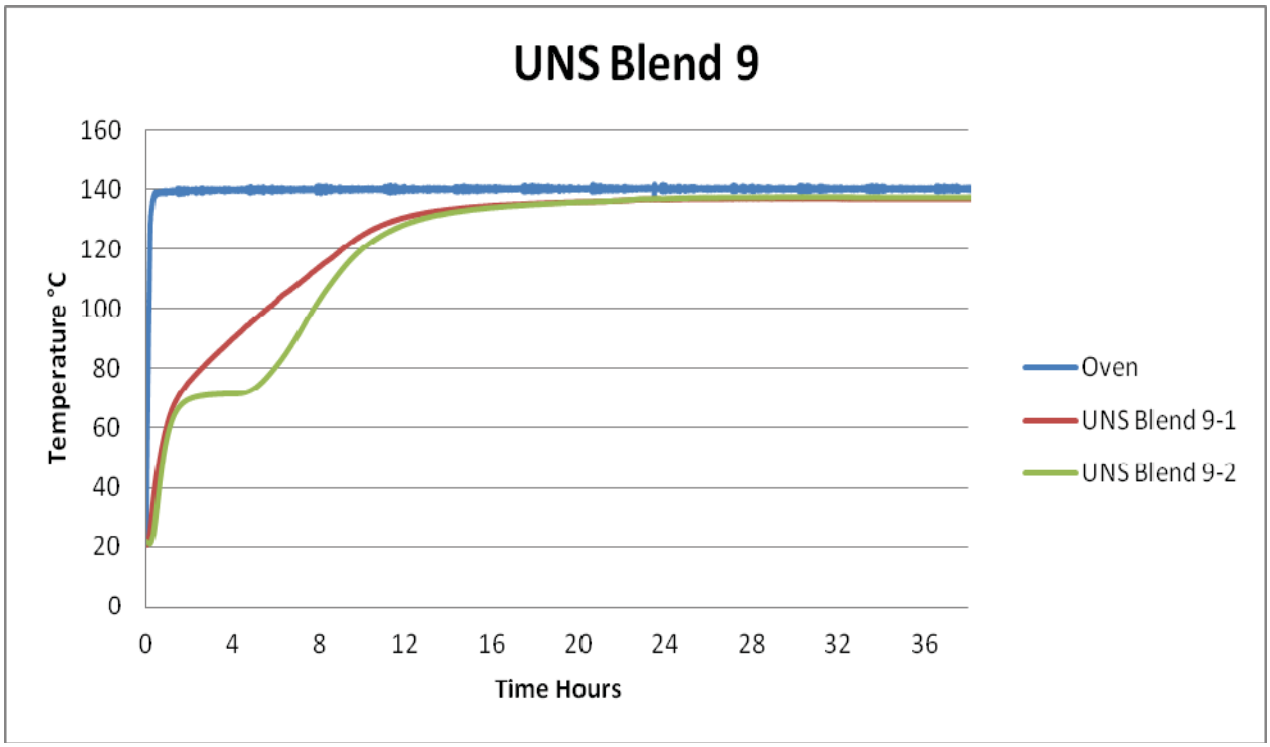


Figure 13. Method 1050 – Temperature of UNS Blend 9 (100 mm cube)

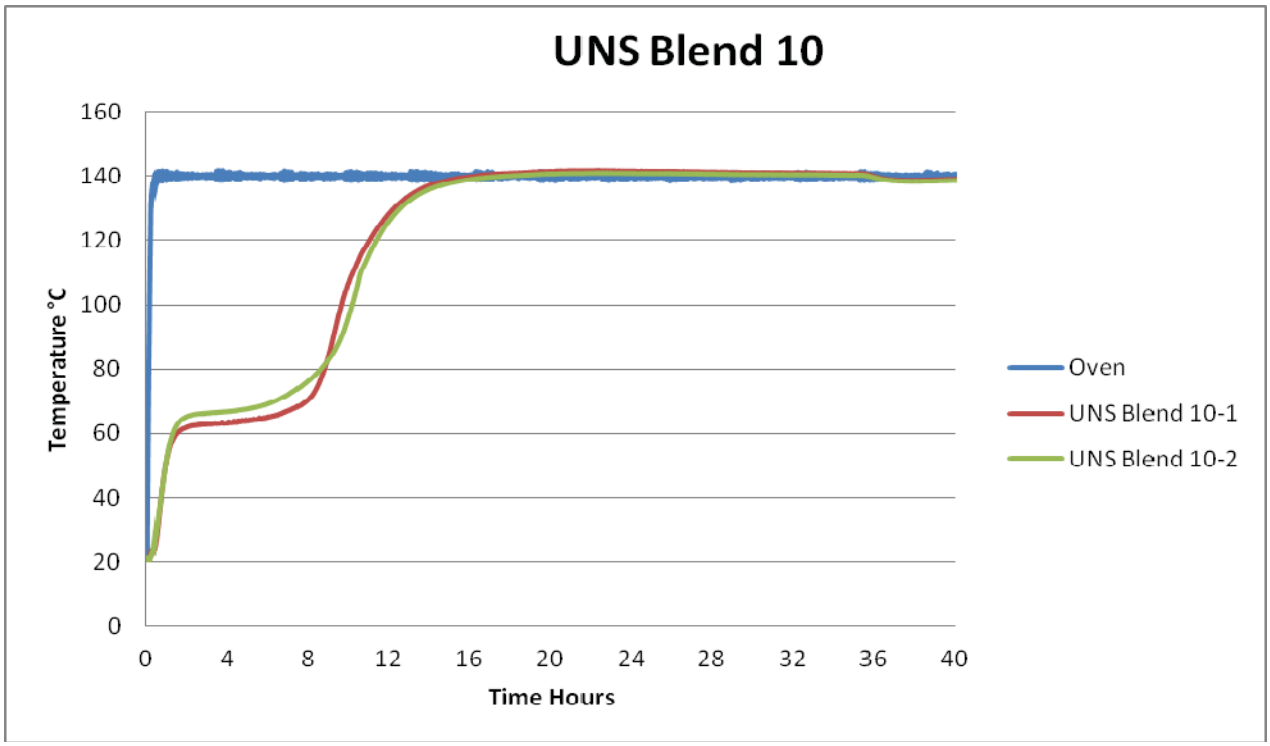


Figure 14. Method 1050 – Temperature of UNS Blend 10 (100 mm cube)

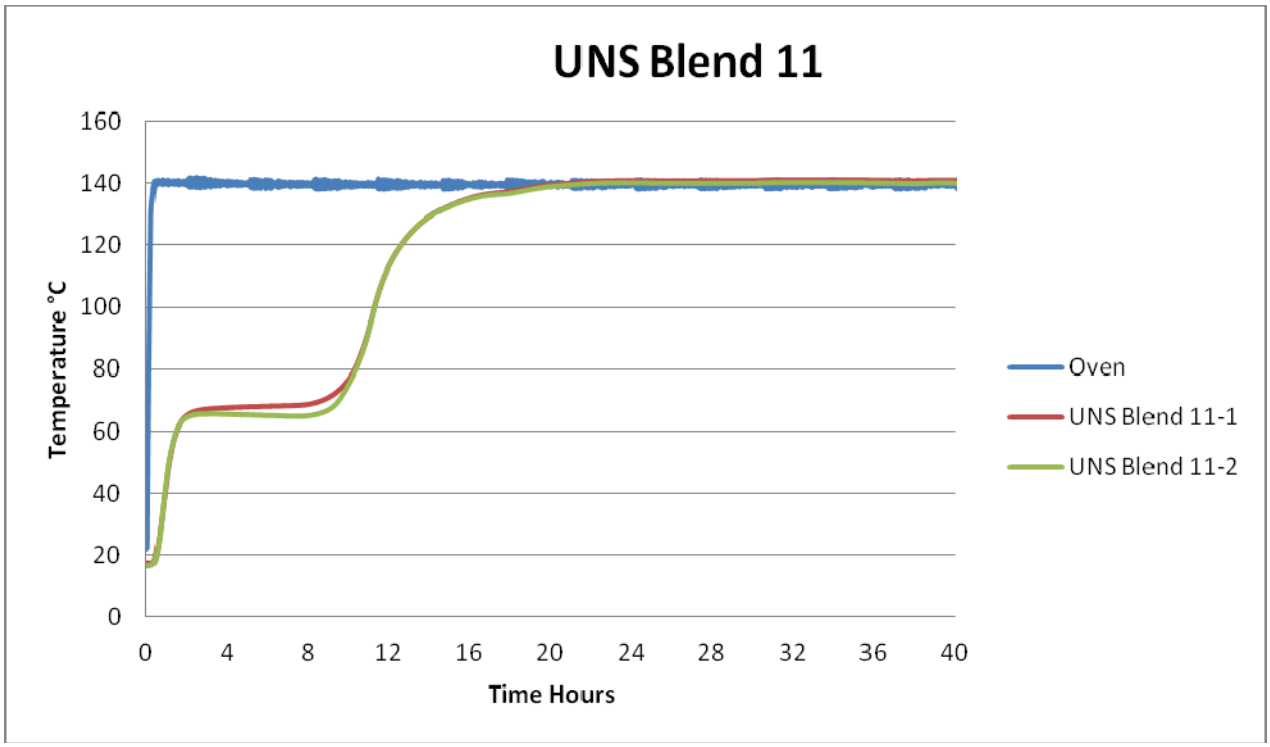


Figure 15. Method 1050 – Temperature of UNS Blend 11 (100 mm cube)

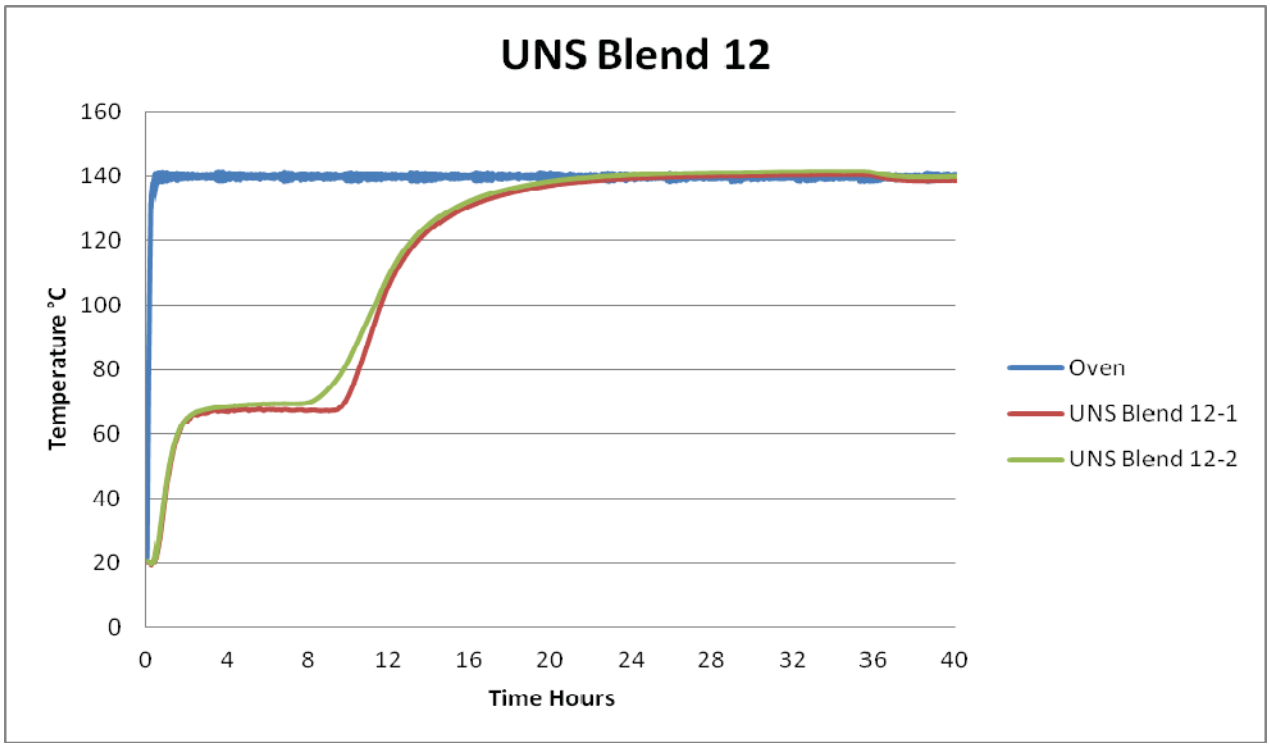


Figure 16. Method 1050 – Temperature of UNS Blend 12 (100 mm cube)

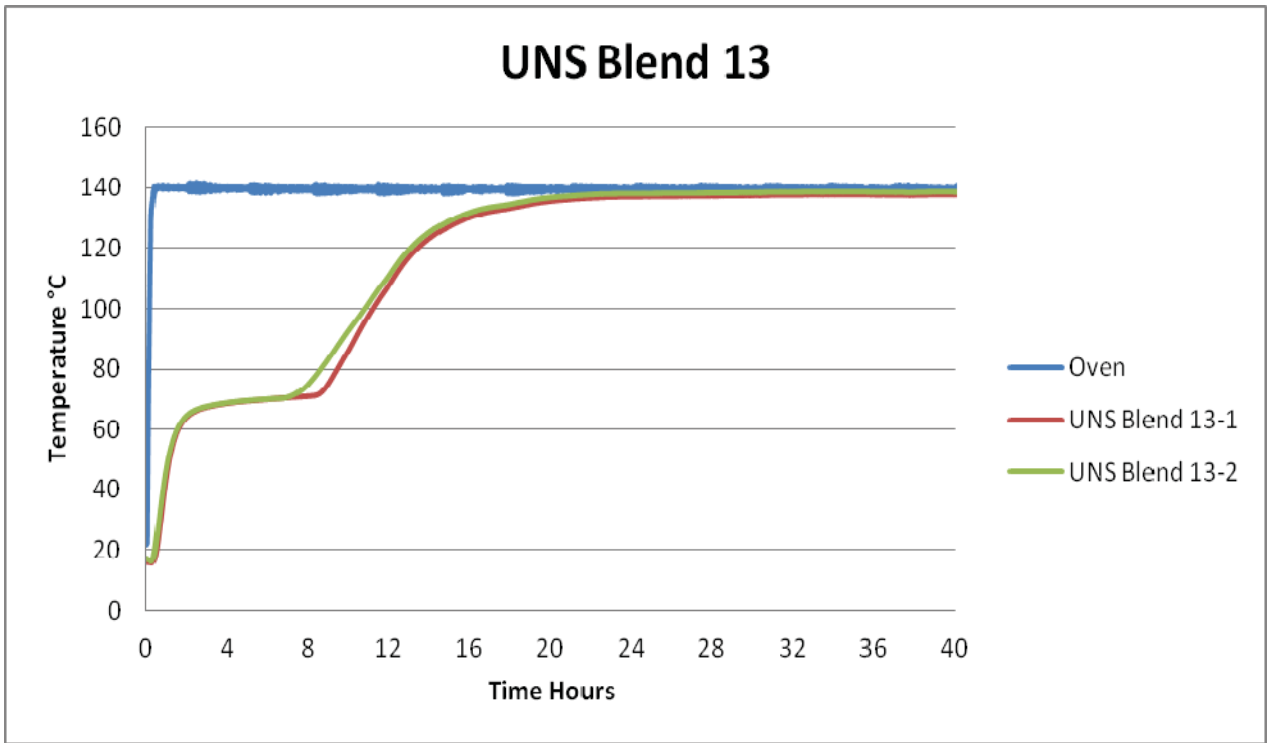


Figure 17. Method 1050 – Temperature of UNS Blend 13 (100 mm cube)

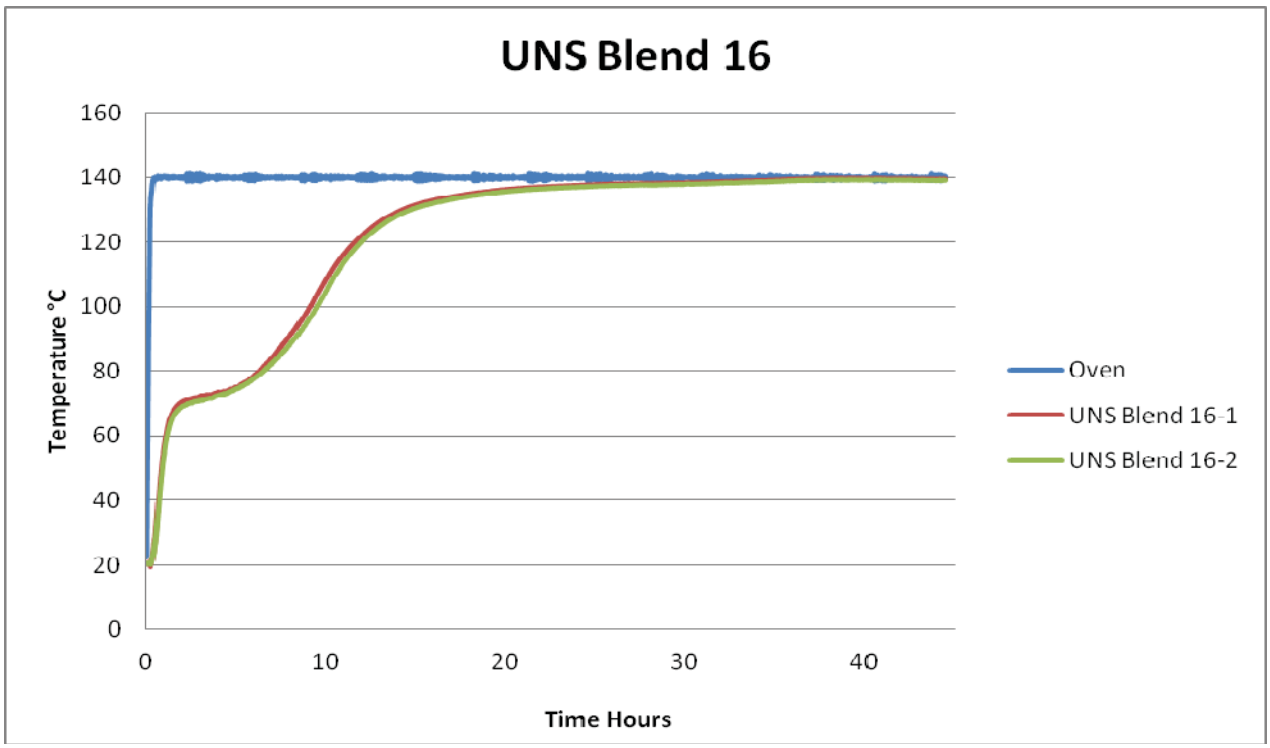


Figure 18. Method 1050 – Temperature of UNS Blend 16 (100 mm cube).

