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Test Report
Performance Evaluation Test Series Of
Century Industries' Model VP-55
Versa-Pac Shipping Container

US NRC Docket Number 71-9342

Test Conducted in Accordance with Test Plan TP-002 Revision 0
And
Test Specification TS-002 Revision 0
Prepared & Conducted By:
Century Industries
William M. Arnold

Prepared By: _Signature on File - WMA_____ Date: _September 25, 2009_

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1.0 INTRODUCTION

This Report describes the methods and guidelines Century Industries followed for the preparation and testing of the Versa-Pac Shipping Container in accordance with the requirements specified in Century Industries Test Plan TP-002 Revision 0 and Century Industries Test Specification TS-002 Revision 0 (Attachment A and B). The test program was conducted by Century Industries located in Bristol, Virginia between September 23 and September 25, 2009. This report includes the program objective, test procedure, item description, test results, test records (Attachment C) and other applicable documents including photographs of the testing.

2.0 OBJECTIVE

The objective of this test program was to conduct the accelerated shallow angle drop (slap-down) physical performance evaluation tests for Century Industries VP-55, Versa-Pac Shipping Container to provide additional information and demonstrate the capabilities of the 55 gallon version to meet the requirement in accordance with the normal conditions and hypothetical accident conditions specified in Title 10 Part 71.73 [1], Test Plan TP-002 Revision 0 and Test Specification TS-002 Revision 0.

The test item was identified as 55 gallon Versa-Pac shipping container prototype and subjected to the following performance tests:

1. Initial visual inspection of the outer and inner container surfaces.

2. Drop testing in accordance with 10 CFR 71.71(c)(7), Shallow Angle Drop, 71.73 (c)(3), Puncture Drop, along with NUREG 6818, 30‘ Shallow Angle Drop.

3. Post Test Visual Inspection of the outer and interior container surfaces.

Following each test the physical condition of the shipping container was inspected and the results recorded.

3.0 RESPONSIBILITIES

Century Industries personnel conducted the test program and were responsible for the base analysis of the test articles, the test plan and oversight of the test series. All test personnel completed the Pre-test Readiness Review and associated procedures.

The test series was performed in accordance with the applicable requirements and guidance of Century Industries QA Program QA-1 Revision 1, 10 CFR 71 and this test plan.

The program manager was William M. Arnold, President of Century Industries who also acted as the Quality Assurance Coordinator for the test series.

4.0 TEST ITEM IDENTIFICATION

Century Industries was responsible for the design, fabrication, inspection, recording the preliminary measurements and the loading of payload and payload containers with multiple size gravels, steel bars and loose sand.

5.0 TEST ITEM DESCRIPTION

The Versa-Pac Shipping Container is designed for the shipment of Type A radioactive and fissile materials in the form U-metal, oxides, fluorides and nitrate for both product and scrap materials. The fissile payload was design for 350 grams at 100% enrichment and a criticality safety index of 1.5.

The Versa-Pac Shipping Container was designed in two basic versions, a UN1A2 -55 gallon and 110 gallon outer drum with a 16 gauge body, bottom and cover, in addition to the standard 12 gauge closure ring with a 5/8" ASTM A307 bolt, the cover is reinforced and secured using the addition of bolts attached to the internal structure of the package as detailed in the design drawings. The internal structure consists of vertical and horizontal stiffeners at specific points around the package. Outer and inner 16 gauge liners, with an insulating ceramic fiber blanket between the liners complete the primary inner structural components. A secondary barrier of insulation consisting of ceramic fiber blanket; surround the inner containment body. The payload gasket is a woven fiberglass yarn in a flexible substrate, coated with high grade silicone rubber. The gasketed payload containment cavity is made of 10 gauge body and bottom with a ¼" thick top flange to which in the initial series of testing, a 1/2" thick top flange was secure using 12 -1/2" bolts. The payload cavity is attached to the internal structural components by use of a bolted connection through a fiberglass thermal break between the payload cavity and the structure. Closed cell polyurethane foam is utilized to provide insulation and added impact protection, to both the top and bottom of the Versa-Pac. The top insulation plug is encapsulated in sheet metal welded to the outer drum closure lid. Plastic plugs enclosed within the body of the structure provide a path for venting to the external acetate plug on the exterior of the drum. The cavity is designed to be loaded directly or with the use of an insert to reduce the diameter or with up to a 30 gallon standard drum in the 110 gallon version.

The Versa-Pac was designed in accordance with the requirements of 10 CRF 71 [1] and Century Industries – QA-8, Plan for Manufacture of Versa-Pac Shipping Containers [2].

Pre-Test Photographs 55 Gallon Version

55 Gallon - Outer Side Top View

55 Gallon - Internal Loaded View

55 Gallon – Blind Flange Bolted

55 Gallon - Top Closure Side View

55 Gallon Version - Side View

6.0 TEST FACILITES & EQUIPMENT

6.1 Environmental Conditioning

The test series was conducted at ambient air temperatures.

6.2 Drop Test Pad Facilities

The drop test pad consists of a 70 ton concrete pad made in accordance with IAEA Safety Series No. 37. The pad is 10 feet wide by 10 feet long by 10 feet deep, reinforced with a grid of ¾ inch re-bar spaced on 12 inch centers and capped with a 1 inch thick by 8 feet wide by 10 feet long carbon steel plate, which is embedded into the surface of the concrete and secured by fourteen 1-1/2 inch diameter bolts by 16 inches long.

6.3 Release Device

The release device utilized was capable of releasing the package in a manner that provided a smooth clean drop without imparting any twisting or turning of the package. The device has a safe working load limit of 18,000 pounds. The test articles were lifted into place by use of a crane.

6.4 Orientation and Angles

The orientation if each drop was controlled by the use of nylon fixed straps and adjustable straps used to set the angles required. The orientation of the container was verified using a magnetic protractor attached to the test article surface.

6.5 Measurements and Weights

Drop heights were determined by use of a pre-measured plumb line set by a 100 foot steel tape measure Serial Number 08461846, calibrated by Starett Company and traceable to NIST. The test items tare and payload weights were made using a set of scales calibrated by Carlton Scales, Kingsport, Tennessee.

6.6 Temperature and Wind Speed

Surface and air temperatures were obtained using calibrated surface gauge Serial Number 05548 with a range of -100°F to +160°F and Dickson Temperature Recorder Model SM320 and traceable to NIST. Wind speed was obtained thru the local metro airport service**.**

6.7 Puncture Device

The puncture device consist of a 6 inch diameter by 22 inches long carbon steel round bar welded to a ¾ inch thick plate, which was then secured to the drop test pad by means of tack welding to the center of the pad.

6.8 Photographic Equipment

Color photographs were taken with a Sony 4.1 Mega pixel digital camera by Century Industries

7.0 EQUIPMENT AND INSTRUMENT CALIBRATION

All applicable test and measurement equipment were calibrated in accordance with Century Industries Quality Assurance Program. Test and measurement calibration certificates are found in Attachment E. The instrumentation used during testing is listed in Table 1 below.

ITEM	MODEL	S/N	CALIBRATION DUE DATE	COMENTS
Starett 100' Tape Measure	N/A	08461846	November 17, 2009	Used to measure length of plumb bob drop heights
Dickson Temperature Recorder	SM320	09057179	February 01, 2009	Used to calibrate surface thermometer and record air temperature
PTC Instruments Surface Thermometer	330F	05548	July 09, 2009	Used to measure the temperature of the test articles during the conditioning
Floor Scale	0-300 Pound	98530806V1812	February 15, 2009	Used to measure the weight of the payload
Elizabethton Airport	N/A	N/A	N/A	Used to check wind speed
Protractor	N/A	N/A	N/A	Used to measure angles, Calibration not required
4 ' Level	N/A	N/A	N/A	Used as straight edge for measurements
Plumb Bob 30', 4' & 1 Meter Drop height	N/A	N/A	N/A	Used during drop series length determined by calibrated tape

Table 1 – Test Instruments

8.0 ACCEPTANCE CRITERIA

The acceptance criteria for this series of testing was retention of the outer closure, no openings, tears or failure that would lead to loss of materials, no open pathway to the insulation materials and no loss of the inner containment payload.

9.0 TEST PREPARATION AND RESULTS

9.1 Initial Inspection

On September 23, 2009, the visual inspection of the test item was conducted prior to performing any of the physical evaluation tests. During the inspection no damage was found to the exterior or interior surface of the shipping containers. Measurements were taken and recorded on all test articles.

Test Article Serial Number 10553

Location	Pre-Test Measurement	Description
A-C	15” ID	Inner Container
A-C	23-1/2” Ø	Outer Container
A	34”	Drum Height
A	2-1/8”	Wall – In/Out
A	4-1/4”	Inside Container/Outside
A	4-1/8”	Top Rim – Inside Top Flange
B	33-15/16”	Drum Height
B	4”	Top Rim – Inside Top Flange
B	2-1/16”	Wall – In/Out
B	4-1/4”	Inside Container/Outside
B-D	15” ID	Inner Container
B-D	23-5/8”Ø	Outer Container
C	4-1/4”	Inside Container/Outside
C	2-3/16”	Wall – In/Out
C	34”	Drum Height
C	4”	Top Rim – Inside Flange
D	4-3/16”	Inside Container/Outside
D	33-15/16”	Outer Container
D	4-1/8”	Top Rim – Inside Flange
D	2-1/4”	Wall – In/Out

9.2 Weights and Payload

The package tare weight was recorded on the individual test record. In order to provide the test articles with the most aggressive challenge to the inner payload containment of the Versa-Pac it was decided to use contents of multiple size gravel, steel bar and sand. The materials once place into the containment are partially filled the containment. The payload provided a secondary piston action occurring from the payload materials to containment flange impact. 1-1/2 pounds of loose sand was place within the containment area in order to provide content material capable of breaching the containment flange seal.

Item/Serial Number	**10553**
Package Tare Weight	390
Payload Drum/Gravel and Sand	253
Loose Sand Weight	1.5
Total	**644.5 lbs.**

9.3 Loading of the Test Item

The 1/8" thick silicone coated fiberglass gasket and 1/2" thick containment flange were placed into position and the bolts inserted and hand tightened. The flange bolts were then tightened using an alternating method and torqued to 60 ft/lbs. The top gasket and outer closure, which includes the attached encased polyurethane foam insulation top plug, was installed on the test article and the top outer bolts installed and torqued using the same alternating method to a tension of 60 ft/lbs. The outer drum closure ring was then installed and tightened to a torque of 60 ft/lbs.

