INL/MIS-21-63842-Revision-0

ECAR-1943 AGC-1 INDIVIDUAL SPECIMEN FLUENCE, TEMPERATURE, AND LOAD CALCULATION AND TABULATION

August 2021

Ted R Reed

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Idaho National Laboratory

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Engineering Calculations and Analysis

ECAR Title: AGC-1 Individual Specimen Fluence, Temperature, and Load Calculation and Tabulation

ECAR No.: 1943

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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.

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7. Objective/Purpose: This ECAR documents the temperature and fluence corrections performed to account for the changing elevations of the AGR-1 specimens. This specimen elevation change is due to irradiation shrinkage and load induced creep which causes the specimen stacks to move downwards. Also calculated is the power averaged load on the compressed specimen stacks. These fluence, temperature, and load results are tabulated along with each specimen ID number, specimen stack number, and initial specimen elevation.

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

   NA

9. Conclusions/Recommendations:

   The specimen fluence change is significant in the uppermost compressed specimen stacks, resulting in a maximum fluence correction of +16.3% in the top specimen of stack S-6. However, the needed correction becomes smaller in the compressed specimens that are closer to the reactor mid-plane. Fluence correction in the uncompressed center stack shows that the correction below mid-plane is <0.2%. Therefore no fluence correction is performed on the uncompressed outer stacks, S-1 thru S-6.

   The maximum temperature correction calculated is 10.2 C (+1.7%) and is observed in the compressed portion of S-6. Similar to the fluence correction, the temperature correction was not performed on the specimens below reactor mid-plane as the elevation change, and thus the temperature correction is minimal, resulting in temperature adjustments of <0.3%.

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APPENDICES

Title: AGC-1 Individual Specimen Fluence, Temperature, and Load Calculation and Tabulation

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PROJECT ROLES AND RESPONSIBILITIES

Project Role	Name (Typed)	Organization	Pages covered (if applicable)
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Nuclear Safety[e]	NA		
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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.

Title: AGC-1 Individual Specimen Fluence, Temperature, and Load Calculation and Tabulation

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SCOPE AND BRIEF DESCRIPTION

This ECAR calculates the fluence and temperature of the AGC-1 specimens as they change elevation through the course of the experiment. The specimen elevation varies as the specimen stack shrinks due to irradiation and load induced creep. The compressed specimen stacks (S-1 thru S-6) have a graphite pushrod that applies a gas cylinder load. The top of the pushrod position is measured and recorded in the NGNP Data Management and Analysis System (NDMAS). The bottom of each of these compressed stacks is supported by the lower specimen holder which also shrinks as a result of irradiation and load. The specimen holder post-irradiation length was recorded during post-irradiation examination (PIE). Assuming the specimen holder shrinkage is linear with respect to the fluence received, the position of the top of the specimen holder can be calculated with respect to reactor integrated power. Assuming that individual specimen shrinkage is proportional to the fluence received, and that the shrinkage behavior is similar in all the specimens, the individual specimen position can be calculated.

As documented in ECAR 1406, the DPA for graphite for this experiment varies by nearly a factor of five from reactor mid-plane to the top of core. Therefore as the specimen elevation changes there is a significant change in DPA. During the course of the AGC-1 experiment, the upper compressed specimens moved downward as much as 1.3 inches and thus into a 20% higher DPA region. To correct for this changing flux, the calculations are broken into seven sections, corresponding to each of the seven reactor cycles: Cycles 145A, 145B, 146A, 146B, 147A, 148A and 148B. The specimen fluence received in each reactor cycle is calculated by finding the fluence based on average specimen elevation for that cycle. The total specimen fluence is then the sum of the fluence received during each reactor cycle.

The temperature experienced by the specimens also varies as the specimen elevation changes. The average temperature of the specimens are calculated in ECAR-1944, however they are based on a constant specimen elevation. In a similar manner to the fluence correction, the average specimen temperature for each reactor cycle can be calculated based on the power averaged specimen elevation. The integrated specimen temperature is then the reactor power weighted average of all seven reactor cycles.

The specimen load on the compressed stacks remains relatively constant throughout the experiment with the exception of brief periods when the load is removed. The load reported is a reactor power weighted average of the load recorded on NDMAS, and therefore is slightly less that the steady state load.

DESIGN OR TECHNICAL PARAMETER INPUT AND SOURCES

1. NDMAS Data from ATR Reactor from 4 September, 2009 thru 8 January, 2011

2. Spreadsheet “AGC graphite body dimensions”, from Philip Winston (see attached e-mail, Appendix B)

ASSUMPTIONS

Length changes of the specimens were assumed to be linear with respect to fluence and therefore reactor integrated power (megawatt-days).

Length changes of the all specimens were assumed to be equal and proportional to fluence. This assumption was used only to calculate the position change of specimens

COMPUTER CODE VALIDATION

Excel software results were validated by random hand calculation checks performed by the checker as allowed per LWP-10200, Appendix E, Ref. 1).

DISCUSSION/ANALYSIS

The calculations performed in this analysis are done in a series of 6 spreadsheets and are individually discussed below.

AGC-1 Raw NDMAS Data

The reactor cycle data was taken from NDMAS and compiled on this single sheet.

AGC-1 Specimen Holder Displacement

This spreadsheet calculates the total length change of the graphite specimen holders and insulator as a function of reactor megawatt-days. This is necessary to calculate the changing position of the bottom of the compressed specimen stacks. This calculation is based on PIE measurements of the overall length of the specimen holders. However, the insulator length and the lower .75 inches of the Upper Specimen Holder Bottom were not measured. Therefore the measured length change of the specimen holders are used to calculate the change in length of the insulator and the lower section of the Upper Specimen Holder Bottom. This calculation is based on the relative fluence and therefore the shrinkage of individual 0.125 inch slices of the specimen holder. The total specimen holder length change is then the total the individual slice length change. The correlation between the individual slice length change versus the fluence in then used to calculate the length change of the insulator and Upper Specimen Holder Bottom. The total integrated fluence received by the holders is assumed to be an average of all the positions and is calculated on the *Fluence Curve Fit Sheet*.