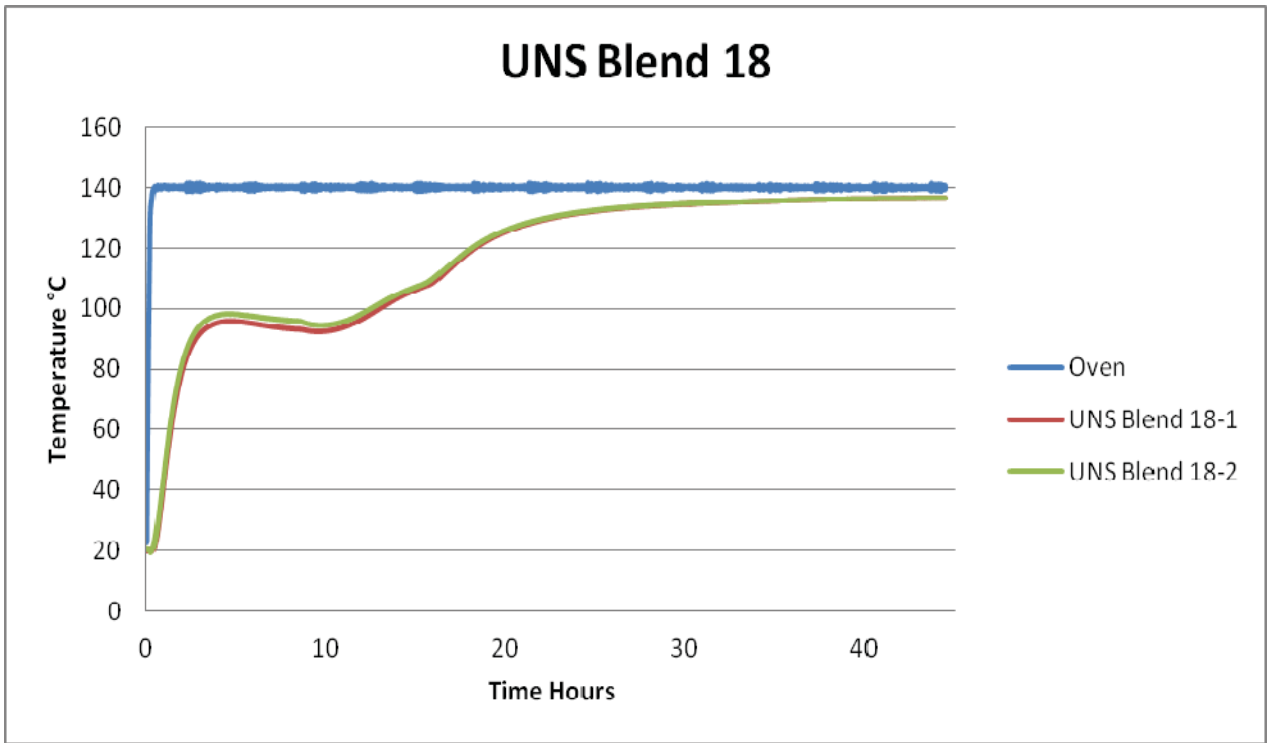


Figure 19. Method 1050 – Temperature of UNS Blend 18 (100 mm cube).

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	47.168	
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 @ 65°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 +
1:1	2	15.0360	15.0028	⊙ > 180.68	charring around wire, sample didn't
1:1	3	15.0621	15.0023	⊙ > 180.36	ignite + burn.
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

Weighted Samples: B. Villasenor Balance#: 135 Date: 1/6/16 mg
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/7/16
Sample Dried ? (YES) NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 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 after power turned off
1:1	1	15.0665	15.0038	>2400	flame at wire leads tin back, started to pop.
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 4 mins 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)
Tested Samples: Monica Gabaldon Timer ID: 80493988 Date: 1/7/16 MG
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 1/21/16	Burning Time, sec	Comment
4:1	1	24.0347	~~24.0347~~ 6.0859	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 Mower 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 sheer 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 upper 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. Villaseñor 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 90494146 Date: 1-18-16 4 pm

Sample Dried ? (YES) NO CI 1/21/16 MG Dried: @ Room temp for 1 day

Cellulose: Inorg# 161124 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 ✓ (te)
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. Villaseñor Balance#: L35 Date: 1-15-16
Tested Samples: B. Villaseñor Timer ID: S/N 804941416 Date: 1-15-16
Sample Dried ? (YES)/NO CI 1/21/16 mG 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, charring
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, charr
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

Southwest Research Institute 010055

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 = 186.94	No Reaction	

Ratio	Rep	Actual Sample Wt, g	Actual Cellulose Wt, g	Burning Time, sec	Comment
1:1	1	~~60~~ 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 UNS_BLEND 11 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
1:1	1	15.0095	15.0203	>240	charring, smoke. 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. 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# 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

Southwest Research Institute 010059

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	180.56	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: 80494146 Date: 1-20-16
Sample Dried ? (YES) / NO Dried: @ Room temp for 1 day
Cellulose: Inorg# 16552O 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# 65520 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	180.97	
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: 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 past burn point	propagation past burn	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 wet at the burn point	
Blend 24	NO	NO	NO		
Blend 25	NO	No	No	sample bubbled and oozed to the back of the plate burned and melted outward but left inside moist	
UNS Blend #2	No	No	No	flame maintained several seconds after removal of torch	
Blend #3	NO	No	Yes	high moisture most likely prevented much burning.	
Blend #4	NO	NO	NO	flame maintained briefly after removing torch burnt sample green	
Blend #5	No	No	Yes		
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 ester energy.	
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: Date: 1/25/16

Reviewed by: Date: 2/2/16

Book I.D. 14-0406-021 Book/ Page : 12 00196

Southwest Research Institute®
Logbook: Physical Testing

010066

Analysis / Method: Paint filter Project# 21592.01.006

Client: LANL TO# 16010 5-3 12/21/15

LCS Info: DI H2O TV= positive Balance#: 05

Notes: balance #5

Sample ID	Sample Vol / wgt	Sample pass through	positive / negative		
DI H_2O	100mL	yes	positive		
WIPP 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		
LANS 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: Date: 11/25/16

Reviewed by: 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 WNS	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 WNS	Blend 8 & 9	Start: 16:21 1/10/16			
		Stop: 6:36 1/12/16			
WNS 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:

Calibrator: 012017

Sample ID									
UNS Blend #2			start: 10:28 1/12/16				stop: 12:59		1/13/16
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 1/13/16									
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: 1/12/16

Reviewed by: [signature] Date: 2/2/16

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					
UNS Blend #4		Start: 15:23 11/3/16		Stop: 6:33 11/5/16	
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.					
UNS Blend 11 B		start: 14:39 11/8/16		Stop: 9:09 11/20/16	
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: 11/3/16

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 characteristics 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: Dana Mahr Date: 1/20/16

Reviewed by: [signature] 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# 21592.01.806

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	11/29/16
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: 11/29/16

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 cures

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 puffy/aerated 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 surfeat
10/2/12WCS12 50:150

800mL UNS (10-01-WCS12 A) + 2400mL surfeat
let sit 24 hr 13:50 #12
UNS surfeat
10-3/WCS12 50:150

700
800mL* UNS (10-01-WCS12 A/B)* + 700*
2400mL surfeat
let sit 24 hr 13:58 #15

*TE run out of surfeat charged up blend

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Work continued to Page

SIGNATURE James Nash DATE 12/28/15

DISCLOSED TO AND UNDERSTOOD BY R Spoler DATE WITNESS DATE 1/15/16

Work continued from Page

SWRI 12-01-WCS12 UNS:meat 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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Work continued to Page

SIGNATURE James Pen DATE 12/29/15

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 1/15/16

Work continued from Page

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) + ~~300~~ 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 (10-02-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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Work continued to Page

SIGNATURE [signature] DATE 12/29/15

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 1/15/16

Work continued from Page

010078

SWRI 16-01-WG12 UNS Blend # 8

400mL (12-02-WG12) + 200mL DI H_2O mix and take 600 mL of this and add it to 1800 mL zeolite #15

SAM 1/11/16

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Work continued to Page

SIGNATURE

DATE 12/30/15

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE 1/15/16

Work continued from Page

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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Work continued to Page

SIGNATURE DATE 1/28/16

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE 2/2/16

Work continued from Page

SWRI

010080

for 25mm cube

UNS Blend #2 36-01-WCS12

75mL UNS Blend #1 (10-01-WCS12) + 75mL soilheat let sit for 24 hr
8:50 1/28/16

JAM 2/2/16

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Work continued to Page

SIGNATURE [signature] DATE 1/28/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 2/2/16

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

SIGMA-ALDRICH®

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Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

Certificate of Analysis

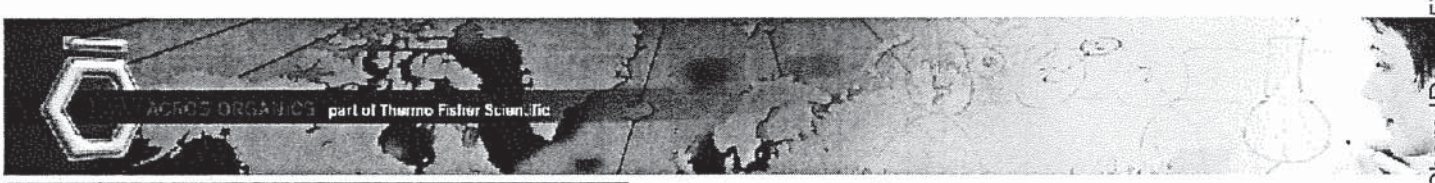
Product Name:	ALUMINUM NITRATE NONAHYDRATE ACS reagent, >= 98 %
Product Number:	237973
Batch Number:	BCBQ6140V
Brand:	Sigma-Aldrich
CAS Number:	7784-27-2
Formula:	$Al(NO_3)_3 \bullet 9H_2O$
Formula Weight:	375.13
Quality Release Date:	19 AUG 2015

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

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: 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

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:

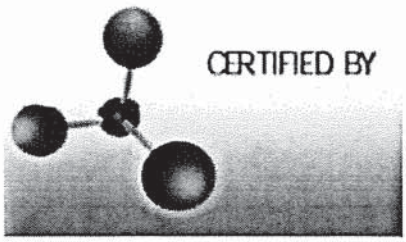
Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

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

010084



CERTIFIED BY

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

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

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 05.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

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Certificate of Analysis

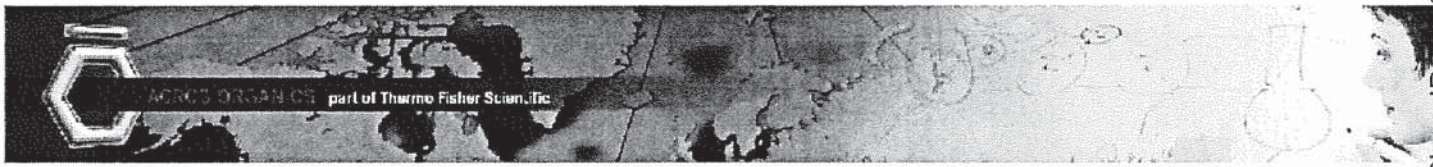
Product Name:	NICKEL(II) NITRATE HEXAHYDRATE purum p.a., crystallized, >= 97.0 % KT
Product Number:	72253
Batch Number:	BCBP4160V
Brand:	Sigma-Aldrich
CAS Number:	13478-00-7
Formula:	$Ni(NO_3)_2 \bullet 6H_2O$
Formula Weight:	290.79
Quality Release Date:	26 JAN 2015

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	331.20
Molecular formula	N2 O6 Pb
CAS No	10099-74-8
Linear formula	Pb(NO3)2
Flash point (°C)	

Certificate of Analysis

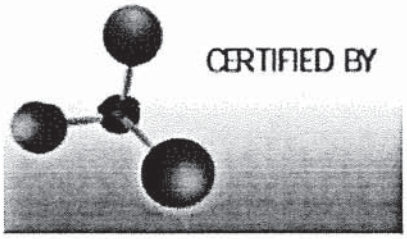
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Catalog Number	42385	**Quality Test / Release Date**	7 August 2014
Lot Number	A0350156	**Suggested Retest Date**	August 2019

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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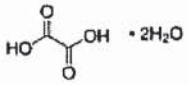
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3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
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



SwRI Chem ID: 63607

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 $KMnO_4$	99.5 - 102.5 %	99.9 %
Residue on ignition (Ash)	≤ 0.01 %	< 0.01 %
Insoluble Matter C=8%, H_2O	≤ 0.005 %	< 0.001 %
Calcium (Ca)	≤ 0.001 %	< 0.001 %
Chloride Content	≤ 0.002 %	< 0.002 %
Substances Darkened (by H_2SO_4)	Pass	Pass
Iron (Fe)	≤ 2 ppm	< 2 ppm
Heavy Metals	≤ 5 ppm	< 3 ppm
Nitrogen Compounds	≤ 0.001 %	< 0.001 %
Sulfate (SO_4)	≤ 0.005 %	< 0.005 %
Meets ACS Requirements	Current ACS Specification	Conforms
Recommended Retest Period 5 years	----------	----------

SwRI Chem ID: 63607

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SwRI Chem ID: 63607

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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: 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

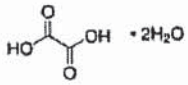
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Certificate of Analysis

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	----------	----------

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

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:

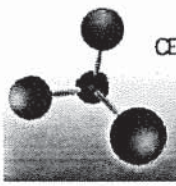
Catalog Number	**A509**	**Mfg. Date**	7/3/2015
Lot Number	**1115060**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

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: 62998
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SwRI Chem ID: 62998

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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

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

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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

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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

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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

SwRI Chem ID: 63613

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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: 63613

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

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Outside USA: eurtechserv@sial.com

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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SwRI Chem ID: 63614

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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

SwRI Chem ID: 63614

SwRI Chem ID: 63614

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SwRI Chem ID: 63614

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: 63605

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Outside USA: eurtechserv@sial.com

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

$Mg(NO_3)_2 \cdot 6H_2O$

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 %

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SwRI Chem ID: 63605

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SwRI Chem ID: 63605

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Outside USA: eurtechserv@sial.com

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: 63605

SwRI Chem ID: 63605

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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:	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

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: 63609
SwRI Chem ID: 63609
SwRI Chem ID: 63609

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:	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

Dr. Claudia Geitner
Manager Quality Control
Buchs, Switzerland

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SwRI Chem ID: 63610
SwRI Chem ID: 63610
SwRI Chem ID: 63610

SwRI Chem ID: 65519

SIGMA-ALDRICH®

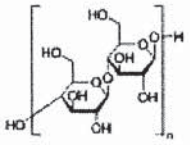
sigma-aldrich.com

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: 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

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: 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.

SwRI Chem ID: 63457
SwRI Chem ID: 63457
SwRI Chem ID: 63457

010110

SIGMA-ALDRICH®

sigma-aldrich.com

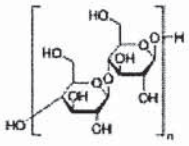
3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

SwRI Chem ID: 61124

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: 61124

SwRI Chem ID: 61124

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

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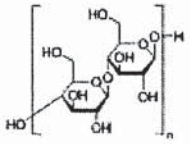
sigma-aldrich.com

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 ordered
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 1732	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 1752	DRmZ	✓	✓ 18.0	36975.6	✓
12/11/15 1650	DRmZ	✓	✓ 18.0	36976.7	✓
12/14/15 1802	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 (18.1) DRmZ	~~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 1812	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 shipped out.
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	✓	✓	18.0	37103.4	✓
1/25/16 1521	DRmz	✓	✓	18.0	37106.1	✓
1/26/16 1803	DRmz	✓	✓	18.0	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
2-1-16 KE 2-1-16 (RE)	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.

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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
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		

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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
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

ACCREDITED
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		

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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

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

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		

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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

010129

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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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

ACCREDITED
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		

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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:	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

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

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

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.

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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
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

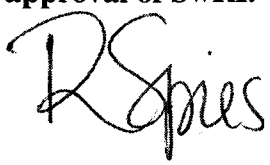
DOT UN Oxidation Testing

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

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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):	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

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

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	

Page Printed: 03/11/2016 13:08
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

Page Printed: 03/11/2016 13:08
ver: (7/18/2014)

56087 Los Alamos National Laborato

Southwest Research Institute
Traffic Report

010010

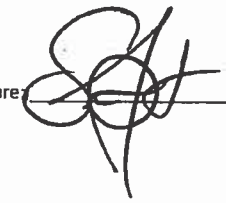
Sample Custodian Signature: _____

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: 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
Remarks: 19869.01.00X	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: 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.

Background 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

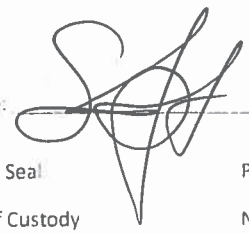
Page Printed: 03/11/2016 13:09
ver: (7/18/2014)

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.: NA
Remarks: 21592.01.00X	SAS Number: NA

			EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
1.	Custody Seal(s)	Present/Absent* Intact/Broken	10cm x 10cm (Count 150) Gloves	N/A	591438	Intact
2.	Custody Seal Nos.	N/A	10cm x 10cm (Count 156) Cardboard	N/A	591439	Intact
3.	Chain-of-Custody Records	Present/Absent	10cm x 10cm (Count 314) Black Plastic Gloves	N/A	591440	Intact
4.	Traffic Reports or Packing Lists	Present/Absent	2.5cm x 2.5cm (Count 150) Black Plastic Gloves	N/A	591441	Intact
5.	Airbill	Airbill/Sticker Present/Absent*	2.5cm^2 (Count 75) Black Plastic Gloves	N/A	591442	Intact
6.	Airbill No.	590817800468, 590817800479	25cm x 2cm (Count 105) Black Plastic Gloves	N/A	591443	Intact
7.	Sample Tags	Present/Absent	25cm x 2cm (Count 40) Black Plastic Gloves	N/A	591444	Intact
	Sample Tag Numbers	Listed/Not Listed on Chain of Custody	25cm x 2cm Cardboard	N/A	591445	Intact
8.	Sample Condition	Intact/Broken*/ Leaking	Wipe All	N/A	591446	Intact
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				

Sample Transfer						
Fraction: ORG	Fraction					
Area #: CABINET	Area #					
By: STEVEN	By					
On: 01/27/2016 DOUGLAS	On					

* Contact SMO and attach record of resolution

Reviewed By: 2.10.16	Logbook No.: Sample Receipt (56933)
Date	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

Page Printed: 03/11/2016 13:10
ver: (7/18/2014)

56955 Los Alamos National Laborato

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	

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.	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	

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
Black Full Length - 8N15	Intact	591577	Intact
Purple _ LANL- BAG-3-SPVC DOM.01-14	Intact	591578	Intact
Purple _ LANL- BAG-3-SPVC DOM.07-13	Intact	591579	Intact
Wypall	Intact	591580	Intact

Sample Transfer					
Fraction: Inorh	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

Client: Los Alamos National Laboratory
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.

Client: Los Alamos National Laboratory
SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2

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.

Client: Los Alamos National Laboratory
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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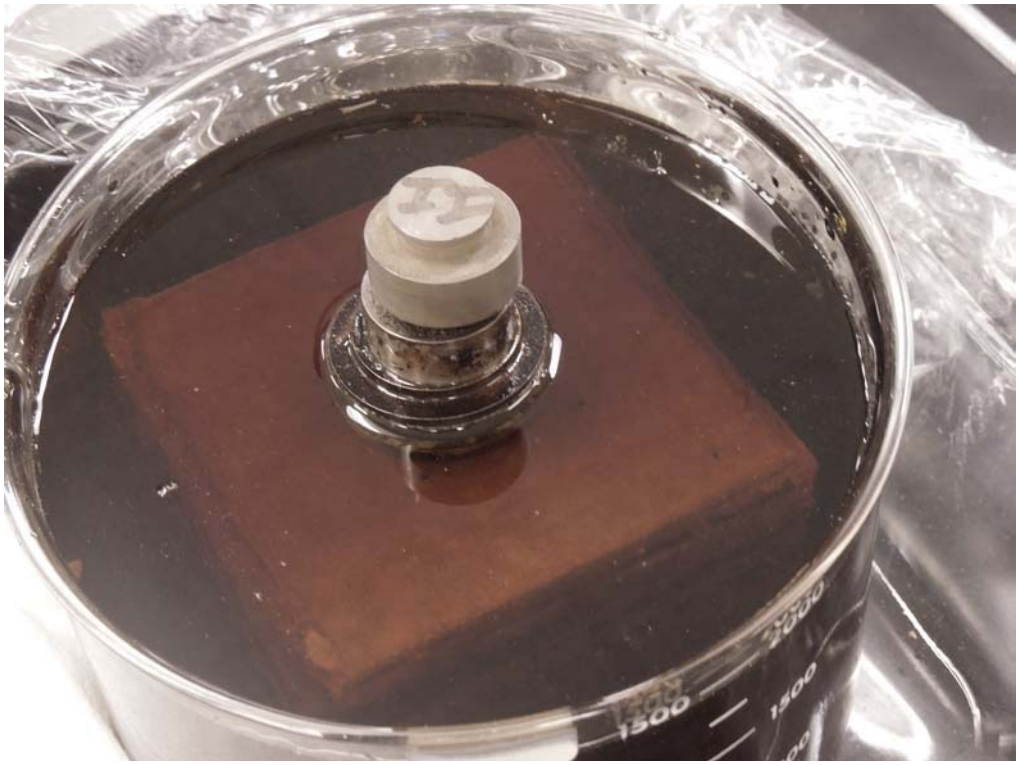


Image 1: Soaking of the cardboard sample in UNS solution for 1050 analysis.