Containment Loaded With 254-1/2 Pounds of Loose Gravel

Bolted Inner Blind Flange and Top Gasket

Side View – 55 Gallon Acetate Plug

9.4 Test Article Temperature

To measure the temperature a calibrated surface thermometer was placed on the surface of the test articles and at time of the test the test article temperature was 89°F.

10.0 DROP TEST SEQUENCES

The drop test sequences were chosen to provide additional information for the Versa-Pac application and support for the previous NCT and HAC drop test series reported on March 25, 2009, Appendix 2.12.2 and the original prototype testing results are included in Attachment D. The test article was produced in accordance with the fabrication drawings and QA-8, plan for the Manufacture of Versa-Pac Shipping Containers. The test article was tested in accordance with Century Industries Test Plan TP-002 Revision 0.

11.0 TEST PACAKGE SERIAL NUMBER 10553 – TEST RECORD TS-002-1

11.1 Test Number 1-55-A – NCT - 4’ Shallow Angle Accelerated Drop (Slap-Down)

The drop test performance evaluation describe in the Test Plan TP-0002 Revision 0 was performed with the undamaged Versa-Pac Shipping Container. Test Configuration 1-55-A was a 4’ shallow angle accelerated free drop onto the bolted closure end of the test article at an angle of 17 degrees from horizontal. The air temperature at the start of this series was 90°F and wind speed was 2 mph. The test article was suspended from a crane by use of a sling connected to the release mechanism. It was lifted above the test pad so that the lowest point of the package was at 4 feet above the top surface of the test pad.

NCT 55-Gallon 17 Degree Angle

Side View 4' Shallow Angle Set-up

The test article was released so that it did not impart rotational motion into the package free fall to the test pad.

End View- NCT 4' Set-up

Post Drop Damage to Bolt End Impact Area

View of Long Side Post Impact

View of Bottom End Post Impact

The container impact on to the test pad surface and produced a 7-1/4" long x ¼" deep indentation at the rim on the top drum closure ring with no openings or tearing. The long impact side showed only minor indentations along the length of the container. The bottom secondary impact produced a 5-3/4" long x ¼" deep flat area at the bottom edge of the outer package wall. No other damage was noted. Measurements and photographs were taken showing the extent of the damage.

There were no tears or openings to the drum surface. All bolts remained in tact.

11.2 Test Number 1-55-B – HAC 30' Shallow Angle Accelerated Drop (Slap-Down)

Configuration 1-55-B was a free drop in the shallow angle configuration onto the same impact area thru the bolted closure end of the previously used test article from test number 1-55-A from a height of 30 feet-1-1/2 inch from the lowest point of the package to the test pad surface. It was positioned at an angle of 17 degrees from the horizontal. The air temperature at the start of this series was 90°F and wind speed was 2 mph. The test article was suspended from a crane by use of a sling connected to the release mechanism. It was lifted above the test pad in the shallow angle accelerated drop orientation to appropriate height listed above. The test article was released so that it did not impart rotational motion into the package free fall to the test pad. Measurements and photographs were taken showing the extent of damage.

Shallow Angle Accelerated 30' HAC Drop Position

Side View of HAC 30' Shallow Angle Accelerated Drop Position

Upon impact to the top end of the package the flat area at the outer drum lid closure to drum body rim was increased to a length of 11-1/2" x 3/8" deep from the previous NCT impact. The package remained sealed and closed with no opening. A small tear in the outer drum sidewall material occurred due to the impact of the drum ring closure lug/bolt impact on to the outer drum rolling hoop (top swedge), but due to the design of the Versa-Pac's inner liner, which is in contact with the outer drum wall, there was no damage to the inner liner and no breach of the package integrity. The secondary impact increased the damaged area along the bottom edge to a length of 10" x ¼" deep in the same location as the previous NCT drop. Although the closure ring had a lug break all bolts on the reinforced top remained in tact and secure.

End View – Top End Damage

End View – Bottom End Damage

Impact Damage to Closure End

Close-up of Closure End Damage

Close-up of Closure End Damage

Close-up of Sealed Lid to Package Interface

11.3 Test Number 1C – HAC 1 Meter Puncture Drop – Center of Gravity thru the Bolted Closure

Configuration 1-55-C was a puncture drop from a height of 41 inches from the lowest point of the package top closure to the top of the puncture ram, this impact location was chosen due to the previous damage incurred during the accelerated impact drops as the area most vulnerable to the puncture drop. The package was suspended by use of nylon straps which were attached to the release mechanism at a height of 41 inches measured from the lowest point of the package to the top of the puncture ram. The angle of orientation was 56-1/2 degrees from the horizontal position. The air temperature was 90°F and the wind speed was 2 mph. The test package was released so as not to impart rotation motion to the test article free fall to the impact point of the puncture ram.

Center of Gravity – Puncture Drop Positioned over the Puncture Ram

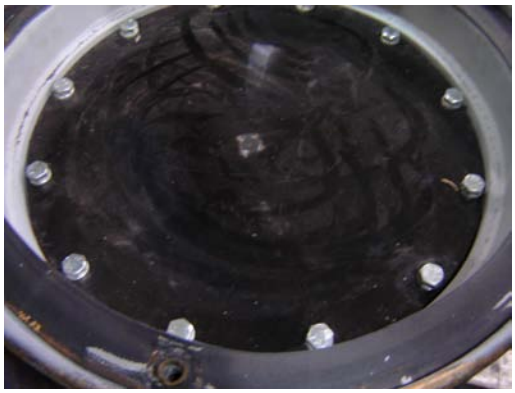
Upon impact the deformation to the impact area of the test article was measured at showing an affect area of 8-3/8” wide with a diameter of 23” at the top of the closure area. There were no tears or opening of the package as a result of the puncture drop.

Puncture Impact Damage – No Opening

As a result of this test series the outer closure bolts recorded a post test torque of 42 to 55 ft/lbs with the bolt at the impact area at 49 ft/lbs. The outer lid was removed and no loss of containment or damage to the inner containment blind flange was found. The bolt torque of the inner blind flange was found to have a range between 30-50 ft/lbs. The gaskets and the internal cavity of the containment were found to be in good condition with no damage.

Side View - Damage from Impact of Bolt Lug onto Side Wall

Top View of Package Prior to Opening



Inner Containment Blind Flange

Top End Impact Area Damage

View of Damage to Top Closure

View of Outside Impact Area

Post Test View of Test Payload

Post Test View of Inner Containment

Post Test View of Inner Containment

12.0 POST TEST MEASEUREMENTS

On September 24, 2009, the post test inspection and measurements were taken and recorded on all test articles.

Test Article Serial Number 10553

Location	Post-Test Measurement	Description
A-C	14-15/16” ID	Inner Container
A-C	23” Ø	Outer Container
A	33-15/16”	Drum Height
A	2-1/8”	Wall – In/Out
A	4-5/16”	Inside Container/Outside
A	4-1/4”	Top Rim – Inside Top Flange
B	34”	Drum Height
B	4-1/8”	Top Rim – Inside Top Flange
B	2”	Wall – In/Out
B	4-1/8”	Inside Container/Outside
B-D	15” ID	Inner Container
B-D	23-1/2”Ø	Outer Container
C	4-5/16”	Inside Container/Outside
C	2-7/16”	Wall – In/Out
C	33-5/8”	Drum Height
C	3-15/16”	Top Rim – Inside Flange
D	4-1/4”	Inside Container/Outside
D	33-15/16”	Outer Container
D	4-1/8”	Top Rim – Inside Flange
D	2-1/8”	Wall – In/Out

Final Tare Weight – 390 Pounds
Final Gross Weight – 644-1/2 Pounds

13.0 Results and Conclusions

The objective of this test program was to conduct additional physical evaluation testing of Century Industries 55 gallon version of the Versa-Pac Shipping Container design in accordance with the Normal Conditions of Transport (NCT) and the Hypothetical Accident Conditions (HAC) specified in 10 CFR 71 and Century Industries Test Plan TP-002 Revision 0 to verify the performance capabilities under specified conditions. The 55 gallon Versa-Pac was subjected to performance test simulating normal conditions testing and hypothetical accident condition for shallow angle and puncture described in NUREG 6818, 10 CFR 71.71 and 73. Following each test, the physical condition of the test package was inspected and the results were recorded and photographed.

The acceptance criteria for the all testing was retention of the outer closure, no openings, tears or failure that would lead to loss of material, no open pathways to the insulation materials and no loss of the inner containment payload.

Along with previous preliminary testing of the Versa-Pac shipping container and with the completion of the shallow angle (accelerated slap –down) drops, the results of this series of tests demonstrate that the 55 gallon version is capable of meeting the requirements set forth in 10 CFR 71 and Century Industries Test Plan TP-0002 Revision 0.

14.0 ATTACHMENTS & CALIBRATION RECORDS

Attachment A – Test Plan TP-002 Revision 0
Attachment B – Test Specification TS-001-2 Revision 0
Attachment C – Century Industries NCT and HAC Test Record
Attachment E – Training & Calibration Records

NOTE: The last paragraph of this report was amended January, 2010 by the author.

Attachment A

Test Plan TP-002 Revision 0

(Consisting of 14 pages)

Century Industries
Bristol, Virginia 24209

Versa-Pac Shipping Container
Test Plan
TP-002 Revision 0

US NRC Docket No. 71-9342

Prepared By:
Century Industries
William M. Arnold

Prepared By: William M. Arnold – Signature of File Date: September 1, 2009

Reviewed By: Heather Little – Signature on File Date: September 1, 2009

Proprietary Information Notice

A-1

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Record of Revision

Revision No.	Description of Revision	Date
0	Original Issue	09-01-09

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Table of Contents

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1.0 INTRODUCTION

Century Industries Versa-Pac Shipping Container is designed for the shipment of Type A radioactive and fissile materials in the form of U-metal oxides, fluorides and nitrates for both product and scrap materials. The fissile payload was design for 350 grams at 100% enrichment and a criticality safety index of 0.9.

The Versa-Pac Shipping Container was designed in two basic versions, a UN1A2 - 55 gallon and 110 gallon outer drum with a 16 gauge body, bottom and cover, in addition to the standard 12 gauge closure ring with a 5/8" ASTM A307 bolt, the cover is reinforced and secured using the addition of bolts attached to the internal structure of the package as detailed in the design drawings. The internal structure consists of vertical and horizontal stiffeners at specified points around the package. Outer and inner 16 gauge liners, with an inner insulating ceramic fiber blanket between the liners complete the primary inner structural components. A secondary barrier of insulation consisting of ceramic fiber blankets; surround the inner containment body. The payload gasket is a woven fiberglass yarn in a flexible substrate, coated with a high grade silicone rubber. The gasketed payload containment cavity is made of 10 gauge body and bottom with a ½" thick top flange to which a 3/16" top cover is secured using 12 – ½" bolts. The payload cavity is attached to the internal structural components by use of a bolted connection through a fiberglass thermal break between the payload cavity and the structure. Closed Cell Polyurethane foam is utilized to provide insulation and added impact protection, to both the top and bottom of the Vera-Pac. Plastic plugs enclosed within the body of the structure provide a path for venting to external acetate vent plug on the exterior of the drum. The cavity is designed to be loaded directly or with the use of an insert to reduce the inside diameter or with up to a 30 gallon drum.

