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Title/Desc:

TEST PLAN FOR LITC ARROW-PAK PACKAGING DOCKET  
95-40-7A TYPE A CONTAINER

OCT 23 1995

22

## ENGINEERING DATA TRANSMITTAL

Station 35

Page 1 of /

1. EDT

No 611188

2. To: (Receiving Organization) Packaging Operations & Development	3. From: (Originating Organization) Packaging Operations & Development	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: 84400/TH540	6. Cog. Engr.: D. L. Kelly	7. Purchase Order No.: (LITCO/WHC) C95-K24120
8. Originator Remarks: For review, approval, and release.		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: N/A
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		13. Permit/Permit Application No.: N/A
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1	WHC-SD-TP-OTP-002		0	Test Plan for Lockheed Idaho Technologies Company, ARROW-PAK Packaging, Docket 95-40-7A, Type A Container	S,Q	1,2	1 <i>D.L.K.</i> 10/12/95	/

16.

## KEY

Approval Designator (F)	Reason for Transmittal (G)				Disposition (H) & (I)			
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval	4. Review	1. Approved	4. Reviewed no/comment	2. Release	5. Post-Review	2. Approved w/comment	5. Reviewed w/comment
	3. Information	6. Dist. (Receipt Acknow. Required)	3. Disapproved w/comment	6. Receipt acknowledged				

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1	/	Cog. Mgr./D. M. McCall/	<i>D. M. McCall</i>		G2-02						
1	/	QA/C. R. Hoover	<i>C. R. Hoover</i>	10-10-95	G2-02						
1	/	Safety/D. W. McNally/	<i>D. W. McNally</i>	10-11-95	G2-02						
		Env. -- N/A									
1	/	T. Romano/	<i>T. Romano</i>	10-10-95	G2-02						
1	1	J. H. O'Brien/	<i>J. H. O'Brien</i>	10-10-95	G2-02						

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D. L. Kelly/ <i>D. L. Kelly</i> Signature of EDT Originator	D. L. Kelly/ <i>D. L. Kelly</i> Authorized Representative Date for Receiving Organization	D. L. McCall/ <i>D. L. McCall</i> Cognizant Manager	Ctrl. No. <input type="checkbox"/> Approved <input type="checkbox"/> Approved w/comments <input type="checkbox"/> Disapproved w/comments

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## RELEASE AUTHORIZATION

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Document Title:	Test Plan for Lockheed Idaho Technologies Company (LITCO), ARROW-PAK Packaging, Docket 95-40-7A, Type A Container
Release Date:	10/23/95

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**APPROVED FOR PUBLIC RELEASE**

WHC Information Release Administration Specialist:

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10/23/95

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## SUPPORTING DOCUMENT

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		<b>Organization/Charge Code 84400/TH540</b>

## 7. Abstract

This report documents the U.S. Department of Transportation Specification 7A Type A (DOT-7A) compliance testing to be followed for qualification of the Lockheed Idaho Technologies Company, ARROW-PAK, for use as a Type A packaging. The packaging configuration being tested is intended for transportation of radioactive solids, Form No. 1, Form No. 2, and Form No. 3.

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**TEST PLAN FOR LOCKHEED IDAHO TECHNOLOGIES COMPANY,  
ARROW-PAK PACKAGING, DOCKET 95-40-7A,  
TYPE A CONTAINER**

**1.0 INFORMATION**

The packaging being tested in this Test Plan is designed and constructed by Arrow Construction, Inc., of Montgomery, Alabama. This packaging manufacturer is being sponsored by Lockheed Idaho Technologies Company (LITCO), Idaho Falls, Idaho. The packaging is being tested for use by the U.S. Department of Energy (DOE) and its contractors, and according to U.S. Department of Transportation Specification 7A Type A (DOT-7A) requirements. The DOE-approved test facility and personnel that will be utilized are located at the Hanford Site in Richland, Washington. Testing is being conducted by Westinghouse Hanford Company (WHC).

The objective of this Test Plan is to describe the testing for certification of the 25.4-cm (10-in) diameter, ARROW-PAK packaging. The nominal, overall length of the tested ARROW-PAK package is 182.88-cm (72-in). The estimated gross weight of the packaging is 453.6 kg (1000 lb). Actual gross weight for the packaging configuration will be obtained at time of testing.

The ARROW-PAK packaging system consists of a Marlex M-8000 resin pipe manufactured by Phillips-Driscopipe, Inc.<sup>1</sup>, and is sealed with end caps manufactured from the same materials via a patented process developed by Arrow Construction, Inc. The patented process involves the use of electrical energy to heat opposing faces of the pipe and end caps, and hydraulic rams to press the heated surfaces together. The result is a homogeneous bonding of the end cap to the pipe. A total of two plywood spacers were used inside the loaded ARROW-PAK test units. The purpose of these spacers is to hold the simulated contents in place during the fusion process. One spacer is placed at the "open" end of the cylindrical tube and the second spacer is placed at the "open" end of the second end cap, prior to these two pieces being fused together.

Due to the complexity of the thermal sealing process and the machinery involved, the test units will be filled with the simulated contents as described in Section 2.0 of this Test Plan, assembled, loaded, and closed by BOH Brothers Construction Company, Inc., New Orleans, Louisiana. (BOH Brothers Construction Company is a subcontractor to Arrow Construction Company.) The WHC test and/or project engineer(s) will witness the assembly, loading, and closure process prior to testing.

The ARROW-PAK packaging is designed to ship Type A, solid, radioactive materials, normal form, Form Number 1, Form Number 2, and Form Number 3.

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<sup>1</sup>Phillips Driscopipe is a Division of Phillips Petroleum Company.

A description of the packaging to be tested is provided in Section 2.0 of this Test Plan. Refer to Appendix A for a sketch of the ARROW-PAK configuration being tested.

Test Date: October 16, 1995  
Docket No.: 95-40-7A  
Packaging Name(s): LITCO, ARROW-PAK Packaging  
Applicant Name and Address: Dr. Harley W. Reno  
Lockheed Idaho Technologies Company  
P.O. Box 1625  
Idaho Falls, Idaho 83415-2113  
Applicant Phone: (208) 526-9865

## 2.0 PACKAGING DATA

Packaging Manufacturer: Arrow Construction, Inc.  
216 Gunn Road  
P.O. Box 240427  
Montgomery, Alabama 36124  
(205) 271-6185

Container Identification Numbers: Not applicable.

Physical Specifications:

The ARROW-PAK is constructed from Phillips Driscopipe Marlex M-8000 resin, high-density polyethylene (HDPE) tubing that is thermally butt-welded to thick HDPE end caps that are manufactured from the same materials.

Overall Length 182.88-cm (72-in) (nominal)

Cylindrical Tube:

Length	121.92-cm (48-in) (nominal)
Diameter	27.30-cm (10.75-in) - outside 22.34-cm (8.796-in) - inside (nominal)
Wall thickness	2.532-cm (0.997-in) (minimum)

Materials	The pipe/tube is to be manufactured from Phillips Driscopipe Marlex M-8000 resin and bear Driscopipe label of 8000 (gas) or 8600 (industrial).
<u>End Caps:</u>	Phillips Driscopipe; 10 (SDR 11) IPS; Part No. 80M100110CPSTB
Length	2 end caps, each 30.48-cm (12-in) (nominal)
Diameter	27.30-cm (10.75-in) - outside 22.34-cm (8.796-in) - inside (nominal)
End-cap thickness	2.532-cm (0.997-in) (minimum)
<u>Plywood Spacers:</u> (optional)	Top, outer diameter 21.9 cm (8.625-in) Bottom, outer diameter 20.6 cm (8.125-in) Thickness 1.9 cm (0.75-in)
<u>Gross Weight:</u>	The 25.4-cm (10-in) diameter ARROW-PAK has an estimated gross weight, including contents, of 453.6-kg (1000-lb). The actual gross weight of test packagings will be obtained at time of testing.
<u>Net Weight:</u>	The 25.4-cm (10-in) diameter ARROW-PAK has an estimated net weight of 45.36-kg (100-lb). The weight of the pipe, per foot, is 5.94-kg (13.09-lb). The weight of each end cap is 7.71-kg (17-lb). Net weight of test packagings will be determined during preloading inspection at BOH Brothers Construction Company, Inc., by using up-to-date calibrated equipment.
<u>Physical Form:</u>	<u>Form Number 1:</u> Solids--any particle size. <u>Form Number 2:</u> Solids--large particle size only (e.g., sand, concrete, debris, soil). <u>Form Number 3:</u> Solids--objects with no significant dispersible or removable contamination.

**NOTE: Due to the complexity of the thermal sealing process and the machinery involved, the test units will be partially filled with simulated contents and closed at BOH Brothers Construction Company, Inc., New Orleans, Louisiana. The WHC test and/or project engineer(s) will witness the assembly, loading, and closure process prior to testing. The sponsor is responsible for ensuring that all three test units are sound and do not leak prior to shipment to the DOE-approved test facility for Type A testing. The remaining simulated contents, a tracer material used for leak testing, will be added at the DOE-approved test facility.**

**Contents:**

The packagings described herein are designed to ship Type A quantities of solid radioactive materials, normal form, Form Number 1, Form Number 2, and Form Number 3.

Three complete units will be supplied for testing purposes.

Two 25.4-cm (10-in) diameter ARROW-PAKs will be filled with simulated contents of clean, noncontaminated, and taped lead bricks. Carbon steel shot will be added as a filler material. It is estimated that the lead bricks will make up 65% of the content fill weight [265.35-kg (585-lb)], and the steel shot will make up 35% of the content fill weight [142.88-kg (315-lb)].

A third ARROW-PAK will be left empty. All three packagings will then be sealed via the patented thermal process.

Prior to testing at the approved DOE-test facility, fluorescein will be added to all three test units. The fluorescein will be used to simulate material Form Number 1, and for leak detection purposes.

**3.0 TEST UNIT MARKING**

**LOADING AND CLOSURE OF TEST UNITS WILL BE PERFORMED AT BOH BROTHERS CONSTRUCTION COMPANY, NEW ORLEANS, LOUISIANA.  
WHC TEST FACILITY PERSONNEL NEED TO BE PRESENT DURING THE  
LOADING AND CLOSURE OF TEST UNITS TO ENSURE PROPER MARKING.**

Each test unit should be marked in accordance with *DOT-7A Packaging Test Procedure*, Section 6.3 (Kelly 1995). The components to be marked are the ARROW-PAK tube and end caps. The numbers to be used in marking the test units are listed below. Mark the exterior assembled surface with four axis lines, 90° apart. The axis lines shall be labelled W, X, Y, and Z. Orientation

angles for drop test or penetration test impact locations will be measured from the W axis.

Test Unit Marking

40-TU-01 and 40-TU-02	Filled with simulated contents
40-TU-03	Empty

The test applicant will supply the following:

- Calibrated weighing and measuring devices will be provided by BOH Brothers Construction Company, at the time of inspection and loading. This will be to ensure proper net and gross weight is recorded prior to the permanent sealing process being applied to the test units. Calibration and equipment information is to be supplied to the WHC test personnel prior to inspection and loading. An example of the information to be supplied is equipment type, model, serial number, calibration accuracy, date of calibration, and calibration expiration.
- Two test units, 25.4-cm (10-in) diameter ARROW-PAK packagings, each filled with the identified simulated contents as described in Section 2.0 of this Test Plan.

NOTE: The sponsor is responsible for drilling and tapping two holes into the center of one end cap, on each of these test units. The sponsor is responsible for placing a suitable hex-socket plug into each of the holes. It is suggested that the hex-socket plugs be 1/2-inch normal pipe thread (NPT), and be flush or below the surface of the end caps. Refer to Appendix B, Figure B-1, for diagram of hole placement on these two test units.

- One empty test unit, 25.4-cm (10-in) diameter ARROW-PAK packaging.

NOTE: The sponsor is responsible for drilling and tapping a hole into one end cap. The sponsor is responsible for placing a suitable hex-socket plug into the hole. It is suggested that the hex-socket plugs be 1/2-inch NPT, and be flush or below the surface of the end cap. Refer to Appendix B, Figure B-1, for diagram of hole placement on this test unit.

#### 4.0 PRELOADING INSPECTIONS

PRELOADING INSPECTIONS WILL BE PERFORMED AT BOH BROTHERS  
CONSTRUCTION COMPANY, NEW ORLEANS, LOUISIANA,  
BY THE WHC TEST FACILITY PERSONNEL PRIOR TO PACKAGING CLOSURE.

**NOTE:** Calibrated weighing and measuring devices will be provided at the time of inspection and loading by BOH Brothers Construction Company, to ensure proper net and gross weight is recorded prior to the permanent sealing process being applied to the test units. Calibration and equipment information is to be supplied to the WHC test personnel prior to inspection and loading. An example of the information to be supplied is equipment type, model, serial number, calibration accuracy, date of calibration, and calibration expiration.

Perform preloading inspections on each test unit in accordance with *DOT-7A Packaging Test Procedure*, Section 6.4 (Kelly 1995) and per the manufacturer's instructions. Record the data on the supplied test data sheets 6.4.1, 6.4.2, and 6.4.3 (see Appendix C of this Test Plan). A separate set of data sheets is supplied for each test unit.