Image 2: Draining of the Cardboard sample for the UNS 1050 analysis.

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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.

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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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Image 7: RNS-Plastic as it was being stuffed into the 100mm cube for 1050 analysis.



Image 8: RNS-Towel for 1050 analysis.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2



Image 9: RNS-Rubber gloves for 1050 analysis.

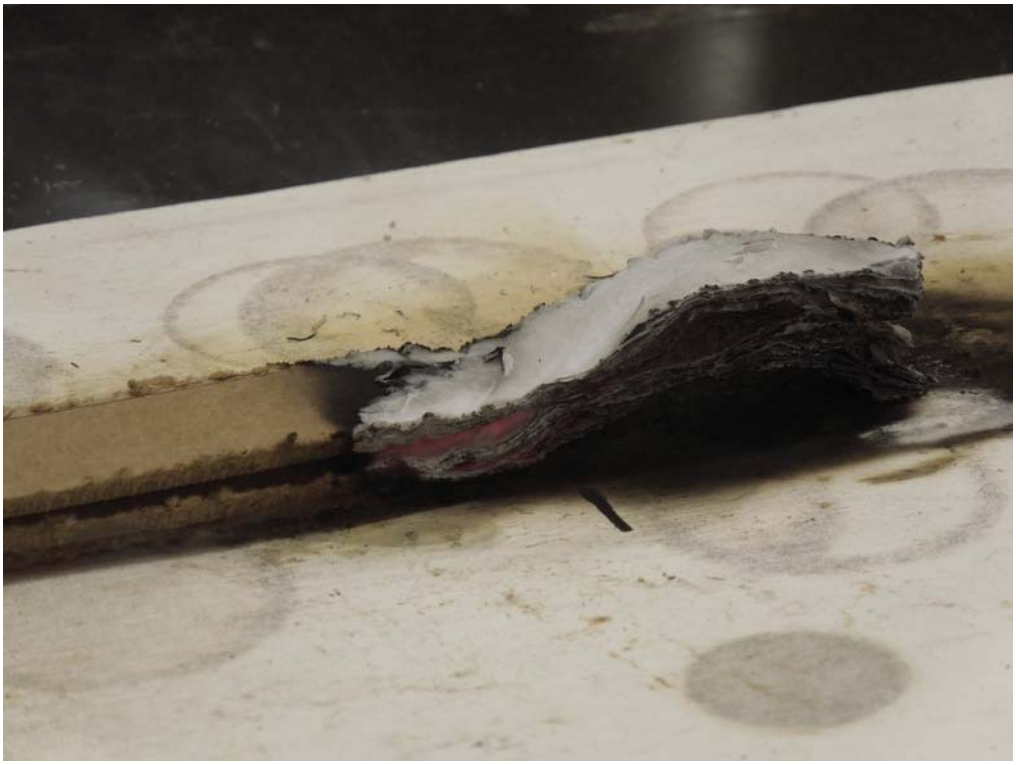


Image 10: Cardboard 1030 baseline analysis showing the sample reaching the 80mm but slowing down and just smoldering slightly after the mark.

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Image 11: Rubber end that was under the torch during the baseline 1030 analysis.

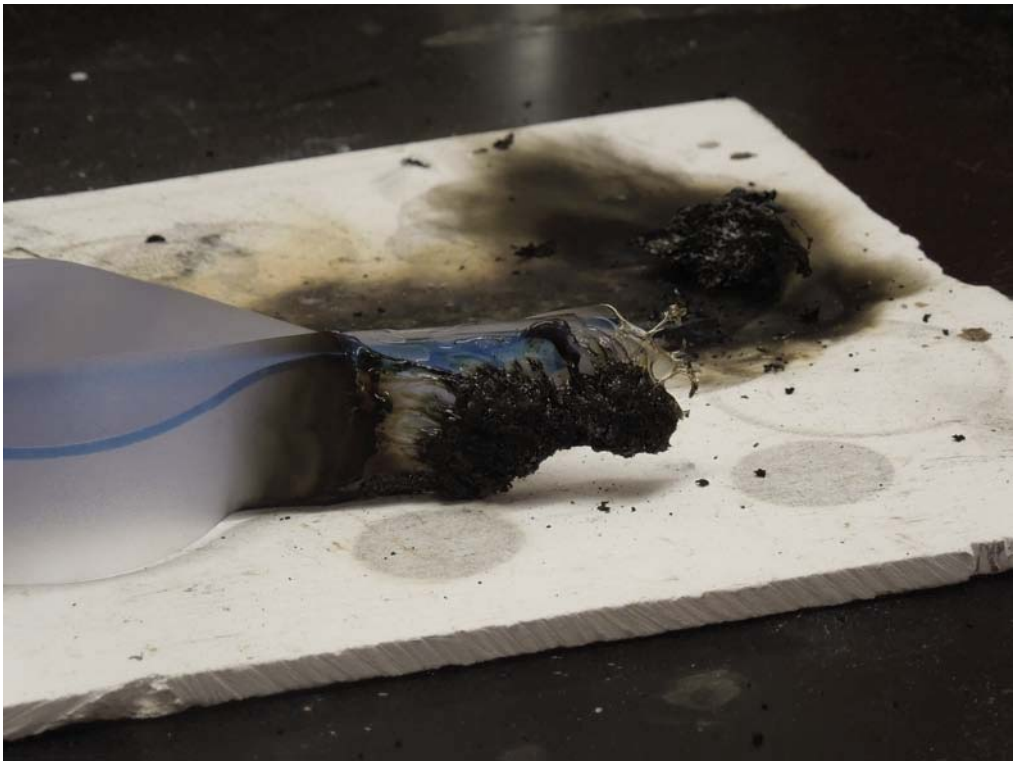


Image 12: Melted and charred end of the plastic during the baseline 1030 analysis.

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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.

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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.

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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.

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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.

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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.

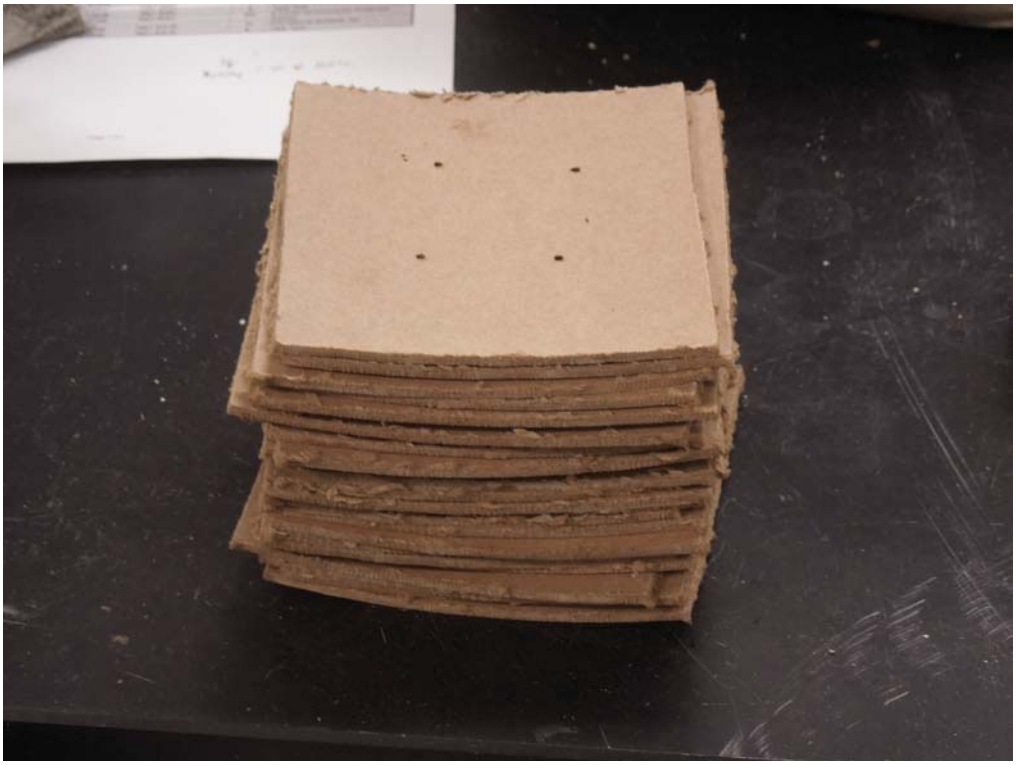


Image 22: Baseline Cardboard for 1050 analysis showing little change after the analysis was performed.

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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.

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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.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2

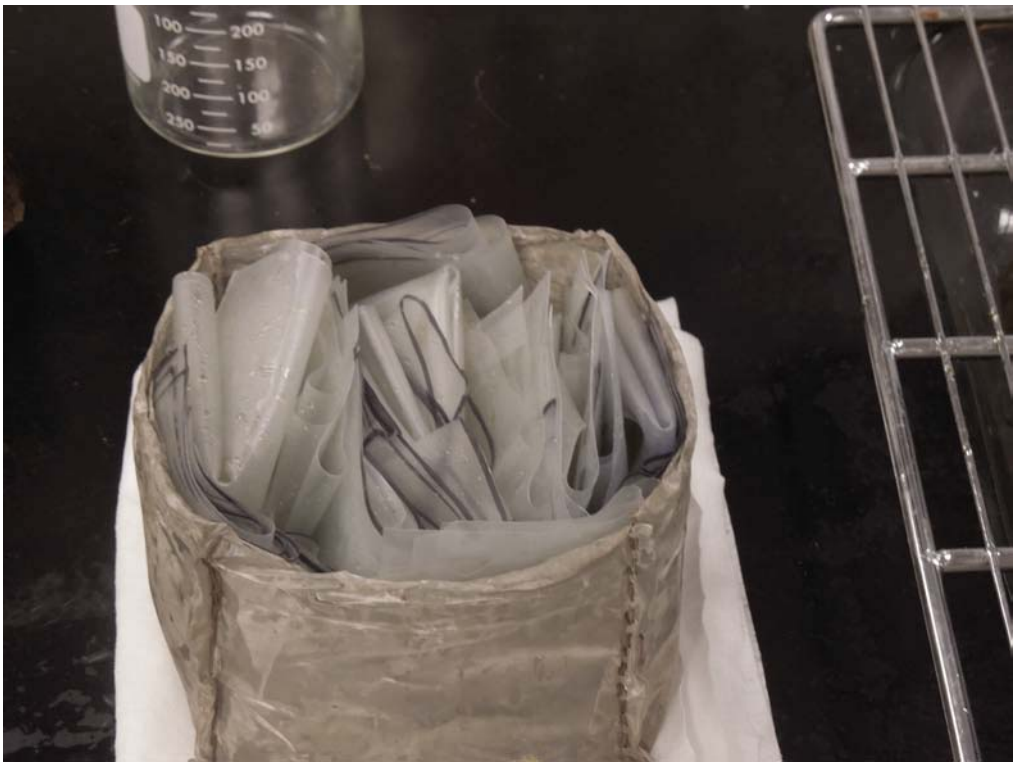


Image 27: UNS-Plastic while stuffing the 100mm cube prior to analysis.



Image 28: UNS-Plastic after 1050 analysis showing the darkened color and the cube form the sample took on.

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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.

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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.

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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.

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SwRI Project Number: 21592.01.00X
SwRI Task Order Number(s): 160307-2

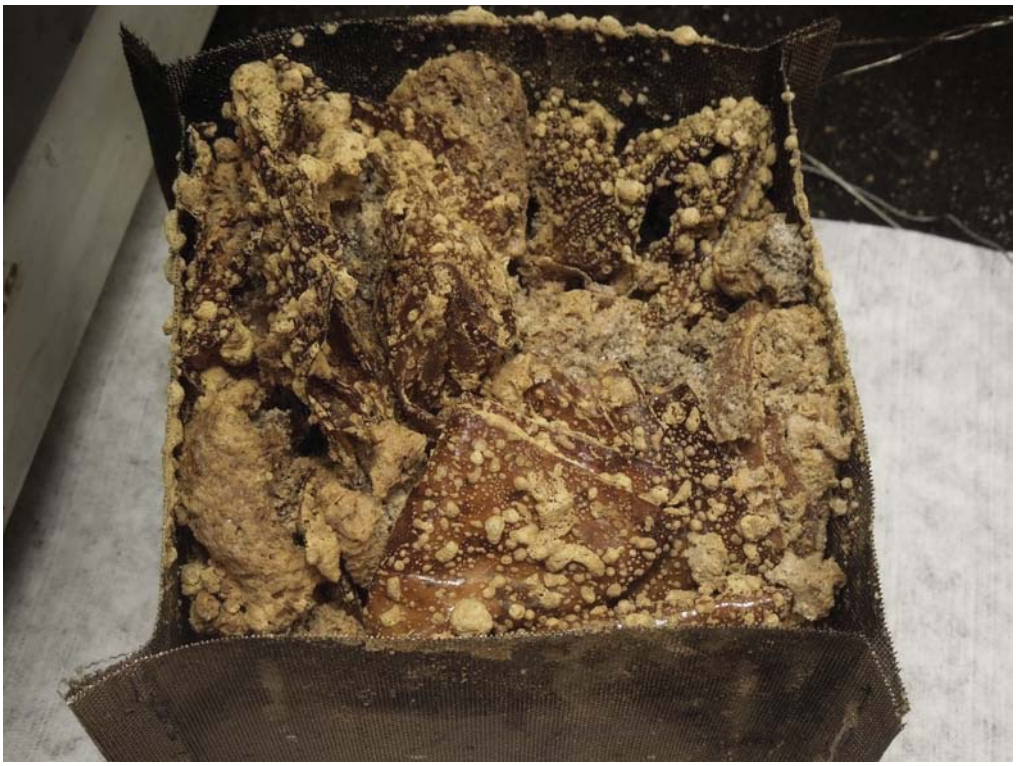


Image 35: RNS-Plastic after 1050 analysis showing the darkening of the sample and the NS waste expanding within the 100mm cube.



Image 36: RNS-Rubber gloves after 1050 analysis showing the expansion of the sample due to the RNS waste.

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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.

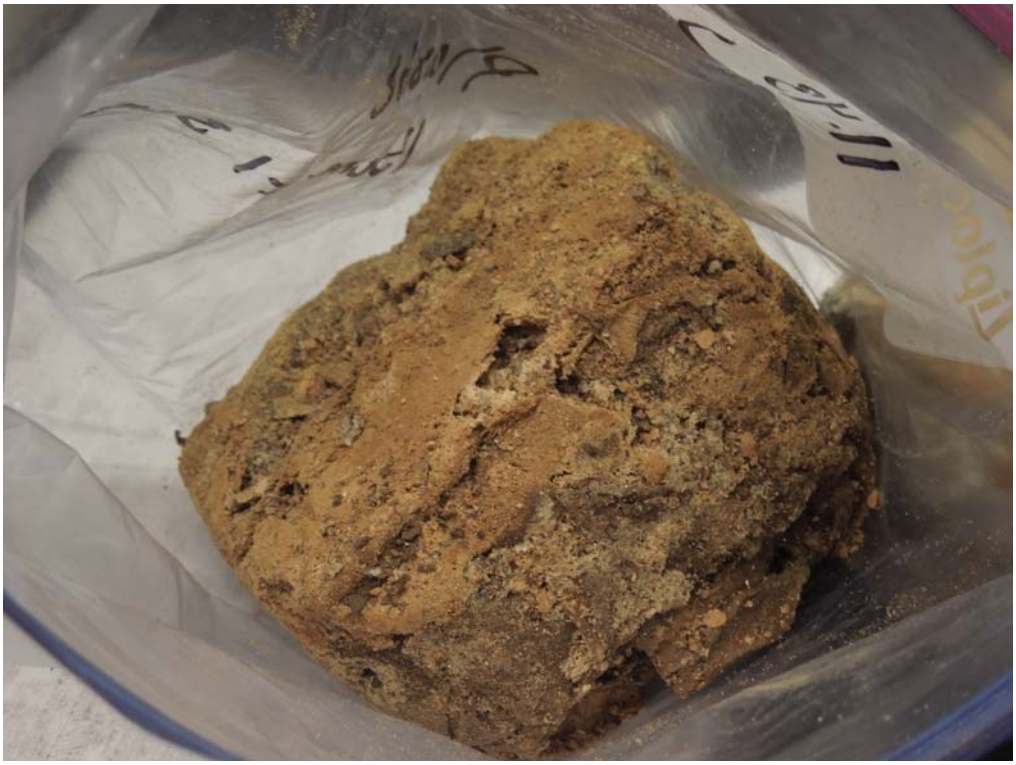


Image 38: RNS-Towel after 1050 analysis showing how it became a hardened cube during the analysis.

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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 **Date** **3-10-16**

Attachment A

Method 1050 Graphs

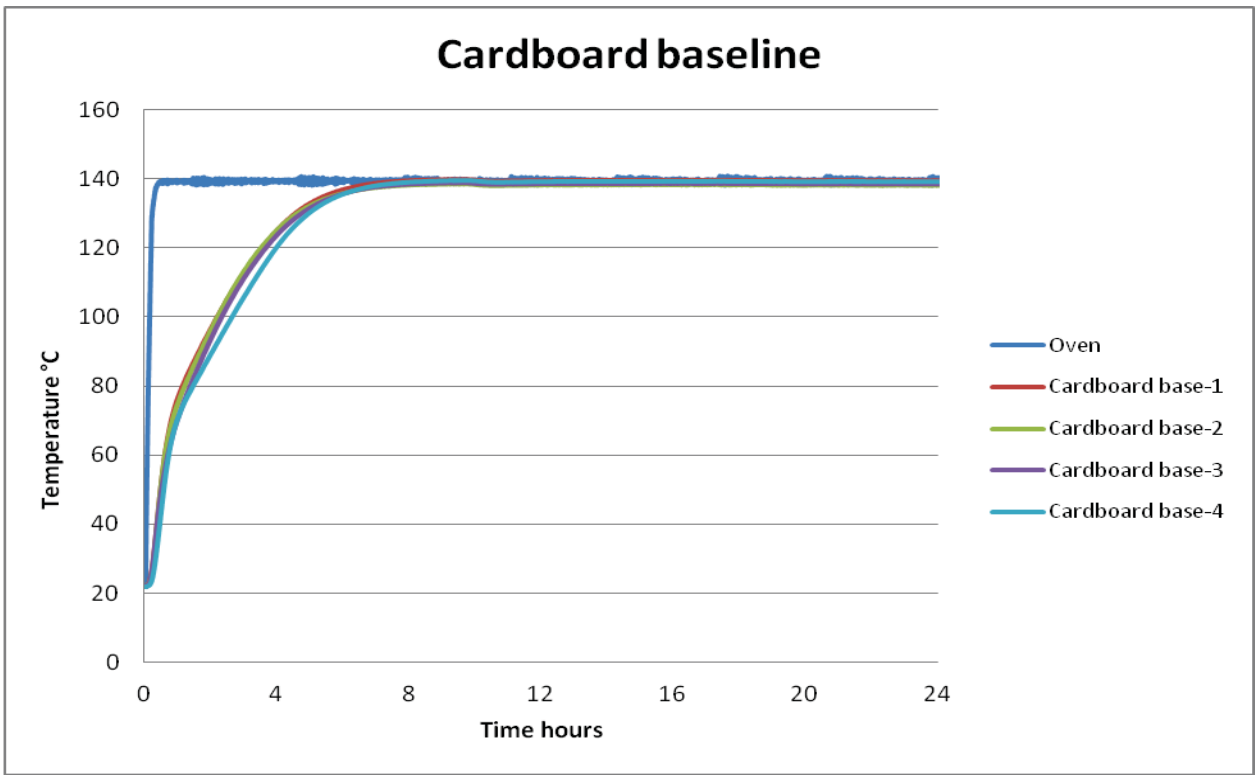


Figure 1. Method 1050 – Cardboard Baseline (100mm cube) full run.