It was designed in accordance the requirements of 10 CFR Part 71 [1]] and Century Industries – QA-8 Plan for Manufacture of Versa-Pac Shipping Containers [2].

In order to resolve concerns regarding the ability of the 55 gallon version to successfully meet the HAC test conditions including the slap-down (shallow angle) drop orientation Century Industries is conducting an additional test series consisting of a three foot center of gravity drop, 30 foot center of gravity drop, along with a slap-down (accelerated drop) from a height of 30 feet.

2.0 SCOPE AND OBJECTIVE

2.1 Scope

This test plan describes the methods, guidelines and requirements that are to be utilized during the performance of the task described in this procedure.

2.2 Objective

The objective of this test plan is to provide the requirements for a series if physical test to demonstrate the performance capabilities of the 55 gallon Versa-Pac Shipping Container to supplement Century Industries, Safety Analysis Report under Docket Number 71-09342, in satisfying the requirements of 10 CFR 71 [1], Century Industries – Test Specification TS-0001 [3] and this test plan for both normal and hypothetical accident conditions of transport.

The primary objectives of this test plan are as follows:

1. Define the responsibilities of the personnel performing the drop test series.
2. Define the general requirements
3. Define the test sequences that will be performed.
4. Define the required configurations for each test.
5. Define the required pre-test and post test measurements.
6. Define the data acquisition requirements for each test.
7. Define the documentation requirements.

3.0 RESPONSIBILITIES

Century Industries has the overall responsibility for the test program and is responsible for the design and analysis of the test articles, development of the test specification, the test plan and oversight of the Versa-Pac test series. Century Industries is also responsible for the procurement, fabrication and inspection of the test articles. The test series will be performed in accordance with the applicable requirements of Century Industries QA Program QA-1 [4], Test Specification TS-001 [3] and this test plan.

Individual responsibilities include the following:

1. Test Program Manager: This individual is responsible for the overall management and implementation of the test program. The Test Manager has the authority to resolve any question that may arise between members of the team.
2. Test Engineer: This individual is responsible for preparation of the equipment and facilities required to conduct the testing. They are also responsible for the both the pre-test and post test measurements and documentation.
3. Quality Assurance: This individual; is responsible for the QA oversight and witness of the test series

4.0 TEST SEQUENCES

Based upon preliminary prototype testing of both the 55 and 110 gallon versions, testing indicated that the 110 gallon version would bind the 55 gallon Versa-Pac version. Three prototypes were fabricated for the test series. All test articles were tested using a 30 gallon drum containing 250 pounds of the test media, placed within the inner package cavity, a residual amount of sand was placed into the inner cavity so that some material would face the possibility of release from within the inner cavity to the external surface of the package between the inner and outer closures. The inner drum was being utilized to simulate a piston action within the inner containment cavity of the test articles. Upon completion and adjustments to the 110 gallon version all test series were successful in meeting the requirements set-forth in the original test program. After initial review and questions regarding the lack of an accelerated drop in the preliminary testing previously conducted and used to establish reasoning for use of the 110 gallon version to bind the 55 gallon package a test sample previously fabricated will be prepared to conduct the testing described within the following sections of this test plan. The 55 gallon test package will be loaded with 250 pounds of test media in the payload area of the package.

The test series is planned, as shown in Table 1 below to verify satisfactory compliance with 10 CFR 71 [1] and this plan:

4.1 Test Series No. 1-55 – NCT & HAC Shallow Angle Drop

This series will include an NCT shallow angle drop and one HAC shallow angle drop. During this test surfaces are to be examined and measured and the damage recorded between drops.

Note: A Puncture Test will be conducted on one of the test packages based upon initial drop damage.

Table 1 –Planned Test Sequences

Package Number	Test Number	Test Description	Test Objective
1-55	1-55-A	NCT 4' Shallow Angle Accelerated Drop	Evaluate the Damage From an Accelerated Shallow Angle Drop
	1-55-B	HAC 30' Shallow Angle Accelerated Drop	Evaluate the Damage From an Accelerated Shallow Angle Drop
To Be Determined	1-55-C	HAC 1 Meter Puncture Drop	Evaluate & Attack a Vulnerable Area

Notes:

1. All NCT Drops are from a height of 4' feet, HAC drops are from a height of 30 feet and all puncture drops are from a height of 40 inches. Distance measured from the lowest point of the package to the test pad surface.
2. All tests are conducted at the ambient air temperature.

5.0 TEST SERIES REQUIREMENTS

5.1 General Requirements

5.1.1 Quality Assurance

All testing shall be witnessed using the Quality Assurance oversight as required in the test specification.

5.1.2 Rigging

Rigging methods shall be chosen such that the test article is lifted in the correct inclination and orientation as necessary. Rigging locations shall be positioned so as not to interfere or affect the performance or response of the Versa-Pac during the test series.

5.1.3 Measuring and Equipment

The guidelines for measurement and test equipment are described in the Test Specification TS-001 []. All items that require calibration shall be conducted against a certified known that are referenced to the National Institute of Standards and Technology (NIST), for scales the applicable state standards and bureaus are acceptable. Where such standards do not exist, the basis for the calibration shall be documented.

Height measurements may be established using either; a pre-measured line and plumb bob attached to the lowest point of the test article, a properly calibrated laser or other means that are verifiable.

5.1.4 Test Media

The test media may consist of the proper combination of either lead, gravel, sand, steel shot and/or clean soil needed to obtain the appropriate payload test weight. The test weight of each test article must be within +5/-0 pounds of the required test weight of 250 pounds.

5.1.5 Environmental

The requirements for environmental controls are described in the Test Specification TS-001 [3] and shall be recorded as required by each individual test sequence.

5.1.6 Electronic Recording Documentation

All aspects of the test series shall be recorded as required in the test plan using equipment as specified within the Test Specification TS-001 [3].

6.0 TEST PACAKAGE NO. 1-55

6.1 Test Number 1-55-A – NCT Center of Gravity Top Closure Drop

6.1.1 Test Configuration

Test 1-55-A is a free drop thru the center of gravity onto the top closure of an undamaged test article from a height of 1.2 meters (4 Feet) as shown in Figure 3. The test article suspended from a crane by slings and attached to a release mechanism is to be lifted above the test pad in a center of gravity thru the top closure orientation so that the lowest point of the package is at 1.2 meters (4 feet) above the top surface of the test pad. The test article should be released so that it does not impart rotational motion into the package free fall to the test pad.

6.1.2 Pre-test Requirements & Measurements

Prior to performing Test Number 1-55-A, the following pre-test activities are to be complete:

- Measure and record the test article temperature prior to drop.
- Record the test article serial number.
- Measure the centerline and the near side distance to the edge of the cavity, prior to closure of the inner containment cavity. All measurement locations should be marked on the package.
- Take photographs of the interior and exterior of the package to provide visual evidence of the pre-test condition.
- Weigh and record the empty test article.
- Load the test media into the test article inner containment cavity.
- Spread one (1) pound of residual sand/dirt into the inner containment cavity.
- Verify that components used for the inner containment cavity are in good condition and are the proper components per the drawings.
- Install the containment cavity gasket and blind flange. Snug all lid bolts prior to applying the required torque of 60 ft. lbs. in an alternating torque rotation.
- Install the outer gasket and reinforced drum lid using the appropriate bolts as required by the drawing, applying torque of 60 ft. lbs to the closure bolts in the proper alternating manner.

- Install outer drum ring and torque to 60 ft. lbs. and install security seal.
- Weigh and record the loaded test article.
- Upon closure, measure the height, from the bottom rim to the top of the closure ring and diameter of the outer package at the center rolling hoop of the drum. All measurement locations should be marked on the package.
- Verify that the external acetate vent plug is in place.
- Take photographs of the exterior of the test article to provide visual evidence of the test article pre-test condition.
- Measure and record the air temperature at the drop pad.
- Measure and record the temperature on the surface of the package.
- Once suspended measure and record the angle at which the test article is oriented to the nearest 1° increment. The measurement is to be within ± 1.0° of the specified drop orientation.
- Lift the test article to the required drop height. Measure and record the height from the surface of the test pad to the lowest point of the test article. The measured height must be at least the specified height required for the drop, but no more than plus 2 inches.

6.1.3 Post-Test Requirements

Following the NCT shallow angle drop (Test Number 1-55-A), the following activities are required:

- Photograph the exterior surfaces of the test article to provide visual evidence of any apparent damage.
- Document any apparent damage to the package, e.g. deformation or bolt failure.
- Measure the height and diameter of the test article and record the information.
- Record the information on the applicable test forms and proceed to next test sequence.

6.2 Test Sequence Number 1-55-B – HAC 30' Shallow Angle Accelerated Drop

6.2.1 Test Configuration

Test 1-55-B is a shallow angle accelerated drop at an angle of 17 degrees from the horizontal side of the damaged test article from a height of 9 meters (30 feet) as shown in Figure 1-55. The test article should be oriented so that the top closure makes the initial impact with test pad surface. The test article suspended from a crane by slings and attached to a release mechanism is to be lifted above the test pad so that the lowest point of the package is at 9 meters (30 feet) above the top surface of the test pad. The test article should be released so that it does not impart rotational motion into the package free fall to the test pad.