Perform a visual inspection in accordance with *DOT-7A Packaging Test Procedure*, Section 6.4.1 (Kelly 1995). Visually inspect all surfaces of all units received to ensure that they are in good condition. The visual inspection shall include the following:

Tube - The ARROW-PAK tube shall be free from visible cracks, holes, voids, foreign inclusions, or other evidence of damage.

End Caps - The ARROW-PAK end caps shall be free from visible cracks, holes, voids, foreign inclusions, or other evidence of damage.

Note any deviations from the manufacturer's specifications; defects in construction, deterioration, deformation, or distortion of features. Record the data on the Packaging Visual Inspection Data Sheet (6.4.1) (see Appendix C of this Test Plan). Use a separate data sheet for each test unit.

Weigh the major components of all major packaging parts. The major components to be weighed are the following:

- ARROW-PAK tube
- ARROW-PAK end caps

Conduct the weighing in accordance with *DOT-7A Packaging Test Procedure*, Section 6.4.2 (Kelly 1995). Note the weight of the inspected parts on the Packaging Component Weight Data Sheet (6.4.2) (see Appendix C of this Test Plan). Use a separate data sheet for each test unit. The following measurements will be recorded:

- Measure the net weight of the assembled and closed packaging without contents.
- Measure the gross weight of the package loaded with simulated contents.

**NOTE: Although a net and gross weight measurement will be taken by the test engineer at the BOH Brothers Construction Company field office, the weights will be confirmed at the DOE-approved test facility prior to testing.**

The package consists of one containment boundary. Containment is provided by the ARROW-PAK tube and two thermally sealed end caps. Conduct the containment inspection in accordance with *DOT-7A Packaging Test Procedure*, Section 6.4.3 (Kelly 1995). Record the results and locations of the measurements of the Packaging Component Wall Thickness Data Sheet (6.4.3) (see Appendix C of this Test Plan). Use a separate data sheet for each test unit.

- Measure the external length of the tube.
- Measure the inner diameter and outer diameter of the tube. Check the roundness of the cylindrical tube.
- Measure the diameter of the end caps.
- Measure the thickness of the end caps in three randomly chosen places.
- Measure the length of the end caps.

The packaging provides containment for Type A radioactive solids, Form Number 1, Form Number 2, and Form Number 3. Upon receipt of the packagings from the sponsor, conduct the "soap bubble test" as outlined in Section 6.1 of this Test Plan. At the conclusion of all testing, conduct the containment boundary verification in accordance with Section 8.1 of this Test Plan.

## 5.0 SIMULATED PAYLOAD

The simulated payload to be used is described below.

40-TU-01 &

40-TU-02

Loading, assembly, and closure will be performed per the manufacturer's instruction. Refer to Appendix B of this Test Plan. These two test units will be filled with simulated contents of clean, noncontaminated, and taped lead bricks. Carbon steel shot will be added as a filler material. It is estimated that the lead bricks will make up 65% of the content fill weight [265.35-kg (585-lb)], and the steel shot will make up 35% of the content fill weight [142.88-kg (315-lb)]. Straight fluorescein will be added prior to testing (see Appendix B, Section 6.0 of this Test Plan). These test units will undergo vibration and drop testing.

40-TU-03      Assembly, and closure will be performed per the manufacturer's instruction. Refer to Appendix B of this Test Plan. This will be an empty packaging. Straight fluorescein will be added prior to testing (see Appendix B, Section 6.0 of this Test Plan). This test unit will undergo the water spray, penetration bar drop, and compression tests.

## 6.0 DESIGN CONFIRMATION SEQUENCE

### 6.1 INITIAL CONTAINMENT BOUNDARY VERIFICATION

The containment boundary consists of the HDPE cylindrical wall and two end caps. Upon receipt of the test units from the sponsor, a preliminary containment boundary verification will be performed on all test units to ensure that no leakage or damage occurred to the test units during transport to the DOE-approved test facility.

Soap Bubble Test. Perform the "soap bubble" test on all three test units as initially received from the sponsor (i.e., without fluorescent dye added). Complete the following steps, recording all data and observations onto test data sheet 7.1.2 (see Appendix C of this Test Plan).

**NOTE:** Prior to receipt of these test units by the DOE-approved test facility, the sponsor is responsible for drilling and tapping two holes into the center of one end cap, on test units 40-TU-01 and 40-TU-02. The sponsor is responsible for placing a suitable hex-socket plug into each of the holes. It is suggested that the hex-socket plugs be 1/2-inch normal pipe thread (NPT), and be flush or below the surface of the end caps. Refer to Appendix B, Figure B-1, for diagram of hole placement on these two test units.

**NOTE:** Prior to receipt of the test units by the DOE-approved test facility, the sponsor is responsible for drilling and tapping a hole into one end cap on test unit 40-TU-03. The sponsor is responsible for placing a suitable hex-socket plug into the hole. It is suggested that the hex-socket plugs be 1/2-inch NPT, and be flush or below the surface of the end cap. Refer to Appendix B, Figure B-1, for diagram of hole placement on this test unit.

1. A compressed gas bottle (nitrogen) will supply pressure to the test units during the soap bubble test. A pressure regulator will limit the pressure applied to the test units. A calibrated pressure gauge will indicate the pressure applied to the test units.
2. Lay test unit onto its horizontal side. Remove the end cap plug.
3. Attach pressure tubing and fitting into the end cap hole.
4. Verify that the compressed gas bottle valve is closed.
5. Verify that the pressure regulator is adjusted to the zero output pressure position.

6. Connect the pressure tubing to the pressure regulator.

CAUTION: Before proceeding to the following step, close the gas bottle valve if the regulator's left gauge (output pressure) begins to indicate pressure. This condition indicates that the pressure regulator is defective and should not be used.
7. Slowly open the gas bottle valve while observing the regulator's pressure gauges. When the bottle's valve is fully open, the regulator's right gauge should read the bottle's pressure, and the left gauge should read zero.
8. Slowly increase internal pressure to 27.6 kPa (4 psi), and hold for 15 minutes to ensure there is no leakage.
9. Coat or brush a low viscosity soap bubble solution around the cylindrical side and the area where the end caps are fused to the cylindrical wall of the packaging.
10. Observe for bubbles, i.e., leaks. Very fine leaks may take more time to become apparent and are indicated by a foamy appearance. If no leaks are detected, indicate "pass."

If detectable leakage occurs, indicate "fail."
11. Record the results of this effort on test data sheet 7.1.2 (see Appendix C of this Test Plan).
12. Relieve the payload cavity pressure, and secure the test equipment.
13. Place leak detection materials into test units, per Appendix B, Section 6.0 of this Test Plan.
14. Reclose plugs.

Failure of this initial containment boundary verification procedure will result in the cancellation of the testing that follows Section 6.0 of this Test Plan.

Upon conclusion of all testing, a final containment boundary verification will be made as outlined in Section 8.1 of this Test Plan.

## 6.2 SHIELDING VERIFICATION

Shielding is not a component of the ARROW-PAK packaging system. A visual check for cracks in the exterior of the packaging tube and end caps will be made before and after completion of testing.

## 7.0 TEST SEQUENCE: TEST UNITS 40-TU-01 THROUGH 40-TU-03

Test units will undergo marking, inspection, and assembly. Each test unit will be subjected to the water spray test as a prerequisite to any other testing (with the exception of the vibration test) unless it is determined by the test engineer that after the water spray test is conducted on the first test unit, this test does not result in any significant deterioration of the packaging.

The vibration test (see Section 7.2 of this Test Plan) will be conducted before the water spray test (see Section 7.3 of this Test Plan). As stated, the water spray test will precede each of the following tests: Penetration (see Section 7.4 of this Test Plan), compression (see Section 7.5 of this Test Plan), and drop (see Section 7.6 of this Test Plan). The test sequence shown in Table 7-1 may be varied by the test engineer, except where prohibited.

The packages must perform adequately when subjected to the applicable performance tests, which are described in Table 7-1 of this Test Plan. There should be evidence that the integrity of the packaging would remain with no release of the hazardous materials to the environment (49 CFR 173.24), no loss or dispersal of radioactive contents, and no significant increase in the radiation levels recorded or calculated at the external surfaces for the condition before the test [49 CFR 173.412(m)].

Each configuration will be considered a unique package for testing purposes. In the event of a failed configuration, the test and project engineer, in conjunction with the test sponsor, may make an evaluation to determine whether an alternative internal packaging arrangement may warrant further testing.

Table 7-1. Testing Sequence.

Type of test	Reference	Test unit number
Vibration test	(Section 7.2)	40-TU-01 40-TU-02
Water spray test <sup>a</sup>	(Section 7.3)	40-TU-03 <sup>b</sup> (Empty)
Penetration test - 1.0 m (3.3 ft)	(Section 7.4)	40-TU-03 (Empty)
Compression test	(Section 7.5)	40-TU-03 (Empty)
Drop test - 1.2 m (4 ft)	(Section 7.6)	40-TU-01 40-TU-02
Containment boundary verification	(Section 8.1)	40-TU-01 40-TU-02 40-TU-03

Table 7-1. Testing Sequence.

<sup>a</sup>The time interval between the end of the water spray test and the beginning of the next test shall be such that the water has soaked in to the maximum extent without appreciable drying of the exterior of the package. The time interval is 2 hours if the spray is applied simultaneously from four different directions. Other tests will follow immediately if the spray is applied consecutively from each of the four directions. Testing will need to be carefully scheduled to ensure the time period is not exceeded by a significant time interval to the extent that the exterior of the package dries out.

<sup>b</sup>If after the first water spray test the test engineer determines that the water spray test does not result in any significant deterioration of the packaging, no further water spray tests will be performed on packagings before testing.

## 7.1 ASSEMBLY, LOADING, AND CLOSURE

<u>Event/Test No.</u>	<u>Event/Test Description</u>
40-TU-01-1	Assemble, load, and close the packaging with simulated payload in position in accordance with Section 5.0 and Appendix B of this Test Plan.
40-TU-02-1	
40-TU-03-1*	

\*This is an empty packaging.

Take pretest photo(s) phs.

## 7.2 VIBRATION TEST

NOTE: The water spray test is not a precondition for the following test.

<u>Event/Test No.</u>	<u>Event/Test Description</u>
40-TU-01-2	Photograph the pretest condition.
40-TU-02-2	Perform the vibration testing in accordance with 49 CFR 178.608.

Use test units as prepared in Section 7.1 of this Test Plan. Place the test units on a vibrating platform that has a vertical, double amplitude (peak-to-peak displacement) of one inch. The packages should be constrained horizontally to prevent them from falling off the platform but must be left free to move vertically, bounce, and rotate.

The test must be performed for 1 hour at a frequency that causes each package to be raised from the vibrating platform to such a degree that a piece of material of approximately 1.6-mm (0.063-in.) thickness (such as steel strapping or paperboard) can be passed between the bottom of any package and the platform.

Immediately following the vibration period, each package shall be removed from the platform, turned onto its side, and observed for any evidence of leakage. Verify if there is any leakage of fluorescein by using a black light. The package will be judged to pass if there is no significant damage to the packaging and no loss of the simulated load. Rupture or leakage from any of the packages constitutes failure of the test.

Take post-test photographs. Record the results on the supplied Vibration Test Data Sheet (see Appendix C of this Test Plan). Use a separate data sheet for each test unit.

Upon completion of the vibration test, conduct the containment boundary verification procedure as described in Section 8.1 of this Test Plan. Next, conduct the water spray test described in Section 7.3 of this Test Plan.

### 7.3 WATER SPRAY TEST

**NOTE:** The following step is a precondition for any further testing. Because timing is a critical element of this step, it is important to plan the water spray and soak such that the packaging is ready when required for the next test.

Refer to Section 7.0 of this Test Plan, Table 7-1, Notes a and b, before conducting this test.

Ensure that the package is elevated such that no additional water, other than would normally be introduced during the water spray, may soak into the package. Do not handle the package until the soak and inspection have been accomplished.

Event/Test No.

40-TU-03-3

Event/Test

This is an empty packaging. Straight fluorescein will be added for leak detection. Close the ARROW-PAK in accordance with Section 5.0 and Appendix B of this Test Plan.

Photograph the pretest condition.

Perform a water spray test in accordance with *DOT-7A Packaging Test Procedure*, Section 7.2 (Kelly 1995).

This test simulates exposure to rainfall of approximately 5 cm (2 in.) per hour for at least 1 hour.

Following the water spray test, verify if there is any leakage of fluorescein on the exterior of the package by using visual inspection under a black light. The package will be judged to pass this test if no indication of tracer material is noted.

Take pre-test and post-test photographs. Record the results on the Water Spray Test Data Sheet (see Appendix C of this Test Plan). Use a separate data sheet for each test unit.

**NOTE:** If the above noted test unit is not adversely affected by the water spray test, the test engineer may determine that further water spray testing is not necessary before additional tests are conducted. If the water spray test appears to negatively influence the performance of the packaging, then the water spray test will be conducted on the remaining test units in the same manner as stated above.

Next, conduct the 1.0 m (3.3 ft) penetration bar drop test outlined in Section 7.4 of this Test Plan.

