INL/MIS-19-52628-Revision-0

AGC-3 Specimen Load Calculations by Stack

David T Rohrbaugh

June 2019

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INL/MIS-19-52628-Revision-0

AGC-3 Specimen Load Calculations by Stack

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June 2019

Idaho National Laboratory
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Prepared for the
U.S. Department of Energy

Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

Title: AGC-3 Specimen Load Calculations by Stack

ECAR No.: 3932 Rev. No.: 0 Project No.: 32138 Date: 06/11/2019

SIGNATURES

	(Name)	(Organization)	(Signature)	(Date)
Performer:	David Rohrbaugh	D520		4/29/2019
Checker[1]:	W. D. Swank	B120		4/24/19
Independent Peer Reviewer[2]:	N/A			
CUI Reviewer: Yes ☐ or No[5] ☐	N/A			
Manager[3]:	Scott McBride	D520		5/22/2019
Owner[4]:	William Windes	B120		4/30/19
Nuclear Safety[4]:	N/A			
Cognizant Engineer[4]:	N/A			
Quality Assurance:	Michelle T. Sharp	H330/C020		6/11/19

1. Confirmation of completeness, mathematical accuracy, and correctness of data and appropriateness of assumptions.
2. Concurrence of method or approach. See definition, LWP-10106.
3. Concurrence of procedure compliance. Concurrence with method/approach and conclusion.
4. Concurrence with the document's assumptions and input information. See definition of Acceptance, LWP-10200 [1].
5. Does the document contain CUI material please check either yes or no.

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REVISION LOG

Rev.	Date	Affected Pages	Revision Description
0	06/11/2019	All	New document.

Title: AGC-3 Specimen Load Calculations by Stack

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1.	Does this ECAR involve a Safety SSC?	NA	**Professional Engineer's Stamp** See LWP-10010 for requirements.
2.	Safety SSC Determination Document ID	NA	
3.	Engineering Job (EJ) No.		
4.	SSC ID		
5.	Building	NA	
6.	Site Area	NA	

7. Objective/Purpose:

   This engineering calculations and analysis report documents the results of the threshold averaging on the load cell data taken during the third advanced graphite creep (AGC) test, AGC 3. Specimens were irradiated in the Advance Test Reactor (ATR) during Cycles 152B, 154B, 155A, and 155B (the AGC-3 capsule was not in ATR for Cycles 153A/B and 154A). During each cycle, the specimens located in the upper portions of the stacks were subjected to a compressive load to induce irradiation creep in the specimens. The applied load of each stack was monitored and load data were recorded in 1 minute intervals. Collecting data detailing the loads applied over the life of the experiment is necessary for use in future analyses. This load summary data will be used in specimen creep rate estimations and post irradiation examination of material properties.

8. If revision, please state the reason and list sections and/or pages being affected:

   NA

9. Conclusions/Recommendations:

   The load data from the AGC 3 experiment were analyzed. Quantification of the data was necessary to obtain a single load value for each stack of specimens. These values will be used in future analysis and characterization of material properties. The mean load values were calculated when ATR was near steady state. Steady state was defined as the load being above 50 lbf and the reactor power greater than 2 MW. After the averaging, the coefficient of variation was calculated for each stack. This provided an evaluation of the precision of the load cell data. Coefficients of variation ranged between 2.93% (Stack 6) and 4.98% (Stack 4).

   A gas leak in the load control system was identified in the first few days of operation. The evaluation and solution to the gas leak was performed in the first few days of the initial cycle and resulted in lowering the applied load to channel pairs 1-4 to the values used for channel pair 2-5 (377 lbf) applied during the experiment. Analysis of the data shows the variation in average force for Stacks 1, 2, 4, and 5 during steady-state operation was less than 1%. No specimens were loaded at 470 lbf as originally planned.

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PROJECT ROLES AND RESPONSIBILITIES

Project Role	Name (Typed)	Organization	Pages covered (if applicable)
Performer	David Rohrbaugh	D520	All
Checker[a]	W. David Swank	B120	All
Independent Reviewer[b]	NA		
CUI Reviewer[c] INL/MIS-19-52628	John T. Major II	M310	All
Manager[d]	Scott McBride	D520	All
Requestor[e]	William Windes	B120	All
Nuclear Safety[e]	NA		
Document Owner[e]	William Windes	B120	All

Responsibilities:

a. Confirmation of completeness, mathematical accuracy, and correctness of data and appropriateness of assumptions.

b. Concurrence of method or approach. See definition, LWP-10106.

c. Concurrence with the document's markings in accordance with LWP-11202.

d. Concurrence of procedure compliance. Concurrence with method/approach and conclusion.

e. Concurrence with the document's assumptions and input information. See definition of Acceptance, LWP-10200 [**Error! Bookmark not defined.**].

NOTE: *Delete or mark "N/A" for project roles not engaged. Include ALL personnel and their roles listed above in the eCR system. The list of the roles above is not all inclusive. If needed, the list can be extended or reduced.*

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SCOPE AND BRIEF DESCRIPTION

This engineering calculations and analysis report documents the results of the threshold averaging on the load cell data taken during the third advanced graphite creep (AGC) test, AGC-3. Specimens were irradiated in the Advance Test Reactor (ATR) during Cycles 152B, 154B, 155A, and 155B (the AGC-3 capsule was not in ATR for Cycles 153A/B and 154A). During each cycle, the specimens located in the upper portions of the stacks were subjected to a compressive load. The applied load of each stack was monitored and load data were recorded in 1-minute intervals. This estimate of the mean load applied to each stack will be used to calculate creep rates and draw correlations in post-irradiation material property comparisons.

From the onset of the AGC-3 experiment, a gas leak rate of 5.6 L/min was detected in the compressive load control system. This leak rate was relatively high in comparison to previous AGC experiments with leak rates only on the order of 1 L/min. The significant increase was attributed primarily to the portion of the system providing the load on Stack 4. Therefore, a compressive load was not placed on Stack 4 until the source and future consequences of the leak were evaluated. In addition, a compressive load was not placed on Stack 1 (diametrically opposite and load pair companion to Stack 4) to prevent eccentrically loading the graphite specimen holder and possibly damaging the holder and capsule. The compressive loads on Stacks 2 and 5 were reduced from nominally 470 to 377 lbf on December 5, 2012, to maximize the range of specimen loading in the event that Stacks 1 and 4 were not able to have compressive loads applied for the remainder of the experiment.

Since the compressive loads have to remain constant throughout the irradiation, there were two major concerns: (1) the leak rate may increase to the point that the load could not be maintained; and (2) sufficient helium may not be obtainable to overcome the leak rate due to a national shortage of helium. Data from the inlet and outlet system flow meters indicated that the source of the leak was internal to the test train, most probably within the pneumatic ram for Stack 4. After discussions with the vendor and reviewing data taken during preassembly testing of the pneumatic rams, it was decided to test the system to determine the stability of the leak rate. The desired loads were imposed on Stacks 1 and 4 on Tuesday, December 11, 2012, and the leak rate was monitored until Monday, December 17, 2012. The leak rate was extremely stable with essentially no perceptible change over the 6-day period. This result indicated that the leak was most likely located in a metallic component (such as a fitting) and should remain very stable throughout the irradiation. Sufficient helium was located to support maintaining the load on the stacks for the duration of Cycle 152B. However, the compression gas was switched from helium to argon at the end of Cycle 152B. With the determination that the leak rate was stable, it was concluded that loads could successfully be applied to Stacks 1 and 4 for the duration of the AGC 3 experiment, albeit at a lower pressure to both conserve gas and to preclude any further damage to the compressive load system.

A nominal compressive load of 377 lbf was applied to Stacks 1 and 4 for the remainder of the experiment. Stacks 2 and 5 remained at nominally 377 lbf for the duration of the experiment so that the load applied to these stacks would be constant. Therefore, four stacks were nominally loaded to 377 lbf for the experiment and two stacks were loaded to 564 lbf (Stacks 3 and 6). It is also important to note that during reactor outages, as with previous AGC experiments, the load was removed until the beginning of the next reactor cycle.

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DESIGN OR TECHNICAL PARAMETER INPUT AND SOURCES

Load, power, and stack position data were obtained from the Next Generation Nuclear Plant (NGNP) Data Management and Analysis System (NDMAS) from ATR starting at Cycle 152B (November 28, 2012) and ending at Cycle 155B (April 12, 2014).

The accuracy of the load cells that are used is 0.3% of full scale. Full scale for this model is 1000 lb, thus the accuracy is ±3 lb. During assembly of the experiment, these load cells were Quality Assurance verified to be calibrated[1]. Table 1, DWG 603535,[2] and DWG 603520[3] show additional information about the instruments used in the load control system.

Table 1. Load control system instrumentation.

Instrument	Manufacturer	Model/Part No.	Accuracy or Linearity	Repeatability
Precision miniature load cell	Honeywell Corp.	31/AL311CV	±0.3% of full scale (full scale = 1000 lbf) accuracy	±0.05% full scale
Position sensor (linear variable differential transformer [LVDT])	Macro Sensors	PRH 812-1000-080	≤ ±0.25% of full range linearity	<0.01% of full scale output

RESULTS OF LITERATURE SEARCHES AND OTHER BACKGROUND DATA

1. The requirements for this analysis were the following:

    a. Describe the AGC capsule mechanical loading system, verify that the system operated as designed during irradiation, and describe any issues that occurred.

    b. Calculate the steady-state compressive load imposed on the specimens for each outer stacks (1-6) in the AGC-3 capsule at steady state.

    c. Describe the method used to quantify the loads for the specimen stacks.

    d. Provide an estimate of the precision and accuracy of the calculated loads at steady state.

    Requirements for the AGC-3 capsule irradiation data collection are presented in TFR-791,[4] TFR-509,[5] and TFR-510.[6] A description of the approach to the load data qualification is included in INL/EXT-14-32425,[7]

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ASSUMPTIONS

For this analysis, it was assumed that the specimens in each stack did not become lodged or stuck in a position that would alter the load of the remainder of the specimens in the stack. To help prevent this from happening, during reactor outages, the compressive loads are removed from the specimen stacks and each graphite stack is raised vertically by using lower pneumatic rams. Stack raising was performed at the end of Cycle 152B, between Cycles 154B and 155A, and at the end of Cycle 155B (which was the end of the capsule irradiation). No evidence of sticking was observed during any of those events.[7] In addition, the position of each stack remained unaffected between cycles (see Figure 1).

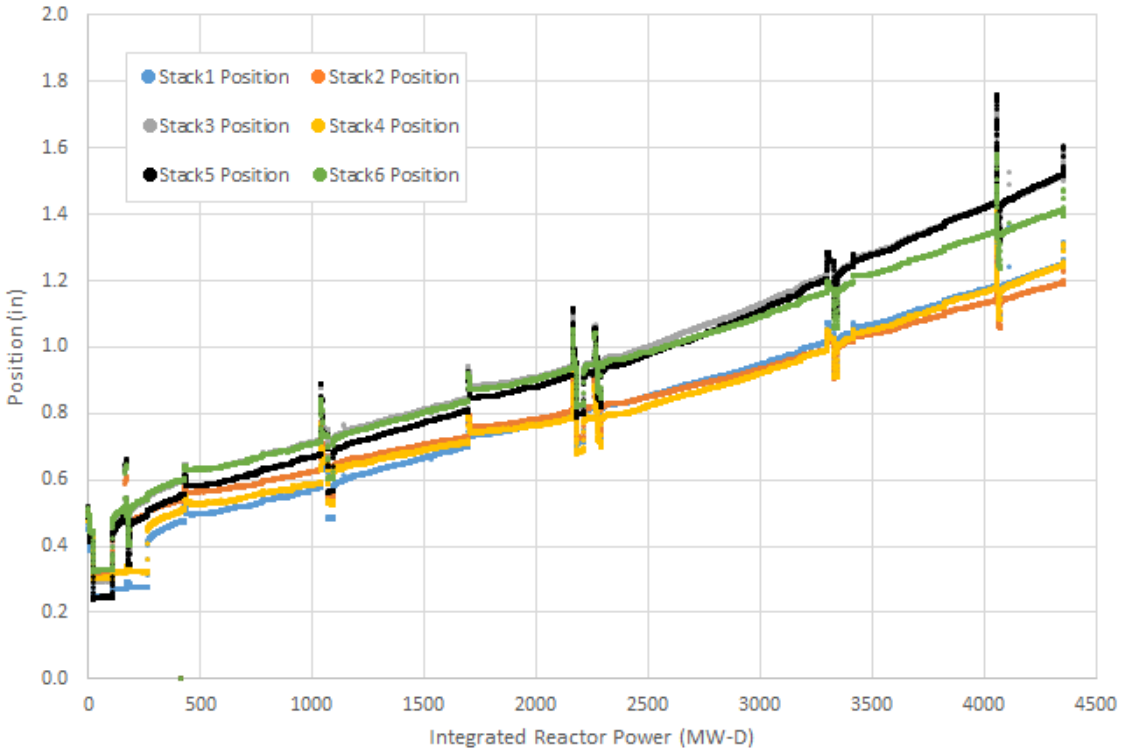

Figure 1. AGC-3 stack position data.

The condition of the load cells was checked during assembly of the compressive load control system by performing wire-to-wire resistance checks. Load cell resistance values were measured and recorded for both the excitation and signal lines. A similar process was used on the position sensors.[2] It was impossible to make similar checks on the load and monitoring system after completion of the experiment due to disassembly actions and high levels of radiation; however, the load and position data are consistent within itself indicating that the load cells and LVDTs operated properly for the entire experiment.

COMPUTER CODE VALIDATION

The “AGC3 10min Load Data ECAR-3932.xlsx” is the Excel spreadsheet used to make the load calculations. The spreadsheet contains load and reactor power data obtained from NDMAS. These data were first reduced from 1-minute increments to 10-minute increments by averaging the applied

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loads. The output of the spreadsheet is an average load value for each stack (1–6) of specimens along with an uncertainty estimation. This is shown in Table 3 below. The calculations performed in the spreadsheet are basic enough that they were easily validated by random hand-calculations performed by the checker.

DISCUSSION/ANALYSIS

Load cell data from each stack of specimens in the AGC-3 experiment were recorded in 1-minute intervals and saved to NDMAS. Data logging for AGC-3 began on November 27, 2012, with Cycle 152B and ended on April 12, 2014, with Cycle 155B.[7] Figure 2 provides a history plot of the loads for each stack across all reactor cycles. The load data distributions were also plotted as histograms. These are shown in Figure 3 through Figure 5. The statistics shown are the steady-state statistics in that they only include data that is over 50 lbf when the power is greater than 2 MW.

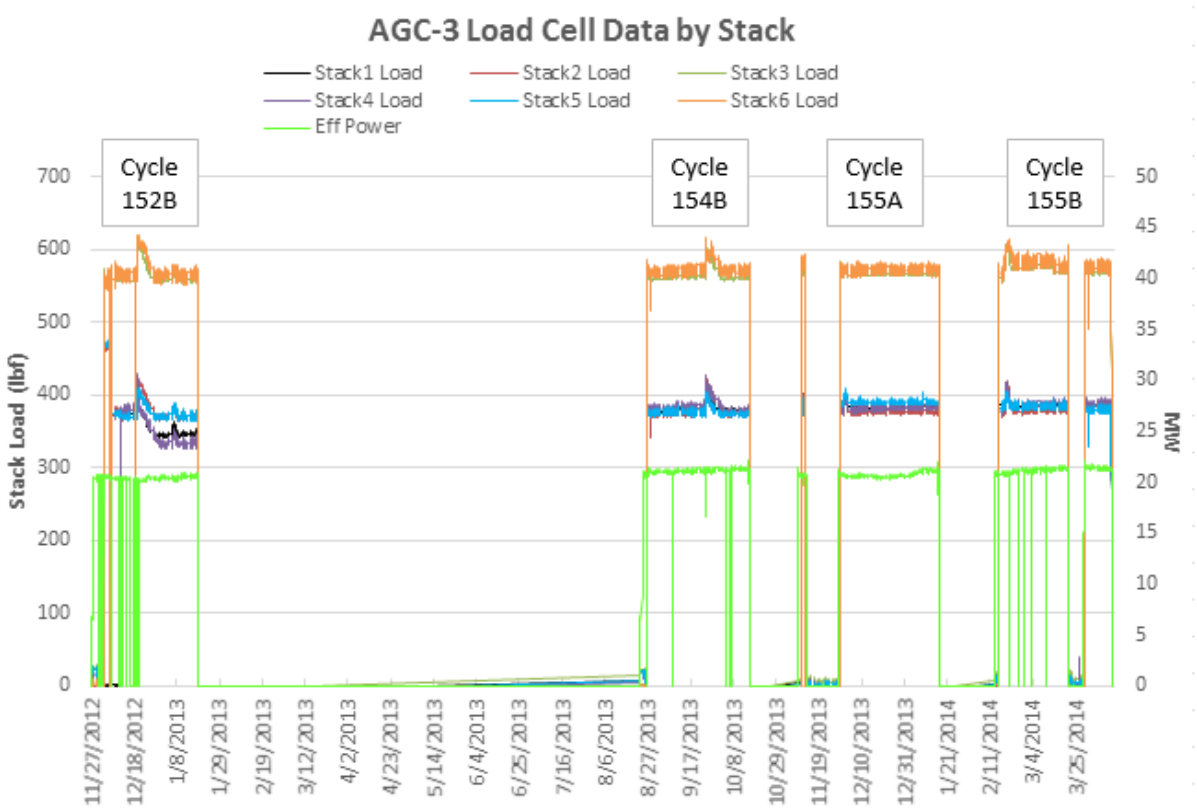

Figure 2. Time series data of load cell output from AGC-3 capsule.

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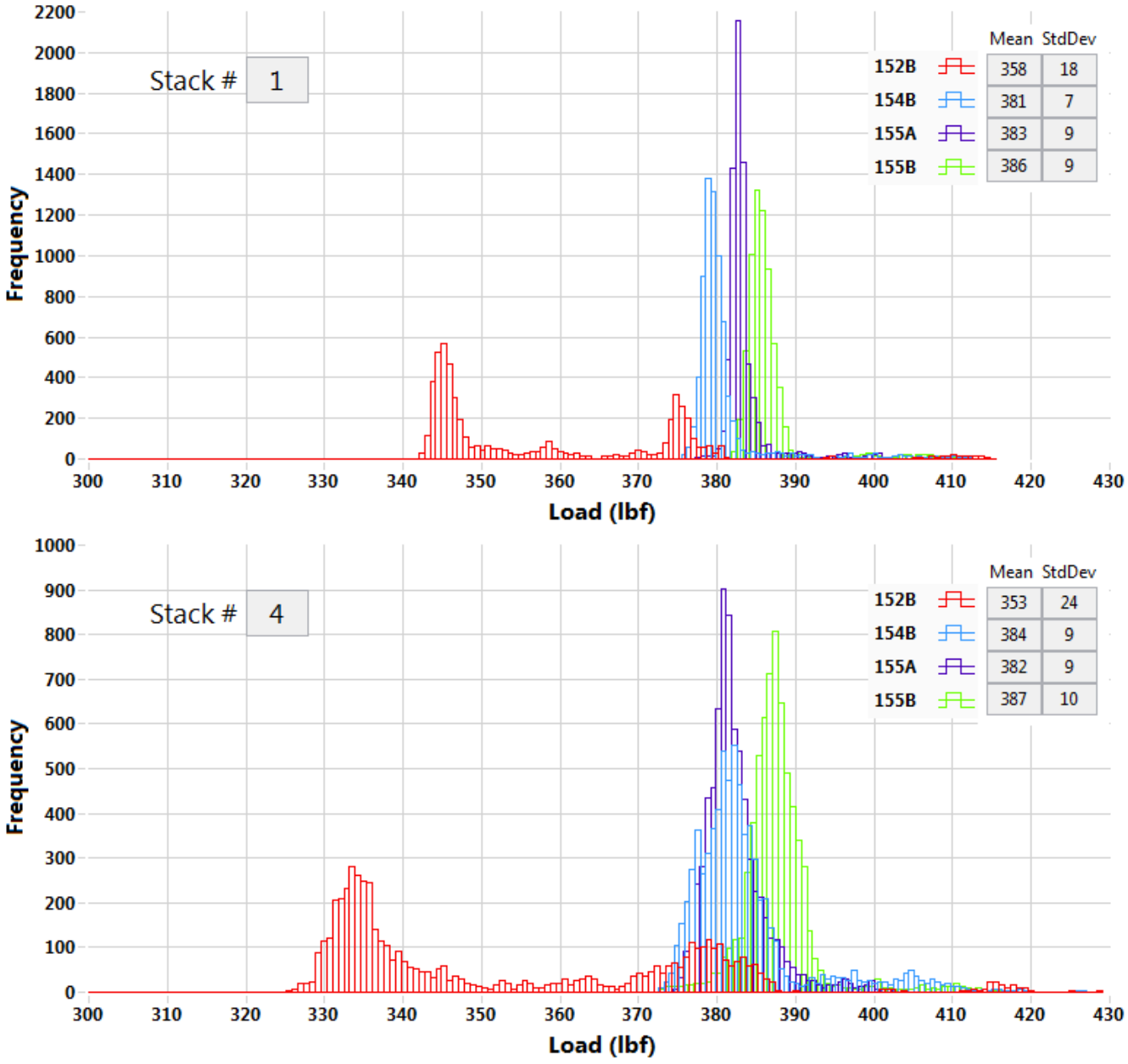

Figure 3. Histogram of loads for Stacks 1 and 4.

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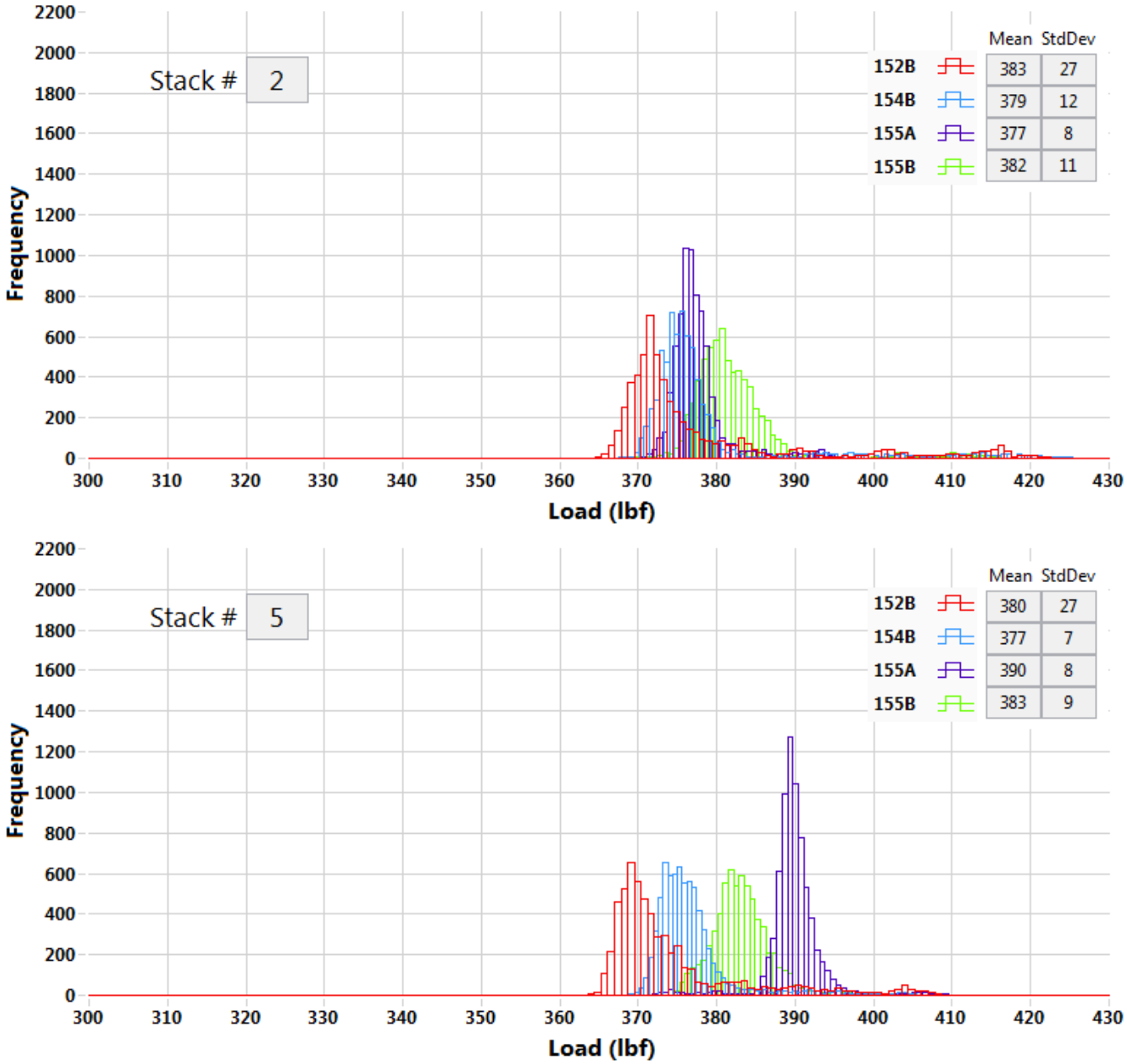

Figure 4. Histogram of loads for Stacks 2 and 5.

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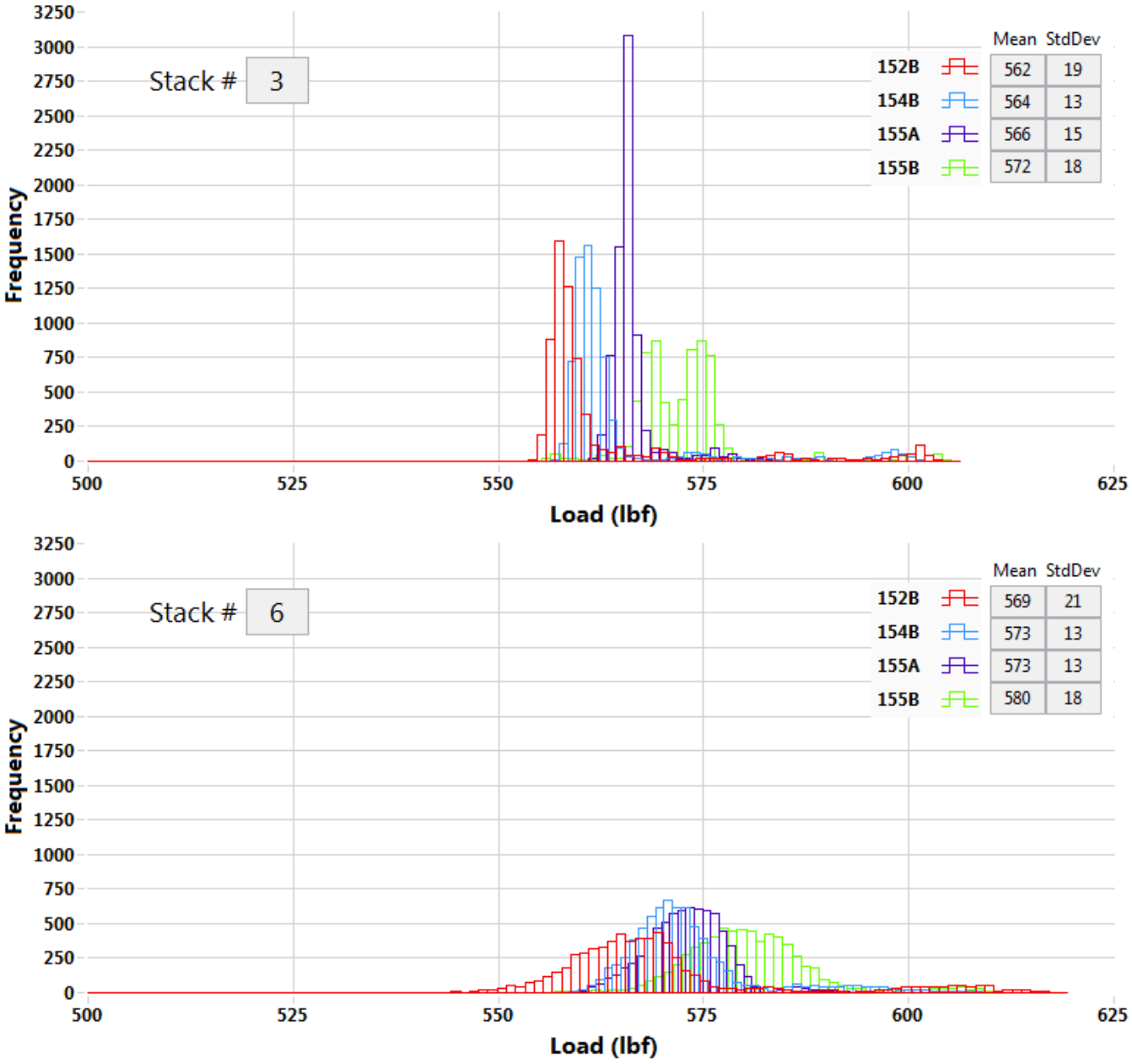

Figure 5. Histogram of loads for Stacks 3 and 6.

SUMMARY AND CONCLUSIONS

The load data from the AGC-3 capsule were analyzed. Quantification of the data was necessary to obtain a single load value for each stack of specimens. These values will be used in future analysis and characterization of material properties of the AGC-3 specimens. The mean load values were calculated when the reactor was near steady state. Steady state was defined as the load being above 50 lbf and the reactor power greater than 2 MW. Table 2 shows the results of this averaging. Table 3 shows the average loads by cycle.

Table 2. Steady-state load statistics by specimen stack.

Steady-State Statistics	Stack 1	Stack 2	Stack 3	Stack 4	Stack 5	Stack 6
Average load (lbf)	378	380	566	378	382	574
2*Std Dev (lbf)	31	32	33	38	31	34
Coefficient of variation (%)	4.0	4.2	3.0	5.0	4.0	2.9

Table 3 Steady-state load averages for each specimen stack by cycle.

	Steady-State Load Average (lbf)					
Cycle	Stack 1	Stack 2	Stack 3	Stack 4	Stack 5	Stack 6
152B	358	383	562	353	380	569
154B	381	379	564	384	377	573
155A	383	377	566	382	390	573
155B	386	382	572	387	383	580

REFERENCES

[1] WO 159704-01, “Engineering Work Instructions for Assembling the AGC-3 Experiment.”

[2] DWG 603535, “ATR Advanced Graphite Capsule (AGC) Upper Cylinder Assembly,” June 12, 2012.

[3] DWG 603520, “ATR Advanced Graphite Capsule (AGC-3) Test Train Facility Assembly,” June 25, 2012.

[4] TFR-791, “NGNP Advanced Graphite Capsule AGC-3 Experimental Test Train.”

[5] TFR-509, “Advanced Graphite Capsule Temperature Control System.”

[6] TFR-510, “Advanced Graphite Capsule Compressive Load Control Gas System.”

[7] INL/EXT-14-32425, *AGC-3 Experiment Irradiation Monitoring Data Qualification Final Report*, October 2014.

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Appendix A

INL Calibration Input Data

INL
CALIBRATION INPUT DATA

11/6/2017

NAME: MATT WESEMAN | BADGE: 45985 | PH: 526-2573 | AREA: REC | BLDG: NHL | RM:

ID Number: 729031 Mfr: HONEYWELL Model: 31-1000 Noun Name: LOAD CELL Serial #: 1339701
Next Cal Due Date: 1/16/2013

		ACTION PERFORMED		AS-FOUND CONDITION	
Calibration Date:	1/16/2012	1 ☐	Acceptance Test	1 ◉	In Tolerance
Charge Level:	12	2 ☐	Calibration - SCL Specs	2 ○	Out of Tolerance >1x <2x
Repair/Adj/etc C.L:	0	3 ☐	Calibration - MFG Specs	3 ○	Out of Tolerance >2x <3x
Material Amount:	0	4 ☐	Clean	4 ○	Out of Tolerance >3x <5x
Charge Number:	100778251	5 ☑	Limited Calibration	5 ○	Out of Tolerance >5x
Cal Work Inst ID:	5748R	6 ☐	Functional Check	6 ○	Out of Tolerance-Undetermined
Outside Vendor:		7 ☐	Performance Check	7 ☐	Inoperative
		8 ☐	Modify	8 ☐	Damaged
		9 ☐	Repair-needs Charge Level	9 ☐	Not Used
		10 ☐	Other	10 ☐	Not Determined
				11 ☐	Excessed
Calibrated By:	Stan Zohner	S#: 58146	Phone: 526-2350	12 ☐	Extension

CALIBRATION STANDARDS USED

304399	350815	375257					

STANDARDS USED ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY DERIVED FROM ACCEPTED VALUES FOR NATURAL PHYSICAL CONSTANTS, OR DERIVED FROM THE RATIO TYPE OF SELF CALIBRATION TECHNIQUES.

LABORATORY TEMPERATURE AND HUMIDITY

Physical STD (106C)	(20.0 ± 0.3) °C (40 to 55) %RH	Electronic STD (106D)	(23.0 ± 0.5) °C (30 to 45) %RH
Dimensional STD (106B)	(20.0 ± 0.25) °C (30 to 45) %RH	Electronic CAL (Lab 112)	(23.0 ± 1.0) °C (20 to 50) %RH
Phys/Dim CAL (Lab 111)	(20.0 ± 0.5) °C (20 to 50) %RH	Remaining S&CL calibration areas:	(23.0 +5, -3) °C (20 to 50) %RH

Manufacturer's environmental specifications are evaluated for conformance when calibrations are performed outside the above stated conditions.

OUT OF TOLERANCE CONDITIONS FOUND DURING CALIBRATION

Function Tested	Standard Reading	UUT Reading	UUT Tolerance

COMMENTS

LIMITED: MUST USE COEFFICIENTS GENERATED:
A= 1.353623013E-1 B= -4.457032127E+1 C= -2.959957248E-4,
EXCITATION VOLTAGE 10 VDC, TENSION NOT CALIBRATED PER USER (SCOTT BARRIE)

Title: AGC-3 Specimen Load Calculations by Stack

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INL
CALIBRATION INPUT DATA

11/6/2017

NAME: MATT WESEMAN | BADGE: 45985 | PH: 526-2573 | AREA: REC | BLDG: NHL | RM:

ID Number: 727812 Mfr: HONEYWELL Model: 31-1000 Noun Name: LOAD CELL Serial #: 1295038

Next Cal Due Date: 12/22/2012

Calibration Date: 12/22/2011
Charge Level: 12
Repair/Adj/etc C.L.: 0
Material Amount: 0
Charge Number: 101817504
Cal Work Inst ID: 5748R
Outside Vendor:

ACTION PERFORMED

1	☐	Acceptance Test
2	☐	Calibration - SCL Specs
3	☐	Calibration - MFG Specs
4	☐	Clean
5	☑	Limited Calibration
6	☐	Functional Check
7	☐	Performance Check
8	☐	Modify
9	☐	Repair-needs Charge Level
10	☐	Other

AS-FOUND CONDITION

1	◉	In Tolerance
2	○	Out of Tolerance >1x <2x
3	○	Out of Tolerance >2x <3x
4	○	Out of Tolerance >3x <5x
5	○	Out of Tolerance >5x
6	○	Out of Tolerance-Undetermined
7	☐	Inoperative
8	☐	Damaged
9	☐	Not Used
10	☐	Not Determined
11	☐	Excessed
12	☐	Extension

Calibrated By: Stan Zohner S#: 58146 Phone: 526-2350

CALIBRATION STANDARDS USED

304399	350815	375257					

STANDARDS USED ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY DERIVED FROM ACCEPTED VALUES FOR NATURAL PHYSICAL CONSTANTS, OR DERIVED FROM THE RATIO TYPE OF SELF CALIBRATION TECHNIQUES.

LABORATORY TEMPERATURE AND HUMIDITY

Physical STD (106C)	(20.0 ± 0.3) °C (40 to 55) %RH	Electronic STD (106D)	(23.0 ± 0.5) °C (30 to 45) %RH
Dimensional STD (106B)	(20.0 ± 0.25) °C (30 to 45) %RH	Electronic CAL (Lab 112)	(23.0 ± 1.0) °C (20 to 50) %RH
Phys/Dim CAL (Lab 111)	(20.0 ± 0.5) °C (20 to 50) %RH	Remaining S&CL calibration areas:	(23.0 +5, -3) °C (20 to 50) %RH

Manufacturer's environmental specifications are evaluated for conformance when calibrations are performed outside the above stated conditions.

OUT OF TOLERANCE CONDITIONS FOUND DURING CALIBRATION

Function Tested	Standard Reading	UUT Reading	UUT Tolerance

COMMENTS

LIMITED: MUST USE NEW COEFFICIENTS GENERATED:
A = -2.242700453E-1, B = -4.753217677E+1, C = -2.440357825E-3, EXCITATION VOLTAGE 10 VDC, TENSION NOT CALIBRATED PER USER (SCOTT BARRIE)

Title: AGC-3 Specimen Load Calculations by Stack

ECAR No.: 3932 Rev. No.: 0 Project No.: 32138 Date: 06/11/2019

INL
CALIBRATION INPUT DATA

11/6/2017

NAME: MATT WESEMAN | BADGE: 45985 | PH: 526-2573 | AREA: REC | BLDG: NHL | RM:

ID Number: 727789 Mfr: HONEYWELL Model: 31-1000 Noun Name: LOAD CELL Serial #: 1295039

Next Cal Due Date: 12/22/2012

Calibration Date: 12/22/2011
Charge Level: 12
Repair/Adj/etc C.L.: 0
Material Amount: 0
Charge Number:
Cal Work Inst ID: 5748R
Outside Vendor:

ACTION PERFORMED

1	☐	Acceptance Test
2	☐	Calibration - SCL Specs
3	☐	Calibration - MFG Specs
4	☐	Clean
5	☑	Limited Calibration
6	☐	Functional Check
7	☐	Performance Check
8	☐	Modify
9	☐	Repair-needs Charge Level
10	☐	Other

AS-FOUND CONDITION

1	◉	In Tolerance
2	○	Out of Tolerance >1x <2x
3	○	Out of Tolerance >2x <3x
4	○	Out of Tolerance >3x <5x
5	○	Out of Tolerance >5x
6	○	Out of Tolerance-Undetermined
7	☐	Inoperative
8	☐	Damaged
9	☐	Not Used
10	☐	Not Determined
11	☐	Excessed
12	☐	Extension

Calibrated By: Stan Zohner S#: 58146 Phone: 526-2350

CALIBRATION STANDARDS USED

304399	350815	375257					

STANDARDS USED ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY DERIVED FROM ACCEPTED VALUES FOR NATURAL PHYSICAL CONSTANTS, OR DERIVED FROM THE RATIO TYPE OF SELF CALIBRATION TECHNIQUES.

LABORATORY TEMPERATURE AND HUMIDITY

Physical STD (106C)	(20.0 ± 0.3) °C (40 to 55) %RH	Electronic STD (106D)	(23.0 ± 0.5) °C (30 to 45) %RH
Dimensional STD (106B)	(20.0 ± 0.25) °C (30 to 45) %RH	Electronic CAL (Lab 112)	(23.0 ± 1.0) °C (20 to 50) %RH
Phys/Dim CAL (Lab 111)	(20.0 ± 0.5) °C (20 to 50) %RH	Remaining S&CL calibration areas:	(23.0 +5, -3) °C (20 to 50) %RH

Manufacturer's environmental specifications are evaluated for conformance when calibrations are performed outside the above stated conditions.

OUT OF TOLERANCE CONDITIONS FOUND DURING CALIBRATION

Function Tested	Standard Reading	UUT Reading	UUT Tolerance

COMMENTS

LIMITED: MUST USE NEW COEFFICIENTS GENERATED:
A = 2.521207478E-1, B = -4.651409641E+1, C = 4.704088638E-3, EXCITATION VOLTAGE 10 VDC, TENSION NOT CALIBRATED PER USER (SCOTT BARRIE)

Title: AGC-3 Specimen Load Calculations by Stack

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INL
CALIBRATION INPUT DATA

11/6/2017

NAME: MATT WESEMAN | BADGE: 45985 | PH: 526-2573 | AREA: REC | BLDG: NHL | RM:

ID Number: 727818 Mfr: HONEYWELL Model: 31-1000 Noun Name: LOAD CELL Serial #: 1295091

Next Cal Due Date: 12/21/2012

Calibration Date: 12/21/2011
Charge Level: 12
Repair/Adj/etc C.L.: 0
Material Amount: 0
Charge Number: 101817504
Cal Work Inst ID: 5748R
Outside Vendor:

ACTION PERFORMED

1	☐	Acceptance Test
2	☐	Calibration - SCL Specs
3	☐	Calibration - MFG Specs
4	☐	Clean
5	☑	Limited Calibration
6	☐	Functional Check
7	☐	Performance Check
8	☐	Modify
9	☐	Repair-needs Charge Level
10	☐	Other

AS-FOUND CONDITION

1	◉	In Tolerance
2	○	Out of Tolerance >1x <2x
3	○	Out of Tolerance >2x <3x
4	○	Out of Tolerance >3x <5x
5	○	Out of Tolerance >5x
6	○	Out of Tolerance-Undetermined
7	☐	Inoperative
8	☐	Damaged
9	☐	Not Used
10	☐	Not Determined
11	☐	Excessed
12	☐	Extension

Calibrated By: Stan Zohner S#: 58146 Phone: 526-2350

CALIBRATION STANDARDS USED

304399	350815	375257					

STANDARDS USED ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY DERIVED FROM ACCEPTED VALUES FOR NATURAL PHYSICAL CONSTANTS, OR DERIVED FROM THE RATIO TYPE OF SELF CALIBRATION TECHNIQUES.

LABORATORY TEMPERATURE AND HUMIDITY

Physical STD (106C)	(20.0 ± 0.3) °C (40 to 55) %RH	Electronic STD (106D)	(23.0 ± 0.5) °C (30 to 45) %RH
Dimensional STD (106B)	(20.0 ± 0.25) °C (30 to 45) %RH	Electronic CAL (Lab 112)	(23.0 ± 1.0) °C (20 to 50) %RH
Phys/Dim CAL (Lab 111)	(20.0 ± 0.5) °C (20 to 50) %RH	Remaining S&CL calibration areas:	(23.0 +5, -3) °C (20 to 50) %RH

Manufacturer's environmental specifications are evaluated for conformance when calibrations are performed outside the above stated conditions.

OUT OF TOLERANCE CONDITIONS FOUND DURING CALIBRATION

Function Tested	Standard Reading	UUT Reading	UUT Tolerance

COMMENTS

LIMITED: MUST USE NEW COEFFICIENTS GENERATED:
A= 1.437456143E-1 B= -4.436245566E+1 C= 1.003984144E-2, EXCITATION VOLTAGE 10 VDC,
TENSION NOT CALIBRATED PER USER (SCOTT BARRIE)

Title: AGC-3 Specimen Load Calculations by Stack

ECAR No.: 3932 Rev. No.: 0 Project No.: 32138 Date: 06/11/2019

INL CALIBRATION INPUT DATA

2/4/2019

NAME: MATT WESEMAN	BADGE: 45985	PH: 526-2573	AREA: REC	BLDG: NHL	RM:

ID Number: 727880 Mfr: HONEYWELL Model: 31-1000 Noun Name: LOAD CELL Serial #: 1295093

Next Cal Due Date: 1/11/2013

Calibration Date: 1/11/2012

Charge Level: 12

Repair/Adj/etc C.L: 0

Material Amount: 0

Charge Number: 100911C56

Cal Work Inst ID: 5748R

Outside Vendor:

Calibrated By: Stan Zohner S#: 58146 Phone: 526-2350

ACTION PERFORMED

1	☐	Acceptance Test
2	☐	Calibration - SCL Specs
3	☐	Calibration - MFG Specs
4	☐	Clean
5	☑	Limited Calibration
6	☐	Functional Check
7	☐	Performance Check
8	☐	Modify
9	☐	Repair-needs Charge Level
10	☐	Other

AS-FOUND CONDITION

1	○	In Tolerance
2	◉	Out of Tolerance >1x <2x
3	○	Out of Tolerance >2x <3x
4	○	Out of Tolerance >3x <5x
5	○	Out of Tolerance >5x
6	○	Out of Tolerance-Undetermined
7	☐	Inoperative
8	☐	Damaged
9	☐	Not Used
10	☐	Not Determined
11	☐	Excessed
12	☐	Extension

CALIBRATION STANDARDS USED

304399	350815	375257					

STANDARDS USED ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY DERIVED FROM ACCEPTED VALUES FOR NATURAL PHYSICAL CONSTANTS, OR DERIVED FROM THE RATIO TYPE OF SELF CALIBRATION TECHNIQUES.

LABORATORY TEMPERATURE AND HUMIDITY

Physical STD (106C)	(20.0 ± 0.3) °C (40 to 55) %RH	Electronic STD (106D)	(23.0 ± 0.5) °C (30 to 45) %RH
Dimensional STD (106B)	(20.0 ± 0.25) °C (30 to 45) %RH	Electronic CAL (Lab 112)	(23.0 ± 1.0) °C (20 to 50) %RH
Phys/Dim CAL (Lab 111)	(20.0 ± 0.5) °C (20 to 50) %RH	Remaining S&CL calibration areas:	(23.0 +5, -3) °C (20 to 50) %RH

Manufacturer's environmental specifications are evaluated for conformance when calibrations are performed outside the above stated conditions.

OUT OF TOLERANCE CONDITIONS FOUND DURING CALIBRATION

Function Tested	Standard Reading	UUT Reading	UUT Tolerance
lbf	796.85 lbf	800 lbf	+/- 2.9 lbf
lbf	896.56 lbf	900 lbf	+/- 2.9 lbf
lbf	996.28 lbf	1000 lbf	+/- 2.9 lbf

COMMENTS

```
Unit was out of tolerance.
LIMITED: MUST USE NEW COEFFICIENTS GENERATED:
A = 9.614428469E-2, B = -4.731088222E+1, C =  1.096843486E-3,
EXCITATION VOLTAGE 10 VDC, TENSION NOT CALIBRATED PER USER (SCOTT BARRIE)
```

Title: AGC-3 Specimen Load Calculations by Stack

ECAR No.: 3932 Rev. No.: 0 Project No.: 32138 Date: 06/11/2019

INL CALIBRATION INPUT DATA

2/4/2019

NAME: MATT WESEMAN	BADGE: 45985	PH: 526-2573	AREA: REC	BLDG: NHL	RM:

ID Number: 728183 Mfr: HONEYWELL Model: 31-1000 Noun Name: LOAD CELL Serial #: 1315999

Next Cal Due Date: 12/21/2012

Calibration Date: 12/21/2011
Charge Level: 12
Repair/Adj/etc C.L.: 0
Material Amount: 0
Charge Number: 100911C56
Cal Work Inst ID: 5748R
Outside Vendor:

ACTION PERFORMED

1	☐	Acceptance Test
2	☐	Calibration - SCL Specs
3	☐	Calibration - MFG Specs
4	☐	Clean
5	☑	Limited Calibration
6	☐	Functional Check
7	☐	Performance Check
8	☐	Modify
9	☐	Repair-needs Charge Level
10	☐	Other

AS-FOUND CONDITION

1	○	In Tolerance
2	◉	Out of Tolerance >1x <2x
3	○	Out of Tolerance >2x <3x
4	○	Out of Tolerance >3x <5x
5	○	Out of Tolerance >5x
6	○	Out of Tolerance-Undetermined
7	☐	Inoperative
8	☐	Damaged
9	☐	Not Used
10	☐	Not Determined
11	☐	Excessed
12	☐	Extension

Calibrated By: Stan Zohner S#: 58146 Phone: 526-2350

CALIBRATION STANDARDS USED

304399	350815	375257					

STANDARDS USED ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY DERIVED FROM ACCEPTED VALUES FOR NATURAL PHYSICAL CONSTANTS, OR DERIVED FROM THE RATIO TYPE OF SELF CALIBRATION TECHNIQUES.

LABORATORY TEMPERATURE AND HUMIDITY

Physical STD (106C)	(20.0 ± 0.3) °C (40 to 55) %RH	Electronic STD (106D)	(23.0 ± 0.5) °C (30 to 45) %RH
Dimensional STD (106B)	(20.0 ± 0.25) °C (30 to 45) %RH	Electronic CAL (Lab 112)	(23.0 ± 1.0) °C (20 to 50) %RH
Phys/Dim CAL (Lab 111)	(20.0 ± 0.5) °C (20 to 50) %RH	Remaining S&CL calibration areas:	(23.0 +5, -3) °C (20 to 50) %RH

Manufacturer's environmental specifications are evaluated for conformance when calibrations are performed outside the above stated conditions.

OUT OF TOLERANCE CONDITIONS FOUND DURING CALIBRATION

Function Tested	Standard Reading	UUT Reading	UUT Tolerance
lbf	697.07 lbf	700 lbf	+/-2.9 lbf
lbf	796.68 lbf	800 lbf	+/-2.9 lbf
lbf	896.31 lbf	900 lbf	+/-2.9 lbf
lbf	995.97 lbf	1000 lbf	+/-2.9 lbf

COMMENTS

Unit was out of tolerance. Zero balance was 0.35838mV (it should be less than 0.22mV (1%fs)). zero balance can not be fixed. New coefficients were generated to bring within manufactures spec of +/- 0.29% F.S.
LIMITED: MUST USE NEW COEFFICIENTS GENERATED: A= -7.771009165E-2
B= -4.683035475E+1 C= -2.740229045E-3, EXCITATION VOLTAGE 10 VDC, TENSION NOT CALIBRATED PER USER (SCOTT BARRIE) 9/22/2010