6.2.2 Pre-test Requirements & Measurements

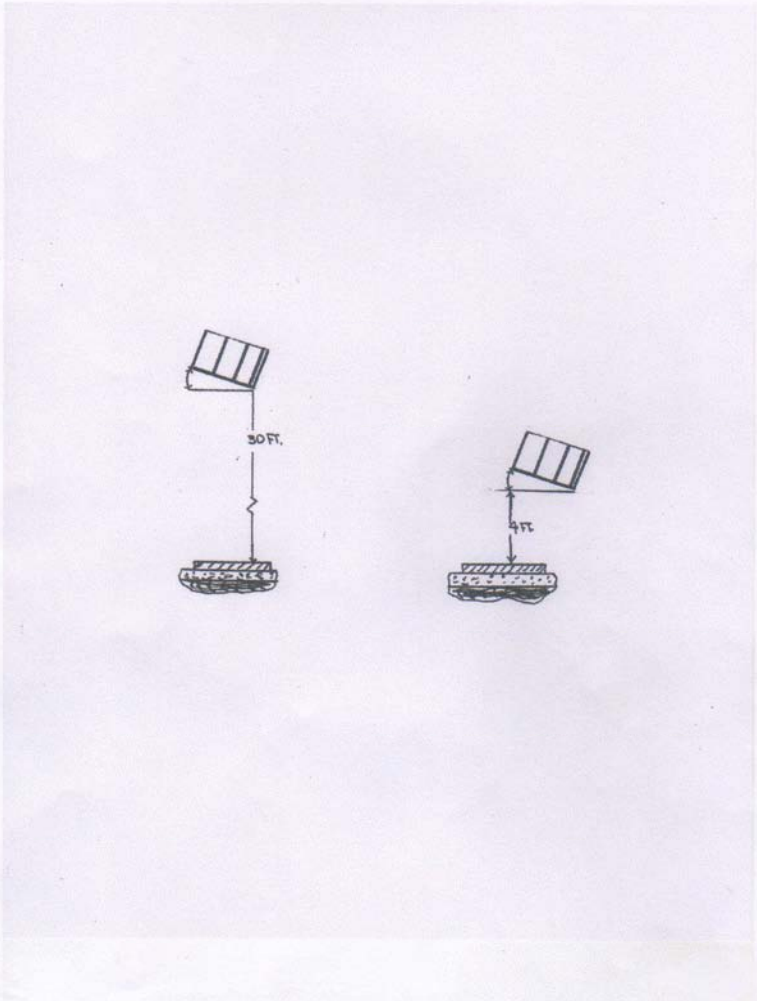
- Record measurements taken from previous test of the test article on the test record.
- Take photographs of the exterior of the test article to provide visual evidence of the test article pre-test condition.
- Measure and record the air temperature at the drop pad.
- Measure and record the temperature on the surface of the package.
- Once suspended measure and record the angle at which the test article is oriented to the nearest 1° increment. The measurement is to be within ± 1.0° of the specified drop orientation.
- Lift the test article to the required drop height. Measure and record the height from the surface of the test pad to the lowest point of the test article. The measured height must be at least the specified height required for the drop, but no more than plus 2 inches.

6.2.3 Post-Test Requirements

Following the HAC shallow angle accelerated drop (Test Number 1-55-B), the following activities are required:

- Photograph the exterior surfaces of the test article to provide visual evidence of any additional apparent damage.
- Document any additional damage to the package, e.g. deformation or bolt failure.
- Measure the height and diameter of the test article and record the information.

- Record the information on the applicable test forms and proceed to next test sequence.



Test No. 1-55-B
HAC Shallow Angle
Accelerated Drop

Test No. 1-55-A
HAC Shallow Angle
Accelerated Drop

Figure 1-55 – Test Package No. 1-55 – Test Configurations

6.3 Test Sequence Number 1-55-C – HAC 1 Meter Puncture Drop

6.3.1 Test Configuration

Test number 1-55-C is a free drop onto the damaged test article used in a previous, to be determined based upon particular damage assessed after the initial package series testing, from a height of 1 meter (40 inches) as shown in Figure 4. The test article will be suspended from a crane by slings and attached to a release mechanism is to be lifted above the test pad at an angle orientated to impact the damaged area so that the lowest point of the package is at 1 meter (40 inches) above the top surface of the puncture pin. The test article should be released so that it does not impart rotational motion into the package free fall to the impact point on the puncture pin.

6.3.2 Pre-test Requirements & Measurements

- Record measurements taken from previous test of the test article on the test record.
- Take photographs of the exterior of the test article to provide visual evidence of the test article pre-test condition.
- Measure and record the air temperature at the drop pad.
- Measure and record the temperature on the surface of the package.
- Once suspended measure and record the angle at which the test article is oriented to the nearest 1° increment. The measurement is to be within ± 1.0° of the specified drop orientation.
- Lift the test article to the required drop height. Measure and record the height from the surface of the test pad to the lowest point of the test article. The measured height must be at least the specified height required for the drop, but no more than plus 2 inches.

6.3.3 Post-Test Requirements

Following the HAC puncture drop (Test Number 1-55-C), the following activities are required:

- Photograph the exterior surfaces of the test article to provide visual evidence of any additional apparent damage.
- Document any additional damage to the package, e.g. deformation or bolt failure.
- Record the information on the applicable test forms and proceed to next test sequence.

- Measure and record the torque of outer closure bolts.
- Open outer package and remove the outer lid.
- Photograph the interior surface of the test article and examine for any apparent indications of containment boundary loss, e.g. payload materials.
- Measure and record the torque of interior bolts and remove the inner containment cavity blind flange.
- Examine the condition of the gasket and payload contents and record the information on the test record.
- Measure and record the centerline and near side distance to the edge of the cavity.
- Remove the inner payload (if possible) and record any apparent damage or movement to the inner containment cavity.
- Photograph the inner cavity to provide visual evidence of any apparent damage.
- Complete the test sequence record.

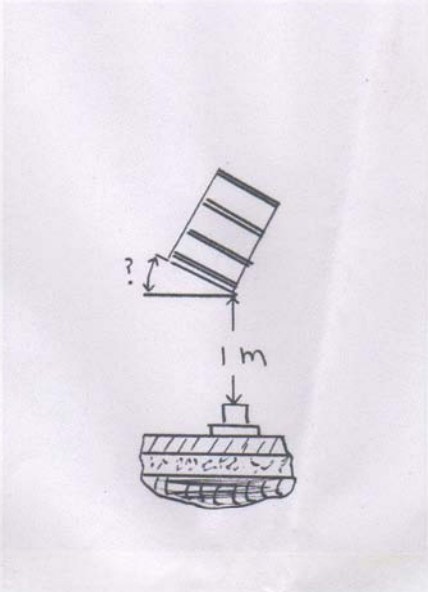


Figure 2 -55 - Meter Puncture Drop – Example Configuration

7.0 References

1. Title 10, Code of Federal Regulations, Pert 71, Packaging and Transportation of Radioactive Materials

2. Century Industries – QA-8 Plan for Manufacture of Versa-Pac Shipping

3. Title 10, Code of Federal Regulations, Part 21, Reporting of Defects and Noncompliance

4. Century Industries, Versa-Pac Shipping Container Test Specification TS-001

5. Century Industries, Quality Assurance Manual, QA-1

Attachment B

Test Specification TS-002 Revision 0

(Consisting of 12 Pages)

Century Industries
Bristol, Virginia 24209

Versa-Pac Shipping Container
Test Specification
TS-002 Revision 0

US NRC Docket No. 71-9342

Prepared By:
Century Industries
William M. Arnold

Prepared By: William M. Arnold –Signature on File Date: September 1, 2009

Reviewed By: Heather Little – Signature on File Date: September 1, 2009

Record of Revision

Revision No.	Description of Revision	Date
0	Original Issue	09-01-09

Table of Contents

1.0 INTRODUCTION

Century Industries is designing and licensing a new transportation package, called the Vera-Pac Shipping Container, in accordance with the requirements of 10 CFR Part 71 [Ref. 1]. The results of this series of test may also be used as part of the analytic information evaluating other areas of the package performance for the Normal Conditions of Transport (NCT) and Hypothetical Accident Conditions (HAC) tests of 10 CFR Part 71.

This document specifies the requirements for the confirmatory test program. A separate Test Plan will be prepared describing the specific test conditions, configurations and the sequence in which they will be carried out. Included in this document will be the fabrication specification for the test packages used in this series of test for the Versa-Pac Shipping Container.

2.0 TEST REQUIREMENTS

2.1 Pre-Test Readiness Review

Prior to performing any test series a readiness review will be conducted by Century Industries to assure the following:

1. All necessary test plans and/or procedures have been prepared in accordance with Century Industries QA program, reviewed and approved.
2. All required test articles and test facilities have been received and inspected by Century Industries personnel.
3. The documentation packages for the test articles have been reviewed and accepted by Century Industries inspection personnel.
4. Personnel are trained and available to perform the test series.
5. Test and inspection personnel have been trained in accordance with the appropriate test plans and/or procedures as required.
6. All test and Measurement equipment to be used fro the test series are current and will remain current during the testing period for which they are required.
7. Any subcontractors to be used have been trained in accordance with the test plan and/or procedures.

2.2 Pre-Test Measurements

Prior to performing any test, any per-test measurements required by the test plan must be taken and documented.

2.3 Instrumentation and Data Acquisition Systems

Prior to performing any test, the instrumentation and data acquisition system, if any, shall be checked to assure that it is properly functioning. Any instrumentation that is not properly functioning shall be either repaired or replaced. The test procedures shall include QA inspection hold points to verify that the instrumentation and acquisition equipment meets pre-test requirements.

2.3.1 Photographic Equipment

At least two consumer grade color video cameras shall be used to record the package response for each drop test series. One camera should have a field of view sufficient to capture the entire drop sequence, both free fall and impact. The field of view of the second camera should concentrate on the lower half of the impact area to provide more detailed footage of the drop sequence. The video recording of each drop test series shall be maintained for visual evidence.

Color still photographs shall be taken to document the test set-up and test results. Photographs should be taken with a minimum 3.0 Mega pixel digital camera or 35 mm standard camera equipment.

2.4 Environmental Conditions

2.4.1 Drop Test

Prior to performing each drop test series the following environmental conditions must be recorded:

1. Precipitation: Any precipitation (i.e. rain, snow. etc.) directly on the test article or test pad surface during the drop test shall be noted.

2. Wind Speed: The wind speed at the time of the drop series shall be recorded. If wind speed is considered to be strong enough to effect the drop orientation the drop test series should be delayed.

3. Package Temperature: Record the package temperature at prior to drop series.

4. Air Temperature: Record the air temperature at the drop site prior to conducting the drop series.

2.5 Test Components

2.5.1 Test Articles

The test article shall be fabricated in accordance with the requirements Section 3 of this test specification and QA-8 - Plan for Manufacture of the Versa-Pac Shipping Container [7].

2.5.2 Puncture Pin

The puncture pin must meet the requirements of 10 CFR 71(c)(3)[1]. The puncture pin must be a solid, vertical, cylindrical, mild steel bar mounted on an essentially unyielding, horizontal surface. The bar must be 15 cm (6 inches) in diameter, with the top horizontal and its edge rounded to a radius of not more than 6 mm (0.25 inches) and a length as to cause maximum damage to the package, but not less than 20 cm (8 inches) long. The long axis of the bar must be vertical. The puncture pin must be attached so as to prevent it from sliding or overturning during the 1-meter puncture drop test.