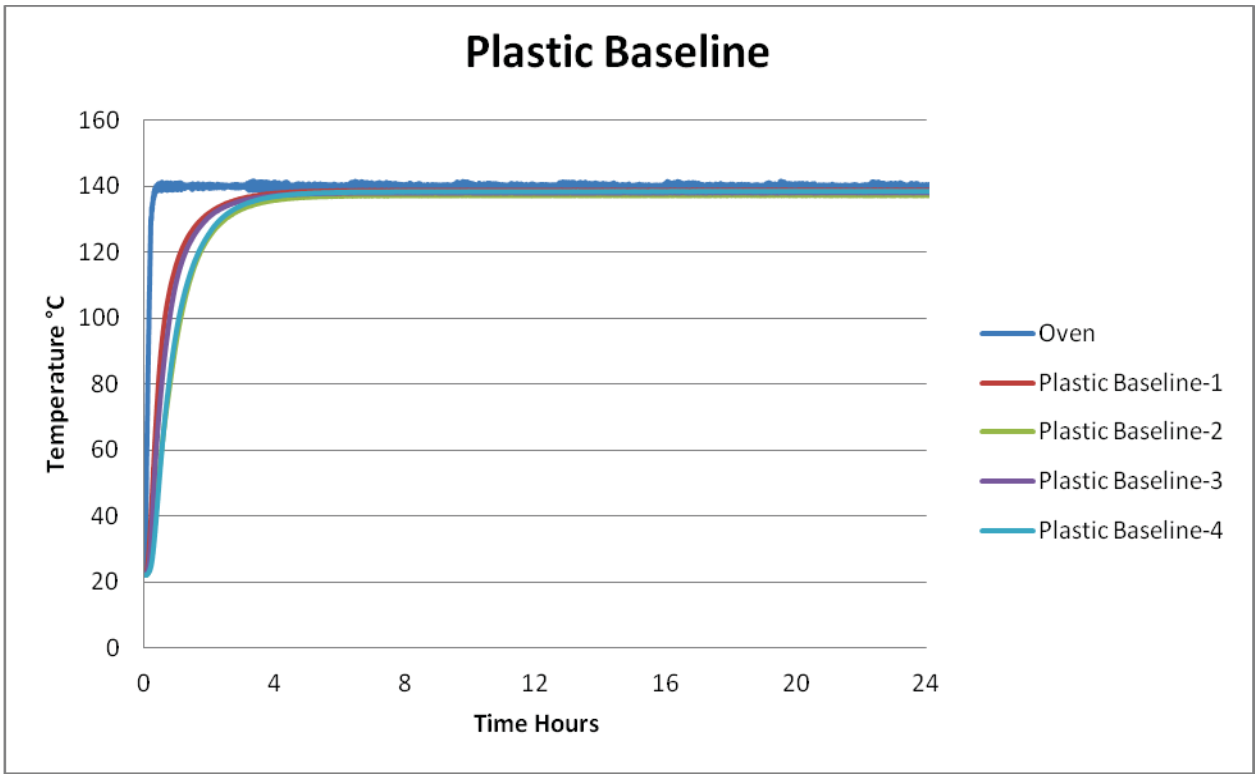


Figure 2. Method 1050 – Plastic Baseline (100mm cube) full run.

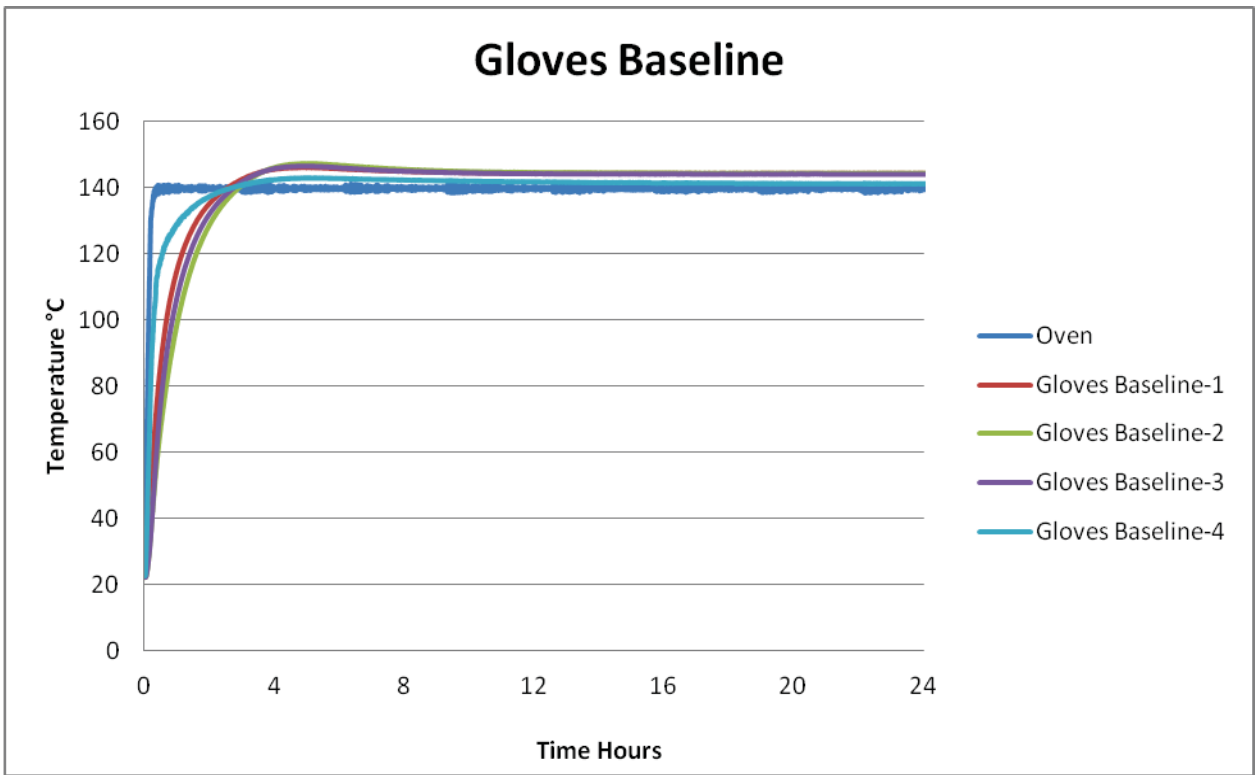


Figure 3. Method 1050 – Rubber Gloves Baseline (100mm cube) full run showing the slightly elevated temperature above 140°C.

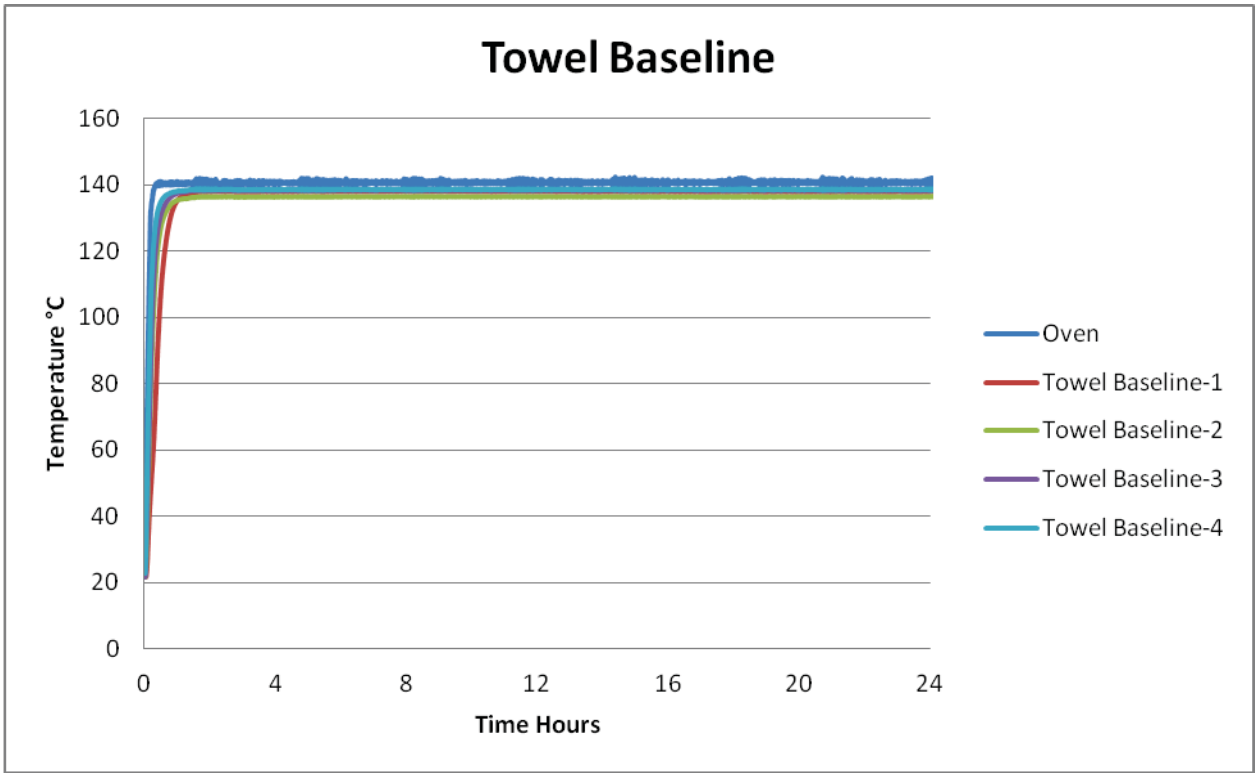


Figure 4. Method 1050 – Towel Baseline (100mm cube) full run.

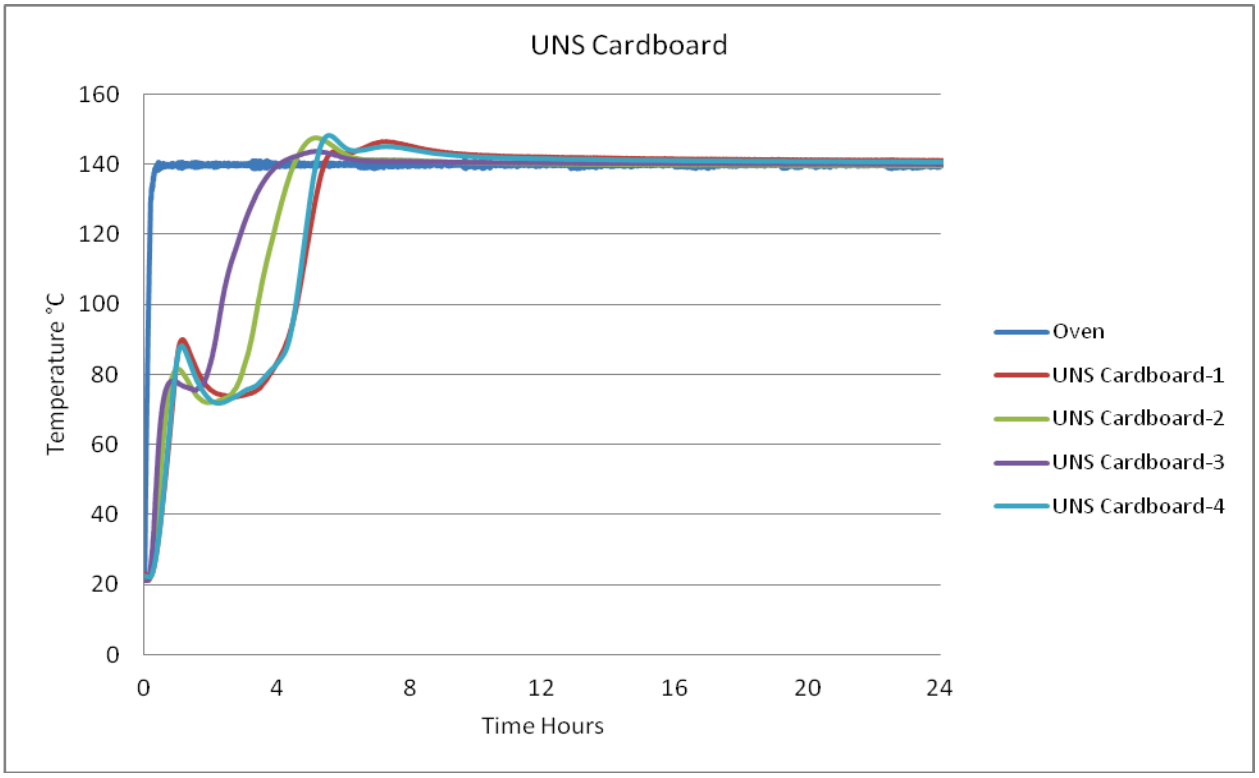


Figure 5. Method 1050 – UNS Cardboard (100mm cube) full run.

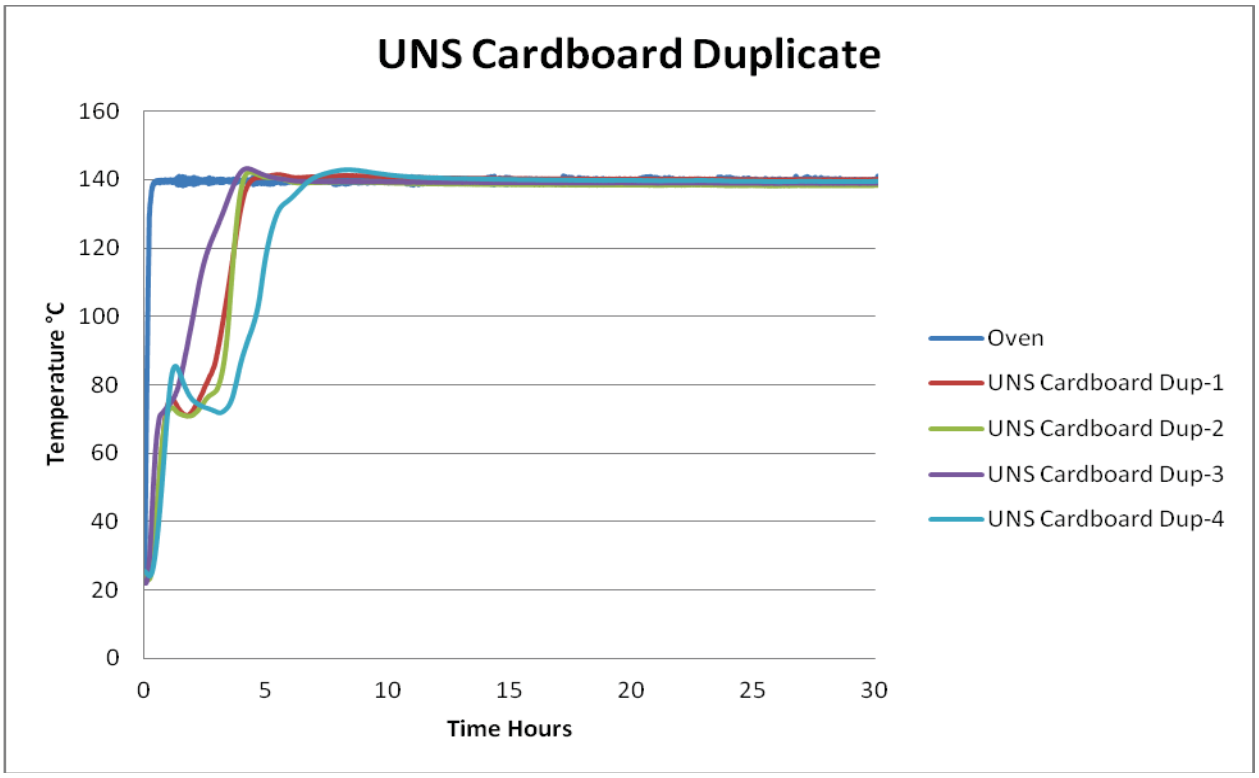


Figure 6. Method 1050 – UNS Cardboard Duplicate (100mm cube) full run.