#### 7.4 PENETRATION TEST - 1.0 m (3.3 ft)

**NOTE:** Refer to Section 7.0 of this Test Plan, Table 7-1, Notes a and b, before conducting this test.

<u>Event/Test No.</u>	<u>Event/Test Description</u>
39-TU-03-4	This is an empty packaging. Straight fluorescein will be added for leak detection. Close the ARROW-PAK in accordance with Section 5.0 and Appendix B of this Test Plan.
	Photograph the pretest condition.
	Perform a penetration test <sup>2</sup> in accordance with <i>DOT-7A Packaging Test Procedure</i> , Section 7.4 (Kelly 1995) with the following parameters.
Penetration bar:	3.2-cm (1.25-in.) diameter with a hemispherical end. The bar shall weigh 6 kg (13.2 lb). Drop bar with its longitudinal axis vertical.
Drop height of penetration bar:	1.0 m (3.3 ft), +2.5 cm (1 in.), -0
	<u>Drop height shall be no less than 104.12-cm (41-in)</u>
Impact point:	The impact location will be measured from the W axis. Lay the ARROW-PAK cylinder flat, onto its horizontal side. The impact point will be onto the center of the packaging.
	Take photographs after the test and ensure any damage is documented.

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<sup>2</sup>NOTE: During the penetration test, personnel shall be excluded from the impact area to the extent to be clear of any fragments that could result from the impact. As a minimum, this distance shall be 6.1 m (20 ft).

The package will be judged to pass if there is no fracturing of the exterior HDPE end caps or tube, and no loss of the simulated load, as determined by a visual inspection under a black light. If the packaging shows signs of damage, take measurements of the damaged area(s). Any change from the pretest condition will be evaluated by the test engineer to determine if the packaging passed or failed the test and if any additional testing will be necessary.

Record the results on the test data sheets provided in Appendix C of this Test Plan. Use a separate data sheet for each test unit.

If the package passed the testing conducted in the previous step, conduct the compression test as described in Section 7.5 of this Test Plan.

## 7.5 COMPRESSION TEST

**NOTE:** Refer to Section 7.0 of this Test Plan, Table 7-1, Notes a and b, before conducting this test.

<u>Event/Test No.</u>	<u>Event/Test Description</u>
40-TU-03-5	This is an empty packaging. Straight fluorescein will be added for leak detection. Ensure the ARROW-PAK is closed in accordance with Section 5.0 and Appendix B of this Test Plan.  Photograph the pretest condition.

Perform a compression test in accordance with *DOT-7A Packaging Test Procedure*, Section 7.3 (Kelly 1995) for at least 24 hours with the compressive load as specified in the calculation below. The load is applied uniformly to two opposite sides of the package, one of which must be the base on which the package normally would stand, i.e., horizontal for this packaging.

<u>Test unit number</u>	<u>Compressive load</u>
40-TU-03	As the actual weight of the test units will not be known until test units are received, apply at least 2903 kg (6400 lb) weight.

Calculations were determined as follows.

- a) Five times the estimated weight of the package is calculated to be:

$$5 \times 453.6 \text{ kg} = 2268 \text{ kg} \quad (5 \times 1000 \text{ lb} = 5000 \text{ lb})$$

b) The weight based on the vertically projected area of the package is calculated to be:

$$182.88 \text{ cm (length)} \times 25.4 \text{ cm (width)} = 4645.15 \text{ cm}^2 = 0.4645 \text{ m}^2$$

$$0.4645 \text{ m}^2 \times 1300 \text{ kg/m}^2 = 603.85 \text{ kg} \\ = (1331.26 \text{ lb})$$

The compressive load was determined by using five times the estimated weight of the packaging as it is greater than the weight of the vertically projected area of the packaging. The load is applied uniformly to two opposite sides of the package, one of which must be the base on which the package would normally stand.

Photograph the package within 1 hour after applying the compressive load. Take photographs of the package at the end of the 24-hour test period before removing the compressive load and after removal.

After removing the compressive load from the packaging, conduct a visual inspection of the container under both normal and visual inspection, under a black light. If the packaging shows signs of damage, take measurements in the same locations as were used for the pretest measurements to document any change. The package will be considered to pass if there is no fracturing of the exterior HDPE end caps or tube, no loss of the tracer material, and no change in the exterior dimensions of the ARROW-PAK packaging by 0.635-cm (1/4-in).

Record the results on the Compression Test Data Sheet (see Appendix C of this Test Plan). Use a separate data sheet for each test unit.

If the package passed the testing conducted in the previous step, conduct the 1.2-m (4-ft) drop test outlined in Section 7.6 of this Test Plan.

## 7.6 DROP TEST - 1.2 m (4.0 ft)

**NOTE:** Refer to Section 7.0 of this Test Plan, Table 7-1, Notes a and b, before conducting this test.

<u>Event/Test No.</u>	<u>Event/Test Description</u>
40-TU-01-6	Assemble, load, and close the packaging with simulated contents according to Section 5.0 and Appendix B of this Test Plan.
40-TU-02-6	Photograph and videotape the pretest condition.
	A total of four drops will be performed on each packaging configuration from this drop height.
	A containment boundary verification will be performed at the conclusion of the third drop orientation. Upon conclusion of this verification procedure, a

fourth drop will then be performed on each packaging configuration from this drop height.

Perform the drop test<sup>3</sup> in accordance with *DOT-7A Packaging Test Procedure*, Section 7.5 (Kelly 1995) with the following parameters.

Drop height: 1.2 m (4.0 ft), +2.5 cm (1.0 in.), -0

Drop height of at least 124.46-cm (49-in)

Impact angle: See orientation instructions.

Orientations: 40-TU-01 and 40-TU-02

- 1) Drop in the vertical position, to impact flat onto the end cap without plugs.
- 2) Drop in the horizontal position, to impact flat onto the side wall of the packaging.
- 3) Drop center of gravity, to impact the edge of the end cap without plugs.

Take photographs and provide video coverage during and after each test to ensure any damage is documented.

Record the results on the test data sheets provided in Appendix C of this Test Plan. Use a separate data sheet for each test unit. Identify any changes to the package. If the packaging shows signs of damage, take measurements of the damaged area(s). Perform a visual inspection of the package under normal and black light. Identify any loss of simulated contents. The packaging will be judged to pass if there is no significant damage to the packaging and no release of simulated contents. Any change from the pretest condition will be evaluated by the test and project engineers to determine if the packaging passed or failed the test, and if any additional testing will be necessary.

Upon completion of the above drop test orientations, conduct the containment boundary verification procedure, soap bubble test, as described in Section 8.1 of this Test Plan.

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Upon completion of the containment boundary verification procedure, soap bubble test, as described in Section 8.1 of this Test Plan, conduct the following test:

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<sup>3</sup>NOTE: During the drop test, personnel shall be excluded from the impact area to the extent to be clear of any fragments that could result from the impact. As a minimum, this distance shall be 6.1 m (30 ft).

<u>Event/Test No.</u>	<u>Event/Test Description</u>
40-TU-01-7	Assemble, load, and close the packaging with simulated contents according to Section 5.0 and Appendix B of this Test Plan.
40-TU-02-7	Photograph and videotape the pretest condition. The fourth drop will be performed on each packaging configuration from the drop height specified below.

Perform the drop test<sup>4</sup> in accordance with *DOT-7A Packaging Test Procedure*, Section 7.5 (Kelly 1995) with the following parameters.

Drop height: 1.2 m (4.0 ft), +2.5 cm (1.0 in.), -0

Drop height of at least 124.46-cm (49-in)

Impact angle: See orientation instructions.

Orientations:

40-TU-01 Drop in the vertical position, to impact flat onto the end cap with plugs.

40-TU-02 Drop center of gravity, to impact the edge of the end cap with plugs.

Take photographs and provide video coverage during and after each test to ensure any damage is documented.

Record the results on the test data sheets provided in Appendix C of this Test Plan. Use a separate data sheet for each test unit. Identify any changes to the package. If the packaging shows signs of damage, take measurements of the damaged area(s). Perform a visual inspection of the package under normal and black light. Identify any loss of simulated contents. The packaging will be judged to pass if there is no significant damage to the packaging and no release of simulated contents. Any change from the pretest condition will be evaluated by the test and project engineers to determine if the packaging passed or failed the test, and if any additional testing will be necessary.

Upon completion of this testing, conduct the containment boundary verification procedure as described in Section 8.1 of this Test Plan.

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<sup>4</sup>NOTE: During the drop test, personnel shall be excluded from the impact area to the extent to be clear of any fragments that could result from the impact. As a minimum, this distance shall be 6.1 m (30 ft).

## 8.0 POST-TEST ACTIONS

### 8.1 CONTAINMENT BOUNDARY VERIFICATION

The following containment boundary verification will be performed after the vibration testing (outlined in Section 7.2 of this Test Plan), and after the initial drop testing (outlined in Section 7.6 of this Test Plan) have been completed. This containment boundary verification will again be performed upon completion of the fourth drop test as identified in Section 7.6 of this Test Plan.

**I. Soap Bubble Test.** Perform the "soap bubble" test on test units 40-TU-01 and 40-TU-02. These test units have been filled with lead bricks and steel shot. Fluorescein has been added for leak detection purposes. Complete the following steps, recording all data and observations onto test data sheet 7.1.2 (see Appendix C of this Test Plan).

**NOTE:** Prior to receipt of these test units by the DOE-approved test facility, the sponsor is responsible for drilling and tapping two holes into the center of one end cap, on test units 40-TU-01 and 40-TU-02. The sponsor is responsible for placing a suitable hex-socket plug into each of the holes. It is suggested that the hex-socket plugs be 1/2-inch normal pipe thread (NPT), and be flush or below the surface of the end caps. Refer to Appendix B, Figure B-1, for diagram of hole placement on these two test units.

1. A compressed gas bottle (nitrogen) will supply pressure to the test units during the soap bubble test. A pressure regulator will limit the pressure applied to the test units. A calibrated pressure gauge will indicate the pressure applied to the test units.
2. Lay test unit onto its horizontal side. Remove the end cap plug.
3. Attach pressure tubing and fitting into the end cap hole.
4. Verify that the compressed gas bottle valve is closed.
5. Verify that the pressure regulator is adjusted to the zero output pressure position.
6. Connect the pressure tubing to the pressure regulator.

**CAUTION:** Before proceeding to the following step, close the gas bottle valve if the regulator's left gauge (output pressure) begins to indicate pressure. This condition indicates that the pressure regulator is defective and should not be used.

7. Slowly open the gas bottle valve while observing the regulator's pressure gauges. When the bottle's valve is fully open, the regulator's right gauge should read the bottle's pressure, and the left gauge should read zero.
8. Slowly increase internal pressure to 27.6 kPa (4 psi), and hold for 15 minutes to ensure there is no leakage.

9. Coat or brush a low viscosity soap bubble solution around the cylindrical side and the area where the end caps are fused to the cylindrical wall of the packaging.
10. Observe for bubbles, i.e., leaks. Very fine leaks may take more time to become apparent and are indicated by a foamy appearance. If no leaks are detected, indicate "pass."  
If detectable leakage occurs, indicate "fail."
11. Record the results of this effort on test data sheet 7.1.2 (see Appendix C of this Test Plan).
12. Relieve the payload cavity pressure, and secure the test equipment.
13. Reinstall the drain plugs.

Upon completion of verification after the vibration testing, conduct the drop tests as outlined in Section 7.6 of this test plan (3 drops each).

Upon completion of verification after the initial drop tests, conduct the fourth drop test as outlined in Section 7.6 of this Test Plan.

Upon completion of the fourth drop test as outlined in Section 7.6 of this Test Plan, conduct the following containment boundary verification on the following test unit.

**II. Hydrostatic Pressure.** Perform the hydrostatic pressure test on "empty" test unit 40-TU-03. It was filled with fluorescein prior to testing for leak detection purposes. This procedure simulates the reduced ambient (external) pressure to the package to 24.1 kPa (3.5 psia). This may be achieved by pressurizing the internal cavity of the packaging to 77.2 kPa (11.2 psig). Complete the following steps, recording all data and observations onto test data sheet 7.1.2 (see Appendix C of this Test Plan).

**NOTE:** Prior to receipt of the test units by the DOE-approved test facility, the sponsor is responsible for drilling and tapping a hole into one end cap on test unit 40-TU-03. The sponsor is responsible for placing a suitable hex-socket plug into the hole. It is suggested that the hex-socket plugs be 1/2-inch NPT, and be flush or below the surface of the end cap. Refer to Appendix B, Figure B-1, for diagram of hole placement on this test unit.

1. A compressed gas bottle (nitrogen) will supply pressure to the test units during the hydrostatic pressure test. A pressure regulator will limit the pressure applied to the test units. A calibrated pressure gauge will indicate the pressure applied to the test units.
2. Secure the test unit in a vertical orientation, with the end cap plug in the top-most position.
3. Remove the end cap plug.

4. Fill the test unit with water so that no air remains inside the packaging.
5. Attach pressure tubing and fitting into the end cap hole.
6. Apply running water to the open tube end to expel as much air as possible.
7. Verify that the compressed gas bottle valve is closed.
8. Verify that the pressure regulator is adjusted to the zero output pressure position.
9. Connect the pressure tubing to the pressure regulator.
10. Verify that the outside of the package is dry and free from water or fluorescent dye.

CAUTION: Before proceeding to the following step, close the gas bottle valve if the regulator's left gauge (output pressure) begins to indicate pressure. This condition indicates that the pressure regulator is defective and should not be used.