AGC-1 Center Stack (S-7) Height Change

This spreadsheet calculates the change in height of the uncompressed center S-7 specimen stack based on PIE measurements (Ref 4). Some of the components in the stack were not measured; therefore their length change is calculated based on the shrinkage behavior measured in similar specimens in the stack. This length change is based on a curve fit of the shrinkage versus fluence data of specimens of the same graphite type. The data in the blue ranges are calculated not measured. The spreadsheet result is an overall length change which can then be related to reactor integrated power.

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AGC-1 Specimen Fluence Correction

This spreadsheet calculates the fluence for each of the specimens based on their respective elevation change during the experiment. Based on the results of correcting the unloaded center stack (S-7) the corrected fluence change in the samples below reactor mid-plane were below 0.13%. Therefore, the uncompressed stacks, which are below mid-plane, were not corrected. In order to correct the fluence of the compressed stacks, and the center stack a curve fit of fluence versus reactor elevation was developed for each stack position (S-1 thru S-7) for each reactor cycle. Therefore, a total of 49 curve fits were developed from the fluence data copied from ECAR-1406. The position of the top of specimen stacks were calculated using the pushrod displacement data from NDMAS and the position of the bottom of the stacks were calculated based on the shrinkage of the specimen holders. The individual specimen position for each cycle was calculated based on fluence weighted shrinkage of all the specimens. This assumes that all the specimens behave similarly with respect to fluence and stress induced shrinkage. Knowing the cycle average elevation of the specimens, the specimen fluence for each cycle can was calculated from the fluence curve fits discussed above. The total specimen fluence is then a summation of the fluence for each reactor cycle.

Modified NDMAS Data Sheet This sheet adds columns to the raw NDMAS data to calculate the integrated reactor power, and adjusts the top of the pushrod data to eliminate displacement offset. The sheet also calculates the power averaged load on the specimen stacks.

TOS Position Sheet This sheet calculates the position of the top of the pushrods for each reactor cycle. These positions are calculated for the power averaged position as well as the pushrod position at the end of cycle (EOC). This data is used to calculate the specimen elevations for each cycle.

Total Uncorrected Fluence Sheet This data was copied from ECAR-1406 and a curve fit applied for each cycle. This is used to calculate the fluence for each of the uncompressed specimens.

145A thru 148B Curve Fits Sheet The source data for the curve fits was copied from ECAR-1406. A curve fit was found for each of the specimen stacks for reactor Cycle 145A. These curve fits were used to calculate the specimen fluence for Cycle 145A. Similar curve fits were developed for each reactor cycle.

Ave Displacement Factor Sheet This sheet calculates the relative movement of the specimens as it relates to the top of stack displacement. It takes in account the shrinkage of the graphite pushrod as well as the individual specimen shrinkage. For example if the specimens were fixed on the bottom and the pushrod displaces one inch, then the top specimen will displace .89 inches and the bottom specimen would see essentially no displacement. This relative displacement of the specimens is based on the relative fluence each specimen receives and is assumed to be a proportional relationship.

Fluence S-1 thru S-6 Sheets This sheet calculates the corrected fluence of the specimens in the S-1 thru S-6 stacks. For each reactor cycle the average position of the top of the stack is read in from the *TOS Position Sheet.* The relative position of the specimens is calculated based on the movement of the specimen holder displacement and the position of the top of the stack. With the calculated elevation for each of the specimens the fluence is calculated based on the curve fits generated in *145A Curve Fit Sheet* through *148B Curve Fit Sheet*. The total specimen fluence is the summation of these cycles. A graph of the corrected and uncorrected specimen fluence values was generated to show the effect of correction.

Fluence S-7 Sheet Since there is no compression on the center stack and also no time dependent position data, the position of the specimens are assumed to shrink linearly with respect to fluence/integrated reactor power. The end of test displacement was calculated in "AGC-1 S-7 Stack Height Change" which was based on PIE measurements. From this, the end of test specimen position can be calculated based on the relative fluence each specimen receives. Thus the specimen fluence was calculated as if the specimens did not move, and also the fluence if the specimens were held in their end of test position. The average specimen fluence is then the average of these two fluence values. This assumes a linear movement of the specimens which is a good assumption based on the linear displacement verses integrated reactor power behavior observed in the pushrods. The graph of this correcting data indicates that there is very little correction needed below reactor mid-plane resulting in a correction difference of <0.13%. This is the basis for not correcting the uncompressed samples that are below reactor mid-plane.

Fluence Results Sheet This sheet summarizes the results of the individual fluence sheets.

Fluence Output Sheet This sheet is similar to the Fluence Results Sheet except the nodes are removed where the flux wire specimens and other spacers are located. This is done so that it maps into the temperature data specimens lists that do not list these items.

Node Elevation vs Cycle This sheet tabulates the power averaged position of the nodes in each cycle. This is used in the "AGC-1 Specimen Temperature Correction" spreadsheet.

AGC-1 Specimen Temperature Correction

This spreadsheet uses data copied from ECAR-1944 which lists the average temperature of each specimen for each reactor cycle. This data is then corrected for specimen elevation for each cycle and a new average specimen temperature is calculated

S1-S6 Cycle input ECAR 1944 Sheet This sheet lists the uncorrected average specimen temperatures for each cycle as calculated in ECAR-1944.