2.5.3 Drop Test Facility

The drop test facility must have a suitable drop test pad, lifting equipment and drop release mechanism. The drop test facilities must meet the following specifications:

1. Drop Test Pad

The drop test pad must satisfy the requirements of IAEA [2] recommendations for an unyielding target. An example of an unyielding surface is: The drop test pad should consist of a rigid steel plate mounted on a concrete pad with the combined mass of the steel and concrete at least 10 times that of the test article, with a surface area sufficient in size so as to allow the entire test article to contact the steel surface plate. The steel and concrete interface should be floated on grout and mechanically anchored to the concrete base (e.g. anchor blots). The concrete must reach design strength prior to performing any drop test series. The drop test pad steel plate should be clean, and free from any significant surface imperfections (e.g. large gouges) that could affect the response of the package.

The drop test pad must also include a provision for attaching the puncture pin device used in the 1-meter puncture drop.

2. Lifting Equipment

The drop test facility must be equipped with a lifting device (e.g. crane) and lifting slings that are capable of lifting the lowest point of the test packages to the height prescribe above the top surface of the drop test pad for all drops in the test series. The lifting equipment (e.g. crane, slings) shall have at least the working load capacity to safely handle the test article weight.

3. Drop Release Mechanism

The drop test release mechanism must be capable of releasing the test articles without causing the package to rotate during the free fall to the test pad. Mechanical or administrative means shall be provided to prevent inadvertent release of the test article.

2.6 Test Plan and Procedures

Detailed test plans and procedures shall be developed for each droop test series and approved by Century Industries prior to perform any drop test. The test plan and procedures shall include step-by-step instructions for performing the test series. Each step or sequence shall include a provision for the responsible person to initial and date to indicate completion of the step(s). Each sequence shall allow for QA Hold Points necessary to confirm critical test items.

2.7 Test Sequences

Test sequences shall comply with the requirements of 10 CFR 71 [1]. A separate test article may be used for the NCT test series. When assessing cumulative package damage for the HAC test series; the test must be performed in the order shown within the Versa-Pac Shipping Container Test Plan [9] using the same test article within any given test series.

2.8 Quality Assurance Requirements

2.8.1 Test Inspection Personnel

All personnel performing measurements and inspections required by the test plan shall be qualified and trained in accordance with the requirements of the applicable test plan and procedures.

2.8.2 Quality Assurance Hold Points

The test package manufacturing plan and test plan shall establish appropriate hold points for QA for QA personnel to perform the following activities:

1. Receipt inspection of test articles.
2. Verification that all test personnel have been trained in accordance with the test plan prior to test activities.
3. Verification that all prerequisites have been satisfied.

2.8.3 Material and Test Equipment

When calibrated measurement and test equipment is required by the test plan, the equipment shall meet the applicable requirements of Century Industries QA Program QA-1 [10].

2.9 Documentation and Reporting Requirements

The following documents must be provided after the test series has been completed:

1. Test article documentation package(s).
2. Measurement and test equipment records.
3. Personnel training and qualification records.
4. Test Plan and procedures.
5. Pre-test and post-test inspection data, photographic records, video recordings and other pertinent records.

3.0 Responsibilities

Century Industries is responsible for all activities including the preparation of fabrication control records, shop drawings, material procurement, testing and inspection, material certification records as required, welding procedures and final documentation packages.

3.1 Design Requirements

The Century Industries Versa-Pac is designed in accordance with the requirements of 10 CFR 71 [1] and the structural design in accordance with the American Welding Society D1.1 [4]. Welder and welding procedure are in accordance with the applicable requirements of AWS D1.1 [4].

3.2 Fabrication and Material Requirements

Century Industries Versa-Pac shall be fabricated in accordance with the requirements as outlined in the appropriate manufacturing plan and instructions referenced in the sections below. Century Industries Versa-Pac Shipping Container Test Plan [9]

3.2.1 Manufacturing Plan

Century Industries shall prepare a manufacturing plan for the Versa-Pac Shipping Container which should address the following items as a minimum:

- Receipt of materials
- Cutting and Preparation Instructions (Route Sheets)
- Fabrication Control Records (FCR's)
- Performance of functional tests
- Final inspections
- Package documentation review

3.2.2 Fabrication Procedures and Processes

All operations associated with the fabrication of the Versa-Pac shall include written instructions (e.g. Fabrication Control Records and/or Standard Operating Procedures). Additional instructions may be given in the form of drawings and/or sketches, along with verbal communications.

3.2.3 Base Materials

Base materials shall conform to the requirements given in the purchase orders and/or drawings as applicable.

3.2.4 Welding Materials

All weld filler materials shall conform to the requirements of the appropriate welding procedure and be in compliance with the requirements in AWS D1.1 [4].

General welding material certificates are acceptable.

3.2.5 Polyurethane Foam Insulation Materials

The Versa-Pac Shipping Container utilizes polyurethane closed cell foam to provide thermal insulation and impact protection in both the top and bottom ends of the container, this material shall be manufactured in accordance with the requirements of Century Industries Standard Operation Procedure 6.11 Revision 1 [5]. Sample foam specimens shall be taken and analyzed in accordance with the requirements of the procedure to confirm that the product meets the requirements for density, compressive strength, thermal conductivity, flame retardancy, water absorption, moisture content and chloride content. The foam manufacturer shall provide a Certificate of Compliance and a written report of all testing required by the procedure.

3.2.6 Ceramic Fiber Insulation Materials

The Versa-Pac Shipping Container body is surrounded by two separate insulation chambers which utilize a 6# refractory ceramic fiber blanket (Aluminosilicate Fiber) in accordance with the requirements of Century Industries Standard Operating Procedure 6.12 Revision 1 [6].

3.2.7 Welding

All welding shall be in accordance with applicable requirements of AWS D1.1 [4], qualified welding procedures and written instructions.

All welding personnel shall be qualified in accordance with AWS D1.1 [4].

Precautions should be taken to minimize objectionable weld spatter and arc strikes outside the weld joint.

AWS Pre-qualified Welding Procedures and/or qualified welding procedures shall be used.

3.3 Testing and Inspection Requirements

3.3.1 General

1. All test articles shall be inspected to assure that the dimensions of the test article satisfy the requirements of the drawings.

2. Inspection personnel are qualified in accordance AWS CWI or CAWI and/or ASNT-TC-1A [8], as applicable.

3. Welds requiring NDE examination are performed in accordance with Century Industries Standard Operating Procedures, as applicable.

4. Written reports for any NDE shall be completed as required by the appropriate test procedure.

5. Acceptance criteria shall meet AWS D1.1 [4] and/or the requirements of the manufacturing plan and drawings.

6. Functional tests shall be performed as required by the Fabrication Control Records.

7. All test and measurement equipment shall be properly calibrated.

3.4 Quality Assurance

All work shall be performed in accordance with Century Industries QA Program or specific requirements imposed upon its subcontractors.

The Vera-Pac Shipping Container specifications require the application of 10 CR Part 21 [3]. Century Industries is responsible for providing notification to its suppliers and subcontractors.

3.5 Material Traceability

Material traceability shall be maintained throughout the fabrication process thru the use of Route Sheets and Fabrication Control Records as appropriate and by marking on necessary components that will not result in harmful contamination or damage affecting the performance of that component in the end product.

3.6 Storage, Handling and Shipping Requirements

All test articles that must be shipped to a subcontractor's facility shall be packaged using blocking, straps, hold-down devices and/or other materials required to prevent damage to the test article during transportation. Storage and handling may be conducted using the appropriate equipment needed to safely handle the test articles.

4.0 References

1. Title 10, Code of Federal Regulations, Pert 71, Packaging and Transportation of Radioactive Materials
2. International Atomic Energy Agency (IAEA), Regulations for the Safe Transportation of Radioactive Material, No. TS-R-1
3. Title 10, Code of Federal Regulations, Part 21, Reporting of Defects and Noncompliance
4. American Welding Society, Structural Welding Code D1.1
5. Century Industries, Standard Operating Procedure, Polyurethane Closed Cell Foam Specification for Century Products
6. Century Industries, Standard Operating Procedure, Ceramic Fiber Insulation Specification for Century Products
7. Century Industries, QA-8, Plan for the Manufacture of Versa-Pac Shipping Containers
8. American Society of Nondestructive Testing (ASNT), Recommended Practice No. SNT-TC-1A
9. Century Industries, Versa-Pac Shipping Container Test Plan - TP-002
10. Century Industries, Quality Assurance Manual, QA-1

Attachment C

NCT & HAC Test Series Records

(5 Pages)

Century Industries **NCT and HAC Test Record No.** TS-002-1 **Page 1 of 5**
Bristol, Virginia **in accordance with**
Versa- Pac Test Specification, TS-002, Rev. 0

Test Package Serial No. 10553 Package Description: Versa-Pac (55-Gallon Version)

Test Program Manager: William M. Ard Date: 9-24-09
Test Engineer: William M. Ard Date: 9-24-09
Quality Assurance Coordinator: William M. Ard Date: 9-24-09

Photographic Equipment

Sony Cybershot (4.1 MegaPixel) Digital Camera DSC-P73

Calibrated Equipment Utilized

Surface Thermometer S/N: 05548
Stanlett Steel Tape Measure S/N: 08461846
16' Tape measure S/N: QC-001

Package Preparation Checklist and Measurements

Procedure Step No.	Description	Date	Initials
6.1.2	Photograph interior and exterior of the package prior to loading	9-23-09	WMA
	Measure centerline and near side distance to edge of cavity and mark on package	9.23-09	WMA
	Weigh empty test package 390 Package tare weight (lbs)	9-23-09	WMA
	Load simulated test payload ± 254½ Lbs.	9-23-09	WMA
	Spread one (1) pound of residual sand/dirt into the inner containment cavity	9-23-09	WMA
	Inspect the inner containment components for good condition and in accordance with drawings	9-23-09	WMA
	Install cavity gasket and blind flange, snug all bolts, then torque to 60 ft-lbs	9-24-09	WMA
	Install outer gasket and reinforced drum lid with proper bolts per drawing and torque to 60 ft-lbs.	9-24-09	WMA
	Install outer drum ring and torque to 60 ft-lbs	9-24-09	WMA
	Weigh loaded test package 644½ Package test weight (lbs)	9-23-09	WMA
	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		

Century Industries **NCT and HAC Test Record No.** TS002-1 **Page 2 of 5**
Bristol, Virginia **in accordance with**
Versa- Pac Test Specification, TS-002, Rev. 0

Procedure Step No.	Description	Date	Initials
6.1.2	Measure height from bottom rim to top of closure ring and diameter of outer package at center rolling hoop of drum and mark measurements on the test package 34" Package height (in.) 23 1/2" Package diameter (in.)	9-24-09	WMA
	Verify the external acetate vent plug is in place	9-24-09	WMA
	Photograph exterior of test package for evidence of pre-test condition	9-24-09	WMA