11. Slowly open the gas bottle valve while observing the regulator's pressure gauges. When the bottle's valve is fully open, the regulator's right gauge should read the bottle's pressure, and the left gauge should read zero.
12. Slowly increase internal pressure to 77.2, +3.45/-0.0 kPa (11.2, +0.5/-0.0 psi or 11.7 psi), and hold for 15 minutes to ensure there is no leakage.
13. At the completion of the hold period, evaluate the time, pressure, and temperature data. Visually inspect the package under normal and black light conditions. Indicate a leakage rate of zero if no water and fluorescein solution is detected, and "pass" if this is the case.

If detectable leakage occurs, indicate "fail."

14. Record the results of this effort on test data sheet 7.1.2 (see Appendix C of this Test Plan).
15. Relieve the payload cavity pressure, and secure the test equipment.
16. Drain the water from the package. Orient the package in a vertical position, with the drain hole located at the bottom, and allow to drip-dry for a minimum of 24 hours.
17. Reinstall the drain plug.

## 8.2 SHIELDING VERIFICATION

Shielding is not a component of the ARROW-PAK packaging. Movement of the load will be evaluated to determine changes in dose rate at the surface of the package. An increase of 20% or greater will be judged as a failure. A visual check for cracks in the exterior of the packaging tube and end caps, and loss of simulated contents will be made before and after completion of testing.

## 9.0 POST-TEST ACTIONS - ADMINISTRATIVE

Written measurements will be thoroughly documented on the appropriate test data sheets after each drop test has been performed. Photographs of damage and video coverage of the tests performed also will be used as documentation.

Perform post-test activities outlined in Section 8.0 of *DOT-7A Packaging Test Procedure* (Kelly 1995).

Upon test completion, test units shall be marked as follows:

- a. Packaging is a test unit belonging to "Arrow Construction, Inc., Montgomery, Alabama."
- b. Package testing completed "enter month/day/year."
- c. Packaging is an "on hold" test unit; do not return or dispose of without the approval of 7A Testing Support Program Project Engineer, Packaging Operations & Development.
- d. Packaging "does not contain" radioactive material.
- e. Packaging "does not contain" hazardous material.
- f. Packaging "contains" wrapped, lead bricks. As this material is considered a hazardous waste, it will not be disposed of at the Hanford Site. The test unit will be shipped back to the sponsor, at their full cost, for disposal.
- g. Packaging surface "does not contain" radioactive contamination.

Refer to TP-D01, *Transportation and Packaging Desk Instructions* (O'Brien 1992), for guidance on returning test units to the test sponsor.

10.0 SIGNATURES

Prepared:

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D. L. Kelly, Test Engineer 10-10-95  
Date

Reviewed:

J. H. O'Brien  
J. H. O'Brien, Project Engineer 10/10/95  
Date

Reviewed:

Tom Roman  
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Date

Reviewed:

CCR  
Quality Assurance 10-10-95  
Date

Reviewed:

Dale W. Mc Nally  
Safety 10-11-95  
Date

## 11.0 REFERENCES

49 CFR 173, "Shippers - General Requirements for Shipments and Packaging," *Code of Federal Regulations*, as amended.

49 CFR 178, "Shipping Container Specification," *Code of Federal Regulations*, as amended.

Kelly, D. L., 1995, *DOT-7A Packaging Test Procedure*, WHC-SD-TP-RPT-018, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

O'Brien, J. H., 1992, *Transportation and Packaging Desk Instructions*, TP-D01, "Return/Disposal of Test Packaging," Rev. 00, Westinghouse Hanford Company, Richland, Washington.

## 12.0 BIBLIOGRAPHY

ANSI, 1987, *American National Standard for Radioactive Materials--Leakage Tests on Packages for Shipment*, ANSI N14.5-1987, American National Standards Institute, New York, New York.

## 13.0 GLOSSARY

### ABBREVIATIONS AND ACRONYMS

DOE	U.S. Department of Energy
DOT-7A	U.S. Department of Transportation Specification 7A Type A Packaging
HDPE	high-density polyethylene
LITCO	Lockheed Idaho Technologies Company
NPT	Normal Pipe Thread
WHC	Westinghouse Hanford Company

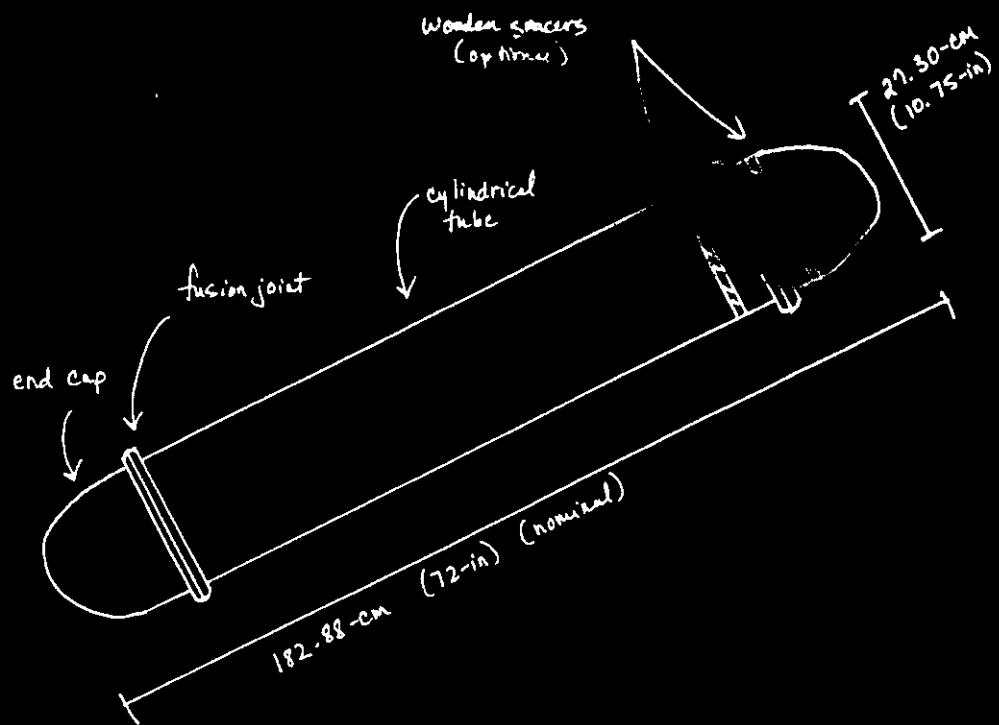
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**APPENDIX A**

**25.4-cm (10-in) ARROW-PAK PACKAGING CONFIGURATION**

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Figure A-1. Diagram of ARROW-PAK Packaging.



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## APPENDIX B

### ASSEMBLY, LOADING, AND CLOSURE FOR TESTING PURPOSES

#### B1.0 GENERAL INFORMATION

Refer to Appendix A of this Test Plan for a sketch of the ARROW-PAK configuration being tested. The ARROW-PAK packaging system consists of a Marlex-resin pipe manufactured by Phillips-Driscopipe, Inc.<sup>1</sup>, and is sealed with end caps manufactured from the same materials via a patented process developed by Arrow Construction, Inc. The patented process involves the use of electrical energy to heat opposing faces of the pipe and end caps, and hydraulic rams to press the heated surfaces together. The result is a homogeneous bonding of the end cap to the pipe.

#### B2.0 INSTRUCTIONS

**NOTE:** Due to the complexity of the thermal sealing process and the machinery involved, the test units will be partially filled with simulated contents and sealed at BOH Brothers Construction Company, Inc., New Orleans, Louisiana. The WHC test and/or project engineer(s) will witness the loading and sealing process prior to testing. The sponsor is responsible for ensuring that all three test units are sound and do not leak prior to shipment to the DOE-approved test facility for Type A testing. The remaining simulated contents, a tracer material used for leak testing, will be added at the DOE-approved test facility.

Three test units will be supplied for testing purposes. Two 25.4-cm (10-in) diameter ARROW-PAKS will be filled with simulated contents of clean, noncontaminated, taped lead bricks. Carbon steel shot will be added as a filler material.

**NOTE:** The sponsor is responsible for drilling and tapping two holes into the center of one end cap, on each of these test units. The sponsor is responsible for placing a suitable hex-socket plug into each of the holes. It is suggested that the hex-socket plugs be 1/2-inch normal pipe thread (NPT), and be flush or below the surface of the end caps. Refer to Figure B-1 for diagram of hole placement on these two test units.

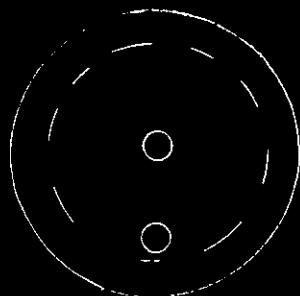
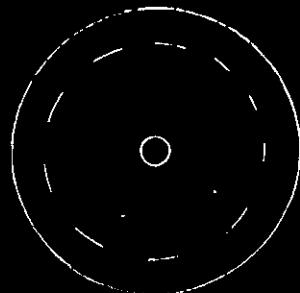
A third ARROW-PAK will be left empty.

**NOTE:** The sponsor is responsible for drilling and tapping a hole into one end cap. The sponsor is responsible for placing a suitable hex-socket plug into the hole. It is suggested that the hex-socket plugs be 1/2-inch NPT, and be flush or below the surface of the end cap. Refer to Figure B-1 for diagram of hole placement on this test unit.

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<sup>1</sup>Phillips Driscopipe is a Division of Phillips Petroleum Company.

Figure B-1. Diagram for Recommended Hole Placements for Testing.



### B3.0 ASSEMBLY

1. Follow the manufacturer's instructions for fusion unit setup, calibration, loading of tubing onto the fusion unit, facing, heating, fusing, and unloading of the packaging assembly from the fusion unit. Follow the manufacturer's instructions for appropriate cool down period. (Information on this process has been included at the end of this Appendix.)
2. Fuse one of the end caps that has had the appropriate hole(s) drilled and tapped into it (for testing purposes only), to the pipe. Remove this partial assembly from the fusion unit.

### B4.0 LOADING CONTENTS

NOTE: The dimensions of the lead bricks used during testing are 5x10x20-cm (2x4x8-in).

1. Load lead bricks into the first end cap. About four lead bricks will fit into an end cap.
2. Load lead bricks, vertically, into the cylindrical tube. The bricks should fit snugly into the packaging. Four lead bricks should fit snugly across the diameter of the ARROW-PAK cylindrical tube.
3. Continue to fill the cylindrical tube with lead bricks. Leave an estimated 2.54-cm (2-in) space between the last level of bricks and the top of the tube.
4. Fill the void space within cylindrical tube and first end cap with steel shot. Leave an estimated 2.54-cm (2-in) space between the steel shot and the top of the tube.

**NOTE: Adequate space is required for the placement of a wooden spacer and to allow for fusion of the second end cap to the cylindrical tube.**

5. Place a plywood spacer on top of the simulated load. Pound the spacer down into the tube about 2.54-cm (2-in), until it is touching the simulated contents. The purpose of this spacer is to keep the simulated load in place while the second end cap is fused onto the cylindrical tube.

**NOTE: The spacer needs to fit down snugly onto the layer of bricks and shot. It may be necessary to wrap the outside edge of this spacer with several layers of tape so that the spacer does not move and shift.**

6. Load lead bricks into the second end cap. About four lead bricks will fit into an end cap. Leave an estimated 2.54-cm (2-in) space between the bricks and the top of the second end cap.

7. Fill the void space within the second end cap with steel shot. Leave an estimated 2.54-cm (2-in) space between the steel shot and the top of the tube.

**NOTE: Adequate space is required for the placement of a wooden spacer and to allow for fusion of the second end cap to the cylindrical tube.**

8. Place a plywood spacer on top of the simulated load. Pound the spacer down into the tube about 2.54-cm (2-in), until it is touching the simulated contents. The purpose of this spacer is to keep the simulated load in place while the second end cap is fused onto the cylindrical tube.

**NOTE: The spacer needs to fit down snugly onto the layer of bricks and shot. It may be necessary to wrap the outside edge of this spacer with several layers of tape so that the spacer does not move and shift.**

#### B5.0 CLOSURE

1. Follow the manufacturer's instructions for fusion unit setup, calibration, loading of tubing onto the fusion unit, facing, heating, fusing, and unloading of the packaging assembly from the fusion unit. Follow the manufacturer's instructions for appropriate cool down period. (Information on this process has been included at the end of this Appendix.)

#### B6.0 ADDITION OF TRACER MATERIAL

1. Prior to testing at the approved DOE-test facility, tracer material for leak detection purposes will be added to the test units.
2. The tracer material will be added by removing one of the plugs that is located on an end cap from each test unit.
3. Tracer material used will be as follows:
  - Fluorescein will be added to the two test units containing the simulated contents of lead bricks and steel shot.
  - The third, empty, test unit, will be filled with about 1/2 cup of fluorescein.
4. Secure the plug, once the tracer material has been added.

**Note: An appropriate thread sealer, such as Teflon tape, may need to be applied to the thread plugs to assure that there is no leakage in this area during testing.**

5. Ensure that the exterior of the test units is clean, and no trace of fluorescent material exists. Use a light water mist and black light for detection of tracer material.

### 3.2.2 McElroy Fusion Unit Descriptions

As previously stated, two different McElroy fusion machines will be used to perform the fusion operations. The McElroy No. 412 will be used to fuse the 6-in. and 10-in. diameter containers and the No. 1236 will be used to fuse the 28-in. diameter containers. The difference between the two machines is that the No. 1236 uses automated hydraulic cylinders to position the heater plate, tubing clamps and facer, whereas these functions are performed manually on the No. 412. Detailed step-by-step procedures for operating the McElroy No. 412 operations and 1236 fusion machines are presented in Appendix A.