S7 Cycle Input ECAR 1944 Sheet This sheet lists the uncorrected average specimen temperature for each cycle as calculated in ECAR-1944

Experiment Ave Input ECAR 1944 Sheet This sheet list the average specimen temperature averaged over the entire AGC-1 experiment.

Node Position vs Cycle Sheet This sheet lists data copied from spreadsheet "AGC-1 Specimen Fluence Correction"

EFPD Sheet This sheet list data copied from ECAR 1406 and lists the Reactor Full Power Days for each cycle. This is used for weighting the temperature averages for each reactor cycle.

S-1 thru S-7 Sheets In these sheets the specimen temperature is corrected for the changing elevation. The node position is known for each cycle from the *Node Position vs Cycle Sheet*. A linear interpolation is performed using this corrected elevation verses the node temperature at the initial elevation. This is accomplished for all reactor cycles and the results are averaged using weighting factor based on the

EFPD for each cycle. Similar to the fluence correction, the specimens below reactor mid-plane were not corrected due to negligible changes (<0.3%)

S-7 Bottom Specimen Prediction Sheet The temperature of the bottom specimen in stack S-7 was not calculated in ECAR-1944. This sheet estimates this temperature based on a curve fit of the bottom four specimen temperatures.

Results S-1 thru S-7 Sheet These are the results that are input into the "AGC-1 Specimen Fluence-Temperature-Load" spreadsheet. They include the corrected as well as uncorrected temperature values.

AGC-1 Specimen Fluence-Temperature-Load

This spreadsheet lists the compiled output data from the spreadsheets discussed above. Additionally this sheet lists the neutron fluence monitor (flux wire) fluence as calculated by MCNP in ECAR-1406, as well as the values derived from PIE (Ref. 9). On average, the PIE fluence values are 5.2% higher, with the PIE extremes being 19.2% higher and 12.1% lower than the MCNP values. This is considered to be good correlation and validates the MCNP values. The flux wire reactor elevations listed in Ref 9 do not match the latest center of mass (COM) elevations shown in reference 5, 6, 7, and 8. However this does not affect the measured fluence values or the validity of this comparison. The flux wire elevations shown in this ECAR are considered to be the initial as-run positions, and are consistent with INL drawing 630431.

REFERENCES

1 LWP-10200, "Engineering Calculations and Analysis Report," Rev. 7, April 10, 2012.

2. ECAR-1406, "As-Run Neutronic Analysis of the AGC-1 Experiment Irradiated in the ATR South Flux Trap",Rev. 0, March 2011

3. ECAR-1944, "AGC-1 As Run Thermal Results", Rev. 0, September 2012

4. INL/EXT-12-26255, "Data Report on Post-Irradiation Dimensional Change in AGC-1 Samples", June 2012

5. INL Drawing 630427 "ATR Advanced Graphite Capsule (AGC) Specimen Holder and Insulator Details and Assemblies"

6. INL Drawing 630428 "ATR Advanced Graphite Capsule (AGC) Stainless Steel and Aluminum Component Details"

7. INL Drawing 630430 "ATR Advanced Graphite Capsule (AGC) Capsule Facility Assemblies"

8. INL Drawing 630431 "ATR Advanced Graphite Capsule Graphite Specimen Stack Up Arrangements"

9. PNNL Project Number 62451 "Analysis of AGC-1 Neutron Fluence Monitors" August 2012.

Appendix A

Tabulation of Specimen Fluence, Temperature and Load

S-1, Compressed

(Fluence and temperature are corrected)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-34	1S12	NBG-17	19.250	589	3.47	377
-35	BW12-02	NBG-18	18.000	597	3.93	377
-33	1S14	PCEA	16.750	606	4.36	377
-37	1S9	IG-110	15.500	621	4.75	377
-37	1S7	IG-110	14.250	635	5.11	377
-32	1S15	H-451	13.000	649	5.44	377
-36	FW13-01	IG-430	11.750	662	5.72	377
-34	1S11	NBG-17	10.500	668	5.97	377
-35	3S2	NBG-18	9.250	671	6.19	377
-33	4S1	PCEA	8.000	680	6.37	377
-34	1S3	NBG-17	6.750	690	6.51	377
-35	1S4	NBG-18	5.500	700	6.63	377
-33	1S2	PCEA	4.250	706	6.73	377
-36	1S5	IG-430	3.000	708	6.79	377
-32	1S8	H-451	1.750	706	6.84	377

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence, Corrected (DPA)	PIE Flux Wire Fluence (DPA)
-71	2	Fe+Nb	18.625		3.70	3.33
-71	3	Fe+Nb	13.625		5.28	5.04
-71	4	Fe+Nb	7.375		6.44	7.12
-78	8F	Fe+Nb+Ti	2.375		6.82	7.28

S-2, Compressed

(Fluence and temperature are corrected)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-34	2U4	NBG-17	19.250	592	3.49	467
-35	5U5	NBG-18	18.000	599	3.95	467
-33	2S14	PCEA	16.750	609	4.38	467
-36	2S15	IG-430	15.500	625	4.78	467
-36	2S9	IG-430	14.250	639	5.15	467
-34	2S6	NBG-17	13.000	653	5.47	467
-35	2S11	NBG-18	11.750	665	5.76	467
-33	2S8	PCEA	10.500	670	6.02	467
-37	2S7	IG-110	9.250	674	6.24	467
-32	2S13	H-451	8.000	683	6.42	467
-36	2S3	IG-430	6.750	693	6.58	467
-34	2S4	NBG-17	5.500	703	6.70	467
-35	2S2	NBG-18	4.250	709	6.80	467
-33	2S1	PCEA	3.000	711	6.87	467
-32	6S5	H-451	1.750	708	6.92	467

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence, Corrected (DPA)	PIE Flux Wire Fluence (DPA)
-71	H	Fe+Nb	13.625		5.31	5.07
-71	I	Fe+Nb	2.375		6.89	7.66