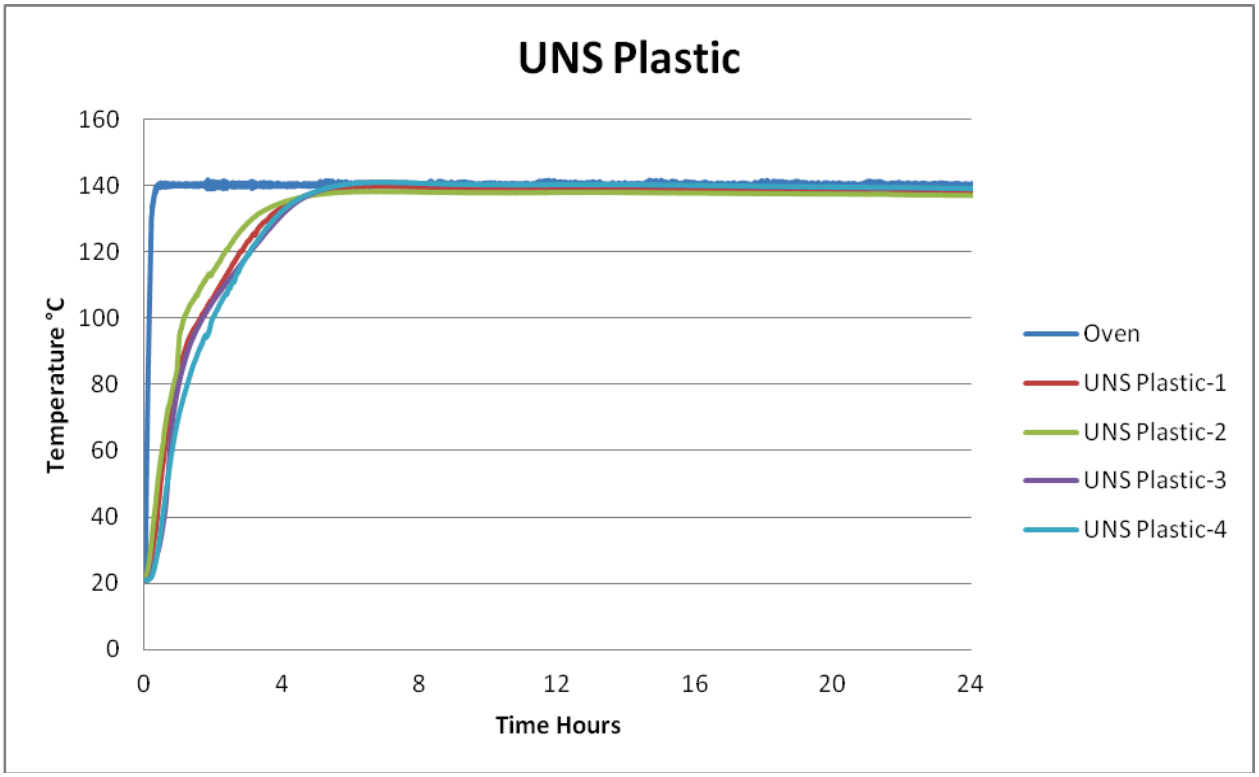


Figure 7. Method 1050 – UNS Plastic liner (100mm cube) full run

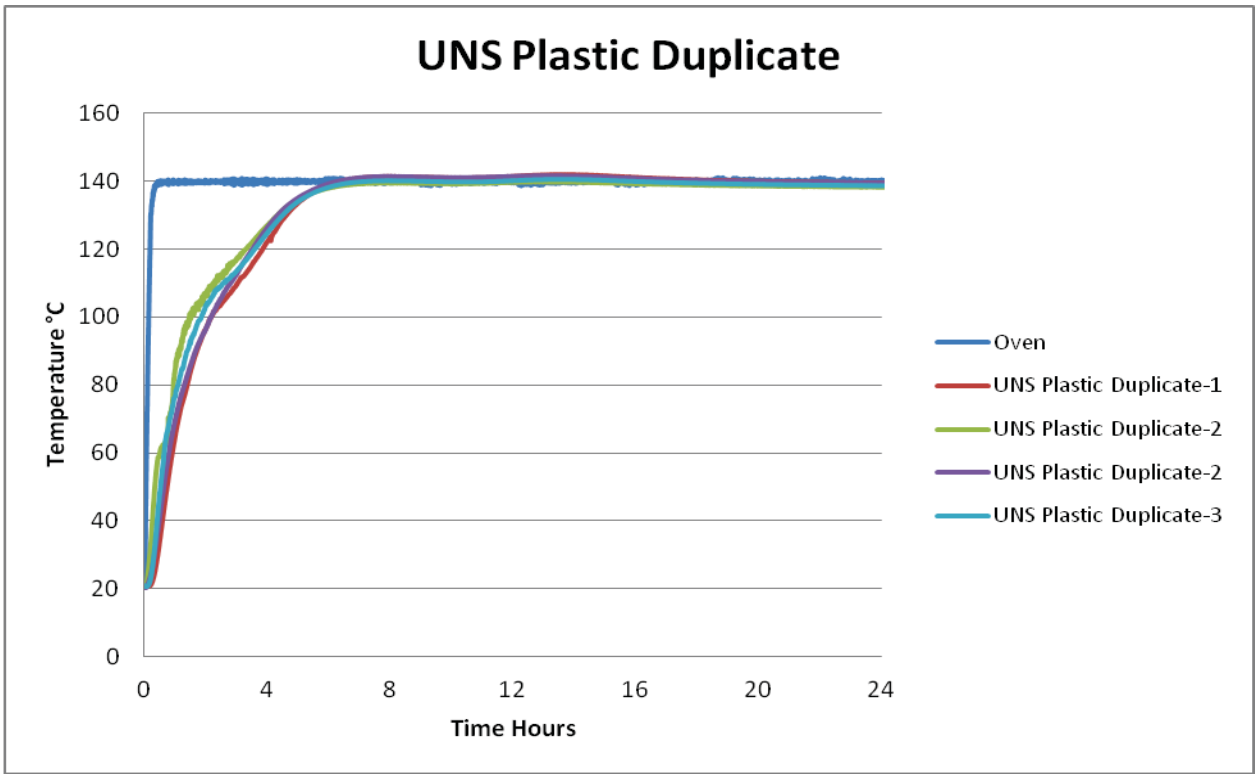


Figure 8. Method 1050 – UNS Plastic liner Duplicate (100mm cube) full run.

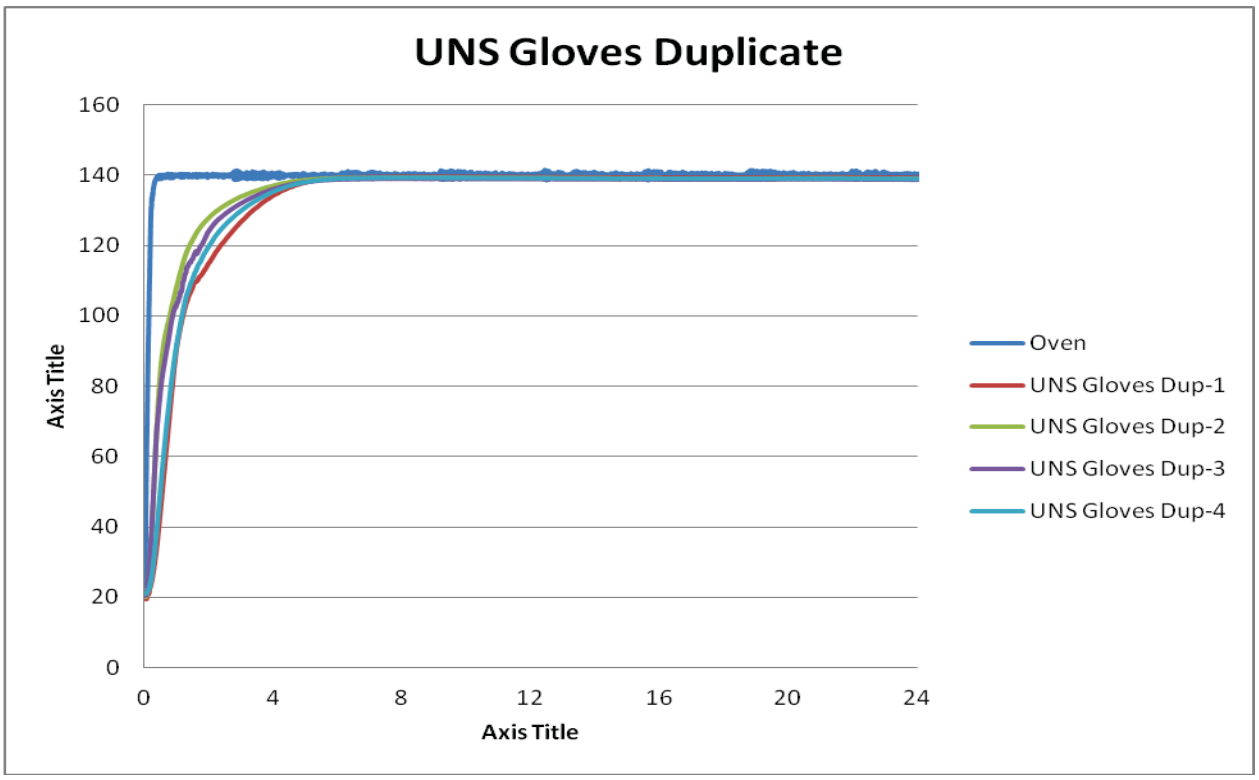


Figure 9. Method 1050 – UNS Rubber Gloves Duplicate (100mm cube) full run.

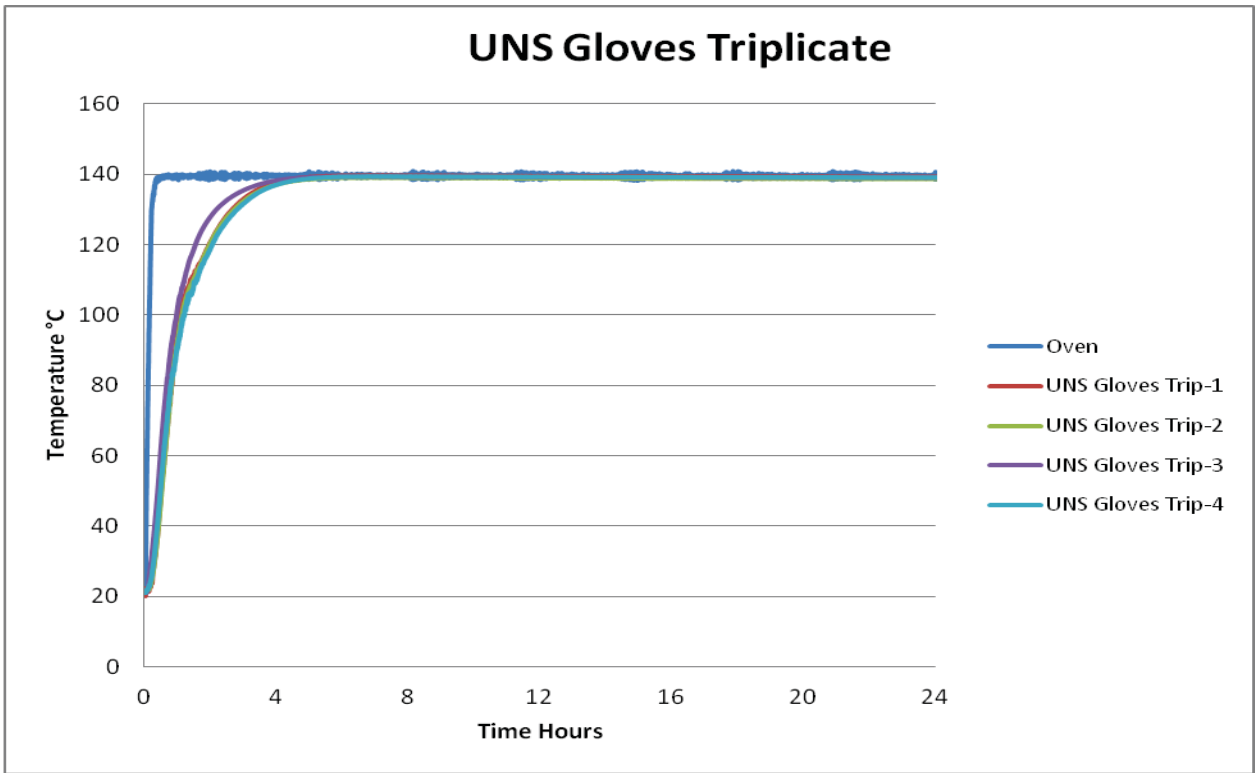


Figure 10. Method 1050 – UNS Rubber Gloves Triplicate (100mm cube) full run

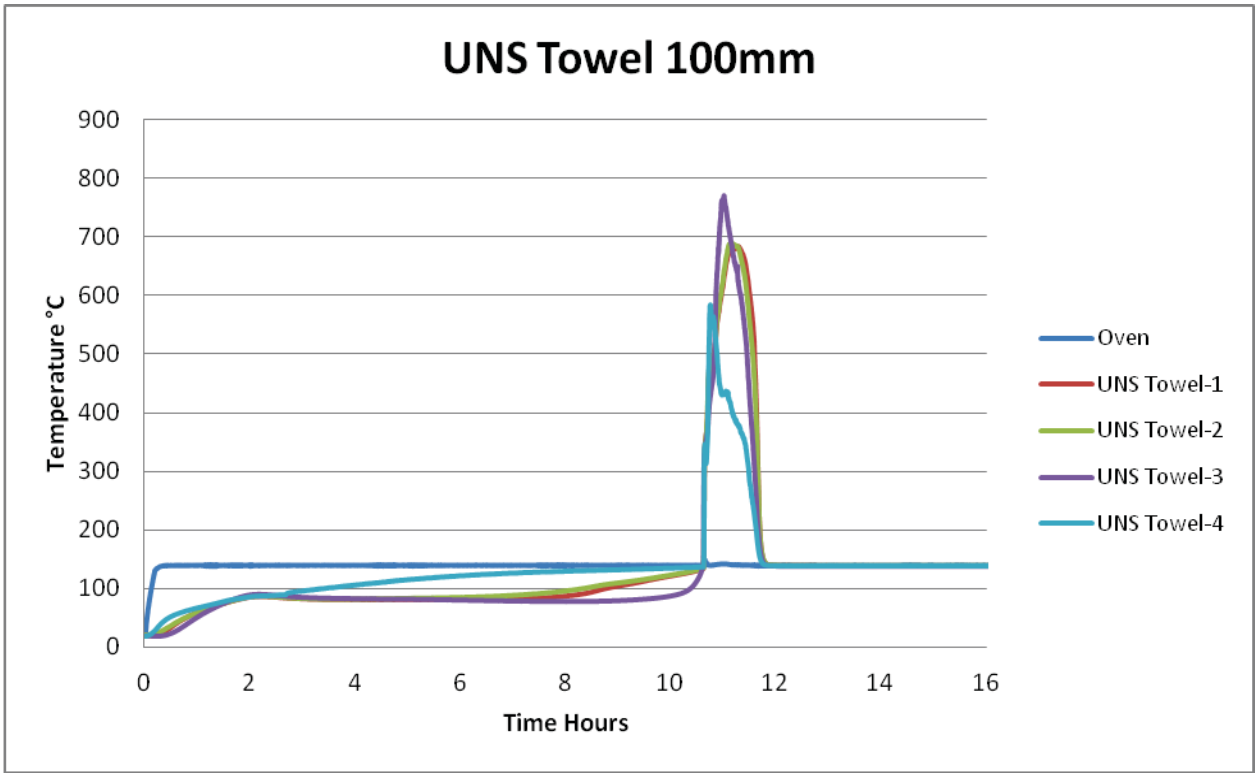


Figure 11. Method 1050 – UNS Towel (100 mm cube) showing an event occuring around ll hours into the analysis.

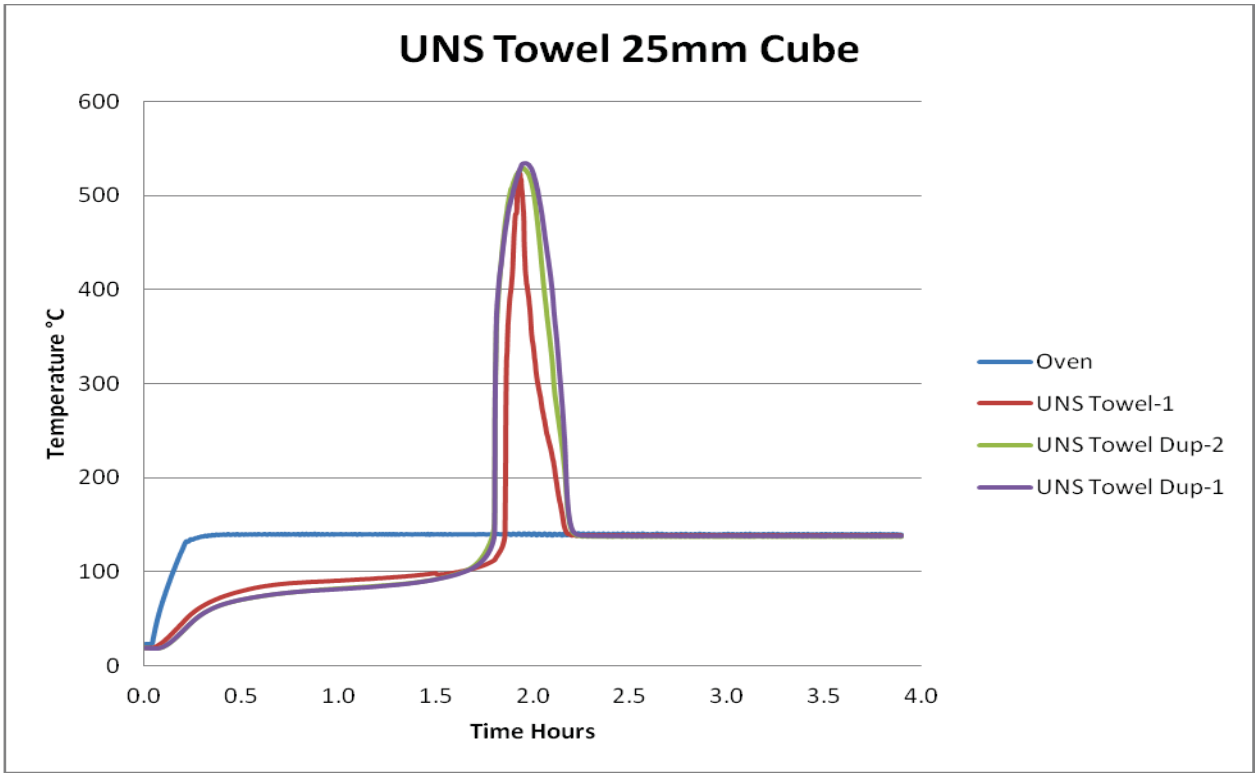


Figure 12. Method 1050 – UNS Towel (25 mm cube) showing an event occuring a little over 1½ hours into analysis.