1-55-A
Test Number (Description): NCT 4' Shallow Angle (Accelerated – Slap-Down) Drop

Procedure Step No.	Description	Date	Initials
6.1.2	Measure and record package surface &air temperature at drop pad 89 Package Surface Temperature (°F) 90 Air Temperature(°F) 2 Wind speed (mph)	9-24-09	WMA
	Measure and record the angle at which the test article is oriented to the nearest degree (within ±1 degree of specified drop orientation) 17° Angle of orientation	9-24-09	WMA
	Lift test article to required drop height	9-24-09	WMA
	Measure and record height from test pad surface to lowest point on test package (at least the specified drop height and not more than +2 inches) 48 1/2" Drop test height (in.)	9-24-09	WMA
6.1.3	Photograph exterior surfaces of test article for visual evidence of damage	9-24-09	WMA
	Document visual damage to package (e.g. deformation or bolt failure) 7 1/4" Long X 1/4" AT Rim ON Top Drum Ring - INDENTATION ON OUTER Drum Rolling Hoop. 5 3/4" FLAT AT Bottom EDGE X 1/4" Deep NO TEARING OR OPENING Sketch of Damage: Top	9-24-09	WMA
	Measure height and diameter of test package 33 15/16 Package height (in.) AT BOLT Impact 23 5/16 Package diameter (in.) AT BOLT Impact	9-24-09	WMA

Century Industries **NCT and HAC Test Record No.** TS-002-1 **Page 3 of 5**
Bristol, Virginia **in accordance with**
Versa- Pac Test Specification, TS-002, Rev. 0

1-55-B
Test Number (Description): HAC 30' Shallow Angle (Accelerated – Slap-Down) Drop

Procedure Step No.	Description	Date	Initials
6.2.2	Photograph exterior surfaces of test article for visual evidence of pre-test condition	9-24-09	WMA
	Measure and record the package surface & air temperature at the drop pad 89 Package Surface Temperature (°F) 90 Air temperature(°F) 2 Wind speed (mph)	9-24-09	WMA
	Once suspended, measure and record the angle at which the test article is oriented to the nearest degree (within ±1 degree of specified drop orientation) 17° Angle of orientation	9-24-09	WMA
	Measure and record height from test pad surface to lowest point on test package (at least the specified drop height and not more than +2 inches) 361 ½" Drop test height (in.)	9-24-09	WMA
6.2.3	Photograph exterior surfaces of test article for visual evidence of additional damage	9-24-09	WMA
	Document visual damage to package (e.g. deformation or bolt failure) MINOR TRACE DUE TO BOLT CLOSURE LUG @ SMALL Ripple IN MIDDLE OF OUTER DRUM LID. MINOR FLAT AREAS ALONG Impact Side of OUTER DRUM. NO OPENING OF CLOSURE. 11½" Long x 3/8" Deep AT LID INTERFACE ON BOLT Ring. BOLT Ring BROKEN AT Lug. 10" Long x ¼" Deep AT Bottom Edge Sketch of Damage  Top	9-24-09	WMA
	Measure and record height and diameter of test article 34 ¼" Package height (in.) AT BOLT Impact 23 ⅛" Package diameter (in.) AT BOLT Impact	9-24-09	WMA

1-55-C
Test Number (Description): HAC 1 Meter Puncture Drop C/G THRU Previous Impact AREAS

Procedure Step No.	Description	Date	Initials
6.3.2	Photograph exterior surfaces of test article for visual evidence of pre-test condition	9-24-09	WMA
	Measure and record the package surface & air temperature at the drop pad 89 Package Surface Temperature (°F) 90 Air temperature (°F) 2 Wind speed (mph)	9-24-09	WMA

Century Industries
Bristol, Virginia

NCT and HAC Test Record No. TS-002-1
in accordance with
Versa- Pac Test Specification, TS-002, Rev. 0

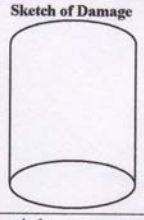
Page 4 of 5

Procedure Step No.	Description	Date	Initials
6.3.2	Once suspended, measure and record the angle at which the test article is oriented to the nearest degree (within ±1 degree of specified drop orientation) 56½° Angle of orientation C/G	9-24-09	WMA
	Measure and record height from test pad surface to lowest point on test package (at least the specified drop height and not more than +2 inches) 41" Drop test height (in.)	9-24-09	WMA
6.3.3	Photograph exterior surfaces of test article for visual evidence of additional damage	9-24-09	WMA
	Document visual damage to package (e.g. deformation or bolt failure) 8 3/8" WIDE AREA FLAT FROM PUNCTURE TEST. Top Sketch of Damage  	9-24-09	WMA
	Measure and record height and diameter of test article 33 3/16" Package height (in.) AT BOLT AREA 23" Package diameter (in.) AT BOLT AREA	9-24-09	WMA

Test Number (Description): N/A

Procedure Step No.	Description	Date	Initials
N/A	Photograph exterior surfaces of test article for visual evidence of pre-test condition	N/A	N/A
	Measure and record the air temperature at the drop pad _____ Air temperature(°F) _____ Wind speed (mph)		
	Once suspended, measure and record the angle at which the test article is oriented to the nearest degree (within ±1 degree of specified drop orientation) _____ Angle of orientation		
	Measure and record height from test pad surface to lowest point on test package (at least the specified drop height and not more than +2 inches) _____ Drop test height (in.)		
	Photograph exterior surfaces of test article for visual evidence of additional damage		

Century Industries **NCT and HAC Test Record No.** TS-002-1 **Page 5 of 5**
Bristol, Virginia **in accordance with**
Versa- Pac Test Specification, TS-002, Rev. 0

Procedure Step No.	Description	Date	Initials
N/A	Document visual damage to package (e.g. deformation or bolt failure) _____ _____ _____ _____ _____ Top **Sketch of Damage** 	N/A	N/A
N/A	Measure and record height and diameter of test article _____ Package height (in.) _____ Package diameter (in.)	N/A	N/A

Final Test Record Measurements

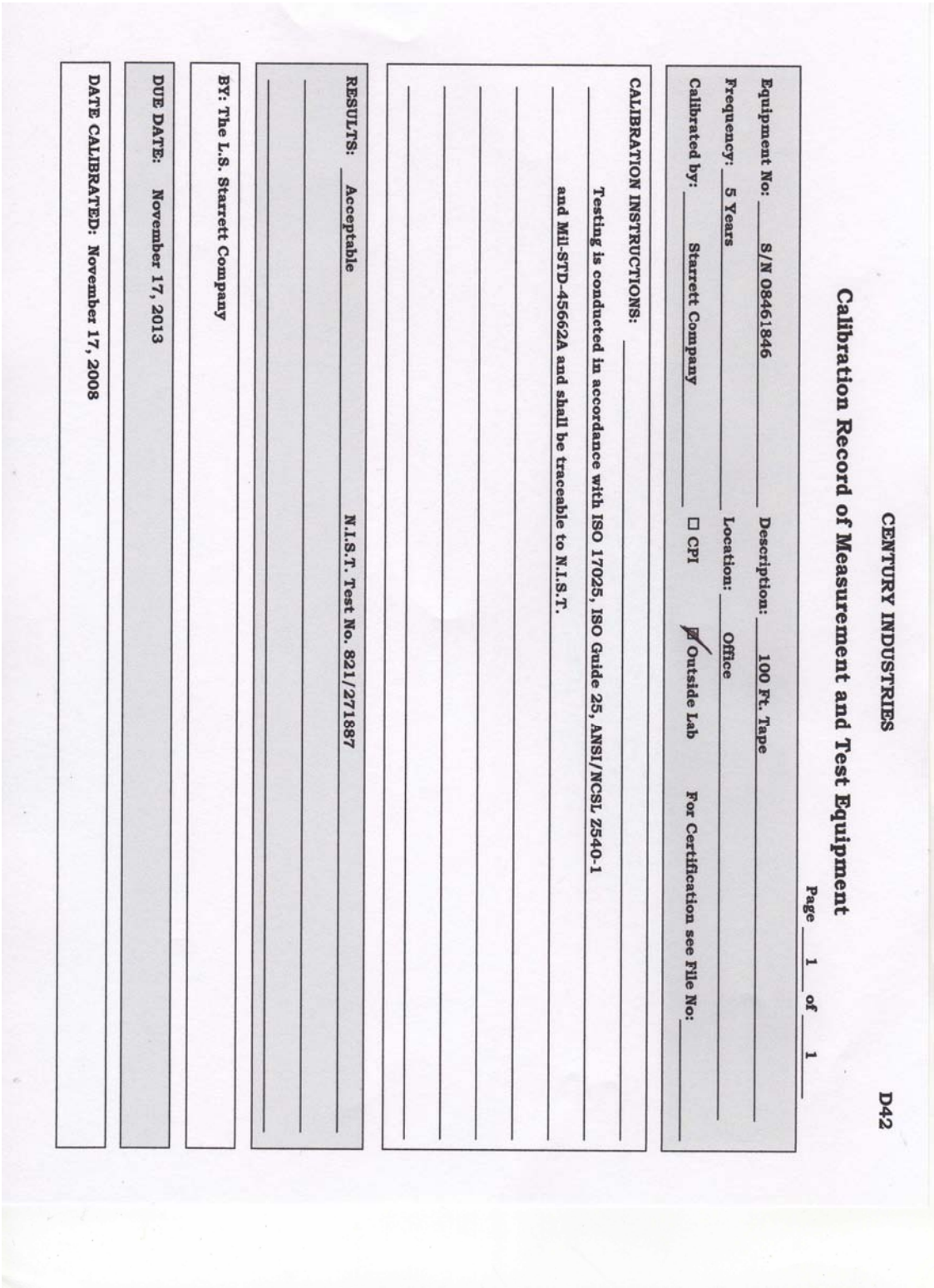
Procedure Step No.	Description	Date	Initials
6.3.3	Measure and record torque of outer closure bolts 42 to 55 Torque (ft-lbs) Impact Top Bolt 49 Ft/lb	9-24-09	WMA
	Open outer package and remove outer lid	9-24-09	WMA
	Photograph interior surface of test article and examine for any apparent indications of containment boundary loss, e.g. payload materials No Loss of Containment, No Damage To Blind Flg OR Flg. To Blind Flg. Interface.	9-24-09	WMA
	Measure and record torque of interior bolts 30-50 Torque (ft-lbs)	9-24-09	WMA
	Remove inner containment cavity blind flange	9-24-09	WMA
	Examine and document condition of the gasket and payload contents Inner Gaskets in Good Condition No Loss of Payload Contents Payload in tact.	9-24-09	WMA
	Measure and record the pre-test and post-test centerline and near side distance to edge of cavity for comparison (See attached Measurement Data Sheet)	9-24-09	WMA
	Remove (if possible) and document any apparent damage or movement to the inner containment cavity Payload Removed - No Damage or Change of Containment Found.	9-24-09	WMA
	Photograph inner cavity to provide visual evidence of any apparent damage	9-24-09	WMA

Attachment D

Training & Equipment Calibration Records

(8 Pages)

Starett 100’ Tape Measure Calibration Record



CENTURY INDUSTRIES D42

Calibration Record of Measurement and Test Equipment

Page 1 of 1

Equipment No: S/N 08461846 Description: 100 Ft. Tape

Frequency: 5 Years Location: Office

Calibrated by: Starrett Company ☐ CPI ☑ Outside Lab For Certification see File No:

CALIBRATION INSTRUCTIONS:

Testing is conducted in accordance with ISO 17025, ISO Guide 25, ANSI/NCSL Z540-1 and Mil-STD-45662A and shall be traceable to N.I.S.T.

