WORKSHEET 15.2 DROP & PUNCTURE TEST CHECKLIST

Test: 1.2m (4-foot) Free Drop Test (10 CFR 71.71(c)(7))		
Test Location: QSA Global, 40 North Ave Burlington, MA		
Step	**Data**	
1. Record test specimen serial number:	TP186A	
2. Record the test specimen weight:	54 lbs	
3. Record the ambient temperature (°C):	65°F (18°C)	Instrument S/N: T198776
3. Record the test unit temperature (°C):	-45°F (-43°C)	Instrument S/N: T198776
4. Identify set-up orientation figure:	TP186 Figure 10.1.1	
5. Record drop height.	48 inches (1.22 meters)	
6. Photograph set-up in at least two perpendicular planes. ✓		
7. Begin video recording of the test so that impact is recorded. ✓		
8. Release the test specimen. ✓		
9. Stop the video recorder. Ensure the point of impact and orientation specified in the plan has been achieved. ✓		
10. Record the damage to the test specimen. Use a separate sheet and attach, if needed. ✓		
11. Engineering, Regulatory Affairs and Quality Assurance make a preliminary assessment relative to 10 CFR 71. Record the assessment on a separate sheet and attach.		

Test witnessed by (Signature)	**Print Name**	**Date**
Engineering:	Paul Rief	12 APR 2010
Regulatory Affairs:	C. P. Ave	12 Apr 10
Quality Assurance: C. Roughan	C Roughan	11 Apr 10

WORKSHEET 15.3 DROP & PUNCTURE TEST DATA SHEET

Test Unit Model/Serial No.: Model 88095 S/N TP186A	Test: 1.2m (4-foot) Free Drop Test (10 CFR 71.71(c)(7))
Test Date: 11 March 2010	Test Time: 1:30 PM

Describe drop orientation and drop height:

TP186 Figure 10.1.1. Oriented with the 880 axis normal to the impact surface (vertical) with the Rear Plate assembly down

Describe impact (location, rotation, etc.):

Impact was as planned, hitting directly on the lock cover with the 880 axis vertical

Describe on-site inspection (damage, broken parts, etc.):

The impact crushed and cracked the lock cover. It also broke the head off on of one lock cover mounting screw.

On-site test assessment:

- Was the test performed in accordance with 10 CFR 71, IAEA TS-R-1 1996, and this test plan? **Yes** or **No**.
- Does the test specimen meet the requirements of 10 CFR 71 and IAEA TS-R-1 1996 for this test? **Yes** or **No**.
- Are any changes to subsequent drop orientations needed to achieve maximum damage? **Yes** or **No**.
  If yes, then identify and justify.

- Did sufficient damage occur to warrant additional drop? **Yes** or **No**.
- Should testing continue with this test specimen? **Yes** or **No**. If yes, next test: TP186 30 foot drop
- Will the test specimen pass the thermal test based on the accumulated damage assessment? **Yes** or **No**

Engineering: 15 APR 2010 **Regulatory:** **QA:**

Describe any post-test disassembly and inspection:

No dis-assembly was done at this time as additional testing is required on this device

Describe any change in source position (if possible):

Source position is unchanged

Describe results of radiography (if performed):

Not performed

Completed by: Paul Rice	Date: 12 APR 2010

WORKSHEET 15.4 TEST INSPECTION DATA SHEET

Test Specimen Serial No.: Model 88095 S/N TP186A	Last Test Performed: 1.2m (4-foot) Free Drop Test (10 CFR 71.71(c)(7))

Describe and measure (if appropriate) any damage or broken parts, etc.:

The lock cover, PN 88023-1 Rev E, was crushed and cracked. This is an aluminum part intended to absorb impact and protect the source.
One screw, PN SCR159, connecting a cover pin PN 88023-2 to the cover broke. The cover remained attached to the Rear Plate assembly

Describe and measure (if appropriate) any signs of permanent strain or deformation:

See the attached photos

Describe the condition of the simulated source wire assembly.

The source wire was still locked in position and had not moved

Reassemble the package using a representative active source, making sure that the source position and the package configuration is the same as they were immediately after the last test.

Measure and record a radiation profile of each test specimen in accordance with QSA Global Work Instruction WI-Q-1806. ✓

Compare the pre-test dose levels with post-test dose levels at the surface of the package and at 1 meter from the surface of the package.

This test will be performed after all testing is complete

Is a radiograph required to inspect for hidden component damage or failure? If radiography is performed, describe any damage or failures found.

This test will be performed after all testing is complete

Completed by: Paul Rice	Date: 12 APR 2010

Section 8.2 Test Plan 186

QSA GLOBAL	Document Number **TP186**	Revision **0**

TEST PLAN 186

Model 880 Pipeliner
Type (B) Transport Package Test Results

10 CFR 71, Packaging and Transportation of Radioactive Materials
Subpart F – Package, Special Form, and LSA-III Tests
Sect 71.71 Normal Conditions of Transport
Sect 71.73 Hypothetical Accident Conditions

Originator	Paul Rice	Date: 15 DEC 09

APPROVALS		
Engineering		Date: 15 Dec 09
Regulatory		Date: 16 Dec 09
Quality Assurance		Date: 16 Dec 09

Contents Page

Section 1 Introduction

This document describes the mechanical test plan for the Model 880 Pipeliner Projector to meet NRC requirements for Type B(U)-96 packages as described in the Code of Federal Regulations, 10 CFR Part 71 , revised as of January 1, 2009.

The test plan also covers the criteria stated in the International Atomic Energy Agency (IAEA), Safety Standards Series No. TS-R-1, Regulations for the Safe Transport of Radioactive Material, 1996 Edition, Section VI.

This document describes the test package specifications, testing equipment, testing scenario, justifies the package orientations for the different test specimens and provides test worksheets to record key steps in the testing sequence.

This series of tests is intended to evaluate any impact the Pipeliner Jacket assembly may have on the Model 880 Projector.

Section 2 Transport Package Description

Description of the Model 880 Projector Assembly

The radioactive material is sealed in a special form source capsule. The source capsule, stop and connector are swaged to a flexible steel wire to form the source wire assembly. The source wire assembly is held securely to the device by components of the rear plate assembly. One of these components, the sleeve, in conjunction with the selector ring retainer, prevents the stop ball of the source wire from being pulled through the rear of the package. Another component, the lock slide, prevents the stop ball from being pushed out of the front when in the secured position. A cover over the source wire connector prevents access to the source assembly until a keyed lock is actuated and the cover removed. This cover is in place during transport of the package.

The selector ring retainer is fastened to the rear plate with four, #10 stainless steel machine screws. The rear plate is attached to rivnuts assembled on the endplate weldment with four 5/16-18 stainless steel security screws. The endplate weldment consists of the endplate disc, a U-shaped bracket and the four rivnuts. The U-brackets are welded to the endplate disc and the endplate disc is welded to the cylindrical shell.

The shield is fastened within the device at each end by a titanium shield pin. The pin passes through the shield and the U-bracket. The shield is centered in the shell and has the source tube cast into its center. The source tube provides a cavity for the source wire assembly to travel through during use. The source capsule is positioned at the center of the ball of the shield within the source tube cavity when the source wire is in its secured position.

The model 880 uses polyurethane foam to fill the cavity around the depleted uranium shield. The foam prevents contamination to and from the depleted uranium shield.

Previous thermal tests have shown charred polyurethane foam will inhibit the flow of oxygen to the shield and prevent oxidation from occurring during a fire as long as the foam remains confined. This is shown on AEA Technology QSA Test plan number 70.

It has also been shown the charred foam will not support the shield at temperatures of 800°C. The model 880 relies on the shield pins to hold the shield in place at all times. These pins are designed to retain the shield throughout testing without the added support of the foam.

The outlet port, located at the front end, serves to block access into or out of the source tube cavity. Four stainless steel security screws fix the front plate to the endplate rivnuts.

Testing of the Model 880 Projector was performed under the following Test Plan:

- AEA Technology QSA Test Report 108 August 2000

Description of the Pipeliner Jacket Assembly

The Pipeliner Jacket Assembly, Part No PL1000H, consists of:

- The Pipeliner Jacket, Part No PL1013, constructed of cast Polyurethane
  - Pipeliner Axle Nut, Part No PL1025, constructed of Stainless Steel
- The Pipeliner Wheel Assembly, Assembly No PL1010, constructed of cast Polyurethane and:
  - Pipeliner Wheel Hub, Part No PL1023, constructed of 6061-T6 Aluminum
  - Pipeliner Wheel Bushing, Part No PL1024, constructed of Sintered Bronze
- The Pipeliner Wheel Axle Bolt, Part No PL1002, constructed of 303 Stainless Steel
- The Pipeliner Mounting Screws, Part No PL1030, constructed of Stainless Steel

The Pipeliner Jacket Assembly is secured to the Model 880 Projector by six #14 x ¾ Tamperproof screws (IRSS PN PL1030) inserted through existing holes in the Projector shell.

Figure 2.1 shows the Pipeliner Jacket Assembly.

Figure 2.2 shows the transport package with the Pipeliner plastic jacket assembly installed.

Figure 2.3 shows section views of the transport package with the Pipeliner plastic jacket assembly installed.

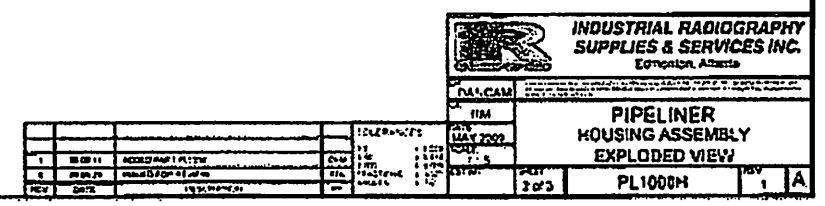
Since the jacket will be on the package during transport and its weight will add approximately 8 lbs, this series of tests will be performed with the jacket assembly installed.

In a drop, the plastic jacket may add additional protection for the transport package from further damage by absorbing energy upon impact.

The 4 foot, 30 foot and puncture orientations for these tests will be based on damage observed from orientations previously tested as part of AEA Technology QSA Test Plan 108 and speculative damaging effects the jacket may have on the safety aspects of the package.

The weight of the Model 880 transport package without a jacket installed is not greater than 46 pounds.
The total weight of the package with the Pipeliner jacket installed is not greater than 55 pounds.

Security-Related Information
Figure Withheld Under 10 CFR 2.390



PART NO	REV	TITLE
PL1000H	1	Housing Assembly Exploded View
PL1002	3	Wheel Axle Bolt
PL1010	0	Wheel Assembly
PL1023	0	Wheel Hub Machining Details
PL1024	0	Wheel Hub Bushing Machining Details
PL1013	0	Jacket Casting Details & General Dimensions
PL1025	0	Axle Nut Machining Details
PL1030	0	Mounting Screws

FIGURE 2.1 PIPELINER JACKET ASSEMBLY, IRSS PART NO PL1000H

REVISIONS				
REV.	ERF	DESCRIPTION	APPROVALS	DATE
A	2277	INITIAL RELEASE	SEE TITLE BLOCK	

Security-Related Information
Figure Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED:

1. DIMENSIONS ARE IN INCHES.
2. DIMENSIONS APPLY AFTER FINISH.
3. NOTES APPLY TO ALL SHEETS.
4. REMOVE ALL BURR & SHARP EDGES.
5. 63 RMS MAX. SURFACE ROUGHNESS.
6. DO NOT SCALE DRAWING.

TOLERANCES:

FRACTIONAL: ± 1/64
TWO PLACE DECIMAL: ±0.01
THREE PLACE DECIMAL: ±0.005
ANGULAR: MACH ±1° & BEND ±5°

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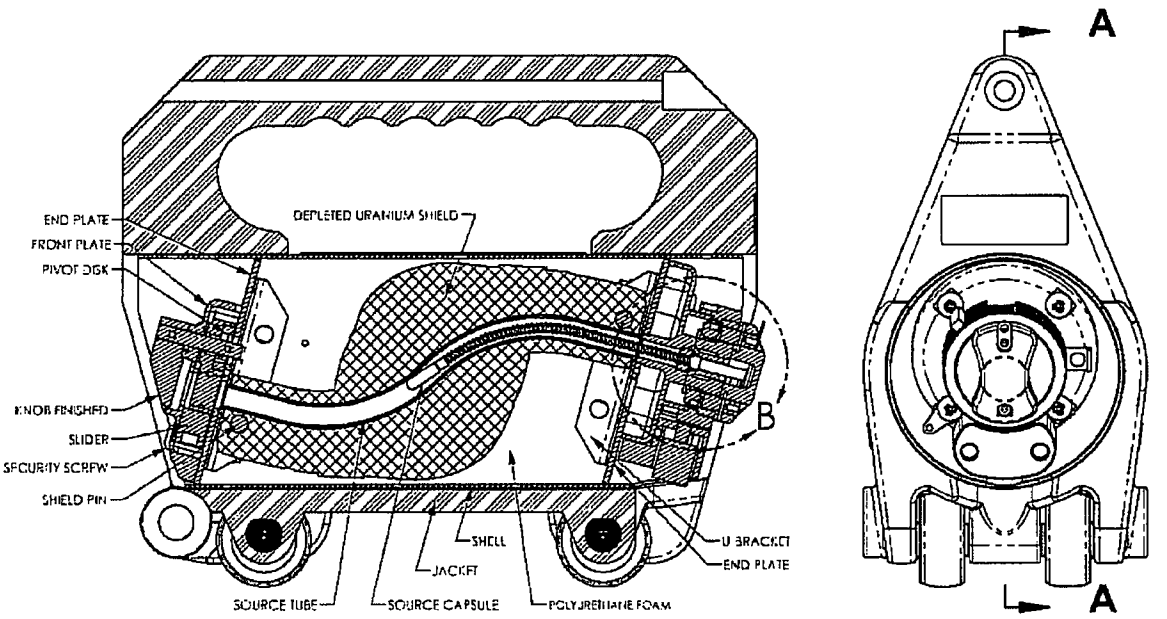
DRAWN: 09Dec09
APPR.: 10Dec09
MATERIAL: SEE BOM
FINISH: NA
SAFETY CLASS: A
THIRD ANGLE PROJECTION

OSA GLOBAL
30 NORTH AVE. BURLINGTON, MA 01803

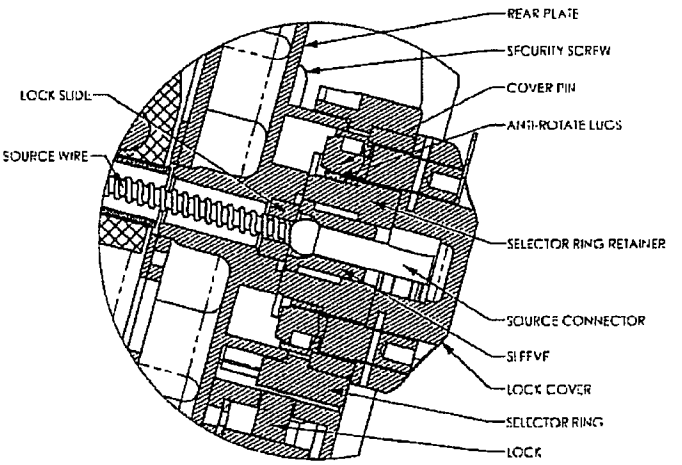
TITLE: PIPELINER TYPE B TRANSPORT DEVICE
SIZE: A | DWG. NO.: 88095 | REV.: A
SCALE: 1:6 | SHEET: 1 OF 1

CAD FILE: K:\Product Drawings\880\Solidworks Files\88095.SLDDRW

FIGURE 2.2 MODEL 880 PROJECTOR WITH PIPELINER JACKET, DN 88095 Rev A



SECTION A-A



DETAIL B

FIGURE 2.3 MODEL 880 PROJECTOR WITH PIPELINER JACKET - SECTION VIEWS

Section 3 Regulatory Compliance

The purpose of this plan, which was developed in accordance with QSA WI-E-1808, is to demonstrate that the Model 880 Pipeliner projector complies with the Type B(U)-96 transport package test requirements as described in the Code of Federal Regulations, 10 CFR Part 71 , revised as of January 1, 2009 and the International Atomic Energy Agency (IAEA), Safety Standards Series No. TS-R-1, Regulations for the Safe Transport of Radioactive Material, 1996 Edition, Section VI.

The Model 880 Projector assembly was previously tested and approved for use as a transport package without the addition of a jacket as well as with the standard Sentinel jacket. This series of tests will evaluate the effect of adding the Pipeliner jacket to the Model 880 Projector.

The water spray preconditioning of the package will not be performed as the Model 880 Projector and the Pipeliner Jacket assemblies are constructed of waterproof materials throughout. The water spray would not contribute to any degradation in structural integrity.

The Normal Condition of Transport test to be performed is the 1.2m (Four-foot) free drop test (10 CFR 71.71 (c) (7)). (IAEA, TS-R-1, Para 722 (a)

The Hypothetical Accident Tests (10 CFR 71.73) to be performed are the 9m (30 foot) free drop test and the puncture test. (IAEA, TS-R-1, Para. 727(a) and 727(b))

The Stacking (Compression) Test TS-R-1 para 723 and 10CFR 71.71(c)(9) will not be performed as the Model 880 Projector was previously tested and the Pipeliner Jacket assembly should not adversely affect the results of this test.

The Penetration Test TS-R-1 para 724 and 10CFR 71.71(c)(10) will not be performed as the Model 880 Projector was previously tested and the Pipeliner Jacket assembly should not adversely affect the results of this test.

The Crush Test (10 CFR 71.73(c)(2)) will not be performed because the radioactive contents are qualified as Special-Form radioactive material.

The Thermal Test of (10 CFR 71.73(c)(4)) will not be performed as the Model 880 Projector has previously been evaluated for this requirement and the materials used in the Pipeliner Jacket have no different effect than the original Sentinel jacket. If damage to the 880 itself should occur during testing and there is an opening in the stainless steel shell that could expose the DU shield the waiver of thermal testing will be re-evaluated.

The melting points for the materials of the package are listed below:

TABLE 3.1 MATERIAL MELTING POINTS

Material	Melting Point
Stainless steel	1390°C (2530°F)
Depleted uranium	1135°C (2075°F)
Titanium	1700°C (3100°F)
Tungsten	3410°C (6170°F)
Copper/Brass	1080°C (1980°F)
Aluminum	580°C (1080°F)
Rubber/Plastic	Less than 540°C (1000°F)

The immersion test will not be performed. Only the source capsule (containment vessel) is sealed. . The source capsule is designed and tested to withstand external pressures well in excess of 22 lbf/in^2. All other assemblies are designed to allow equalization of internal and external pressure

Section 4 Discussion on System Failure Modes of Interest

General

The tests in this plan focus on damaging those components of the package which could cause displacement of the source from its stored position within the depleted uranium shield and which affect the integrity of the shield itself.

Normal and Accident Conditions of Transport

The modes of failure under normal and accident conditions that could lead to elevated dose rates include the following:

- Fracture or penetration of the projector weldment.
- Displacement of the shield within the projector weldment and distortion or fracture of the source.
- Failure of the source lock assembly and/or lock mounting screws.

The test conditions specified in this Test Plan are intended to challenge the ability of the Model 880 Pipeliner package with respect to these failure modes.

Orientations to be Tested

Based on previous testing of the 880 camera the area most subject to damage is the Rear Plate Assembly PN 88020. Damage to the Rear Plate Assembly could cause the source to become displaced or loose. Although this area passed all previous testing the Pipeliner jacket is oriented differently than the standard 880 jacket and may not offer the same protection to this assembly. This could affect the results.

Other orientations:

- Bottom Surface Impact; if an impact to the bottom surface caused the jacket to split the wheels would spread out around the body rather than impacting the shell. If the jacket did not split the jacket should absorb the impact of the wheels. In either case there is little likely hood that the shell would be significantly damaged.
- Top & Side Impacts; Impacts to the top or side surfaces might cause the plastic jacket to split, but it is highly unlikely that this would significantly damage the metal shell.

Based on the above, two orientations will be tested, both impacting the Rear Plate Assembly:

- The first orientation will be with the longitudinal axis of the camera vertical
- The second orientation will be with the Rear Plate Assembly parallel to the impact surface

Section 5 Assessment of Package Conformance

Regulatory Requirements

- **Normal Conditions of Transport (10 CFR 71.43(f))**

  There should be no loss or dispersal of radioactive contents, no significant increase in external surface radiation levels and no substantial reduction in the effectiveness of the packaging.

  IAEA Safety Standards Series No. TS-R-1, Para 622 (b) stipulates that the loss of shielding integrity should not result in more than a 20% increase in the radiation level at any external surface of the package.

- **Hypothetical Accident Conditions (10 CFR 71.51(a))**

  There should be no escape of radioactive materials greater than A_2 in one week and no external dose rate greater than 1 R/hr at 1m from the external surface with the maximum radioactive contents which the package is designed to carry.

Test Package Contents

The Model 880 Pipeliner projector is designed to carry a special form source. Containment of the radioactive source is tested at manufacture. The source capsule design has been certified in accordance with the performance requirements for special form as specified in 10 CFR Part 71 and IAEA Safety Standards Series No. TS-R-1.

A simulated source assembly, model 424-9, will be used during testing of the package. The radiation levels after testing will be measured by replacing the simulated source with an active source

Section 6 Construction and Condition of Test Specimens

The Model 880 transport package test specimens will be manufactured in accordance with the QSA Global, Inc. (QSA) Quality Assurance Program. The weight of each test specimen per this drawing is not greater than 46 pounds.

The Pipeliner jacket assemblies will be manufactured and supplied by IRSS in accordance with the Industrial Radiography Supplies and Services Inc. (IRSS) Quality Assurance Program, as an approved supplier to QSA. IRSS Certificates of Compliance for the supplied parts and assemblies will be included as part of the final test report.

Assembly of the Pipeliner test specimens used for these tests will be done by QSA staff qualified to perform maintenance on 880 projectors in accordance with Industrial Radiography Supplies and Services Inc. (IRSS) instructions for conversion of a standard Model 880 projector titled "Work instruction for performing Pipeliner Retro Fit" Rev 1.
Inspection of the finished assemblies will be performed by the QSA QC department in accordance with the requirements of Industrial Radiography Supplies and Services Inc. (IRSS) instructions for conversion of a standard Model 880 projector titled "Work instruction for performing Pipeliner Retro Fit" Rev 1.
This represents the process QSA and IRSS intend to use for the manufacture of production units.
Additionally, the test specimens will be inspected in accordance with IIR 88095 Rev

The IRSS assembly instructions include the installation of the Collimator and Shoe assemblies as required for use. These components are not part of the transport container assembly and are not included in this test plan. After the assembly and inspection of each test unit is completed the test units will be reconfigured to the transport condition as specified in IRSS Pipeliner Operations and Maintenance Manual. This involves the removal of the Pipeliner Shoe and Collimator assemblies. A copy of this manual will be included as part of the final test report.

The weight of each test specimen with the Pipeliner jacket is not greater than 55 pounds

The structural materials of the Model 880 are made of AISI Type 300 series stainless steel and titanium.
The shielding materials are depleted uranium and tungsten.
The non-safety related parts are made from aluminum, brass, copper, plastic, and rubber.

The Pipeliner jacket assembly is constructed of cast polyurethane, aluminum, bronze & Type 303 stainless steel.

All tests of this plan will subject the test specimen to an impact from a drop. The mechanical strength and ductility of the critical components of the package must continue to perform as expected at the ambient temperature conditions of –40°F to 100°F.

The fracture toughness, strength and ductility, of the structural materials in the Model 880 Projector do not change significantly at or between the temperatures of –40°F to 100°F. The shielding materials are relatively brittle throughout this entire temperature range.

The Pipeliner jacket material has a rated operating temperature range of approximately –30°F to 200°F. Because this does not meet the minimum -40°F temperature requirement of "10 CFR 71, Sect 71.73 Hypothetical Accident Conditions" this series of tests will be performed with the test units cooled to -40°F.

The primary containment is the source capsule, a special form sealed capsule welded at atmospheric pressure and pressure tested to 290 psi minimum. Except for this capsule the package is open to the atmosphere. The internal operating pressure of the containment system is considered to be in equilibrium with the outside pressure of the package. Therefore, the initial pressure of the Pipeliner system has no effect on these tests.

The equipment list worksheets in Section 15 identify the equipment required, with additional space to list other necessary equipment and measuring instruments needed to perform the tests. Additional materials and equipment used to facilitate the tests will be listed as needed.

Section 8 Test Procedure

General

All test specimens are to be tested in the sequence presented below. Each test has been designed to check the integrity of various components of the package. An assessment of transport integrity of the package will be made based on the cumulative effect of the tests performed on the package

The test specimens will have an orientation selected to produce the most damage to the package based on the results of Test Plan 108. The justification and description for this orientation shall be documented.

The tests have the following sequence:

1. Test specimen preparation and inspection
2. 1.2m (Four-foot) free drop test (10 CFR 71.71 (c) (7))
3. 9m (30-foot) free drop test (10 CFR 71.73 (c) (1))
4. Puncture test (10 CFR 71.73 (c) (3))
5. Final test inspection and/or assessment.
    a. The Pipeliner jacket assembly is to be removed prior to profiling.
    b. Repeat the profiling procedure used to inspect QSA PN 88015 prior to testing
6. Test specimen storage.

Roles and Responsibilities

The responsibilities of the groups identified in this plan are:

- **Engineering** executes the tests according to the test plan and summarizes the test results. Engineering also provides technical input to assist Regulatory Affairs and Quality Assurance as needed.
- **Regulatory Affairs** monitors the tests and reviews test reports for compliance with regulatory requirements.
- **Quality Assurance** oversees test execution and test report generation to assure compliance with the QSA Global Quality Assurance Program.
- **Engineering, Regulatory Affairs** and **Quality Assurance** are jointly responsible for assessing test and specimen conditions relative to 10 CFR 71 and IAEA TS-R-1..
- **Quality Control** is responsible for ensuring test and specimen data is measured and recorded throughout the test cycle.

Section 9 Test Specimen Preparation and Inspection

1. Manufacture three Model 880 projectors per QSA Global drawing number B88015, revision C. The projector is profiled per WI-Q1816 as part of this procedure.

2. Mount the three projectors in the Pipeliner jacket assemblies, IRSS part number PL1000H revision 1 , per IRSS instructions for conversion of a standard Model 880 projector titled "Work instruction for performing Pipeliner Retro Fit" Rev 1.

3. Clearly and indelibly mark each specimen: "TP186(X)". Where X is an alphabetically incremented letter beginning with "A". One of the three projectors will be used as a spare and used to replace a specimen dropped onto the wrong impact point, if necessary. The spare, if used, will follow the same test sequence as the initially selected specimen.

4. Measure and record the weight of each specimen.
   This weight must not exceed the maximum specified 55 lbs

5. Inspect the test specimens to ensure that:

   a. All fabrication and inspection records are documented in accordance with the QSA Global Quality Assurance Program.

   b. The test specimens comply with the requirements of the drawings and the IRSS assembly instructions.

Section 10 Summary of Test Schedule

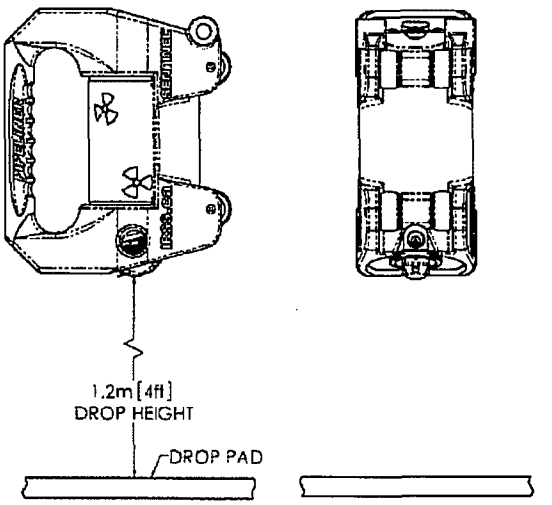
Normal Conditions Test	Para.	Specimen	Diagram
1.2m Drop 1.	71.71(c)(7)	TP186(A)	

FIGURE 10.1.1 NORMAL CONDITIONS - 1.2M DROP 1

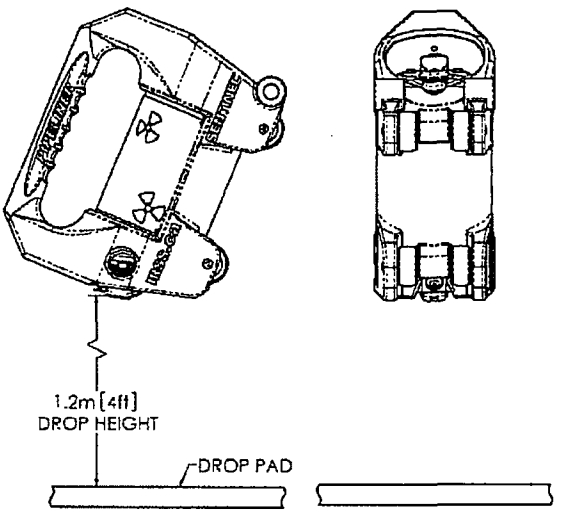
1.2m Drop 2.	71.71(c)(7)	TP186(B)	

FIGURE 10.1.2 NORMAL CONDITIONS - 1.2M DROP 2

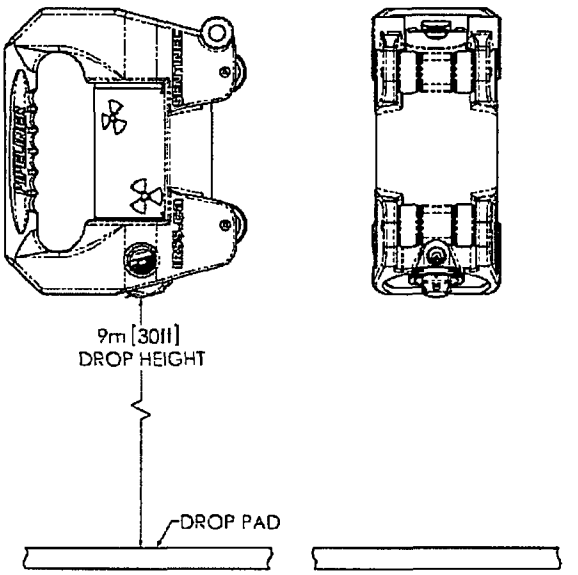
Accident Conditions Test	Para.	Specimen	Diagram
9m Drop 1.	71.73(c)(1)	TP186(A)	

FIGURE 10.2.1 ACCIDENT CONDITIONS - 9M DROP 1

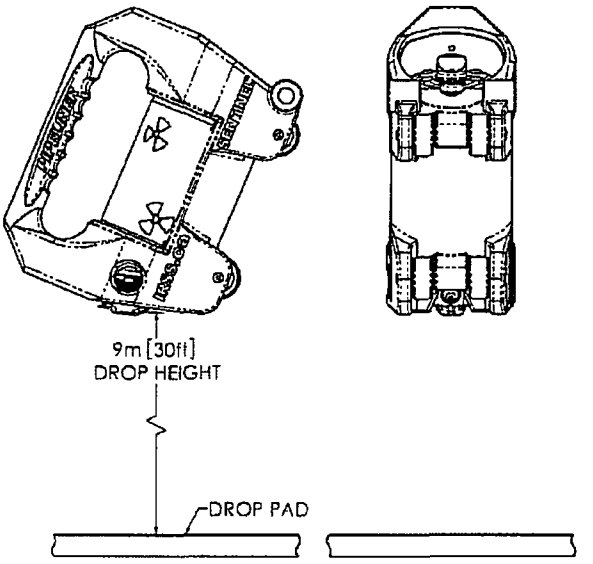
9m Drop 2.	71.73(c)(1)	TP186(B)	

FIGURE 10.2.2 ACCIDENT CONDITIONS - 9M DROP 2

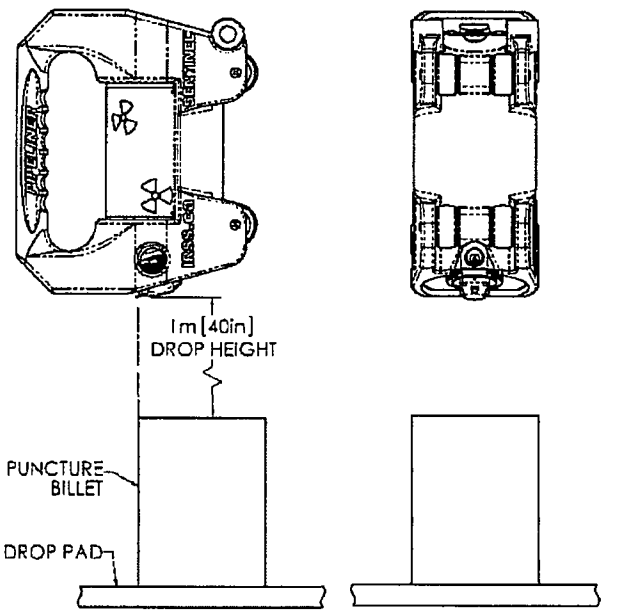
Accident Conditions Test	Para.	Specimen	Diagram
Puncture 1.	71.73(c)(3)	TP186(A)	

FIGURE 10.3.1 ACCIDENT CONDITIONS - PUNCTURE 1

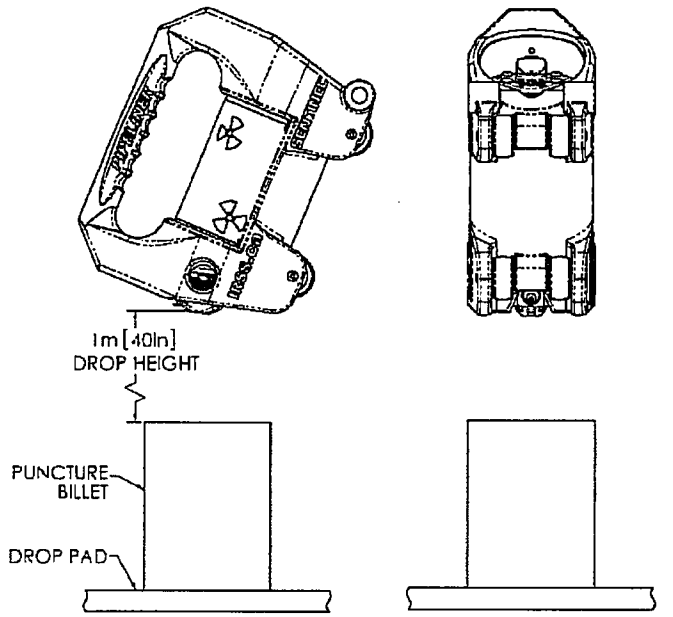
Accident Conditions Test	Para.	Specimen	Diagram
Puncture 2.	71.73(c)(3)	TP186(B)	

FIGURE 10.3.2 ACCIDENT CONDITIONS - PUNCTURE 2

Section 11 1.2m (4-foot) Free Drop Test (10 CFR 71.71(c)(7))

The Normal Transport Conditions Test is the 1.2m (4-foot) free drop test as described in 10 CFR 71.71(c)(7).