S-3, Compressed

(Fluence and temperature are corrected)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-34	3S13	NBG-17	19.250	594	3.42	565
-36	3S7	IG-430	18.000	602	3.87	565
-36	3S5	IG-430	16.750	612	4.30	565
-37	1U9	IG-110	15.500	628	4.69	565
-37	3S9	IG-110	14.250	642	5.05	565
-35	3S14	NBG-18	13.000	656	5.38	565
-33	3S15	PCEA	11.750	669	5.66	565
-34	AW13-02	NBG-17	10.500	674	5.92	565
-35	3S11	NBG-18	9.250	678	6.13	565
-33	DW11-01	PCEA	8.000	687	6.32	565
-32	3S10	H-451	6.750	697	6.47	565
-36	3S4	IG-430	5.500	707	6.59	565
-34	EW10-02	NBG-17	4.250	713	6.69	565
-35	3S12	NBG-18	3.000	714	6.76	565
-32	3S1	H-451	1.750	712	6.81	565

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence, Corrected (DPA)	PIE Flux Wire Fluence (DPA)
-71	K	Fe+Nb	13.625		5.21	4.92
-71	N	Fe+Nb	2.375		6.78	6.21

S-4, Compressed

(Fluence and temperature are corrected)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-34	4S12	NBG-17	19.250	594	3.32	359
-35	4S14	NBG-18	18.000	603	3.76	359
-33	4S6	PCEA	16.750	612	4.17	359
-32	4S13	H-451	15.500	628	4.56	359
-32	4S2	H-451	14.250	642	4.91	359
-34	4S8	NBG-17	13.000	656	5.23	359
-36	4S10	IG-430	11.750	669	5.51	359
-35	BW12-03	NBG-18	10.500	675	5.76	359
-33	4S15	PCEA	9.250	679	5.97	359
-36	3S3	IG-430	8.000	688	6.15	359
-35	4S5	NBG-18	6.750	698	6.30	359
-37	4S9	IG-110	5.500	708	6.42	359
-33	4U1	PCEA	4.250	714	6.52	359
-36	4S3	IG-430	3.000	716	6.59	359
-37	4S4	IG-110	1.750	713	6.63	359

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence, Corrected (DPA)	PIE Flux Wire Fluence (DPA)
-71	S	Fe+Nb	18.625		3.54	3.11
-71	T	Fe+Nb	13.625		5.07	4.86
-71	V	Fe+Nb	7.375		6.23	6.77
-78	U8	Fe+Nb+Ti	2.375		6.61	7.40

S-5, Compressed

(Fluence and temperature are corrected)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-36	6U7	IG-430	19.250	593	3.37	474
-37	5S13	IG-110	18.000	601	3.82	474
-33	5S12	PCEA	16.750	611	4.25	474
-32	6U5	H-451	15.500	627	4.64	474
-32	5S7	H-451	14.250	641	5.00	474
-34	3S8	NBG-17	13.000	655	5.33	474
-35	5S15	NBG-18	11.750	668	5.62	474
-33	5S9	PCEA	10.500	674	5.87	474
-34	5S14	NBG-17	9.250	677	6.09	474
-35	5S8	NBG-18	8.000	686	6.28	474
-36	5S10	IG-430	6.750	697	6.43	474
-33	5S4	PCEA	5.500	706	6.55	474
-34	5S6	NBG-17	4.250	712	6.65	474
-36	5S2	IG-430	3.000	714	6.72	474
-37	5S1	IG-110	1.750	712	6.77	474

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence, Corrected (DPA)	PIE Flux Wire Fluence (DPA)
-71	CJ	Fe+Nb	13.625		5.17	No Data
-71	CK	Fe+Nb	2.375		6.74	7.69

S-6, Compressed

(Fluence and temperature are corrected)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-34	6S15	NBG-17	19.250	593	3.51	558
-35	4S7	NBG-18	18.000	599	3.96	558
-33	6S11	PCEA	16.750	610	4.39	558
-36	6S10	IG-430	15.500	626	4.78	558
-36	6S7	IG-430	14.250	639	5.14	558
-32	6S9	H-451	13.000	653	5.46	558
-37	6S14	IG-110	11.750	666	5.75	558
-34	6S8	NBG-17	10.500	670	6.00	558
-35	6S13	NBG-18	9.250	674	6.21	558
-33	1S6	PCEA	8.000	683	6.39	558
-37	2S5	IG-110	6.750	693	6.54	558
-34	6S1	NBG-17	5.500	703	6.66	558
-35	6S6	NBG-18	4.250	709	6.76	558
-33	6S4	PCEA	3.000	710	6.83	558
-36	6S2	IG-430	1.750	708	6.87	558

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence, Corrected (DPA)	PIE Flux Wire Fluence (DPA)
-71	CE	Fe+Nb	13.625		5.30	5.59
-71	CA	Fe+Nb	2.375		6.85	6.79