RESULTS: Acceptable N.I.S.T. Test No. 821/271887

BY: The L.S. Starrett Company

DUE DATE: November 17, 2013

DATE CALIBRATED: November 17, 2008

Starrett®

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Fax.: 978 249-8495
www.starrett.com

ATTN: QUALITY ASSURANCE
MCMASTER-CARR SUP CO
6100 FULTON IND BLVD
ATLANTA GA 30336-2853

NOVEMBER 17, 2008

STANDARD LETTER of CERTIFICATION

THIS IS TO CERTIFY THAT THE ITEM LISTED BELOW MEETS THE REQUIREMENTS OF ACCURACY OF THE APPLICABLE SPECIFICATION ON DATE OF SHIPMENT.

STANDARDS AND EQUIPMENT USED FOR INSPECTION ARE CERTIFIED ACCURATE WITH REFERENCE TO 68 DEGREES F, TRACEABLE TO MASTER STANDARDS AT THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, WASHINGTON, D.C. CALIBRATION IS PERFORMED WITH TRANSFER STANDARDS WHICH ARE PROGRESSIVELY MORE ACCURATE IN THE ORDER OF 4: 1.

WE ATTEST THAT OUR MEASURING AND TEST EQUIPMENT, AND CALIBRATIONS PERFORMED ON THE ITEM (S) LISTED BELOW, ARE IN ACCORDANCE WITH ISO 17025, ISO GUIDE 25, ANSI/NCSL Z540-1 AND MIL-STD-45662A.

YOURS VERY TRULY,
THE L. S. STARRETT COMPANY

Candace Sheffield

DEXTER J. CARLSON,
CHIEF INSPECTOR

YOUR ORDER NO.	OUR ORDER NO.	TOOL	SPECIFICATION
QA-87917960	1335247	530-100 TAPE S/N 08461846	GGG-T-106F NIST HANDBOOK #44

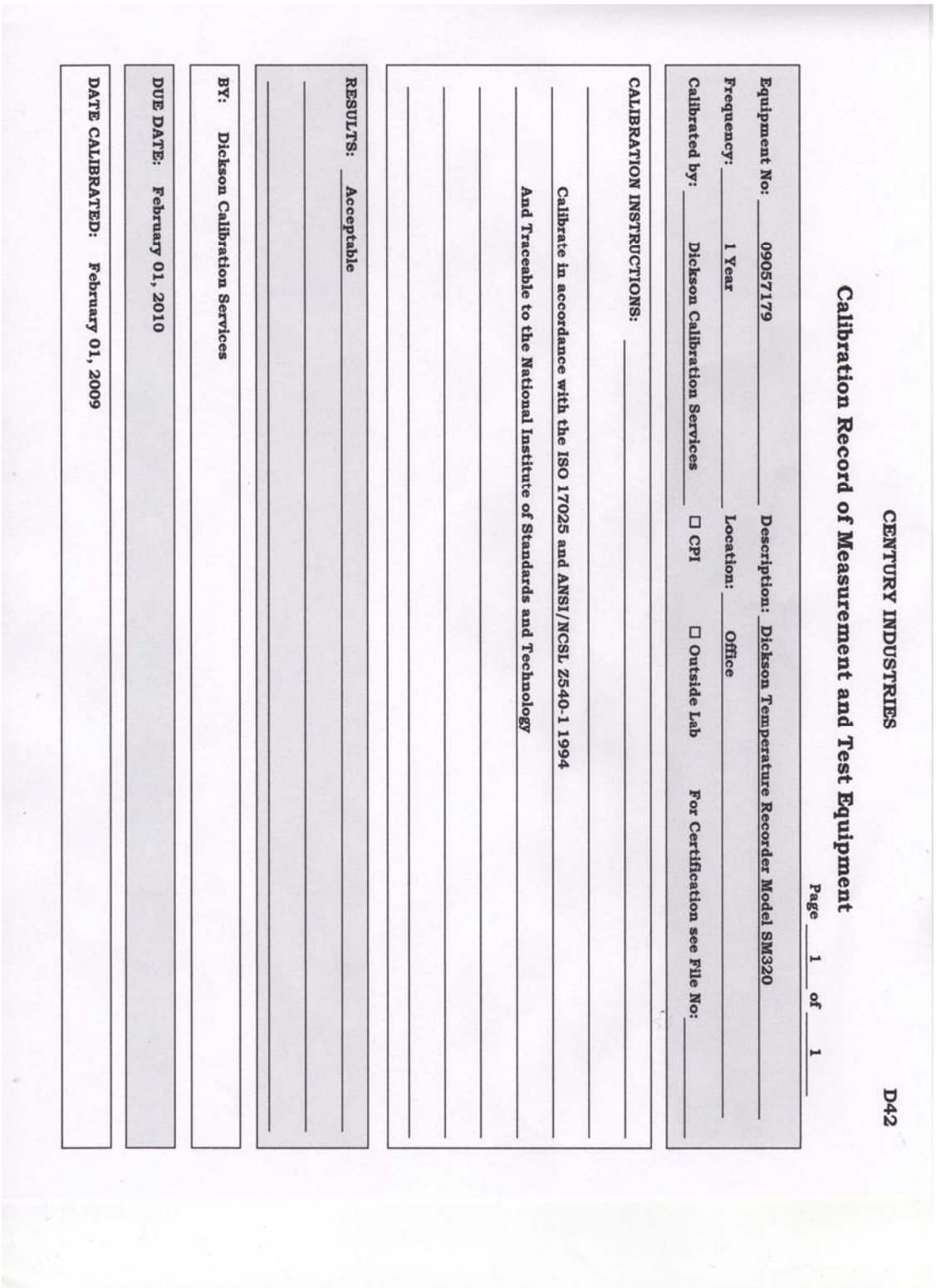
N.I. S.T. TEST NO.
821/271887

ACCURACY-WHEN THE TAPE IS SUPPORTED ON A HORIZONTAL SURFACE, AND PULLED WITH A TENSION OF 10 POUNDS AT A TEMPERATURE OF 68 DEGREES FAHRENHEIT, THE OVERALL LENGTH WILL NOT BE IN ERROR BY MORE THAN .100" IN 100' OR LESS.

The estimated uncertainties reflect a Confidence Probability of approximately 95%.

D-2

Calibration Record for Dickson Data Thermometer



CENTURY INDUSTRIES D42

Calibration Record of Measurement and Test Equipment

Page 1 of 1

Equipment No: 09057179 Description: Dickson Temperature Recorder Model SM320

Frequency: 1 Year Location: Office

Calibrated by: Dickson Calibration Services ☐ CPI ☐ Outside Lab For Certification see File No:

CALIBRATION INSTRUCTIONS:

Calibrate in accordance with the ISO 17025 and ANSI/NCSL Z540-1 1994

And Traceable to the National Institute of Standards and Technology

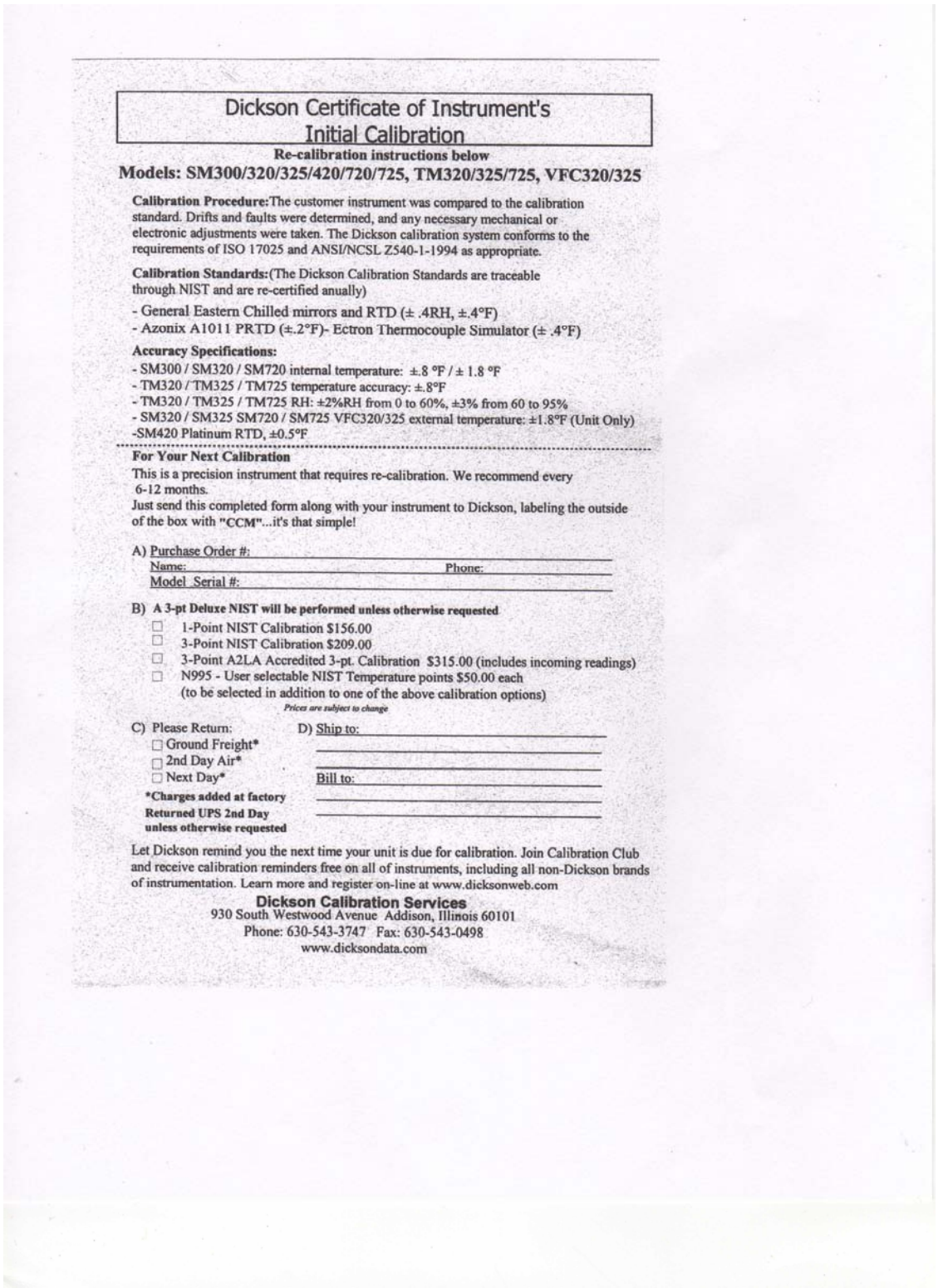
RESULTS: Acceptable

BY: Dickson Calibration Services

DUE DATE: February 01, 2010

DATE CALIBRATED: February 01, 2009

D-3



Dickson Certificate of Instrument's Initial Calibration

Re-calibration instructions below

Models: SM300/320/325/420/720/725, TM320/325/725, VFC320/325

Calibration Procedure: The customer instrument was compared to the calibration standard. Drifts and faults were determined, and any necessary mechanical or electronic adjustments were taken. The Dickson calibration system conforms to the requirements of ISO 17025 and ANSI/NCSL Z540-1-1994 as appropriate.

Calibration Standards: (The Dickson Calibration Standards are traceable through NIST and are re-certified anually)

- General Eastern Chilled mirrors and RTD (± .4RH, ±.4°F)
- Azonix A1011 PRTD (±.2°F)- Ectron Thermocouple Simulator (± .4°F)

Accuracy Specifications:

- SM300 / SM320 / SM720 internal temperature: ±.8 °F / ± 1.8 °F
- TM320 / TM325 / TM725 temperature accuracy: ±.8°F
- TM320 / TM325 / TM725 RH: ±2%RH from 0 to 60%, ±3% from 60 to 95%
- SM320 / SM325 SM720 / SM725 VFC320/325 external temperature: ±1.8°F (Unit Only)
- SM420 Platinum RTD, ±0.5°F

For Your Next Calibration

This is a precision instrument that requires re-calibration. We recommend every 6-12 months.

Just send this completed form along with your instrument to Dickson, labeling the outside of the box with **"CCM"**...it's that simple!

A) Purchase Order #: _____

Name: _____ Phone: _____

Model Serial #: _____

B) **A 3-pt Deluxe NIST will be performed unless otherwise requested**

- ☐ 1-Point NIST Calibration $156.00
- ☐ 3-Point NIST Calibration $209.00
- ☐ 3-Point A2LA Accredited 3-pt. Calibration $315.00 (includes incoming readings)
- ☐ N995 - User selectable NIST Temperature points $50.00 each (to be selected in addition to one of the above calibration options)

Prices are subject to change

C) Please Return:

- ☐ Ground Freight*
- ☐ 2nd Day Air*
- ☐ Next Day*

***Charges added at factory**

Returned UPS 2nd Day unless otherwise requested

D) Ship to: _____

Bill to: _____

Let Dickson remind you the next time your unit is due for calibration. Join Calibration Club and receive calibration reminders free on all of instruments, including all non-Dickson brands of instrumentation. Learn more and register on-line at www.dicksonweb.com

Dickson Calibration Services
930 South Westwood Avenue Addison, Illinois 60101
Phone: 630-543-3747 Fax: 630-543-0498
www.dicksondata.com

D-4

Calibration Record for PTC Surface Thermometer

CENTURY INDUSTRIES

D42

Calibration Record of Measurement and Test Equipment

Page 1 of 1

Equipment No: 05548 Description: PTC Instruments Model 330F -100°F to +160°F

Frequency: 3 Months Location: Office

Calibrated by: Century Industries ☐ CPI ☐ Outside Lab For Certification see File No: ______

CALIBRATION INSTRUCTIONS:

Surface thermometer shall be place on a flat surface next to the NIST Traceable gauge. The thermometers should be allowed to equalize for a period of not less than 15 minutes at the ambient air temperature. The readings shall be within ± 2°F. A second reading shall also be obtained by placing both units in a cooling chamber, allowing the gauges to equalize for not less than 15 minutes. The reading shall be within ± 2°F. Calibrate in accordance with the ISO 17025 and ANSI/NCSL Z540-1 1994 and Traceable to the National Institute of Standards and Technology.

RESULTS: Acceptable

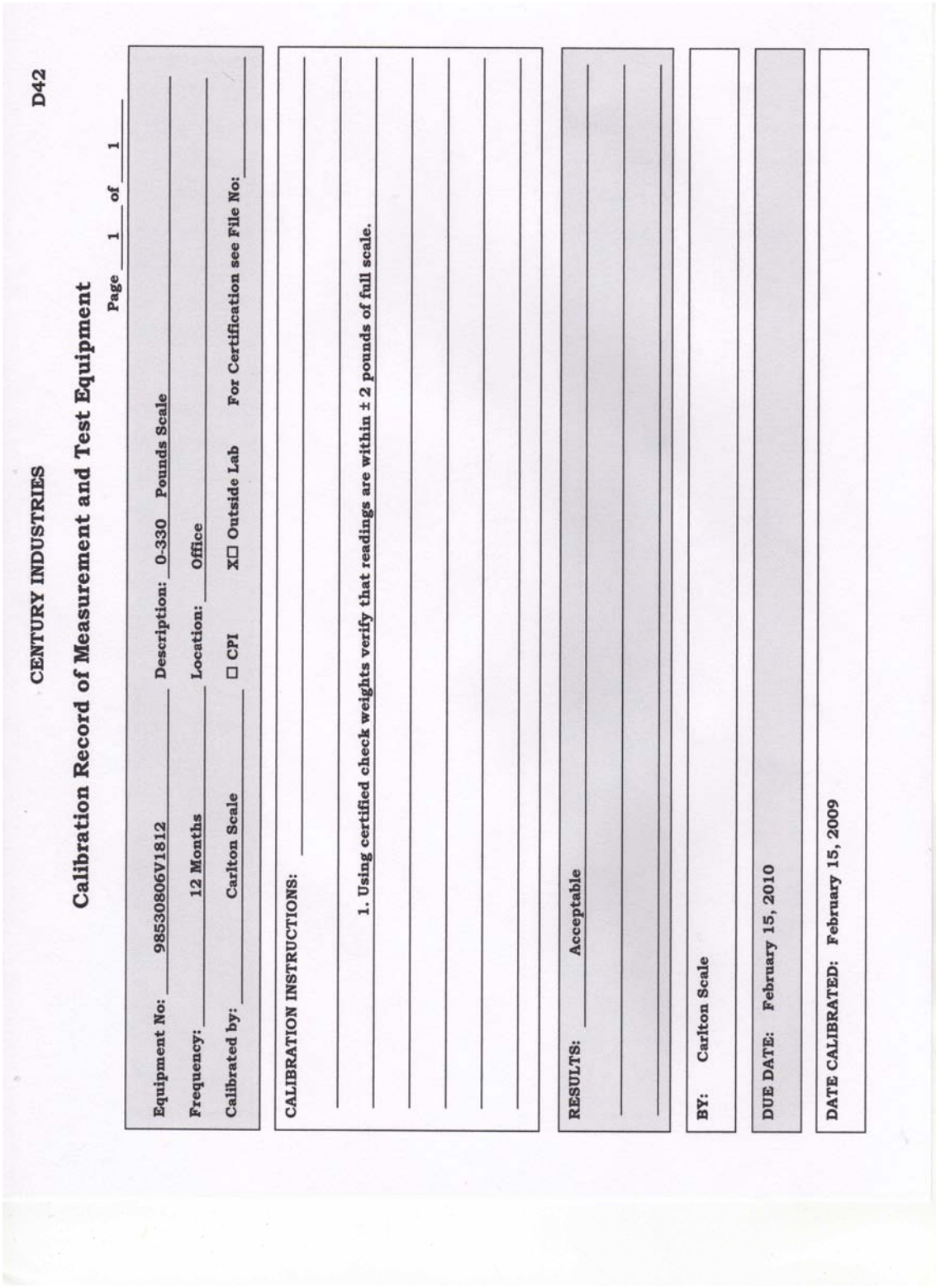
BY: Century Industries

DUE DATE: October 09, 2009

DATE CALIBRATED: July 09, 2009

D-5

Floor Scale



CENTURY INDUSTRIES D42

Calibration Record of Measurement and Test Equipment

Page 1 of 1

Equipment No: 985308006V1812 Description: 0-330 Pounds Scale

Frequency: 12 Months Location: Office

Calibrated by: Carlton Scale ☐ CPI X☐ Outside Lab For Certification see File No:

CALIBRATION INSTRUCTIONS:

1. Using certified check weights verify that readings are within ± 2 pounds of full scale.

RESULTS: Acceptable

BY: Carlton Scale

DUE DATE: February 15, 2010

DATE CALIBRATED: February 15, 2009

Indoctrination or Training Session Outline D52

Century Industries
P.O. Box 17084
Bristol, VA 24209
423-646-1864

Page 1 of 1

Title **TEST SPECIFICATION & TEST PLAN FOR THE VERSA-PAC SHIPPING CONTIANER** **Type:** ☑ Indoct. ☑ Training **Recommended Min. Duration:** 40 min.	**Dept** Testing Assistants **Outline No** 4F **Rev.** 0 **APPROVED:** Will M. Hall 2-25-09 Department Manager Date Will M. Hall 2-25-09 QA Manager Date

1. **Review duties and responsibilities per:**

   TS-001 Rev. 0 – Versa-Pac Test Specification

   TP-001 Rev. 0 – Versa-Pac Shipping Container Test Plan

D-7

Session Record **D50**

TEST PERSONNEL

Department

Century Industries

P.O. Box 17084
Bristol, VA 24209
423-646-1864

Position/Job Classification: Test Assistant

Outline Number: 4F **Date Completed** 2-25-09 **Duration** 1 HR.

Remarks:

Instructor 2-25-09 Date

The following Personnel have satisfactorily completed the above indoctrination or training outline:

Employee	Employee
Steve Salla	
Jamie Butler	
Drew Seller	
Fredy Buser	
Mark Osborne	
Heather Little	

D-8