The figures of this section illustrate the orientations for the test specimens.

- **1.2m Free Drop Test Set-up**

To set up a package for the 1.2m (4-foot) drop test:

1. Measure and record the weight of the test specimen.
2. Cool the test specimen to -40°F
3. Measure and record the test specimen and ambient temperatures.
4. Position the 1st specimen on the drop surface and position it according to the orientation shown in Figure 11.1.1
5. Raise the package so that the impact target is 1.2m (4 feet) above the drop surface. Ensure the center of gravity is over the impact point
6. Measure and record the ambient temperature.
7. Photograph the set-up.
8. Start the video recorder.
9. Drop the package.
10. Stop the video recorder.
11. Record the damage to the package and take a photographic record.
12. Repeat steps 3 - 10 with the 2nd specimen positioned as shown in Figure 11.1.2

Specimen TP186(A) Orientation for the 1.2m Drop Test

Figure 11.1.1 shows the package orientation for Specimen TP186(A).

The specimen will be dropped with its axis normal to the drop surface with the lock assembly facing down.

The object of the drop is to use the lock cover as leverage to drive the rear plate across the endplate to shear the rear plate mounting screws.

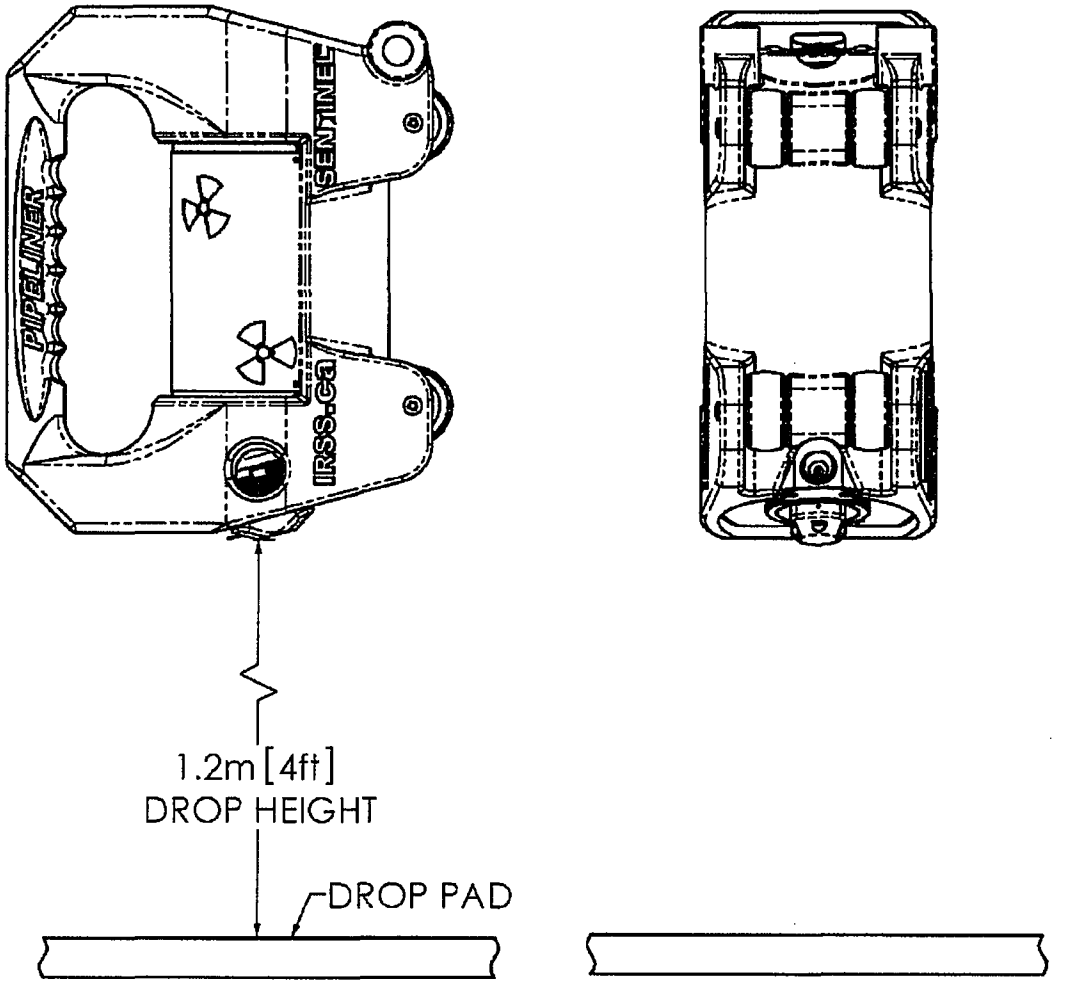


FIGURE 11.1.1 SPECIMEN TP186(A) ORIENTATION FOR THE 1.2M DROP TEST

Specimen TP186(B) Orientation for the 1.2m Drop Test

Figure 11.1.2 shows the package orientation for Specimen TP186(B).

The specimen will be dropped with its axis at approximately 22.5 degrees to the drop surface with the lock assembly facing down.

The object of this drop is to test the integrity of the end plate and to determine the effect of the drop on the depleted uranium shield.

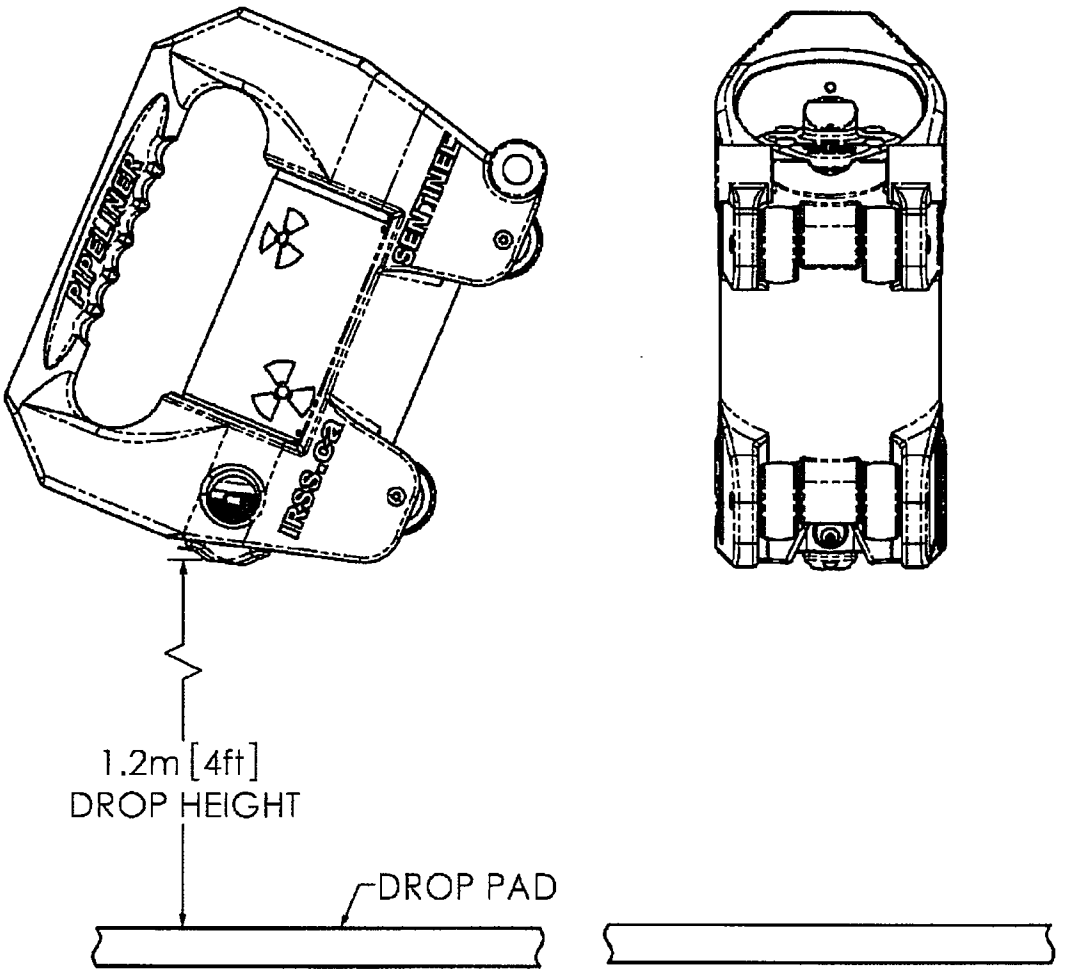


FIGURE 11.1.2 SPECIMEN TP186(B) ORIENTATION FOR THE 1.2M DROP TEST

1.2m Free Drop Test Assessment

Upon completion of each test, **Engineering, Regulatory Affairs** and **Quality Assurance** team members will jointly take the following actions:

1. Review the test execution to ensure that each test was performed in accordance with this test plan.

2. Make a preliminary evaluation of the specimens relative to the requirements of 10 CFR 71 and IAEA Safety Standards Series No. TS-R-1.

3. Assess the damage to each specimen to decide whether testing of that specimen is to continue.

4. Evaluate the condition of each specimen to determine what changes, if any, are necessary in package orientation in the 30-foot drop test to achieve maximum damage.

Section 12 9m Free Drop Test (10 CFR 71.73(c)(1))

The first Hypothetical Accident Test is the 9m (30-foot) free drop test as described in 10 CFR 71.73(c)(1).

The figures of this section illustrate the orientations for the test specimen.

- **9m Free Drop Test Set-up**

To set up a package for the 9m (30-foot) drop test:

1. Measure and record the weight of the test specimen.
2. Cool the test specimen to -40°F
3. Measure and record the test specimen and ambient temperatures.
4. Position the 1st specimen on the drop surface and position it according to the orientation shown in Figure 12.2.1
5. Raise the package so that the impact target is 9m (30 feet) above the drop surface. Ensure the center of gravity is over the impact point
6. Measure and record the ambient temperature.
7. Photograph the set-up.
8. Start the video recorder.
9. Drop the package.
10. Stop the video recorder.
11. Record the damage to the package and take a photographic record.
12. Repeat steps 3 - 10 with the 2nd specimen positioned as shown in Figure 12.2.2

Specimen TP186(A) Orientation for the 9m Drop Test

Figure 12.2.1 shows the package orientation for Specimen TP186(A).

The specimen will be dropped with its axis normal to the drop surface with the lock assembly facing down.

The object of the drop is to use the lock cover as leverage to drive the rear plate across the endplate to shear the rear plate mounting screws.

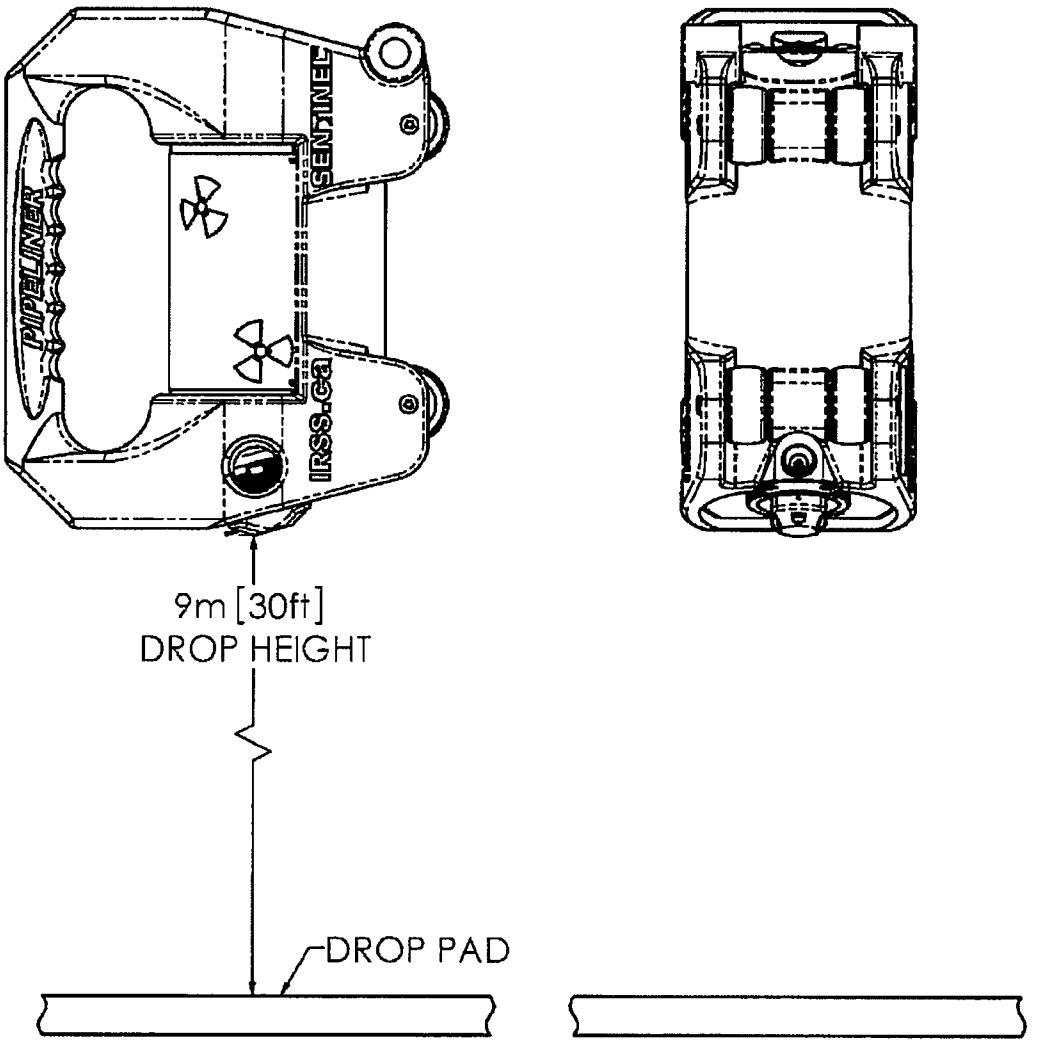


FIGURE 12.2.1 SPECIMEN TP186(A) ORIENTATION FOR THE 9M DROP TEST

Specimen TP186(B) Orientation for the 9m Drop Test

Figure 12.2.2 shows the package orientation for Specimen TP186(B).

The specimen will be dropped with its axis at approximately 22.5 degrees to the drop surface with the lock assembly facing down.

The object of this drop is to test the integrity of the end plate and to determine the effect of the drop on the depleted uranium shield.

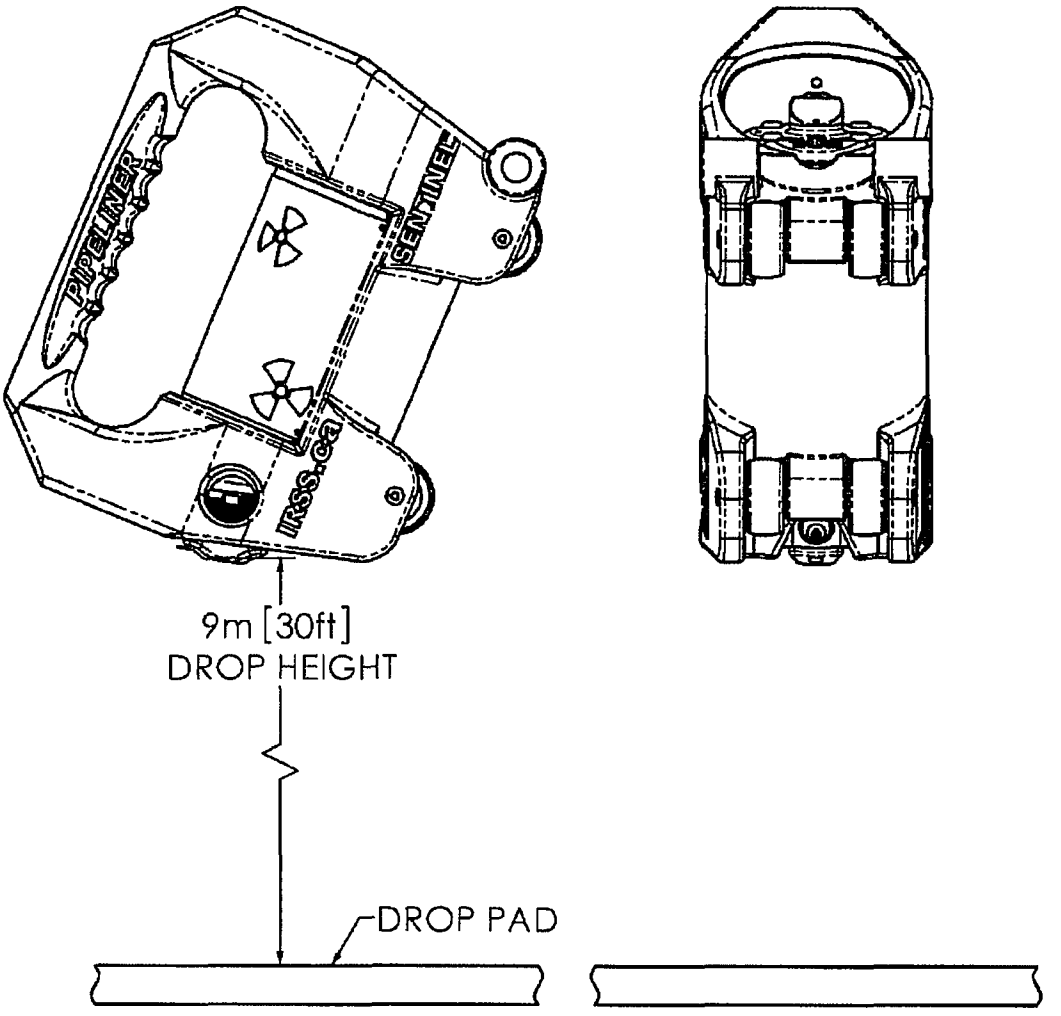


FIGURE 12.2.2 SPECIMEN TP186(B) ORIENTATION FOR THE 9M DROP TEST

9m Free Drop Test Assessment

Upon completion of each test, **Engineering, Regulatory Affairs** and **Quality Assurance** team members will jointly take the following actions:

Review the test execution to ensure that each test was performed in accordance with 10 CFR 71, IAEA Safety Standards Series No. TS-R-1, and this test plan.

Make a preliminary evaluation of the specimens relative to the requirements of 10 CFR 71 and IAEA Safety Standards Series No. TS-R-1.

1. Assess the damage to each specimen to decide whether testing of that specimen is to continue.

2. Evaluate the condition of each specimen to determine what changes, if any, are necessary in package orientation in the puncture test to achieve maximum damage.

Section 13 Puncture Test (10 CFR 71.73(c)(3))

The package is dropped from a height of 1m (40") onto the puncture billet. This test uses the 12" high puncture billet. The billet meets the minimum height (8") required in 10 CFR 71.73(c)(3). The specimen has no projections or overhanging members longer than 12" which could act as impact absorbers, allowing the billet to cause the maximum damage to the specimen. The billet is to be bolted to the drop surface used in the drop tests.

The figures of this section illustrate the orientations for each puncture test.

The justification for each puncture orientation is the same as the orientation for the 30-foot drop test. If the orientation needs to be changed, the new orientation must be documented and approved with a justification describing how it would be a worst condition than the planned orientation.

Puncture Test Set-up

NOTE: *Because each test is designed to add to damage inflicted on a specific component or assembly in the preceding test, it is important that each specimen maintain its identity throughout the battery of tests and that the set-up instructions specific to the specimen are strictly followed.*

To set up a package for the puncture test:

1. Measure and record the weight of the test specimen.
2. Cool the test specimen to -40°F
3. Measure and record the test specimen and ambient temperatures.
4. Position the 1st specimen on the drop surface and position it according to the orientation shown in Figure 13.3.1
5. Raise the package so that the impact target is 1m (40") between the impact point on the package and the top of the puncture billet. Ensure the center of gravity is over the impact point
6. Photograph the set-up.
7. Start the video recorder.
8. Drop the package.
9. Stop the video recorder.
10. Record the damage to the package and take a photographic record.
11. Repeat steps 1 - 9 with the 2nd specimen positioned as shown in Figure 13.3.2

Specimen TP186(A) Orientation for the Puncture Test

The objective of this drop orientation (Figure 13.3.1) is to continue the damage inflicted on the specimen by the 9m-drop test.

The specimen will be dropped with its axis normal to the drop surface with the lock assembly facing down.

The specimen will be offset from the Puncture Billet as shown so that the jacket does not hit first.

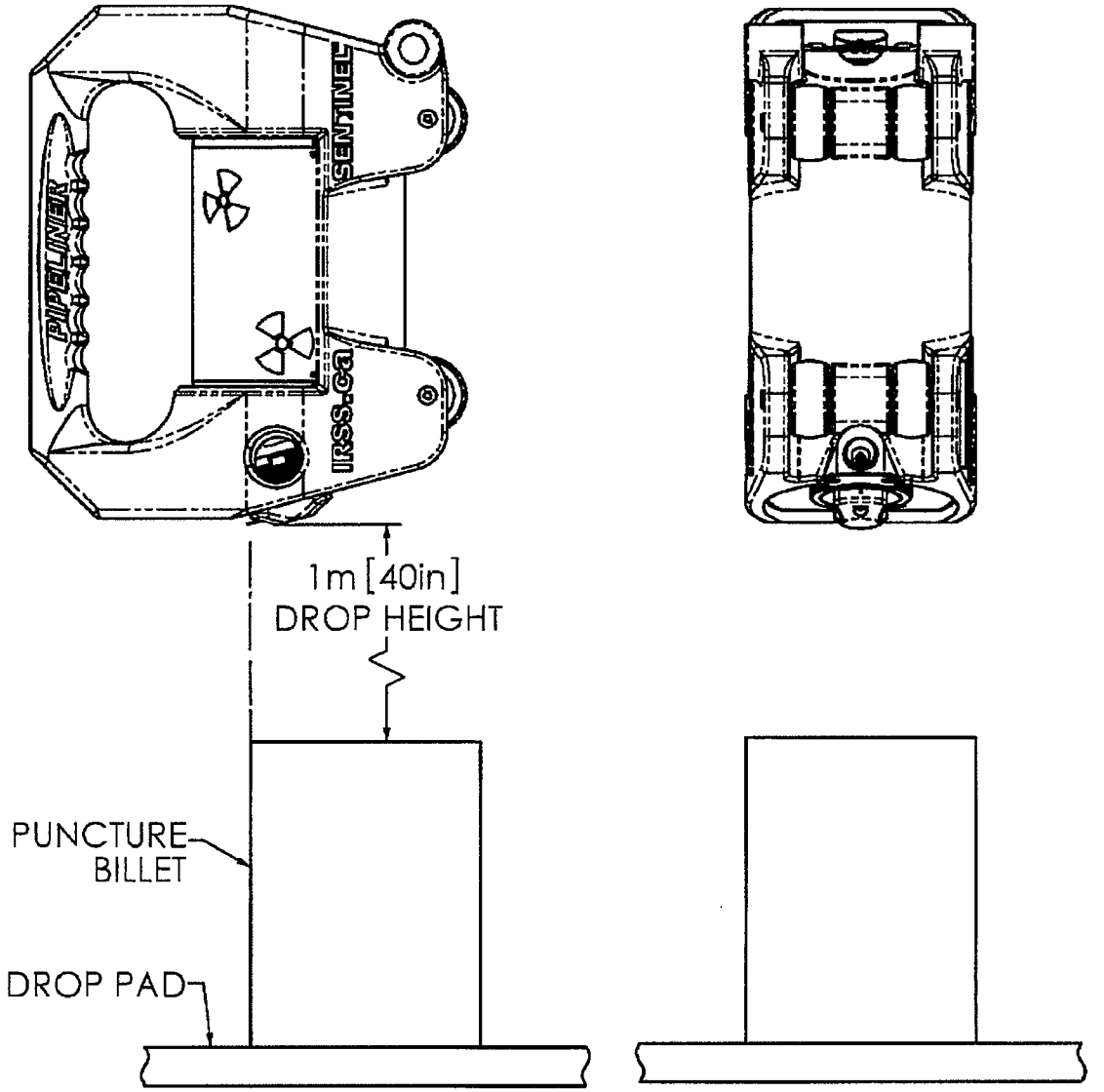


FIGURE 13.3.1 SPECIMEN TP186(A) ORIENTATION FOR THE PUNCTURE TEST

Specimen TP186(B) Orientation for the Puncture Test

The objective of this drop orientation (Figure 13.3.2) is to continue the damage inflicted on the specimen by the 9m-drop test.

The specimen will be dropped with its axis at approximately 22.5 degrees to the drop surface with the lock assembly facing down.

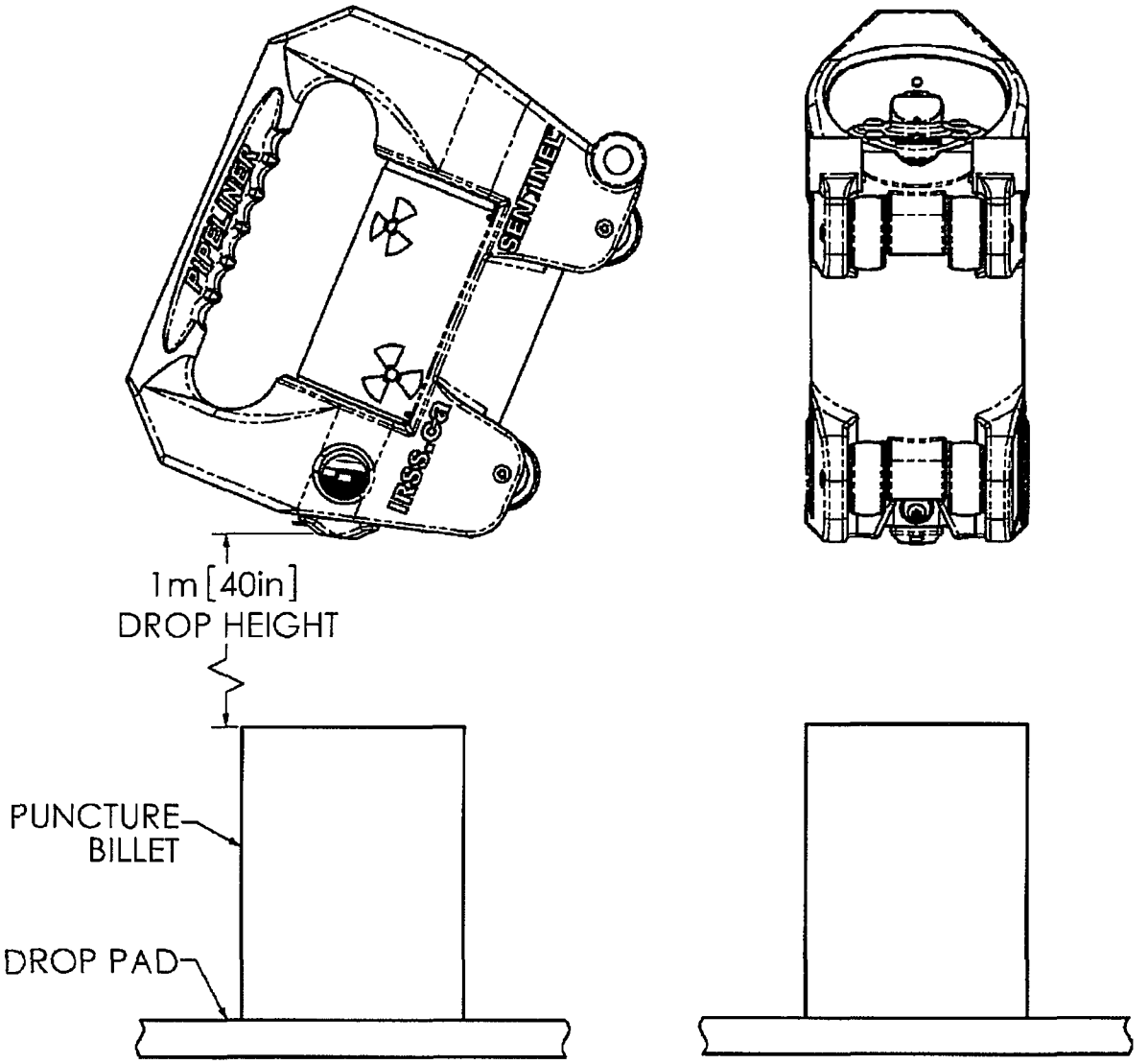


FIGURE 13.3.2 SPECIMEN TP186(B) ORIENTATION FOR THE PUNCTURE TEST

Puncture Test Assessment

Upon completion of the test, **Engineering**, **Regulatory Affairs** and **Quality Assurance** team members will jointly take the following actions:

Review the test execution to ensure that the tests were performed in accordance with 10 CFR 71, IAEA Safety Standards Series No. TS-R-1, and this test plan.

Make a preliminary evaluation of each specimen relative to the requirements of 10 CFR 71 and IAEA Safety Standards Series No. TS-R-1.

Final Test Inspection and Assessment

Perform the test inspection after the puncture tests.

1. Measure and record the damage to each of the test specimens. Measure and record the package for signs of any permanent strain.

2. Measure and record the location of the source from the front plate.

3. Remove and assess the condition of the simulated source.

4. Reassemble the packages using a representative active source, making sure that the source position and the package configuration are the same as they were immediately after the puncture test.