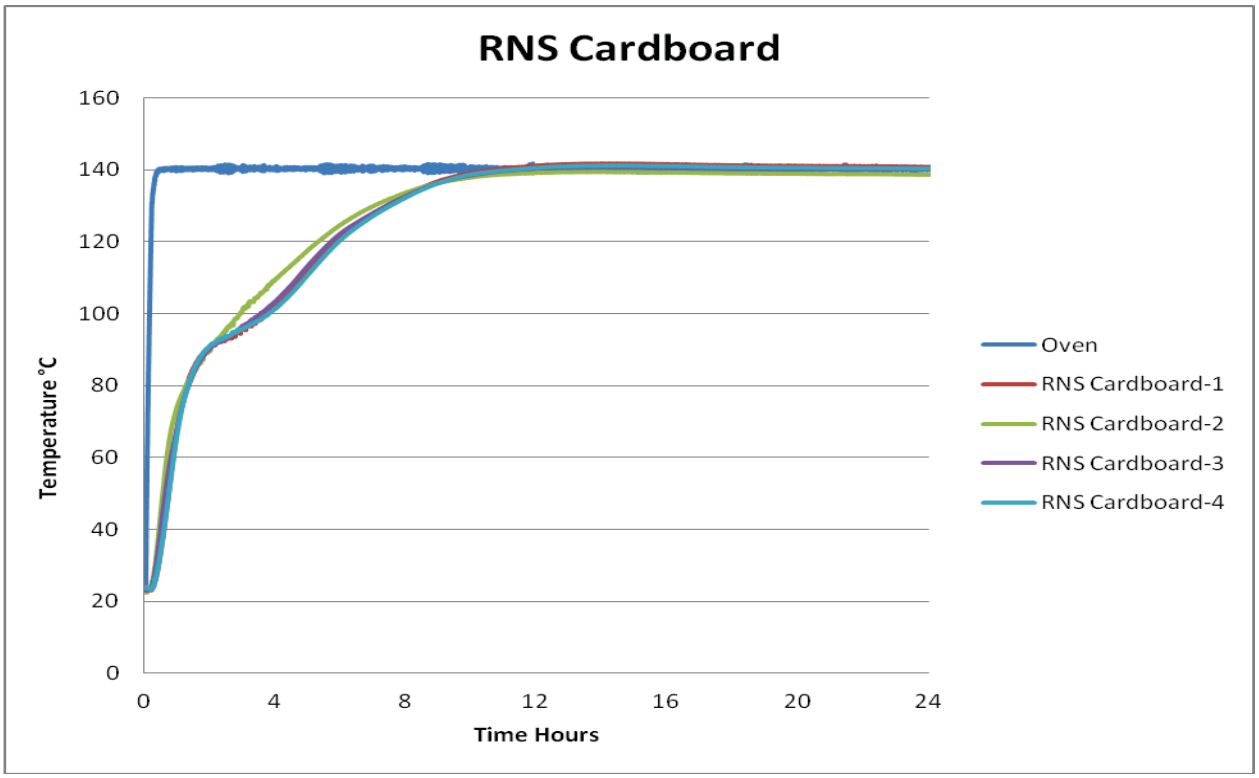


Figure 13. Method 1050 – RNS Cardboard (100mm cube) full run

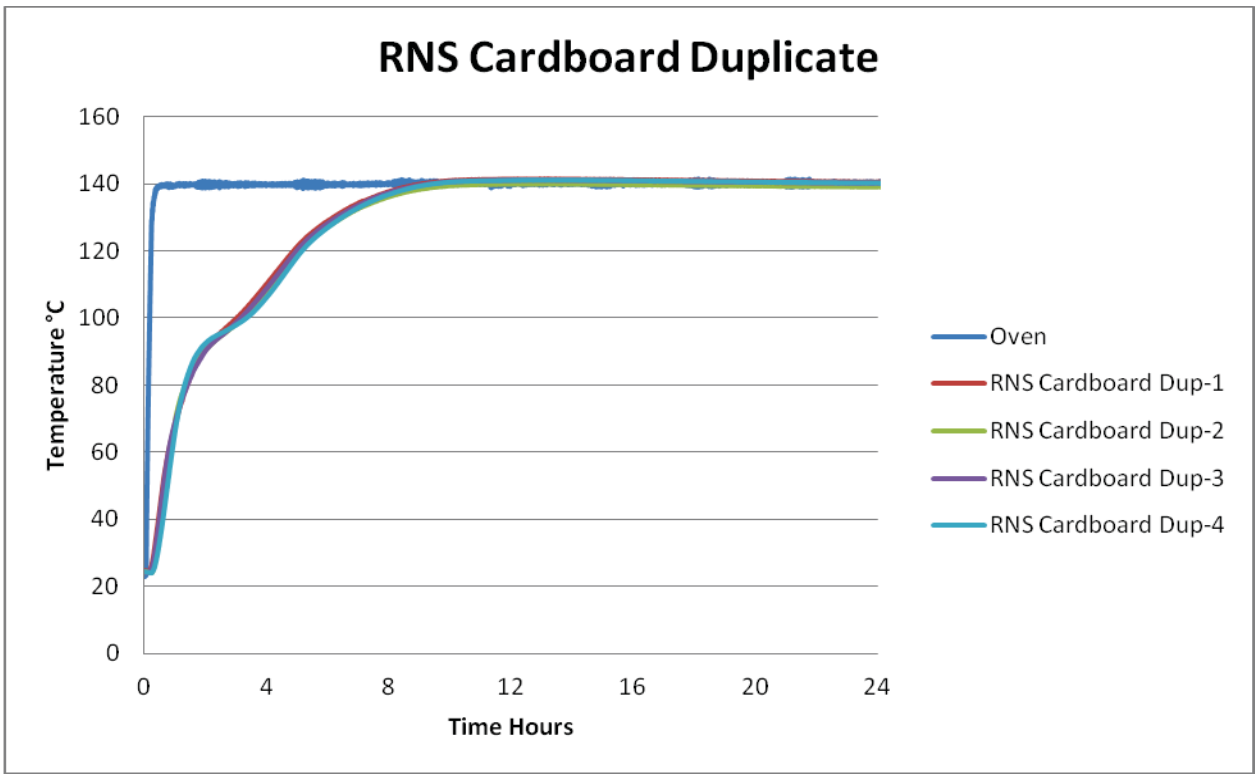


Figure 14. Method 1050 – RNS Cardboard Duplicate (100mm cube) full run

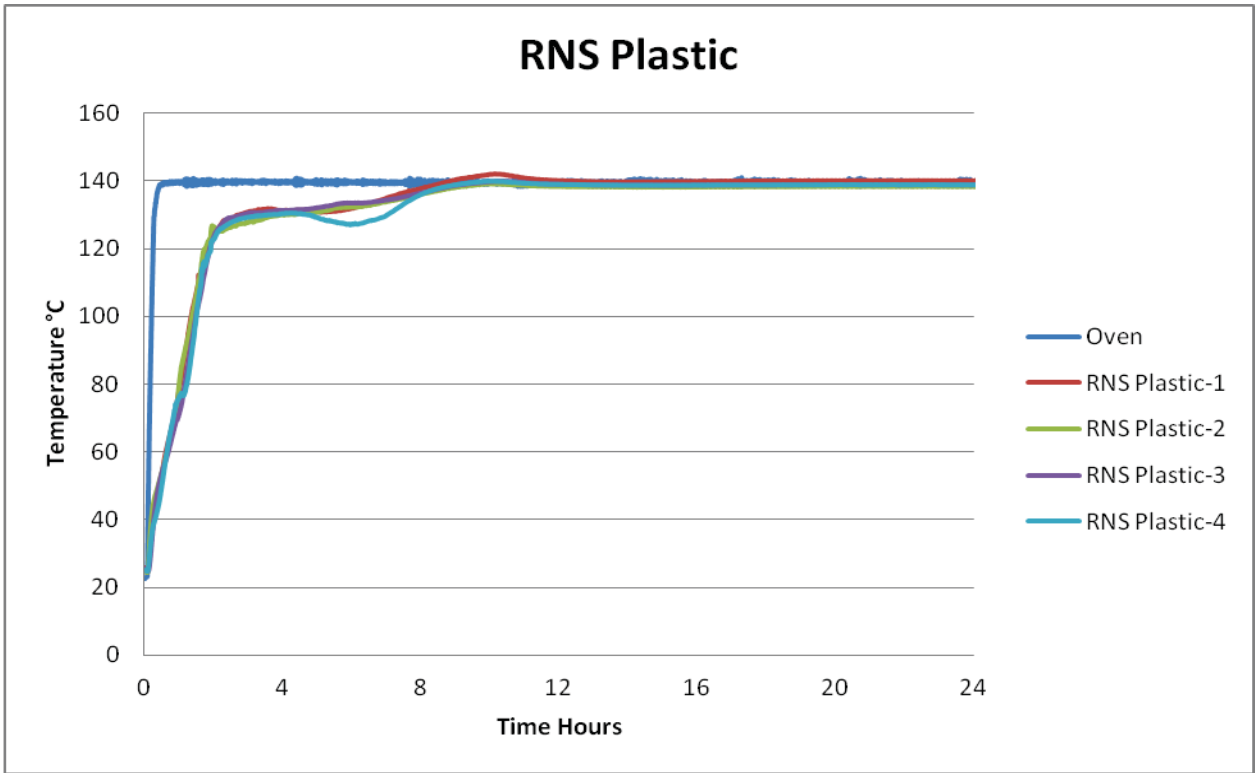


Figure 15. Method 1050 – RNS Plastic liner (100mm cube) full run.

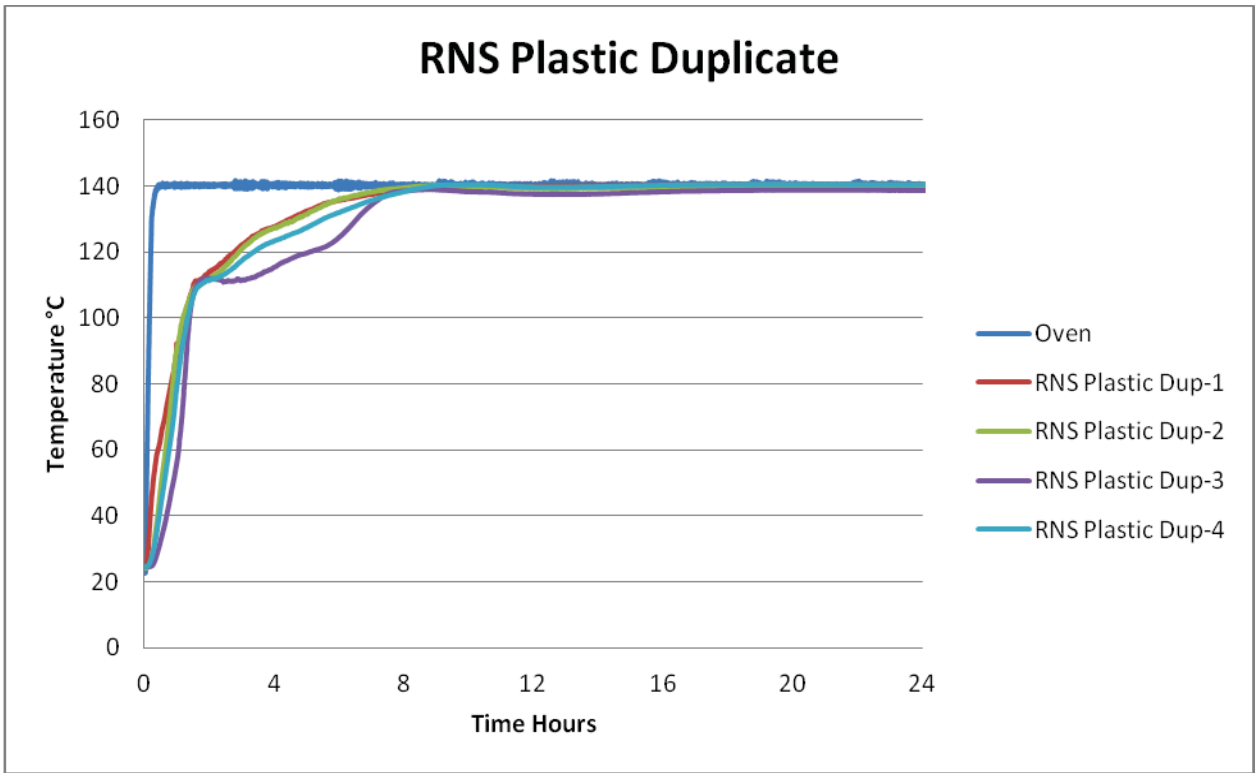


Figure 16. Method 1050 – RNS Plastic liner Duplicate (100mm cube) full run

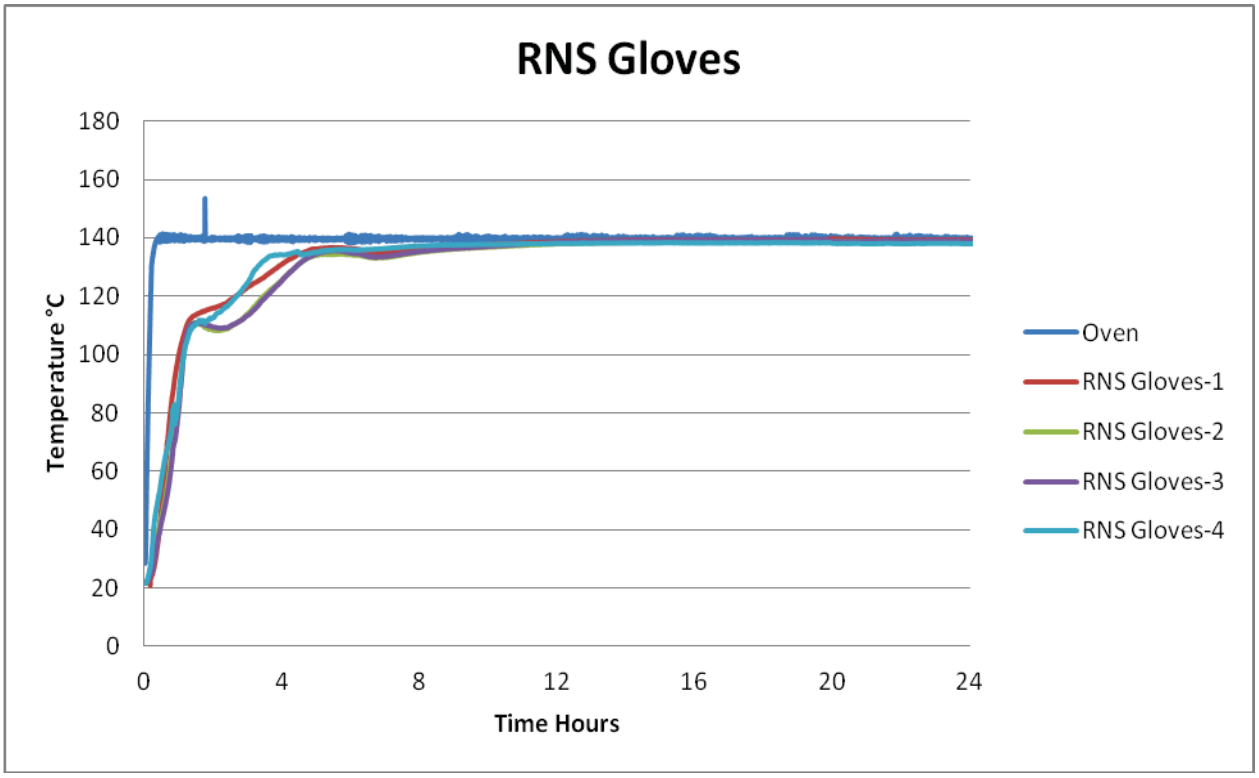


Figure 17. Method 1050 – RNS Rubber gloves (100mm cube) full run.

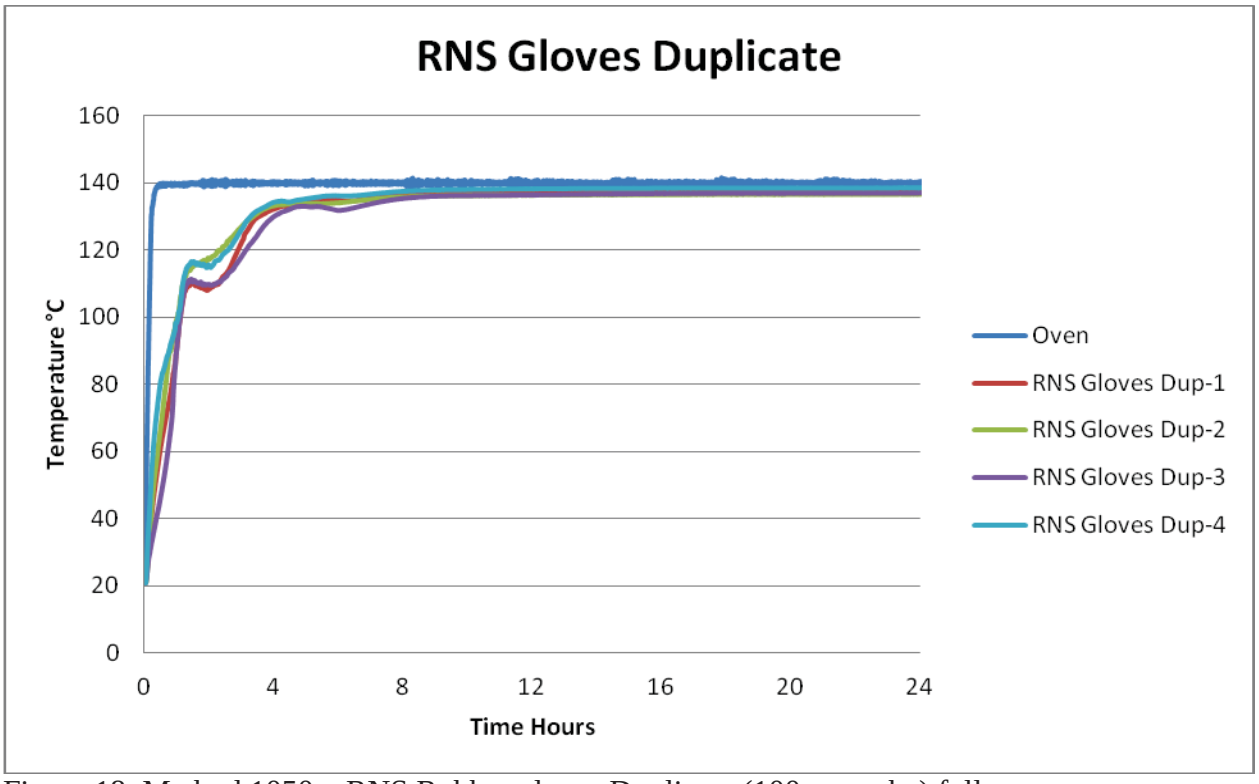


Figure 18. Method 1050 – RNS Rubber gloves Duplicate (100mm cube) full run.

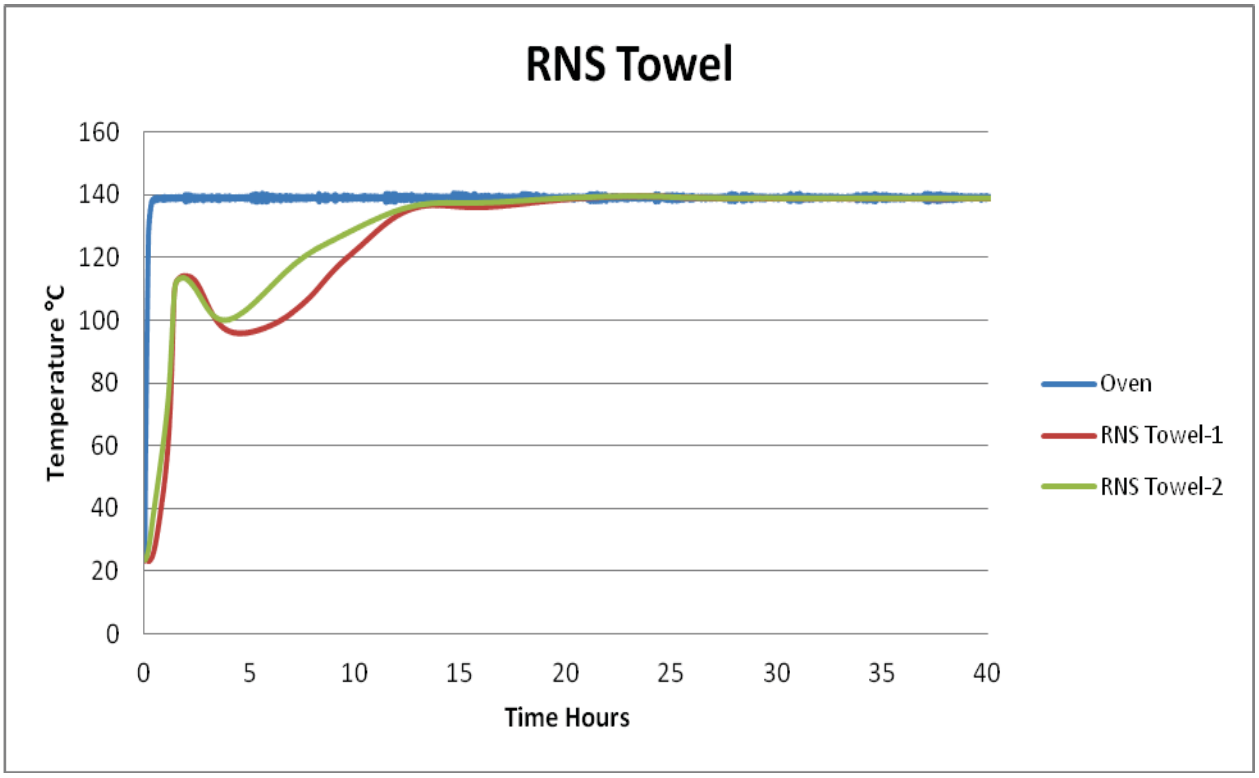


Figure 19. Method 1050 – RNS Towel (100mm cube) two thermocouples malfunctioned during this analysis which is why there are only two in the sample instead of the usual four.