The hydraulic pump for the McElroy No. 412 is powered by a gasoline engine that is also connected to a 220 V, 60 Hz, single phase, 3.0 kW capacity alternator to power the heater plate. All these items are mounted on the chassis of the fusion unit. Power for the No. 1236's electrically driven hydraulic pump and heater plate is provided by a separate, stand alone gasoline powered generator that provides 230 V, 60 cycle, 3-phase power with a rating of 30 KVA. Details of the operation of each Fusion Unit are described below.

#### 3.2.2.1. McElroy No. 412 Fusion Unit Operations:

##### **SETUP**

The unit is positioned outside of the warehouse, in an area free from hazardous vapors. It is then secured in place by setting the break provided on the rear left tire, and chocking the tires. The gasoline engine is started to provide power to the hydraulic pump and electrical power to the heater plate.

##### **CALIBRATION**

While the heater plate is coming up to operational temperature (410°F for the 6-in. MACRO, 500°F for the 10-in. MACRO), the pressure regulators used to control the facing pressure, heating pressure, and fusing pressure are adjusted to the appropriate setting by the operator. It takes approximately 20 to 25 minutes for the heater plate to reach operational temperature. The temperature is displayed by a dial thermometer located on the perimeter of the heater plate. The heater plate resides in an insulated cradle when not in use.

##### **LOADING**

The HDPE tubing is loaded into the double clamshell clamps located on the left side of the machine facing the controls. The end cap is placed in the single clamshell on the right side of the machine. The clamps are secured by manual screw jacks. After the first end cap-to-sleeve fusion is completed, the loading of lead or lead filled containers will be accomplished using a

combination of manual labor and lifting slings. The lead that is placed in each container is expected to be approximately 65 wt% lead bricks (2-in. x 4-in. x 8-in.) and 35 wt% lead shot.

### **FACING**

The facer is then rotated into position between the two pieces to be fused. The facer is sandwiched between the two pieces by activating a set of hydraulic cylinders applying a slight pressure. The facer is operated hydraulically and rotates at approximately 30 RPM. The surfaces to be fused are simultaneously planed establishing clean and parallel surfaces for fusing. After the two mating surfaces have been sufficiently planed, the alignment of the two surfaces is checked and, if necessary, reface until proper alignment is achieved.

### **HEATING**

After the two mating surfaces have been planed, the facer is manually rotated out of position and is manually replaced by the heating plate. The two surfaces to be fused are hydraulically brought in contact with the heater plate under light pressure (close to zero). After a bead of heated material measuring 3/16- to 1/4-in. thick is formed at the circumference of each HDPE piece, the hydraulic pressure is released and the hot plate is manually removed.

### **FUSING**

After the heater plate is removed, the hydraulic cylinders are actuated bringing the two heated surfaces together under a compressive load. The surfaces are held under sustained hydraulic pressure and allowed to cool for a period of approximately 35 minutes. This ensures a single monolithic bond of fused material.

### **UNLOADING**

The fused pieces are then removed from the machine by releasing the screw jacks securing clamshell clamps. If the fusion is only on the first end cap-to-sleeve, there is no need for any special handling equipment (due to the lightness of the material). However, after completing the second fusion on both the 6-in. and 10-in. MACROs, special handling procedures shall be used to safely remove the completed HAZ-PAKs from the fusion machine. The special handling procedures are needed due to the 200-500 lb of lead that are to be in each MACRO. For the demonstration at IDAHO FALLS a forklift with a sling system will be used to load and unload the HDPE pieces.

**SUBSEQUENT FUSING**

In the event of subsequent fusing, the same operations are followed to fuse other sections of the HDPE sleeves. To fuse a different diameter, the internal jaw inserts on each clamshell clamp are replaced with jaw inserts conforming to the new diameter. The process of loading, facing, heating, and fusing is then repeated.

**SHUTDOWN**

Upon completion of the fusing process, the gasoline engine on the No. 412 Fusion Unit will be turned off removing hydraulic pressure to the cylinders and power to the heater plate. This will be followed by cleanup of the area.

**3.2.2.2. McElroy No. 1236 Fusion Unit Operations:****SETUP**

The unit is positioned in an area free from hazardous vapors, and then secured in place by setting the brake provided on the left rear wheel, and chocking the wheels. The generator unit is then positioned outside of the warehouse, but near the No. 1236 Unit, at a distance that will allow adequate working space around the fusion unit. Consideration should be given, where the placement of the generator is concerned, to route the power cord in a manner to prevent it from being driven over by the forklift and out of the operator's way.

**ALIGNMENT/CALIBRATION**

During the IDAHO FALLS demonstration the end cap holder/alignment fixture will be positioned in the fusion unit and then secured using the hydraulic clamps. The end cap will be placed on the fixture then centered with the mating piece using the adjusting screws for proper alignment. Upon completion of the loading, the generator unit is started, providing electrical power to operate the hydraulic pump and the heater plate. The hydraulic pressure regulators, used to control the facing pressure, heating pressure, and fusing pressure, are then adjusted accordingly.

**LOADING**

HDPE sleeves are easily handled with forklifts, synthetic web slings, and spreader bars. After the end cap has been loaded and positioned, a 28-in. diameter x 60-in. section of HDPE sleeve will be loaded into the No. 1236 using a forklift and material handling equipment. The HDPE is then secured in place using the hydraulic clamps. Once the HDPE has been fused to form the

McELROY NO. 618 HYDRAULIC FUSION UNIT  
INSTRUCTION MANUAL

GENERAL DESCRIPTION OF UNIT

The McElroy 618 Fusion Unit is a self-contained unit designed to butt fuse polyolefin pipe from 6" IPS (6 5/8" OD) minimum to 18" IPS (18" OD) maximum.

Weight is 1200 lbs. Overall dimensions are 46" wide x 51" high x 82" long. With reasonable maintenance and care, this machine will give years of satisfactory service. Although all parts are designed for and protected against the elements, inside storage is preferable. The McElroy shipping and storage container also provides an inventory control of auxiliary parts.

DESCRIPTION OF COMPONENTS

Clamping Unit

While on the wagon, the clamping unit consists of two fixed jaws and two hydraulically operated movable jaws bolted to the frame.

The two hydraulic jaws and the inner fixed jaw are attached together, and can be unbolted from the wagon frame and removed for remote operation. For this we offer optional hydraulic extension hoses.

For hazardous environments the jaw works must be removed from the cart. There must be sufficient hose and cable length for the cart to remain in a safe location.

Wagon

This compact and self-contained fusion system is mounted on a four-wheel wagon for mobility and movement along a pipe line. The front axle has an automotive spindle-type steering, controlled by the tongue. The tongue has a ring on the end to slip over a ball hitch so that the unit may be conveniently maneuvered at the job site. The cart is not designed for over-road towing.

---

!!! WARNING !!!

**TOWING AT SPEEDS GREATER THAN 5 MPH CAN RESULT IN MACHINE DAMAGE AS WELL AS INJURY. ALWAYS TRANSPORT THE MACHINE BY FLATBED TRUCK OR SIMILAR MEANS.**

---

**Engine**

A 16 HP Kohler "Cast Iron" electric-start, industrial quality, gasoline engine drives the hydraulic pump for fusion force and power of the facer motor, and a 3.0 KW/220V (1) Phase, 60 Hz, alternator to power the heater plate.

**Pump**

The Oil Gear pressure compensated pump should be set at 1100 PSI and 5.5 GPM.

**Oil Reservoir**

The reservoir is incorporated in the wagon frame. The oil level should remain visible in the sight gauge in the side of the filler spout. Never allow dirt or other foreign matter to enter the open tank. Use Sunmark 2105 or equivalent. Refer to Hydraulic Fluids Recommendations included with this manual.

**Filter**

This unit is equipped with a 10 Micron Filter on the suction side of the pump. Replace filter and oil approximately every 500 hours of operation.

**Hydraulic Manifold Block**

Mounted on this block are (1) carriage control valve, (1) selector valve, (3) pressure valves and (1) 1500 PSI gauge. The carriage control valve is mounted on top with the gauge. The selector valve, mounted on the front, selects a reduced pressure from one of the pressure reducing valves. Each pressure reducing valve is labeled with a different function; top for facing pressure, middle for heating pressure and bottom for fusion pressure.

**Lift Roller Control**

The control valve is located under the inner fixed jaw. Pull to lift and push to lower the pipe lift cylinder.

**Hydraulic Cylinders**

The two carriage cylinders and the lift cylinder have air bleed screws and must be bled if the system ever runs low on oil or leaks air on suction side of pump. The bleeding procedure for this unit is listed below:

1. Tilt unit so the fixed jaw end is higher than the opposite end.
2. Shift the directional control and move the carriage to the fixed jaw end. Adjust the pressure to approximately 50-100 PSI before proceeding to step 3.

3. Loosen the bleed plug on one cylinder next to the fixed jaw.
4. Hold pressure on the cylinder until no air is indicated and quickly retighten the plug.
5. Repeat this operation on the opposite cylinder.
6. Tilt the unit so the opposite end is higher than the fixed jaw end. Move the carriage to the end opposite the fixed jaw and repeat the above procedure on that end of the cylinders.

The lift cylinder also has adjustable cushions on each end of stroke to reduce the shock at end of stroke.

#### Facer

The facer is of the McElroy rotating planer-block design and each face contains (3) cutter blades. The block rotates on sealed ball bearings and is chain driven by a hydraulic motor. The facer is packed with a high temperature grease at assembly. This grease should be good for the life of the unit.

The facer weighs approximately 135 lbs. and is pivoted on a shaft attached to the two movable jaws. It is supported by a facer pivot shaft, guided by the cylinder rods, and will face all sizes of pipe from 4" IPS to 12" IPS. It has a release mechanism on the pivot side for quick and easy removal from the unit and is provided with a lifting ring for handling with hoist (by others) for remote operation.

---

#### !!! WARNING !!!

DO NOT LIFT THE FUSION UNIT WITH THIS LIFTING EYE. THE RING IS NOT DESIGNED TO LIFT THE ENTIRE WORKS. ATTEMPTING TO DO SO CAN RESULT IN SEVER MACHINE DAMAGE AS WELL AS INJURY.

---

#### Alternator

On an 3.0 YCB-3S or 220V, 1 Phase, 60 Hz belt driven generator, refer to enclosed manufacturer's manual.

---

#### !!! CAUTION !!!

THIS ALTERNATOR IS DESIGNED TO SUPPLY POWER TO THE HEATER ONLY. PLUGGING ANY LIGHTS OR APPLIANCES INTO ALTERNATOR WILL CAUSE THE CIRCUIT TO BE BROKEN.

---

**Heater****!!! DANGER !!!**

**THE HEATER IS NOT EXPLOSION PROOF! FOR OPERATION IN HAZARDOUS ENVIRONMENTS, DISCONNECT THE HEATER FROM THE POWER SOURCE BEFORE ENTERING THE DANGEROUS AREA. FAILURE TO DO SO WILL RESULT IN EXPLOSION AND DEATH.**

---

The heater assembly has cast in place Calrod Units and contains a thermoswitch for temperature control and a dial type thermometer for temperature observation.

There are two heater assemblies: one for 18"-10" IPS pipe (3000 watts), one for 6"-12" IPS pipe (3000 watts). The 6"-12" heater weighs approximately 30 lbs. and the 18"-10" heater weighs 43 lbs. Each heater has two handles for ease of positioning. A scabbard type storage box is available.

**!!! WARNING !!!**

---

INCORRECT TEMPERATURE ADJUSTMENT CAN RESULT IN INJURY AS WELL AS MACHINE DAMAGE. FOLLOW THESE INSTRUCTIONS CAREFULLY.

---

To adjust heater temperature:

1. Disconnect electric plug to avoid electric shock.
2. The heater thermoswitch adjustment shaft protrudes thru the heater handle base. Turn the adjustment shaft clockwise to lower temperature, counter-clockwise to raise temperature. One revolution equals about 100° F.
3. Reconnect electric plug and allow heater to stabilize at new temperature (5 to 10 minutes) after each adjustment.

**!!! CAUTION !!!**

---

INCORRECT HEATING TEMPERATURE CAN RESULT IN BAD FUSION JOINTS. CHECK HEATER PLATE PERIODICALLY WITH A TEMPILSTIK OR PYROMETER FOR SURFACE TEMPERATURE, AND MAKE NECESSARY ADJUSTMENTS.

**Pipe Support Stands**

For fixed fusion installation, install pipe support stands about 20'  
in front and behind the unit, and adjust to proper height.

When moving the unit from joint to joint, an optional pipe support  
trailer is available. It is pulled behind the unit, and incorporates  
a jack to obtain the proper height.

MC ELROY NO. 618 HYDRAULIC FUSION UNIT  
INSTRUCTION MANUALOPERATING INSTRUCTIONS

---

!!! WARNING !!!

KEEP CLEAR OF JAW AREA. UNIT OPERATES UNDER PRESSURE AND CAN CRUSH HANDS, ARMS, OR OTHER BODY PARTS. BE AWARE OF YOURSELF AND OTHERS WHEN OPERATING THIS UNIT.

---

Before starting unit, the following checkout and lubrication should be performed to insure trouble-free operation and optimum life of the unit.