5. Measure and record a radiation profile of each test specimen in accordance with QSA Work Instruction WI-Q-1806.

6. Assess the significance of any change in radiation at the surface and at one meter from the packages.

7. Determine whether it is necessary to dismantle either of the test specimens for inspection of hidden component damage or failure.

8. If the decision is taken to proceed with the inspection, record and photograph the process of removing any component.

9. Measure and record any damage or failure found in the process of dismantling the test specimens.

Engineering, Regulatory Affairs, and **Quality Assurance** team members will make a final assessment of each test specimen and jointly determine whether the specimens meet the requirements of 10 CFR 71 and IAEA TS-R-1.

Section 15 Worksheets

Use the following worksheets for executing the tests of section 8. Each test shall have three worksheets; an equipment list, a procedure checklist, and a data sheet. Record the information onto copies of these worksheets for each test performed.

Attach a copy of the relevant inspection report or calibration certificate after the range and accuracy of the equipment has been verified.

WORKSHEET 15.1 DROP & PUNCTURE TEST SPECIMEN & EQUIPMENT LIST

Test Specimen & Equipment Documentation

Test Specimen

Configuration	Drawing Number	Serial Number	**Attach IIR	**Attach NCR	**Attach Route Cards
Pipeliner Transport	88095 Rev A	TP180A	Yes	See IIR	See TMI 279
Pipeliner Transport	88095 Rev A	TP180B	Yes	See IIR	See TMI 279
Pipeliner Transport	88095 Rev A	TP180C	Yes	See IIR	See TMI 279

** Note: Copies of these records are stored on the network in the following directory:
"K:\4 Design History Files\Model 880 Pipeliner\Verification (Testing)\TP 186 \Test Specimen Records"

Tools & Equipment

Tool Description	Enter the Model and Serial Number Mark NA when not used.	**Attach Inspection Report or Calibration Certificate
Drop Surface, Drawing No. T10740	S/N 001	Yes
Puncture Billet, Drawing No. T10143	S/N 01	Yes
Weight Scale		Yes

Record any additional tools used to facilitate the test and attach the appropriate inspection report or calibration certificates.

Radiation Meter with Probe	1863 Meter / SHP-270 Probe	Yes

Signature	Print Name	Date
Engineering:		
Regulatory:		
Quality Assurance:		

WORKSHEET 15.2 DROP & PUNCTURE TEST CHECKLIST

Test:		
Test Location:		
Step	**Data**	
1. Record test specimen serial number:		
2. Record the test specimen weight:		
3. Record the ambient temperature (°C):		Instrument S/N:
3. Record the test unit temperature (°C):		Instrument S/N:
4. Identify set-up orientation figure:		
5. Record drop height.		
6. Photograph set-up in at least two perpendicular planes.		
7. Begin video recording of the test so that impact is recorded.		
8. Release the test specimen.		
9. Stop the video recorder. Ensure the point of impact and orientation specified in the plan has been achieved.		
10. Record the damage to the test specimen. Use a separate sheet and attach, if needed.		
11. Engineering, Regulatory Affairs and Quality Assurance make a preliminary assessment relative to 10 CFR 71. Record the assessment on a separate sheet and attach.		
Test witnessed by (Signature)	**Print Name**	**Date**
Engineering:		
Regulatory Affairs:		
Quality Assurance:		

WORKSHEET 15.3 DROP & PUNCTURE TEST DATA SHEET

Test Unit Model/Serial No.:	Test:
Test Date:	Test Time:
Describe drop orientation and drop height:	
Describe impact (location, rotation, etc.):	
Describe on-site inspection (damage, broken parts, etc.):	

On-site test assessment:

- Was the test performed in accordance with 10 CFR 71, IAEA TS-R-1 1996, and this test plan? **Yes or No.**
- Does the test specimen meet the requirements of 10 CFR 71 and IAEA TS-R-1 1996 for this test? **Yes or No.**
- Are any changes to subsequent drop orientations needed to achieve maximum damage? **Yes or No.**
  If yes, then identify and justify.
- Did sufficient damage occur to warrant additional drop? **Yes or No.**
- Should testing continue with this test specimen? **Yes or No.** If yes, next test: _____
- Will the test specimen pass the thermal test based on the accumulated damage assessment? **Yes or No**

Engineering: **Regulatory:** **QA:**

Describe any post-test disassembly and inspection:	
Describe any change in source position (if possible):	
Describe results of radiography (if performed):	
Completed by:	Date:

WORKSHEET 15.4 TEST INSPECTION DATA SHEET

Test Specimen Serial No.:	Last Test Performed:
Describe and measure (if appropriate) any damage or broken parts, etc.:	
Describe and measure (if appropriate) any signs of permanent strain or deformation:	
Describe the condition of the simulated source wire assembly.	
Reassemble the package using a representative active source, making sure that the source position and the package configuration is the same as they were immediately after the last test. Measure and record a radiation profile of each test specimen in accordance with QSA Global Work Instruction WI-Q-1806.	
Compare the pre-test dose levels with post-test dose levels at the surface of the package and at 1 meter from the surface of the package.	
Is a radiograph required to inspect for hidden component damage or failure? If radiography is performed, describe any damage or failures found.	
Completed by:	Date:

ATTACHMENT 16.1 IRSS "WORK INSTRUCTIONS FOR PERFORMING PIPELINER RETROFIT"

IR SUPPLIES & SERVICES INC
14705-115 Avenue,
Edmonton AB T5M 3E6
Office: 780 452 4761
Fax: 780 453 6239

Effective Date:
Oct 21/09

Originator	Approved By
Name: ROBERT MUSCHKET	Name: ROBERT MUSCHKET
Date: Oct 21/09	Date: Oct 21/09

Work instruction for performing PipeLiner Retro Fit

Scope

This work instruction describes how to correctly install 880 projector models, Delta, Sigma, Elite and Omega, into the PipeLiner accessory. The PipeLiner accessory has been designed exclusively for the 880 series of projectors using only a source assembly with a capsule diameter of ¼".
Only a technician trained in the operations and maintenance of 880 projectors and specifically approved by QSA Global, can perform this modification retrofit to an 880 projector.

Tools Required

1. 5/32 hex socket security bit with drivers or 5/32 hex socket security key
2. 3/16 hex socket security bit with drivers
3. Inch pound torque wrench (3/8 drive) with adapters
4. Right angle 3/8 air operated drill (small arm)
5. 5/32 short drill bit (2 ¼" or shorter)
6. 3/8 hex key or 3/8 hex bit with drivers
7. Small flat head screw driver

Equipment

1. Safety glasses
2. Survey meter and Dosimetry (PPE)
3. 880 projector Delta, Sigma, Elite, Omega (Empty)
4. PipeLiner retro fit kit
5. Source storage container if applicable
6. Guide tube extension and controls if applicable
7. QSA KIT018, Detent retrofit kit

Oct 21/09

Preparation

Rev#: 1	1	Date: June 15, 2009

1. Inspect the tools and the equipment too ensure they are in good working order, and fully functional.
2. With a calibrated working survey meter survey the 880 projector to ensure surface reading are below 200mr/hr

3. Perform a daily inspection on the 880 projector as required.

4. If the 880 projector has a source assembly, remove the source assembly to a safe storage location.
   Note: performing this act can only be done by trained individuals wearing proper dosimetry

Disassembly of standard 880 projector

1. Remove label by drilling out the four rivets that hold the label to the projector. (Note: rivets cannot be removed and must be carefully pushed into the housing to allow new rivets to be installed)

2. Drill out the four-¼ inch SS rivets that hold the 880 projector to the jacket taking care not to enlarge the holes in the metal housing.

3. Remove source tag if present.

4. Slide the 880 projector out of the original standard jacket.

5. Remove the rear end plate from the 880 projector.

Assembling 880 projector into the PipeLiner

1. Match up the correct color of PipeLiner Jacket, part# PL1000H, for Delta, Sigma, Elite or Omega.

2. With the PipeLiner Jacket, positioned on its wheels, invert the 880 projector 180° and slide the 880 projector into the PipeLiner jacket so the lock slide aligns with the lock slide access hole of the PipeLiner jacket. The 880 projector will be orientated so that the printing on the rear lock assembly will be upside down.
   Note: Be careful while handling projector, as it is not attached at this time. Tipping or moving the PipeLiner could cause the projector to slide out unintentionally.

OCT 21/09

Rev#: 1	2	Date: June 15, 2009

3. Install shoe assembly part# PL1000S. This is accomplished by matching up the shoe with the jacket in the open position; both the wheels of the Jacket and the pipe shoe feet will be flat on the work surface. Use the pipe shoe pivot bolts Part# PL1003 to attach the lower portion of the shoe.

4. Install Collimating guide tube part # PL1017 by matching up the bayonet fitting male connector of the collimator with the female connector of the outlet port. Insert the collimator and turn 90°. Turn outlet port cover 45° to lock in collimator and open outlet port. The collimating guide tube attachment is accomplished in the same fashion as a standard bayonet fitting.

5. Lift up pipe shoe to mate surface of shoe and jacket. Install bolt part# PL1001. Once the bolt is secure, gently tilt entire assembly forward so that the PipeLiner wheels are off the work surface and the Pipe shoe is flat on the work surface (exposure position). The collimating guide tube will now be resting on the inside surface of the shoe. Check alignment of lock slide hole. The lock slide hole may not be perfectly aligned forward to back but should aligned evenly top to bottom and at no point should the hole on the jacket cover any portion of the hole on the 880. Once the projector is in this position the projector is properly aligned and ready for mounting.

6. With the 880 projector still in position and using an angle drill, drill into the PipeLiner jacket through the top mounting hole ½" deep using the 5/32 drill bit and right angle drill. *(Do not drill beyond ½" deep. Tape can be used to mark the drill bit ½" from the tip to accomplish an accurate depth)* Screw the #14 x ¾ tamper proof screw into the top hole. *(Turn screws by hand slowly so urethane doesn't strip out)* Drill and screw the remaining 2 holes securing the rear of the 880 projector.

Note: If a small enough drill isn't available the hole could be marked while the 880 projector is in position and the holes drilled after the 880 projector is removed from the jacket.

7. Tilt the PipeLiner back onto its wheels. Open the shoe by removing the PL1001 bolt, hinge shoe forward and remove the collimating guide tube. Remove shoe by removing the 2 PL1003 hinge bolts.

8. Remove the front end plate.

9. Repeat step #6 on the front end of the projector.

8. Install QSA KIT018. Detent retrofit kit, per instructions included with the kit

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10. Replace the front and rear end plates of the 880 projector according to manufacture specifications.

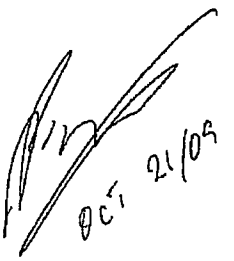
11. Insert a dummy source into the device

12. Attach the PipeLiner collimating guide tube

13. Perform a function test and cycle the dummy source several times ensuring the projector is functioning properly.

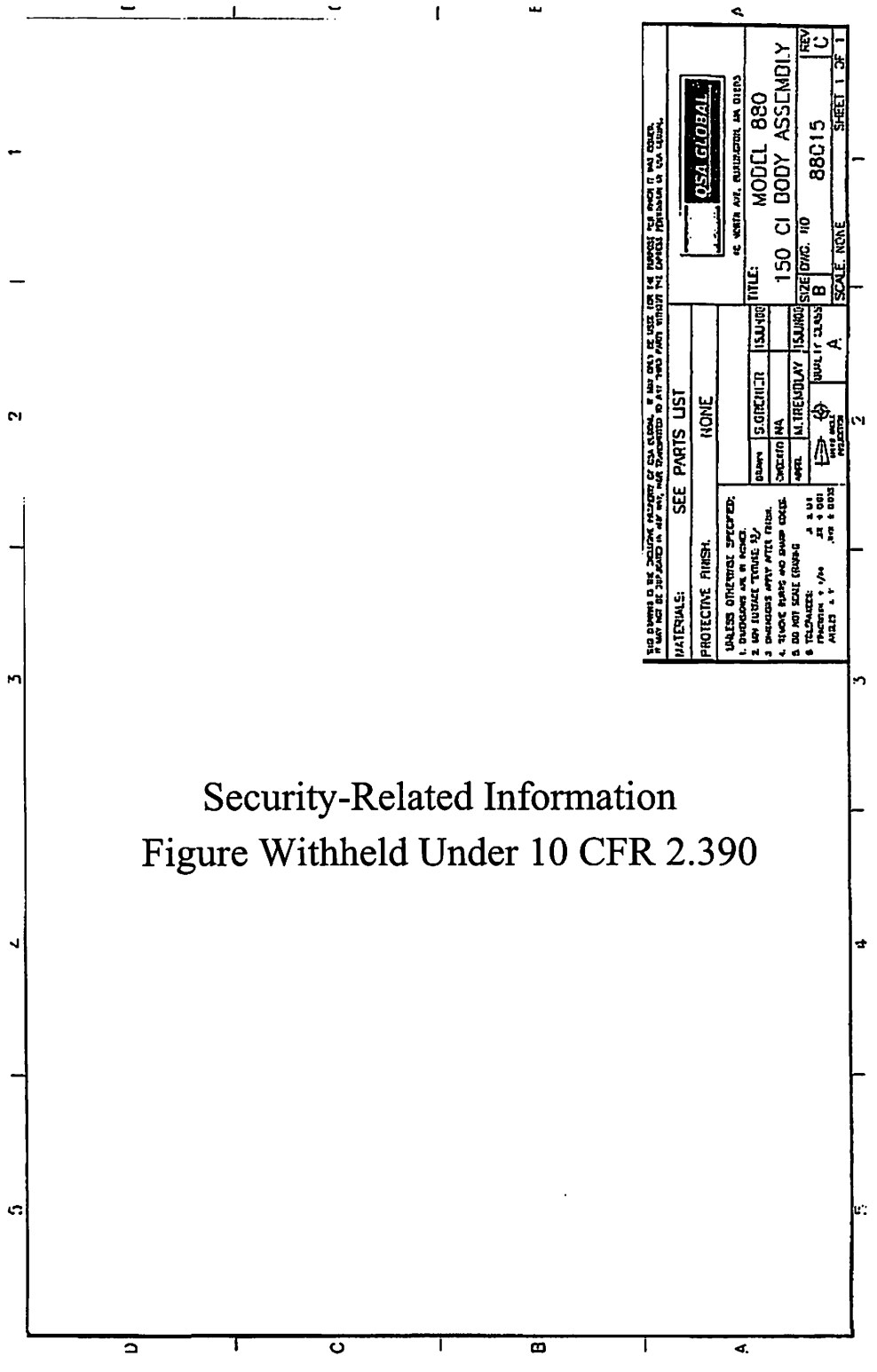
14. Inspect label to ensure it is in good condition, replace if necessary. Drill new holes in label to **match** holes on projector. DO NOT DRILL NEW HOLES IN THE 880 ASSEMBLY. Doing so may damage the shield and will violate Regulatory requirements for the device. Tuck the label under the edges of the PipeLiner jacket and rivet label to projector.

15. The source may now be reinserted and the source tag attached. An area has been designed to accommodate the source ID tag on the rear of the projector.



Rev#: 1	4	Date: June 15, 2009

ATTACHMENT 16.2 DRAWING NO 88015 REV C – MODEL 880 150 CI BODY ASSEMBLY



Security-Related Information
Figure Withheld Under 10 CFR 2.390

ATTACHMENT 16.3 IRSS PIPELINER OPERATIONS AND MAINTENANCE MANUAL, APR 4, 2007

To be attached as a separate document

INDUSTRIAL RADIOGRAPHY SUPPLIES & SERVICES INC.

THE PIPELINER

ACCESSORY FOR
SENTINEL 880
DELTA
SIGMA
ELITE
OMEGA

OPERATIONS AND MAINTENANCE MANUAL

DANGER - IMPORTANT WARNINGS

The IRSS PipeLiner System must be operated only by trained and qualified radiographers who have read and understood this Operations Manual and the 880 Series Source Projector Operating and Maintenance Manual, or by trained assistants working under their direct supervision.

WARNING

The use of radiographic exposure devices by unqualified personnel or when safety procedures are not fully met, could result in life threatening dangers.

Gamma radiography systems emit high levels of penetrating ionizing radiation during use and present a significant health risk to operators and the public including injury, sickness and/or death if appropriate safety and operational procedures are not employed.

Unshielded sources or source assemblies must never come in contact with any body parts under any circumstances.

Since gamma radiation is undetectable by the human senses, strict operating and emergency procedures must be followed. The proper use of PPE must be employed at all times during radiographic operations including calibrated survey meters, direct reading dosimeters, direct alarming dosimeters and the wearing of thermoluminecent dosimeters.

During use of this radiography system, never assume the position of the radiation source. Always conduct a thorough confirmatory survey using a calibrated survey meter to verify the location of the radiation source. Be reminded that a multitude of overexposure incidents which include injuries are directly attributed to a failure of the operator to perform or supervise an adequate confirmatory survey.

It is very important and required by regulation to prevent access by unauthorized persons to radiography equipment and to the area where radiography is performed.

Take advantage of the three basic radiation protection methods to minimize radiation exposure.

TIME

Spend less time near a source of radiation

DISTANCE

Increase your distance in a direction away from a radiation source

SHEILDING

Use effective shielding between you and the source of radiation

DO NOT

Perform any unauthorized modifications to the radiography exposure device or the components of this system

Use components that are not approved for use with this radiography system or after market components as this may compromise the safety designed into the system.

DO

Perform daily safety inspections of the radiography system for defects, wear and tear, replacing components as required. Inspections will be carried out or supervised only by trained and qualified radiographers

TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS

THE 880 SERIES PROJECTOR PIPELINER ACCESSORY

DESCRIPTION

The PipeLiner is a rugged, easy to use attachment for the Sentinel 880 series of gamma ray radiography projectors to improve utilization and reduce dose rates to operators when performing pipeline radiography, while still maintaining the option of conventional set ups. The addition of the PipeLiner accessory essentially converts the 880 series of projectors into a dual purpose exposure device.
The PipeLiner accessory consists of four main components; the jacket, collimating guide tube, pipe shoe and swing arm assembly

PIPELINER JACKET

The PipeLiner jacket is made of polyurethane for strength, durability and weight reduction The jacket is similar to the stock 880 jacket in design and serves the same functions with a few exceptions. Wheels have been added to the jacket for easy transportation from weld to weld along pipelines. Accommodations have be made for the attachment of the "pipe shoe" and " swing arm assembly" to the front of the jacket.
A significant change, mounts the projector 180° or upside down in contrast to it's current or original jacket orientation. This new position gives a better angle to the control assembly for added durability and the collimating guide tube for ease of operation.
The PipeLiner jacket is attached to the 880 device in the same manner as the original jacket, with four stainless steel rivets.

PIPELINER COLLIMATING GUIDE TUBE

The collimator, guide tube and bayonet fitting are made of tungsten and manufactured as one component producing a unique design that maintains continuous shielding of the source while it is being projected to the beam port.
The beam port of the guide tube has been carefully designed to minimize the size of exclusion areas, reduce dose to operators, virtually eliminate flash dose, while still maintaining proper beam orientation.
The collimating guide tube fits securely inside the "Pipe Shoe" when in use.

PIPE SHOE

The pipe shoe is made from similar polyurethane as the jacket and is designed to sit on the pipe during exposures. It consists of a molded bottom for positioning the exposure device along the center line of the pipe. This portion also includes the focal opening, a transverse groove that is used to align the beam port of the collimating guide tube into the position that best suits the intended geometry of the radiograph.
The top section consists of a raised area and a large indent. The raised portion will not allow the shoe to be closed unless the 880 outlet port cover is either fully closed or in the fully open position with the collimating guide tube attached. The indented area accommodates the collimating guide tube keeping it secure and protected.
The jacket accommodates the pipe shoe at the front by hinging it to the bottom portion of the jacket using two 2 3/4"x 2" socket head shoulder bolts. This hinging action is important as it allows the PipeLiner to be quickly prepared for the use of conventional guide tubes. The connection of the pipe shoe is completed by fastening the top portion of the jacket through the handle with the 3/8" x 12" socket head shoulder bolt.

CLAMP ASSEMBLY

The clamp assembly consists of three main sections, the right side plate including swing arm, the left side plate, and the hook plate that includes strapping, quick release latch and cam buckles.
The swing arm and right side plate is attached to the right side of the pipe shoe and the left side plate is attached to the left side using four 3/4"x 2" socket head shoulder bolts with the two rear bolts also acting to hinge the pipe shoe to the PipeLiner Jacket.
An important safety feature has been built into the Clamp assembly that will not allow the hook plate to be removed from the hook plate pin without depressing the cam buckles, releasing the strapping. This feature will not allow the PipeLiner to prematurely disengage from the pipe and fall to the ground. If the swing arm has not been engaged and the PipeLiner is accidentally allowed to fall uncontrolled it will only swing to the bottom of the pipe where it will hang until it is righted or removed.

APPLICATION

The PipeLiner Accessory has been designed for the industrial applications of gamma radiography of pipeline butt welds using double wall contact and single wall viewing technique.
By hinging open or removing the pipe shoe standard guide tubes can be attached to the 880 projector and conventional radiography performed. (SEE 880 OPERATION and MAINTENANCE MANUAL)

880 PROJECTOR

The PipeLiner is designed specifically for the 880 series of projectors. It is necessary that the operator has been trained and qualified in the operations of the 880 projector. Only those individuals who have received a certificate of competence for the maintenance of 880 devices should perform the jacket replacement. See your nearest Sentinel service center.

SOURCE ASSEMBLIES

The PipeLiner accommodates 1/4" diameter source capsules using TCI 5222 Teleflex cable style source assemblies **only**.
The following source assemblies meet the above requirements:

ISOTOPE	ASSEMBLY MODEL NO.	GAMMA ENERGY RANGE	HALF LIFE	APPROXIMATE STEEL WORKING THICKNESSES
Selenium 75	A424-25W	66-612 keV	120 days	3-29mm
Iridium 192	A424-9	206-612 keV	74 days	12-63mm
Cobalt 60	A424-19	1.17-1.33 MeV	5.27 years	50-150mm

Activities

Authorized isotope activities are dependant on the 880 model, user license, and regulatory restrictions.

OPERATING DISTANCE/POSITION

All lengths of control assemblies can be used with the PipeLiner accessory. A 5.5 meter (18 feet) PipeLiner control assembly is available that incorporates a short .3 meter (1 foot) return. This control assembly should only be used in conjunction with the PipeLiner accessory.
It is recommended that the operator, under normal conditions, position himself to the rear of the projector and no closer than 5 meters during an exposure.
The shielding characteristics of the collimating guide tube are such that it favors the operator standing directly behind the projector. Directly forward of the projector offers the least protection while the sides as you proceed from front to back will continue to produce a reduction in dose rate until directly behind the projector.

ACCESSORY SPECIFICATIONS

Manufacturer
Industrial Radiography Supplies and Services Inc.
14705 116 Ave
Edmonton, Alberta
Canada T5M 3E8

Primary Application
Industrial Pipeline Gamma Radiography

ACCESSORY FOR:

880 MODEL	ASSEMBLED WEIGHT	LENGTH	WIDTH	HEIGHT	SOURCE ASSEMBLIES
DELTA	65LBS	15"	7.5"	10"	A424-25W, A424-9,A424-19
SIGMA	65LBS	15"	7.5"	10"	A424-25W, A424-9,A424-19
ELITE	55LBS	15"	7.5"	10"	A424-25W, A424-9,A424-19

MATERIALS

Polyurethane jacket and pipe shoe, aluminum and stainless steel

INSPECTION REQUIRMENTS

Daily pre-operational inspection for obvious damage to the system

MAINTENANCE REQUIRMENTS

Clean and dry after each days use

OPERATING TEMPATURE RANGE

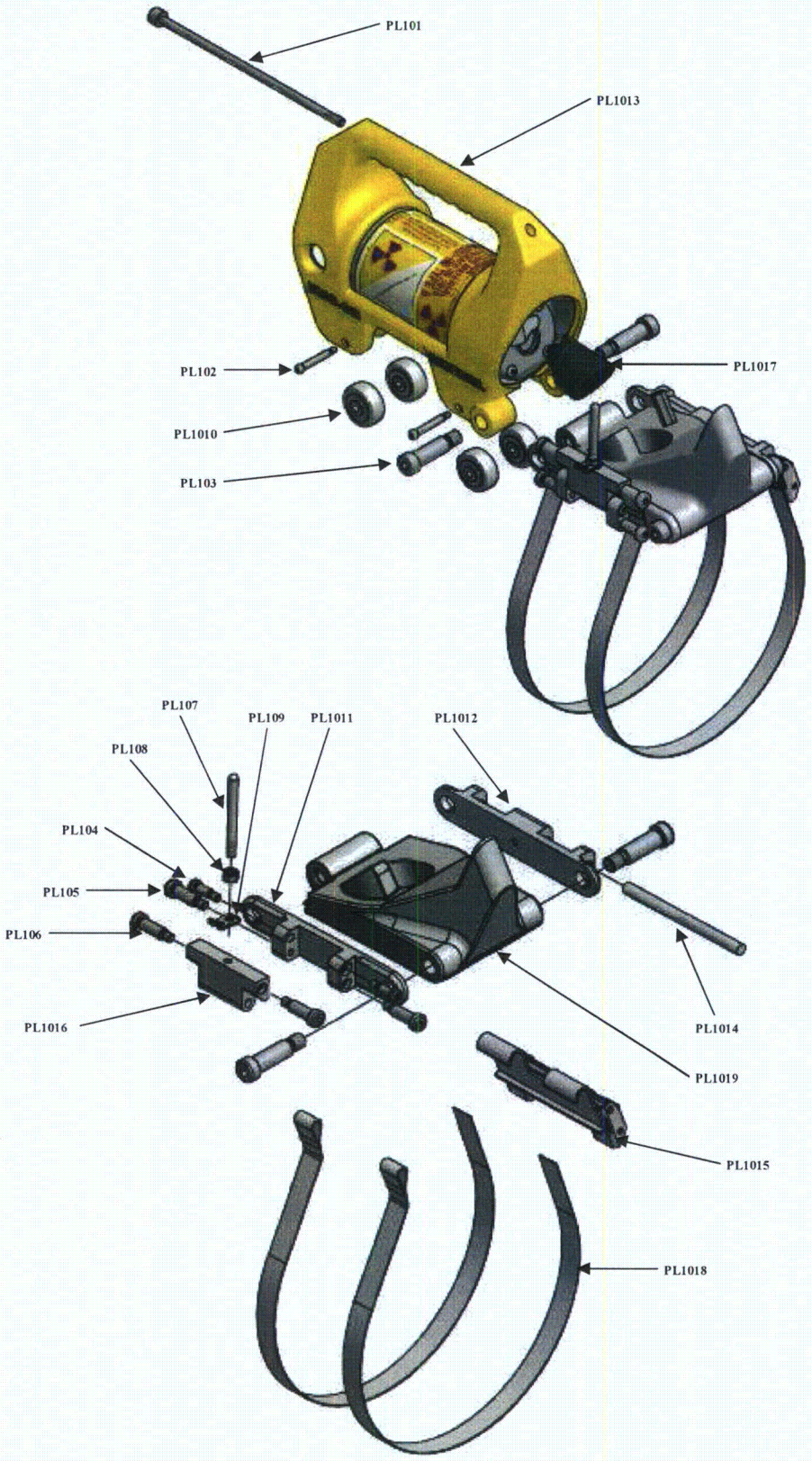
-40˚C to 149˚C

NOTICE

*The 880 PipeLiner accessory jacket has been registered as part of the Type B(U)-85 shipping container for AEA Technology QSA Inc. source assemblies and thus can remain on the projector during shipment. However all other parts of the PipeLiner accessory must be removed in their entirety before transport.
The purpose of this manual is to provide information which will assist qualified radiographers in using the PipeLiner accessory with the 880 series of projectors. The user must be thoroughly familiar with the 880 instruction manual and this instruction manual before attempting operation and use of this equipment.
Prior to use of PipeLiner Jacket in conjunction with the 880 projector as a shipping container a registered user certificate specifying the combination must be obtained from the CNSC.
It is the responsibility of the user's of this equipment to comply with local, national and international regulatory, licensing and transport rules and regulations as they apply in their respective countries.

* to be approved

DIAGRAM


PL101
PL1013
PL102
PL1017
PL1010
PL103
PL107
PL109
PL1011
PL1012
PL108
PL104
PL105
PL106
PL1016
PL1014
PL1019
PL1015
PL1018

PARTS LIST

PART NUMBER	QTY	DESCRIPTION
PL101	1	3/8" x 12" SOCKET HEAD CAP BOLT
PL102	4	5/16" x 1 3/4" SOCKET HEAD CAP BOLT
PL103	4	3/4"x 2" SOCKET HEAD CAP BOLT
PL104	2	3/8" x 3/4" SOCKET HEAD CAP BOLTS
PL105	2	1/2" X 1 1/4" SOCKET HEAD CAP BOLTS
PL106	2	1/2" X 1 1/4" SOCKET HEAD CAP BOLTS
PL107	1	SWING ARM HANDLE
PL108	1	SWING ARM HANDLE NUT
PL109	1	BUNGEE CATCH
PL1010	4	WHEELS
PL1011	1	RIGHT SIDE PLATE
PL1012	1	LEFT SIDE PLATE
PL1013	1	PIPELINER JACKET
PL1014	1	HOOK PLATE PIN
PL1015	1	HOOK PLATE
PL1016	1	SWING ARM
PL1017	1	COLLIMATING GUIDE TUBE
PL1018	2	STRAPS
PL1019	1	PIPE SHOE

WARRANTY AND LIMITATION OF LIABILITY

Industrial Radiography Supplies and Services Inc. (IRSS, herein referred to as the manufacturer) warrants its product which it manufactures and sells to be free from defects in material and workmanship for a period of one year from the date of shipment. This warranty shall not apply to any products or parts which have been subjected to misuse, improper installation, repair, alteration, neglect, accident, abnormal conditions of operation, or use in any manner contrary to instruction or intended application.

The manufacturers liability under such warranty shall be limited to replacing or repairing at it's option, any parts found to be defective in such respects, which are returned to the manufacturer, transportation prepaid; or at it's option, to returning the purchase price thereof.

The warranty on other manufacturer's components shall be that of the original manufacturer whose warranty shall be binding.

In no event shall the manufacturer be liable for any incidental or consequential damages whether or not such damages are alleged to have resulted from the use of such product in accordance with instructions given by or referred to by the manufacturer.

IRSS assumes no liability or responsibility for the usage of any radioactive material or device generating penetrating radiation used in connection with this product.

All other warranties, except those warranties expressly stated herein, including without limitation warranties of, merchantability and implied warranties of fitness, are expressly excluded.

The warranty on this accessory is specifically limited to its use with the Sentinel 880 series of gamma ray projectors and sealed source assemblies as described on page 4 of this manual.

IRSS shall not be liable for any errors or omissions contained herein and the provision by IRSS of the information set out in this manual does not in it's self constitute acceptance of any liability on the part of IRSS.

OPERATING INSTRUCTIONS

NOTE

This manual assumes that the reader has a thorough understanding of the operation and maintenance of the Sentinel 880 projector. Only personnel trained and qualified in the operation and maintenance of 880 projectors should attempt to use the PipeLiner accessory and only personnel with formal maintenance training should attempt to install an 880 projector into the PipeLiner Jacket.

