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Test Report

NCT Evaluation Test Series (Compression & Penetration) Of Century Industries' Versa-Pac Shipping Containers

US NRC Docket Number 71-9342

Prepared & Conducted By:
Century Industries
William M. Arnold

Prepared By: _____ Date: _____

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1.0 INTRODUCTION

This Report describes the methods and guidelines Century Industries followed for the testing of the Versa-Pac Shipping Container in accordance with the requirements specified in 10 CFR 71. The test program was conducted by Century Industries located in Bristol, Virginia between December 15 & 16. This report includes the objective, procedure, item description, test results, test records and other applicable documents including photographs of the testing.

2.0 OBJECTIVE

The objective of this test series was to conduct the physical performance evaluation tests for Century Industries Versa-Pac Shipping Containers by the designer and manufacturer of the package, in accordance with the normal conditions specified in Title 10 Part 71.71(9) and 71.71(10).

The test items were identified as Versa-Pac shipping container previously tested prototype and subjected to the following performance tests:

1. Initial visual inspection of the outer container surfaces for pre-existing damage from the original HAC test series.

2. Penetration testing in accordance with 10 CFR 71.71(10) and Compression in accordance with 10 CFR 71.71(9).

3. Post Test Visual Inspection of the outer 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 series and were responsible for the base analysis of the test articles, and oversight of the test series

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

The test manager was William M. Arnold, President of Century Industries.

4.0 TEST ITEM IDENTIFICATION

Century Industries was responsible for the design, fabrication, inspection, and measurements of the previously tested package. 55 Gallon Package - Serial Number 10553. This package was utilized in the 55 gallon test series for shallow angle impacts and penetration test reported in Appendix 2.12.4.

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 3/16" thick top flange was secure using 12 -1/2" bolts. In the second round of testing the 3/16" thick flange was replaced by a ½ " thick flange and secured by the same number of 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.

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

Previously Dropped Prototype

6.0 TEST FACILITES & EQUIPMENT

6.1 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.

6.2 Measurements and Weights

Penetration rod drop heights were determined by use of a pre-measured slide tube set by a 100 foot steel tape measure Serial Number 08461846, calibrated by Starett Company and traceable to NIST.

6.3 Temperature

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.

6.4 Puncture Device

The puncture device consists of a 1.25 inch diameter carbon steel round bar, weighing 13.2 pounds.

6.5 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 was calibrated in accordance with Century Industries Quality Assurance Program. Test and measurement calibration certificates are found in Attachment A. The instrumentation used during testing is listed in Table 1 below.

ITEM	MODEL	S/N	CALIBRATION DUE DATE	COMENTS
16' Tape Measure	N/A	QC-001	May 05, 2010	Used to measure drop height for penetration bar
Dickson Temperature Recorder	SM320	09057179	February 01, 2010	Used to calibrate surface thermometer and record air temperature
PTC Instruments Surface Thermometer	330F	05548	January 09, 2010	Used to measure the temperature of the test articles during the conditioning

Table 1 – Test Instruments

8.0 ACCEPTANCE CRITERIA

The acceptance criteria for this series of testing was (Penetration) 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 (Compression) no buckling of side walls.

9.0 TEST PREPARATION AND RESULTS

9.1 Initial Inspection

On December 15, 2009, the visual inspection of the previously used test item was conducted prior to performing any of the required evaluation tests in order to determine if any unacceptable damage would occur due to the penetration and compression testing.

9.2 Article Temperature

All tests were performed with the test article at ambient temperature of 65°F. Test packages had been stored inside and tests were conducted at that location.

10.0 PENETRATION DROP TEST SEQUENCE

The penetration drop test locations were chosen based upon historical drop testing of similar products and damage results. The test article was utilized in a previous HAC test series. The test article was produced in accordance with the fabrication drawings and QA-8, plan for the Manufacture of Versa-Pac Shipping Containers.

10.1 Penetration Bar Drop – Sidewall Over Vertical Stiffener

The test article was positioned horizontally on a flat 8 inch concrete floor with the penetration bar positioned vertically directly over a vertical inner stiffener thru the outer sidewall of the package. The bar was lifted to a height 40 inches (1 meter) and allowed to be released through a 2 inch PVC guide tube to provide the correct impact on the surface of the test package.

Pre-Drop Surface

Penetration Set-up

10.2 Results

The result of this impact to the sidewall of the test articles resulted in un-measurable damage to the package impact area.

Post Drop Results

10.3 Penetration Bar Drop – Sidewall Between Vertical Stiffeners

The test article was positioned horizontally on a flat 8 inch concrete floor with the penetration bar positioned vertically directly between two vertical inner stiffener thru the outer sidewall of the package. The bar was lifted to a height 40 inches (1 meter) and allowed to be released through a 2 inch PVC guide tube to provide the correct impact on the surface of the test package.