1. Engine Oil Level Dip Stick - Do not screw in for proper reading. (Refer to engine manual for further instructions.)
2. Hydraulic Fluid Level - Check for oil in sight gauge on filler spout and add if necessary. Use Sunmark 2105 or equivalent oil.
3. Fuel - Fill the tank with unleaded gasoline in a nonhazardous area.

---

!!! DANGER !!!

SPARKS COULD IGNITE GASOLINE, CAUSING EXPLOSION AND DEATH.  
DO NOT SMOKE OR OPERATE UNIT WHEN FILLING WITH GAS.

---

4. Grease all zerk fittings one shot each week.

Start-Up Procedure

---

!!! DANGER !!!

DO NOT OPERATE ENGINE IN A HAZARDOUS ENVIRONMENT. THE ENGINE SHOULD ALWAYS REMAIN IN A SAFE LOCATION. REMOVE FACER AND TOP WORKS AND ATTACH HOSES.

---

1. Disconnect heater plug and open facer operating valve before starting engine.
2. To start engine, close choke (move lever away from engine), turn switch to "ON", and press starter button.

3. Open choke as engine warms up. Engine speed is governor controlled and has been factory set to obtain 255 no load Volts, or 230 full load Volts from the alternator. DO NOT EXCEED 255 NO LOAD VOLTS.
4. Close facer operating valve.
5. Plug in heater in a NONHAZARDOUS environment. Allow unit to run long enough to bring heater to temperature before attempting to fuse pipe.

#### Check Hydraulic Pressure

The pressure gauge indicates the pressure at the carriage control valve. How much pressure depends on the position of the selector valve and the pressure set on the (3) pressure reducing valves. With the selector valve up, the facing pressure can be set (80 - 100 PSI). Shift the selector valve to center and the heating pressure can be set. If heating pressure is not required, set the pressure reducing valve at its lowest setting. With the selector valve down, the fusion pressure can be set. The heating and fusion pressures can be calculated using the enclosed nomogram.

The hydraulic pump is set at 1100 PSI from the plant. When facing SDR 11 and thicker wall pipe, it is necessary to increase the pump pressure to 1400-1500 PSI. To increase the pressure, shift the selector valve to the down (fusion) position and screw the bottom pressure reducing valve "IN" as far as it will go. The actual pump pressure should be shown on the pressure gauge at the manifold block.

With the pump running and the system deadheading with no motion occurring, loosen the locknut on the pressure adjusting screw (see pump specification sheet for location) and turn it clockwise to increase the pressure. Watch the pressure gauge on the manifold block and retighten the locknut on the adjusting screw when the desired pressure is reached. Then back off the lower pressure reducing valve to the required fusion pressure.

#### Butt Fusion Procedure

1. Open upper jaws and insert pipe in each pair of jaws with applicable inserts installed. Let end of pipe protrude about 1 $\frac{1}{2}$ " - 2" past face of jaw.
2. Lower facer into place.
3. With the carriage control valve lever, move the carriage toward the fixed clamps, while watching the gap at each end of the facer rest buttons. When the pipe is in contact with the facer, this gap indicates the amount of material that will be trimmed from the pipe end.
4. Tighten the clamp screw knobs on the outside clamps.

5. Snug down the inside clamp knobs.
6. Turn facer on by opening facer operating valve on top 90°. Be sure selector valve handle is in "UP" position. Move the control valve lever all the way toward the facer. Allow facer to cut until the rest buttons are against the stops on either side of the facer.
7. Turn off the facer motor.
8. Move carriage to the right.
9. Swing facer to storage position.
10. Move carriage to the left until ends of pipe butt together.
11. Check pipe joint for proper alignment. The pipe ends should be flush with each other. To check misalignment between the jaws (hi/lo), use a pencil or similar object between the jaws to look for ridges. If any exist, tighten the high side to align.

---

!!! WARNING !!!

DO NOT USE FINGERS TO CHECK FOR HI/LO. THE UNIT IS UNDER PRESSURE AND SLIPPERY COULD RESULT IN CRUSHED FINGERS.  
ALWAYS STAY CLEAR OF JAW AREA.

---

If pipe is lined up, proceed with Step 12. If pipe is not lined up, tighten high side clamp to bring into alignment.

12. Move carriage to the right.
13. Check heater temperature. HEATER PLATE SHOULD BE CHECKED PERIODICALLY WITH A TEMPILSTIK OR PYROMETER FOR CORRECT SURFACE TEMPERATURE.
14. Move selector valve handle to bottom position.
15. Insert heater on rods between pipe ends.

---

!!! DANGER !!!

THE HEATER IS NOT EXPLOSION PROOF! FOR OPERATION IN HAZARDOUS ENVIRONMENTS, DISCONNECT THE HEATER FROM THE POWER SOURCE BEFORE ENTERING THE DANGEROUS AREA. FAILURE TO DO SO WILL RESULT IN EXPLOSION AND DEATH.

---

16. Move the carriage to the left, bringing the heater into contact with both pipe ends.
17. Move selector valve to center position. If heating pressure is not required, quickly return carriage control valve to neutral position.
18. After following the pipe manufacturer's suggested heating procedure, shift carriage control valve to neutral position and then the selector valve down to fusion position.
19. Move the carriage to the right just enough to remove the heater. Remove the heater.
20. Quickly move the carriage to the left, bringing the pipe ends together under the pipe manufacturer's recommended pressure. Allow joint to cool under pressure according to pipe manufacturer's recommendations. If working in a hazardous environment, plug the heater into power source outside of hazardous environment between joints to maintain operating temperature.

---

!!! CAUTION !!!

FAILURE TO FOLLOW PIPE MANUFACTURER'S HEATING AND COOLING PRESSURE, TEMPERATURE, AND TIME RECOMMENDATIONS, CAN RESULT IN BAD JOINTS.

---

21. Shift the carriage control valve to the neutral position.
22. Loosen clamp screws on movable jaws and move carriage to the right enough to open the jaw to the left of the facer.
23. Loosen clamp screws on fixed jaws and open jaws.
24. Raise pipe with hydraulic lift.
25. Move unit to end of pipe or pull pipe to rear through the jaws until the end of the pipe is protruding 1 $\frac{1}{2}$ " - 2" past the jaw face.
26. Insert new joint of pipe in movable jaws and repeat procedure, starting with Step 1.

# Fusion Equipment Safety

## Safety Alerts

This hazard alert sign  appears in this manual. When you see this sign, carefully read what it says. **YOUR SAFETY IS AT STAKE.**

You will see the hazard alert sign with these words: **DANGER**, **WARNING**, and **CAUTION**.



**DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



**WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



**CAUTION** Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.



In this manual you should look for two other words: **NOTICE** and **IMPORTANT**.

**NOTICE:** can keep you from doing something that might damage the machine or someone's property. It may also be used to alert against unsafe practices.

**IMPORTANT:** can help you do a better job or make your job easier in some way.

100000-12-1-42

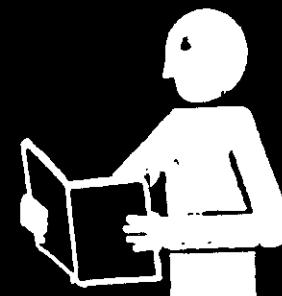
## Read and Understand

Do not operate this equipment until you have carefully read, and understand the "Safety" and "Operation" sections of this manual, and all other equipment manuals that will be used with it.

Your safety and the safety of others depends upon care and judgment in the operation of this equipment.

Follow all applicable federal, state, local, and industry specific regulations.

McElroy Manufacturing, Inc. cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this manual and on the machine are therefore not all inclusive. You must satisfy yourself that a procedure, tool, work method, or operating technique is safe for you and others. You should also ensure that the machine will not be damaged or made unsafe by the method of operation or maintenance you choose.



## Fusion Equipment Safety

### General Safety

Safety is important. Report anything unusual that you notice during set up or operation.

LISTEN for thumps, bumps, rattles, squeaks, air leaks, or unusual sounds.

SMELL odors like burning insulation, hot metal, burning rubber, hot oil, or natural gas.

FEEL any changes in the way the equipment operates.

SEE problems with wiring and cables, hydraulic connections, or other equipment.

REPORT anything you see, feel, smell, or hear that is different from what you expect, or that you think may be unsafe.

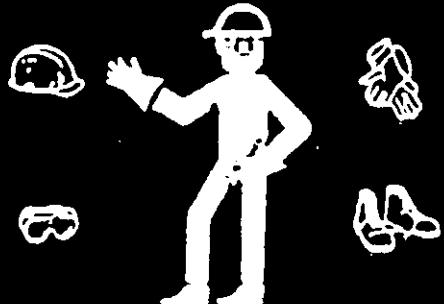
10000004-4-03-02



### Wear Safety Equipment

Wear a hard hat, safety shoes, safety glasses, and other applicable personal protective equipment.

Remove jewelry and rings, and do not wear loose-fitting clothing or long hair that could catch on controls or moving machinery.



10000004-4-7-02

### Units With Hydraulics

Although the hydraulic pressures in fusion machines are low compared to some hydraulically operated equipment, it is important to remember that a sudden hydraulic oil leak can create serious injury, or even be fatal if the pressure is high enough.

#### **WARNING**

Escaping fluid under pressure can penetrate the skin causing serious injury. Keep hands and body away from pinholes which eject fluid under pressure. Use a piece of cardboard or paper to search for leaks. If any fluid is injected into the skin, it must be immediately removed by a doctor familiar with this type of injury.

**NOTICE:** wear safety glasses, and keep face clear of area when bleeding air from hydraulic system to avoid spraying oil into eyes.



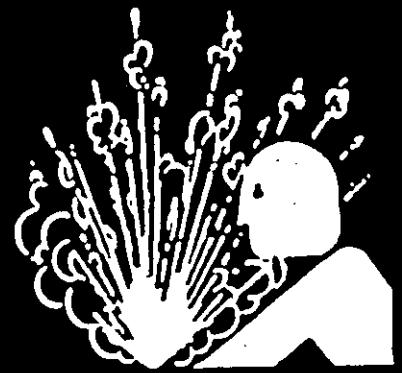
## Fusion Equipment Safety

### Heater Is Not Explosion Proof

**DANGER** This unit is not explosion proof. Operation of heater in a hazardous environment without necessary safety precautions will result in explosion and death.

When operating in a hazardous environment, heater plates should be brought up to temperature in a safe environment, then unplugged before entering the hazardous atmosphere for fusion.

TD000004-14-03



### Electric Motors are not Explosion Proof

**DANGER** Electric motors are not explosion proof. Operation of these components in a hazardous environment without necessary safety precautions will result in explosion and death.

When operating in a hazardous environment, remove both brushes from the facer motor and hand crank the unit using the hex drive. Keep pump motor and chassis in a safe area by using hydraulic extension hoses.

TD000004-13-03



### Electrical Safety

**WARNING** Always ensure power cords are properly grounded. It is important to remember that you are working in a wet environment with electrical devices. Proper ground connections help to minimize the chances of an electric shock.

Frequently inspect electrical cords and unit for damage. Have damaged components replaced and service performed by a qualified electrician.

Do not carry electrical devices by the cord.

**NOTICE:** Always connect units to the proper power source as listed on the unit, or in the owner's manual. On units with two power cords, plug each cord into separate power circuits. Do not plug into both outlets of one duplex receptacle.

**NOTICE:** Disconnect the machine from the power source before attempting any maintenance or adjustment.

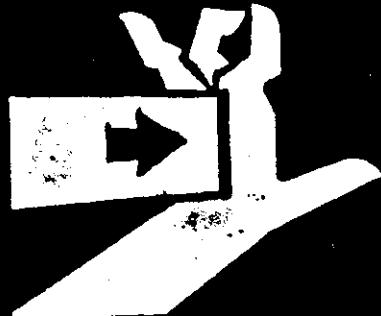


## Fusion Equipment Safety

### Crush Points

**WARNING**

Hydraulically operated jaws are operated under pressure. Anything caught in the jaws will be crushed. Keep fingers, feet, arms, legs, and head out of the jaw area. Always check pipe alignment with a pencil or similar object.



MEC00100-04-00

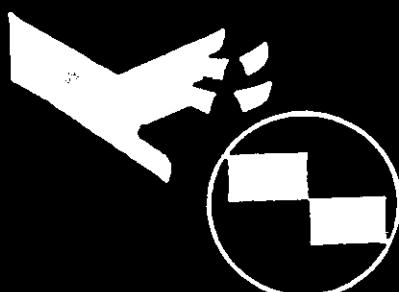
### Facer Blades Are Sharp

**WARNING**

Facer blades are sharp and can cut. Never attempt to remove shavings while the facer is running, or is in the facing position between the jaws. Use care when operating the facer, and when handling the unit.

**NOTICE:** Disconnect power from the facer, and remove the facer blades before attempting any maintenance or adjustment.

MEC00100-04-00



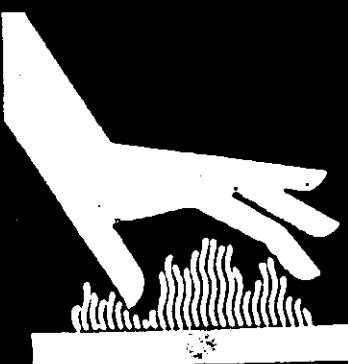
### Heater Is Hot

**CAUTION**

The heater is hot and will burn clothing and skin. Keep the heater in its insulated storage box when not in use, and use care when heating the pipe.

**NOTICE:** Use only a clean non-synthetic cloth such as a cotton cloth to clean the heater plates.

MEC00100-04-00



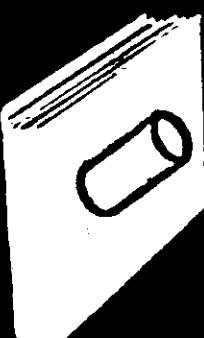
### Fusion Procedures

Obtain a copy of the pipe manufacturer's procedures for the pipe being fused. Follow the procedure carefully, and adhere to all specified parameters.

**CAUTION**

Failure to follow pipe manufacturer's procedure could result in a bad joint. Always follow pipe manufacturer's procedures.

MEC00100-04-00



## Fusion Equipment Safety

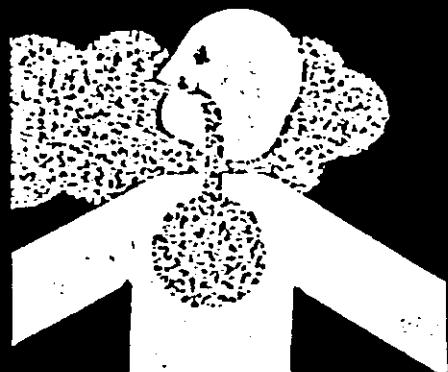
### Units With Gas Engines

**WARNING**

Handle fuel with care. Fuel is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine. Fill fuel tank outdoors. Help prevent fires by keeping machine clean of accumulated trash, grease, debris, and metal shavings. Always clean up spilled fuel.

**WARNING**

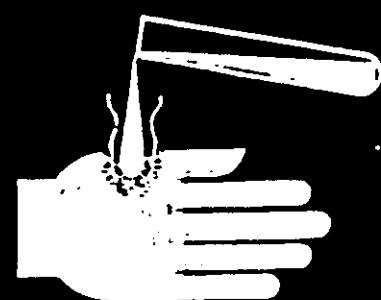
Danger Breathing exhaust gases can cause sickness or death. Always operate machine outdoors in an area with adequate ventilation.



### Units with Batteries

**CAUTION**

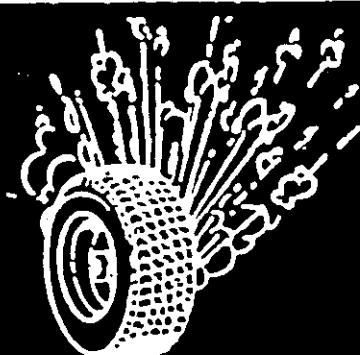
Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes. Avoid contact with eyes, skin, or clothing. Exploding gases from battery could cause blindness or serious injury. Keep sparks, flames, and cigarettes away.



### Have Tires Properly Serviced

**WARNING**

Failure to follow proper procedures when mounting a tire on a wheel or rim can produce an explosion which may result in serious injury or death. Have tires mounted by someone that is experienced, and has the proper equipment to perform the job safely.



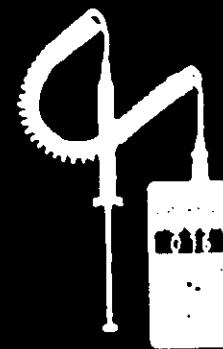
## Fusion Equipment Safety

### Periodically Check Temperature

**NOTICE:** Incorrect heating temperature can result in bad fusion joints. Check heater plate surface temperature periodically with a tempilstik or pyrometer and make necessary adjustments.

The thermometer on heaters indicates internal temperature, and should be used as a reference only.

TIG00107-4-12-03

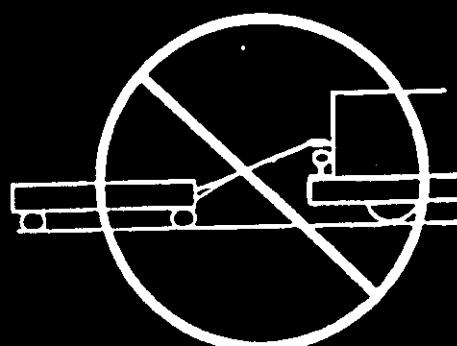


### Do Not Tow Fusion Unit At Speeds Greater Than 5 MPH

**WARNING**

The cart is not designed for over-road towing. Towing at speeds greater than five miles per hour can result in machine damage as well as injury. Always transport the machine by flat bed truck or similar means, and make sure that unit is properly secured.

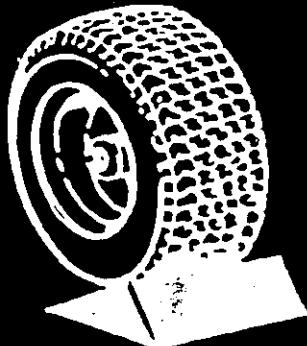
TIG00107-4-12-03



### Positioning Unit

Place unit on as level ground as possible, and set the brake on the rear wheel. If it is necessary to operate machine on unlevel grade, chock the wheels and block the unit to make it as stable as possible.

TIG00107-4-12-03

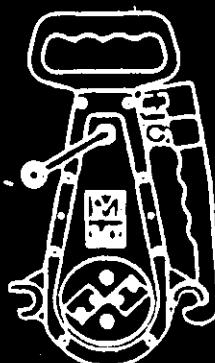


### Transporting 2LC and 2CU Units

On smaller machines it is easiest to carry the unit if the facer is securely installed and locked on the fusion unit. The facer has a handle that allows the unit to be firmly grasped and carried.

**NOTICE:** Do not carry unit by the lever handles because they can release or bend. Care must be used if the unit is grasped elsewhere because numerous pinch points exist.

TIG00107-4-12-03



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**APPENDIX C**  
**TEST DATA SHEETS**

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**DOT-7A PROGRAM**  
**TEST DATA SHEET 6.4.1**  
**PACKAGING VISUAL INSPECTIONS**

DOCKET: \_\_\_\_\_

TEST UNIT NO.: \_\_\_\_\_

Perform Inspections Per Procedure Section 6.4.1.

Component: \_\_\_\_\_

[ ] - Accept      [ ] - Reject

Remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Component: \_\_\_\_\_

[ ] - Accept      [ ] - Reject

Remarks: \_\_\_\_\_  
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Component: \_\_\_\_\_

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[ ] - Accept      [ ] - Reject

Remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Remarks: \_\_\_\_\_

COMPLETION:

Test Engineer

Date

[Use additional sheets as needed]

**DOT-7A PROGRAM****TEST DATA SHEET 6.4.2-1/2****PACKAGING COMPONENT WEIGHTS****DOCKET:** \_\_\_\_\_**TEST UNIT NO.:** \_\_\_\_\_**Measure Major Component Weights and Record Per Procedure Section 6.4.2.**

Component: \_\_\_\_\_

Weight: \_\_\_\_\_ (lb.) Date Measured: \_\_\_\_\_  
Equipment Note: \_\_\_\_\_ Test Engineer - Initial/Date: \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Weight: \_\_\_\_\_ (lb.) Date Measured: \_\_\_\_\_  
Equipment Note: \_\_\_\_\_ Test Engineer - Initial/Date: \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Weight: \_\_\_\_\_ (lb.) Date Measured: \_\_\_\_\_  
Equipment Note: \_\_\_\_\_ Test Engineer - Initial/Date: \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Weight: \_\_\_\_\_ (lb.) Date Measured: \_\_\_\_\_  
Equipment Note: \_\_\_\_\_ Test Engineer - Initial/Date: \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Weight: \_\_\_\_\_ (lb.) Date Measured: \_\_\_\_\_  
Equipment Note: \_\_\_\_\_ Test Engineer - Initial/Date: \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Weight: \_\_\_\_\_ (lb.) Date Measured: \_\_\_\_\_  
Equipment Note: \_\_\_\_\_ Test Engineer - Initial/Date: \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Weight: \_\_\_\_\_ (lb.) Date Measured: \_\_\_\_\_  
Equipment Note: \_\_\_\_\_ Test Engineer - Initial/Date: \_\_\_\_\_ / \_\_\_\_\_Remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COMPLETION:

Test Engineer

Date

(Use additional sheets as needed)

## DOT-7A PROGRAM

## TEST DATA SHEET 6.4.2-2/2

## PACKAGING COMPONENT WEIGHTS

DOCKET: \_\_\_\_\_

TEST UNIT NO.: \_\_\_\_\_

Measure Major Component Weights and Record Per Procedure Section 6.4.2.

Component: \_\_\_\_\_

Weight: \_\_\_\_\_ (lb.)

Date Measured: \_\_\_\_\_

Equipment Note: \_\_\_\_\_

Test Engineer - Initial/Date \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Weight: \_\_\_\_\_ (lb.)

Date Measured: \_\_\_\_\_

Equipment Note: \_\_\_\_\_

Test Engineer - Initial/Date \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Complete Packaging - Assembled and Closed (Net)W/O CONTENTS

Weight: \_\_\_\_\_ (lb.)

Date Measured: \_\_\_\_\_

Equipment Note: \_\_\_\_\_

Test Engineer - Initial/Date \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Package - Loaded with Simulated Payload (Gross)W/ CONTENTS

Weight: \_\_\_\_\_ (lb.)

Date Measured: \_\_\_\_\_

Equipment Note: \_\_\_\_\_

Test Engineer - Initial/Date \_\_\_\_\_ / \_\_\_\_\_

## Equipment Notes:

1) Description: \_\_\_\_\_

Serial No. \_\_\_\_\_ Accuracy: \_\_\_\_\_

Calibration No. &amp; Expiration: \_\_\_\_\_ / \_\_\_\_\_

2) Description: \_\_\_\_\_

Serial No. \_\_\_\_\_ Accuracy: \_\_\_\_\_

Calibration No. &amp; Expiration: \_\_\_\_\_ / \_\_\_\_\_

3) Description: \_\_\_\_\_

Serial No. \_\_\_\_\_ Accuracy: \_\_\_\_\_

Calibration No. &amp; Expiration: \_\_\_\_\_ / \_\_\_\_\_

Remarks: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

COMPLETION:

Test Engineer \_\_\_\_\_ Date \_\_\_\_\_

{Use additional sheets as needed}



**DOT-7A PROGRAM**  
**TEST DATA SHEET 6.4.3-2/2**  
**PACKAGING COMPONENT WALL THICKNESS**

DOCKET: \_\_\_\_\_

TEST UNIT NO.: \_\_\_\_\_

Measure Component Wall Thicknesses Per Test Plan and Record Per Procedure Section 6.4.3.

Component: \_\_\_\_\_

Feature or Location: \_\_\_\_\_

Thickness: \_\_\_\_\_ (in.) Date Measured: \_\_\_\_\_

Equipment Note \_\_\_\_\_ Test Engineer - Initial/Date \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Feature or Location: \_\_\_\_\_

Thickness: \_\_\_\_\_ (in.) Date Measured: \_\_\_\_\_

Equipment Note \_\_\_\_\_ Test Engineer - Initial/Date \_\_\_\_\_ / \_\_\_\_\_

Component: \_\_\_\_\_

Feature or Location: \_\_\_\_\_

Thickness: \_\_\_\_\_ (in.) Date Measured: \_\_\_\_\_

Equipment Note \_\_\_\_\_ Test Engineer - Initial/Date \_\_\_\_\_ / \_\_\_\_\_

Equipment Notes:

1) Description: \_\_\_\_\_

Serial No. \_\_\_\_\_ Accuracy: \_\_\_\_\_

Calibration No. &amp; Expiration: \_\_\_\_\_ / \_\_\_\_\_

2) Description: \_\_\_\_\_

Serial No. \_\_\_\_\_ Accuracy: \_\_\_\_\_

Calibration No. &amp; Expiration: \_\_\_\_\_ / \_\_\_\_\_

3) Description: \_\_\_\_\_

Serial No. \_\_\_\_\_ Accuracy: \_\_\_\_\_

Calibration No. &amp; Expiration: \_\_\_\_\_ / \_\_\_\_\_

Remarks: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

COMPLETION: \_\_\_\_\_

Test Engineer \_\_\_\_\_ Date \_\_\_\_\_

(Use additional sheets as needed)

**DOT-7A PROGRAM**  
**TEST DATA SHEET 7.1.2**  
**SOAP BUBBLE TEST**

DOCKET: \_\_\_\_\_

TEST UNIT NO.: \_\_\_\_\_

Perform the Reduced Pressure Test and Record Data per Procedure Section 7.1.2;  
 Indicate Completion of Steps as Follows:

7.1.1	Initial Conditions Established.	Test Engineer - Initial/Date	/
7.1.2.1	Test Assembly Set-up.	Test Engineer - Initial/Date	/
through	"		
7.1.2.3	"		
7.1.2.4	Pressurize Payload Cavity	Test Engineer - Initial/Date	/
Time: _____ (use military notation - 1:30 p.m. = 13:30)			
Pressure: _____ (psig)			
Temperature: _____ (F)			
7.1.2.5	Hold ( _____ Minutes, Observe, Conduct Leakage Rate Testing	Test Engineer - Initial/Date	/
7.1.2.6	Record Final Data.	Test Engineer - Initial/Date	/
Time: _____ (use military notation - 1:30 p.m. = 13:30)			
Pressure: _____ (psig)			
Temperature: _____ (F)			
7.1.2.7	Relieve Pressure.	Test Engineer - Initial/Date	/
7.1.2.8	Evaluate Leakage Rate.	Test Engineer - Initial/Date	/
[ ] - Pass		[ ] - Fail	