880 PROJECTOR CONVERSION

Tools required

Only specially trained personnel should attempt this procedure.
SEE SENTINEL 880 SERIES SOURCE PROJECTOR OPERATING AND MAINTENANCE MANUAL OR YOUR LOCAL DISTRIUTOR

Parts Required

IRSS PipeLiner Jacket
PipeLiner Label
4 - 1/4" Stainless Steel Rivets
***Retrofitted 880 Projector**

***NOTE: 880 Projectors to be converted for use with the PipeLiner Accessory must have been retrofitted by a trained technician before conversion can be performed. See your Sentinel dealer for information on the necessary retrofits needed for your specific 880 projector.**

Conversion

In order to use the PipeLiner accessory with the 880 projector the projector must be removed from it's original jacket and reinstalled into the PipeLiner jacket. **This can only be performed with an empty projector.** Remove the rear end plate, labels and four stainless steel rivets holding the projector to the jacket. (See Sentinel 880 Series Source Projector Operating and Maintenance Manual)
Once the projector has been removed from its original jacket it is rotated 180° and inserted into the PipeLiner jacket, making sure that the plunger lock access holes in the jacket and projector line up correctly, and then riveted into place. The rear end plate and new labels can now be re-installed and the source assembly transferred back to the device. This completes the jacket installation.
At this point the 880 projector can be operated using conventional guide tubes and controls, the only difference in operation being the upside down positioning of the device to its original orientation. Operators will soon become accustomed to this new position that provides improved support of control assemblies.

PIPELINER ASSEMBLY

Tools Required

3/8" T Handle Allen Key (Supplied)

Parts Required

Converted 880 Projector
Pipe Shoe
Right Side Plate with Swing Arm
Left Side Plate
Tungsten Collimating Guide Tube
Hook Plate
Polyurethane Straps
4 - 3/4" x 2" Socket Head Cap Bolts
1 - 3/8"x 12" Socket Head Cap Bolt

Pipe Shoe Attachment

Place the Pipe Shoe foot side down, hinge joint in front of the projector with the 880 projector on it's wheels. Approaching from the right side, plunger lock opening to your left, slide the pipe shoe back toward the projector inserting the pipe shoe hinge joint between the PipeLiner jacket hinge joints.
Align the over right side plate bolt hole, swing arm handle pointing up, with the jacket hinge joint bolt hole and insert the 3/4" x 2" socket head cap bolt and tighten loosely. Align the over right side plate bolt hole with the bolt hole in the front of the pipe shoe and insert a 3/4" x 2" socket head cap bolt through the hole and hand tighten using the T handle Allen key wrench.
Approaching the projector from the opposite side attach the left side plate in the same manner as the over right side plate using the two remaining 3/4" x 2" socket head cap bolts. With the front bolts securely fastened the rear bolts can now be securely hand tightened using the T handle Allen key wrench. The pipe shoe is now effectively hinged to the PipeLiner jacket.

Attaching The Collimating Guide Tube

The collimating guide tube has been manufactured with a bayonet connector, all as one piece. The swivel bayonet connector used with conventional guide tubes is not used with the PipeLiner accessory.
Connect the collimating guide tube in the same manner a you would a conventional guide tube remembering that the 880 projector is now upside down or 180° to its original position. (See step 2 "Connecting the Source guide tube(s)" pg.2.3, in the Sentinel 880 Series Source Projector Operating and Maintenance Manual)
Once the collimating guide tube is attached and the outlet port cover fully rotated clockwise until it stops, the pipe shoe can be lifted up, closing it over the collimating guide tube sealing from view, the front of the device. The 3/8" x 12" socket head cap bolt is then inserted through the carrying handle of the jacket and tightened securely using the T handle Allen key wrench.

Attaching The Clamping Plate

Select a strap length that best suits the diameter of pipe being radiographed. The proper length should leave a minimum of 6" of strapping material or tag end, projecting out of the cam buckles.
Placing the hook plate, hook side down, thread about 8" to 12" of the urethane strapping, unlooped end under the cam buckle. Reversing the direction, thread the strapping back and through the cam buckle jaw. Perform the same steps for the other cam buckle. The straps are now secured to the hook plate.
There are four horizontal posts attached to the over right side plate and swing arm. Two fixed "fulcrum" posts below and two posts that pivot as part of the swing arm. Attach the looped end of the strapping to the swing arm posts by sliding the loops over the ends. The hook plate should be positioned so that the hook points away from you and the straps should not be twisted or crossed but remain parallel.
Next lift the hook plate to create slack in the strap and force it between the gap made between the fixed fulcrum post and the over right side plate attachment bolt, positioning the strap behind the fixed fulcrum post. Repeat for the other strap.
This completes the assembly of the Sentinel 880 PipeLiner accessory.

Disassembly

If the operator wishes to use conventional guide tubes only the 3/8" x 12" socket head cap bolt needs to be removed to allow the pipe shoe to hinge open. Enough space is provided to attach conventional guide tubes. If the operator wishes to remove the pipe shoe entirely, in addition to the 3/8" x 12" socket head cap bolt, the two 3/4" x 2" hinge bolts are all that need to be removed. This procedure will leave the swing arm assembly attached to the pipe shoe for quick reattachment later.

NOTE

The 880 series of projectors are not approved for transport of sealed sources while the pipe shoe remains attached to the Jacket.

OPERATION

Set up

Place the PipeLiner accessory, wheels first, pipe shoe forward, on the pipeline and roll it to within a few inches of the weld to be radiographed. Number belts or other identification markers can be attached to the pipe adjacent to the weld at this time. The projector is then tilted forward off it's wheels so that it is resting on the feet of the pipe shoe. The feet of the pipe shoe are designed to accommodate piping as small as 2" diameter and will automatically align the beam port along the center line of the pipe.
Position the focal opening, the apex of the transverse groove in the bottom of the pipe shoe, directly above the weld. This position can be arranged to the front or rear of the weld depending on the intended resultant radiograph.
Working from the right side of the PipeLiner with the swing arm handle in the "open" or down position, keep one hand on the PipeLiner and either reach over or under the pipeline, grasp the hook plate then hooking it onto the left side plate hook pin.
While still holding the device in place with one hand, grasp the tag ends of the straps with the your free hand and pull in a downward direction until the straps are tight. If the straps have been tightened properly it should be impossible to remove the hook plate from the hook pin without loosening the straps. In some cases, and especially with small diameter pipe, 3" and under, it is useful to give the straps one or two quick tugs to ensure the straps are sufficiently tight. Now lift the swing arm handle to lock the device securely to the pipe. It should now require a force much greater than the weight of the device to move the projector around the radius of the pipe. The larger the diameter of the pipe the greater the force required to move it, or the less tension required to hold the device in place.
The remote control assembly can now be connected to the projector and the exposure performed. (See Sentinel 880 Series Source Projector Operating and Maintenance Manual Step 3 pg.2.5).

360° Rotation Around the Pipe

In order to position the PipeLiner to produce radiographs of the entire weld, it needs to be rotated into various positions around the circumference of the pipe. To accomplish this, first grasp the PipeLiner near the plunger lock opening with your left hand, curling your fingers over and around the end of the jacket. Next grasp the swing arm handle and lower it slightly to release just enough tension so that the projector can be pushed or pulled and rotated into the position required. The swing arm handle can, in this fashion, be used as a break providing the operator a high degree of control. Once you have attained the desired position, the swing arm handle is lifted locking the projector into position. This maneuver requires very little effort and can be accomplished with considerable accuracy with only a little practice.

Positioning of Film or Flexible Imaging Plates

Provisions for the attachment of bungee cord or similar material to the hook plate and a catch to fasten the bungee cord to, has been added to the swing arm handle so that film cassettes or imaging plates can be held firmly in place.

Moving to the Next Welded Joint

Once the required number of radiographs have been produced and it is time to move to the next welded joint, the PipeLiner is rotated back to the upright position on top of the pipe. If the remote control assembly is wound around the pipe it should unwound at this time and the pistol grip hung over the pipe close to and in front of the PipeLiner.
With your left hand holding firmly onto the PipeLiner, remove the hook plate from the hook pin by depressing the quick release mechanism with your right hand and allow it to fall under the pipe. Tilt the PipeLiner back onto it's wheels. Retrieve number belts and/or other identification markers and again with your right hand, reach under the pipe and retrieve the clamping plate. Position the clamping plate comfortably in your left hand while still maintaining a grip on the PipeLiner handle. This may seem awkward at first but becomes quite routine very quickly.
Pick up the pistol grip with your right hand and begin rolling the PipeLiner along the pipe to the next welded joint. The set up procedure is now repeated.

INSPECTION AND MAINTENANCE

NOTE

Maintenance instructions in this manual for the PipeLiner accessory apply only to the parts listed in this manual. For maintenance instruction for the 880 projector, remote control assemblies or other Sentinel products not listed herein please refer to the Sentinel 880 Series Source Projector Operation and Maintenance Manual or the original product Operations Manual.

Daily Inspection of the Radiography System

A daily inspection of the gamma radiography system for obvious defects is essential.
The daily inspection ensures that the equipment is in a safe and proper operating condition.
It is important that all radiographers perform or supervise this inspection prior to the first radiographic exposure of the shift regardless of any previous inspections that may have been performed that day. As an example, damage to a component of the system may occur during transport of the equipment to the job site. If damaged equipment were used without detection, the result may be the inability to retract the source assembly into the exposure device and secure it.
The result of a daily inspection should be recorded and include the date, name of the inspector and what specific equipment was inspected. If any defective or damaged components are discovered during daily inspection, the component must be removed from service and identified with a status indicator (tag, label, tape) to prevent inadvertent use by other radiography personnel.. Defective or damaged components must be repaired or replaced before reuse in radiography operations. The main components of the radiography system consisting of the radiographic exposure device, remote controls, source guide tubes must be inspected in addition to accessories such as lab stands, collimators, jigs, j-tubes, and pipe clamping apparatus.
Radiographers must take a proactive roll in preventing incidents, by performing or directly supervising a simple but thorough daily inspection of the radiography system. The implications that effect safety and the importance of the daily inspection must be emphasized and understood by the entire radiography staff.

Daily Inspection of the PipeLiner Accessory

1. Before starting any inspection, survey the surface of the exposure device to ensure that the radiation level is less than 2mSv/hr (200mR/hr).This survey provides a function test of the survey instrument, that it is responding to radiation, in addition to providing the radiographer with a reference measurement that can be compared to confirmatory surveys after terminating each radiographic exposure.

2. Inspect the labels on the exposure device to ensure they are legible and securely attached. The warning label containing the trefoil should be legible from a distance of 1 meter (approximately 3 feet). Inspect the legibility and attachment of the source identification tag that describes the radioactive source contained within the exposure device.

3. Check the PipeLiner jacket for cracks and gouges that could pinch or cut hands and fingers or wear damage that could affect the safe operation of the exposure device. Replace or repair as necessary.
It is common for the polyurethane material of the jacket to darken in color over time especially if the jacket is in direct sunlight for long periods. This is natural and will not affect the function of the jacket or the device.
Inspect the wheels for smooth rotation, and the tires for wear, gouges or chunks missing. Replace as needed.

4. Inspect the collimating guide tube for obvious damage. Ensure the guide tube is free of dirt or debris. Check the bayonet fitting for burrs, cracks or dents. If damaged is found to the bayonet fitting the collimating guide tube should be replaced. Ensure the bayonet fitting engages and rotates smoothly into place in the outlet port by installing and removing it. A crunchy or gritty feeling indicates that dirt and/or sand has entered the outlet port mechanism and it must be serviced before use.

5. Inspect the pipe shoe for rough or sharp edges these should be filed smooth to prevent injury. Inspect the feet for excessive wear. The feet of the pipe shoe receives the most wear from contact with the pipe and will eventually wear to a point that the shoe will need to be replaced. Check the apex of the focal opening and of the concave between the feet for cracks. Ensure the indent that houses the collimating guide tube is free of dirt or debris and is sound with no wear through areas, allowing dirt into the collimating guide tube.

6. Inspect the entire swing arm assembly, right and left side plates, for obvious damage or wear and nicks or sharp edges that could cause injury. These can be filed smooth. The over swing arm should operate smoothly, the fulcrum and swing arm posts should be free of bends or burrs.
Check the straps for wear, cuts or abrasions. Check the loops, paying special attention to the inside of the loop where it rubs against the posts. If the straps show obvious fatigue or wear they need to be replaced.
Inspect the operation of the cam buckles, they should open and close smoothly, firmly grasping the strapping.
Check the hook plate and hook plate pin for damage and deformities.

7. During the initial set up of the days work and with the PipeLiner on the pipeline, the following exercise needs to be performed to ensure all components of the PipeLiner accessory are functioning together as intended.
Engage the hook plate onto the hook plate pin, tighten the straps and check to ensure the hook plate cannot be removed from the hook plate pin without releasing the quick release cam buckles first.
Next rotate the entire device 120° away from you and engage the swing arm. Put slight hand pressure on the PipeLiner with the intent of trying to force it further towards the bottom of the pipe. Now rotate the device from the top of the pipeline 120° in a direction towards you and engage the over centering mechanism. Again put slight hand pressure on the PipeLiner with the intent of trying to force it further towards the bottom of the pipe. Return the device to the top of the pipeline. If the device failed to hold sufficiently at any time, retighten the straps and repeat the above tests until the projector is held securly.

MAINTENANCE
Daily (routine) and annual (complete) maintenance requirements

Radiographic exposure devices and associated equipment must be maintained regularly by trained and qualified personnel to ensure consistent and safe operation of the radiographic system. The routine inspection and maintenance also ensures the integrity of the Type B(U)-85 transport packages are maintained in compliance with the package certification number USA/9296/B(U)-85.

Manufacturers base the recommended inspection and maintenance requirements on the system's design, application, materials, anticipated work cycles, environmental factors of use under the normal and abnormal conditions of industrial radiography and while in the transport system. A program of systematic maintenance will prolong the working life of the radiographic exposure device and associated equipment in addition to ensuring safety during use. By most national regulations, routine maintenance of the systems is required at intervals not to exceed 3 months in addition to the radiographer's daily inspections for obvious defects. The complete annual servicing ensures the integrity of the system.
Maintenance program administrators must recognize the need for maintenance intervals that are less than the required 3 month interval especially in cases where the systems are used in severe environmental conditions. Maintenance program administrators must ensure the systems are completely serviced immediately after certain jobs in severe conditions. Extreme or severe conditions may include, but is not limited to:

- Conditions where the equipment was immersed in water or mud.
- Subjected to high-concentrations of particulate such as fly ash or sand.
- Subjected to hot radiography conditions.
- Subjected to salt-water conditions, caustic or acidic materials.
- Subjected to accidental drops or falling objects.
- Whenever subjected to extreme environmental conditions.

The routine maintenance of the PipeLiner accessory performed daily requires cleaning, inspection and operational checks of the system. The complete maintenance (performed once a year) involves a complete disassembly, cleaning, inspection and operational tests of the entire system.
Equipment maintenance can be performed by trained and qualified individuals within the licensee's organization. AEA Technology QSA service engineers are available to provide maintenance on the systems at the licensee's premises or at on of he service centers.

Routine Daily Maintenance Requirements

At the end of each days use the PipeLiner accessory needs to be cleaned of any obvious debris, mud, dirt, or other foreign material. Use a soft wire brush or stiff bristle brush to remove dried mud and to reach tight spaces. Mild detergent and water can be used to remove dirt and grime with a damp rag. Spilled chemicals or other chemical compounds should be removed immediately using proper methods approved for the chemical involved.
NOTE: **Safety glasses** should be worn when using brushes to remove dirt and mud.

Yearly Maintenance Requirements

Once a year the entire system should be dismantled and thoroughly cleaned and inspected. (see inspection portion of this manual)
The PipeLiner uses no lubricants or does it require regular replacement of parts. Simple cleaning and a thorough inspection of all parts including bolts is all that is necessary.

Records

The results of the inspections, repairs and maintenance should be recorded and retained. Reports should contain the name of the person(s) involved, dates, location and should identify the specific equipment that was serviced.

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April 4, 2007

Section 8.3 Profile Reports

QSA GLOBAL

SHIELDING PROFILE AND INSPECTION FORM (SPIF) F-Q-1806-2

Re-Profile Drop Test unit (TP186A) Sheet 1 of 1

Shield Data

Model: 880 Delta	Serial # 5520	Radionuclide: Ir-192	Max. Capacity 150 Ci
Shield P/N: 88001	Shield Heat # 866-D48		Lot # 0916900203

Profile Process Data

Source Model: 424-9	Source Ser. # 60864B	Radionuclide: Ir-192	Activity: 125.2 Ci
Survey Inst. 1 ND-500P	Serial # 42363	Date Cal. 8/18/09	Date Due: 8/18/10
Survey Inst. 2 E600	Serial # 2750	Date Cal. 4/2/09	Date Due: 4/2/10
Inst. Probe: 1 101-03	Serial # P11973	Inst. Probe: 2 HB-270	Serial # 706
Capacity Correction Factor: 1.20			

	Measured Dose Rate mR/hr				Adjusted Dose Rate mR/hr		
Location	At Surface	Surface Corr. Factor	At 30 Cm [Note 2]	At One Meter	At Surface	At 30 Cm [Note 2]	At One Meter [Note 1]
Top	*	*	NA	.7	*	NA	.8
Right				.7			.8
Front				.7			.8
Left				.8			1.0
Rear				1.2			1.4
Bottom				.7			.8
			Acceptance Criteria:		≤200	NA	≤2.0
			Result: (Check one)	Accept		Reject	

Inspector: _____ Date: 4/10/10 NCR # _____

Comments:

* Ref. to Auto-Profiler printout for Data (Meter used E600, 3055, Cal due 8/28/10)

Notes:

1. Refer to F-Q-1806-1, Shield Efficiency Testing Surface Correction Factors for an existing device model, or F-Q-1806-3, Shield Profile Worksheet for One meter acceptance limit.
2. The 30cm readings are only required when specifically requested.
3. Additional sheets may be used to describe results or indicate reading locations using sketches. Number all sheets and indicate total number of sheets. Make sure shield Identification is included on each sheet.
4. Attach auto profiler print out to this sheet if used.

QSA GLOBAL

880 Shielding Profile and Inspection Form (SPIF) F-Q-1806-4 Delta & Sigma

(TP186A)

Sheet 1 of 1

Shield Data

Model:	880D/S	Serial # 5520	Radionuclide: Ir192	150 Ci Capacity Correction Factor:	1.32
		Shield Heat # 866-D48	Lot # 0916500203	130 Ci Capacity Correction Factor:	1.15

Profile Process Data

Source Model	424-9	Source Ser.# 53962B	Radionuclide: Ir192	Activity (Ci)	113.4	Acceptance Criteria		
Instrument	ND-500P	Serial # 42363	Date Cal. 4/7/08	Date Due:	4/7/10	At Surface < or =	200	mr/hr
	E-600	Serial # 2578	Date Cal. 12/8/08	Date Due:	12/8/09	At One Meter < or =	2	mr/hr

Measured Dose Rate mR/hr			Surface Corr. Factors			880 Delta Adj. Dose Rate mR/hr			880 Sigma Adj. Dose Rate mR/hr		
Location	At Surface	At One Meter	Auto Profiler	ND-500P *	E-600 *	ND-500P	E-600	At One Meter	ND-500P	E-600	At One Meter
Top	*	.7	1.17	1.18	1.28	NA	NA	.9	NA	NA	NA
Right	↓	.7	1.17	1.18	1.28	↓	↓	.9	↓	↓	↓
Front		.6	1.17	1.08	1.13			.8			
Left		.7	1.17	1.18	1.28			.9			
Rear		1.0	1.17	1.07	1.11			1.3			
Bottom	↓	.8	1.17	1.18	1.28	↓	↓	1.1	↓	↓	↓

Result: (Check One)	Accept as:	880 Delta	✓	880 Sigma		Reject	
		Shield P/N	88001		88040	NCR #	

Inspector: [signature] Date: 7 Jul 09 Reviewer: [signature] Date: 9 Jul 09

Comments:

* ND-500P and E-600 results are for manual profiles only. Refer to auto-profiler print out for data if blank.

1 meter performed using E600, SN 1863, cal 2/24/09, due 2/24/10

Notes: Additional sheets may be used to describe results or indicate reading locations using sketches. Number all sheets and indicate total number of sheets. Make sure shield identification is included on each sheet.

OSA GLOBAL

SHIELDING PROFILE AND INSPECTION FORM (SPIF) F-Q-1806-2

Re-Profile Drop Test Unit (TP186B) Sheet 1 of 1

Shield Data

Model: 880 Delta	Serial # D5523	Radionuclide: Ir-192	Max. Capacity 150 Ci
Shield P/N: 88001	Shield Heat # 866-D40		Lot # 0916900203

Profile Process Data

Source Model: 424-9	Source Ser. # 60865B	Radionuclide: Ir-192	Activity: 117.2 Ci
Survey Inst. 1 ND-500P	Serial # 42363	Date Cal. 8/18/09	Date Due: 8/18/10
Survey Inst. 2 E600	Serial # 2750	Date Cal. 4/2/09	Date Due: 4/2/10
Inst. Probe: 1 101-03	Serial # P11973	Inst. Probe: 2 HB-270	Serial # 706
Capacity Correction Factor: 1.28			

	Measured Dose Rate mR/hr				Adjusted Dose Rate mR/hr		
Location	At Surface	Surface Corr. Factor	At 30 Cm [Note 2]	At One Meter	At Surface	At 30 Cm [Note 2]	At One Meter [Note 1]
Top	*	*	NA	.6	*	NA	.8
Right				.6			.8
Front				.6			.8
Left				.6			.8
Rear				.9			1.2
Bottom				.6			.8
			Acceptance Criteria:		≤200	NA	≤2.0
			Result: (Check one)	Accept		Reject	

Inspector: _____ Date: 4/10/10 NCR # _____

Comments:

* Refer to Auto Profiler Printout for Data
(Meter used E600, 3055, cal due 8/28/10) (Multiplied on 4/10/10, Activity = 116.1 CCF = 1.29

Notes:

1. Refer to F-Q-1806-1, Shield Efficiency Testing Surface Correction Factors for an existing device model, or F-Q-1 806-3, Shield Profile Worksheet forOne meter acceptance limit.
2. The 30cm readings are only required when specifically requested.
3. Additional sheets may be used to describe results or indicate reading locations using sketches. Number all sheets and indicate total number of sheets. Make sure shield Identification is included on each sheet.
4. Attach auto profiler print out to this sheet if used.

QSA GLOBAL

880 Shielding Profile and Inspection Form
(SPIF) F-Q-1806-4 Delta & Sigma

(TP186B)

Sheet 1 of 1

Shield Data

Model:	880D/S	Serial # 5523	Radionuclide: Ir192	150 Ci Capacity Correction Factor:	1.25
		Shield Heat # 866 D40	Lot # 09169002O3	130 Ci Capacity Correction Factor:	1.08

Profile Process Data

Source Model	424-9	Source Ser.# 53962B	Radionuclide: Ir192	Activity (Ci)	119.9	Acceptance Criteria		
Instrument	ND-500P	Serial # 42363	Date Cal. 4/7/08	Date Due:	4/7/10	At Surface < or =	200	mr/hr
	E-600	Serial # 2578	Date Cal. 12/8/08	Date Due:	12/8/09	At One Meter < or =	2	mr/hr

Measured Dose Rate mR/hr			Surface Corr. Factors			880 Delta Adj. Dose Rate mR/hr			880 Sigma Adj. Dose Rate mR/hr		
Location	At Surface	At One Meter	Auto Profiler	ND-500P *	E-600 *	ND-500P *	E-600 *	At One Meter	ND-500P *	E-600 *	At One Meter
Top	*	.5	1.17	1.18	1.28	NA	NA	.6	NA	NA	NA
Right		.6	1.17	1.18	1.28			.8			
Front		.6	1.17	1.08	1.13			.8			
Left		.6	1.17	1.18	1.28			.8			
Rear		.9	1.17	1.07	1.11			1.1			
Bottom		.6	1.17	1.18	1.28			.8			

Result: (Check One)	Accept as:	880 Delta	✓	880 Sigma		Reject	
		Shield P/N	88001		88040	NCR #	

Inspector: [signature] Date: 7/1/09 Reviewer: C. Rogers Date: 9/11/09

Comments:

* ND-500P and E-600 results are for manual profiles only. Refer to auto-profiler print out for data if blank.

1 meter performed with, E600, SN 1863, cal 2/24/09, due 2/24/10

Notes: Additional sheets may be used to describe results or indicate reading locations using sketches. Number all sheets and indicate total number of sheets. Make sure shield identification is included on each sheet.

QSA GLOBAL

Sheet 1 of 1

Inspection Instruction And Record	Originator/Date: Tom Shea 24 Aug 09	Rev. B	Part No. T10740	Reg. Approval/Date: C. Leighton 24 Aug 09
	QA Approval/Date: [illegible] 28 Aug 09	CM. NA	PIL NA	Eng. Approval/Date: TSR 14 Sept 09

Item Description: 8 X 8 DROP PAD-BURLINGTON

Characteristics	Tolerance	MTE	AQL	1	2	3	4	5	6	7	8	9
General Visual	NA	Visual	C/100%	~~0~~ / 1	REF IS 0568							
Cracks in Concrete	NA	Note & Photograph	C/100%	~~0~~ / 1	N/A							
1/2-13 threaded hole, four (4) places	Go/NoGo	Thread Gage	C/100%	1 / ~~0~~	0 / 1							
Pitch of Slab 1/2, N-S Corners	+/-1/4	Level & Scale	C/100%	~~0~~ / 1	N/A							
Surface Condition of Steel Plate	NA	Note & Photograph	C/100%	~~0~~ / 1	N/A							

Comments:												
Calibration: Re-Inspect Prior to use. Inspection to be valid 60 days only !	PO / WO #	N/A	N/A									
	Traveler	N/A	N/A									
	Lot / Serial #	001	001									
	Lot Qty.	1	1									
	Qty. Rej / NCR	RWK IS0568	0 / N/A									
	Qty. Acc.	0	1									
F-Q1807-1, rev.	Insp / Date	JV 28AUG09	MD 3SEP 09									

AEATECHNOLOGY QA

PERIODIC MAINTENANCE

Sheet 1 of 1

Inspection Instruction And Record		Originator/Date			Rev C	Part No. T10143		Supplier ENGINEERING				
		QA Approval/Date		18 Sept 01	CM NA	PIL NA	Eng. Approval/Date				19 Sept 01	

Item Description: Puncture Test Billet

Characteristics	Tolerance	MTE	AQL	1	2	3	4	5	6	7	8	9
General Visual	N/A	N/A	C / 100%	~~0~~ / 1	~~0~~ / 1							
Securely Mounts to Drop Test Pad	N/A	N/A	C / 100%	~~0~~ / 1	~~0~~ / 1							
Comments		Due Date		19 Sept 02	07 JULY 2010							
		Freq / Days		365 Days	365 DAYS							
		Serial #		01	01							
		Lot Qty.		1	1							
		Qty. Rej / NCR		~~0~~ / NA	~~0~~ / NA							
		Qty. Acc.		1	1							
		Insp / Date		~~F~~ / 19 Sept 01	JH / 07JUL09							

S/N: T-198776

ESSCO CALIBRATION LABORATORY
DIVISION OF WALSH ENGINEERING SERVICES, INC.
CALIBRATION/REPAIR OF ALL TYPES OF ELECTRONIC / MECHANICAL TEST EQUIPMENT
27 INDUSTRIAL AVE, CHELMSFORD, MA 01824-4102
TEL: (800) 325-2201 (978) 250-0880 www.esscolab.com

ISSUE DATE: 2/22/2010

CERTIFICATE OF CALIBRATION

Certificate #: 296477 BARCODE: 1030907

CUSTOMER / LOCATION	EQUIPMENT INFORMATION	
QSA GLOBAL INC		
40 NORTH AVENUE	MANUFACTURER:	OMEGA
BURLINGTON MA 01803	MODEL NO:	CL23A
	SERIAL NO:	T-198776
DEPT:	CONTROL NO:	ENG-20
PURCHASE ORDER: P32150	TYPE:	CALIBRATOR

CONDITION RECEIVED	CONDITION RETURNED
IN TOLERANCE	IN TOLERANCE

METHOD / ENVIRONMENT		CALIBRATION	
PERFORMED:	IN LAB	CALIBRATION DATE:	2/22/2010
TEMPERATURE (deg C):	23	CALIBRATION DUE:	2/22/2011
RELATIVE HUMIDITY (%RH):	21		
METHOD:	OMEGA CL23A/24/25/26	METROLOGIST:	Joseph D. Freedman

E1540	KAYE K140-4 ICE POINT REFERENCE	178302	5/15/2009	5/14/2010
E2483	FLUKE 8508A REFERENCE MULTIMETER	257701	5/27/2009	4/27/2010
E706	FLUKE 5700A\03 CALIBRATOR	276832	1/7/2010	4/7/2010

JL

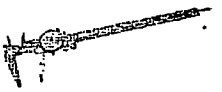
The ESSCO Quality System is certified to ISO 9001:2008

The results above relate only to the item(s) calibrated. Unless otherwise stated, a minimum TUR of 4:1 was used.
This certifies that the unit conformed to applicable specifications upon successful completion of the calibration. The standards used are traceable to NIST or a National Measurement Institute. This certificate shall not be reproduced, except in full, without written approval of ESSCO.
The signature to the right signifies responsibility for the quality system.
This calibration was performed in compliance with the ESSCO Quality Manual, ECL 1, Rev. 26, 29 September 2009, and complies with ISO 9001:2008, ANSI/NCSL Z540-1, QS9000 (exp), MIL-STD-45662A (exp), ISO 10012:2003, 10CFR21, and the calibration requirements of ISO 13485.

Kevin R. Pistey
Quality Assurance Manager

1	1 MTR IN K 0.000 mV	32.0	32.5 31.5	DEG F	31.9	31.9	+/- 0.5 DEG F
2	2 MTR IN K 54.856 mV	2500.0	2502.0 2498.0	DEG F	2500.4	2500.4	+/- 2.0 DEG F
3	3 MTR IN J 0.000 mV	32.0	32.5 31.5	DEG F	31.7	31.7	+/- 0.5 DEG F
4	4 MTR IN T 0.000 mV	32.0	32.5 31.5	DEG F	31.7	31.7	+/- 0.5 DEG F
5	5 CAL OUT K 32.0 F	0.000	0.011 -0.011	mV	0.008	0.008	+/- 0.011 mV
6	6 CAL OUT K 2500.0F	54.856	54.894 54.818	mV	54.867	54.867	+/- 0.038 mV
7	7 CAL OUT J 32.0 F	0.000	0.014 -0.014	mV	0.012	0.012	+/- 0.014 mV
8	8 CAL OUT T 32.0 F	0.000	0.011 -0.011	mV	0.007	0.007	+/- 0.011 mV

End of Data
Note: A = Adjusted F = Failed L = Limited



Hunt Metrology Service, Inc.
121 Ferry Street
Lawrence, MA 01841
(978) 688-7278
(978) 794-4632
Hmsi@verizon.net

Calibration Certificate
HMSCC-22922-12-P Total Pages: 15
Tech: Paul Rabs

QSA Global
40 North Avenue
Burlington, MA 01803

Purchase Order No: P31363-00
Date Cal: September 24, 2009 Due: September 24, 2010

The calibration performed on the following measuring and test equipment (M&TE) of this document is traceable to the National Institute of Standards and Technology (N.I.S.T.) through N.I.S.T. number 821/276493-08; Certificate number 09-69006A dated May 29, 2009 for dimensional calibration.
The M&TE have been cleaned and lubricated, as needed. Our technician(s) have calibrated, adjusted and/or reset the M&TE, affixed a calibration label to the M&TE, updated the corresponding record(s), and provided this calibration certificate. The standard(s) utilized to perform the calibration have been calibrated, certified and maintained in our laboratory which sustains a temperature of 68 degrees (+/-2ø) and less than 50% relative humidity. All records pertaining to our standards, and the masters utilized to calibrate them, are kept on file in our laboratory for a period of no less than 3 years. The services provided, traceability to the N.I.S.T., and Hunt Metrology Service's calibration system comply with the requirements of ANSI/NCSL Z540-1-1994, ISO 10012-1:1002 (E) and ISO/IEC 17025. The reported value is both "as found" and "as left" data, unless otherwise specified. A calibration uncertainty ratio of at least 4:1 is maintained unless otherwise stated. This calibration certificate cannot, in any way, be reproduced, except in full, without prior written consent from a representative of Hunt Metrology Service, Inc.