Penetration Set-up

Post Test Results No Damage

10.4 Results

The result of this impact to the sidewall of the test articles resulted in measurable damage to the package impact area with only a slight marring of the package paint.

10.5 Penetration Bar Drop – Top Drum Lid Outer Closure

The test article was positioned vertically on a flat 8 inch concrete floor with the penetration bar positioned vertically directly between on the center of the drum lid of the package. The bar was lifted to a height 40 inches (1 meter) and allowed to be released through a 2 inch PVC guide tube to provide the correct impact on the surface of the test package

Pre-Drop Surface

Penetration Set-up

10.6 Results

The results of this drop produced a slight marring of the drum lid surface.

Post Test Damage - Marring

11.0 Compression Test

The compression test was conducted in accordance with the requirement of 71.71(c)(9). The test article was utilized in a previous HAC & NCT test series. The test article was produced in accordance with the fabrication drawings and QA-8, plan for the Manufacture of Versa-Pac Shipping Containers.

11.1 Compression Loading

The test article was positioned vertically so that the load was directly applied to the top of the package. The test article weighed 624.5 pounds, to meet the requirement of 5 times the weight of the package; a load of 3,200 pounds was loaded on the top surface of the package, for a period of 24 hours.

11.2 Results

No damage or buckling of the package was found upon inspection of the test article.

Stacking Test

Stacking Test

12.0 FINAL CONCLUSIONS OF ALL TEST RESULTS

The results of this test series were found to have little to no affect on the test article and found to be in compliance with the requirements of the 10 CFR 71.71(c)(9) and 71.71(10).

13.0 ATTACHMENTS, REFERENCES & CALIBRATION RECORDS

Attachment A –Calibration Records
Reference 1 – 10 CFR Part 71
Reference 2 – NUREG 6818

Attachment A

Equipment Calibration Records

(5 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

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Starrett®

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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%.

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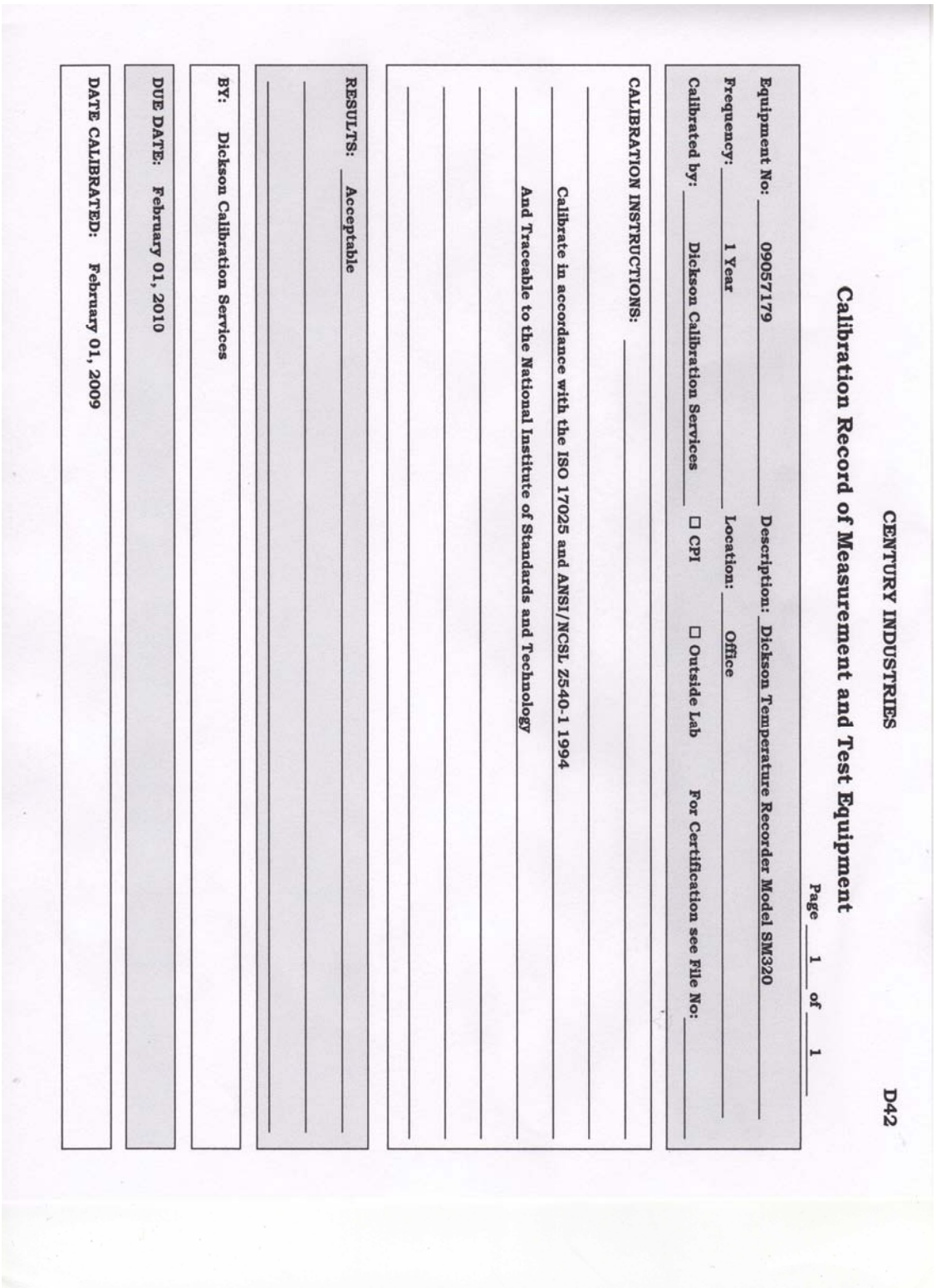
Calibration Record for Dickson Data Thermometer



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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

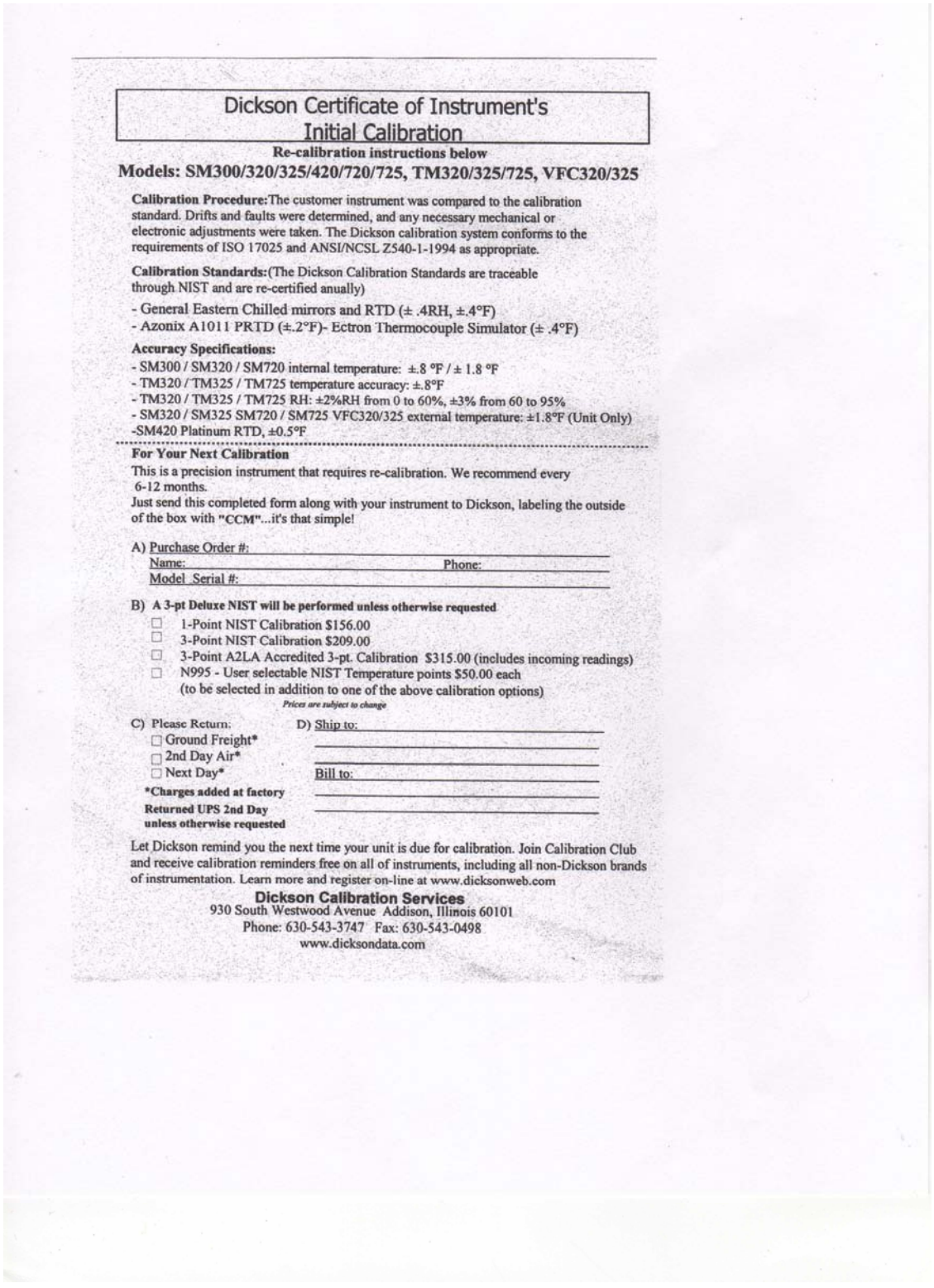
And Traceable to the National Institute of Standards and Technology

RESULTS: Acceptable

BY: Dickson Calibration Services

DUE DATE: February 01, 2010

DATE CALIBRATED: February 01, 2009



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

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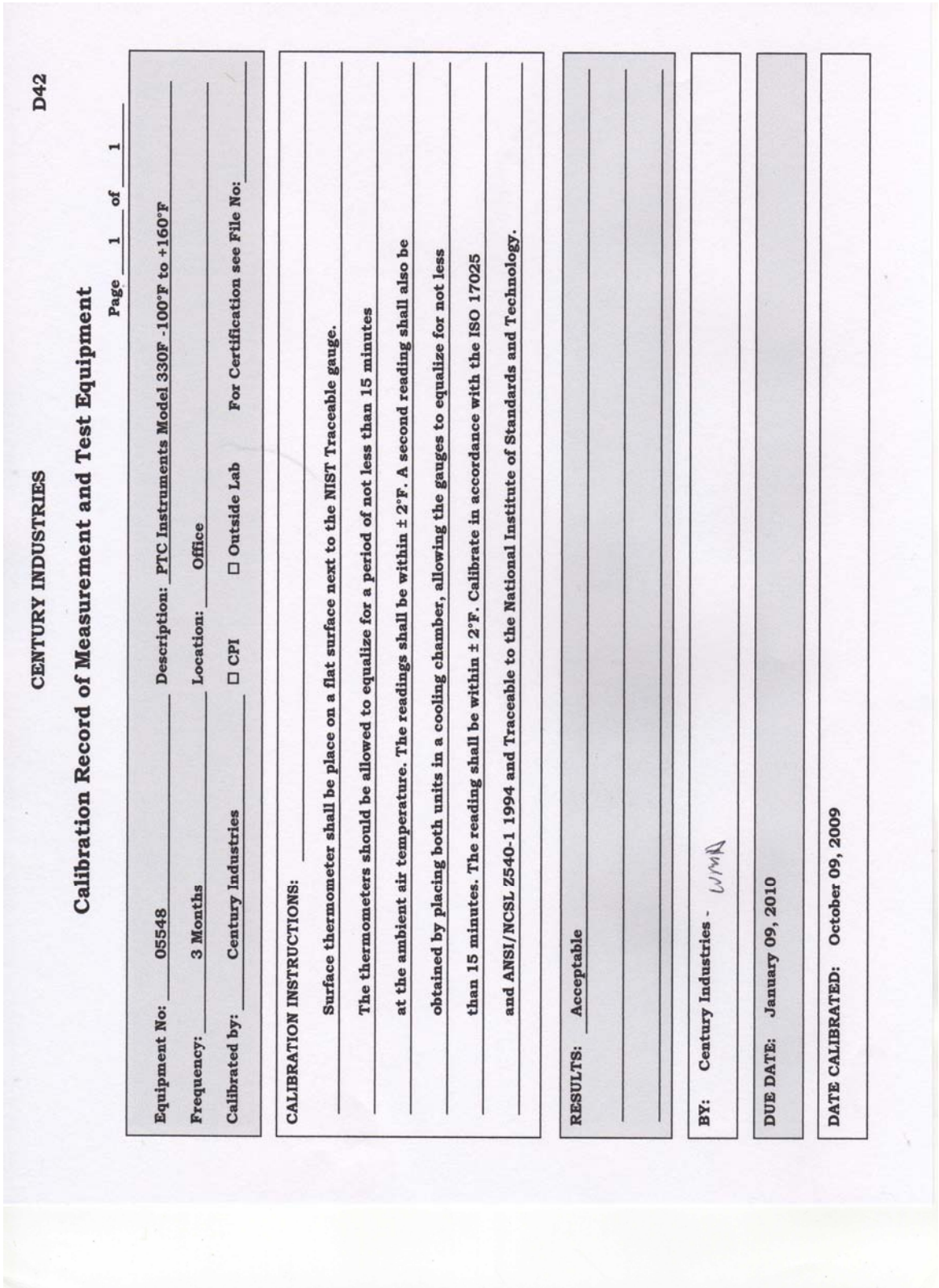
PTC Instruments Model 330F -100°F to +100°F



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 - LVMA

DUE DATE: January 09, 2010

DATE CALIBRATED: October 09, 2009

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