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

COMPLETION:

Test Engineer

Date

**DOT-7A PROGRAM**  
**TEST DATA SHEET**  
**VIBRATION TEST**

DOCKET: \_\_\_\_\_

TEST UNIT NO.: \_\_\_\_\_

Perform the Vibration Test per 49 CFR 178.608, "Vibration Standards," and Record Data  
 Indicate Completion of Steps as Follows:

1)	Initial Conditions Established.	Test Engineer - Initial/Date	/
2)	Test Assembly Set-up.	Test Engineer - Initial/Date	/
3)	Start Vibration.	Test Engineer - Initial/Date	/
	Time: _____	(use military notation - 1:30 p.m. = 13:30)	
4)	Maintain Vibration, Observe, Photograph.	Test Engineer - Initial/Date	/
5)	Stop Vibration, Secure Equipment.	Test Engineer - Initial/Date	/
	Time: _____	(use military notation - 1:30 p.m. = 13:30)	
6)	Evaluate Performance.	Test Engineer - Initial/Date	/
	<input type="checkbox"/> - Pass <input type="checkbox"/> - Fail		

## Equipment Notes:

1) Description:	_____		
Serial No.	_____	Accuracy:	_____
Calibration No. & Expiration:	_____	/	_____
2) Description:	_____		
Serial No.	_____	Accuracy:	_____
Calibration No. & Expiration:	_____	/	_____

Remarks:

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COMPLETION:

Test Engineer	Date
[Use additional sheets as needed]	

## DOT-7A PROGRAM

## TEST DATA SHEET 7.2

## WATER SPRAY TEST

DOCKET: \_\_\_\_\_

TEST UNIT NO.: \_\_\_\_\_

Perform the Water Spray Test and Record Data per Procedure Section 7.2;  
 Indicate Completion of Steps as Follows:

7.2.1	Initial Conditions Established.	Test Engineer - Initial/Date	/
7.2.2.1	Test Assembly Set-up.	Test Engineer - Initial/Date	/
7.2.2.2	Start Water Spray.	Test Engineer - Initial/Date	/
	Time: _____ (use military notation - 1:30 p.m. = 13:30)		
7.2.2.3	Maintain Spray, Observe, Photograph.	Test Engineer - Initial/Date	/
7.2.2.4	Stop Water Spray, Secure Equipment.	Test Engineer - Initial/Date	/
	Time: _____ (use military notation - 1:30 p.m. = 13:30)		
7.2.2.5	Evaluate Performance.	Test Engineer - Initial/Date	/
<input type="checkbox"/> - Pass <input type="checkbox"/> - Fail			

Remarks:

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COMPLETION:

Test Engineer

Date

**DOT-7A PROGRAM**  
**TEST DATA SHEET 7.4**  
**PENETRATION TEST**

DOCKET: \_\_\_\_\_

TEST UNIT NO.: \_\_\_\_\_

Perform the Penetration Test and Record Data per Procedure Section 7.4;  
 Indicate Completion of Steps as Follows:

7.4.1	Initial Conditions Established.	Test Engineer - Initial/Date	/
7.4.2.1	Test Assembly Set-up.	Test Engineer - Initial/Date	/
	Drop Height: _____ (in.)		
	Impact Area: _____		
7.4.2.2	Elevate Penetration Bar, Photograph Set-up	Test Engineer - Initial/Date	/
7.4.2.3	Drop Penetration Bar.	Test Engineer - Initial/Date	/
7.4.2.4	Examine, Photograph Impact Area.	Test Engineer - Initial/Date	/
7.4.2.5	Evaluate Performance.	Test Engineer - Initial/Date	/

 - Pass - Fail

Remarks:

COMPLETION:

Test Engineer

Date

**DOT-7A PROGRAM**  
**TEST DATA SHEET 7.3**  
**COMPRESSION TEST**

DOCKET: \_\_\_\_\_

TEST UNIT NO.: \_\_\_\_\_

Perform the Compression Test and Record Data per Procedure Section 7.3;  
 Indicate Completion of Steps as Follows:

7.3.1	Initial Conditions Established.	Test Engineer - Initial/Date	/
7.3.2.1	Test Assembly Set-up.	Test Engineer - Initial/Date	/
7.3.2.2	Test Load: _____ (lb.)		
7.3.2.3	Load Package, Record Time.	Test Engineer - Initial/Date	/
	Time: _____ (use military notation - 1:30 p.m. = 13:30)		
7.3.2.4	Hold (24 hrs), Observe, Photograph.	Test Engineer - Initial/Date	/
7.3.2.5	Unload Package, Record Time.	Test Engineer - Initial/Date	/
	Time: _____ (use military notation - 1:30 p.m. = 13:30)		
7.3.2.6	Evaluate Performance.	Test Engineer - Initial/Date	/
	<input type="checkbox"/> - Pass <input type="checkbox"/> - Fail		

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

COMPLETION: \_\_\_\_\_  
 Test Engineer \_\_\_\_\_ Date \_\_\_\_\_

**DOT-7A PROGRAM**  
**TEST DATA SHEET 7.5-1/2**  
**FREE DROP TEST****DOCKET:** \_\_\_\_\_**TEST UNIT NO.:** \_\_\_\_\_

Perform the Free Drop Test and Record Data per Procedure Section 7.5;  
Indicate Completion of Steps as Follows:

7.5.1 Initial Conditions Established.

Test Engineer - Initial/Date \_\_\_\_\_ /

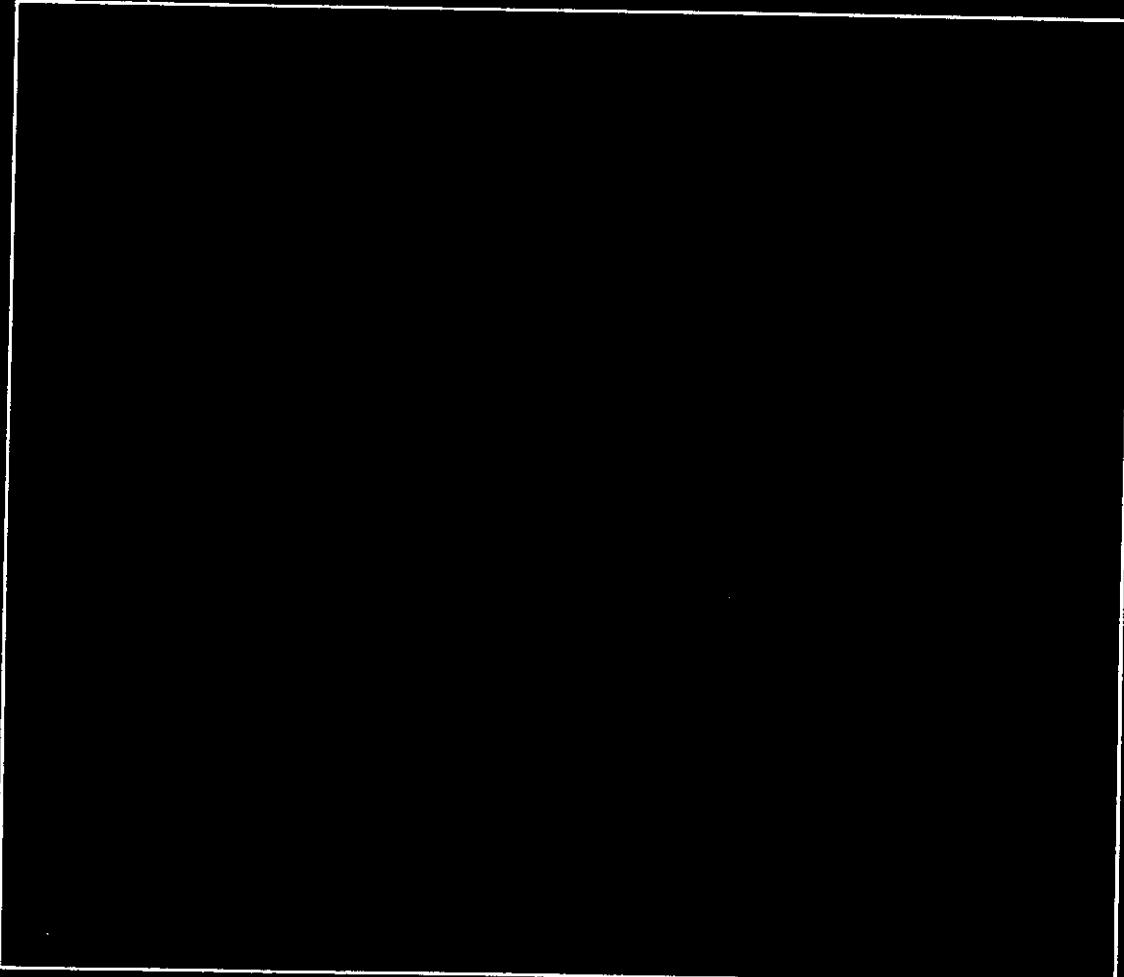
7.5.2.1 Test Assembly Set-up.

Test Engineer - Initial/Date \_\_\_\_\_ /

Drop Height: \_\_\_\_\_ (in.)

Impact Angle: \_\_\_\_\_ (deg.)

Orientation: \_\_\_\_\_

**Sketch - Drop Orientation****COMPLETION:** \_\_\_\_\_

Test Engineer \_\_\_\_\_

Date \_\_\_\_\_

**DOT-7A PROGRAM**  
**TEST DATA SHEET 7.5-2/2**  
**FREE DROP TEST**

**DOCKET:** \_\_\_\_\_**TEST UNIT NO.:** \_\_\_\_\_

7.5.2.2	Rig Package Per 7.5.2.1.	Test Engineer - Initial/Date	/
7.5.2.3	Photograph Set-up, Start Video Coverage.	Test Engineer - Initial/Date	/
7.5.2.4	Drop Package, Secure Video.	Test Engineer - Initial/Date	/
7.5.2.5	Clear Drop Area for Approach.	Test Engineer - Initial/Date	/
7.5.2.6	Examine, Photograph, Videotape Package Damage.	Test Engineer - Initial/Date	/
7.5.2.7	Evaluate Performance.	Test Engineer - Initial/Date	/

[ ] - Pass

[ ] - Fail

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**COMPLETION:**

Test Engineer \_\_\_\_\_

Date \_\_\_\_\_

**DOT-7A PROGRAM**  
**TEST DATA SHEET 7.1.2**  
**REDUCED PRESSURE TEST**

**DOCKET:** \_\_\_\_\_**TEST UNIT NO.:** \_\_\_\_\_

Perform the Reduced Pressure Test and Record Data per Procedure Section 7.1.2;  
 Indicate Completion of Steps as Follows:

7.1.1	Initial Conditions Established.	Test Engineer - Initial/Date	/
7.1.2.1	Test Assembly Set-up. through	Test Engineer - Initial/Date	/
7.1.2.3	"		
7.1.2.4	Pressurize Payload Cavity	Test Engineer - Initial/Date	/
Time: _____ (use military notation - 1:30 p.m. = 13:30)			
Pressure _____ (psig)			
Temperature: _____ (F)			
7.1.2.5	Hold ( _____ Minutes, Observe, Conduct Leakage Rate Testing	Test Engineer - Initial/Date	/
7.1.2.6	Record Final Data.	Test Engineer - Initial/Date	/
Time: _____ (use military notation - 1:30 p.m. = 13:30)			
Pressure _____ (psig)			
Temperature: _____ (F)			
7.1.2.7	Relieve Pressure.	Test Engineer - Initial/Date	/
7.1.2.8	Evaluate Leakage Rate.	Test Engineer - Initial/Date	/
[ ] - Pass		[ ] - Fail	
Remarks: _____ _____ _____ _____ _____ _____			
COMPLETION:		Test Engineer	Date

**DOT-7A PROGRAM  
TEST DATA SHEET 7.1.2  
SOAP BUBBLE TEST**

**DOCKET:**

TEST UNIT NO.:

**Perform the Reduced Pressure Test and Record Data per Procedure Section 7.1.2; Indicate Completion of Steps as Follows:**

7.1.1	Initial Conditions Established.	Test Engineer - Initial/Date	/
7.1.2.1	Test Assembly Set-up.	Test Engineer - Initial/Date	/
through	"		
7.1.2.3	"		
7.1.2.4	Pressurize Payload Cavity	Test Engineer - Initial/Date	/
	Time: _____	(use military notation - 1:30 p.m. = 13:30)	
	Pressure	_____ (psig)	
	Temperature:	_____ (F)	
7.1.2.5	Hold ( _____ Minutes, Observe, Conduct Leakage Rate Testing	Test Engineer - Initial/Date	/
7.1.2.6	Record Final Data.		
	Time: _____	(use military notation - 1:30 p.m. = 13:30)	
	Pressure	_____ (psig)	
	Temperature:	_____ (F)	
7.1.2.7	Relieve Pressure.	Test Engineer - Initial/Date	/
7.1.2.8	Evaluate Leakage Rate.	Test Engineer - Initial/Date	/

**Remarks:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**COMPLETION:** \_\_\_\_\_ **Test Engineer** \_\_\_\_\_ **Date** \_\_\_\_\_