David Dickinson, President

Hunt Metrology Service, Inc. **Data Sheet**

HMSCC-22922-12-P

Customer: **QSA GLOBAL**

P.O. No.: P31363-00
Date Cal: 09/24/09
Date Due: 09/24/10
Technician: PR
Cal Proc. No: 01

ID No: 411
2 ID No:
Department:
Deviation u:
Accuracy: +/-4%
Accuracy:
Temperature: 73.7°
Humidity: 52%

Manufacturer: O'HAUS
Serial No: 0009986-6CE
Model No: CD11ZE0
Standard No: 018 Cal: 03/31/09 Due: 03/31/10
Standard No: 057 Cal: 03/31/09 Due: 03/31/10
Standard No: Cal: Due:

Gage Type: 0-130lb DIGITAL SCALE

REQUIRED	DEVIATION	ACTUAL
0.500	0.00	0.50
1.000	0.00	1.00
2.000	0.00	2.00
5.000	0.00	5.00
10.000	0.00	10.00
20.000	0.00	20.00
30.000	+0.02	30.02
40.000	+0.02	40.02
50.000	+0.02	50.02
60.000	+0.04	60.04
80.000	+0.04	80.04
100.000	+0.04	100.04
120.000	+0.08	120.08

2.12.12 USDOT Special Form Certificate USA/0392/S-96 Rev 10

U.S. Department
of Transportation

**Pipeline and
Hazardous Materials
Safety Administration**

**East Building, PHH-23
1200 New Jersey Avenue SE
Washington, D.C. 20590**

IAEA CERTIFICATE OF COMPETENT AUTHORITY
SPECIAL FORM RADIOACTIVE MATERIALS
CERTIFICATE USA/0392/S-96, REVISION 10

This certifies that the source described has been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in the regulations of the International Atomic Energy Agency[1] and the United States of America[2] for the transport of radioactive material.

1. Source Identification - QSA Global, Inc. Model 875 Capsule.

2. Source Description - Cylindrical single encapsulation made of Type 304 or 304L stainless steel and tungsten inert gas or laser welded. Approximate exterior dimensions are 5.2 mm (0.205 in.) in diameter and 7.84 mm (0.309 in.) in length. Inside dimensions vary, but minimum wall thickness is 0.482 mm (0.019 in.). Construction shall be in accordance with attached QSA Global, Inc. Drawing No. R875 INNER, Rev. C.

3. Radioactive Contents - No more than either 8.9 TBq (240.0 Ci) of Cobalt-60 or 14.8 TBq (400.0 Ci) of Iridium-192 in the form of metallic wafers or pellets.

4. Quality Assurance - Records of Quality Assurance activities required by Paragraph 310 of the IAEA regulations[1] shall be maintained and made available to the authorized officials for at least three years after the last shipment authorized by this certificate. Consignors in the United States exporting shipments under this certificate shall satisfy the applicable requirements of Subpart H of 10 CFR 71.

5. Expiration Date - This certificate expires on April 30, 2013. On June 30, 2009, this certificate supersedes all previous revisions of USA/0392/S-96.

---

[1] "Regulations for the Safe Transport of Radioactive Material, 1996 Edition (Revised), No. TS-R-1 (ST-1, Revised)," published by the International Atomic Energy Agency(IAEA), Vienna, Austria.

[2] Title 49, Code of Federal Regulations, Parts 100-199, United States of America.

CERTIFICATE USA/0392/S-96, REVISION 10

This certificate is issued in accordance with paragraph 804 of the IAEA Regulations and Section 173.476 of Title 49 of the Code of Federal Regulations, in response to the April 07, 2009 petition by QSA Global, Inc., Burlington, MA, and in consideration of other information on file in this Office.

Certified By:

for Robert A. Richard
Deputy Associate Administrator for Hazardous Materials Safety

Apr 08 2009
(DATE)

Revision 10 - Issued to increase the allowed Ir-192 activity.

Security-Related Information
Figure Withheld Under 10 CFR 2.390

APPROVALS	DATE
	25 Jun 07
	25 Jun 07

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES:
FRACTIONS ± 1/8
X.X ± 0.12
X.XX ± 0.06
X.XXX ± 0.020

QSA GLOBAL
40 NORTH AVE, BURLINGTON, MA 01803

DESCRIPTIVE DRAWING

TITLE 875 SERIES INNER CAPSULE

SIZE	DWG. NO.	REV
A	R875 INNER	C
	SCALE: NONE SHEET 1 OF 1	

ERF #	1739

2.12.13 USDOT Special Form Certificate USA/0335/S-96 Rev 9

U.S. Department of Transportation

Pipeline and Hazardous Materials Safety Administration

IAEA CERTIFICATE OF COMPETENT AUTHORITY
SPECIAL FORM RADIOACTIVE MATERIALS
CERTIFICATE USA/0335/S-96, REVISION 9

East Building, PHH-23
1200 New Jersey Avenue SE
Washington, D.C. 20590

This certifies that the sources described have been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in the regulations of the International Atomic Energy Agency[1] and United States of America[2] for the transport of radioactive material.

1. Source Identification - QSA Global, Inc. Model 875 Series.

2. Source Description - Cylindrical single or double encapsulations with the outer capsule made of Type 304L stainless steel and tungsten inert gas or laser welded. Approximate outer dimensions are 6.35 mm (0.25 in.) in diameter and either 19.05 mm (0.75 in.) or 24.2 mm (0.954 in.) in length. Inner capsules, when present, are made of stainless steel or titanium. Construction of the outer capsule shall be in accordance with attached QSA Global, Inc. Drawing No. R875 OUTER, Rev. C. Construction of any inner capsule shall be in accordance with attached QSA Global, Inc. Drawing No. R875 INNER, Rev. C or QSA Global, Inc. Drawing No. R87527-40, Rev. A.

3. Radioactive Contents - No more than either 14.8 TBq (400 Ci) of Iridium-192 as a solid metal; 8.14 TBq (220 Ci) of Cobalt-60 as a solid metal; 5.56 TBq (150 Ci) of Selenium-75 as an encapsulated solid metal; 1.11 TBq (30 Ci) of Cesium-137 as encapsulated $CsCl_2$; 1.85 TBq (50 Ci) of Thulium-170 as Tm_2O_3; or 7.4 TBq (200 Ci) of Ytterbium-169 as Yb_2O_3.

4. Quality Assurance - Records of Quality Assurance activities required by Paragraph 310 of the IAEA regulations[1] shall be maintained and made available to the authorized officials for at least three years after the last shipment authorized by this certificate. Consignors in the United States exporting shipments under this certificate shall satisfy the requirements of Subpart H of 10 CFR 71.

5. Expiration Date - This certificate expires on August 31, 2012. On June 30, 2009, this certificate supersedes all previous revisions of USA/0335/S-96.

---

[1] "Regulations for the Safe Transport of Radioactive Material, 1996 Edition (Revised), No. TS-R-1 (ST-1, Revised)," published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

[2] Title 49, Code of Federal Regulations, Parts 100 - 199, United States of America.

CERTIFICATE USA/0335/S-96, REVISION 9

This certificate is issued in accordance with paragraph 804 of the IAEA Regulations and Section 173.476 of Title 49 of the Code of Federal Regulations, in response to the April 7, 2009 petition by QSA Global, Inc., Burlington, MA and in consideration of other information on file in this Office.

Certified by:

APR - 7 2009

Robert A. Richard (DATE)
Deputy Associate Administrator for Hazardous Materials Safety

Revision 9 - Issued to increase the allowed Iridium-192 activity.

Security-Related Information
Figure Withheld Under 10 CFR 2.390

APPROVALS	DATE
[signature]	7-7-07
[signature]	2 JUL 07

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES:
FRACTIONS ± 1/8
X.X ± 0.12
X.XX ± 0.06
X.XXX ± 0.020

QSA GLOBAL
40 NORTH AVE, BURLINGTON, MA 01803

DESCRIPTIVE DRAWING

TITLE 875 SERIES SSDR OUTER CAPSULE

SIZE	DWG. NO.	REV
A	R875 OUTER	C
	SCALE: NONE	SHEET 1 OF 1

ERF #	1739

Security-Related Information
Figure Withheld Under 10 CFR 2.390

APPROVALS	DATE
R. Jones	25 Jul 07
L. Richter	25 Jul 07

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES:
FRACTIONS ± 1/8
X.X ± 0.12
X.XX ± 0.06
X.XXX ± 0.020

QSA GLOBAL
40 NORTH AVE. BURLINGTON, MA 01803

DESCRIPTIVE DRAWING

TITLE 875 SERIES INNER CAPSULE

ERF #	1739

SIZE	DWG. NO.	REV
A	R875 INNER	C
	SCALE: NONE SHEET 1 OF 1	

Security-Related Information
Figure Withheld Under 10 CFR 2.390

APPROVALS	DATE
	7-24-07
	7/24/07

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES:
FRACTIONS ± 1/8
X.X ± 0.12
X.XX ± 0.06
X.XXX ± 0.020

QSA GLOBAL
40 NORTH AVE, BURLINGTON, MA 01803

DESCRIPTIVE DRAWING

TITLE X540N CAPSULE ASSEMBLY

SIZE	DWG. NO.	REV
A	R87527-40	A
	SCALE: NONE SHEET 1 OF 1	

ERF #	1739

2.12.14 USDOT Special Form Certificate USA/0502/S-96 Rev 7

U.S. Department
of Transportation

**Pipeline and
Hazardous Materials
Safety Administration**

**East Building, PHH-23
1200 New Jersey Avenue SE
Washington, D.C. 20590**

**IAEA CERTIFICATE OF COMPETENT AUTHORITY
SPECIAL FORM RADIOACTIVE MATERIALS
CERTIFICATE USA/0502/S-96, REVISION 7**

This certifies that the sources described have been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in the regulations of the International Atomic Energy Agency[1] and the United States of America[2] for the transport of radioactive material.

1. Source Identification - QSA Global, Inc. Model Nos. X54 (Manufactured before January 1, 1998), X540 (Manufactured on or after February 17, 1981), and X540/1 (Manufactured on or after September 27, 2000).

2. Source Description - Tungsten inert gas or laser seal welded cylindrical single or double encapsulations. The outer encapsulation is made of titanium or stainless steel and the inner encapsulation, if used, is made of titanium, stainless steel, or aluminum. Approximate exterior dimensions are 5.15 mm (0.2 in.) maximum diameter and 15.15 mm (0.6 in.) in length (Model X54); and 5.16 mm (0.2 in.) in diameter and 7.65 mm (0.3 in.) in length (Models X540 and X540/1). Construction shall be in accordance with attached Amersham Drawing No. A10639, Issue C (Model X54) or QSA Global Inc. Drawing No. R87527, Rev. G (Models X540 and X540/1).

3. Radioactive Contents - No more than 17.0 TBq (459.5 Ci) of Cobalt-60 (Model X54); or no more than either 20.0 TBq (540.5 Ci) of Cobalt-60, 17.0 TBq (459.5 Ci) of Iridium-192, or 5.56 TBq (150.3 Ci) of Selenium-75 (Models X540 and X540/1). The Co-60, Ir-192, and Se-75 are in the form of a metal.

4. Quality Assurance - Records of Quality Assurance activities required by Paragraph 310 of the IAEA regulations[1] shall be maintained and made available to the authorized officials for at least three years after the last shipment authorized by this certificate. Consignors in the United States exporting shipments under this certificate shall satisfy the applicable requirements of Subpart H of 10 CFR 71.

5. Expiration Date - This certificate expires on October 31, 2012.

---

[1] "Regulations for the Safe Transport of Radioactive Material, 1996 Edition (Revised), No. TS-R-1 (ST-1, Revised)," published by the International Atomic Energy Agency(IAEA), Vienna, Austria.

[2] Title 49, Code of Federal Regulations, Parts 100-199, United States of America.

CERTIFICATE USA/0502/S-96, REVISION 7

This certificate is issued in accordance with paragraph 804 of the IAEA Regulations and Section 173.476 of Title 49 of the Code of Federal Regulations, in response to the October 11, 2007 petition by QSA Global, Inc., Burlington, MA, and in consideration of other information on file in this Office.

Certified By:

for Robert A. Richard
Deputy Associate Administrator for Hazardous Materials Safety

Oct 16 2007
(DATE)

Revision 7 - Issued to extend the expiration date.

Security-Related Information
Figure Withheld Under 10 CFR 2.390

TOLERANCES: UNLESS OTHERWISE STATED	MATERIAL	GENERAL NOTES: THIRD ANGLE PROJECTION; MODIFICATIONS INDICATED BY ISSUE IN ◇; THIS DRAWING CONFORMS TO BS308; ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED; DO NOT SCALE	SCALE 10:1	C	MS1211	4.1.95	M.A.			
				ISSUE	MOD No.	DATE	DRAWN	CHECKED	APPROVED	QA APPROVED
SURFACE TEXTURE: UNLESS OTHERWISE STATED	FINISH: REMOVE ALL BURRS	APPROVAL: THIS DRAWING IS NOT TO BE USED FOR ANY PURPOSE UNLESS SIGNED AS APPROVED	USED ON ——	SHT. SIZE A3	DRG NO. A10639	SHT 1 OF SHTS 1			

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TITLE ASSEMBLY OF CAPSULE X54

Security-Related Information
Figure Withheld Under 10 CFR 2.390

APPROVALS	DATE
D. Price	30 May 06
	30 May 06

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES:
FRACTIONS ± 1/8
X.X ± 0.12
X.XX ± 0.06
X.XXX ± 0.020

QSA GLOBAL
40 NORTH AVE, BURLINGTON, MA 01803

DESCRIPTIVE DRAWING

TITLE X540 CAPSULE SERIES

SIZE	DWG. NO.	REV
A	R87527	G
	SCALE: NONE	SHEET 1 OF 1

ERF #	1402

2.12.15 Test Plan 206 (Sep 2013)

QSA GLOBAL	Document Number **F-E-1808-1** **Test Plan Cover Sheet**	Revision 0

TEST PLAN 206

MODEL 880SC TRANSPORT PACKAGE
TYPE B TRANSPORT PACKAGE

Originator		Date: 3 Sept 13

APPROVALS		
Engineering		Date: 3 Sep 13
Regulatory		Date: 2 Sep 13
Quality Assurance		Date: 3 Sep 13

TEST PLAN 206

MODEL 880SC SOURCE CHANGER TYPE (B) TRANSPORT PACKAGE TESTS

As of

September, 2013

Contents

List of Figures and Tables

Test Plan No. 206

Section 1 Introduction

This document describes the mechanical test plan for the Model 880SC Source Changer to meet NRC requirements for Type B(U)-96 packages as described in the Code of Federal Regulations, 10 CFR Part 71, revised as of January 26, 2004. The test plan also covers the criteria stated in the IAEA TS-R-1 (1996 Edition – as Amended 2003)

This document describes the test package specifications, testing equipment, testing scenario, justifies the package orientations for the different test specimens and provides test worksheets to record key steps in the testing sequence.

Section 2 Transport Package Description

Figure 2.1 describes the Model 880SC Source Changer transport package. Figure 2.2 shows the transport package schematic. Figure 2.3 shows the transport package with the plastic jacket. Fig 2.4 shows the transport package overall dimensions without the Jacket.

The radioactive material is sealed in a special form source capsule. The source capsule, stop ball and connector are swaged to a flexible steel wire to form the source wire assembly. Two source wire assemblies can be loaded into the 880SC Source Changer, one in the front and one in the rear. The source wire assemblies are held securely to the device by components of the Source Lock Assembly. There are two Source Lock Assemblies, on each end of the container assembly. The lock assembly sleeve, prevents the stop ball of the source wire from being pushed through the package. Another component, the lock slide, prevents the stop ball from being pulled out of the package when in the secured position. A keyed lock prevents the lock slide from being actuated.

The Top Lock Plate is fastened to the Bottom Lock Plate with four, 1/4-20 stainless steel machine screws. The Bottom Lock Plate is attached to rivnuts assembled on the endplate weldment with four 5/16-18 stainless steel security screws. The endplate weldment consists of the endplate disc, a U-shaped bracket and the four rivnuts. The U-brackets are welded to the endplate disc and the endplate disc is welded to the cylindrical shell.

The shield is fastened within the device at each end by a titanium shield pin. The pin passes through the shield and the U-bracket. The shield is centered in the shell and has the source tube cast into its center. The source tube provides a cavity for the source wire assemblies to travel through during use. The source capsules are positioned in the center of the ball of the shield within the source tube cavity when the source wire is in its secured position.

The model 880SC uses polyurethane foam to fill the cavity around the depleted uranium shield. The foam prevents contamination to and from the depleted uranium shield.

Previous thermal tests have shown charred polyurethane foam will inhibit the flow of oxygen to the shield and prevent oxidation from occurring during a fire as long as the foam remains confined. This is shown on QSA Global Test plan number Report 74.

It has also been shown the charred foam will not support the shield at temperatures of 800°C. The model 880SC relies on the shield pins to hold the shield in place at all times. These pins are designed to retain the shield throughout testing without the added support of the foam.

The plastic jacket is an optional part of the Type B transport package and has been demonstrated to be less damaging during transport testing on the 880D packages (ref. TP Report 108) therefore the 880SC will be tested without the jacket as the worst case condition for the type B transport testing. The absence of the jacket will present a worst case 30-foot drop and puncture test condition. In a drop, the plastic jacket protects the transport package from further damage by absorbing energy upon impact.

The weight of the Model 880SC transport package without the jacket is not greater than 46 pounds. The total weight of the package with the jacket is not greater than 52 pounds.

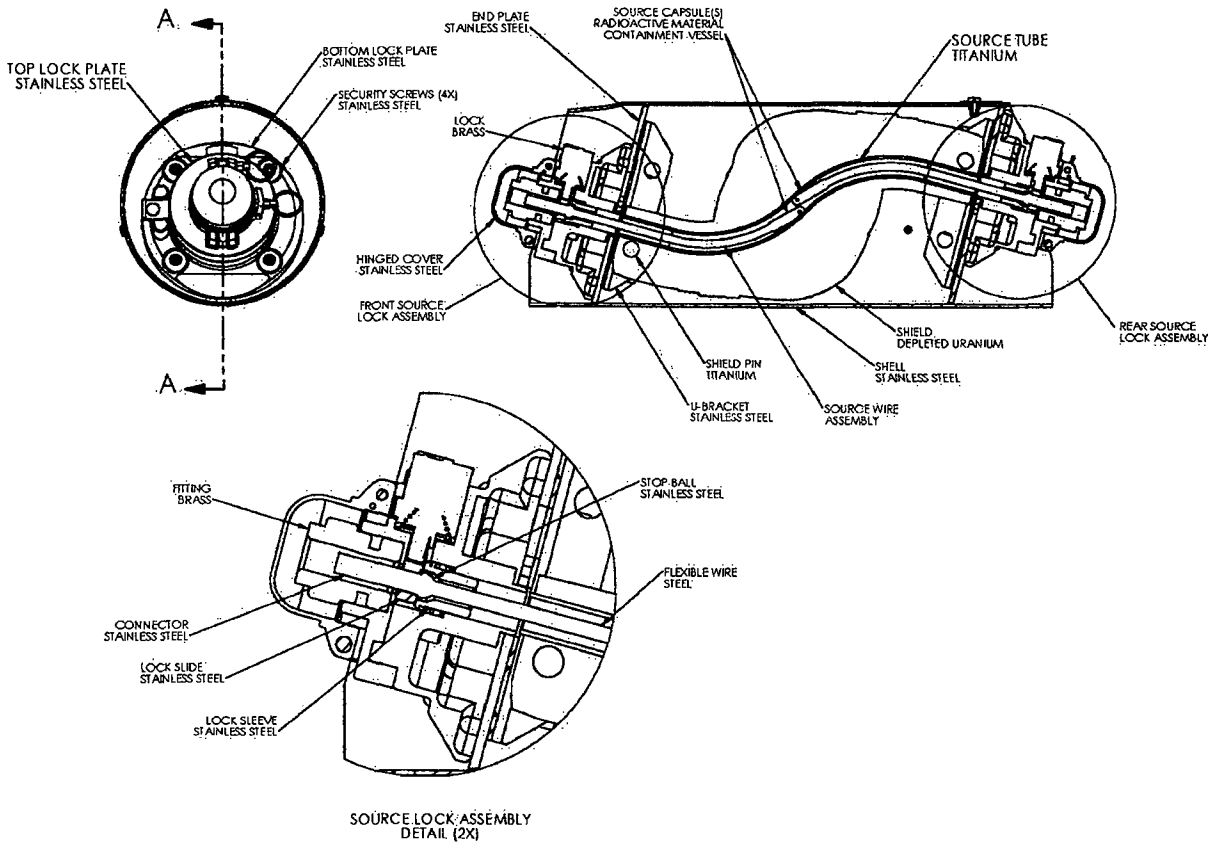


FIGURE 2.1: MODEL 880SC SOURCE CHANGER TRANSPORT PACKAGE

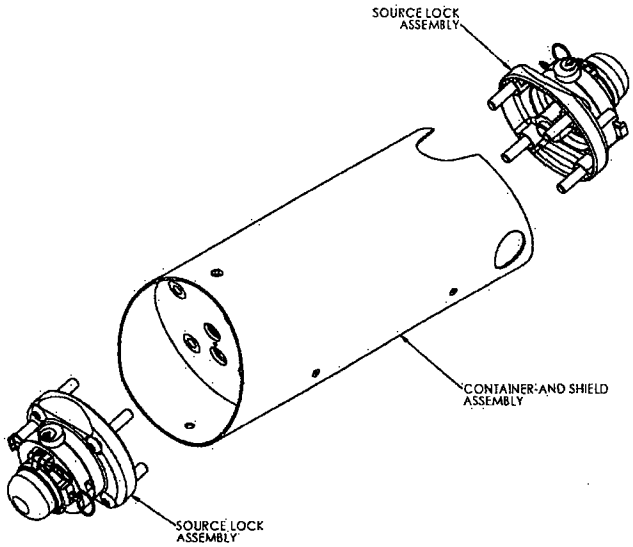


FIGURE 2.2: MODEL 880SC SOURCE CHANGER SCHEMATIC

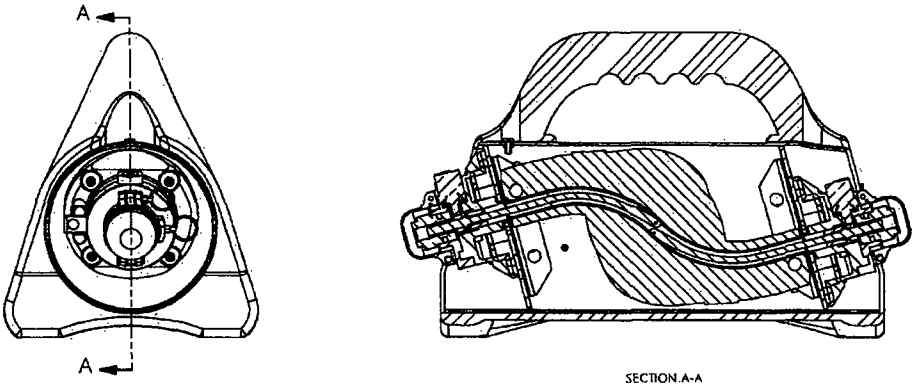


FIGURE 2.3: MODEL 880SC SOURCE CHANGER WITH JACKET

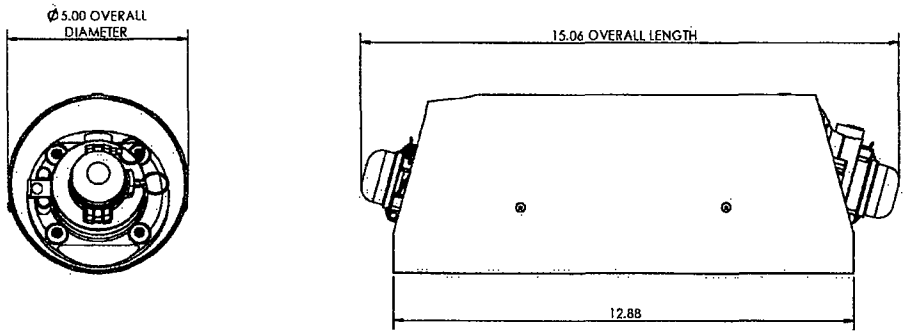


Figure 2.4: MODEL 880SC SOURCE CHANGER OVERALL DIMENSIONS

Section 3 Regulatory Compliance

The main purpose of this test plan is to demonstrate that the Model 880SC transport package complies with the Type A and Type B(U)-96 transport package test requirements of 10 CFR 71 and IAEA TS-R-1.

All test specimens are first subjected to the required normal conditions of transport tests 10 CFR Part 71.71 followed by the hypothetical accident condition tests of 10 CFR Part 71.73.

3.1 Normal Conditions of Transport (NCT) Tests

The ***water spray test*** per 10 CFR 71.71 (c) (6) and IAEA TS-R-1 Section VII, paragraph 721 of the package will not be performed as the Model 880SC transport package is constructed of waterproof materials throughout. Water spray will not degrade the structural integrity of the Model 880SC transport package.

The ***compression or stacking test*** per 10 CFR 71.71 (c) (9) and IAEA TS-R-1 Section VII, paragraph 723 will not be performed. This test was conducted as part of the Model 880 Transport Package Evaluation (see Test Plan Report No. 100).

The Model 880SC transport package shall be subjected to the ***penetration test*** of 10 CFR 71.71 (c) (10) and IAEA TS-R-1 Section VII, paragraph 724 and then the ***1.2 meter free drop test*** per 10 CFR 71.71 (c) (7) and IAEA TS-R-1 Section VII, paragraph 722

The Model 880SC transport package shall be tested as stated above to demonstrate its ability to withstand normal conditions of transport as identified in 10 CFR 71.71 and IAEA TS-R-1. Successfully passing the NCT tests means there is no loss or dispersal of radioactive contents, no significant increase in external surface radiation levels and no substantial reduction in the effectiveness of the packaging.

IAEA TS-R-1 Section VI, paragraph 646 stipulates the same criteria except that it also requires that the loss of shielding integrity should not result in more than a 20% increase in the radiation level at any external surface of the package.

3.2 Hypothetical Accident Condition (HAC) Tests

The ***crush test*** 10 CFR 71.73 (c) (2) and IAEA TS-R-1 Section VII, paragraph 727 (c) will not be performed because the Model 880SC transport package is not designed to transport radioactive contents greater than 1000 A_2 not as special form radioactive material.

The Model 880SC transport package shall be subjected to the ***9-meter free drop test*** per 10 CFR 71.73 (c) (1) and IAEA TS-R-1 Section VII, paragraph 727 (a), and then the ***puncture test*** per 10 CFR 71.73 (c) (3) and IAEA TS-R-1 Section VII, paragraph 727 (b).

The ***thermal test*** per 10 CFR 71.73 (c) (4) and IAEA TS-R-1 Section VII, paragraph 728 will not be performed it will be assessed.

The ***immersion test – fissile material test*** per 10 CFR 71.73 (c) (6) and IAEA TS-R-1 Section VII, paragraph 733. will not be performed. The Model 880SC transport package does not transport fissile material.

The ***immersion test – all packages test*** per10 CFR 71.73 (c) (6) and IAEA TS-R-1 Section VII, paragraph 729 will not be performed. Only the source capsule (containment vessel) is sealed and able to pressurize as a result of 50 feet of water depth. The source capsules intended for transport in these containers are designed and tested to withstand a minimum external pressure of 290-lbf/in^2 (minimum ANSI HPS N43.6-1997 pressure classification of 3). This will ensure that the containment can meet the 22-lbf/in^2 limit specified in the regulations.

The materials used in the construction of the Model 880SC transport package are impervious to water and are not structurally affected when immersed in water of at least 15 meters (50 feet).

The Model 880SC transport package shall be subjected to the cumulative effects of the tests as stated above to demonstrate its ability to withstand the hypothetical accident conditions of transport as identified in 10 CFR 71.73 and IAEA TS-R-1. A successful pass shall indicate; there is no escape of radioactive materials greater than A_2 in one week and no external dose rate greater than 1 R/hr at 1m from the external surface with the maximum radioactive contents which the package is designed to carry.

The melting points for the materials of the package are listed below:

Material	Melting Point
Stainless steel	1390°C (2530°F)
Depleted uranium	1135°C (2075°F)
Titanium	1700°C (3100°F)
Tungsten	3410°C (6170°F)
Copper/Brass	1080°C (1980°F)
Aluminum	580°C (1080°F)
Rubber/Plastic	Less than 540°C (1000°F)

Section 4 Discussion on System Failure Modes of Interest

4.1 General

The tests in this plan focus on damaging those components of the package which could cause displacement of the source(s) from its stored position within the depleted uranium shield and which affect the integrity of the shield itself.

4.2 Normal and Accident Conditions of Transport

The modes of failure under normal and accident conditions that could lead to elevated dose rates include the following:

4.2.1 Fracture or penetration of the Source Changer weldment.

4.2.2 Displacement of the shield within the Source Changer weldment and distortion or fracture of the source.

4.2.3 Failure of the source lock assemblies and/or lock mounting screws.

4.2.4 Fracture or cracking in the depleted uranium shield.

The test conditions specified in this Test Plan are intended to challenge the ability of the Model 880SC transport package with respect to these failure modes.

Section 5 Assessment of Package Conformance

5.1 Regulatory Requirements

5.1.1 Normal Conditions of Transport (71.43(f))

There should be no loss or dispersal of radioactive contents, no significant increase in external surface radiation levels and no substantial reduction in the effectiveness of the packaging.

IAEA TS-R-1 para. 646 stipulates the same criteria except that it states in paragraph 646(b) that the loss of shielding integrity would not result in more than a 20% increase in the radiation level at any external surface of the package.

5.1.2 Hypothetical Accident Conditions (71.51(a))

There should be no escape of radioactive materials greater than A_2 in one week and no external dose rate greater than 1 R/hr at 1m from the external surface with the maximum radioactive contents which the package is designed to carry.

5.2 Test Package Contents

The Model 880SC Source Changer is designed to carry either one or two special form sources. Containment of the radioactive source is tested at manufacture. The source capsule design has been certified in accordance with the performance requirements for special form as specified in 10 CFR Part 71 and IAEA TS-R-1.

This test plan therefore does <u>not</u> discuss/specify tests of the containment of the radioactive source. The purpose of the tests is to demonstrate that the sources remain shielded within the limits specified by the regulations.

Since source integrity has been demonstrated through special form testing, simulated sources will be used during testing of the package. The radiation levels after testing will be measured by replacing the simulated sources with active sources. The post-test measurements will be compared with pre-test measurements to verify the sources have not shifted within the shield.

5.3 Test Orientation Assessment

The following is an assessment of all the possible test orientations for the Model 880SC transport package. Only the test orientations deemed necessary for causing failure relative to the failure modes described in section 5.1 will be used in the Penetration, 1.2 meter, 9 meter, and Puncture tests of this plan.

The Model 880SC transport package is a cylindrically shaped container. On each end of the container is an identical lock assembly. The assemblies are

parallel to one another but at a 15 degree angle. The center of gravity is located essentially at the geometric center of the package.

The objective in every test is to cause significant damage to the extent that it would directly compromise the radiological safety of the package or adversely influence the results of subsequent tests in the test sequence. Dropping or penetrating the package just to cause damage without affecting the radiological safety consequences is not necessary.

Figure 8.5.2.1 is the first Penetration Test orientation. The penetration bar will impact the lock in its most vulnerable location potentially causing failure of the lock. The penetration bar may also produce a large enough force which could shear the lock assembly attachment screws.

Figure 8.5.3.1 is the second Penetration Test orientation. The penetration bar will impact the lock slide. This impact could shear the lock slide or cause significant damage.

Figure 8.6.2.1 is the first 1.2m Drop orientation (end drop). This orientation is based on the center of gravity of the 880SC and should cause the 880SC to impact on the cap of the lock assembly. The impact from this drop could shear the lock assembly attachment screws on the first lock assembly. This impact will also damage the cap which may shear off and allow for damage to the other components of the lock assembly. The cap may also collapse during impact and provide some level of dampening since it is constructed of relatively thin stainless steel. The collapse or damage of the cap during this test will reduce any dampening from the cap during the 9m Drop test.