S-1, Uncompressed

(Fluence and temperature correction negligible)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-64	1PB16	NBG-17	-1.625	677	6.86	No Load
-68	1PB17	PCEA	-2.125	678	6.85	No Load
-66	1PB18	NBG-18	-2.625	678	6.83	No Load
-69	1PB19	IG-430	-3.125	678	6.82	No Load
-66	BW15C05	NBG-18	-3.625	678	6.80	No Load
-67	1PB21	IG-110	-4.125	677	6.78	No Load
-46	1PB22	BAN	-4.625	676	6.75	No Load
-52	1U8	H-451	-5.500	674	6.70	No Load
-51	1U5	IG430	-6.750	672	6.61	No Load
-49	1U2	PCEA	-8.000	672	6.49	No Load
-48	1U4	NBG-18	-9.250	664	6.34	No Load
-50	1U3	NBG-17	-10.500	650	6.17	No Load
-49	3S6	PCEA	-11.750	632	5.96	No Load
-48	3U2	NBG-18	-13.000	611	5.72	No Load
-50	1U11	NBG-17	-14.250	592	5.44	No Load
-51	1U10	IG430	-15.500	580	5.12	No Load
-52	1U14	H-451	-16.750	580	4.76	No Load
-53	1U7	IG-110	-18.000	562	4.36	No Load
-49	1U13	PCEA	-19.250	533	3.91	No Load
-48	1U1	NBG-18	-20.500	504	3.41	No Load
-50	1U12	NBG-17	-21.750	468	2.87	No Load
-69	1PB23	IG-430	-22.625	438	2.46	No Load
-68	1PB24	PCEA	-23.125	426	2.22	No Load
-66	1PB25	NBG-18	-23.625	409	1.98	No Load

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence (DPA)	PIE Flux Wire Fluence (DPA)
-71	6	Fe+Nb	-7.375		6.55	7.41
-71	7	Fe+Nb	-13.625		5.58	5.87
-71	F	Fe+Nb	-21.125		3.14	3.45

S-2, Uncompressed

(Fluence and temperature correction negligible)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-64	2PB16	NBG-17	-1.625	679	6.94	No Load
-68	2PB17	PCEA	-2.125	681	6.93	No Load
-66	2PB18	NBG-18	-2.625	681	6.92	No Load
-69	2PB19	IG-430	-3.125	681	6.90	No Load
-65	2PB20	H-451	-3.625	680	6.88	No Load
-67	2PB21	IG-110	-4.125	679	6.86	No Load
-46	2PB22	BAN	-4.625	678	6.83	No Load
-52	4U2	H-451	-5.500	677	6.77	No Load
-49	2U1	PCEA	-6.750	674	6.68	No Load
-48	2U2	NBG-18	-8.000	675	6.55	No Load
-50	1S13	NBG-17	-9.250	667	6.40	No Load
-51	2U3	IG430	-10.500	653	6.22	No Load
-52	2U12	H-451	-11.750	635	6.00	No Load
-53	2U7	IG-110	-13.000	613	5.76	No Load
-49	2U8	PCEA	-14.250	594	5.47	No Load
-48	2U11	NBG-18	-15.500	582	5.15	No Load
-50	2U6	NBG-17	-16.750	582	4.78	No Load
-51	2U9	IG430	-18.000	564	4.37	No Load
-49	2U13	PCEA	-19.250	534	3.91	No Load
-48	6U3	NBG-18	-20.500	505	3.41	No Load
-50	2U10	NBG-17	-21.750	470	2.86	No Load
-67	2PB23	IG-110	-22.625	439	2.46	No Load
-66	2PB24	NBG-18	-23.125	427	2.22	No Load
-69	2PB25	IG-430	-23.625	411	1.97	No Load

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence (DPA)	PIE Flux Wire Fluence (DPA)
-71	J	Fe+Nb	-13.625		5.61	6.61

S-3, Uncompressed

(Fluence and temperature correction negligible)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-64	3PB16	NBG-17	-1.625	683	6.83	No Load
-68	3PB17	PCEA	-2.125	684	6.82	No Load
-66	3PB18	NBG-18	-2.625	685	6.80	No Load
-69	3PB19	IG-430	-3.125	685	6.79	No Load
-65	3PB20	H-451	-3.625	684	6.77	No Load
-67	3PB21	IG-110	-4.125	683	6.74	No Load
-46	3PB22	BAN	-4.625	682	6.72	No Load
-52	3U1	H-451	-5.500	681	6.66	No Load
-48	2S12	NBG-18	-6.750	678	6.56	No Load
-50	EW10-03	NBG-17	-8.000	678	6.43	No Load
-51	3U4	IG430	-9.250	670	6.28	No Load
-52	3U10	H-451	-10.500	657	6.09	No Load
-49	3U6	PCEA	-11.750	638	5.88	No Load
-48	3U11	NBG-18	-13.000	617	5.63	No Load
-50	3U8	NBG-17	-14.250	597	5.35	No Load
-49	3U14	PCEA	-15.500	585	5.02	No Load
-48	3U13	NBG-18	-16.750	585	4.66	No Load
-53	3U9	IG-110	-18.000	567	4.25	No Load
-51	3U5	IG430	-19.250	537	3.80	No Load
-51	3U7	IG430	-20.500	508	3.32	No Load
-50	3U12	NBG-17	-21.750	472	2.79	No Load
-68	3PB23	PCEA	-22.625	441	2.40	No Load
-69	3PB24	IG-430	-23.125	430	2.17	No Load
-68	3PB25	PCEA	-23.625	413	1.93	No Load

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence (DPA)	PIE Flux Wire Fluence (DPA)
-71	O	Fe+Nb	-13.625		5.49	5.76

S-4, Uncompressed

(Fluence and temperature correction negligible)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-64	4PB16	NBG-17	-1.625	684	6.65	No Load
-68	4PB17	PCEA	-2.125	686	6.65	No Load
-66	4PB18	NBG-18	-2.625	686	6.63	No Load
-69	4PB19	IG-430	-3.125	686	6.62	No Load
-65	4PB20	H-451	-3.625	685	6.60	No Load
-67	4PB21	IG-110	-4.125	684	6.58	No Load
-46	4PB22	BAN	-4.625	683	6.55	No Load
-53	4U4	IG-110	-5.500	682	6.49	No Load
-51	4U3	IG430	-6.750	679	6.40	No Load
-49	4U6	PCEA	-8.000	679	6.27	No Load
-53	4U9	IG-110	-9.250	671	6.13	No Load
-48	4U5	NBG-18	-10.500	658	5.95	No Load
-51	3U3	IG430	-11.750	639	5.74	No Load
-49	4U14	PCEA	-13.000	618	5.50	No Load
-48	4U7	NBG-18	-14.250	599	5.22	No Load
-51	4U10	IG430	-15.500	587	4.91	No Load
-50	4U8	NBG-17	-16.750	587	4.55	No Load
-52	4U12	H-451	-18.000	568	4.16	No Load
-49	5S11	PCEA	-19.250	538	3.72	No Load
-48	4U13	NBG-18	-20.500	509	3.24	No Load
-50	4U11	NBG-17	-21.750	473	2.73	No Load
-66	4PB23	NBG-18	-22.625	442	2.34	No Load
-68	4PB24	PCEA	-23.125	431	2.11	No Load
-66	4PB25	NBG-18	-23.625	414	1.88	No Load

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence (DPA)	PIE Flux Wire Fluence (DPA)
-71	X	Fe+Nb	-7.375		6.34	7.30
-71	XX	Fe+Nb	-13.625		5.36	6.39
-71	Y	Fe+Nb	-21.125		2.98	3.32

S-5, Uncompressed

(Fluence and temperature correction negligible)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-43	5PB16	NBG-25	-1.625	683	6.79	No Load
-44	5PB17	S-2020	-2.125	684	6.78	No Load
-45	5PB18	PCIB	-2.625	685	6.76	No Load
-46	5PB19	BAN	-3.125	685	6.75	No Load
-47	5PB20	NBG-10	-3.625	684	6.73	No Load
-68	DW15C04	PCEA	-4.125	683	6.70	No Load
-39	5PB22	A3	-4.625	682	6.68	No Load
-53	5U1	IG-110	-5.500	681	6.62	No Load
-51	5U2	IG430	-6.750	678	6.52	No Load
-50	5U6	NBG-17	-8.000	678	6.40	No Load
-49	5U4	PCEA	-9.250	670	6.24	No Load
-51	5U10	IG430	-10.500	656	6.06	No Load
-48	5U8	NBG-18	-11.750	638	5.85	No Load
-50	5U13	NBG-17	-13.000	617	5.61	No Load
-49	5U9	PCEA	-14.250	597	5.33	No Load
-48	5U14	NBG-18	-15.500	585	5.01	No Load
-50	4S11	NBG-17	-16.750	585	4.65	No Load
-52	5U7	H-451	-18.000	567	4.24	No Load
-49	5U11	PCEA	-19.250	537	3.80	No Load
-53	5U12	IG-110	-20.500	507	3.31	No Load
-51	2U14	IG430	-21.750	472	2.78	No Load
-46	5PB23	BAN	-22.625	441	2.38	No Load
-43	5PB24	NBG-25	-23.125	430	2.15	No Load
-42	5PB25	PPEA	-23.625	413	1.91	No Load

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence (DPA)	PIE Flux Wire Fluence (DPA)
-71	CC	Fe+Nb	-13.625		5.47	No Data

S-6, Uncompressed

(Fluence and temperature correction negligible)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Fluence (DPA)	Power Averaged Load (lbf)
-69	FW19C04	IG-430	-1.625	679	6.89	No Load
-39	6PB17	A3	-2.125	681	6.88	No Load
-40	6PB18	HLM	-2.625	681	6.87	No Load
-41	6PB19	PGX	-3.125	681	6.85	No Load
-42	6PB20	PPEA	-3.625	680	6.83	No Load
-65	6PB21	H-451	-4.125	679	6.81	No Load
-39	6PB22	A3	-4.625	678	6.79	No Load
-51	6U2	IG430	-5.500	677	6.73	No Load
-49	6U4	PCEA	-6.750	674	6.63	No Load
-48	6U6	NBG-18	-8.000	674	6.51	No Load
-50	5U3	NBG-17	-9.250	667	6.36	No Load
-53	2U5	IG-110	-10.500	653	6.18	No Load
-49	1U6	PCEA	-11.750	634	5.96	No Load
-48	6U12	NBG-18	-13.000	613	5.72	No Load
-50	6U8	NBG-17	-14.250	594	5.43	No Load
-53	6U13	IG-110	-15.500	582	5.11	No Load
-52	6U9	H-451	-16.750	582	4.74	No Load
-51	6U10	IG430	-18.000	564	4.34	No Load
-49	6U11	PCEA	-19.250	534	3.88	No Load
-48	5S5	NBG-18	-20.500	505	3.39	No Load
-50	6U14	NBG-17	-21.750	470	2.85	No Load
-44	6PB23	S-2020	-22.625	439	2.45	No Load
-40	6PB24	HLM	-23.125	427	2.21	No Load
-45	6PB25	PCIB	-23.625	411	1.97	No Load

Flux Wire Dash No.	Flux Wire ID No.	Flux Wire Type	Flux Wire COM Elevation (in)		MCNP Fluence (DPA)	PIE Flux Wire Fluence (DPA)
-71	CH	Fe+Nb	-13.625		5.58	6.15

S-7, Uncompressed (1 of 6)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Corrected Fluence (DPA)
-77	CPB1	NBG-25	18.875	619	3.41
-62	CPB2	A3 MATRIX	18.625	622	3.50
-54	CPB3	HLM	18.375	625	3.60
-55	CPB4	PGX	18.125	627	3.69
-56	CPB5	PPEA	17.875	628	3.78
-57	CPB6	NBG-25	17.625	630	3.87
-58	CPB7	S-2020	17.375	632	3.96
-59	CPB8	PCIB	17.125	634	4.04
-60	CPB9	BAN	16.875	637	4.13
-61	CPB10	NBG-10	16.625	639	4.22
-77	CPB181	NBG-25	16.375	642	4.30
-62	CPB12	A3 MATRIX	16.125	646	4.38
-54	CPB13	HLM	15.875	650	4.46
-55	CPB14	PGX	15.625	654	4.54
-56	CPB15	PPEA	15.375	658	4.62
-57	CPB16	NBG-25	15.125	662	4.70
-58	CPB17	S-2020	14.875	666	4.78
-59	CPB181	PCIB	14.625	669	4.85
-60	CPB19	BAN	14.375	672	4.92
-61	CPB20	NBG-10	14.125	675	4.99
-77	CPB21	NBG-25	13.875	678	5.06
-62	CPB22	A3 MATRIX	13.625	681	5.13
-54	CPB23	HLM	13.375	684	5.20
-55	CPB24	PGX	13.125	688	5.27
-56	CPB25	PPEA	12.875	691	5.33
-57	CPB26	NBG-25	12.625	695	5.39
-58	CPB27	S-2020	12.375	698	5.45
-59	CPB28	PCIB	12.125	702	5.51
-60	CPB29	BAN	11.875	705	5.57
-61	CPB30	NBG-10	11.625	707	5.63

S-7, Uncompressed (2 of 6)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Corrected Fluence (DPA)
-77	CPB31	NBG-25	11.375	710	5.68
-62	CPB32	A3 MATRIX	11.125	712	5.74
-54	CPB33	HLM	10.875	713	5.79
-55	CPB34	PGX	10.625	714	5.84
-56	CPB35	PPEA	10.375	715	5.89
-57	CPB36	NBG-25	10.125	716	5.94
-58	CPB37	S-2020	9.875	716	5.99
-59	CPB38	PCIB	9.625	717	6.03
-60	CPB39	BAN	9.375	719	6.07
-61	CPB40	NBG-10	9.125	720	6.12
-77	CPB41	NBG-25	8.875	722	6.16
-62	CPB42	A3 MATRIX	8.625	724	6.20
-54	CPB43	HLM	8.375	726	6.23
-55	CPB44	PGX	8.125	728	6.27
-56	CPB45	PPEA	7.875	730	6.31
-57	CPB46	NBG-25	7.625	732	6.34
-58	CPB47	S-2020	7.375	734	6.37
-59	CPB48	PCIB	7.125	737	6.41
-60	CPB49	BAN	6.875	739	6.44
-61	CPB50	NBG-10	6.625	741	6.46
-77	CPB51	NBG-25	6.375	744	6.49
-62	CPB52	A3 MATRIX	6.125	746	6.52
-54	CPB53	HLM	5.875	748	6.55
-55	CPB54	PGX	5.625	750	6.57
-56	CPB55	PPEA	5.375	752	6.59
-57	CPB56	NBG-25	5.125	753	6.61
-58	CPB57	S-2020	4.875	755	6.64
-59	CPB58	PCIB	4.625	756	6.66
-60	CPB59	BAN	4.375	758	6.67
-61	CPB60	NBG-10	4.125	759	6.69

S-7, Uncompressed (3 of 6)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Corrected Fluence (DPA)
-77	CPB61	NBG-25	3.875	760	6.71
-62	CPB62	A3 MATRIX	3.625	760	6.72
-54	CPB63	HLM	3.375	761	6.74
-55	CPB64	PGX	3.125	761	6.75
-56	CPB65	PPEA	2.875	761	6.76
-57	CPB66	NBG-25	2.625	761	6.78
-58	CPB67	S-2020	2.375	760	6.79
-59	CPB68	PCIB	2.125	759	6.80
-60	CPB69	BAN	1.875	757	6.80
-61	CPB70	NBG-10	1.625	755	6.81
-77	CPB71	NBG-25	1.375	751	6.82
-62	CPB72	A3 MATRIX	1.125	747	6.83
-54	CPB73	HLM	0.875	742	6.83
-55	CPB74	PGX	0.625	738	6.83
-56	CPB75	PPEA	0.375	735	6.84
-57	CPB76	NBG-25	0.125	732	6.84
-58	CPB77	S-2020	-0.125	731	6.84
-59	CPB78	PCIB	-0.375	730	6.84
-60	CPB79	BAN	-0.625	730	6.84
-61	CPB80	NBG-10	-0.875	730	6.84
-77	CPB81	NBG-25	-1.125	730	6.84
-62	CPB82	A3 MATRIX	-1.375	731	6.84
-54	CPB83	HLM	-1.625	732	6.83
-55	CPB84	PGX	-1.875	732	6.83
-56	CPB85	PPEA	-2.125	733	6.82
-57	CPB86	NBG-25	-2.375	733	6.82
-58	CPB87	S-2020	-2.625	733	6.81
-59	CPB88	PCIB	-2.875	733	6.80
-60	CPB89	BAN	-3.125	733	6.79
-61	CPB90	NBG-10	-3.375	732	6.78

S-7, Uncompressed (4 of 6)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Corrected Fluence (DPA)
-77	CPB91	NBG-25	-3.625	732	6.77
-62	CPB92	A3 MATRIX	-3.875	732	6.76
-54	CPB93	HLM	-4.125	731	6.75
-55	CPB94	PGX	-4.375	731	6.74
-56	CPB95	PPEA	-4.625	730	6.72
-57	CPB96	NBG-25	-4.875	730	6.71
-58	CPB97	S-2020	-5.125	729	6.69
-59	CPB98	PCIB	-5.375	728	6.68
-60	CPB99	BAN	-5.625	728	6.66
-61	CPB100	NBG-10	-5.875	727	6.64
-77	CPB101	NBG-25	-6.125	726	6.62
-62	CPB102	A3 MATRIX	-6.375	726	6.60
-54	CPB103	HLM	-6.625	725	6.58
-55	CPB104	PGX	-6.875	725	6.56
-56	CPB105	PPEA	-7.125	725	6.53
-57	CPB106	NBG-25	-7.375	724	6.51
-58	CPB107	S-2020	-7.625	724	6.48
-59	CPB108	PCIB	-7.875	723	6.46
-60	CPB109	BAN	-8.125	722	6.43
-61	CPB110	NBG-10	-8.375	721	6.40
-77	CPB111	NBG-25	-8.625	719	6.37
-62	CPB112	A3 MATRIX	-8.875	717	6.34
-54	CPB113	HLM	-9.125	715	6.31
-55	CPB114	PGX	-9.375	713	6.28
-56	CPB115	PPEA	-9.625	710	6.24
-57	CPB116	NBG-25	-9.875	707	6.21
-58	CPB117	S-2020	-10.125	704	6.17
-59	CPB118	PCIB	-10.375	701	6.13
-60	CPB119	BAN	-10.625	697	6.10
-61	CPB120	NBG-10	-10.875	694	6.06

S-7, Uncompressed (5 of 6)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Corrected Fluence (DPA)
-77	CPB121	NBG-25	-11.125	690	6.01
-62	CPB122	A3 MATRIX	-11.375	686	5.97
-54	CPB123	HLM	-11.625	682	5.93
-55	CPB124	PGX	-11.875	678	5.88
-56	CPB125	PPEA	-12.125	673	5.84
-57	CPB126	NBG-25	-12.375	669	5.79
-58	CPB127	S-2020	-12.625	664	5.74
-59	CPB128	PCIB	-12.875	660	5.69
-60	CPB129	BAN	-13.125	656	5.63
-61	CPB130	NBG-10	-13.375	651	5.58
-77	CPB131	NBG-25	-13.625	647	5.53
-62	CPB132	A3 MATRIX	-13.875	643	5.47
-54	CPB133	HLM	-14.125	639	5.41
-55	CPB134	PGX	-14.375	636	5.35
-56	CPB135	PPEA	-14.625	632	5.29
-57	CPB136	NBG-25	-14.875	629	5.23
-58	CPB137	S-2020	-15.125	627	5.16
-59	CPB138	PCIB	-15.375	625	5.09
-60	CPB139	BAN	-15.625	624	5.03
-61	CPB140	NBG-10	-15.875	623	4.96
-77	CPB141	NBG-25	-16.125	622	4.88
-62	CPB142	A3 MATRIX	-16.375	621	4.81
-54	CPB143	HLM	-16.625	619	4.74
-55	CPB144	PGX	-16.875	617	4.66
-56	CPB145	PPEA	-17.125	613	4.58
-57	CPB146	NBG-25	-17.375	609	4.50
-58	CPB147	S-2020	-17.625	605	4.42
-59	CPB148	PCIB	-17.875	600	4.34
-60	CPB149	BAN	-18.125	594	4.25
-61	CPB150	NBG-10	-18.375	588	4.17

Title: AGC-1 Individual Specimen Fluence, Temperature, and Load Calculation and Tabulation

ECAR No.: 1943 Rev. No.: 0 Project No.: 23747 Date: 09/20/2012

S-7, Uncompressed (6 of 6)

Drawing 630431 Dash No.	Drawing 630431 Specimen ID No.	Graphite Type	Initial Specimen COM Elevation (in)	Experiment Averaged Specimen Temperature (C)	Corrected Fluence (DPA)
-77	CPB151	NBG-25	-18.625	581	4.08
-62	CPB152	A3 MATRIX	-18.875	575	3.99
-54	CPB153	HLM	-19.125	569	3.89
-55	CPB154	PGX	-19.375	562	3.80
-56	CPB155	PPEA	-19.625	555	3.70
-57	CPB156	NBG-25	-19.875	547	3.61
-58	CPB157	S-2020	-20.125	542	3.51
-59	CPB158	PCIB	-20.375	536	3.41
-60	CPB159	BAN	-20.625	528	3.30
-61	CPB160	NBG-10	-20.875	520	3.20
-77	CPB161	NBG-25	-21.125	511	3.09
-62	CPB162	A3 MATRIX	-21.375	506	2.99
-54	CPB163	HLM	-21.625	498	2.88
-55	CPB164	PGX	-21.875	489	2.77
-56	CPB165	PPEA	-22.125	481	2.65
-57	CPB166	NBG-25	-22.375	474	2.54
-58	CPB167	S-2020	-22.625	470	2.42
-59	CPB168	PCIB	-22.875	476	2.31
-60	CPB169	BAN	-23.125	492	2.19
-61	CPB170	NBG-10	-23.375	503	2.07
-77	CPB171	NBG-25	-23.625	509	1.95
-62	CPB172	A3 MATRIX	-23.875	508	1.82

Appendix B

PIE Specimen Holder Data

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Phone: (208) 526-8088

Philip L Winston/WINSPL/CC01/INEEL/US

Philip L Winston/WINSPL/CC01/INEEL/US
03/14/2012 07:26 AM

To: Kevin L Skinner/VKS/CC01/INEEL/US@INEL
cc:
Subject: Holder

AGC graphite body dimensions.xlsx

Tube Number	Graphite Body Section	Dimensions	OD left (Upper end)	OD right (lower end)	Length at OD
TUB-AGC1-021	Bottom section, no end cap		2.07 2.068 2.068	2.036 2.036 2.035	11 3/4
TUB-AGC1-022	Lower middle section		2.074 2.072 2.074	2.069 2.066 2.071	11 3/16
TUB-AGC1-023	Upper middle section		2.055 2.063 2.059	2.0595 2.064 2.058	12 9/16
TUB-AGC1-024	Top section		2.0115 2.012 2.0185	2.053 2.057 2.071	8 13/16