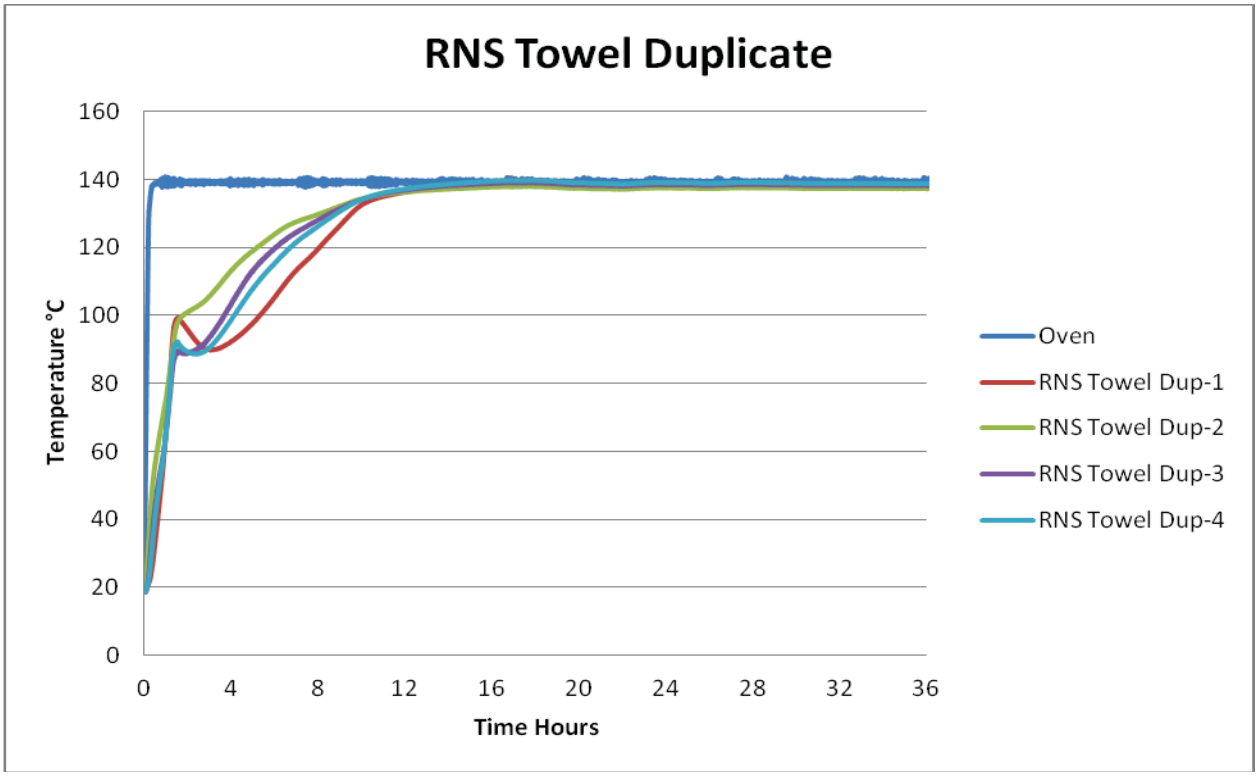


Figure 20. Method 1050 – RNS Towel Duplicate (100mm cube) full run.

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

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
40.847g	Cardboard bulk*	Yes	Yes	Yes	> 4 min 27 sec - did not have to start point + seared tip past shoulder ½ chor.	
	Cardboard 1 piece	Yes TESAM 214116	No	Yes	- flame maintained for several seconds after removal of torch **	
60.154g	rubber gloves	~~Yes~~ No	NO	Yes	- burnt for 3 sec after removing the torch. Charred and burnt around end of torch	
47.876g	plastic	No	NO	Yes	28.40 sec	3.52 mm/sec
6.726g	towel	Yes	Yes	Yes	- sample mainly burned while settling on the outside before burning and charring	
	UNS cardboard	No	NO	slight	- would shrivel and form white granules on the outside of the sample	
	UNS towel	No	NO	No	- maintained a flame 40 sec after removing the torch, blackening ½ sample	
	UNS plastic	NO	NO	Yes	- flame was big when torch initially applied but flame went out when torch removed. Sample charred out from	
	UNS rubber	NO	NO	Yes		

* burnt 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	41.926	66.048
UNS rubber	65.510	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 post 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	- blacks smoke released during extraction of only 3	
UNS cardboard D	No	No	Yes	- flame burnt for 7 sec after torch removed - charred burn burn zone	
UNS plastic D	No	No	Yes	- flame maintained torch. Sample charred and burned only at flame administered point	15 sec after removing
	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: Date: 2/7/16

Reviewed by: 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	
RNs Rubber D	No	No	No	analysis. Did not flame after removing torch.	
RNs towel	No	No	No	the moisture of the towel most likely	
RNs towel D	No	No	No	prevented burning. Sample browned and charred. No propagation.	
RNs cardboard	No	No	Yes	Burned up to 7 seconds after removing the	
RNs cardboard D	No	No	Yes	torch. Bubbled up and heard popping during analysis. No propagation.	
		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.					
LLNS 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: 4:04 2/3/16		stop time: 16:52 2/4/16		
initial wgt dry all trials: 567.77g					
initial wgt soaked trials in cube: 738.74g					
trials not used wgt: 157.35g					
final wgt dry of test trials 482.50g					
Sample came to temperature in about 5 hours. all thermocouples exceeded 140°C by as much as 1°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

Book I.D. 16-0406-001 Book/ Page : 13 009

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 trials in cube:	802.93 g				
trials soaked not used wgt:	129.207 g				
final wgt trials used after analysis:	533.379 g				
Sample runs pretty similarly to the initial run. reaching temperature in about 5 hours. Sample initially exceeded 140°C by as much as 3°C before returning 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

Book I.D. 16-0406-001 Book/ Page : 13 0011

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 (TB 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 stringy 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

Book I.D. 16-0406-001 Book/ Page : 13 0013

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:	13:46 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 cleared from	an	event and some of it appeared to be	charred.		
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 occurred	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. Became sample after all other samples analyzed, became a hardened mass with solidified packets of nitrates.					
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 mixer was not as shiny 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

Book I.D. 16-0406-001 Book/ Page : 13 0015

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 to a darkened charred plastic that was a little brittle to the touch. 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: 15:55	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 RDMs Date: 3/8/16

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

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: [illegible] 2/24/16

RNS Towel

Start:	02/22/16 10:55	Initial wgt:	62.452
Stop:	02/24/16 6:35	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.

[illegible] 2/25/16

RNS Gloves

Start:	02/24/16 12:14	Initial wgt:	351.39
Stop:	02/25/16 13:17	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: [signature] Date: 2/24/16

Reviewed by: [signature] Date: 3/8/16

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 Smith 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 Smith 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 Smith Date: 2/26/16

Reviewed by: RDSmith 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#: S

Notes:

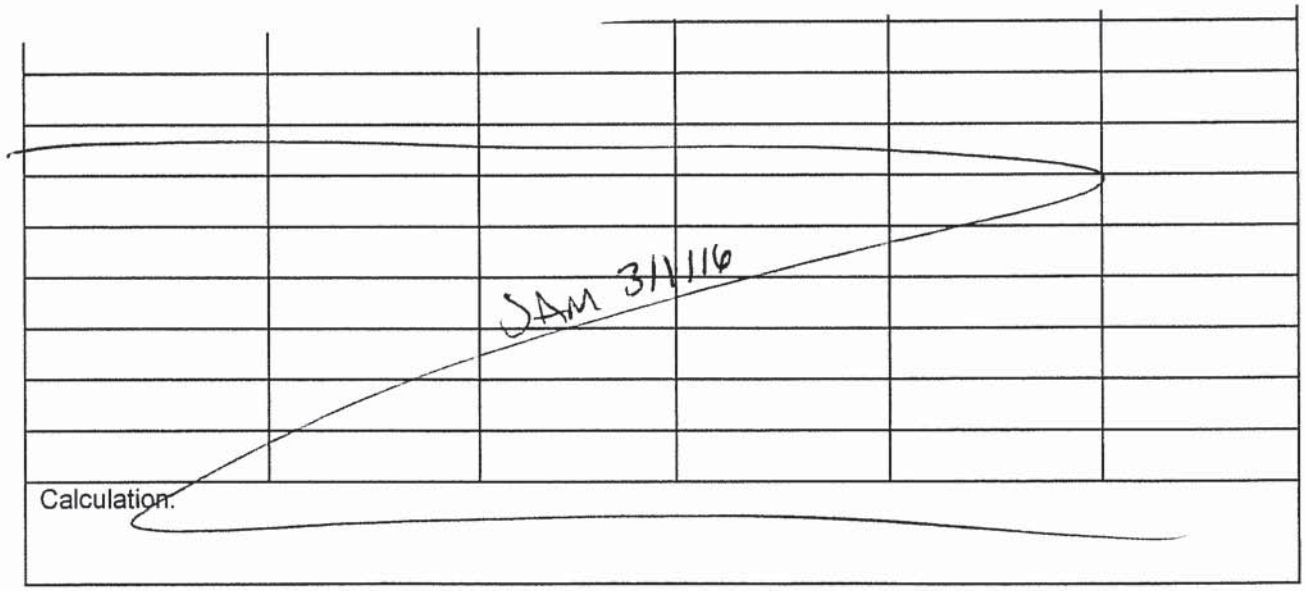
3/11/16

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.



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~~ 135 TESAM 2/9/16

Notes:

Sample ID	Sample Vol / wt	pass through	positive or negative		
LCS	100ml	Yes	positive		
Blend #14	100.4005g	No	negative		
Blend #15	100.7144g	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: Jane Gm Date: 2/9/16

Reviewed by: DDpm 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

154-01-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)

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

SWRI

010084

40-01-WC512 - TISAB3

37.0315 g KCl (# 60103) +
68.0469 g sodium acetate (# 57505) +
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

$AlNO_3$	1387.10	g (# 65580) +
$CaNO_3$	140.1092	g (# 65583) +
$CrNO_3$	10.3012	g (# 61751) +
$FeNO_3$	99.2068	g (# 65581) +
$MgNO_3$	668.10	g (# 65590) +
$NaNO_3$	82.3075	g (# 33383) +
$NiNO_3$	0.4031	g (# 65593) +
$PbNO_3$	99.4642	g (# 66142) +
Oxalic acid	395.604	g (# 65591) +
water	106.904	g +
HNO_3	10.6	g (# 62999)

add 1100 mL DI H_2O

SAM 2/2/16

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Work continued to Page

SIGNATURE James Mark DATE 2/2/16

DISCLOSED TO AND UNDERSTOOD BY R Spencer 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 (184-02-WC011) to water and mix for 5 minutes

42-02-WCS12 Blend #14

40mL of 42-01-WC012 to 120mL zeolite let sit for 24hr

42-03-WCS12 Blend #17

50mL of 42-01-WC012 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-WC011) to water and mix for 5 minutes

42-05-WCS12 Blend #15

40mL of 42-04-WC011 to 120 mL zeolite let sit for 24 hr

42-06-WCS12 Blend #18

50mL of 42-04-WC011 to 100mL zeolite and let sit for 24hr

42-07-WCS12 Blend #20

make a 2:1 water to salt 1:1 solvent (184-01-WC011). take 50mL of this mixture and add it to 100 mL zeolite let sit for 24hr

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Work continued to Page

SIGNATURE [signature] DATE 2/18/16

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE WITNESS DATE 3/8/16

SWRI

Work continued from Page

010086

43-01-WCS12 1:4 salt subtract to water

mix 1part volume to 1part volume of 1:1 salt subtract (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 subtract to water

mix 1part volume to 2part volume of 2:1 salt subtract (43-02-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 subtract (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 subtract (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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Work continued to Page

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Work continued from Page

010087 SWRI

51-01-WCS12 in WB8 : Surrogate

800mL WB8 (29-02-WCS12) to 800mL Surrogate

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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Work continued to Page

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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Work continued to Page

SIGNATURE [signature] DATE 2/18/16

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Work continued from Page

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 TESAM 2/22/16 92	g+
potassium carbonate (# 63914)	39.6017	g+
water	113.18	g

mix A & B together

JAM 2/22/16

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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	✓
1/22/16 1711	DRm2	✓	✓ 16.0	37103.4	✓
1/25/16 1521	DRm2	✓	✓ 18.0	37106.1	✓
1/26/16 1803	DRm2	✓	✓ 18.0	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	Xchange 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 7.6	✓
2/23/16 1801	DRmZ	✓	✓ 17.0	3720 0.3	✓
2/24/16 1703	DRmZ	✓	✓ 15.0	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 1946	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	JK	199.9923	1.99986	0.02001
2-16-15	JK	199.9939	1.99986	0.01996
2/24/15	PW	199.9933	2.00000	0.02001
4/2/15 KE (IC) 4/2/15	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 AN# 011998, 020041, and 012685 11/16/15 KE

DQA RL

Southwest Research Institute®
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	TESTAM 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	1999.95	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

ACCREDITED
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

ACCREDITED
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

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.

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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

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

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		

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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

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.

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

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

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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.

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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

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

010120

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		

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 -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

ACCREDITED
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.

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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

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

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.

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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

ACCREDITED
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.

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

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		

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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

Institute Calibration Laboratory, Bldg. 64, San Antonio, TX 78227, ext. 5215 Page 1 of 1

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

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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		

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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

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		

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:

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

SIGMA-ALDRICH®

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Email USA: techserv@sial.com Outside USA: eurtechserv@sial.com

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

SwRI Chem ID: 63613

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Website: www.sigmaaldrich.com
Email USA: techserv@siai.com
Outside USA: eurtechserv@siai.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: 63613
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010140

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Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

Jamie Gleason

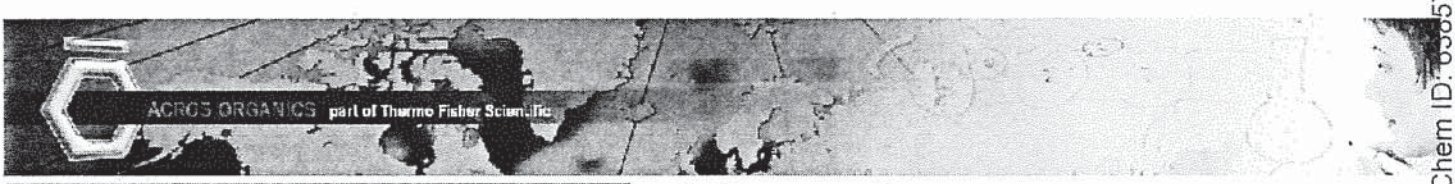
Jamie Gieason, Manager
Quaiity Controi
Miiwaukee, Wisconsin US

SwRI Chem ID: 63613

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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)	

010141

Certificate of Analysis

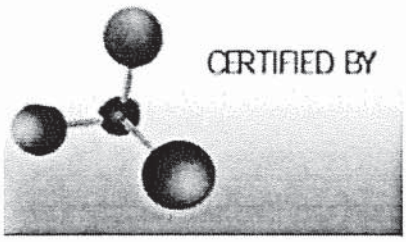
This is to certify that units of the below mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability 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



CERTIFIED BY

L. Van den Broek, QA Manager issued: 28 October 2015

010142

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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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: 63604

Certificate of Analysis

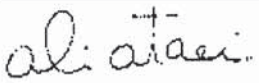
Product Name:
Iron(III) nitrate nonahydrate – ACS reagent, ≥98%

$Fe(NO_3)_3 \cdot 9H_2O$

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



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: 63604

010144

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Email USA: techserv@siai.com
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SwRI Chem ID: 65590

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

SwRI Chem ID: 65590

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: 65590

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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Outside USA: eurtechserv@sial.com

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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010146

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: NTA from D.L.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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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: 65583

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

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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

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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

SwRI Chem ID: 65581

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: 65581

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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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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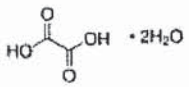
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SwRI Chem ID: 65591

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

010154

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SwRI Chem ID: 65591

Certificate of Analysis

Product Number: 247537
Batch Number: MKBV8626V

Milwaukee, WI US

SwRI Chem ID: 65591

SwRI Chem ID: 65591

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Version Number: 1

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

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:

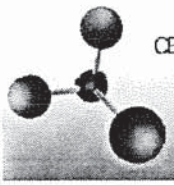
Catalog Number	**A509**	**Mfg. Date**	7/3/2015
Lot Number	**1115060**	**Sample Id**	N/A
Product Description	Nitric Acid (TRACEMETAL GRADE)		
Country Origin	Canada		
Chemical Origin	Inorganic		

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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SwRI Chem ID: 62999
SwRI Chem ID: 62999

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: 62999
SwRI Chem ID: 62999
SwRI Chem ID: 62999

010157

SwRI Chem ID: 61750

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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

SwRI Chem ID: 61750

Certificate of Analysis

010158

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

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: 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

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

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

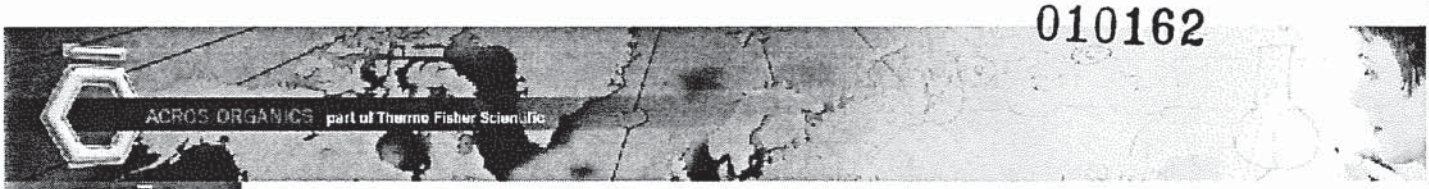
ali ataei

Ali Ataei, Manager
Quality Control
Milwaukee, WI US

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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

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: 36657
SwRI Chem ID: 36657
SwRI Chem ID: 36657

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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

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

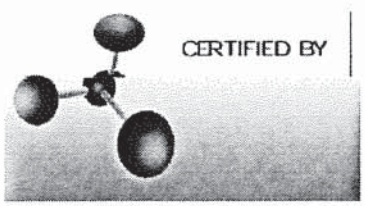
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SwRI Chem ID: 61752

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

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

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

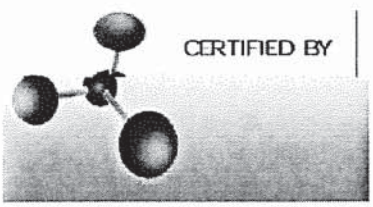
SwRI Chem ID: 47355

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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

SwRI Chem ID: 47355



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

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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

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SwRI Chem ID: 65579
SwRI Chem ID: 65579
SwRI Chem ID: 65579

SwRI Chem ID: 65736

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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: 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

Certificate of Analysis

Product Number: 237124
Batch Number: MKBP5435V

Test	Specification	Result
Recommended Retest Period 3 Years	----------	----------

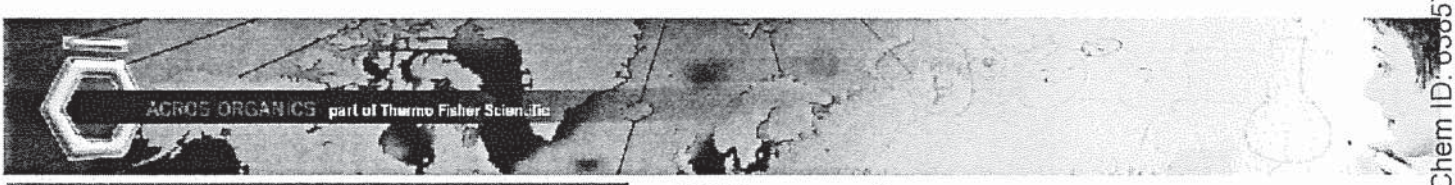
Jamie Gleason

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

SwRI Chem ID: 65736

SwRI Chem ID: 65736

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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

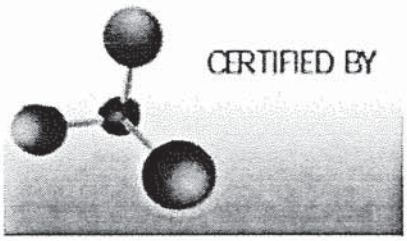
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Catalog Number	21920	**Quality Test / Release Date**	23 January 2014
Lot Number	A0343253	**Suggested Retest Date**	January 2019
Description	Chromium(III) nitrate nonahydrate,99%		
Country of Origin	UNITED STATES OF AMERICA		
Declaration of Origin	synthetic		

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

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

010171

SwRI Chem ID: 63857
SwRI Chem ID: 63857
SwRI Chem ID: 63857

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 %

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SwRI Chem ID: 65737

SwRI Chem ID: 65737

SwRI Chem ID: 65737

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Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

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

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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

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

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

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

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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

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SwRI Chem ID: 65580
SwRI Chem ID: 65580
SwRI Chem ID: 65580

010177

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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

SwRI Chem ID: 63613

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

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

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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: 63613

SwRI Chem ID: 63613

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 K

M7-16-6042, Rev 1 - Results from First Round of Remediated Nitrate Salt Surrogate Formulation and Testing

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.

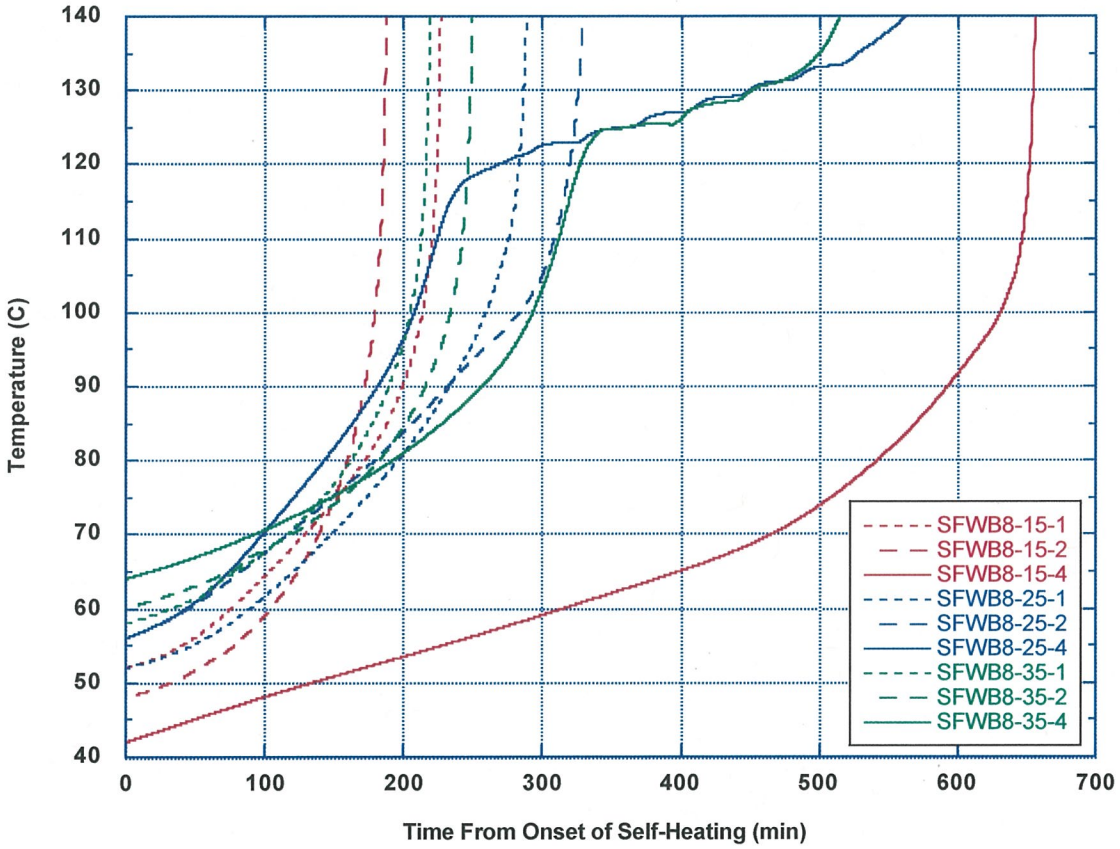


Figure 1. APTAC temperature vs time plots for all RNS mixtures

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.

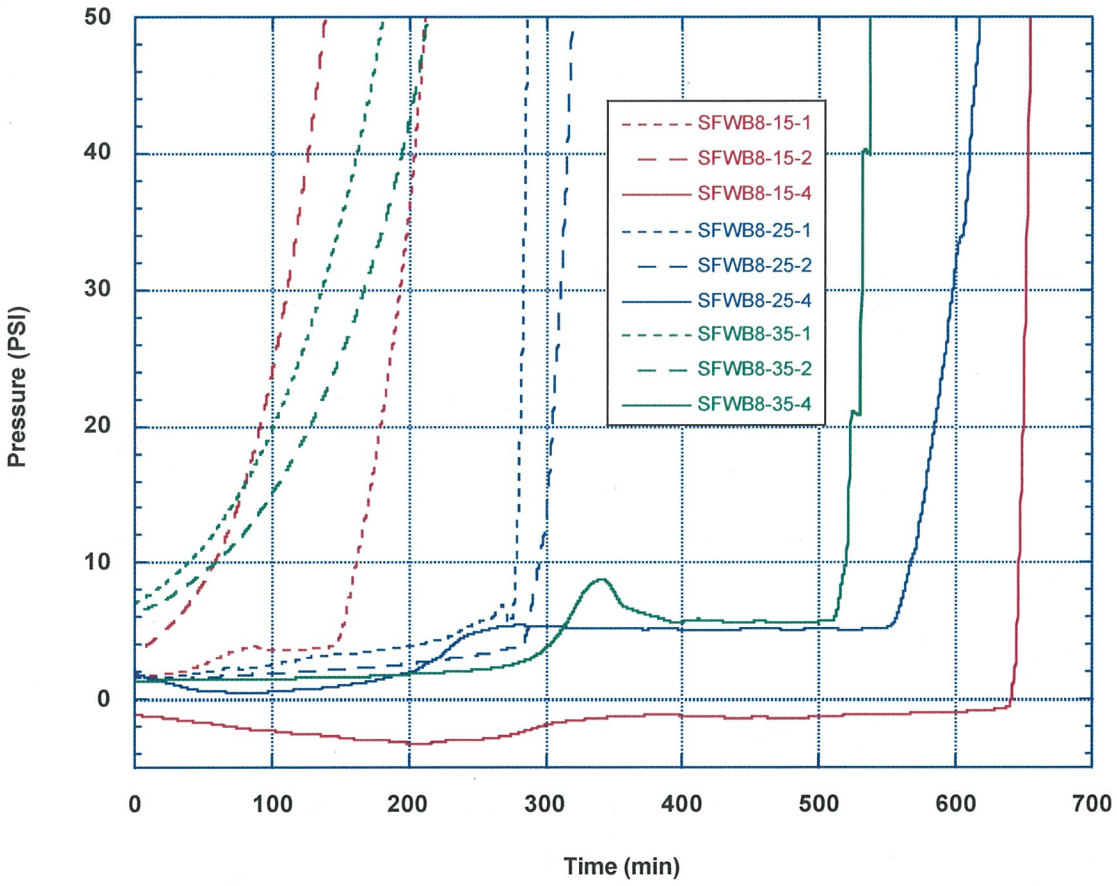


Figure 2. APTAC pressure vs time plots for all RNS mixtures

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 % S wheat Salt mixture 1% Pb

Barcode	LOT#	Material	grams	actual	wt %
1338365	142295	Al(NO3)3 * 9 H20	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
1336089	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	143996	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 precipitated

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 vials 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

Batch 15-2

4.2.11 Add
at
4.2.12 Temp
4.2.13 L
4.2.14 Hea
Time Sta
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 WIPP 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	F04Y024	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 Wheat Scoop to Wetted nitrate salt
4.2.12 Gauge glass Container with mixture and heat ~60°C for ~4 hr

4.2.13 Label sampler
4.2.14 Heat Container heated 4.5 hr, 60.0°C
4.2.15 Remove Cap and allow to stand overnight
4.2.16 Submit material
Material Submitted "SFWBS-35-2"

SIGNATURE _____ DATE _____ 20
READ AND UNDERSTOOD _____ DATE _____ 20

PROJECT NAME WIF formulation Page A-5 NOTEBOOK NO.

Philip Leonard ~~11/30/15~~ 12-7-15 to 12-8-15 pnl

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 Lot#	Column4 grams	Column5 Actual g	Column6 wt %
Barcode	Material	~~142299~~			
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	~~F04Y024~~ F04Y024	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	~~145286~~ pnl	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

4.2.7 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 Sulfuric 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 SFWSS-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 1-ds

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-Tare #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. w
pierced with a 21ga needle. Volume expansion
1.5x was observed but foaming appeared to
be minimal. During heating the contents did n
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 Submitted 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 Sulfheat 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 SFWS8-25-2

4.2.14 Heat Containers Temp Setting = 60°C Time
Surface temp: ~~60~~ 58.5 - 59.0
Observations: Material expanded to 2x volum
ejecting lid and partially sealing containers

4.2.15 Remove Cap and let Stand overnight
Ended 4:45

4.2.16 Submit material
Submitted 12-15 10am

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. Tm 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 "WJ38" 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	143861	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 = 65s

4.2.4 Weigh Swheat Scoop

4.2.5 Transfer to a second mortar

4.2.6 Grind Swheat scoop time = 70s

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. _____

1.29 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 Stainless Steel Scoop to wetted nitrate and stir
time = 66s

2.12 Transfer to Container

2.13 Label Samples with Name, Date, Time of preparation, and hazards
Labelled PuL-V-107 WIPP SFW138-25-4
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

2.16 Submit material
Request sent 10:40a Samples = 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 Hartley	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	12/14/15
	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	10.001 10.000 11/10/15 MMS 138385	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:

12/11/15 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: ~~Hermetic~~ 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) Comp B (VLWM prep) (52220)	58.211	1.022
PBX 9502 88H-891-008	58.513	0.896
PBX 9501 Hol 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 - Numbered Sealing Al pans
pair lock lids for comparability ~~Stab~~ studies
UHP N2 gas

Reference 58.213

Sample	pan wt	Sample wt
Indium Std (Lot B087008)	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 B087008)~~	—	—
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 B087008	58.427	5.329

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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~~ 58.263
mass 2.118 15
1.8387

Sample	pan wt	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	3.838
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

TITLE DSC 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 7A7B) 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	57.424	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

Continued to page

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: S8.003

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

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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: 6/20/16
- Weight Set: Ainsworth Weight Set TFG: 01736 File#: 033587
  Certified: 2/14/14 Expires: 2/14/16
- Room Temperature: 20.0°C
  Relative Humidity: 32%
- Friction Test: F50 = 74.2N 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: 151201001 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.

HI 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 Hongshao Jiao DATE 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: H3O > 320 cm σ = NA
Test 2: H3O > 320 cm σ = NA
Test 3: H3O > 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: H3O > 320cm; σ = NA
Test 2: H3O > 320 cm; σ = NA
Test 3: H3O > 320 cm, σ = NA

HT 230045 12/10/15

Continued to page Stop

SIGNATURE Hongshao Tian
DATE 12/10/15
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DATE

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BALANCE CALIBRATION LOG

BOOK PAGE

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±5 HT

Signature: Hongshuo Yan 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: F50 > 360N; σ = NA
  - Test 2: F50 > 360N; σ = NA
  - Test 3: F50 > 360N; σ = NA
- SFWB 8-25-2
  - Test 1: F50 > 360 ~~N~~; σ = NA
  - Test 2: F50 > 360 ~~N~~; σ = NA
  - Test 3: F50 > 360 ~~N~~; σ = NA

(HI 29000ES 12/18/15)

12/18/15

Room Temp: 19°C
Relative Humidity: 32%
Balance Book: 011-16
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

Continued to page Stop

SIGNATURE Hongzhou Jiao DATE 12/18/15

DISCLOSED TO AND UNDERSTOOD BY NA DATE NA

PROPRIETARY INFORMATION BELONGING TO Los Alamos Research Laboratories

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 230845 HT

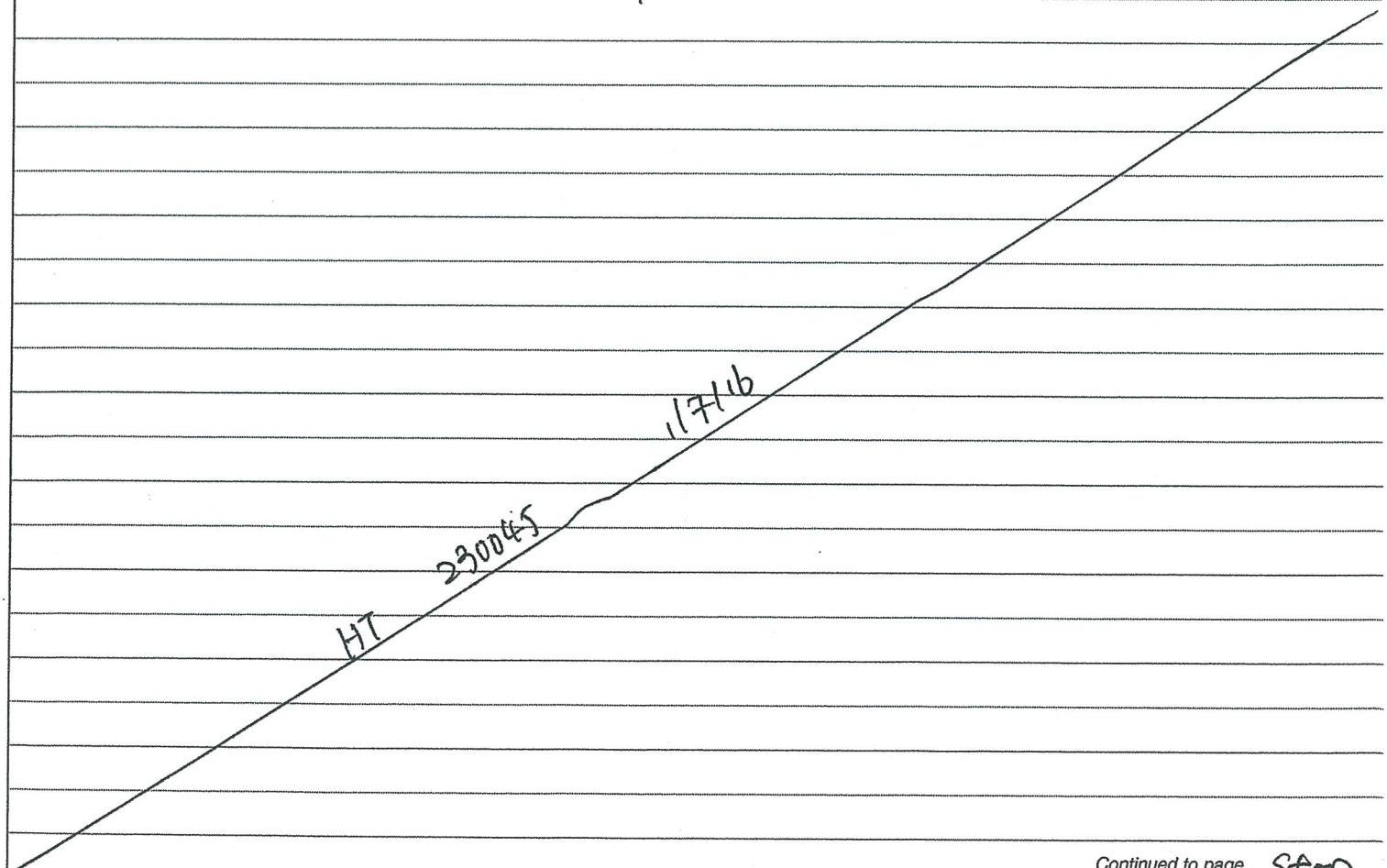
Signature: Hangzhao Jiang Date: 12/18/15 Title: Tech IV

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: 21%
- ESD: 0.025J
- FRI: Mu = 78.2N σ = 17.3N
- 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# 037082 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

Los Alamos National Laboratories

BALANCE CALIBRATION LOG

011 - BOOK 17 PAGE

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 HT 2300645

Signature: Hongshan 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 Start

- 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
- SFWB8-35-2 { 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

PROPRIETARY INFORMATION BELONGING TO Los Alamos Research Laboratories

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

HT 1/14/16 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 jarred 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
Shot 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
Shot vessel = 0	32.2

Continued to page

SIGNATURE DATE

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TITLE WIPP PROJECT

Continued from page

11/3/15 Temperature Verification + Pressure verification
APTAC model: APTAC 264
SERIAL number: 002L0715-6060024447

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

RTD (°C) Temperature	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.

Continued to page

SIGNATURE

DATE 11/3/15

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TITLE WIPP

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: 0.05C
Limit Temp: 250C — Exotherm Limit: 400C
Temp increase: 2C — Heat Rate: 2C/min
cool Down Temp: 50C — Min. Pressure: 0psi
mode: HWS

File Name: Lab52219 SFWB8-15-2

Comments: 1.87g Residue some unreacted material

no plugging

Continued to page

SIGNATURE [signature] DATE 1/13/16

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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 : 250C
Temp increment : 2C
Cool down Temp : 50C
mode : HWS

Exotherm Threshold : 0.05C
Exotherm Limit : 400 C
heat RATE : 2C/min
min. pressure : 0 psi

File NAME : LA052219 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 250psi to 38psi. Will not go below 38.7 pressure increase with system vented back to this pressure. attempting to remove Reaction vessel. PRESSURE @ 39.5psi 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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DATE 12/9/15

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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, File#040858
model: XP504

WIPP sample: SFWB8-25-1 Lims: 151215001
Weight Taken on mettler Toledo scal TFG#02049, File#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: LAB52219SFWB8-25-1

* System Plugged again 525 psi Trapped in vessel @ the Transducer, Lines Removed & flushed to Remove debris.

Continued to page

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ED Hoa

DATE
12/17/15

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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

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DATE 12/18/15

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TITLE WIPP PROJECT

Continued from page

12/3/15
APTAC model: APTAC 264
Serial #: 0021 0715-60600 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 @ 0 psi.

.77g of material Recovered from sample vessel. Excluding glass.

Continued to page

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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: LA652219SFWB8-35-2

comments:

Continued to page

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DATE 1/15/16

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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: SFWB8-35-4, 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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DATE 12/11/15

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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

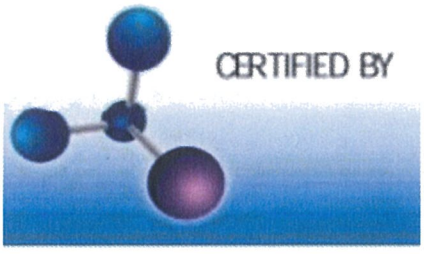
Certificate of Analysis

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



Lab Manager BPF

Appendix L
SwRI Test Report, March 29, 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

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

VTSR: 09/03/15 Time: 08:30:00

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

Sample Receipt Number: S6087
Revision: 3

This Receipt was Revised 12/18/2015

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~~ 1255 ID# 022492
3/28/16

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%