Figure 8.6.3.1 is the second 1.2m Drop orientation (end drop). This orientation is based on the center of gravity of the 880SC for the opposing (2^{nd}) lock assembly and should cause the 880SC to impact on the cap of the lock assembly. The impact from this drop could shear the lock assembly attachment screws on the 2^{nd} lock assembly. This impact will also damage the cap which may shear off and allow for damage to the other components of the lock assembly. The cap may also collapse during impact and provide some level of dampening since it is constructed of relatively thin stainless steel. The collapse or damage of the cap during this test will reduce any dampening from the cap during the 9m Drop test.

Figure 8.6.4.1 is the third 1.2m Drop orientation (oblique drop). The object of this drop is to try and shear off the lock assembly attachment screws. This orientation is a worst case. The center of mass for the lock assembly on the right (as shown in Figure 8.6.4.1) is at a further point from the initial corner of impact on the 880SC than for the lock assembly on the left, and will therefore create a larger moment of inertia.

Neither the side drop nor the corner drop will be performed for the 1.2m Drop. Orientation 8.6.2.1 and 8.6.3.1 will create the larger shear force on the attachment screws, at the same time damaging the lock assembly.

Figure 8.7.2.1 is the first 9m Drop orientation (end drop). The object is to continue to inflict damage from the 1.2m Drop orientation (Figure 8.6.2.1). The cap may have been damaged or collapsed during the 1.2m drop and this will increase the possibility of the lock assembly attachment screws shearing

off. The 9m drop may cause damage to the other components of the lock assembly.

Figure 8.7.3.1 is the second 9m Drop orientation (end drop). The object is to continue to inflict damage on the opposing lock assembly as shown in the 1.2m Drop orientation (Figure 8.6.2.1). The cap may have been damaged or collapsed during the 1.2m drop and this will increase the possibility of the lock assembly attachment screws shearing off. The 9m drop may cause damage to the other components of the lock assembly.

Figure 8.7.4.1 is the third 9m Drop orientation (oblique drop). The object of this drop is to try and shear off the lock assembly attachment screws. This orientation is a worst case. The center of mass for the lock assembly on the right (as shown in Figure 8.7.4.1) is at a further point from the initial corner of impact on the 880SC than for the lock assembly on the left, and will therefore create a larger moment of inertia.

Neither the side drop nor the corner drop will be performed for the 9m Drop. Orientation 8.7.2.1 and 8.7.3.1 will create the larger shear force on the attachment screws, at the same time damaging the lock assembly.

8.8.2.1 is the first Puncture test orientation (end drop). The justification for this drop orientation is the same as for the 1.2m and 9m Drops. This test will continue to inflict damage on the lock assembly.

8.8.3.1 is the second Puncture test orientation (end drop). The justification for this drop orientation is the same as for the 1.2m and 9m Drops. This test will continue to inflict damage on the lock assembly.

8.8.4.1 is the third Puncture test orientation (oblique). Hitting on the corner of the billet is a worst case.

Neither the side drop nor the corner drop will be performed for the 9m Drop. Orientation 8.8.2.1 and 8.8.3.1 will create the larger shear force on the attachment screws, at the same time damaging the lock assembly.

5.4 Vibration Conditions

Vibration normally occurring in transport is not expected to adversely affect the structural aspects of the Model 880SC transport package. The lock assembly attachment screws and thread locking adhesive are identical to the 880D Transport package. The weight of the 880SC lock assembly is similar to the weight of the 880D Rear plate assembly.

Section 6 Construction and Condition of Test Specimens

The Model 880SC transport package test specimens will be constructed in accordance with QSA Global drawing 880SC-TP206 revision 2 and the QSA Global Quality Assurance Program. The weight of the test specimens per this drawing is not greater than 46 pounds.

The structural materials of the Model 880SC are made of AISI Type 300 series stainless steel and titanium. The shielding materials are depleted uranium and tungsten. The non-safety related parts are made from aluminium, brass, copper, plastic, and rubber.

With the exception of the Penetration Test all tests of this plan will subject the test specimen to an impact from a drop. The mechanical strength and ductility of the critical components of the package must continue to perform as expected at the ambient temperature conditions of –40°F to 100°F.

The fracture toughness, strength and ductility, of the structural materials in the Model 880SC do not change significantly at or between the temperatures of –40°F to 100°F. The shielding materials are relatively brittle throughout this entire temperature range. Therefore, any temperature within the –40°F to 100°F range for the 4-foot, 30-foot, and puncture tests will have the same result. So, the test specimen will be dropped at ambient temperature at time of testing.

The internal operating pressure of the containment system, namely the source capsule, is considered to be in equilibrium with the outside pressure of the package. The sealed capsules are welded at atmospheric pressure and except for the capsules, the package is open to the atmosphere. Therefore, the initial internal pressure of the containment system is considered to be insignificant.

Section 7 Material and Equipment List

The equipment list worksheets in Section 9 identify the equipment required, with additional space to list other necessary equipment and measuring instruments needed to perform the tests. Additional materials and equipment used to facilitate the tests will be listed as needed.

Section 8 Test Procedure

8.1 General

All test specimens are to be tested in the sequence presented below. Each test has been designed to check the integrity of various components of the package. An assessment of transport integrity of the package can be made based on the cumulative effect of the tests performed on the package.

A plastic jacket (as shown in figure 2.3) is used to carry the package and is normally present during shipping. There are instances where the jacket may not be present but the 880SC Transport package will be shipped. For this reason the jacket will not be used during testing since it may provide some level of impact absorption during the 1.2m Drop, 9m Drop and Puncture tests and would not provide a worst case for testing. All testing will be conducted without the jacket but the drop heights will be adjusted to compensate for the maximum potential weight of 52lbs vs. the actual weight of the test specimens. Drop height compensation calculations are to be included on each Drop & Puncture Test Data Sheet.

The tests have the following sequence:

1. Test specimen preparation and inspection (including initial profile).
2. Penetration test (10 CFR 71.71(c)(10)) – NCT Test
3. 1.2m (Four-foot) free drop test (10 CFR 71.71(c)(7)) – NCT Test
4. 9m (30-foot) free drop test (10 CFR 71.73(c)(1)) – HAC Test
5. Puncture test (10 CFR 71.73(c)(3)) – HAC Test
6. Test inspection.
7. Final test inspection and/or assessment (including post test profile).
8. Test specimen storage.

Note:
After testing, the package results will be evaluated in the Test Plan Report for impact of the reverse sequence of the 9m Drop and Puncture Testing to determine compliance with IAEA TS-R-1 #727 & #728.

8.2 Roles and Responsibilities

The responsibilities of the groups identified in this plan are:

- **Engineering** executes the tests according to the test plan and summarizes the test results. Engineering also provides technical input to assist Regulatory Affairs and Quality Assurance as needed.

- **Regulatory Affairs** monitors the tests and reviews test reports for compliance with regulatory requirements.

- **Quality Assurance** oversees test execution and test report generation to assure compliance with the QSA Global Quality Assurance Program.

- **Engineering, Regulatory Affairs** and **Quality Assurance** are jointly responsible for assessing test and specimen conditions relative to 10 CFR 71 and IAEA TS-R-1.

- **Quality Control** is responsible for ensuring test and specimen data is measured and recorded throughout the test cycle.

8.3 Test Specimen Preparation and Inspection

1. Manufacture five Model 880SC Source Changers per QSA Global drawing number 880SC-TP206, revision 1. Clearly and indelibly mark each specimen: "TP206(X)". Where X is an alphabetically incremented letter beginning with "A". One of the five Source Changers will be used as a spare and used to replace a specimen dropped onto the wrong impact point, if necessary. The spare, if used, will follow the same test sequence as the initially selected specimen.

2. Measure and record the weight of each specimen.

3. Inspect the test specimens to ensure that:

    - All fabrication and inspection records are documented in accordance with the QSA Global Quality Assurance Program.

    - The test specimens comply with the requirements of the drawing.

4. Measure and record the location of the source from the front plate using the source location tool.

5. Perform and record the radiation profile in accordance with QSA Global Work Instruction WI-Q-1806.

6. **Engineering, Regulatory Affairs** and **Quality Assurance** will jointly verify that the test specimens comply with the drawings and the QSA Global Quality Assurance Program.

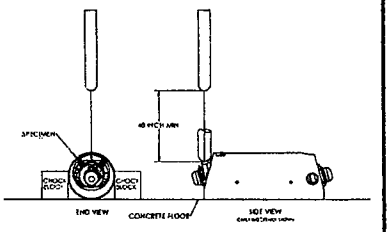
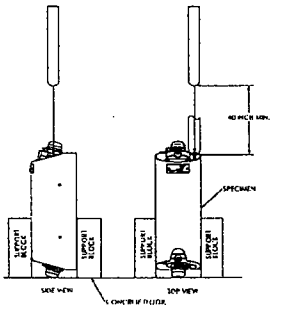
7. Prepare the test specimens for transport.

8.4 Summary of Test Schedule

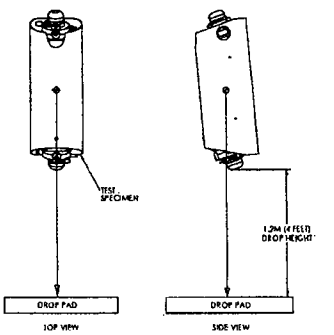
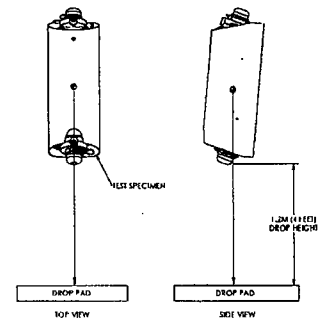
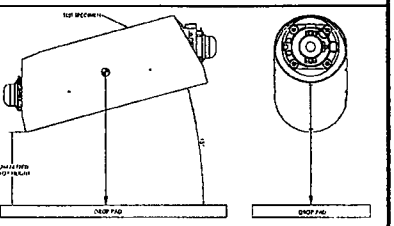
This section provides an overall view of the test specimen orientations for each test.

Normal Conditions of Transportation (NCT) Tests:

Penetration

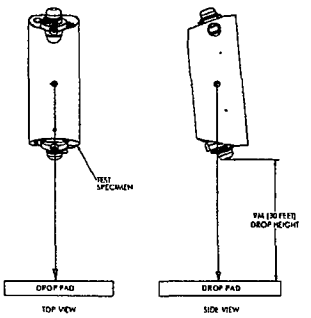
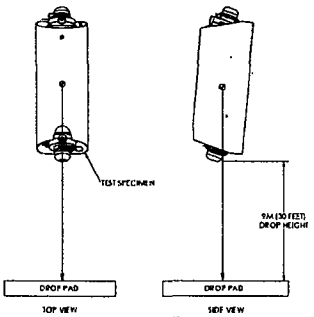
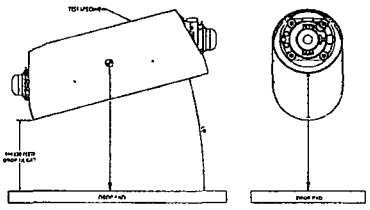
NCT	Para.	Specimen	Diagram
Penetration 1	71.71(c)(10)	TP206(A)	
Penetration 2	71.71(c)(10)	TP206(B)	

1.2m Drop

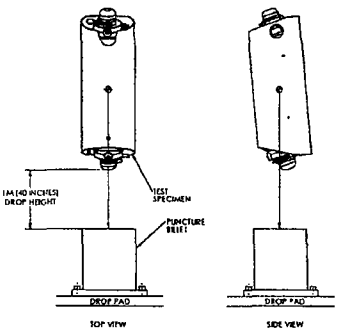
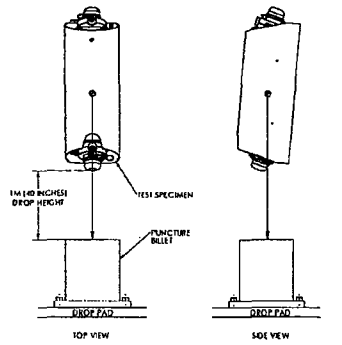
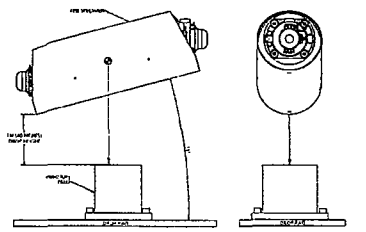
NCT	Para.	Specimen	Diagram
1.2m Drop 1.	71.71(c)(7)	TP206(A)	
1.2m Drop 2.	71.71(c)(7)	TP206(B)	
1.2m Drop 3.	71.71(c)(7)	TP206(C)	

Hypothetical Accident Condition (HAC) Tests:

9m Drop

HAC	Para.	Specimen	Diagram
9m Drop 1.	71.73(c)(1)	TP206(A)	
9m Drop 2.	71.73(c)(1)	TP206(B)	
9m Drop 3.	71.73(c)(1)	TP206(C)	

Puncture

HAC	Para.	Specimen	Diagram
Puncture 1.	71.71(c)(3)	TP206(A)	
Puncture 2.	71.71(c)(3)	TP206(B)	
Puncture 3.	71.71(c)(3)	TP206(C)	

8.5 Penetration Test (10 CFR 71.71 (c) (10))

The penetration test is a normal condition of transport test. Impact of the hemispherical end of a vertical steel cylinder of 3.2 cm (1.25 in) diameter and 6 kg (13 lbs) mass, dropped from a height of 1 m (40 in) onto the exposed surface of the package that is expected to be most vulnerable to puncture. The long axis of the cylinder must be perpendicular to the package surface.

The impact of the steel cylinder may be sufficient to damage the Lock Source assembly. There are two specific areas that are vulnerable, the Lock and the Lock Slide.

8.5.1 Penetration Test Set-up

1. Orient each specimen according to the specimen-specific orientation shown in Figure 8.5.2.1 or Figure 8.5.3.1
2. Raise the penetration bar
3. Measure and record the ambient temperature.
4. Photograph the set-up.
5. Drop the penetration bar.
6. Record the damage to the package and take a photographic record.

8.5.2 Specimen TP206(A) Orientation for the Penetration Test

Figure 8.5.2.1 shows the package orientation for Specimen TP206(A). The object of the drop is to puncture or damage the Lock mechanism.

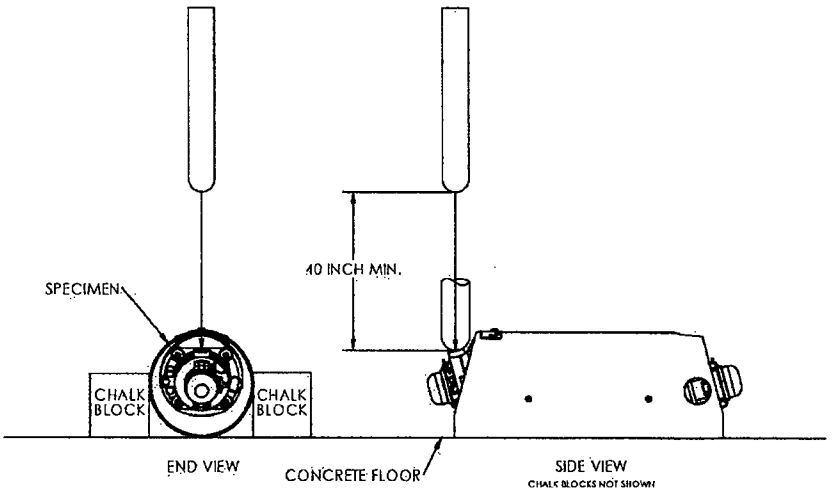


Figure 8.5.2.1: Specimen TP206(A) Orientation for the Penetration Test

8.5.3 Specimen TP206(B) Orientation for the Penetration Test

Figure 8.5.3.1 shows the package orientation for Specimen TP206(B). The object of the drop is to puncture or damage the Lock Slide.

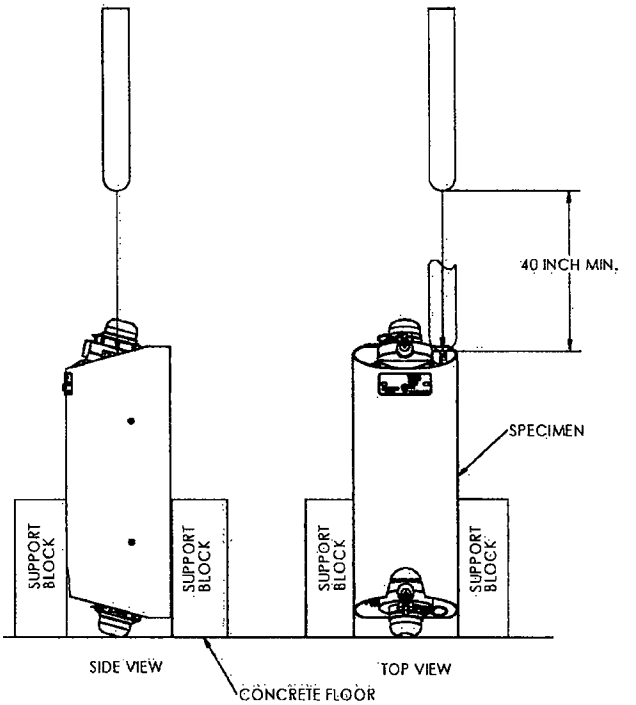


Figure 8.5.3.1: Specimen TP206(B) Orientation for the Penetration Test

8.5.4 Penetration Test Assessment

Upon completion of the test, **Engineering, Regulatory Affairs** and **Quality Assurance** team members will jointly take the following actions:

- Review the test execution to ensure that the test was performed in accordance with 10 CFR 71, IAEA TS-R-1 1996, and this test plan.
- Make a preliminary evaluation of the specimens relative to the requirements of 10 CFR 71 and IAEA TS-R-1 1996.
- Assess the damage to each specimen to decide whether testing of that specimen is to continue.

8.6 1.2m (4-foot) Free Drop Test (10 CFR 71.71(c)(7))

The Normal Transport Conditions Test is the 1.2m (4-foot) free drop test as described in 10 CFR 71.71(c)(7).

The figures of section 8.6.2.1, 8.6.3.1, and 8.6.4.1 illustrate the orientations for the test specimens.

8.6.1 1.2m Free Drop Test Set-up

To set up a package for the 1.2m (4-foot) drop test:

1. Place each specimen on the drop surface and position it according to the specimen-specific orientation shown in Figure 8.6.2.1, Figure 8.6.3.1, or Figure 8.6.4.1

2. Raise the package so that the impact target is 1.2m (4 feet) + Weight compensated distance, above the drop surface. Ensure the center of gravity is over the impact point

3. Measure and record the ambient temperature.

4. Photograph the set-up.

5. Start the video recorder.

6. Drop the package.

7. Stop the video recorder.

8. Record the damage to the package and take a photographic record.

8.6.2 Specimen TP206(A) Orientation for the 1.2m Drop Test

Figure 8.6.2.1 shows the package orientation for Specimen TP206(A). The object of the drop is to damage the Lock Cap and Lock and possibly shear the attachment screws.

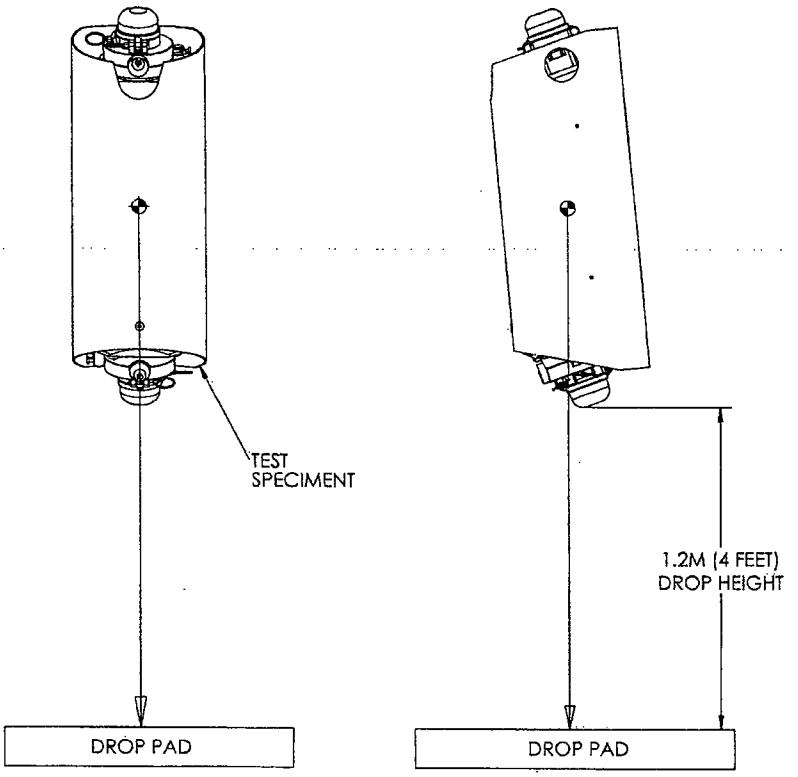


Figure 8.6.2.1: Specimen TP206(A) Orientation for the 1.2m Drop Test

8.6.3 Specimen TP206(B) Orientation for the 1.2m Drop Test

Figure 8.6.3.1 shows the package orientation for Specimen TP206(B). Since the 880SC Transport package has a Lock assembly on each end, and the ends are at different angles the object of this drop is to damage this Lock Cap and Lock or shear the attachment screws.

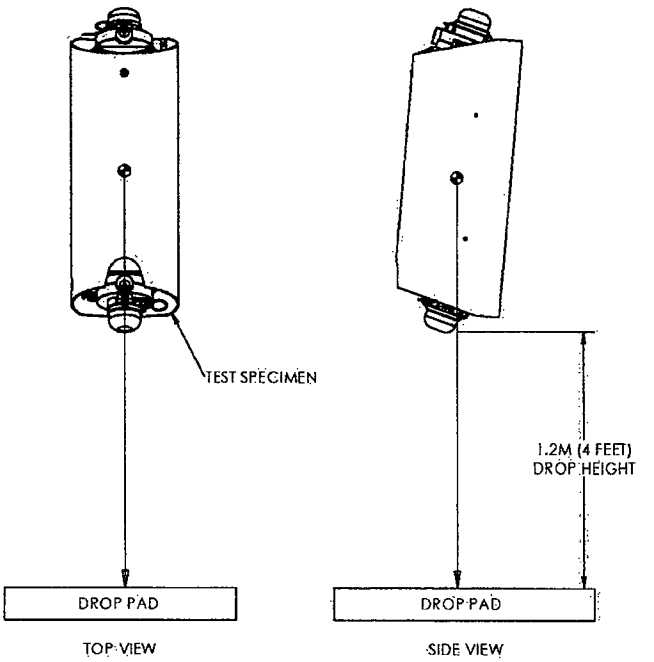


Figure 8.6.3.1: Specimen TP206(B) Orientation for the 1.2m Drop Test

8.6.4 Specimen TP206(C) Orientation for the 1.2m Drop Test

Figure 8.6.4.1 shows the package orientation for Specimen TP206(C). The object of this drop is to try and shear off the attachment screws. This orientation is a worst case. The center of mass for the Lock Slide on the right (as shown in Figure 8.6.4.1) is at a further point from the initial corner of impact on the 880SC than for the Lock Slide on the left, and will therefore create a larger moment of inertia.

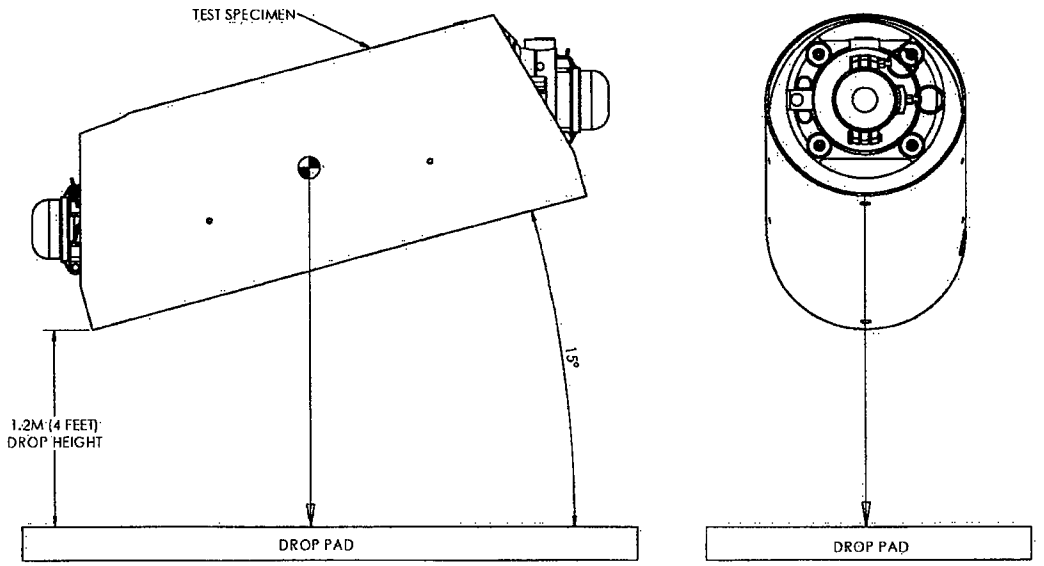


Figure 8.6.4.1: Specimen TP206(C) Orientation for the 1.2m Drop Test

8.6.5 1.2m Free Drop Test Assessment

Upon completion of each test, **Engineering, Regulatory Affairs** and **Quality Assurance** team members will jointly take the following actions:

- Review the test execution to ensure that each test was performed in accordance with 10 CFR 71, IAEA TS-R-1, and this test plan.
- Make a preliminary evaluation of the specimens relative to the requirements of 10 CFR 71 and IAEA TS-R-1.
- Measure and record a radiation profile of each test specimen in accordance with QSA Global Work Instructions WI-Q1806.
- Assess the damage to each specimen to decide whether testing of that specimen is to continue.
- Evaluate the condition of each specimen to determine what changes, if any, are necessary in package orientation in the 30-foot drop test to achieve maximum damage.

8.7 9m Free Drop Test (10 CFR 71.73(c)(1))

The first Hypothetical Accident Test is the 9m (30-foot) free drop test as described in 10 CFR 71.73(c)(1).

The figures of section 8.7.2.1, 8.7.3.1, and 8.7.4.1 illustrate the orientations for the test specimen.

8.7.1 9m Free Drop Test Set-up

To set up a package for the 9m (30-foot) drop test:

1. Measure and record the weight of each of the test specimens.
2. Place each specimen on the drop surface and position it according to the specimen-specific orientation as shown in Figure 8.7.2.1, Figure 8.7.3.1, or Figure 8.7.4.1.
3. Raise the package so that the impact target is 9m (30 feet) + Weight Compensated distance, above the drop surface. Ensure the center of gravity is over the impact point.
4. Measure and record the ambient temperature.
5. Photograph the set-up.
6. Start the video recorder.
7. Drop the package.
8. Stop the video recorder.
9. Record the damage to the package and take a photographic record.

8.7.2 Specimen TP206(A) Orientation for the 9m Drop Test

Figure 8.7.2.1 shows the package orientation for Specimen TP206(A). The object of the drop is to use lock cap to drive the rear plate across the endplate to shear the rear plate mounting screws.

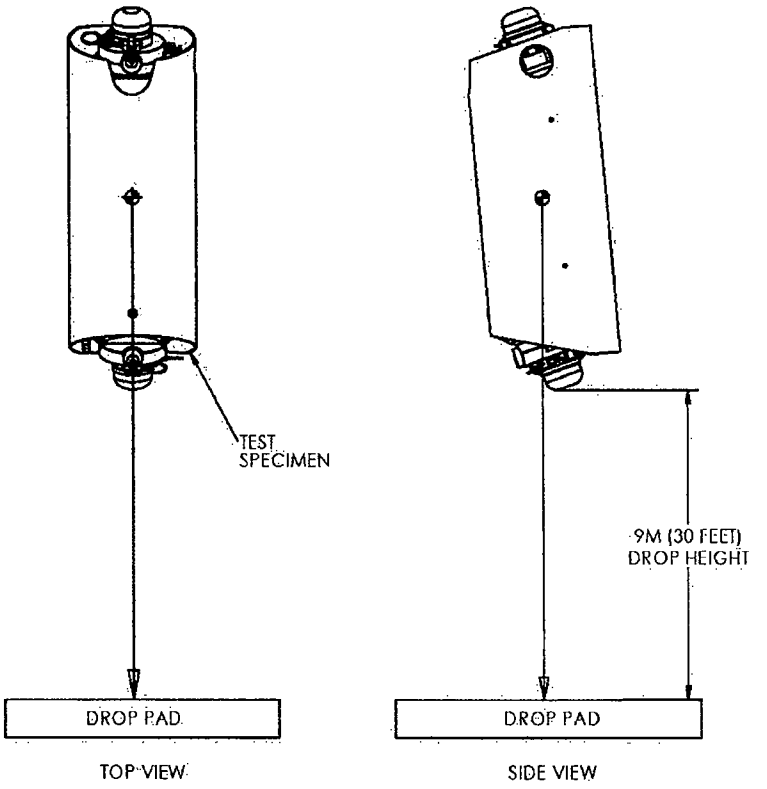


Figure 8.7.2.1: Specimen TP206(A) Orientation for the 9m Drop Test

8.7.3 Specimen TP206(B) Orientation for the 9m Drop Test

Figure 8.7.3.1 shows the package orientation for Specimen TP206(B). The object of the drop is to use lock cap to drive the rear plate across the endplate to shear the rear plate mounting screws.

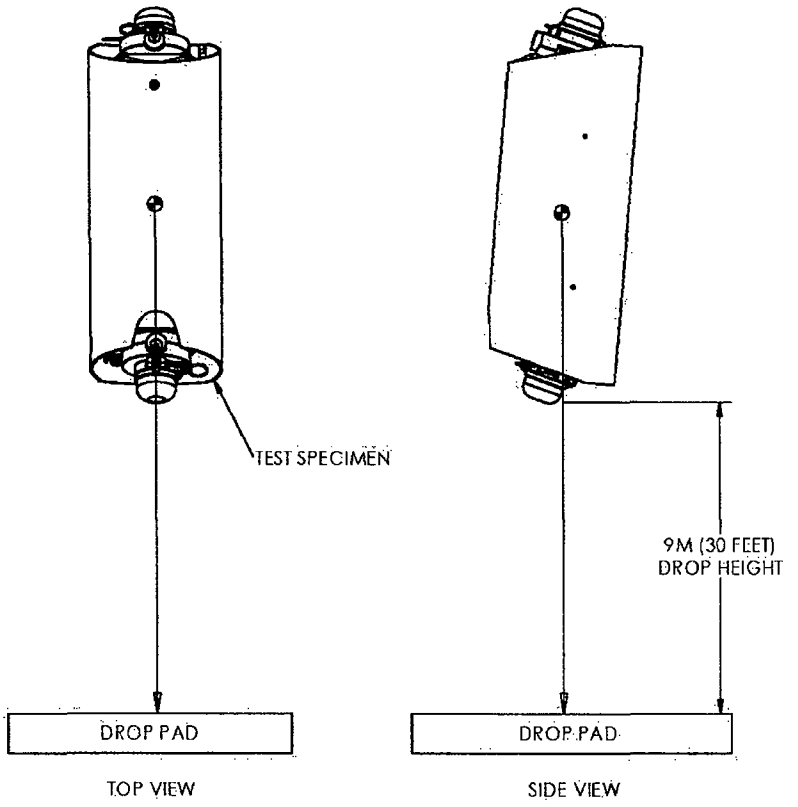


Figure 8.7.3.1: Specimen TP206(B) Orientation for the 9m Drop Test

8.7.4 Specimen TP206(C) Orientation for the 9m Drop Test

Figure 8.7.4.1 shows the package orientation for Specimen TP206(C). The object of this drop is to try and shear off the attachment screws. This orientation is a worst case. The center of mass for the Lock Slide on the right (as shown in Figure 8.7.4.1) is at a further point from the initial corner of impact on the 880SC than for the Lock Slide on the left, and will therefor create a larger moment of inertia.

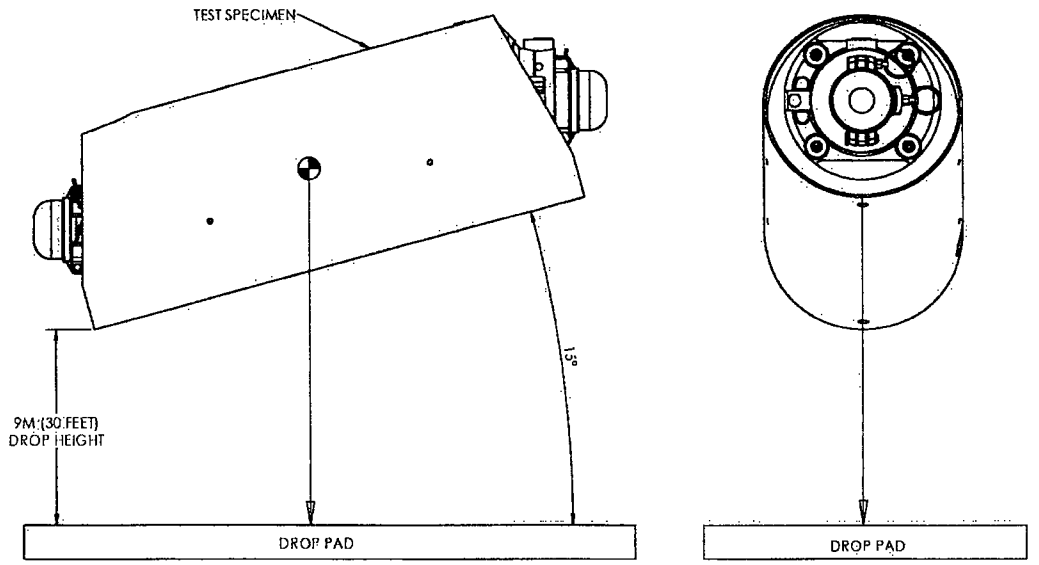


Figure 8.7.4.1: Specimen TP206(C) Orientation for the 9m Drop Test

8.7.5 9m Free Drop Test Assessment

Upon completion of each test, **Engineering, Regulatory Affairs** and **Quality Assurance** team members will jointly take the following actions:

- Review the test execution to ensure that each test was performed in accordance with 10 CFR 71, IAEA TS-R-1, and this test plan.
- Make a preliminary evaluation of the specimens relative to the requirements of 10 CFR 71 and IAEA TS-R-1.
- Assess the damage to each specimen to decide whether testing of that specimen is to continue.
- Evaluate the condition of each specimen to determine what changes, if any, are necessary in package orientation in the puncture test to achieve maximum damage.

8.8 Puncture Test (10 CFR 71.73(c)(3))

The package is dropped from a height of 1m (40") onto the puncture billet. This test uses the 12" high puncture billet. The billet meets the minimum height (8") required in 10 CFR 71.73(c)(3). The specimen has no projections or overhanging members longer than 12" which could act as impact absorbers, allowing the billet to cause the maximum damage to the specimen. The billet is to be bolted to the drop surface used in the drop tests.

The figures: 8.8.2.1, 8.8.3.1 and 8.8.4.1 illustrate the orientations for each puncture test.

The justification for each puncture orientation Drop 1 and Drop 2 is the same as the orientation for the 30-foot drop test (Drop 1 and Drop 2). If the orientation needs to be changed, the new orientation must be documented and approved with a justification describing how it would be a worst condition than the planned orientation.

8.8.1 Puncture Test Set-up

NOTE: *Because each test is designed to add to damage inflicted on a specific component or assembly in the preceding test, it is important that each specimen maintain its identity throughout the battery of tests and that the set-up instructions specific to the specimen are strictly followed.*

To set up a package for the puncture test:

1. Measure and record the weight of the test specimen.
2. Measure and record the ambient temperature.
3. Position the test package according to the specimen-specific orientation shown in figures 8.8.2.1, 8.8.3.1, or 8.8.4.1.
4. Raise the package so that the impact target is 1m (40") + Weight Compensated distance, between the impact point on the package and the top of the puncture billet. Ensure the center of gravity is over the impact point.
5. Photograph the set-up.
6. Start the video recorder.
7. Drop the package.
8. Stop the video recorder.
9. Record the damage to the package and take a photographic record.

8.8.2 Specimen TP206(A) Orientation for the Puncture Test

The objective of this drop orientation (Figure 8.8.2.1) is to continue the damage inflicted on the specimen by the 9m-drop test.

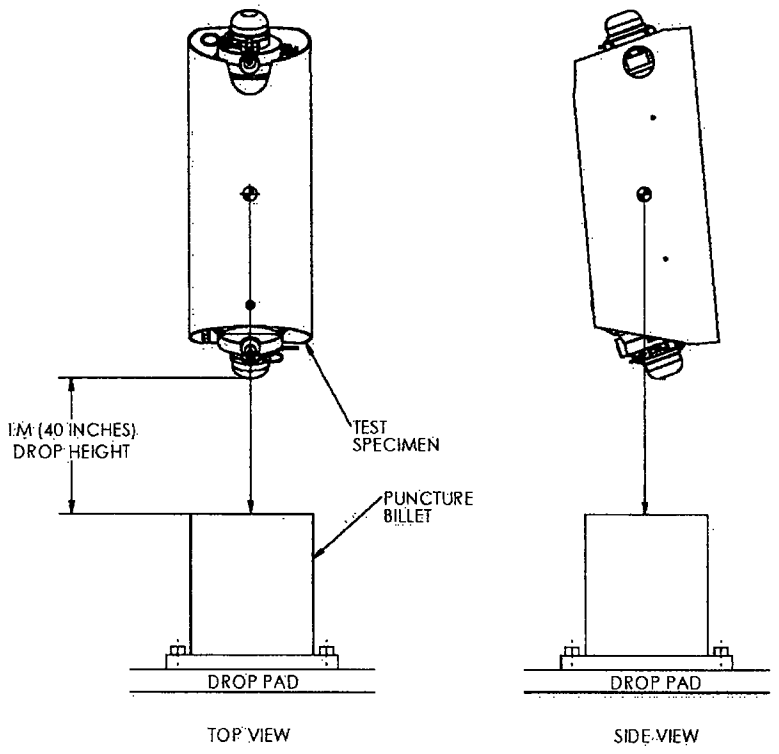


Figure 8.8.2.1: Specimen TP206(A) Orientation for the Puncture Test

8.8.3 Specimen TP206(B) Orientation for the Puncture Test

The objective of this drop orientation (Figure 8.8.3.1) is to continue the damage inflicted on the specimen by the 9m-drop test.

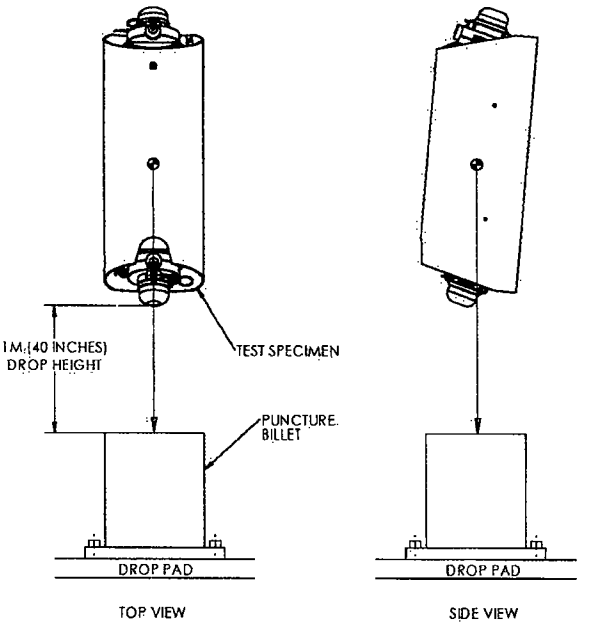


Figure 8.8.3.1: Specimen TP206(B) Orientation for the Puncture Test

8.8.4 Specimen TP206(C) Orientation for the Puncture Test

The objective of this drop orientation (Figure 8.8.4.1) is to puncture the shell of the 880SC.

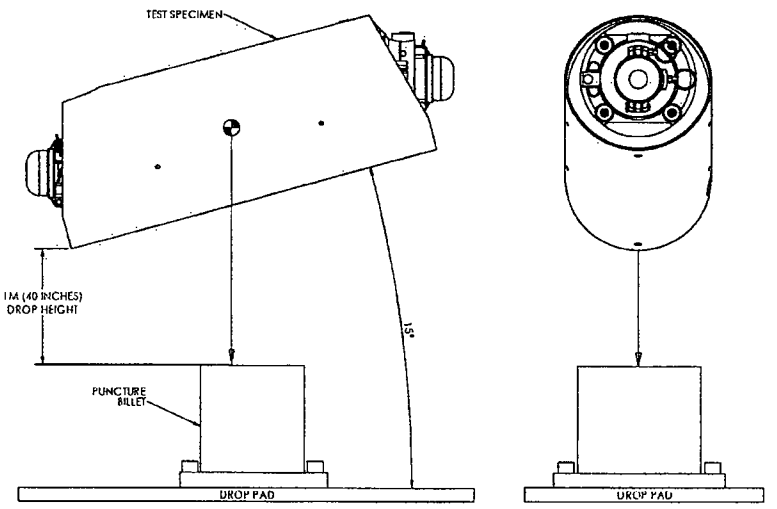


Figure 8.8.4.1: Specimen TP206(C) Orientation for the Puncture Test

8.8.5 Puncture Test Assessment

Upon completion of the test, **Engineering, Regulatory Affairs** and **Quality Assurance** team members will jointly take the following actions:

- Review the test execution to ensure that the tests were performed in accordance with 10 CFR 71, IAEA TS-R-1, and this test plan.
- Make a preliminary evaluation of each specimen relative to the requirements of 10 CFR 71 and IAEA TS-R-1.

8.9 Test Inspection

Perform the test inspection after the puncture tests.

1. Measure and record the damage to each of the test specimens. Measure and record the package for signs of any permanent strain.
2. Measure and record the location of the source from the front plate using the source location tool.
3. Remove and assess the condition of the simulated source.
4. Reassemble the packages using a representative active source, making sure that the source position and the package configuration are the same as they were immediately after the puncture test.
5. Measure and record a radiation profile of each test specimen in accordance with QSA Global Work Instruction WI-Q1806.
6. Assess the significance of any change in radiation at the surface and at one meter from the packages.
7. Determine whether it is necessary to radiograph the test specimens for inspection of hidden component damage or failure.
8. Record any damage or failure found in radiograph of the test specimens, if performed.

8.10 Thermal Test (10 CFR 71.73(c)(4))

The Thermal test will be assessed.

8.11 Test Specimen Storage

Place the test specimens in an appropriate container and store the container in the "low level" waste room. Dispose the test specimens only when authorized in writing by RA and QA.

Section 9 Worksheets

Use the following worksheets for executing the tests of section 8. Each test shall have three worksheets; an equipment list, a procedure checklist, and a data sheet. Record the information onto copies of these worksheets for each test performed.

Attach a copy of the relevant inspection report or calibration certificate after the range and accuracy of the equipment has been verified.

Test Specimen Documentation

Test Specimen – 880SC-TP206

Serial Number	Drawing Number & Revision	Attach IIR's	Attach NCR	Attach TMI

Signature	Print Name	Date
Engineering:		
Regulatory:		
Quality Assurance:		

Drop & Puncture Test Equipment List

Test:		
Description *** Mark NA when not used.**	**Enter the Model and Serial Number**	**Attach Inspection Report or Calibration Certificate**
Test Specimen, Drawing No.		
Drop Surface, Drawing No.		
* Puncture Billet, Drawing No.		
Record any additional tools used to facilitate the test and attach the appropriate inspection report or calibration certificates.		
Signature	**Print Name**	**Date**
Completed by:		
Verified by:		

Drop & Puncture Test Checklist

Test:		
Test Location:		
Step	**Data**	**Measuring Instrument**
1. Record test specimen serial number:		
2. Record the test specimen weight:		
3. Record the ambient temperature (°C):		
4. Record set-up orientation figure:		
5. Verify set-up orientation and drop height.		
6. Photograph set-up in at least two perpendicular planes.		
7. Begin video recording of the test so that impact is recorded.		
8. Release the test specimen.		
9. Stop the video recorder. Ensure the point of impact and orientation specified in the plan has been achieved.		
10. Record the damage to the test specimen on a separate sheet and attach.		
11. Engineering, Regulatory Affairs and Quality Assurance make a preliminary assessment relative to 10 CFR 71. Record the assessment on a separate sheet and attach.		
Test witnessed by (Signature)	**Print Name**	**Date**
Engineering:		
Regulatory Affairs:		
Quality Assurance:		

Drop & Puncture Test Data Sheet

Test Unit Model/Serial No.:	Test:
Test Date:	Test Time:
Describe drop orientation and drop height:	
Describe impact (location, rotation, etc.):	
Describe on-site inspection (damage, broken parts, etc.):	
On-site test assessment: Engineering: Regulatory: QA:	
Describe any post-test disassembly and inspection:	
Describe any change in source position:	
Describe results of radiography:	
Completed by:	Date:

2.12.16 Test Plan 206 Report #1 minus Appendices D & E (Nov 2013)

QSA GLOBAL	Document Number **F-E-1808-2** **Test Report Cover Sheet**	Revision 0

TEST REPORT #1
FOR TEST PLAN 206

Model 880SC Transport Package

Normal Conditions of Transport (NCT) Test Results

Revision: 0

Originator		Date: 19NOV13

APPROVALS		
Engineering		Date: 20 NOV 2013
Regulatory		Date: 21 NOV 2013
Quality Assurance		Date: 21 NOV 2013

TEST PLAN 206 – REPORT #1

MODEL 880SC TRANSPORT PACKAGE

NORMAL CONDITIONS OF TRANSPORT (NCT) TEST

REV 0

Contents

Test Plan No. 206

Section 1 Introduction

This report documents the Normal Conditions of Transport (NCT) test results described on Test Plan 206 performed on the Model 880SC transport package. The results confirm the Model 880SC transport package in its heaviest configuration tested in the most vulnerable drop orientation passes all the NCT test requirements specified in Test Plan 206, the Code of Federal Regulations, 10 CFR Part 71, revised as of January 26, 2004 and criteria stated in the IAEA Regulations for the Safe Transport of Radioactive Material, No. TS-R-1 (1996 Edition – as Amended 2003).

The Model 880SC transport package is tested to demonstrate its ability to withstand normal conditions of transport as identified in 10 CFR 71.71 and IAEA TS-R-1. Successfully passing the NCT tests means there is no loss or dispersal of radioactive contents, no significant increase in external surface radiation levels and no substantial reduction in the effectiveness of the packaging.

IAEA TS-R-1 Section VI, paragraph 646 stipulates the same criteria except that it also requires that the loss of shielding integrity shall not result in more than a 20% increase in the radiation level at any external surface of the package.

Section 2 Construction and Condition of Test Specimens

The test specimens are constructed in accordance with QSA Global engineering drawings and Quality Assurance Program. The drawings and manufacturing documents accurately depict the intended design at the time of testing along with methods for building and verifying the finished product. There were no deviations and/or changes to the test specimen before testing.

The test specimens (4) built for this test are the Model 880SC. **Figures 2.1** and **2.2** shows test specimens, specimen numbers TP206(A) through TP206D. TP206D was assembled as a spare. This unit was not required for the NCT testing. Shipping labels and nameplates were not attached for testing.

Figures 2.1 and **2.2** shows the major assemblies and common components of the Model 880SC transport package. The nomenclature used in **Figures 2.1** and **2.2** are referenced throughout this report.

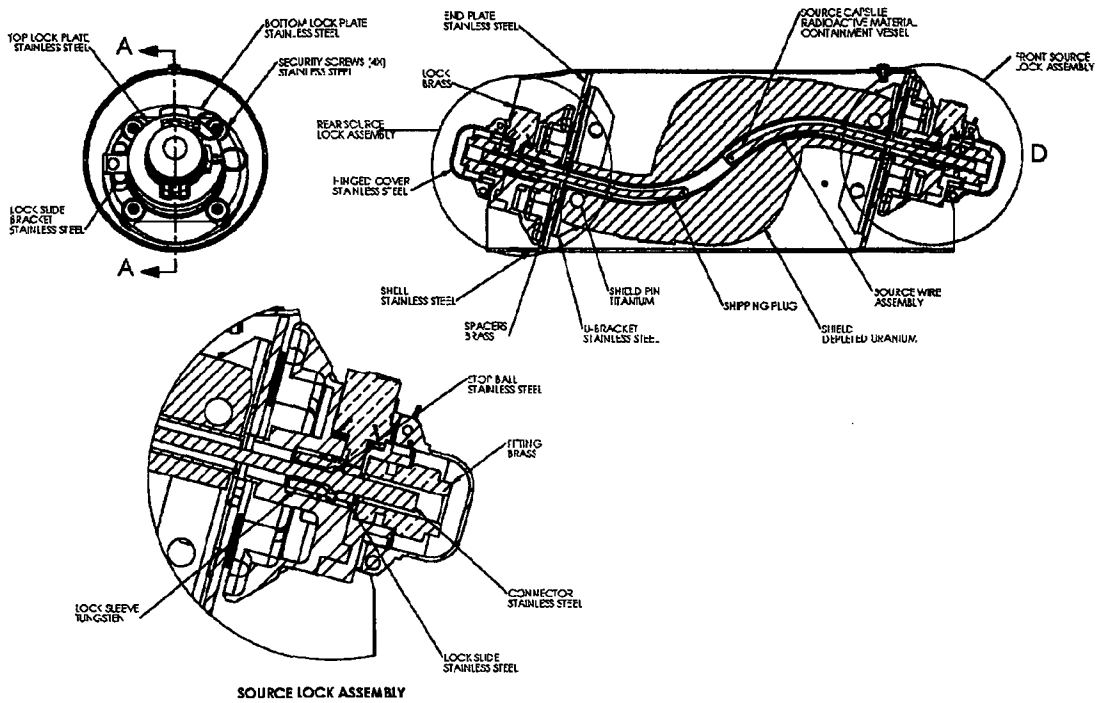


FIGURE 2.1: MODEL 880SC SOURCE CHANGER TRANSPORT PACKAGE
(without optional Jacket)

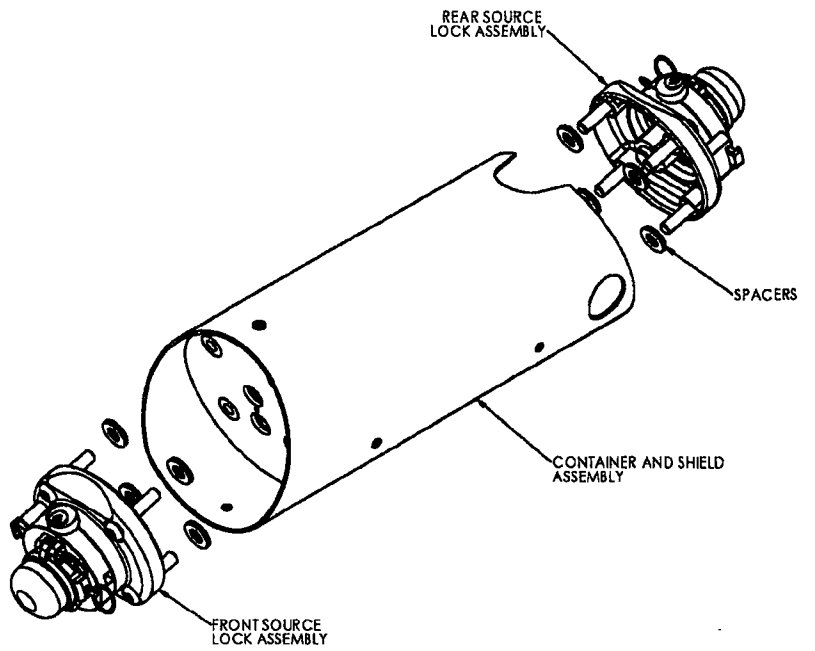


FIGURE 2.2: MODEL 880SC SOURCE CHANGER SCHEMATIC

The primary containment system of the package is the completely seal welded source capsule assembly. The capsule assembly, tested to the ANSI/ISO class 4 or 7MPa pressure test requirements, is manufactured at atmospheric pressure and ambient temperature and therefore does not need to be adjusted for the test.

The secondary containment system, the transport package source lock assemblies and shield assembly, are open to the atmosphere and therefore in constant equilibrium with changing operating pressures.

The structural materials used in the construction of the Model 880SC transport package retain their key mechanical and physical properties between -40°C (-40°F) and +38°C (+100°F). Therefore, the temperature of the test specimens did not need to be adjusted for the tests performed in test plan 206.

Section 3 Regulatory Compliance

The Model 880SC transport package complies with the normal transport package test requirements of 10 CFR 71.71 and IAEA TS-R-1 based on the successful completion of the tests and analysis described in this report.

The pass criteria for a successful normal transport test or analysis is identified 10 CFR part 71.43 paragraph (f). This paragraph states:

"There should be no loss or dispersal of radioactive contents, no significant increase in external surface radiation levels and no substantial reduction in the effectiveness of the packaging.

IAEA TS-R-1 paragraph 646 stipulates the same criteria except that it also requires that the loss of shielding integrity not result in more than a 20% increase in the radiation level at any external surface of the package."

Free Drop Height Adjustment

The free drop test heights specified in 10 CFR Part 71 are adjusted higher to allow for the Model 880SC transport packages built heavier than the test specimen but less than the maximum package weight. The actual test specimens weigh less than the maximum weight specified on the top level assembly drawing. This is primarily due to the absence of the optional jacket.

Table 3.1 shows the adjusted free drop height based on the actual test specimen weight compared to the maximum transport package weight. The adjusted heights provide impact energy equal to or greater than the maximum transport package weight if dropped at the 10 CFR Part 71 specified drop height. The adjusted drop height is determined by multiplying the worst case weight ratio by the required drop test height (4 feet). The worst case weight ratio is calculated by dividing the maximum allowable weight by the actual test specimen weight.

Table 3.1. Test Specimen 1.2 Meter Free Drop Height Adjustment

Test Specimen	Actual Test Specimen Weight (Lbs)	Maximum Transport Package Weight (Lbs)	1.2 Meter (4-foot) Adjusted Height		
			(Meters)	(Feet)	(Inches)
TP206(A)	44.80	52	1.42	4.7	56
TP206(B)	44.85	52	1.42	4.7	56
TP206(C)	44.80	52	1.42	4.7	56

Section 4 Test Results

4.1 Water Spray Test

Per Test Plan 206 the water spray test was not performed:

"The ***water spray test*** per 10 CFR 71.71 (c) (6) and IAEA TS-R-1 Section VII, paragraph 721 of the package will not be performed as the Model 880SC transport package is constructed of waterproof materials throughout. Water spray will not degrade the structural integrity of the Model 880SC transport package."

4.2 Compression Test

Per Test Plan 206 the compression test was not performed:

The ***compression or stacking test*** per 10 CFR 71.71 (c) (9) and IAEA TS-R-1 Section VII, paragraph 723 will not be performed because the maximum weight of the 880SC transport package without the jacket is 46 lbs. and was tested as part of the 880 Transport packeage:

> "Test Plan and Report 100 (Section 2.12) documents that Test Specimens P01 and P02 were subjected simultaneously to a compressive load of 459 lbs (209 kg) for a period of 24 hours. This exceeds five times the maximum transport package weight of 46 lbs for the heaviest version of the Model 880 (without the optional jacket). The actual compressive weight of 459 lbs (209 kg) is greater than 13 kPa (2 lb/in2) multiplied by the vertically projected area of the transport package."

4.3 Penetration Test

4.3.1 Penetration Test Requirement

This test drops a vertically oriented, solid steel, cylindrical bar from a height of 1 m (40 in) onto the exposed surface of the package that is most vulnerable to puncture.

The bar has a diameter of 3.2 cm (1.25 in) with a hemispherical end and a mass of 6 kg (13 lbs). The long axis of the cylinder must be perpendicular to the package surface.

For the 880SC unit it was determined the lock and lock slide would be the most vulnerable areas. Two penetration tests were performed to determine compliance to this test. Test specimens TP206(A) (s/n: D11827) and TP206(B) (s/n: D11828) were used for this test.

4.3.2 Penetration Test Results – TP206(A)

Figure 4.3.2A shows the penetration bar contacting the top of the lock, figure 4.3.2B shows the drop height of the bar, and figure 4.3.2C shows the damage caused by the dropped bar.

Table 4.3.2: Penetration Bar Test Setup – TP206(A)	
Changes to the planned penetration target.	None
Test Specimen Weight	44.80 Pounds
Actual Bar Drop Height	1.0 Meter (39.4 inches)
Temperature during test	61.2 °F/16.2 °C
Test Specimen	TP206(A)

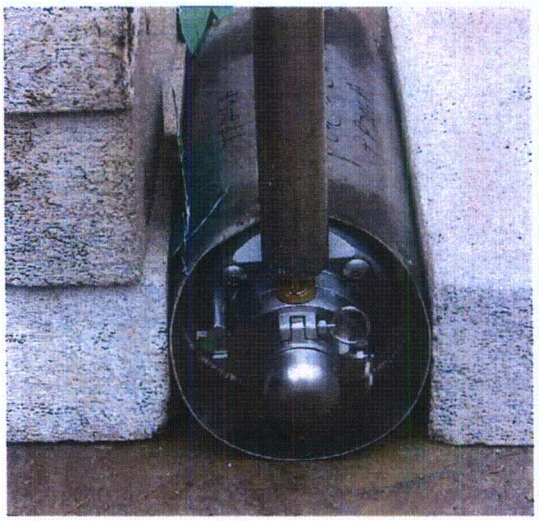


Figure 4.3.2A: Penetration Bar Test Setup – TP206(A)

Figure 4.3.2B: Penetration Bar height – TP206(A)

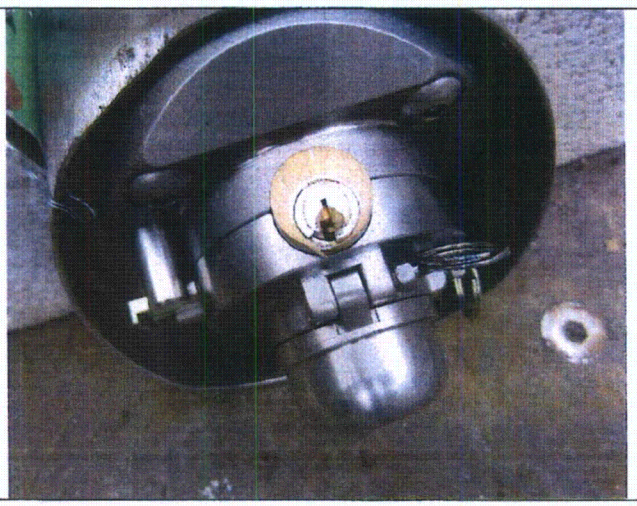


Figure 4.3.2C: Damage from Penetration Bar Test – TP206(A)

4.3.3 Penetration Test Results – TP206(B)

Figure 4.3.3A shows the penetration bar contacting the top of the lock slide, figure 4.3.3B shows the drop height of the bar, and figure 4.3.3C shows the damage caused by the dropped bar.

Table 4.3.3: Penetration Bar Test Setup – TP206(B)	
Changes to the planned penetration target.	None
Test Specimen Weight	44.85 Pounds
Actual Bar Drop Height	1.0 Meter (39.4 inches)
Temperature during test	62.3 °F/16.8 °C
Test Specimen	TP206(B)

Figure 4.3.3A: Penetration Bar Test Setup – TP206(B)

Figure 4.3.3B: Penetration Bar height – TP206(B)

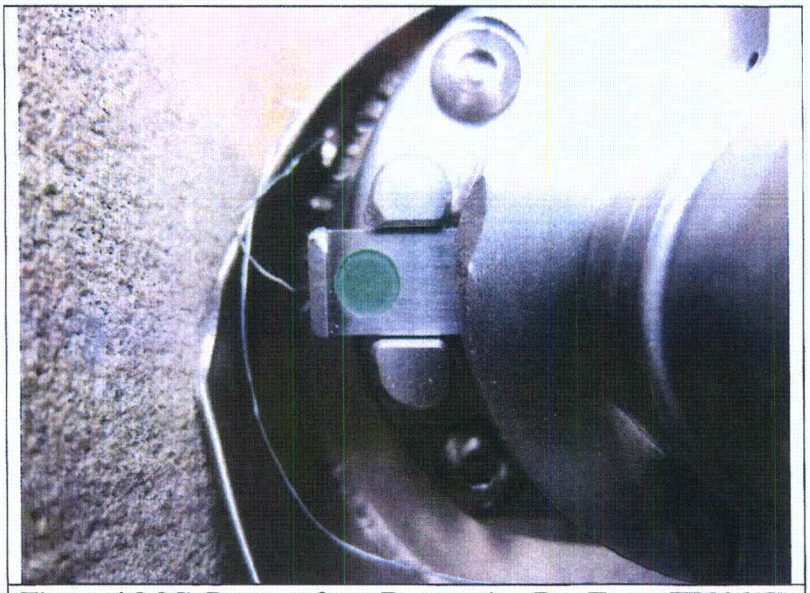


Figure 4.3.3C: Damage from Penetration Bar Test – TP206(C)

4.3.4 Penetration Test Assessment

The penetration test was executed in accordance with Test plan 206, 10 CFR 71.71, and IAEA TS-R-1. An evaluation of the specimen relative to the requirements of 10 CFR 71 and IAEA TS-R-1 confirms the package meets the test requirement. The damage was not sufficient enough to prevent further testing. So, testing continued on to the 1.2 meter free drop test.

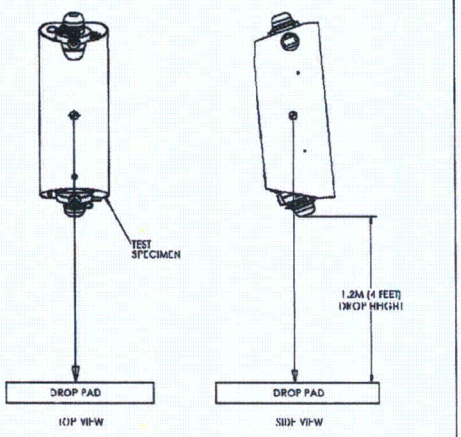
4.4 1.2 Meter Free Drop Test

4.4.1 1.2 Meter Free Drop Test Requirement

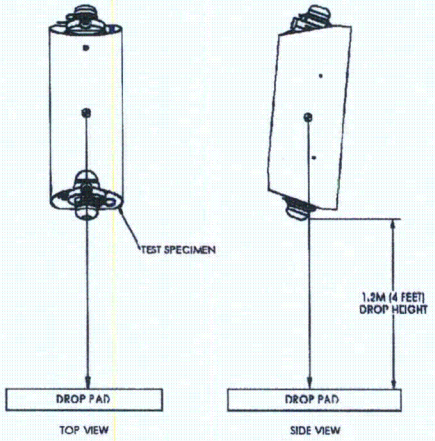
The 1.2 meter free drop test subjects the test specimen to a free drop of at least 1.2 meters (4 feet) onto a rigid, essentially unyielding surface. The orientation of the test specimen during the drop shall be the most unfavourable relative to the failure modes identified in Test Plan 206.

4.4.2 1.2 Meter Free Drop Test Orientation

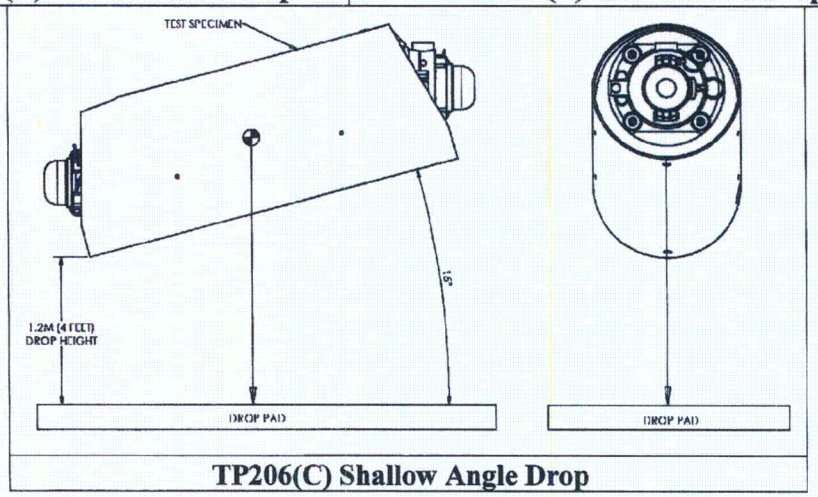
Table 4.4.2 Free Drop Test Orientation Review



TP206(A) Front Surface Drop



TP206(B) Rear Surface Drop



TP206(C) Shallow Angle Drop

4.4.3 1.2 Meter Free Drop Test Results

4.4.3.1 1.2 Meter Free Drop Test – TP206(A) Results

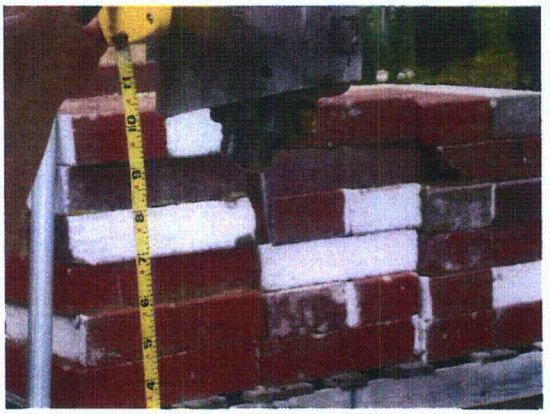
Table 4.4.3.1A. TP206(A) Four Foot Drop Test Setup	
Drop Orientation	Test Plan 206 Figure 8.6.2.1
Test Specimen Weight	44.80 pounds
Actual Drop Height	56 Inches
Temperature during test	17.4°C (63.4°F)
	
Figure 4.4.3.1A TP206(A) Orientation	**Figure 4.4.3.1B TP206(A) Drop Height**

Table 4.4.3.1B: TP206(A) Four Foot Drop Test Damage Assessment	

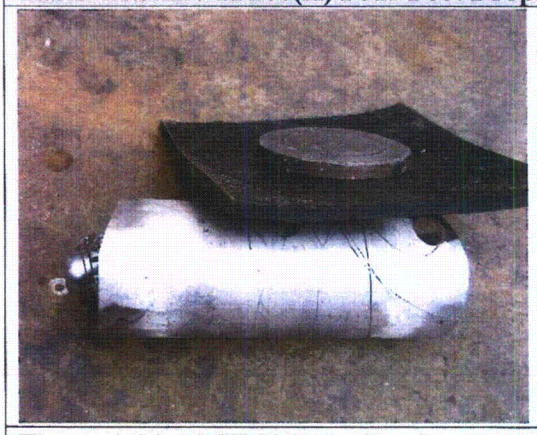
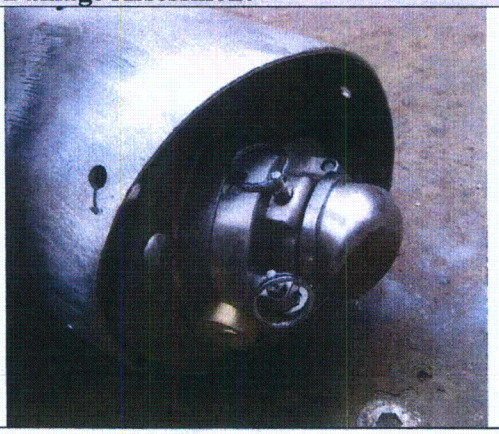

	

Figure 4.4.3.1C TP206(A) after drop	**Figure 4.4.3.1D TP206 Close Up**
Damage: **1. As expected there was some minor damage to the cap.** **2. The spring plunger was damaged.** **3. The cap remained closed.** **4. The lock slide assembly was fully functional.**	

4.4.3.2 1.2 Meter Free Drop Test – TP206(B) Results

Table 4.4.3.2A. TP206(B) Four Foot Drop Test Setup	
Drop Orientation	Test Plan 206 Figure 8.6.3.1
Test Specimen Weight	44.85 pounds
Actual Drop Height	56 Inches
Temperature during test	17.7°C (63.9°F)
	
Figure 4.4.3.2A TP206(B) Orientation	**Figure 4.4.3.2B TP206(B) Drop Height**

Table 4.4.3.2B: TP206(B) Four Foot Drop Test Damage Assessment	

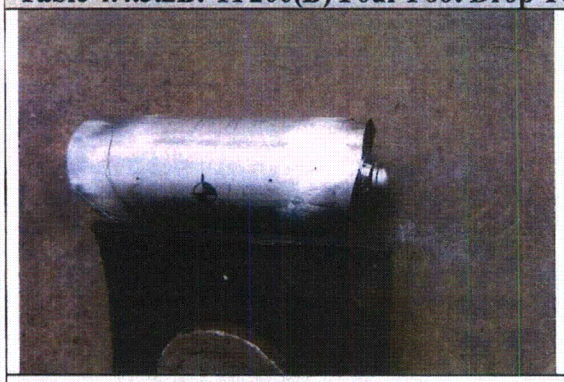
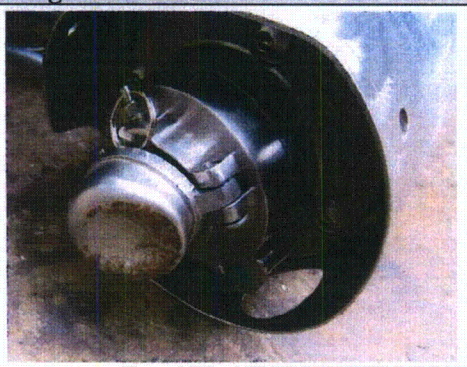

	

Figure 4.4.3.2C TP206(A) after drop	**Figure 4.4.3.2D TP206 Close Up**

Damage:

1. **As expected there was some minor damage to the cap.**
2. **The spring plunger was damaged.**
3. **The cap was open.**
4. **Source was secure.**
5. **The lock slide assembly was fully functional.**

4.4.3.3 1.2 Meter Free Drop Test – TP206(C) Results

Table 4.4.3.3A. TP206(C) Four Foot Drop Test Setup	
Drop Orientation	Test Plan 206 Figure 8.6.4.1
Test Specimen Weight	44.80 pounds
Actual Drop Height	56 Inches
Temperature during test	17.5°C (63.5°F)

Figure 4.4.3.3A TP206(C) Orientation

Figure 4.4.3.3B TP206(C) Drop Height

Table 4.4.3.3B: TP206(C) Four Foot Drop Test Damage Assessment

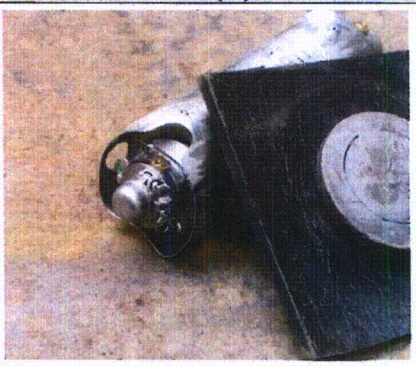


Figure 4.4.3.2C TP206(C) after drop

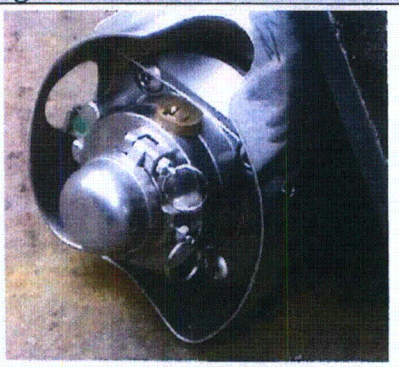


Figure 4.4.3.2D TP206(C) Close Up

Damage:

1. **Shell slightly bent on both ends**
2. **The lock slide assembly was fully functional.**

4.4.4 Radiation Profile Inspection

Tables 4.4.4.1A, 4.4.4.1B and 4.4.4.1C show the surface and one-meter radiation profile measurements taken on the three test specimen (TP206(A) thru TP206(C)). All measurements are factored for a maximum package capacity of 150 curies of Iridium-192. All units were tested with source model A424-9 / source serial number 99334B. Each unit was tested first with the source in the "Front" position and then in the "Rear" position. The opposing end was loaded with the shipping plug. Comparing the measurements of the pre-tested specimen with the tested specimens proves there is no significant change in the radiation levels on the package as a result of the normal conditions of transport testing.

In some cases the dose rates after testing varied more than 25% from the original survey readings. In most cases, the dose rates involved were very low, typically < 2 mR/hr. In these cases, a variance slightly more than 0.5 mR/hr in a post test profile is sufficient to produce a dose rate change of 25% from the initial pre-test profile readings.

A review of the effect of human error introduced by obtaining manual survey measurements for dose rate surveys has demonstrated that this manual process can produce a ±25% difference in measurements due to human variability alone. Factoring in the human error and comparing the results of the pre and post test survey readings and the fact that all post test surveys within the maximum allowed readings on the surface and at 1 meter from the package, it is argued that there was no significant increase in the radiation dose rate readings from the test specimens after performance of the normal condition transport tests.

	Table 4.4.4.1A Maximum Radiation for TP206(A)				
Specimen	**Maximum "Surface" Measurements**				**% Difference**
	Before		**After**		
	Dose mR/hr	**Location**	**Dose mR/hr**	**Location**	
TP206(A) Front Loaded Source	125.9	Top	130.1	Top	3
	139.1	Right	147.3	Right	6
	119.1	Bottom	122.7	Bottom	2
	130.4	Left	132.9	Left	2
	154.1	Front	137.3	Front	-12
	116.6	Rear	117.1	Rear	1
TP206(A) Rear Loaded Source	125.1	Top	124.3	Top	-1
	134.7	Right	132.9	Right	-1
	140.2	Bottom	136.8	Bottom	-2
	138.0	Left	129.8	Left	-6
	97.9	Front	115.4	Front	16
	148.0	Rear	150.7	Rear	2
Specimen	**Maximum "1 Meter" Measurements**				**% Difference**
	Before		**After**		
	Dose mR/hr	**Location**	**Dose mR/hr**	**Location**	
TP206(A) Front Loaded Source	.9	Top	1.0	Top	11
	.9	Right	1.1	Right	20
	1.0	Bottom	1.0	Bottom	0
	1.0	Left	1.0	Left	0
	2.1	Front	2.0	Front	-5
	2.2	Rear	2.2	Rear	0
TP206(A) Rear Loaded Source	.9	Top	1.0	Top	11
	1.0	Right	1.0	Right	0
	1.0	Bottom	1.1	Bottom	10
	.9	Left	1.0	Left	11
	2.5	Front	2.9	Front	15
	1.9	Rear	2.3	Rear	19

Specimen	Table 4.4.4.1B Maximum Radiation for TP206(B)				% Difference
	Maximum "Surface" Measurements				
	Before		After		
	Dose mR/hr	Location	Dose mR/hr	Location	
TP206(B) Front Loaded Source	145.5	Top	142.8	Top	-2
	163.5	Right	156.5	Right	-4
	149.4	Bottom	148.7	Bottom	0
	145.9	Left	148.3	Left	2
	157.4	Front	170.3	Front	8
	104.0	Rear	109.7	Rear	5
TP206(B) Rear Loaded Source	138.2	Top	140.7	Top	2
	138.8	Right	138.6	Right	0
	163.0	Bottom	164.0	Bottom	1
	149.3	Left	148.9	Left	0
	96	Front	138.8	Front	*36*
	136.9	Rear	136.9	Rear	0
Specimen	**Maximum "1 Meter" Measurements**				**% Difference**
	Before		**After**		
	Dose mR/hr	**Location**	**Dose mR/hr**	**Location**	
TP206(B) Front Loaded Source	.9	Top	1.0	Top	11
	1.2	Right	1.0	Right	-18
	1.2	Bottom	1.2	Bottom	0
	1.1	Left	1.0	Left	-10
	2.2	Front	1.9	Front	-15
	2.4	Rear	2.1	Rear	-13
TP206(B) Rear Loaded Source	.8	Top	.9	Top	10
	1.0	Right	1.1	Right	10
	1.1	Bottom	1.1	Bottom	0
	1.0	Left	1.0	Left	0
	2.4	Front	2.0	Front	-18
	2.0	Rear	2.0	Rear	0

	Table 4.4.4.1C Maximum Radiation for TP206(C)				
Specimen	**Maximum "Surface" Measurements**				**% Difference**
	Before		**After**		
	Dose mR/hr	**Location**	**Dose mR/hr**	**Location**	
TP206(C) Front Loaded Source	126.3	Top	141.7	Top	11
	139.9	Right	141.6	Right	1
	130.3	Bottom	140.7	Bottom	8
	139.4	Left	139.9	Left	0
	131.0	Front	137.2	Front	5
	99.7	Rear	109.7	Rear	10
TP206(C) Rear Loaded Source	120.9	Top	124.7	Top	3
	147.8	Right	155.9	Right	5
	138.1	Bottom	143.0	Bottom	4
	135.2	Left	139.6	Left	3
	89.0	Front	94	Front	6
	143.4	Rear	158.5	Rear	10
Specimen	**Maximum "1 Meter" Measurements**				**% Difference**
	Before		**After**		
	Dose mR/hr	**Location**	**Dose mR/hr**	**Location**	
TP206(C) Front Loaded Source	.9	Top	.9	Top	0
	1.1	Right	1.0	Right	10
	1.0	Bottom	1.0	Bottom	0
	1.0	Left	.9	Left	-11
	1.9	Front	2.3	Front	19
	1.9	Rear	2.4	Rear	***23***
TP206(C) Rear Loaded Source	1.0	Top	1.1	Top	10
	1.1	Right	1.1	Right	0
	1.1	Bottom	1.2	Bottom	9
	1.1	Left	1.1	Left	0
	1.7	Front	2.3	Front	***30***
	2.5	Rear	2.6	Rear	4

4.4.5 1.2 Meter Free Drop Test Assessment

The 1.2 meter free drop test was performed in accordance with test plan 206, 10 CFR 71, IAEA TS-R-1.

After the 1.2 meter free drop test, all test specimens continued to successfully meet the normal transport requirements of 10 CFR 71 and IAEA TS-R-1. As a result of the testing, there was no loss or dispersal of radioactive contents, no significant increase in external surface radiation levels and no substantial reduction in the effectiveness of the packaging.

Section 5 Post Test Assessment

The test results confirm the Model 880SC transport package complies with the normal transport test requirements of 10 CFR part 71 and IAEA TS-R-1. The test resulted in no loss or dispersal of radioactive contents, no significant increase in external surface radiation levels and no substantial reduction in the effectiveness of the packaging.

Appendix A: Test Specimen Documentation

Test Specimen Documentation

Test Specimen – 880SC-TP206				
Serial Number	Drawing Number & Revision	Attach IIRs	Attach NCR	Attach TMI
D11827	880SC-TP206(A)	✓	✓	✓
D11828	880SC-TP206(B)	✓	✓	✓
D11829	880SC-TP206(C)	✓	✓	✓
D11830	880SC-TP206(D)	✓	✓	✓

Signature	Print Name	Date
Engineering: PFL	PAUL BENSON	26 Sep 13
Regulatory: L. Pod	LORI PODLAR	26 Sep 13
Quality Assurance: M Fuller	MICHAEL FULLER	27 SEPT 2013

Appendix B: Radiation Profile Results

TP206(A) (s/n: D11827) – Front Load (FL) Radiation Profile Inspection

Pre NCT Test Profile Results

QSA GLOBAL

880 Auto-Profiler Data Form
Form F-Q-1816-1

880 Device Data	
Device s/n:	D11827FL
Model:	~~DELTA~~ 880SC
Shield Lot#:	1321000206
Shield Heat #:	C1286-D07
Ir-192 capacity (Ci):	150.00

Profile Source Data	
Source model:	424-9
Source s/n:	99334B
Isotope:	Ir-192
Source activity (Ci):	151.5
Assay date:	12 Sep 2013

Profile Process Data			
Profile Date:	25 Sep 2013	Profile ID:	D11827FL 9/25/2013 10:31:10 AM
Current Activity (Ci):	134.1	Surface Correction (front/rear):	1.171
Capacity Correction:	1.118	Surface Correction (sides):	1.171

Profile Results - in mR/hr				
	Surface Maximum Values	<= 200 mR/hr?	1 Meter Maximum Values	<= 2 mR/hr?
Top	125.9	Y	0.9	Y
Right	139.1	Y	0.9	Y
Bottom	119.9	Y	1.0	Y
Left	130.4	Y	1.0	Y
Front	154.1	Y	2.1	N
Rear	116.6	Y	2.2	N

Accept		Reject	

Profile Instrument Data					
Instrument Model:	M4612		Cal date:	2013-08-12	
Instrument s/n:	291495		Cal due date:	2013-11-12	
Right Contact s/n:	P3-1	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-2nd s/n:	P3-2	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-3rd s/n:	P3-3	Cal date:	2013-08-12	Cal due date:	2013-11-12
Left Contact s/n:	P3-4	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Side s/n:	PR319789	Cal date:	2013-11-12	Cal due date:	2013-11-12
1-Meter Rear s/n:	PR319787	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Front s/n:	PR319785	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-Ends s/n:	P3-8	Cal date:	2013-08-12	Cal due date:	2013-11-12

Inspector: _____ Date: 9/25/13 NCR #: _____

Comments: FL = Front Load
Unit 880SC - TP206 (A)

Notes:

TP206(A) (s/n: D11827) – Front Load (FL) Radiation Profile Inspection
Post NCT Test Profile Results

QSA GLOBAL

880 Auto-Profiler Data Form
Form F-Q-1816-1

880 Device Data			Profile Source Data	
Device s/n:	D11827FL	TPL	Source model:	424-9
Model:	~~DELTA 880SC~~	17NOV13	Source s/n:	99334B
Shield Lot#:	1321000206		Isotope:	Ir-192
Shield Heat #:	C1286-D07		Source activity (Ci):	151.5
Ir-192 capacity (Ci):	150.00		Assay date:	12 Sep 2013

Profile Process Data			
Profile Date:	30 Sep 2013	Profile ID:	D11827FL 9/30/2013 10:50:49 AM
Current Activity (Ci):	128.0	Surface Correction (front/rear):	1.171
Capacity Correction:	1.172	Surface Correction (sides):	1.171

Profile Results - in mR/hr				
	Surface Maximum Values	<= 200 mR/hr?	1 Meter Maximum Values	<= 2 mR/hr?
Top	130.1	Y	1.0	Y
Right	147.3	Y	1.1	Y
Bottom	122.7	Y	1.0	Y
Left	132.9	Y	1.0	Y
Front	137.3	Y	2.0	Y
Rear	117.1	Y	2.2	N

Accept		Reject	

Profile Instrument Data					
Instrument Model:	M4612		Cal date:	2013-08-12	
Instrument s/n:	291495		Cal due date:	2013-11-12	
Right Contact s/n:	P3-1	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-2nd s/n:	P3-2	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-3rd s/n:	P3-3	Cal date:	2013-08-12	Cal due date:	2013-11-12
Left Contact s/n:	P3-4	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Side s/n:	PR319789	Cal date:	2013-11-12	Cal due date:	2013-11-12
1-Meter Rear s/n:	PR319787	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Front s/n:	PR319785	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-Ends s/n:	P3-8	Cal date:	2013-08-12	Cal due date:	2013-11-12

Inspector: _____ Date: 9/30/13 NCR #: _____

Comments: FL = Front Load
unit 880SC-TP 206 A
Post Drop Test unit

Notes:

TP206(A) (s/n: D11827) – Rear Load (RL) Radiation Profile Inspection
Pre NCT Test Profile Results

QSA GLOBAL

880 Auto-Profiler Data Form
Form F-Q-1816-1

880 Device Data			Profile Source Data	
Device s/n:	D11827RL		Source model:	424-9
Model:	~~DELTA 880 SC~~	19 NOV 13	Source s/n:	99334B
Shield Lot#:	1321000206		Isotope:	Ir-192
Shield Heat #:	C1286-D07		Source activity (Ci):	151.5
Ir-192 capacity (Ci):	150.00		Assay date:	12 Sep 2013

Profile Process Data			
Profile Date:	25 Sep 2013	Profile ID:	D11827RL 9/25/2013 11:04:36 AM
Current Activity (Ci):	134.1	Surface Correction (front/rear):	1.171
Capacity Correction:	1.118	Surface Correction (sides):	1.171

Profile Results - in mR/hr

	Surface Maximum Values	<= 200 mR/hr?	1 Meter Maximum Values	<= 2 mR/hr?
Top	125.1	Y	0.9	Y
Right	134.7	Y	1.0	Y
Bottom	140.2	Y	1.0	Y
Left	138.0	Y	0.9	Y
Front	97.9	Y	2.5	N
Rear	148.0	Y	1.9	Y

Accept [ ] Reject [ ]

Profile Instrument Data

Instrument Model:	M4612		Cal date:	2013-08-12	
Instrument s/n:	291495		Cal due date:	2013-11-12	
Right Contact s/n:	P3-1	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-2nd s/n:	P3-2	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-3rd s/n:	P3-3	Cal date:	2013-08-12	Cal due date:	2013-11-12
Left Contact s/n:	P3-4	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Side s/n:	PR319789	Cal date:	2013-11-12	Cal due date:	2013-11-12
1-Meter Rear s/n:	PR319787	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Front s/n:	PR319785	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-Ends s/n:	P3-8	Cal date:	2013-08-12	Cal due date:	2013-11-12

Inspector: _____ Date: 9/25/13 NCR #: _____

Comments: RL = Rear Load
unit 880SC-TP206(A)

Notes:

TP206(A) (s/n: D11827) – Rear Load (RL) Radiation Profile Inspection
Post NCT Test Profile Results

QSA GLOBAL

880 Auto-Profiler Data Form
Form F-Q-1816-1

880 Device Data	
Device s/n:	D11827RL
Model:	~~DELTA~~ 880SC 19NOV13
Shield Lot#:	1321000206
Shield Heat #:	C1286-D07
Ir-192 capacity (Ci):	150.00

Profile Source Data	
Source model:	424-9
Source s/n:	99334B
Isotope:	Ir-192
Source activity (Ci):	151.5
Assay date:	12 Sep 2013

Profile Process Data			
Profile Date:	30 Sep 2013	Profile ID:	D11827RL 9/30/2013 11:32:26 AM
Current Activity (Ci):	128.0	Surface Correction (front/rear):	1.171
Capacity Correction:	1.172	Surface Correction (sides):	1.171

Profile Results - in mR/hr				
	Surface Maximum Values	<= 200 mR/hr?	1 Meter Maximum Values	<= 2 mR/hr?
Top	124.3	Y	1.0	Y
Right	132.9	Y	1.0	Y
Bottom	136.8	Y	1.1	Y
Left	129.8	Y	1.0	Y
Front	115.4	Y	2.9	N
Rear	150.7	Y	2.3	N

Accept		Reject	

Profile Instrument Data					
Instrument Model:	M4612		Cal date:	2013-08-12	
Instrument s/n:	291495		Cal due date:	2013-11-12	
Right Contact s/n:	P3-1	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-2nd s/n:	P3-2	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-3rd s/n:	P3-3	Cal date:	2013-08-12	Cal due date:	2013-11-12
Left Contact s/n:	P3-4	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Side s/n:	PR319789	Cal date:	2013-11-12	Cal due date:	2013-11-12
1-Meter Rear s/n:	PR319787	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Front s/n:	PR319785	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-Ends s/n:	P3-8	Cal date:	2013-08-12	Cal due date:	2013-11-12

Inspector: _____ Date: 9/30/13 NCR #: _____

Comments: RL = Rear Load
unit 880SC-TP206A
Post Drop Test unit

Notes:

TP206(B) (s/n: D11828) – Front Load (FL) Radiation Profile Inspection

Pre NCT Test Profile Results

QSA GLOBAL

880 Auto-Profiler Data Form
Form F-Q-1816-1

880 Device Data	
Device s/n:	D11828FL
Model:	~~DELTA~~ 880 SC 15 NOV 13
Shield Lot#:	1321000206
Shield Heat #:	C1286-D09
Ir-192 capacity (Ci):	150.00

Profile Source Data	
Source model:	424-9
Source s/n:	99334B
Isotope:	Ir-192
Source activity (Ci):	151.5
Assay date:	12 Sep 2013

Profile Process Data			
Profile Date:	25 Sep 2013	Profile ID:	D11828FL 9/25/2013 12:09:27 PM
Current Activity (Ci):	134.1	Surface Correction (front/rear):	1.171
Capacity Correction:	1.118	Surface Correction (sides):	1.171

Profile Results - in mR/hr				
	Surface Maximum Values	<= 200 mR/hr?	1 Meter Maximum Values	<= 2 mR/hr?
Top	145.5	Y	0.9	Y
Right	163.5	Y	1.2	Y
Bottom	149.4	Y	1.2	Y
Left	145.9	Y	1.1	Y
Front	157.4	Y	2.2	N
Rear	104.0	Y	2.4	N

Accept		Reject	

Profile Instrument Data					
Instrument Model:	M4612		Cal date:	2013-08-12	
Instrument s/n:	291495		Cal due date:	2013-11-12	
Right Contact s/n:	P3-1	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-2nd s/n:	P3-2	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-3rd s/n:	P3-3	Cal date:	2013-08-12	Cal due date:	2013-11-12
Left Contact s/n:	P3-4	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Side s/n:	PR319789	Cal date:	2013-11-12	Cal due date:	2013-11-12
1-Meter Rear s/n:	PR319787	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Front s/n:	PR319785	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-Ends s/n:	P3-8	Cal date:	2013-08-12	Cal due date:	2013-11-12

Inspector: _____ Date: 9/25/13 NCR #: _____

Comments: FL = Front Load
unit 880SC-TP206(B)

Notes:

TP206(B) (s/n: D11828) – Front Load (FL) Radiation Profile Inspection

Post NCT Test Profile Results

QSA GLOBAL

880 Auto-Profiler Data Form
Form F-Q-1818-1

880 Device Data	
Device s/n:	D11828FL
Model:	~~DELTA 880 SC~~ 19 NOV 13
Shield Lot#:	13210000206
Shield Heat #:	C1286-D09
Ir-192 capacity (Ci):	150.00

Profile Source Data	
Source model:	424-9
Source s/n:	99334B
Isotope:	Ir-192
Source activity (Ci):	151.5
Assay date:	12 Sep 2013

Profile Process Data			
Profile Date:	30 Sep 2013	Profile ID:	D11828FL 9/30/2013 12:54:33 PM
Current Activity (Ci):	128.0	Surface Correction (front/rear):	1.171
Capacity Correction:	1.172	Surface Correction (sides):	1.171

Profile Results - in mR/hr				
	Surface Maximum Values	<= 200 mR/hr?	1 Meter Maximum Values	<= 2 mR/hr?
Top	142.8	Y	1.0	Y
Right	156.5	Y	1.0	Y
Bottom	148.7	Y	1.2	Y
Left	148.3	Y	1.0	Y
Front	170.3	Y	1.9	Y
Rear	109.7	Y	2.1	N

Accept		Reject	

Profile Instrument Data					
Instrument Model:	M4612			Cal date:	2013-08-12
Instrument s/n:	291495			Cal due date:	2013-11-12
Right Contact s/n:	P3-1	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-2nd s/n:	P3-2	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-3rd s/n:	P3-3	Cal date:	2013-08-12	Cal due date:	2013-11-12
Left Contact s/n:	P3-4	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Side s/n:	PR319789	Cal date:	2013-11-12	Cal due date:	2013-11-12
1-Meter Rear s/n:	PR319787	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Front s/n:	PR319785	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-Ends s/n:	P3-8	Cal date:	2013-08-12	Cal due date:	2013-11-12

Inspector: _____ Date: 9/30/13 NCR #: _____

Comments: FL = Front Load
Unit 880SC = TP206 B
Post Drop Test unit

Notes:

TP206(B) (s/n: D11828) – Rear Load (RL) Radiation Profile Inspection
Pre NCT Test Profile Results

QSA GLOBAL

880 Auto-Profiler Data Form
Form F-Q-1816-1

880 Device Data	
Device s/n:	D11828RL
Model:	~~DELTA 880 SC~~ 15NOV13
Shield Lot#:	1321000206
Shield Heat #:	C1286-D09
Ir-192 capacity (Ci):	150.00

Profile Source Data	
Source model:	424-9
Source s/n:	99334B
Isotope:	Ir-192
Source activity (Ci):	151.5
Assay date:	12 Sep 2013

Profile Process Data			
Profile Date:	25 Sep 2013	Profile ID:	D11828RL 9/25/2013 2:32:03 PM
Current Activity (Ci):	134.1	Surface Correction (front/rear):	1.171
Capacity Correction:	1.118	Surface Correction (sides):	1.171

Profile Results - in mR/hr				
	Surface Maximum Values	<= 200 mR/hr?	1 Meter Maximum Values	<= 2 mR/hr?
Top	138.2	Y	0.8	Y
Right	138.8	Y	1.0	Y
Bottom	163.0	Y	1.1	Y
Left	149.3	Y	1.0	Y
Front	96.0	Y	2.4	N
Rear	136.9	Y	2.0	Y

Accept		Reject	

Profile Instrument Data					
Instrument Model:	M4612			Cal date:	2013-08-12
Instrument s/n:	291495			Cal due date:	2013-11-12
Right Contact s/n:	P3-1	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-2nd s/n:	P3-2	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-3rd s/n:	P3-3	Cal date:	2013-08-12	Cal due date:	2013-11-12
Left Contact s/n:	P3-4	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Side s/n:	PR319789	Cal date:	2013-11-12	Cal due date:	2013-11-12
1-Meter Rear s/n:	PR319787	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Front s/n:	PR319785	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-Ends s/n:	P3-8	Cal date:	2013-08-12	Cal due date:	2013-11-12

Inspector: _____ Date: 9/25/13 NCR #: _____

Comments: RL = Rear Load
Unit 880SC-TP206(B)

Notes:

TP206(B) (s/n: D11828) – Rear Load (RL) Radiation Profile Inspection
Post NCT Test Profile Results

QSA GLOBAL

880 Auto-Profiler Data Form
Form F-Q-1816-1

880 Device Data	
Device s/n:	D11828RL
Model:	~~DELTA~~ 880SC 9/30/13
Shield Lot#:	1321000206
Shield Heat #:	C1286-D09
Ir-192 capacity (Ci):	150.00

Profile Source Data	
Source model:	424-9
Source s/n:	99334B
Isotope:	Ir-192
Source activity (Ci):	151.5
Assay date:	12 Sep 2013

Profile Process Data			
Profile Date:	30 Sep 2013	Profile ID:	D11828RL 9/30/2013 1:37:03 PM
Current Activity (Ci):	128.0	Surface Correction (front/rear):	1.171
Capacity Correction:	1.172	Surface Correction (sides):	1.171

Profile Results - in mR/hr				
	Surface Maximum Values	<= 200 mR/hr?	1 Meter Maximum Values	<= 2 mR/hr?
Top	140.7	Y	0.9	Y
Right	138.6	Y	1.1	Y
Bottom	164.0	Y	1.1	Y
Left	148.9	Y	1.0	Y
Front	138.8	Y	2.0	N
Rear	136.9	Y	2.0	Y

Accept		Reject	

Profile Instrument Data					
Instrument Model:	M4612		Cal date:	2013-08-12	
Instrument s/n:	291495		Cal due date:	2013-11-12	
Right Contact s/n:	P3-1	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-2nd s/n:	P3-2	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-3rd s/n:	P3-3	Cal date:	2013-08-12	Cal due date:	2013-11-12
Left Contact s/n:	P3-4	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Side s/n:	PR319789	Cal date:	2013-11-12	Cal due date:	2013-11-12
1-Meter Rear s/n:	PR319787	Cal date:	2013-08-12	Cal due date:	2013-11-12
1-Meter Front s/n:	PR319785	Cal date:	2013-08-12	Cal due date:	2013-11-12
Contact-Ends s/n:	P3-8	Cal date:	2013-08-12	Cal due date:	2013-11-12

Inspector: _____ Date: 9/30/13 NCR #: _____

Comments: RL = Rear Load
unit 880SC - TP206B
Post Drop Test unit

Notes: