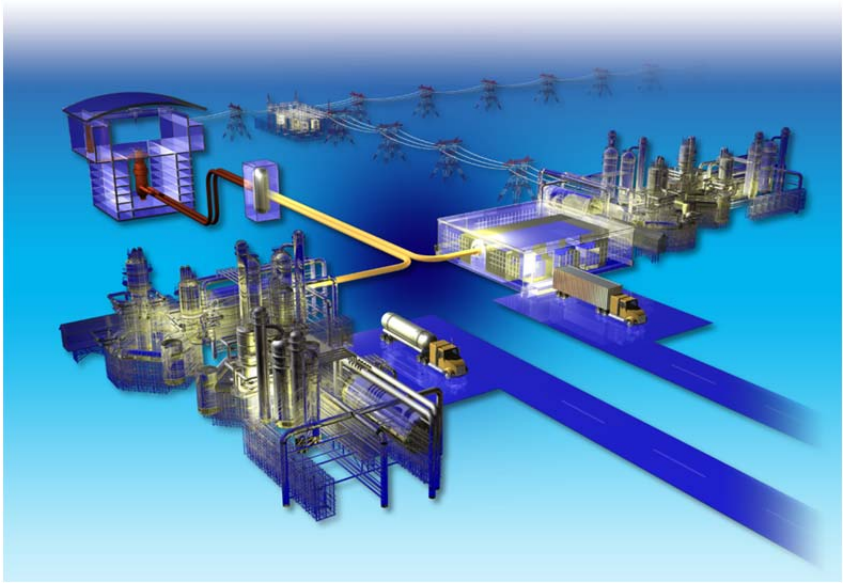
ORNL/TM-2013/242

AGC-1 Specimen Post Irradiation Data Report

Tim Burchell
Oak Ridge National Laboratory

September 2013



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Abbreviations

AG	Against Grain
AGC	Advance Graphite Creep
ATR	Advanced Test Reactor
CTE	Coefficient of Thermal Expansion
INL	Idaho National Laboratory
LAMDA	Low Activation Materials Development & Analysis
ORNL	Oak Ridge National Laboratory
SANS	Small Angle Neutron Scattering
TOF	Time of Flight
PIE	Post Irradiation Examination
WG	With Grain
XRD	X-Ray Diffraction

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Summary

Here we report the results of the Post Irradiation Examination (PIE) of the creep, control, and piggyback specimens from the irradiation creep capsule AGC-1. This is the first (prototype) of a series of six capsules planned as part of the Advanced Graphite Creep (AGC) experiment to fully characterize the neutron irradiation effects and radiation creep behavior of current nuclear graphites. The data reported include: specimen dimensions and hence the dimensional change upon irradiation (a comparison of these data for specimen matched pairs will yield the creep strain); mass and volume, hence density; elastic constants (Young's modulus, shear modulus and Poisson's ratio) from ultrasonic time of flight (TOF) and velocity measurements; Young's modulus from the fundamental frequency of vibration; electrical resistivity; and thermal expansion from 100-550°C (hence coefficient of thermal expansion). Over 8500 individual physical measurement have been made and the data are reduced and reported here.

The AGC-1 capsule was irradiated in the Advanced Test Reactor (ATR) at INL at approximately 700°C and to a peak dose of 7 dpa (displacements per atom). The specimen's final dose, temperature and stress conditions have been reported by INL[1,2] and are also tabulated here. Additionally the analysis of the SiC temperature monitors is reported. These temperature monitors were located along the center of the AGC-1 capsule and provide an independent assessment of the capsules final irradiation temperature.

While all the PIE testing is reported (with the exception of the glued-end tensile strength specimens) additional analysis of the AGC data will be required to allow:

1. Improved fits to the existing models of graphite irradiation induced creep strain.
2. With the eventual advent of temperature dependency data from the additional AGC series of capsules, and microstructural data from piggy back specimens in AGC capsules, the development of new and improved models for the development of irradiation induced creep strain in graphite are anticipated.
3. An Investigation into the effects of creep strain on the physical properties of irradiated graphite.

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1. Introduction

The Post Irradiation Examination (PIE) of the creep, control, and piggyback specimens from the irradiation creep capsule AGC-1 are reported here. AGC-1 was the first of a series of six capsules planned as part of the Advanced Graphite Creep (AGC) experiment to fully characterize the neutron irradiation and radiation creep behavior of current nuclear graphite. The capsule contains two types of specimens, (i) paired specimens in which the dose and irradiation temperature are designed to be similar, but one specimen is under a compressive load (hence stress) and (ii) smaller unstressed "piggyback" specimens with no load applied which are primarily used in dimensional change and thermal material property testing. Under these conditions the irradiation creep strain is defined as the difference between the irradiation induced dimensional changes of the stressed and unstressed specimen under similar temperature and dose conditions. The AGC-1 capsule was irradiated in the Advanced Test Reactor (ATR) at INL. The temperatures achieved by the specimens ranged from ≈ 472°C to ≈ 710°C and to a peak dose of ≈7 dpa (displacements per atom). The large spread of irradiation temperatures in the irradiation capsule definitely complicated the data analysis. The specimen's final dose, average temperature and stress conditions have been reported by INL[1,2] and are also tabulated here for completeness. The AGC-1 Experimental Plan[3] and revised capsule layout[4] discuss the details of the AGC-1 experiment and provide background on the capsules scope and purpose. Given that this was the prototype AGC capsule design the problems experienced with AGC-1 are to be expected and should not reoccur.

2. Experimental

2.1. The AGC-1 Creep Capsule

A schematic of the AGC-1 Creep Capsule is shown in Figure 1.

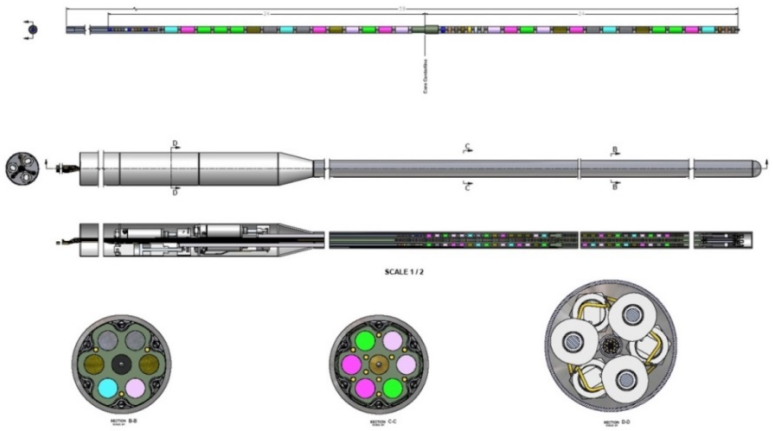


Figure 1 The AGC-1 Creep Capsule (refer to INL Drawing 630431)

The capsule had six channels with an applied load and a center channel with no load applied. The sections of the outer channels above the reactor mid-plane were stressed and the sections of the channels below the reactor mid-plane were unstressed. By pre-ordering the specimen's axial location it should thus be possible to attain matched pairs with similar neutron fluence (due to flux buckling) at the same stress. Three stress levels (i.e., 2.0 ksi, 2.5 ksi and 3.0 ksi nominal) were used in AGC-1 to provide a known stress upon the graphite specimens during irradiation in order to produce irradiation induced creep. Three stress levels large enough to induce irradiation creep within the nuclear graphite grades were chosen to ascertain the effects of stress and irradiation creep levels on changes to the material properties in graphite. The original design of the irradiation capsule specified two stress levels with three channels receiving a higher stress level and 3 channels receiving a lower stress level. However formal review of the design determined that unacceptable bending moments could be imposed upon the entire test capsule if one of the channels could not be loaded to the specified level. The capsule design was modified and a third stress state was added with diametrically opposed channels carrying equal stresses[4]. If one of the channels was not able to be loaded to the desired level the opposing channel would be unloaded so no bending moments would be applied to the capsule.

The AGC-1 capsule had a dose range of 1.4-6.9 dpa and an irradiation temperature range from 472–710 °C. The capsule mean temperatures were calculated from thermocouple inputs and corroborated with SiC temperature monitors (located in the central channel along the capsule centerline). Doses were calculated using MCNP models and operating conditions in the ATR core and corroborated from flux wire data.

The graphites grades in the AGC-1 capsule can be categorized as follows.

a. Major Grades (Irradiation creep and companion specimens)

   These graphites are reactor vendor's candidates for the core structures of NGNP, and include four new grades (NBG-17, NBG-18, PCEA, and IG-430) as well as two historical (reference) grades (H-451 and IG-110). These grades are most likely to receive reasonably large neutron doses in their lifetime and were subjected to the applied loads of the AGC-1 capsule. These grades occupied the stressed and companion unstressed positions in the AGC-1 capsule and hence make up the irradiation creep specimens.

b. Minor Grades (piggyback specimens)

   These grades are NGNP relevant grades that are most likely to be used in low neutron dose regions of the core; e.g., the permanent structure of the prismatic block very high temperature reactor (VHTR) design and includes grades PGX, HLM, NBG-10, and NBG-25.

c. Alternate Grades (piggyback specimens)

   Grades that NGNP vendors have identified as being of interest as alternate graphites for certain components within the reactor, and includes grades PPEA, 2020, and PCIB.

d. Experimental Grades (piggyback specimens)

Two experimental graphites are included in AGC-1 (BAN and A3 matrix). BAN graphite is an experimental grade whose manufacturing process and raw materials are such that it should offer superior irradiation stability. A3 matrix is the blend of graphites and carbonized phenolic resin used as the matrix in the NGNP fuel compact or fuel pebble. Samples of A3 matrix were obtained from the NGNP program and were produced at Oak Ridge National Laboratory (ORNL).

e. Single Crystal Graphite (piggyback specimens)

The dimensional change behavior of graphite is particularly significant to the behavior of polycrystalline (polygranular) graphites. Therefore, samples of HOPG are included in AGC-1.

A more complete description of all of the graphite samples included in capsule AGC-1 is given in the AGC-1 Experimental Plan[3]. The AGC-1 Creep Capsule contents will be evaluated. The six major grades of graphite for which the creep strain response and the effects of creep strain on physical properties as well as the ten minor, experimental, and alternate grades of graphite are summarized in Table 1.

Table 1 The major graphite grade within the AGC-1 capsule3

Graphite Grade	Forming Method	Intended Purpose	AGC Code Letter
NBG-17	Vibrational molded	AREVA NGNP Design	A
NBG-18	Vibrational molded	PBMR (not currently being pursued)	B
H-451	Extruded	Historical Grade (REF)	C
PCEA	Extruded	AREVA NGNP Design	D
IG-110	Isostatically Pressed	PMBR-DM (China) – Under construction	E
IG-430	Isostatically Pressed	Candidate Graphite	F
HOPG	Vapor deposited	Fundamental studies	G
A3 matrix	Hot Pressed	Fuel matrix material	H
HLM	Molded	Low dose core component	I
PGX	Extruded	Low dose core component	J
PPEA	Extruded	Alternate candidate	L
NBG-25	Isostatically Pressed	Low dose core component	M
2020	Isostatically Pressed	Alternate candidate	N
PCIB	Isostatically Pressed	Alternate candidate	P
BAN	Isostatically Pressed and Extruded	Experimental graphite	R
NBG-10	Isostatically Pressed	Low dose core component	S

For grades NBG-17, NBG-18 and PCEA (codes A, B & D) both with-grain (WG) and against grain (AG) specimen orientations are included in the capsule.

Table 2 The number of stressed/unstressed samples, and their graphite grades, included in the outer peripheral channels of irradiation capsule AGC-13

Graphite Grade	Source	Number of stressed/unstressed peripheral column samples
NBG-17	SGL Carbon	34
NBG-18	SGL Carbon	34
H-451 (Reference Grade)	SGL Carbon	20
PCEA	GrafTech International	34
IG-110 (Reference Grade)	Toyo Tanso	20
IG-430	Toyo Tanso	32
TOTAL		**174**

Table 3 Graphite grades and the number of piggyback samples included in the central channel of irradiation capsule AGC-1

Graphite Grade	Source	Number of central column samples
Highly Oriented Pyrolytic Graphite (HOPG)	Advanced Ceramics	20
A3 Matrix Graphite/Carbon	ORNL	20
HLM	SGL Carbon	19
PGX	GrafTech International	19
PPEA	GrafTech International	19
NBG-25	SGL Carbon	19
2020	Carbone of America	19
PCIB	GrafTech International	19
BAN	GrafTech International	19
NBG-10	SGL Carbon	19
TOTAL		**192**

Following irradiation in the Advanced Test Reactor (ATR) at the Idaho National Laboratory (INL) the AGC-1 capsule was disassembled. All specimens recovered from disassembly were visually inspected and physically measured[5]. The majority of the creep and control specimens were shipped to Oak Ridge National Laboratory (ORNL) for PIE in the Low Activation Materials Development & Analysis (LAMDA) laboratories. Figure 2 through Figure 4 show the AGC-1 specimens as they were shipped and received at ORNL, and their subsequent unpacking. After removal from the transit tubes the specimens were visually examined and digitally photographed. Examples of the digital pictures are given in Figure 5 and Figure 6. The specimen nominal dimensions are 25.4 mm length by 12.7 mm diameter.

Figure 2 The AGC-1 specimen shipping cask at ORNL

Figure 3 The AGC-1 specimen shipping cask internals

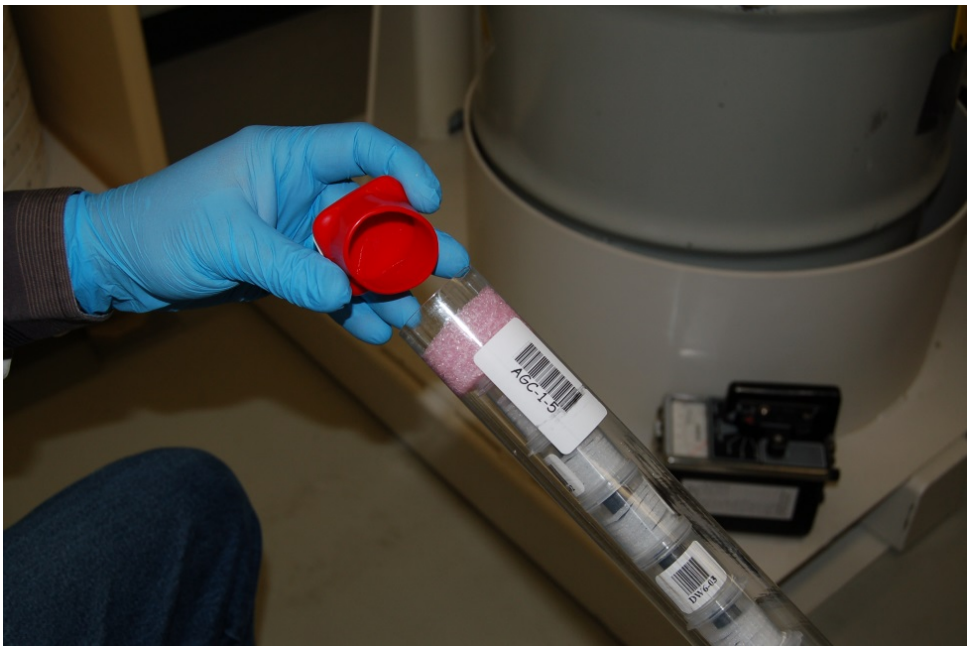


Figure 4 AGC-1 specimens during unpacking at ORNL showing specimens packed inside their individual snap-caps and collectively in transit tubes

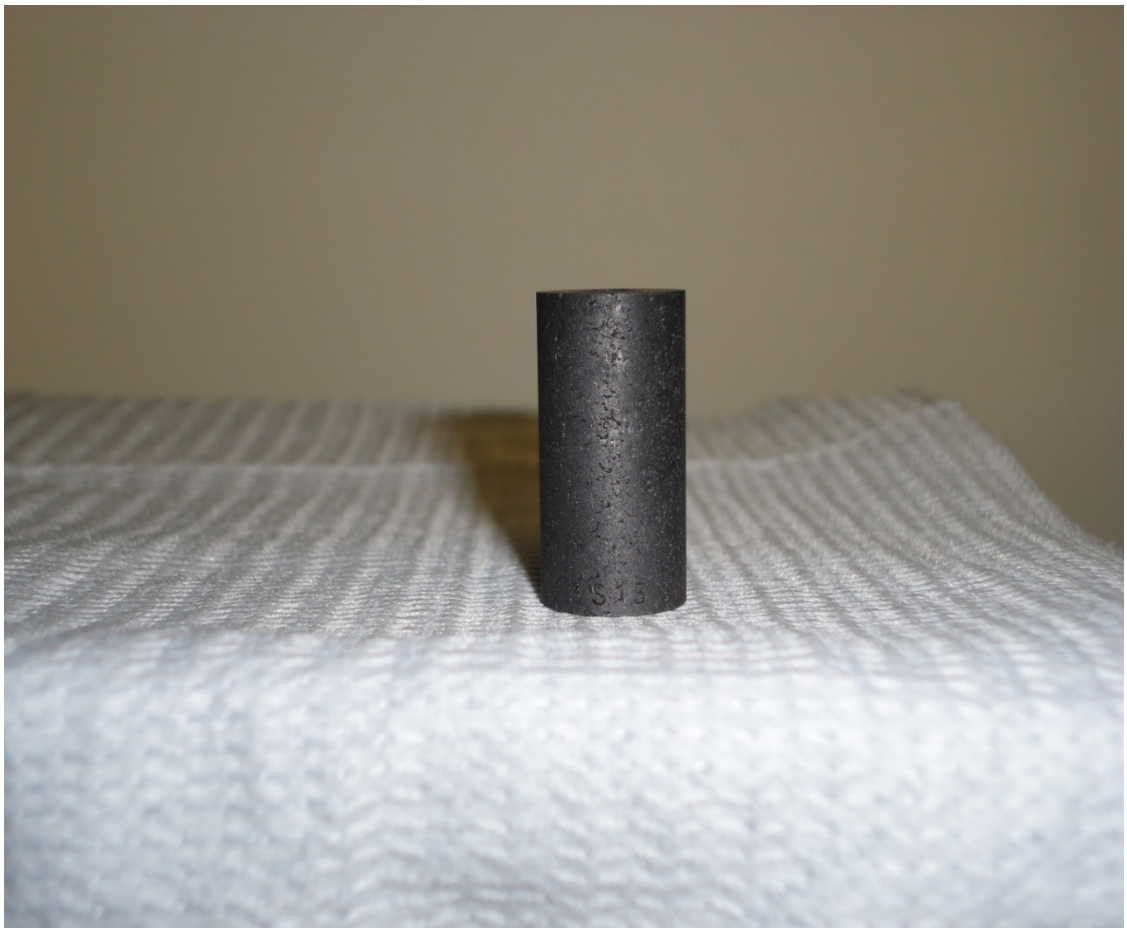


Figure 5 AGC-1 creep specimen 3S-15, DW 5-02 (PCEA Graphite)

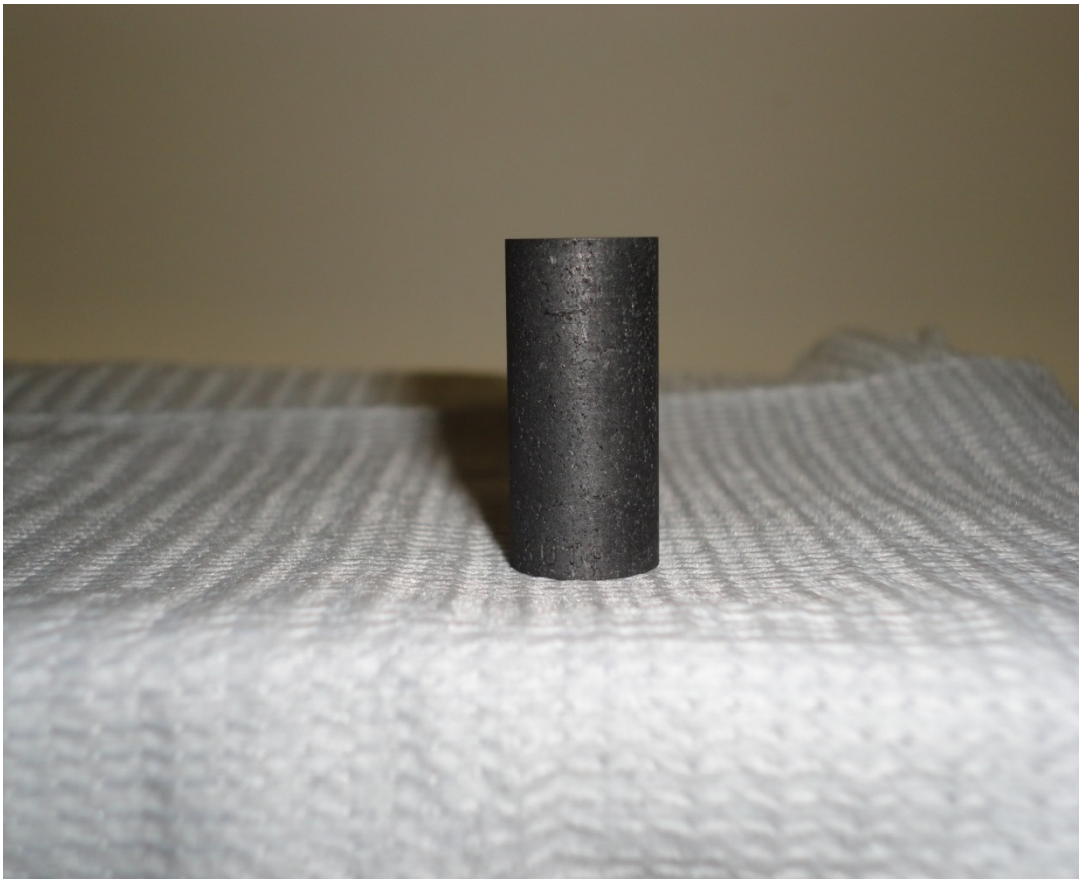


Figure 6 AGC-1 control specimen 3U14, DW 6-10 (PCEA Graphite)

2.2. Testing Methods

AGC-1 testing followed ASTM test methods as prescribed in the Experimental Plan.[6] Only limited testing could be performed on the piggyback specimens due to their small size[3,4,5]. Moreover, AGC-1 piggyback specimens were required to have a hole drilled through their centers to accommodate the SiC temperature monitors. This central hole in the specimens eliminated the possibility for high temperature thermal diffusivity testing, but inclusion of the SiC temperature monitors was considered necessary to ensure the thermocouple (TC) output values were corroborated for this first prototype AGC capsule design. As a consequence, only dimensional change measurements were performed on the piggyback specimens.

No changes in the planned testing were imposed upon the AGC-1 stressed and companion creep specimens. All anticipated thermal and physical testing was completed. The measured thermal and physical material properties for the creep and companion specimens are reported in Table 4. The order of PIE testing was performed was a follows:

1. Visual inspection (photography)
2. Dimensions, mass, density
3. Electrical resistivity
4. Dynamic Young's modulus by resonance

5. Sonic velocity and elastic constants
6. Thermal expansion, CTE
7. Strength
8. XRD, SANS, tomography, microscopy

Note, steps 7 and 8 above are not reported here. These tests are planned as subsequent activities. Dimensional measurements were taken according to the scheme in Table 4 so as to assure complete repeatability from the pre-irradiation measurements. Similarly, specimen alignment (with respect to the engraved number) during PIE physical property measurements were the same as previously employed during Pre-IE[3,6].

Table 4 The physical properties determined in this work and the relevant ASTM test standards

Test Property	Standard Title	ASTM Standard
General	Testing Graphite and Boronated Graphite Materials for High-Temperature Gas-Cooled Nuclear Reactor Components	C781
Dimensions, mass, density	Bulk Density by Physical Measurements of Manufactured Carbon and Graphite Articles	C559
Electrical Resistivity	Electrical Resistivity of Manufactured Carbon and Graphite Articles at Room Temperature	C611
Dynamic Young's Modulus	Moduli of Elasticity and Fundamental Frequencies of Carbon and Graphite Materials by Sonic Resonance	C747
Dynamic Young's Modulus	Dynamic Young's Modulus, Shear Modulus, and Poisson's Ratio for Advance Ceramics by Impulse Excitation of Vibration	C1259
Young's Modulus	Sonic Velocity in Manufactured Carbon and Graphite Materials for Use in Obtaining Young's Modulus	C769
Thermal Expansion	Linear Thermal Expansion of Thermal Materials with a Push-Rod Dilatometer	E228

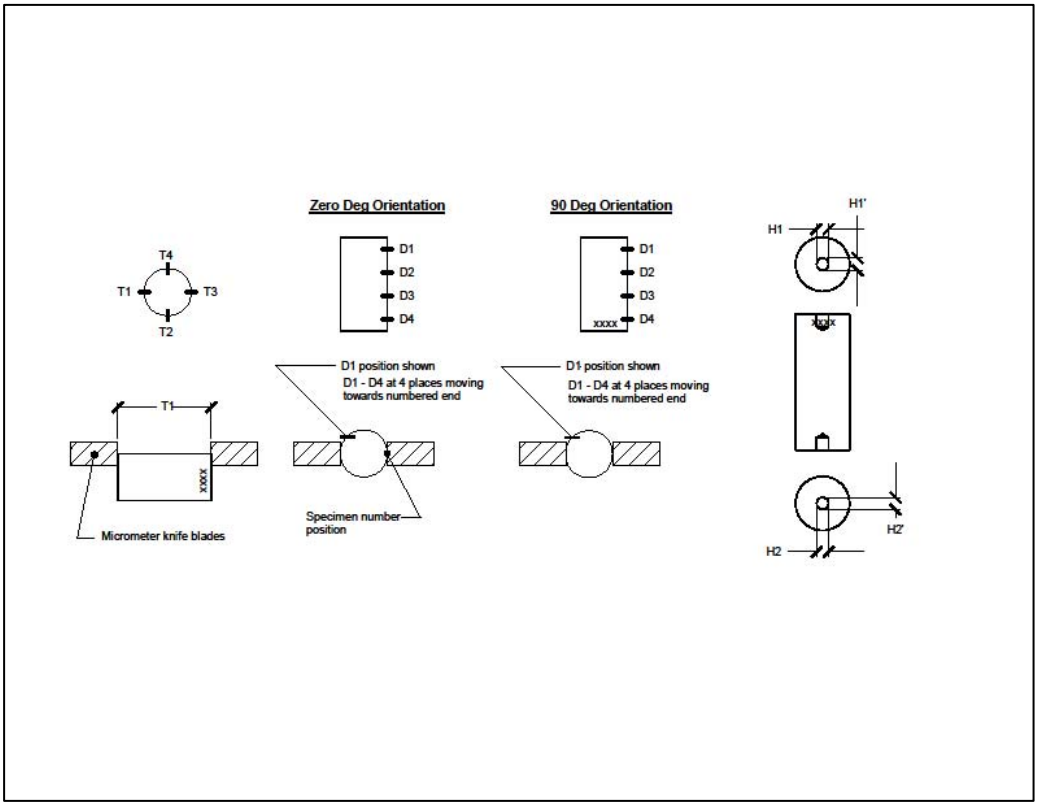


Figure 7 AGC-1 creep specimen measurement scheme

The SiC monitors were retrieved by INL and shipped to ORNL for testing where they were interrogated by isochronal annealing followed by room temperature electrical resistivity determination. A plot of resistivity as a function of annealing temperature displays a marked change in resistivity when the annealing temperature exceeds the maximum irradiation temperature. The isochronal annealing temperature schedule is reported in Table 5.

Table 5 Annealing schedule for SiC temperature monitors

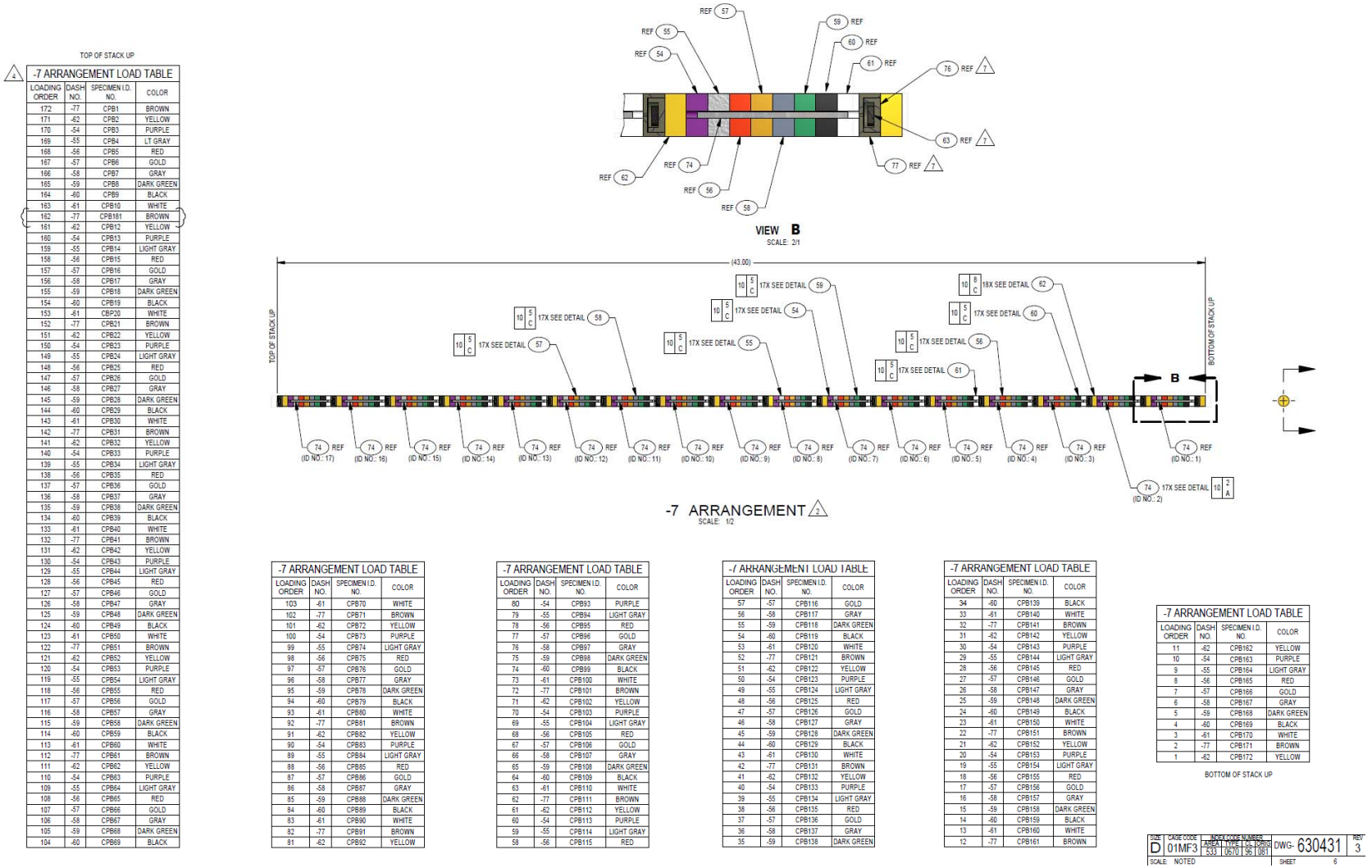
Annealing Temperature, °C	Heating Rate, °C/min	Time at Temperature, minutes	Actions
400	2.5	30	Cool to RT, Measure ER
450	2.5	30	Cool to RT, Measure ER
500	2.5	30	Cool to RT, Measure ER
550	2.5	30	Cool to RT, Measure ER
600	2.5	30	Cool to RT, Measure ER
625	2.5	30	Cool to RT, Measure ER
650	2.5	30	Cool to RT, Measure ER
675	2.5	30	Cool to RT, Measure ER
700	2.5	30	Cool to RT, Measure ER
725	2.5	30	Cool to RT, Measure ER
750	2.5	30	Cool to RT, Measure ER
775	2.5	30	Cool to RT, Measure ER
800	2.5	30	Cool to RT, Measure ER
850	2.5	30	Cool to RT, Measure ER
900	2.5	30	Cool to RT, Measure ER

The Isochronal annealing furnace was heated at 2.5 °C/minute, followed by a 30 minute dwell at temperature, cooled to room temperature and the specimen ER measured. Some of the SiC monitors were found broken on receipt from INL and thus were too short for ER measurement. Table 6 indicates the SiC numbers, tube ID's, and the experimental measurements to be made.

Table 6 SiC temperature monitor information from AGC-1 (10-26-11) as supplied by INL

Number on Plastic Cryo Tube	Piggy back specimen associated with SiC TM in Plexiglas shipping tube from MFC.	SiC TM ID Number per INL Dwg. 630431 rev. 3.	Experimental Measurement Technique
1	CPB24	15	Elec. Resist.
2	CPB1-10	17	Elec. Resist.
3	CPB11-20	16	Elec. Resist.
4	CPB88	9	Too short
5	CPB124, 125	5	Too short
6	CPB76, 77, 79	10	Too short
7	CPB156, 157	2	Elec. Resist.
8	CPB118, 119	6	Elec. Resist.
9	CPB167, 168	1	Elec. Resist.
10	CPB145, 144	3	Elec. Resist.
11	CPB110, 109	7	Elec. Resist.
12	CPB98, 99	8	Elec. Resist.
13	CPB68, 70	11	Elec. Resist.
14	CPB55, 57, 60	12	Elec. Resist.
15	CPB49, 47	13	Elec. Resist.
17	Packaged alone in bottle. By process of elimination this is either ID no. 14 or 4 and therefore no. 14 or 4 are missing.	14 or 4	Elec. Resist.

Figure 8 shows the location of the SiC monitor inside the central channel of AGC-1.



-7 ARRANGEMENT LOAD TABLE

LOADING ORDER	DASH NO.	SPECIMEN I.D. NO.	COLOR
172	-77	CPB1	BROWN
171	-62	CPB2	YELLOW
170	-54	CPB3	PURPLE
169	-55	CPB4	LT GRAY
168	-56	CPB5	RED
167	-57	CPB6	GOLD
166	-58	CPB7	GRAY
165	-59	CPB8	DARK GREEN
164	-60	CPB9	BLACK
163	-61	CPB10	WHITE
162	-77	CPB181	BROWN
161	-62	CPB12	YELLOW
160	-54	CPB13	PURPLE
159	-55	CPB14	LIGHT GRAY
158	-56	CPB15	RED
157	-57	CPB16	GOLD
156	-58	CPB17	GRAY
155	-59	CPB18	DARK GREEN
154	-60	CPB19	BLACK
153	-61	CBP20	WHITE
152	-77	CPB21	BROWN
151	-62	CPB22	YELLOW
150	-54	CPB23	PURPLE
149	-55	CPB24	LIGHT GRAY
148	-56	CPB25	RED
147	-57	CPB26	GOLD
146	-58	CPB27	GRAY
145	-59	CPB28	DARK GREEN
144	-60	CPB29	BLACK
143	-61	CPB30	WHITE
142	-77	CPB31	BROWN
141	-62	CPB32	YELLOW
140	-54	CPB33	PURPLE
139	-55	CPB34	LIGHT GRAY
138	-56	CPB35	RED
137	-57	CPB36	GOLD
136	-58	CPB37	GRAY
135	-59	CPB38	DARK GREEN
134	-60	CPB39	BLACK
133	-61	CPB40	WHITE
132	-77	CPB41	BROWN
131	-62	CPB42	YELLOW
130	-54	CPB43	PURPLE
129	-55	CPB44	LIGHT GRAY
128	-56	CPB45	RED
127	-57	CPB46	GOLD
126	-58	CPB47	GRAY
125	-59	CPB48	DARK GREEN
124	-60	CPB49	BLACK
123	-61	CPB50	WHITE
122	-77	CPB51	BROWN
121	-62	CPB52	YELLOW
120	-54	CPB53	PURPLE
119	-55	CPB54	LIGHT GRAY
118	-56	CPB55	RED
117	-57	CPB56	GOLD
116	-58	CPB57	GRAY
115	-59	CPB58	DARK GREEN
114	-60	CPB59	BLACK
113	-61	CPB60	WHITE
112	-77	CPB61	BROWN
111	-62	CPB62	YELLOW
110	-54	CPB63	PURPLE
109	-55	CPB64	LIGHT GRAY
108	-56	CPB65	RED
107	-57	CPB66	GOLD
106	-58	CPB67	GRAY
105	-59	CPB68	DARK GREEN
104	-60	CPB69	BLACK

-7 ARRANGEMENT LOAD TABLE

LOADING ORDER	DASH NO.	SPECIMEN I.D. NO.	COLOR
103	-61	CPB70	WHITE
102	-77	CPB71	BROWN
101	-62	CPB72	YELLOW
100	-54	CPB73	PURPLE
99	-55	CPB74	LIGHT GRAY
98	-56	CPB75	RED
97	-57	CPB76	GOLD
96	-58	CPB77	GRAY
95	-59	CPB78	DARK GREEN
94	-60	CPB79	BLACK
93	-61	CPB80	WHITE
92	-77	CPB81	BROWN
91	-62	CPB82	YELLOW
90	-54	CPB83	PURPLE
89	-55	CPB84	LIGHT GRAY
88	-56	CPB85	RED
87	-57	CPB86	GOLD
86	-58	CPB87	GRAY
85	-59	CPB88	DARK GREEN
84	-60	CPB89	BLACK
83	-61	CPB90	WHITE
82	-77	CPB91	BROWN
81	-62	CPB92	YELLOW

-7 ARRANGEMENT LOAD TABLE

LOADING ORDER	DASH NO.	SPECIMEN I.D. NO.	COLOR
80	-54	CPB93	PURPLE
79	-55	CPB94	LIGHT GRAY
78	-56	CPB95	RED
77	-57	CPB96	GOLD
76	-58	CPB97	GRAY
75	-59	CPB98	DARK GREEN
74	-60	CPB99	BLACK
73	-61	CPB100	WHITE
72	-77	CPB101	BROWN
71	-62	CPB102	YELLOW
70	-54	CPB103	PURPLE
69	-55	CPB104	LIGHT GRAY
68	-56	CPB105	RED
67	-57	CPB106	GOLD
66	-58	CPB107	GRAY
65	-59	CPB108	DARK GREEN
64	-60	CPB109	BLACK
63	-61	CPB110	WHITE
62	-77	CPB111	BROWN
61	-62	CPB112	YELLOW
60	-54	CPB113	PURPLE
59	-55	CPB114	LIGHT GRAY
58	-56	CPB115	RED

-7 ARRANGEMENT LOAD TABLE

LOADING ORDER	DASH NO.	SPECIMEN I.D. NO.	COLOR
57	-57	CPB116	GOLD
56	-58	CPB117	GRAY
55	-59	CPB118	DARK GREEN
54	-60	CPB119	BLACK
53	-61	CPB120	WHITE
52	-77	CPB121	BROWN
51	-62	CPB122	YELLOW
50	-54	CPB123	PURPLE
49	-55	CPB124	LIGHT GRAY
48	-56	CPB125	RED
47	-57	CPB126	GOLD
46	-58	CPB127	GRAY
45	-59	CPB128	DARK GREEN
44	-60	CPB129	BLACK
43	-61	CPB130	WHITE
42	-77	CPB131	BROWN
41	-62	CPB132	YELLOW
40	-54	CPB133	PURPLE
39	-55	CPB134	LIGHT GRAY
38	-56	CPB135	RED
37	-57	CPB136	GOLD
36	-58	CPB137	GRAY
35	-59	CPB138	DARK GREEN

-7 ARRANGEMENT LOAD TABLE

LOADING ORDER	DASH NO.	SPECIMEN I.D. NO.	COLOR
34	-60	CPB139	BLACK
33	-61	CPB140	WHITE
32	-77	CPB141	BROWN
31	-62	CPB142	YELLOW
30	-54	CPB143	PURPLE
29	-55	CPB144	LIGHT GRAY
28	-56	CPB145	RED
27	-57	CPB146	GOLD
26	-58	CPB147	GRAY
25	-59	CPB148	DARK GREEN
24	-60	CPB149	BLACK
23	-61	CPB150	WHITE
22	-77	CPB151	BROWN
21	-62	CPB152	YELLOW
20	-54	CPB153	PURPLE
19	-55	CPB154	LIGHT GRAY
18	-56	CPB155	RED
17	-57	CPB156	GOLD
16	-58	CPB157	GRAY
15	-59	CPB158	DARK GREEN
14	-60	CPB159	BLACK
13	-61	CPB160	WHITE
12	-77	CPB161	BROWN

-7 ARRANGEMENT LOAD TABLE

LOADING ORDER	DASH NO.	SPECIMEN I.D. NO.	COLOR
11	-62	CPB162	YELLOW
10	-54	CPB163	PURPLE
9	-55	CPB164	LIGHT GRAY
8	-56	CPB165	RED
7	-57	CPB166	GOLD
6	-58	CPB167	GRAY
5	-59	CPB168	DARK GREEN
4	-60	CPB169	BLACK
3	-61	CPB170	WHITE
2	-77	CPB171	BROWN
1	-62	CPB172	YELLOW

BOTTOM OF STACK UP

SIZE	CAGE CODE	INDEX CODE NUMBER				DWG- 630431	REV
D	01MF3	AREA 533	TYPE 0570	SE 96	DRBG 081		3
SCALE: NOTED						SHEET 6	

Figure 8 Drawing of AGC-1 capsule showing positions of SiC temperature monitors in the center of the center channel specimens

2.3. AGC-1 Creep specimen final temperatures, doses, and stresses

The individual creep specimen averaged irradiation (mean) temperature (°C), peak fluence (dpa), and load (lbf) are reported in Table 7 through Table 12 for the stressed specimens1 and Table 13 through Table 18 for the unstressed (control) specimens[1]. The stress levels were nominally 2 ksi (channels 1 & 4), 2.5 ksi (channels 2 & 5), and 3 ksi (channels 3 & 6)[4]. The tabulated specimen fluence data are based on ATR operating history and corrected using flux wires and "MCNP" models. The tabulated specimen temperature data is corrected for specimen position using TC data and thermal models.

Table 7 AGC-1 fluence, temperature, and load values for channel 1 (North Channel) specimens

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

Table 8 AGC-1 fluence, temperature, and load values for channel 2 (North-East Channel) specimens

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

Table 9 AGC-1 fluence, temperature, and load values for channel 3 (South-East Channel) specimens

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

Table 10 AGC-1 fluence, temperature, and load values for channel 4 (South Channel) specimens

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

Table 11 AGC-1 fluence, temperature, and load values for channel 5 (South-West Channel) specimens

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

Table 12 AGC-1 fluence, temperature, and load values for channel 6 (North-West Channel) specimens

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

The individual irradiation temperatures (°C) and fluences dpa) for the unstressed specimens are reported in Table 13 through Table 18. The tabulated specimen fluence data are based on ATR operating history and corrected using flux wires and “MCNP” models. The tabulated specimen temperature data is corrected for specimen position using TC data and thermal models.

Table 13 AGC-1 fluence and temperature values for channel 1 (North Channel) control specimens

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

Table 14 AGC-1 fluence and temperature values for channel 2 (North-East Channel) control specimens

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

Table 15 AGC-1 fluence and temperature values for channel 3 (South-East Channel) control specimens

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

Table 16 AGC-1 fluence and temperature values for channel 4 (South Channel) control specimens

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

Table 17 AGC-1 fluence and temperature values for channel 5 (South-West Channel) control specimens

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

Table 18 AGC-1 fluence and temperature values for channel 6 (North-West Channel) control specimens

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

3. Results and Discussion

3.1. SiC Temperature Monitor Analysis

Data for the room temperature electrical resistivity of the SiC temperature monitors as a function of isochronal annealing are reported in Table 32 through Table 44 (Section 8 Appendices) and are summarized in Table 19.

Measurements were made using the 4-pt probe method in accordance with ASTM Standards C611 – 98 (Reapproved 2010) and B193-02 (Reapproved 2008) using a Keithley 2400 Source Meter, S/N 0987875, and a Keithley 2182 Nano voltmeter, S/N 0985274. The current contacts were 1.4905 inches apart, and the probe location for voltage readings was 0.987 inches apart. Test/room temperature was maintained at 79-81 deg. F.

The data for SiC Monitor ER was plotted and analyzed using a MatLab[7] statistical fitting (best fit) routine to identify the "knee" that occurs in the data. The individual "fits" to the ER data are presented in order of SiC ID No. (INL drwg 630431 rev. 38) and are reported in Figure 9 through Figure 21. Note, this ordering has SiC # 17, (top of stack) first (Figure 9) and SiC #1 (bottom of stack) last (Figure 21).

The irradiation temperature data obtained from the plots (Figure 9 through Figure 21) are reported in Table 20 and plotted in
Figure 22.

Table 19 Summary Table of SiC temperature monitor ER data as a function of isochronal annealing temperature

Annealing Temperature °C	ELECTRICAL RESISTIVITY, Ω.cm												
	Speimen Number												
Tube No	1	2	3	7	8	9	10	11	12	13	14	15	16/17
INL drawing	15	17	16	2	6	1	3	7	8	11	12	13	14 or 4
As Received	6118.1	2347.0	4811.6	3167.5	7583.7	3201.7	3672.6	12392.0	14638.4	14379.9	16694.8	11537.2	8734.8
400	6803.3	2702.5	5910.1	3301.3	7907.7	3435.7	4012.9	12666.4	14559.7	13948.5	17424.7	12223.7	10418.6
450	8675.0	5106.1	8438.3	3498.7	8270.3	3591.8	4157.5	13328.7	15393.2	14832.6	18511.7	12858.7	11431.3
500	8572.5	5123.1	8093.1	3261.6	7724.4	3274.8	3686.3	12338.8	14532.6	14640.7	18354.8	12939.2	11418.0
550	8663.6	5448.9	8304.0	3440.1	7829.7	3517.5	4070.6	12791.5	14711.6	15144.7	17748.2	12733.5	11065.3
600	8322.5	5567.5	8572.6	3674.7	8066.3	3542.8	4040.6	12768.7	14870.2	15674.0	19491.5	13569.3	11577.6
625	8862.5	5694.8	8652.8	3987.5	7932.5	3528.6	3994.4	12403.2	14845.1	13273.8	19833.9	13514.9	11509.4
650	8627.9	5311.0	8242.8	4098.8	7483.6	3635.8	4250.8	12821.1	14697.9	16023.0	19925.6	13850.7	11736.8
675	7560.0	4950.9	7926.9	4026.3	7279.6	3860.0	4506.7	12561.4	14795.6	15952.2	19789.6	13771.4	11694.6
700	9042.7	6077.4	9164.1	5709.7	8290.5	4796.0	4973.5	13543.5	15593.1	16662.9	19899.4	14128.0	12167.5
725	9393.2	6283.2	9369.5	6567.5	7964.2	5555.3	5314.1	12376.5	14322.8	16474.7	19942.9	13937.1	12445.2
750	15622.4	11161.7	13364.3	11747.0	14542.5	10235.0	9988.7	15411.4	18744.3	18933.9	23636.9	14361.5	15282.6
775	16213.3	13546.7	15986.3	12441.1	16046.9	12429.4	12083.5	16581.3	19182.4	19348.3	23253.6	16338.8	18168.0
800	20225.4	15312.2	24240.8	18913.2	18838.7	18730.8	17795.6	18763.0	21927.6	21400.2	25866.3	20732.9	25045.9
850	24266.0	18272.1	30187.9	25241.7	20888.8	23003.2	21398.7	20743.2	24331.6	23115.0	27623.3	26313.2	31159.1
900	34709.6	24146.7	49619.6	39696.2	28595.0	36774.7	34400.9	26035.2	32101.1	28173.7	37317.4	38554.7	46818.7

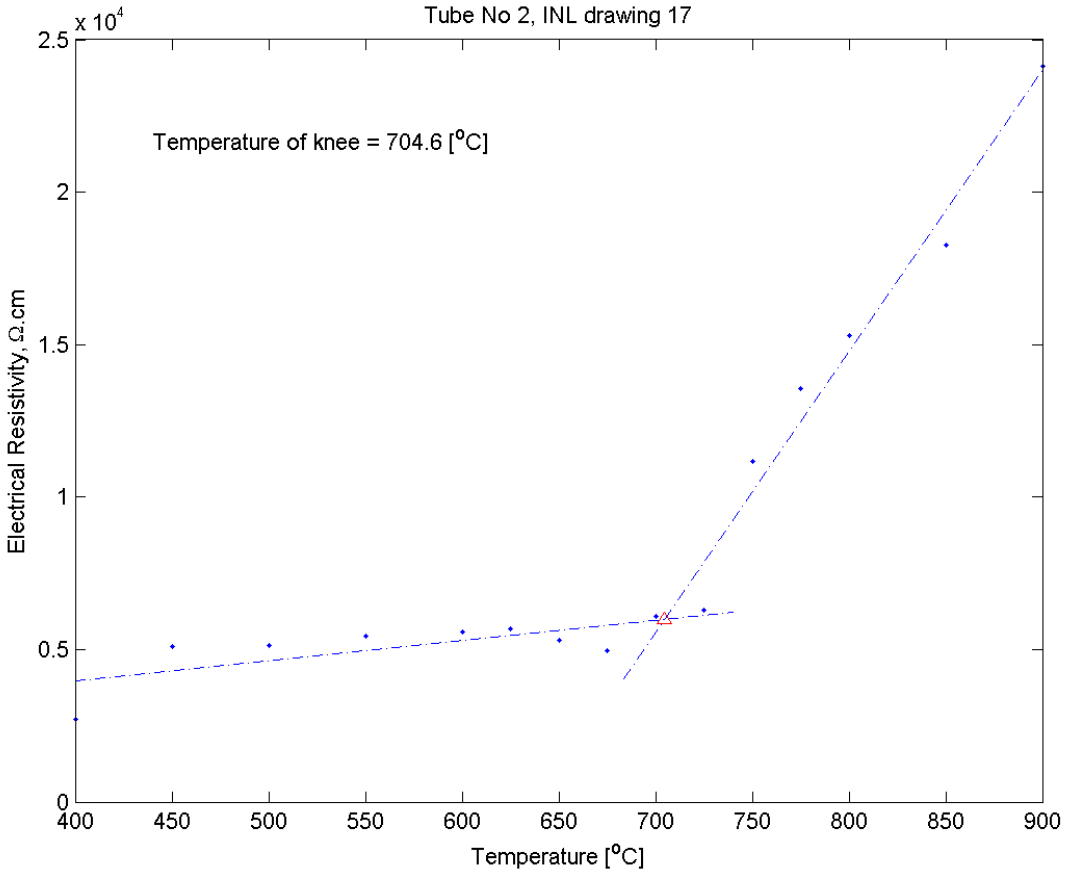


Figure 9 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 17 (INL DRG # 630431 sheet 6 - Rev 3)

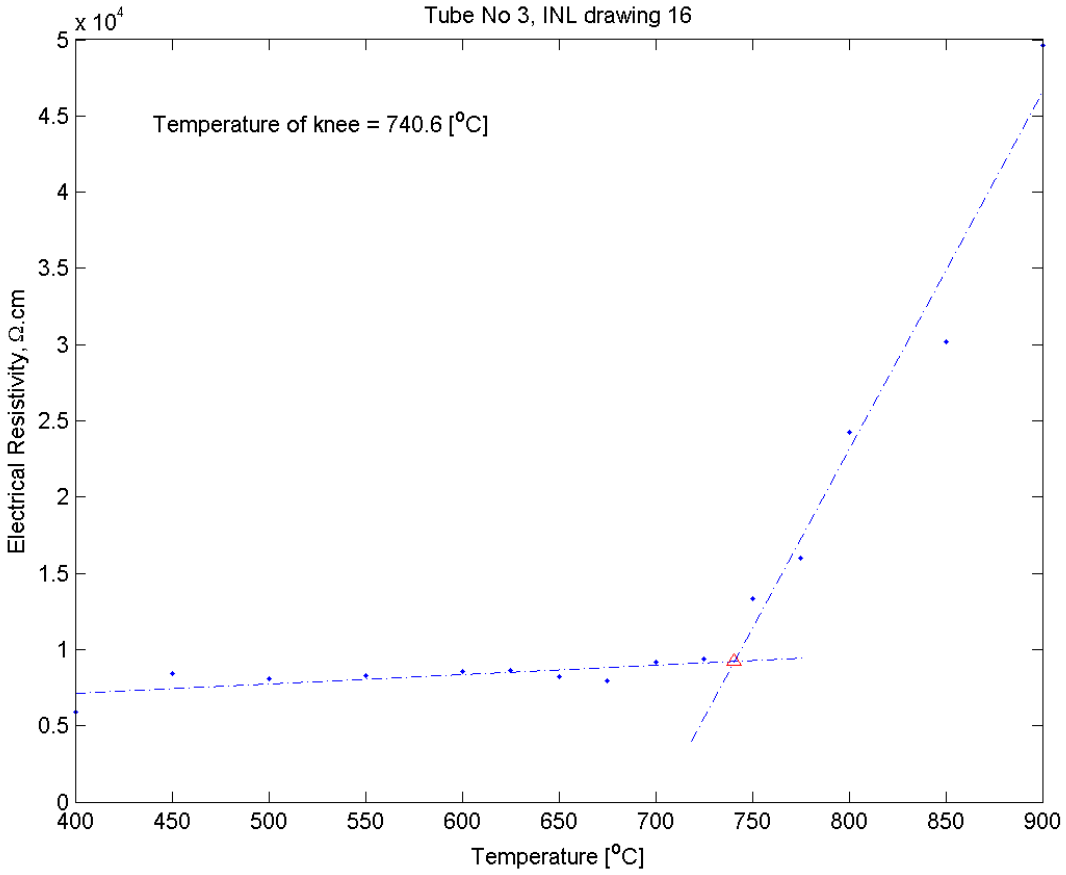


Figure 10 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 16 (INL DRG # 630431 sheet 6 - Rev 3)

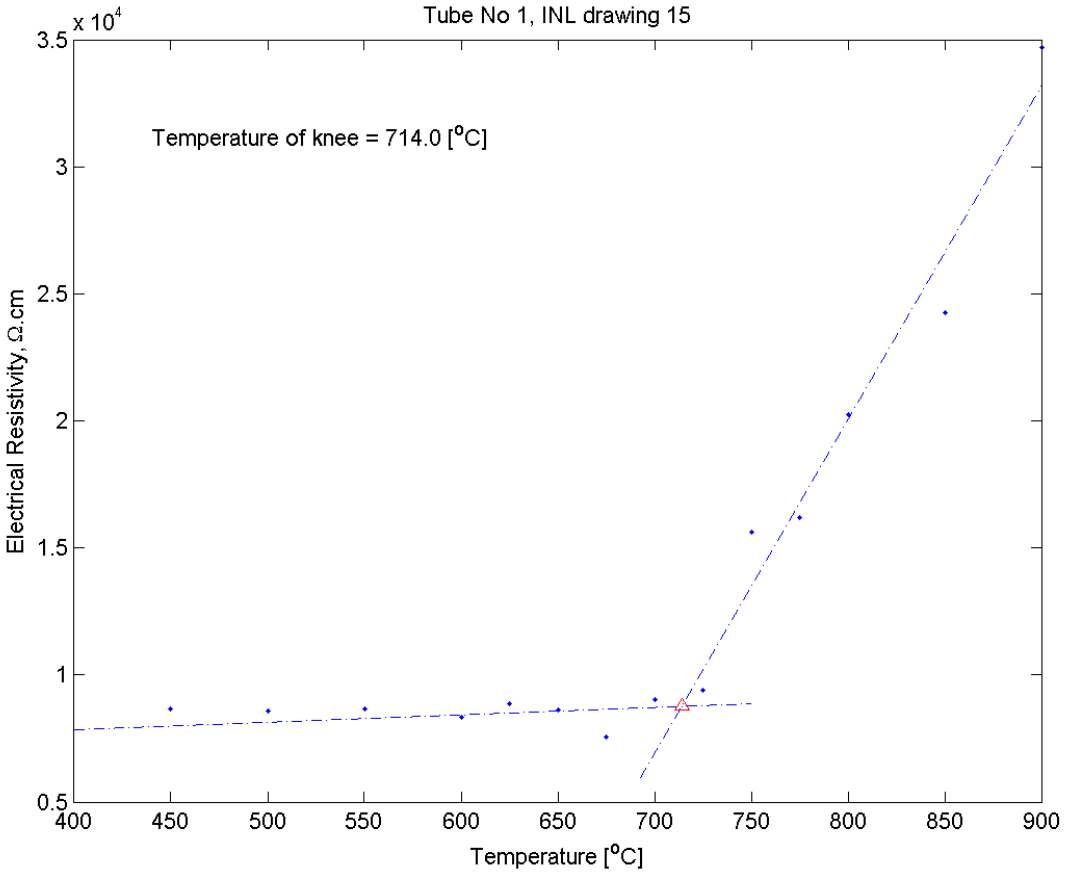


Figure 11 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 15 (INL DRG # 630431 sheet 6 - Rev 3)

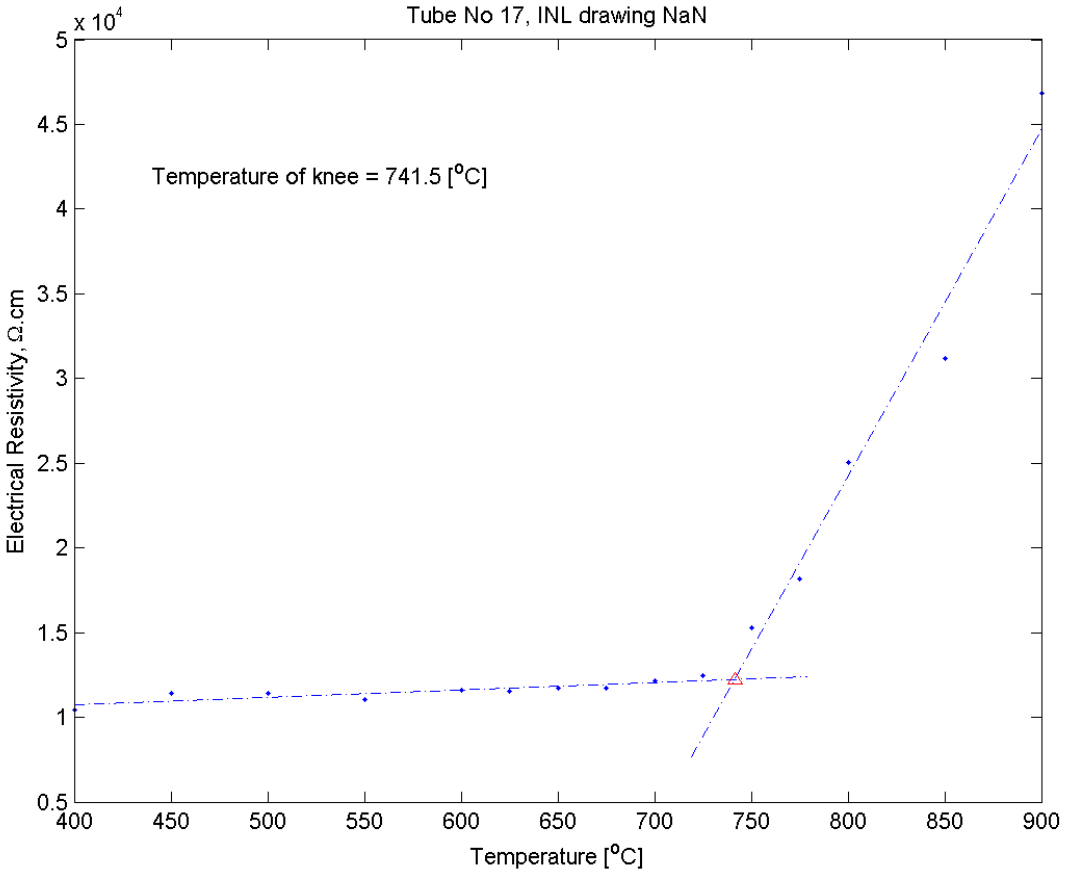


Figure 12 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 4 or 14 (INL DRG # 630431 sheet 6 - Rev 3) [probably specimen # 14]

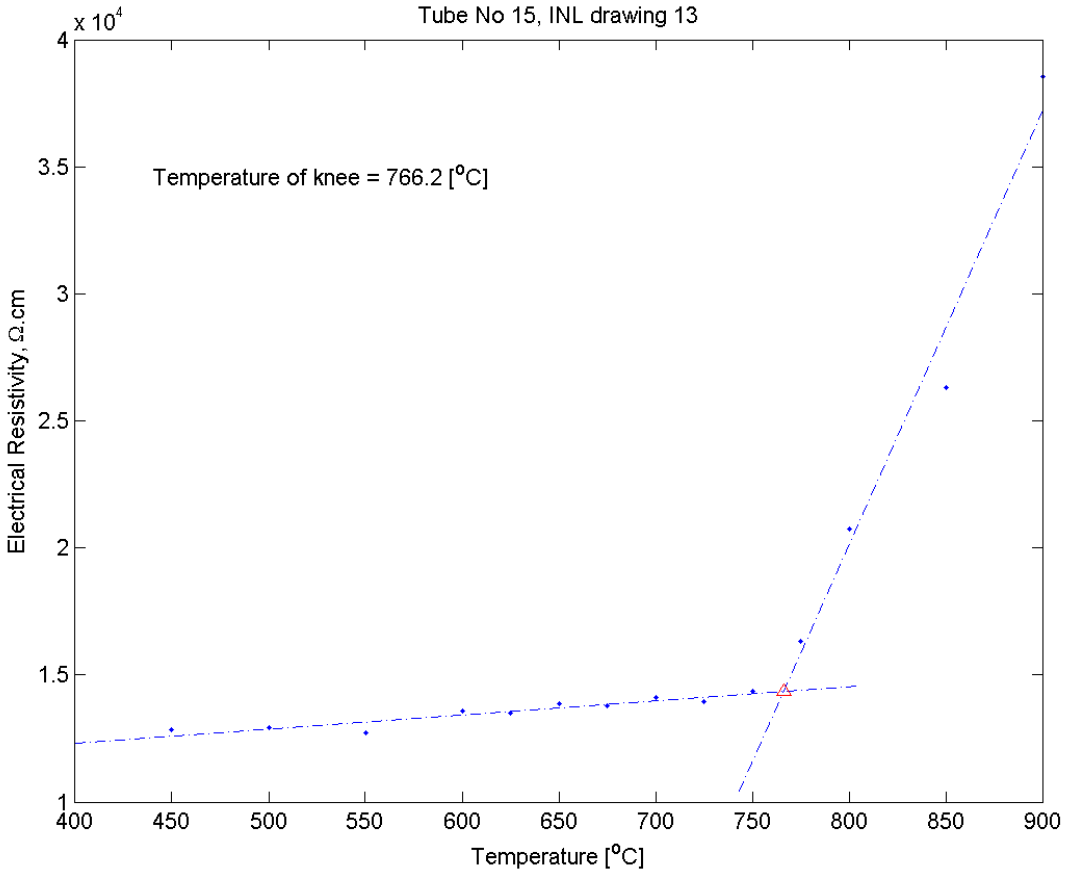


Figure 13 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 13 (INL DRG # 630431 sheet 6 - Rev 3)

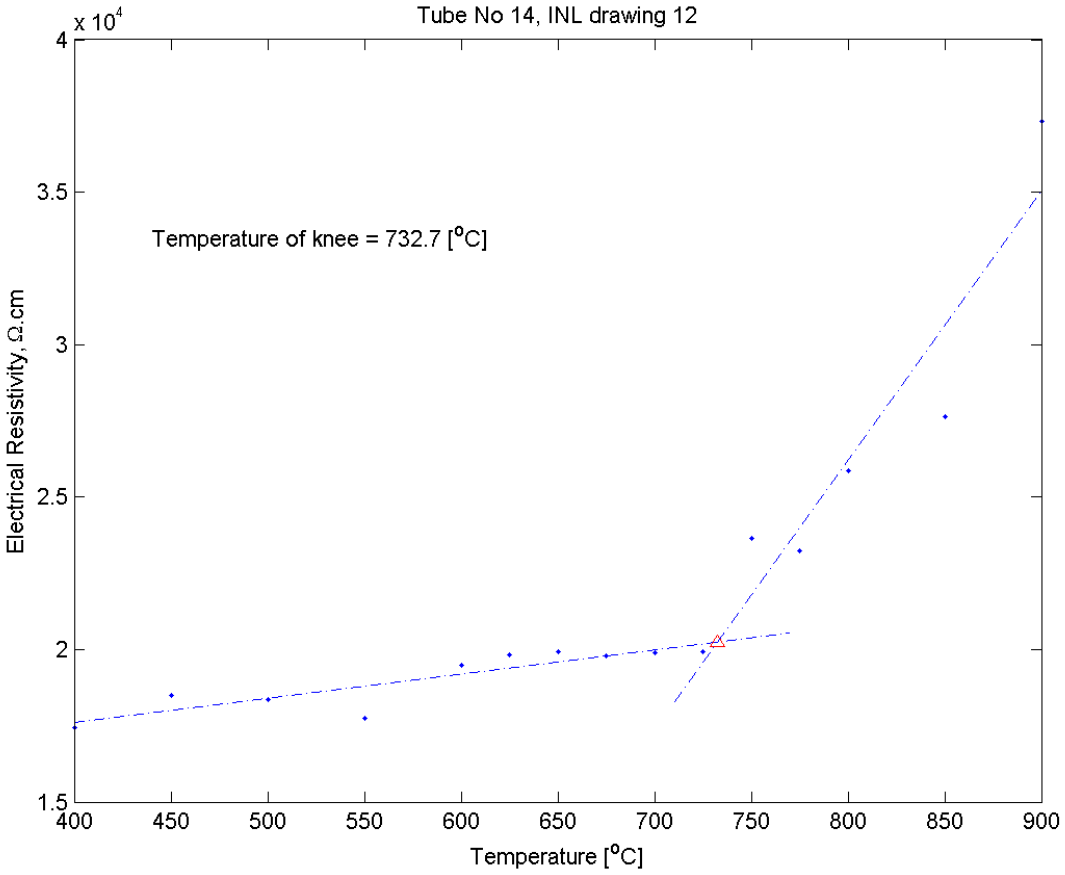


Figure 14 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 12 (INL DRG # 630431 sheet 6 - Rev 3)

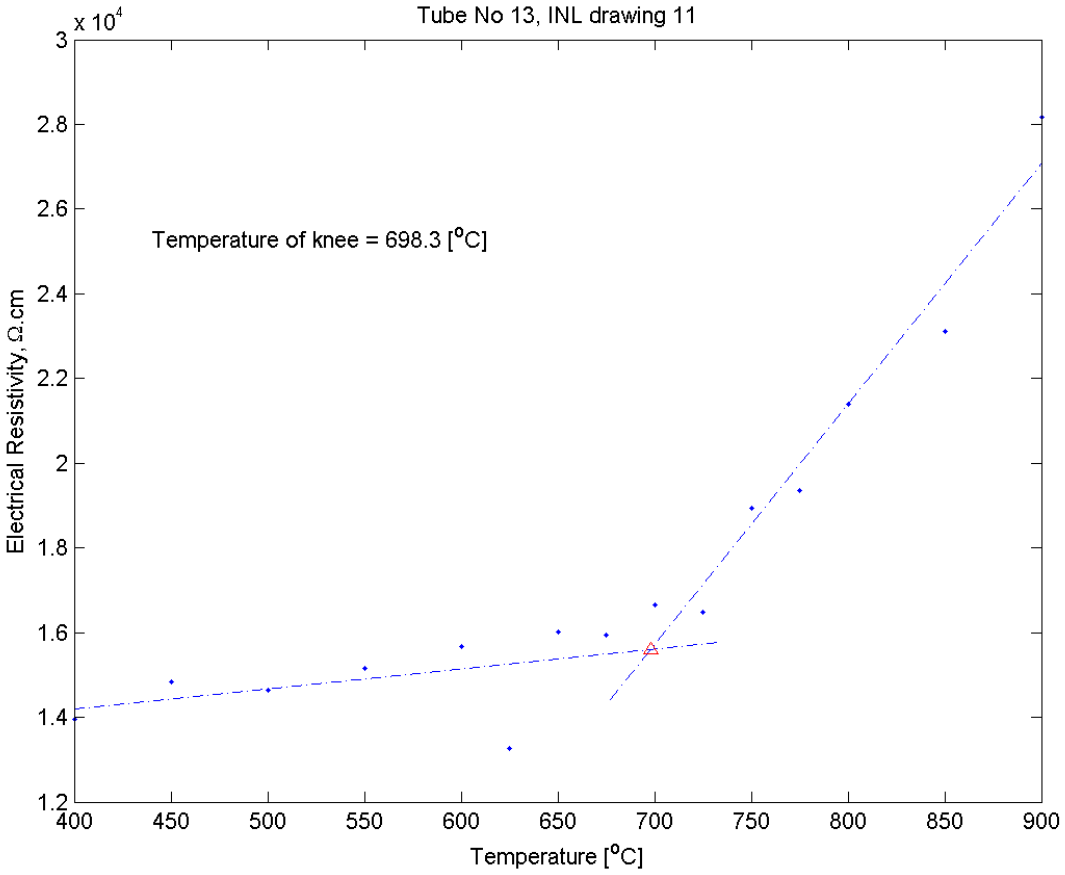


Figure 15 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 11 (INL DRG # 630431 sheet 6 - Rev 3)

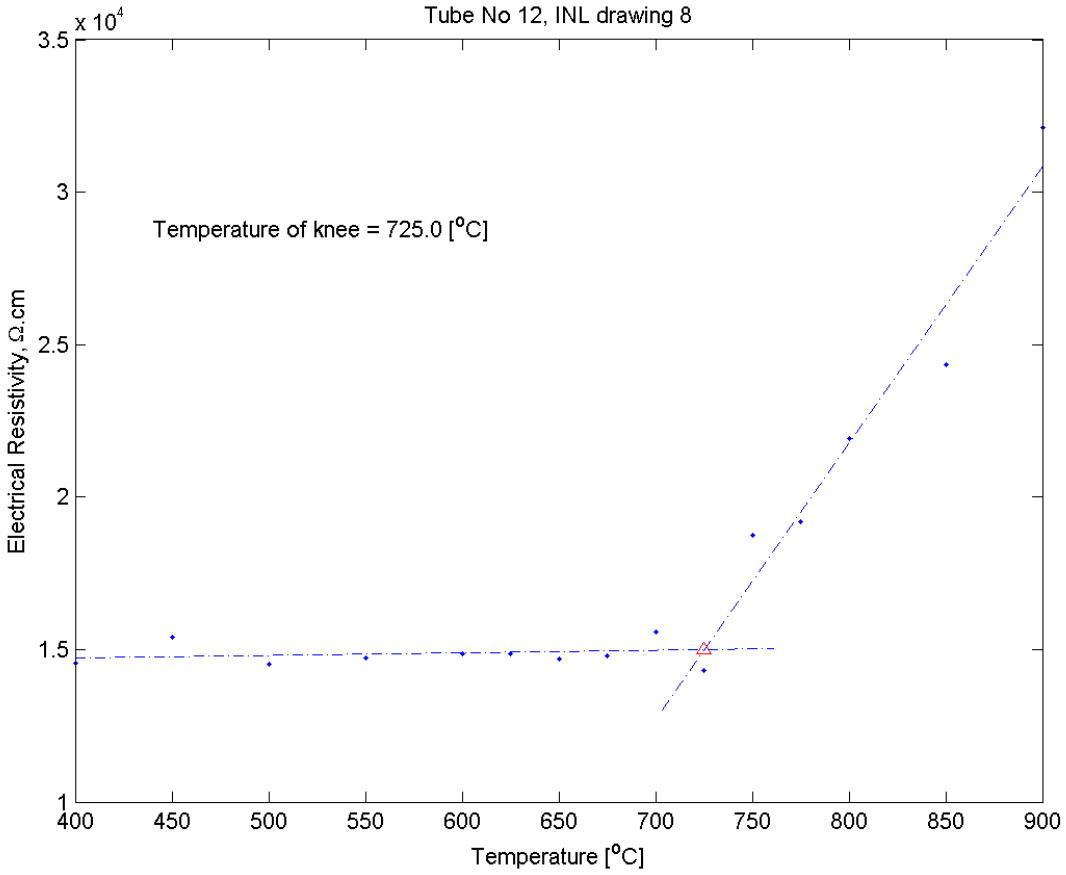


Figure 16 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 8 (INL DRG # 630431 sheet 6 - Rev 3)

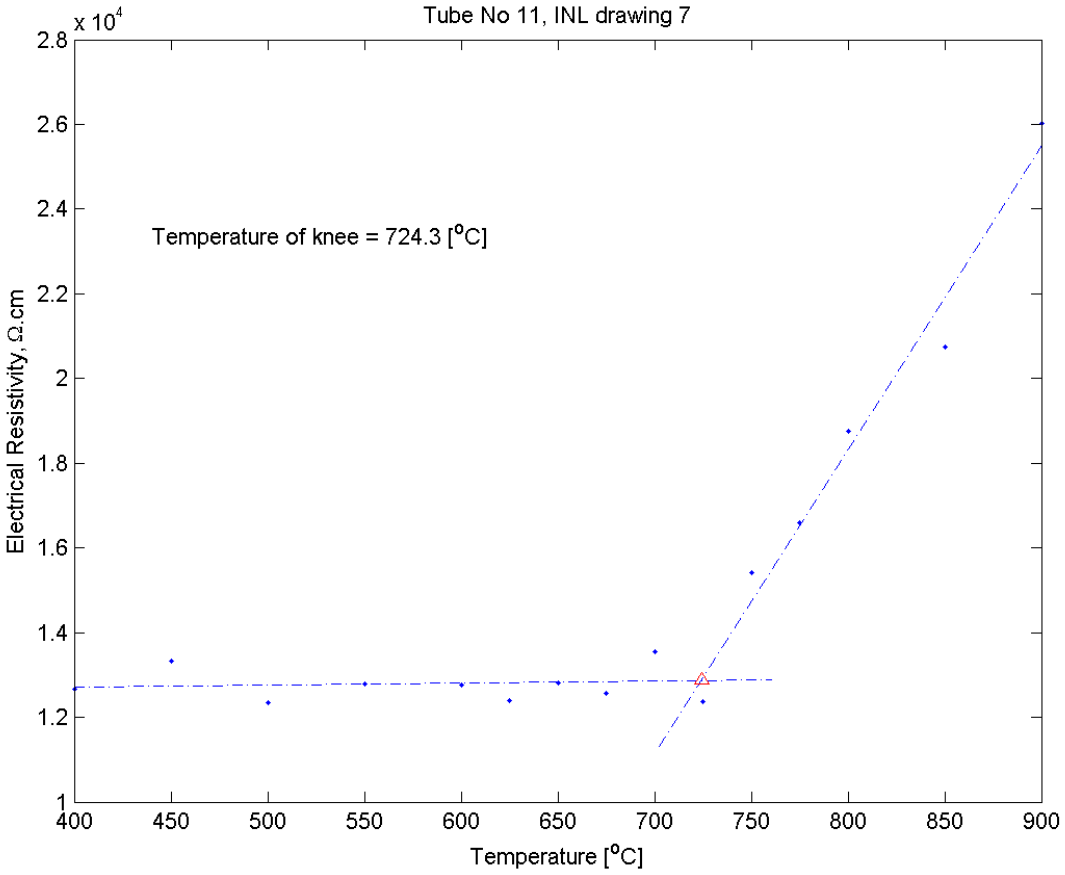


Figure 17 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 7 (INL DRG # 630431 sheet 6 - Rev 3)

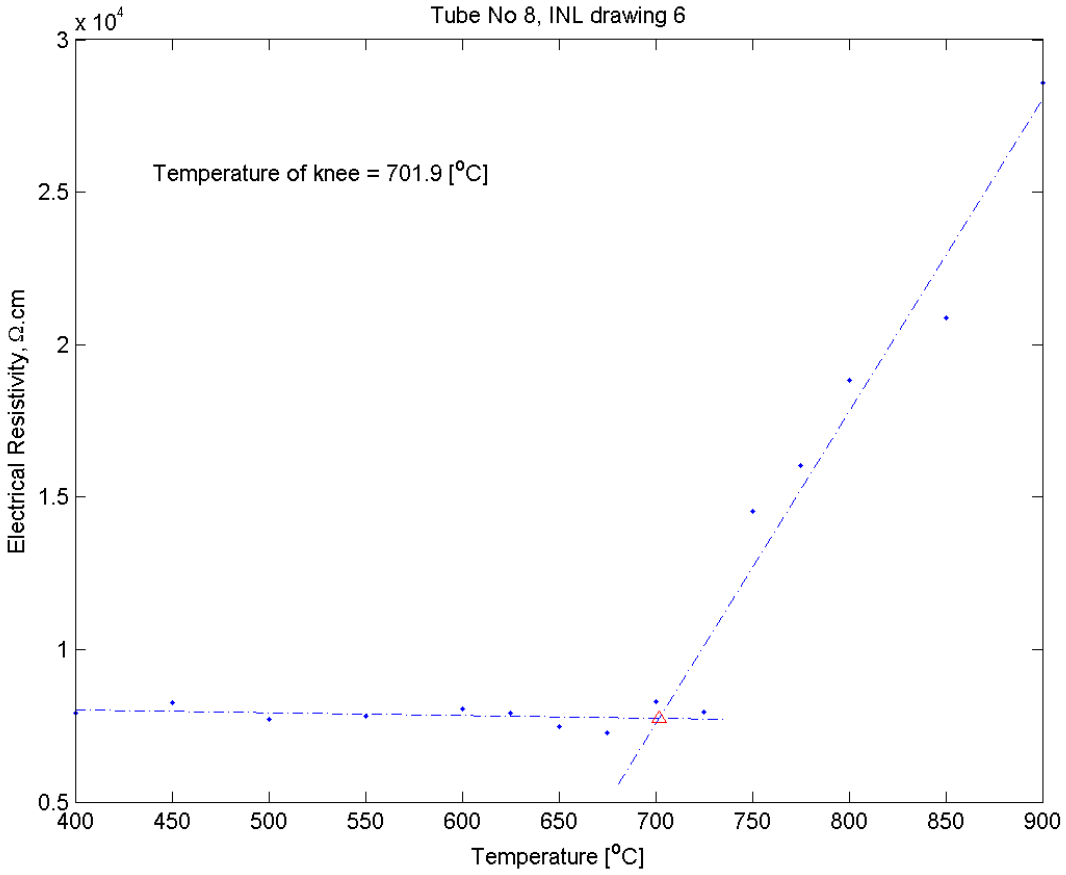


Figure 18 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 6 (INL DRG # 630431 sheet 6 - Rev 3)

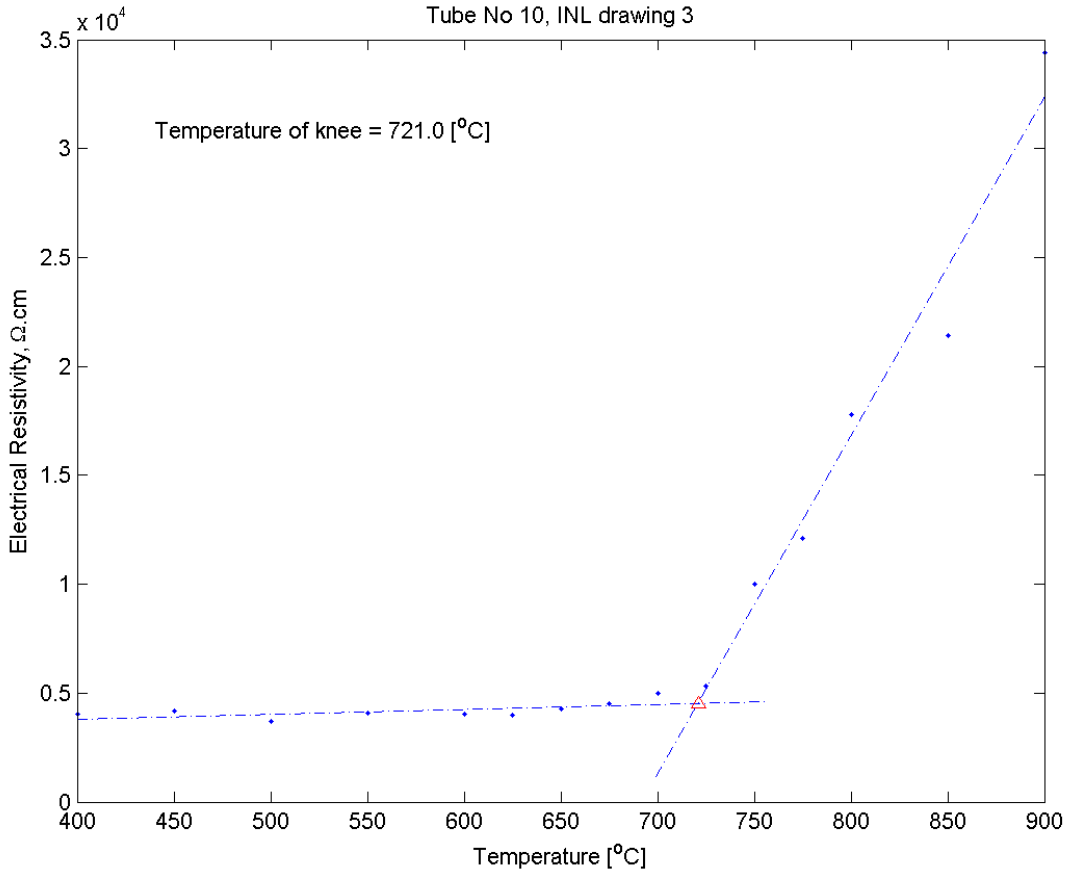


Figure 19 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 3 (INL DRG # 630431 sheet 6 - Rev 3)

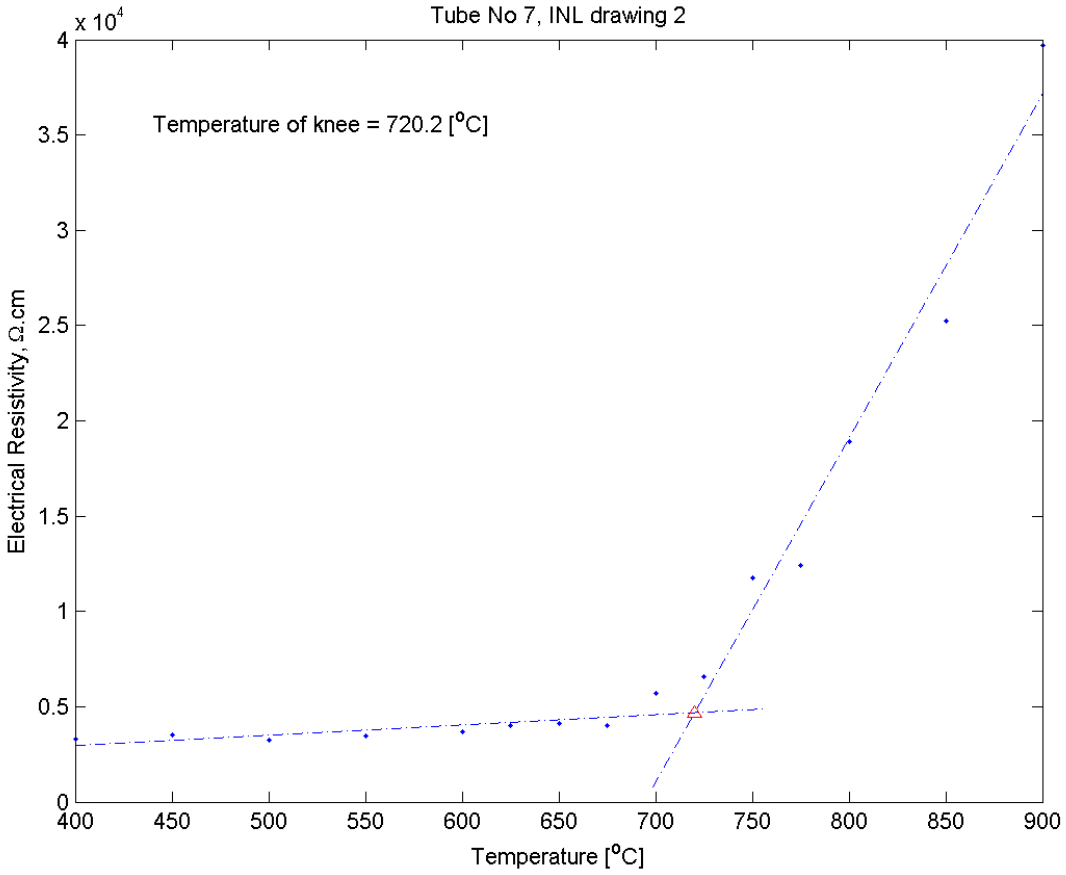


Figure 20 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 2 (INL DRG # 630431 sheet 6 - Rev 3)

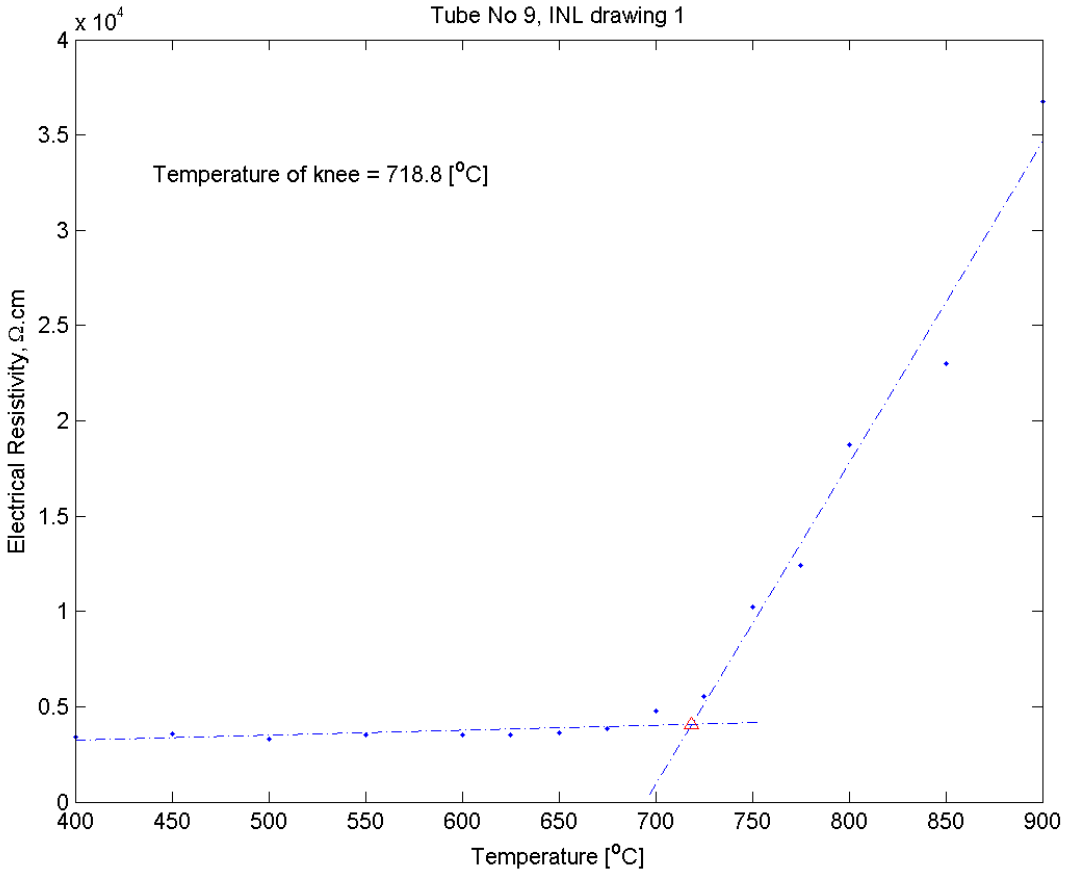


Figure 21 AGC-1 SiC Temperature monitor electrical resistivity (ER) as a function of isochronal annealing temperature for SiC ID No 1 (INL DRG # 630431 sheet 6 - Rev 3)

Table 20 Summary of the SiC Temperatures from isochronal annealing and ER measurements for the AGC-1 capsule center channel

SiC TM ID Number per INL Dwg 630431 rev. 3.	Corresponding Piggy-Back sample Nos	INL Shipping Tube No	Test Method	REF Fig. No.	Estimated SiC Temperature from "knee". °C
Top of stack					
17	CPB 3-10	2	ER	9	704.6
16	CPB 13-20	3	ER	10	740.6
15	CPB 23-30	1	ER	11	714
14	CPB 33-40	17/16 (spec 4 or 14)	ER	12	741.5
13	CPB 43-50	15	ER	13	766.2
12	CPB 53-60	14	ER	14	732.7
11	CPB 63-70	13	ER	15	698.3
8	CPB 93-100	12	ER	16	725
7	CPB 103-110	11	ER	17	724.3
6	CPB 113-120	8	ER	18	701.9
4	CPB 133-140	17/16 (spec 4 or 14)	ER	12	-
3	CPB 143-150	10	ER	19	721
2	CPB 153-160	7	ER	20	720.2
1	CPB 163-170	9	ER	21	718.8
Bottom of stack					
One SiC destroyed in disassembly		16/17			
SiC 4 or 14 probably # 14					

Table 21 Comparison of estimated SiC Temperatures and TC measurements inside AGC-1 capsule center channel

TC	TC Position, cm	Temperature, °C	SiC Monitors	SiC Position, cm	Temperature, °C
			17	54.6	704.6
			16	50.15	740.6
TC01	**45.7**	**590**	**15**	**43.8**	**714**
			14	37.45	741.5
TC02	**33**	**602**	**13**	**31.1**	**766.2**
			12	24.75	732.7
TC04	**15.2**	**760**	**11**	**18.4**	**698.3**
TC05	**15.2**	**740**			
			10	12.05	
TC06	5.1	760	9	5.7	
			8	-0.65	725
			7	-7	724.3
TC07	**-15.2**	**740**	**6**	**-13.35**	**701.9**
TC08	**-15.2**	**675**			
			5	-19.7	
TC09	-28.6	635	4	-26.05	
			3	-32.4	721
			2	-38.75	720.2
TC10	**-45.7**	**560**	**1**	**-45.1**	**718.8**
TC11	**-45.7**	**590**			
TC12	-55.9	460			

Note: In Table 34 bolded thermocouples and SiC monitor numbers indicate they resided at the same elevation within the irradiation capsule

The SiC temperature data are summarized in Table 20 and represent the capsule centerline temperatures that prevailed at the end of the last irradiation cycle for AGC-1. The thermocouple data for the end of the last irradiation cycle is summarized[1,2,8] along with the SiC Temperature monitor data in Table 21. Both temperature datasets are plotted in
Figure 22. Typically the accuracy of the indicated SiC monitor temperature is estimated to be ± 25°C from the actual capsule final temperature. The SiC temperature monitor data show that the AGC-1 was operating at a final temperature between 700 and 750°C. This temperature estimate is in good agreement with the temperature profile from thermocouples for the center 40 cm region of the capsule. The temperatures estimated by SiC and actively measured with thermocouples in the upper and lower 20cm of the capsule do not show as good of a correlation. As shown in Figure 23, the temperature measurements for each TC showed a very large variation both during an irradiation cycle and between cycles. The overall temperature of AGC-I can be seen to progressively rise from approximately 375°C to approximately 450°C at the coolest end of the capsule and from approximately 600°C to approximately 760°C at the capsule mid plane during the course of the experiment due to capsule gas changes and a design flaw as described in the irradiation reports[1,2].

Based upon SiC monitor ER data reported here the following observations are made:

1. Capsule final centerline temperature varied from 700 - 770°C (±25°C)
2. Capsule was cooler at the top and bottom 20cm at the end of operation.
3. There is generally good agreement between the SiC temperatures and the TC measured capsule final cycle temperatures for the central 40cm of the capsule.

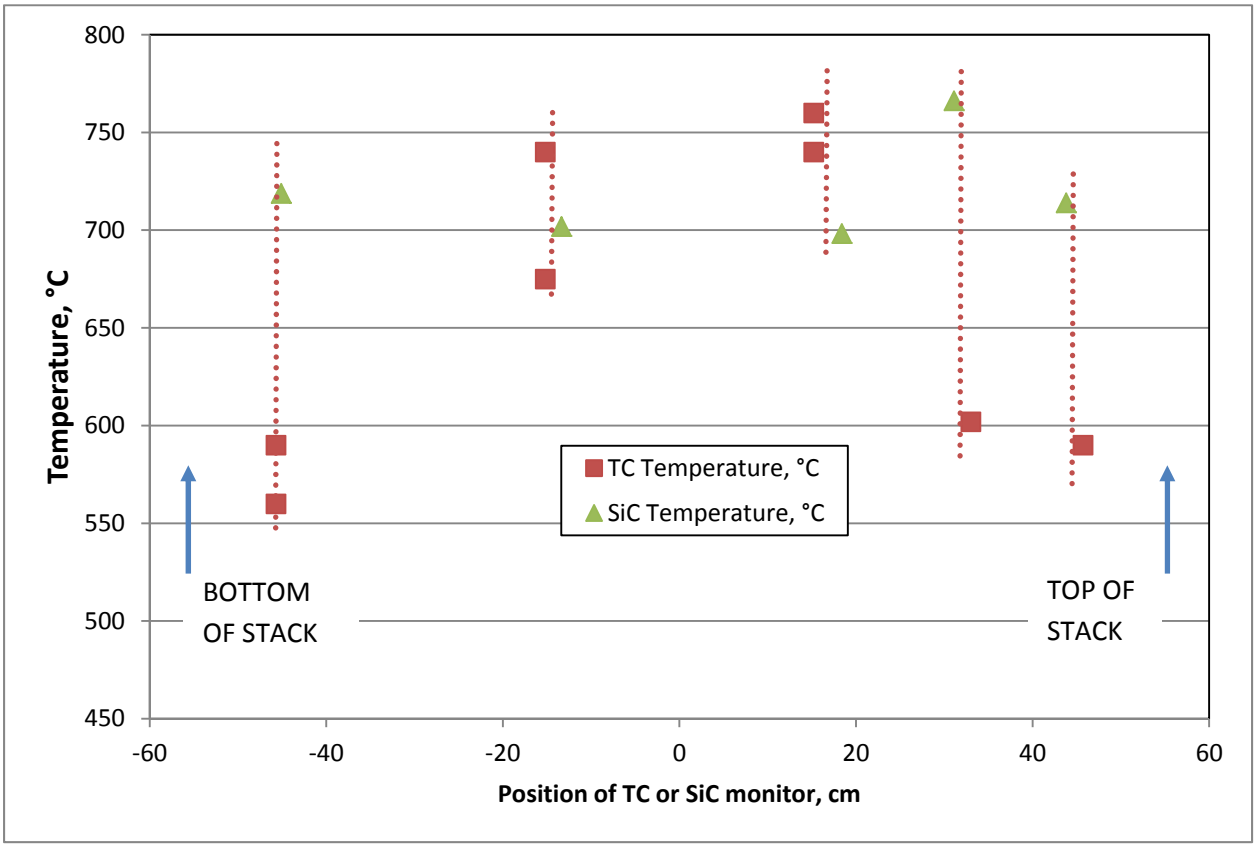


Figure 22 AGC-1 capsule centerline temperature data from the SiC temperature Monitor analysis

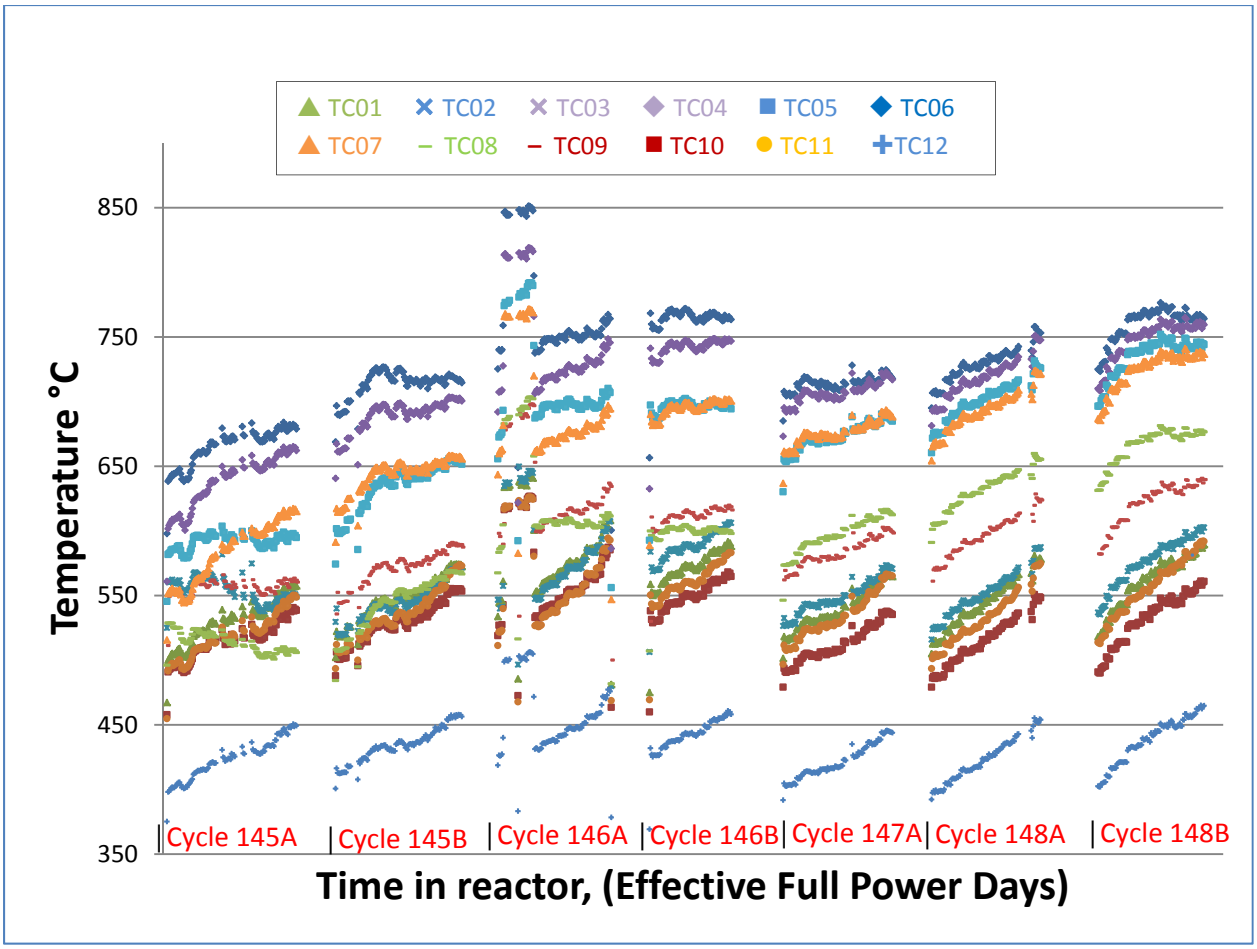


Figure 23 AGC-1 Temperature profile from TC's installed in capsule, from 1st irradiation cycle (Cycle 145A) to final irradiation cycle (Cycle 148B). Note that thermocouple number 03 failed during loading into reactor and values are not shown here.

3.2.Dimensions, Mass, Density, and Dimensional Changes

During neutron irradiation significant internal stresses within the graphite components can arise from irradiation-induced dimensional change, where the graphite physically changes (first shrinking and then expanding if greater levels of irradiation dose are experienced). This disparity in material volume change can induce significant internal stresses within the graphite components. The high internal stresses can become very large at higher dose levels leading to crack formation, crack propagation, spallation of components, and component bending. Such physical damage to the components can cause the creation of coolant gas by-pass pathways, blockage of control rod insertion, and even loss of structural integrity if the components are left in the core too long.

Irradiation-induced creep assists the removal of these large internal stresses thus reducing the risk of fracture, component geometry changes, and component failure. Obviously, higher irradiation creep levels tend to relieve more internal stress allowing the components longer useful lifetimes within the core. Determining the creep rate is understood to be critical in determining the component lifetime within a nuclear reactor. As a consequence, the AGC test series has a significant scope dedicated to determining the irradiation-induced creep rates of the different types of nuclear graphite.

The pre and post irradiation examination data for specimen dimensions, mass, density, and dimensional changes are reported in Table 45 through Table 50 (Section 8 Appendices). The measured dimensional changes for loaded and unloaded AGC-1 creep specimens are presented as a function of dose, Figure 24. The data are further presented by major graphite type and applied load levels to illustrate the influence of graphite forming processes, grain size, and stress levels within the graphite components on the measured behavior in Figure 25 through Figure 30.

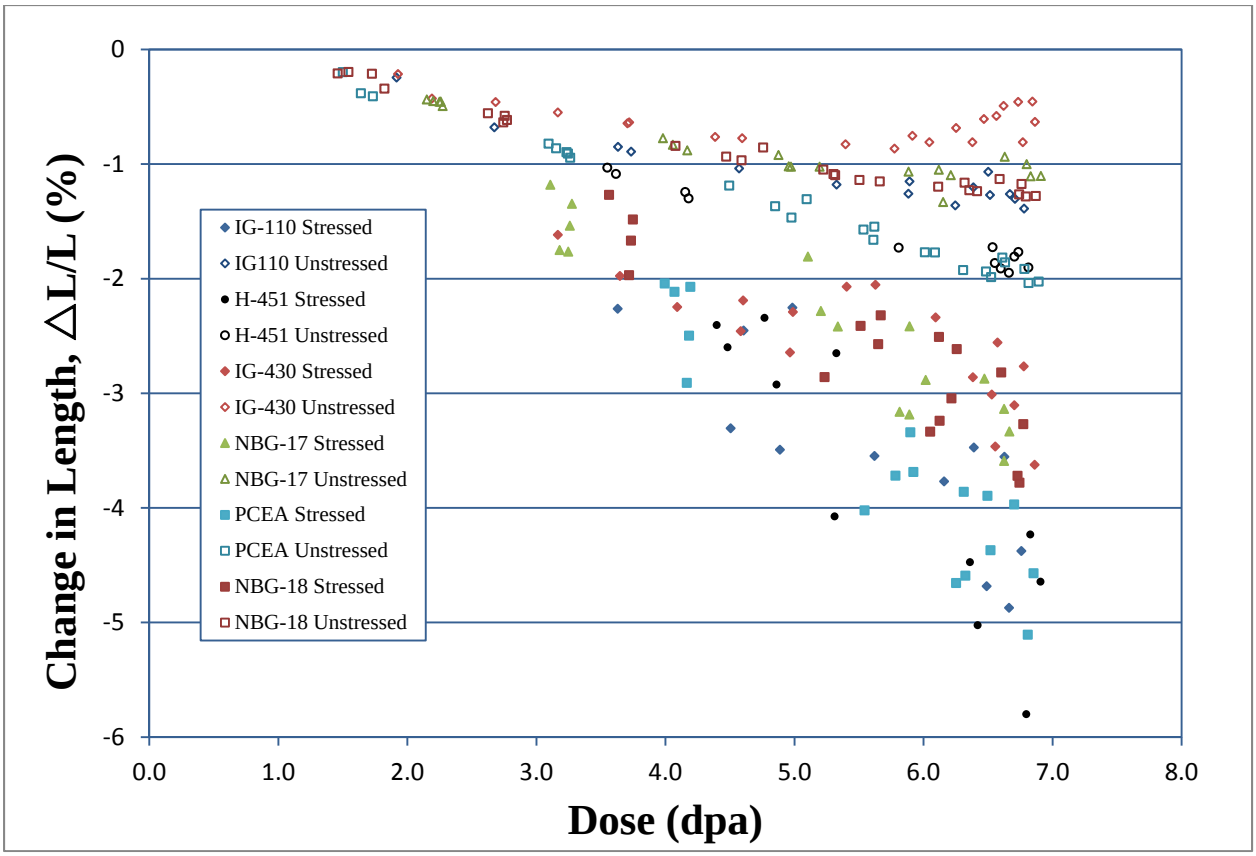


Figure 24 Measured dimensional change for AGC-1 creep specimens

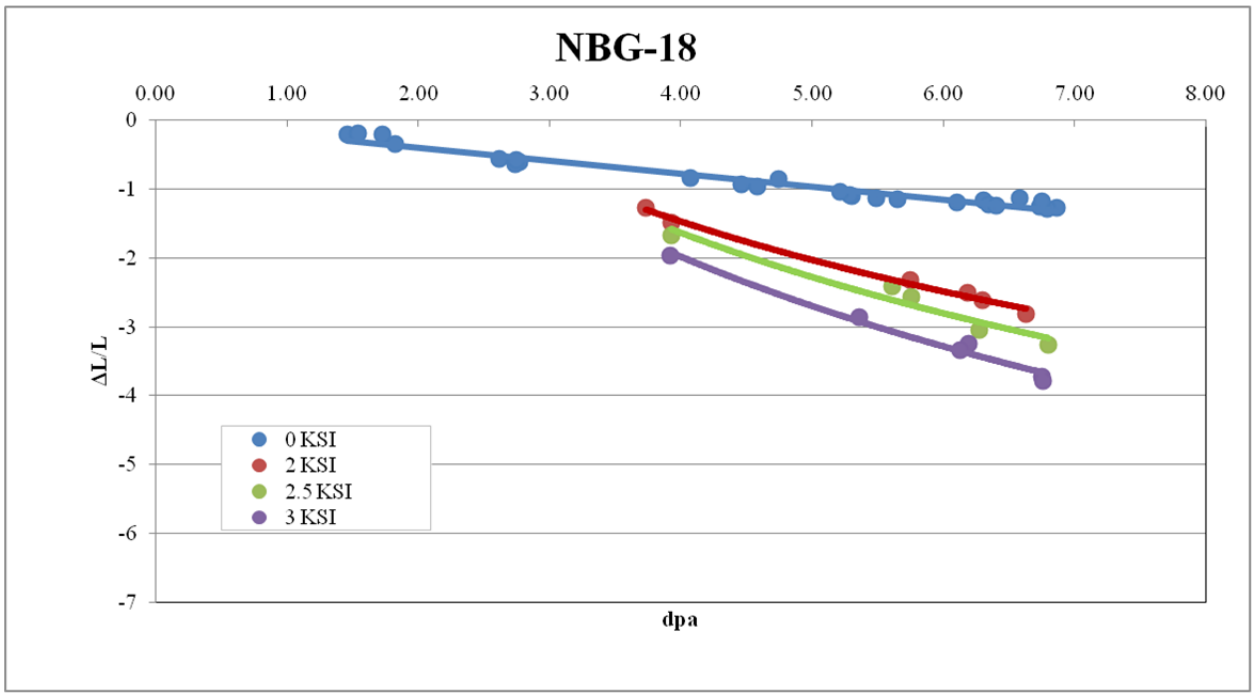


Figure 25 Measured dimensional changes for NBG-18 creep and piggyback specimens

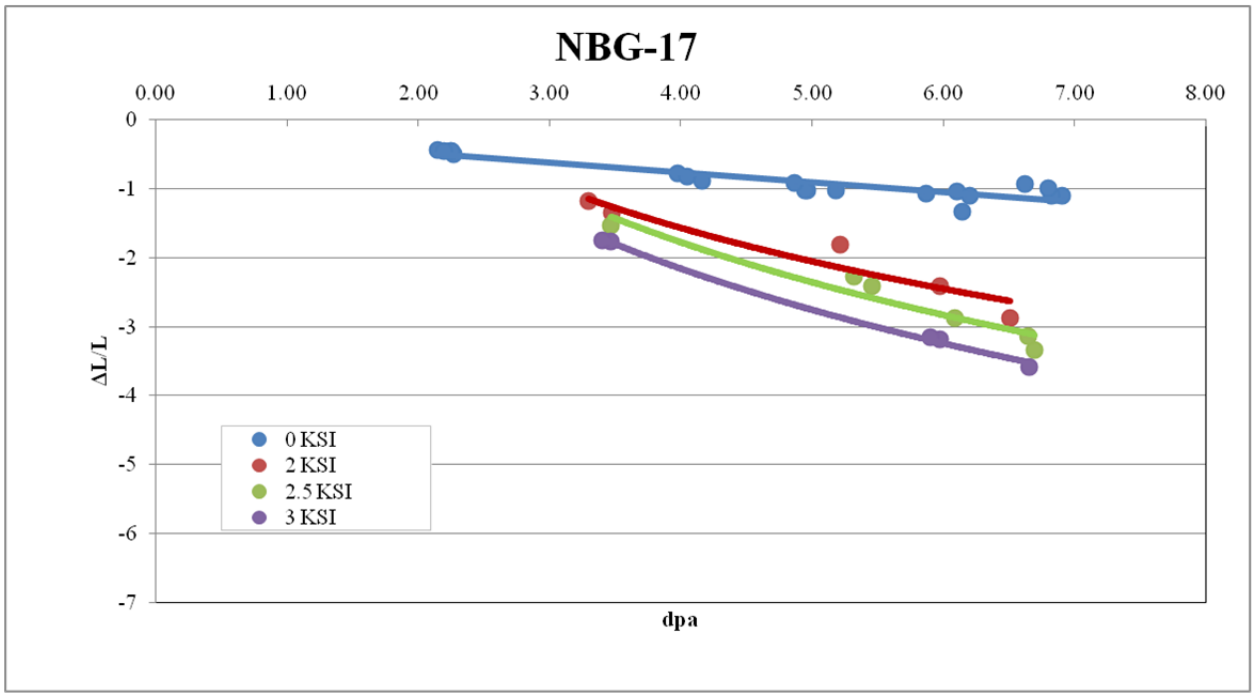


Figure 26 Measured dimensional changes for NBG-17 creep and piggyback specimens

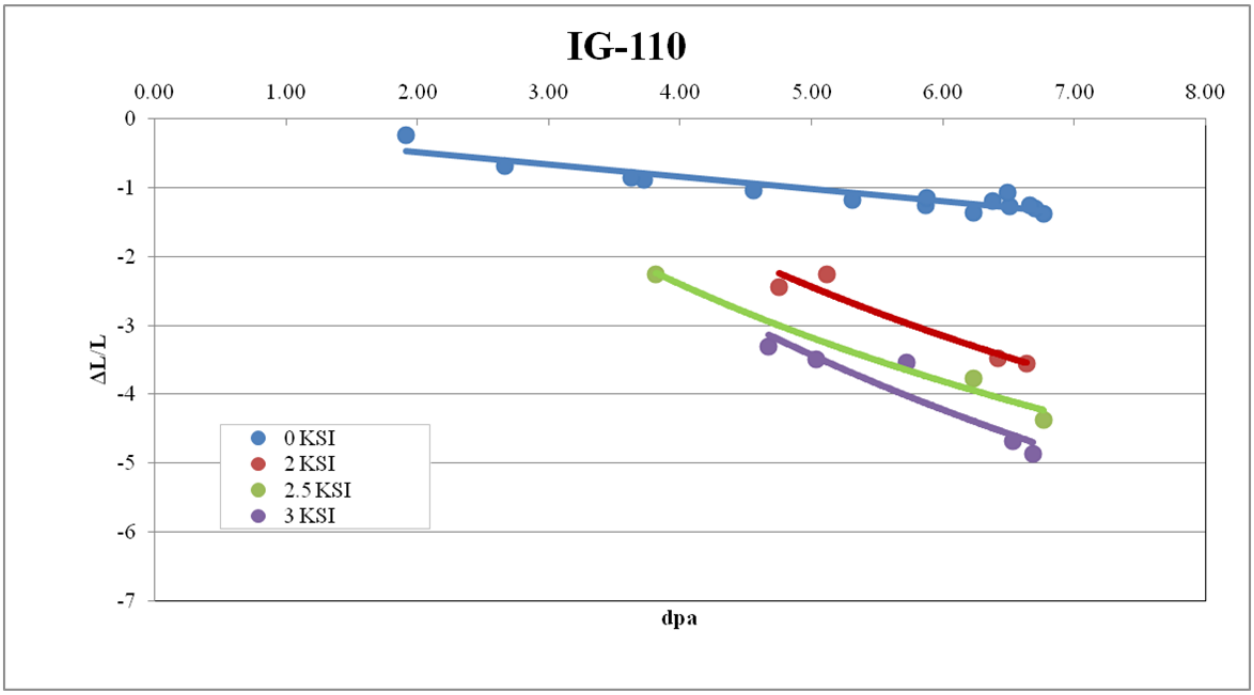


Figure 27 Measured dimensional changes for IG-110 creep and piggyback specimens

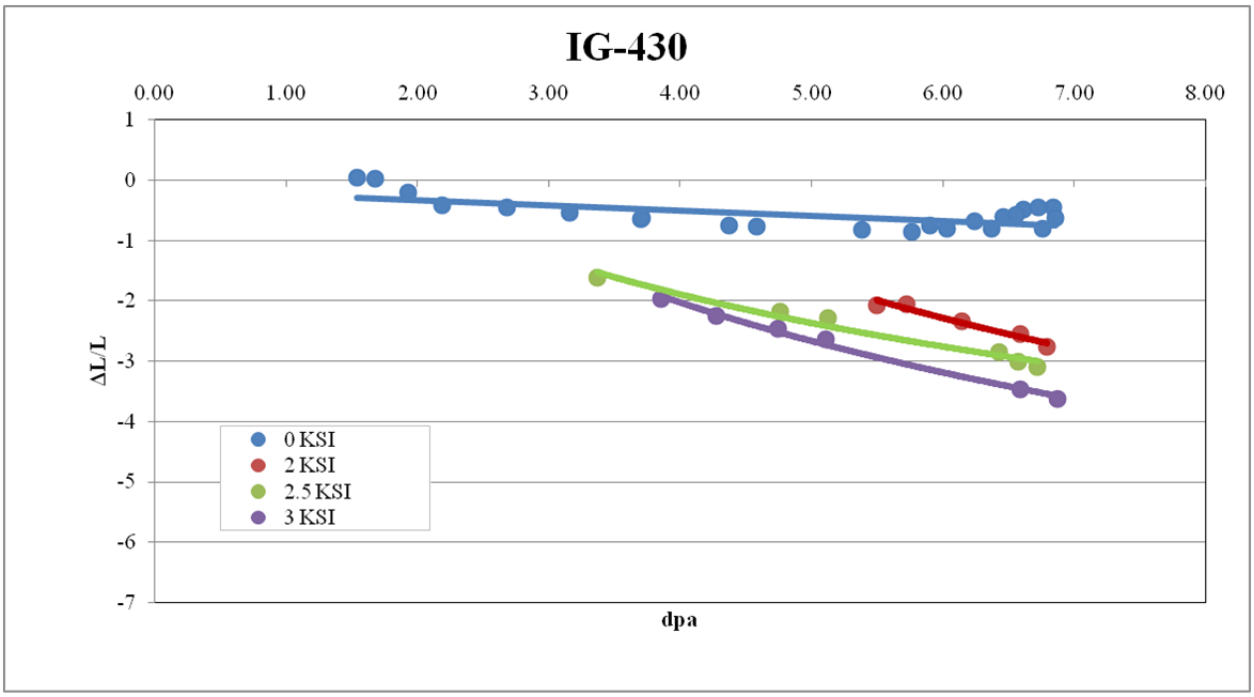


Figure 28 Measured dimensional changes for IG-430 creep and piggyback specimens

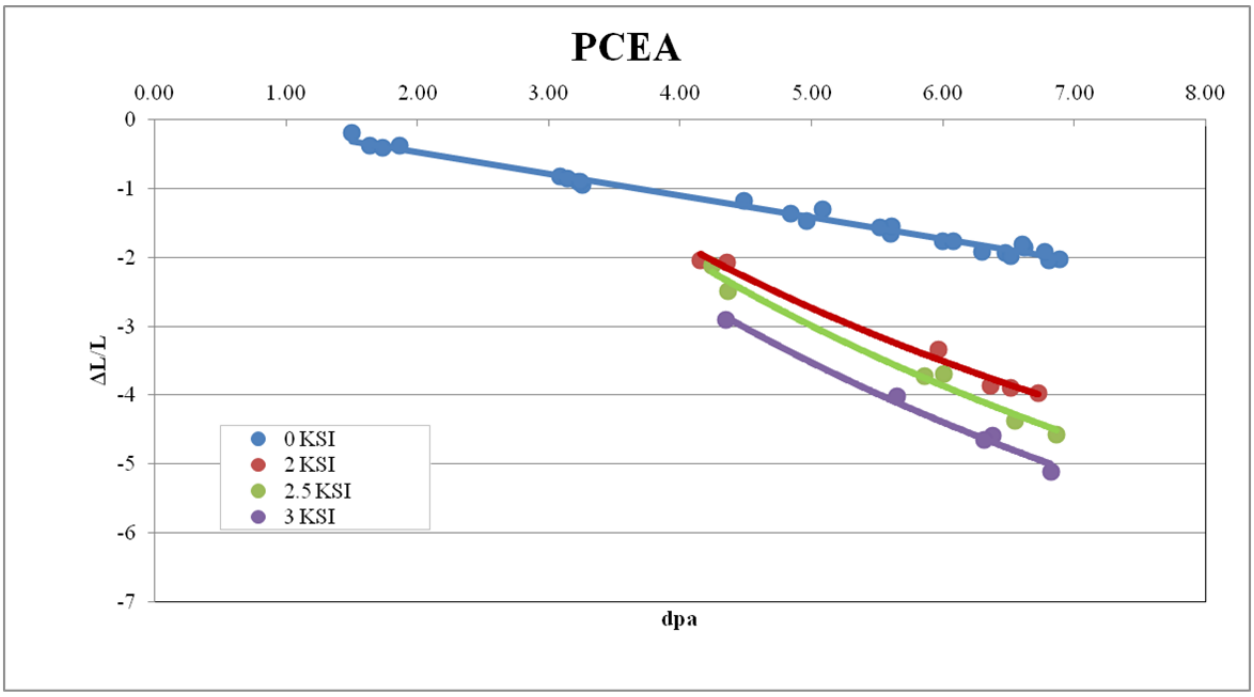


Figure 29 Measured dimensional changes for PCEA creep and piggyback specimens

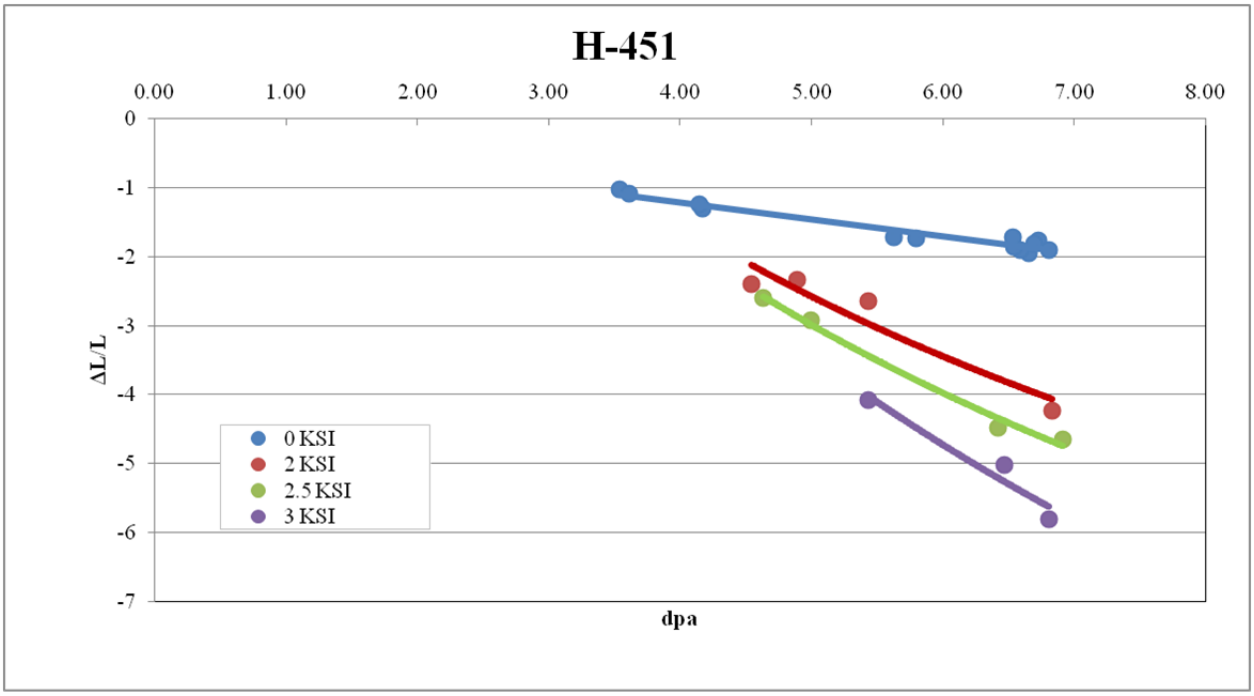


Figure 30 Measured dimensional changes for H-451 creep and piggyback specimens

Individual measured dimensional changes for the alternative, experimental, and minor graphite grades have been reported earlier[5].

3.3.Creep Strain Data

Figure 25 through Figure 30 report the percentage dimensional change exhibited by each AGC-1 Creep (stressed) or Control (unstressed) specimen. The irradiation creep strain is defined as the difference between the irradiation induced dimensional changes of the stressed and unstressed specimen under similar temperature and dose conditions. The creep strain may thus be determined from the data in Table 45 through Table 50 for the larger creep specimen pairs which were stressed during irradiation. No analysis of the creep strain data is reported here however. This is largely due to the difficulty is ascribing an accurate temperature to the specimen pairs. It is anticipated that a creep strain analysis will follow.

3.4.Flexural Dynamic Young's Modulus (Fundamental Frequency)

The pre and post irradiation data for flexural dynamic Young's Modulus (Fundamental Frequency method) are reported in Table 51 through Table 61 (Section 8 Appendix).

Also reported are data for the fractional change (%) on irradiation for the flexural modulus of each of the six major grades in AGC-1.

3.5.Sonic Elastic Constants

PIE data for the sonic elastic constants for NBG-17 are given in Table 22 and Table 23 for the AG and WG orientations, respectively.

Table 22 PIE sonic elastic constants data for NBG-17 graphite (AG)

Young's Modulus, Shear Modulus and Poisson's Ratio by Sonic Velocity (AG)										
			Sonic Velocities, v [m/s]							
Specimen Number	Specimen Location	Density,ρ kg/m^3	Longituginal	Shear 0◦	Shear 90◦	Average Shear Velocity	Elastic Modulus, [Pa] $E=\rho v_l^2$	Shear Modulus, [Pa] $G=\rho v_s^2$	Poisson's Ratio $\mu=(1-[2(v_s/v_l)^2])/(2-[2(v_s/v_l)^2])$	Elastic Modulus, [Pa] $E=\rho v_l^2[(1+\mu)(1-2\mu)/(1-\mu)]$
AW1-01	**1S3**	1925.74	3.515E+03	2.090E+03	2.090E+03	2.090E+03	2.37930E+10	8.412E+09	2.266E-01	2.064E+10
AW1-02	**1S11**	1926.47	3.609E+03	2.120E+03	2.127E+03	2.124E+03	2.50920E+10	8.687E+09	2.352E-01	2.146E+10
AW1-03	**1S12**	1894.57	3.560E+03	2.071E+03	2.071E+03	2.071E+03	2.40110E+10	8.126E+09	2.442E-01	2.022E+10
AW2-01	**1U3**	1934.09	3.639E+03	2.115E+03	2.113E+03	2.114E+03	2.56118E+10	8.643E+09	2.453E-01	2.153E+10
AW2-02	**1U11**	1926.75	3.710E+03	2.130E+03	2.130E+03	2.130E+03	2.65200E+10	8.741E+09	2.542E-01	2.193E+10
AW2-03	**1U12**	1894.16	3.686E+03	2.096E+03	2.096E+03	2.096E+03	2.57352E+10	8.321E+09	2.611E-01	2.099E+10
AW4-01	**2S6**	1928.76	3.552E+03	2.111E+03	2.111E+03	2.111E+03	2.43346E+10	8.595E+09	2.270E-01	2.109E+10
AW4-02	**2U4**	1900.95	3.540E+03	2.077E+03	2.077E+03	2.077E+03	2.38219E+10	8.201E+09	2.375E-01	2.030E+10
AW4-03	**2U6**	1914.86	3.728E+03	2.125E+03	2.125E+03	2.125E+03	2.66127E+10	8.647E+09	2.594E-01	2.178E+10
AW5-01	**2U10**	1894.00	3.673E+03	2.096E+03	1.914E+03	2.005E+03	2.55518E+10	7.614E+09	2.878E-01	1.961E+10
AW5-02	**3S13**	1900.47	3.480E+03	1.862E+03	1.869E+03	1.866E+03	2.30155E+10	6.614E+09	2.984E-01	1.717E+10
AW5-03	**3U8**	1919.38	3.821E+03	1.974E+03	1.999E+03	1.987E+03	2.80230E+10	7.574E+09	3.148E-01	1.992E+10
AW6-01	**3U12**	1891.82	3.667E+03	2.102E+03	2.092E+03	2.097E+03	2.54391E+10	8.319E+09	2.570E-01	2.091E+10
AW6-02	**4S8**	1916.66	3.437E+03	2.047E+03	1.846E+03	1.947E+03	2.26414E+10	7.262E+09	2.639E-01	1.836E+10
AW6-03	**4S12**	1890.79	3.560E+03	1.865E+03	1.880E+03	1.873E+03	2.39631E+10	6.630E+09	3.088E-01	1.735E+10
AW7-01	**4U8**	1912.14	3.741E+03	1.958E+03	1.973E+03	1.966E+03	2.67606E+10	7.387E+09	3.094E-01	1.934E+10
AW7-03	**5S6**	1931.58	3.391E+03	2.029E+03	2.056E+03	2.043E+03	2.22110E+10	8.058E+09	2.153E-01	1.959E+10
AW9-01	**5S14**	1933.28	3.608E+03	2.081E+03	2.081E+03	2.081E+03	2.51668E+10	8.372E+09	2.507E-01	2.094E+10
AW9-03	**5U6**	1934.56	3.780E+03	2.142E+03	2.142E+03	2.142E+03	2.76418E+10	8.876E+09	2.635E-01	2.243E+10
AW10-01	**5U13**	1931.29	3.499E+03	2.113E+03	2.088E+03	2.101E+03	2.36448E+10	8.521E+09	2.183E-01	2.076E+10
AW10-02	**6S1**	1943.56	3.436E+03	1.854E+03	1.879E+03	1.867E+03	2.29459E+10	6.771E+09	2.907E-01	1.748E+10
AW10-03	**6S8**	1938.09	3.452E+03	1.921E+03	2.067E+03	1.994E+03	2.30949E+10	7.706E+09	2.496E-01	1.926E+10
AW12-01	**6S15**	1900.13	3.506E+03	2.056E+03	2.061E+03	2.059E+03	2.33565E+10	8.052E+09	2.370E-01	1.992E+10
AW12-03	**6U8**	1928.39	3.724E+03	2.129E+03	2.129E+03	2.129E+03	2.67433E+10	8.741E+09	2.572E-01	2.198E+10
AW13-01	**6U14**	1888.98	3.655E+03	2.099E+03	2.099E+03	2.099E+03	2.52349E+10	8.322E+09	2.540E-01	2.087E+10
AW13-02	**Spare 1W**	1931.60	3.406E+03	2.050E+03	2.052E+03	2.051E+03	2.24082E+10	8.125E+09	2.155E-01	1.975E+10

Table 23 PIE sonic elastic constants data for NBG-17 graphite (WG)

Young's Modulus, Shear Modulus and Poisson's Ratio by Sonic Velocity (WG)										
			Sonic Velocities, v [m/s]							
Specimen Number	Specimen Location	Density,ρ kg/m^3	Longituginal	Shear 0◦	Shear 90◦	Average Shear Velocity	Elastic Modulus, [Pa] $E=\rho v_l^2$	Shear Modulus, [Pa] $G=\rho v_s^2$	Poisson's Ratio $\mu=(1-[2(v_s/v_l)^2])/(2-[2(v_s/v_l)^2])$	Elastic Modulus, [Pa] $E=\rho v_l^2[(1+\mu)(1-2\mu)/(1-\mu)]$
AL6-01	**1S13**	1939.21	3.742E+03	2.145E+03	2.129E+03	2.137E+03	2.71539E+10	8.856E+09	2.580E-01	2.228E+10
AL6-02	**2S4**	1938.45	3.564E+03	2.128E+03	2.128E+03	2.128E+03	2.46224E+10	8.778E+09	2.230E-01	2.147E+10
AL8-01	**3S8**	1921.32	3.511E+03	2.081E+03	2.081E+03	2.081E+03	2.36843E+10	8.320E+09	2.292E-01	2.046E+10
AL8-02	**4S11**	1916.45	3.734E+03	2.140E+03	2.140E+03	2.140E+03	2.67206E+10	8.777E+09	2.554E-01	2.204E+10

The NBG-17 elastic constants are plotted to assist in the identification of outliers in Figure 31 through Figure 33 for the AG orientation and Figure 34 through Figure 36 for the WG orientation.

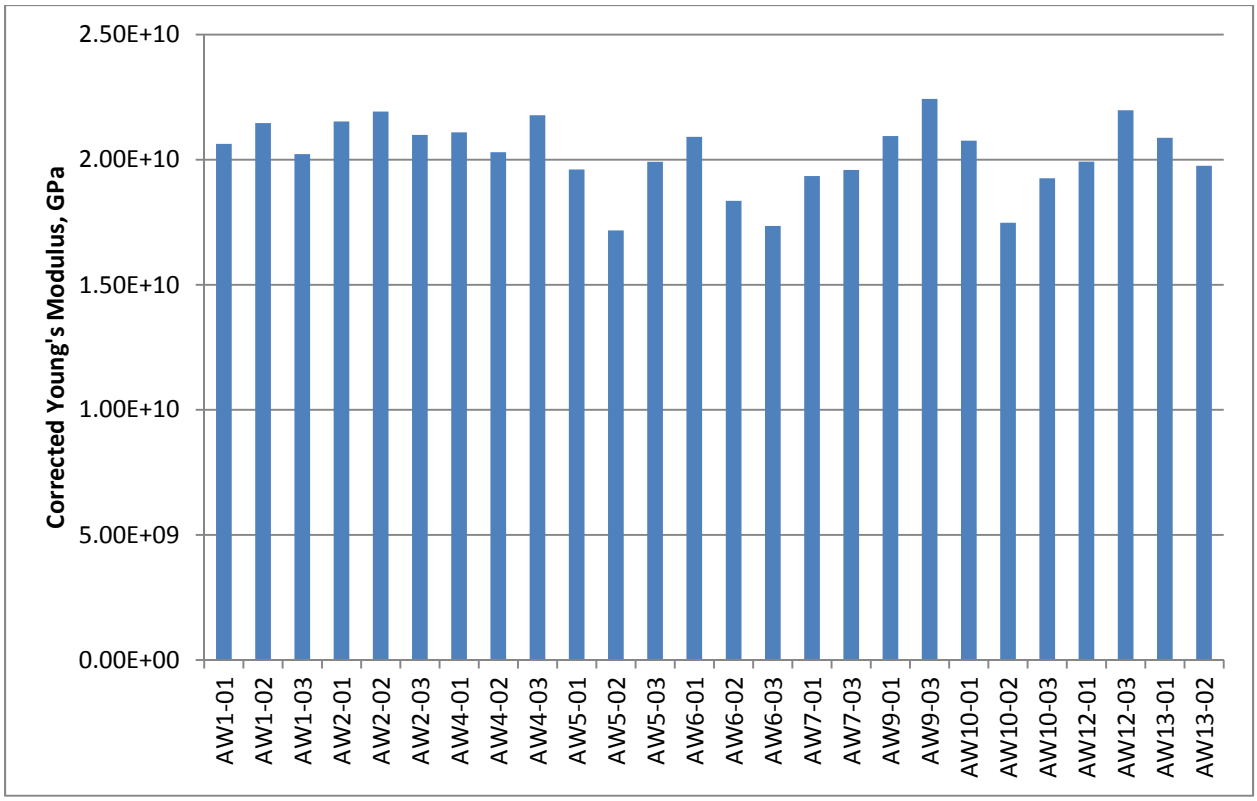


Figure 31 PIE data for Longitudinal Dynamic Young's modulus (from sonic velocity) for NBG-17 (AG) creep and control specimens

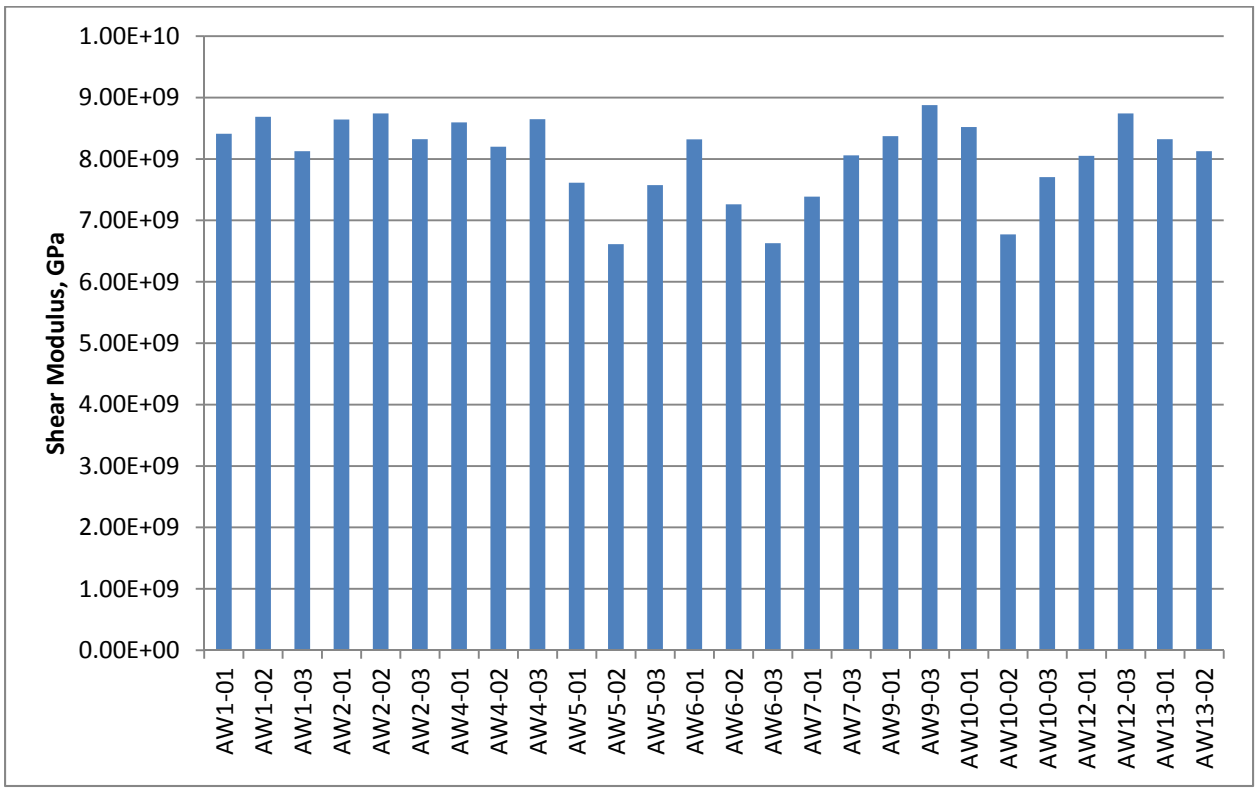


Figure 32 PIE data for Shear modulus (from sonic velocity) for NBG-17 (AG) creep and control specimens

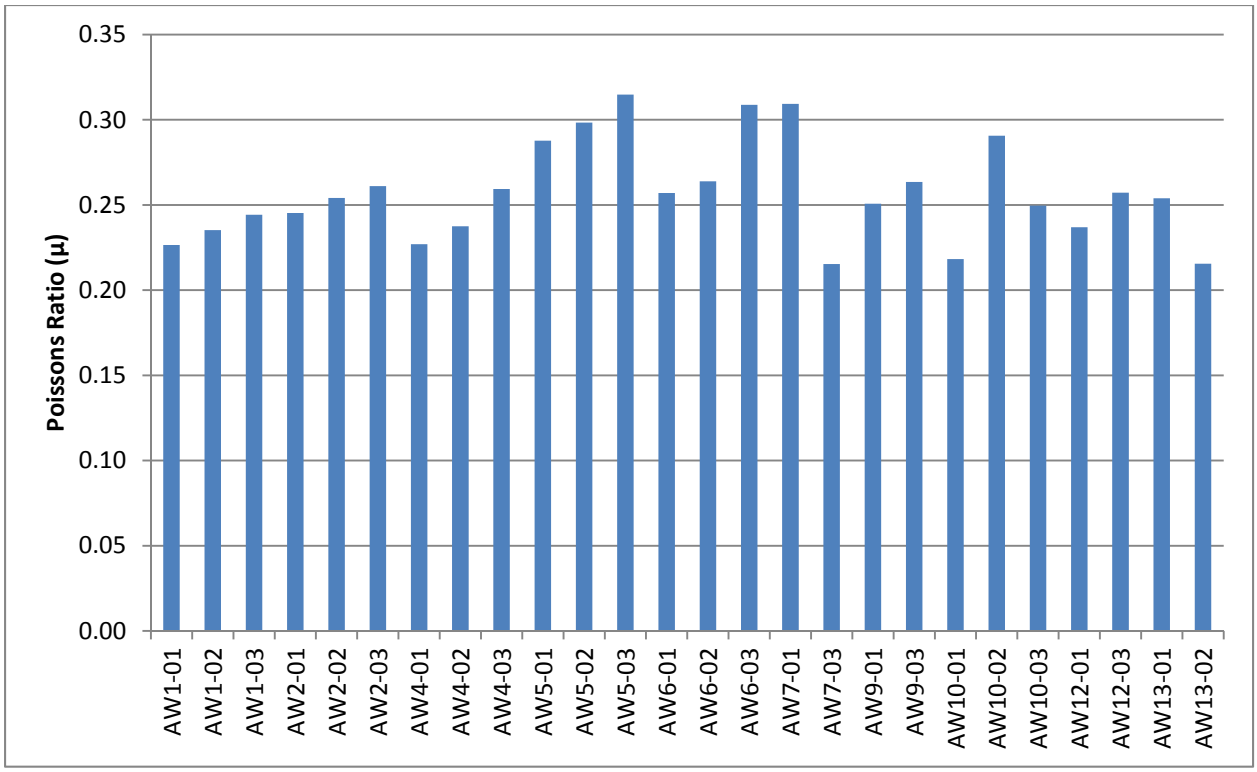


Figure 33 PIE data for Poison's Ratio (from sonic velocity) for NBG-17 (AG) creep and control specimens

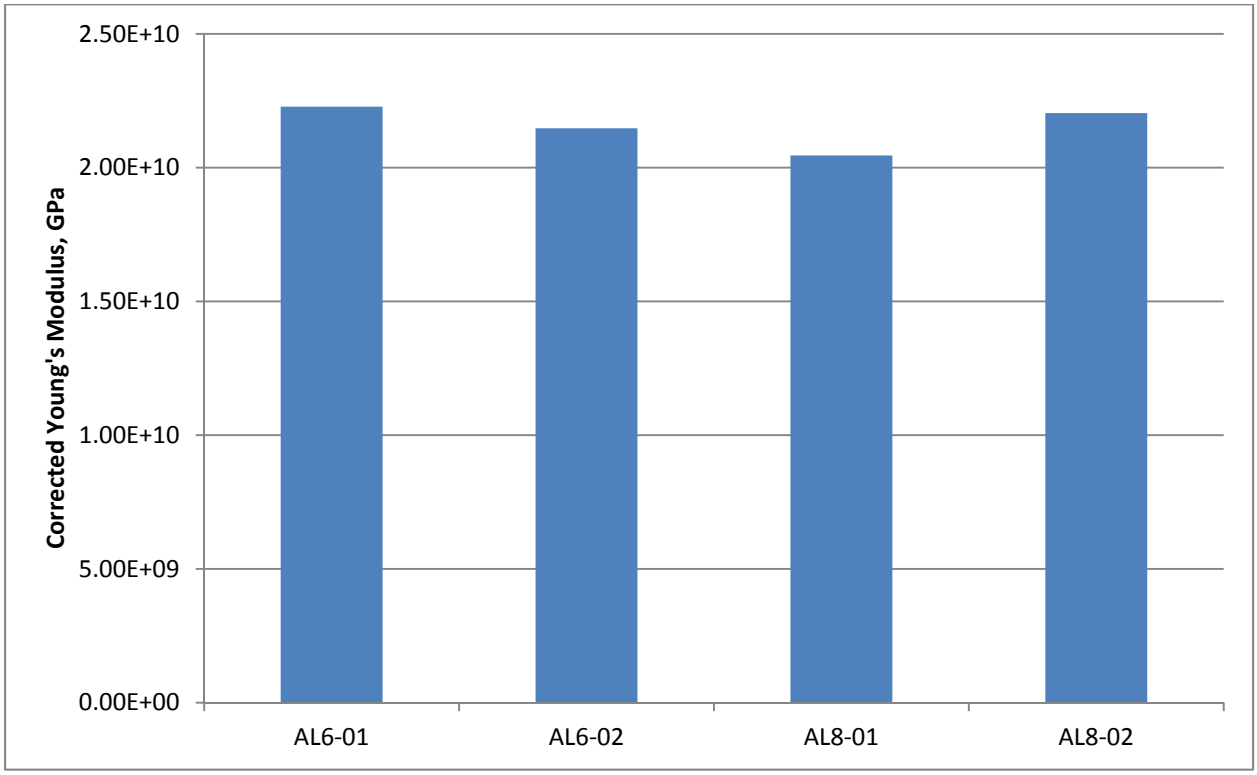


Figure 34 PIE data for Longitudinal Dynamic Young's modulus (from sonic velocity) for NBG-17 (WG) creep and control specimens

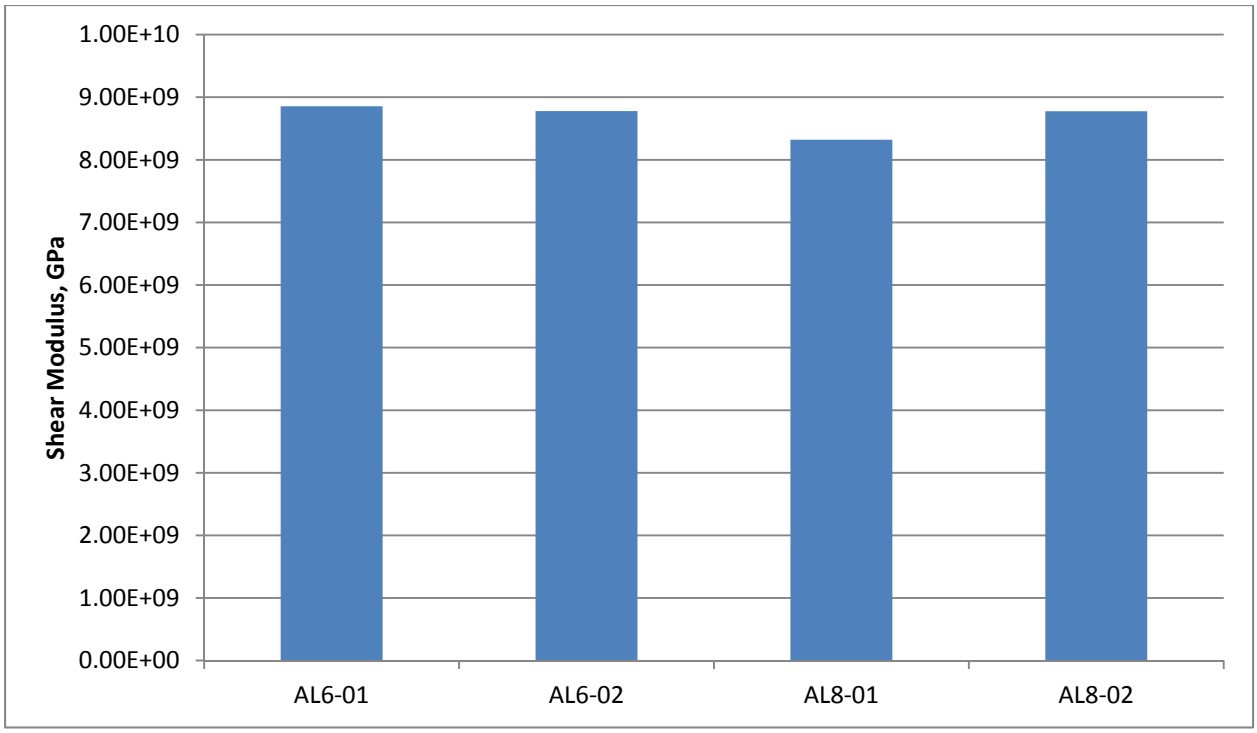


Figure 35 PIE data for Shear modulus (from sonic velocity) for NBG-17 (WG) creep and control specimens

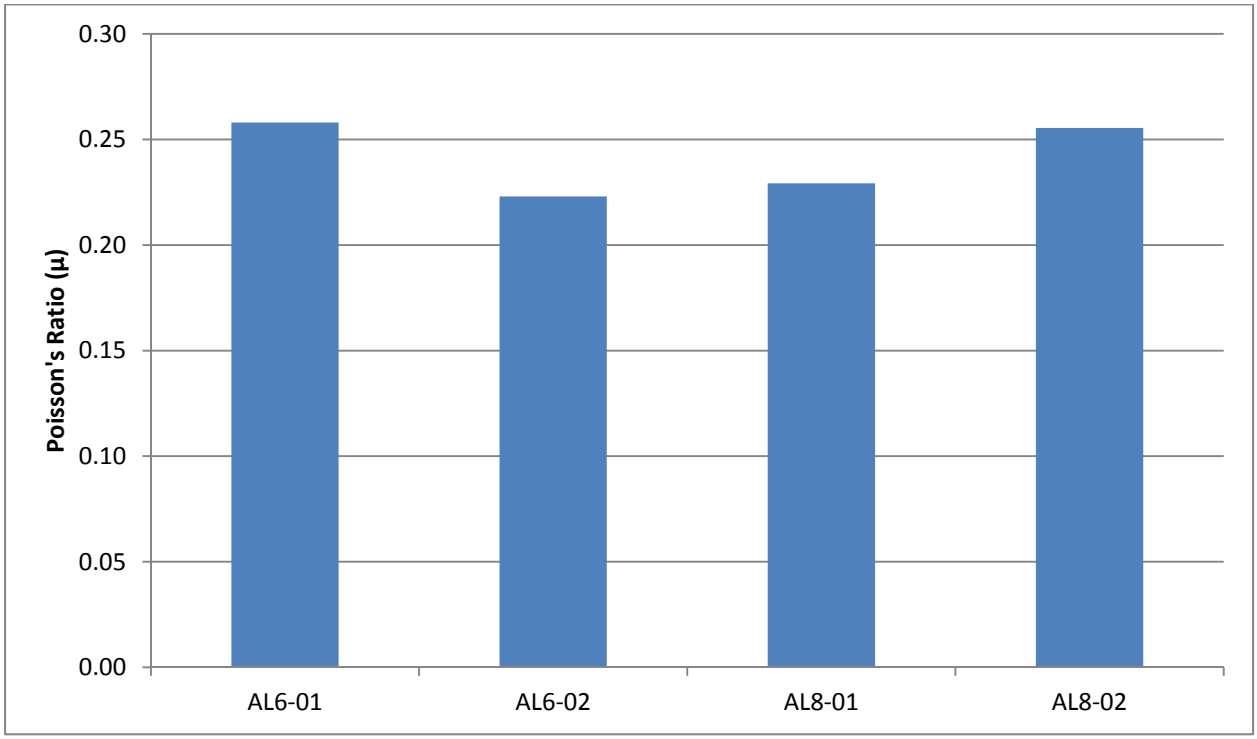


Figure 36 PIE data for Poison's Ratio (from sonic velocity) for NBG-17 (WG) creep and control specimens

PIE data for the sonic elastic constants for NBG-18 are given Table 24 and Table 25 for the AG and WG orientations, respectively.

Table 24 PIE sonic elastic constants data for NBG-18 graphite (AG)

Young's Modulus, Shear Modulus and Poisson's Ratio by Sonic Velocity (AG)										
			Sonic Velocities, v [m/s]							
Specimen Number	Specimen Location	Density,ρ kg/m^3	Longituginal	Shear 0°	Shear 90°	Average Shear Velocity	Elastic Modulus, [Pa] $E=\rho v_l^2$	Shear Modulus, [Pa] $G=\rho v_s^2$	Poisson's Ratio $\mu=(1-[2(v_s/v_l)^2])/(2-[2(v_s/v_l)^2])$	Elastic Modulus, [Pa] $E=\rho v_l^2[(1+\mu)(1-2\mu)/(1-\mu)]$
BW1-01	**1S4**	1956.95	3.568E+03	1.941E+03	1.91E+03	1.925E+03	2.49132E+10	7.248E+09	2.949E-01	1.877E+10
BW1-02	**1U1**	1909.28	3.764E+03	1.964E+03	1.964E+03	1.964E+03	2.70501E+10	7.365E+09	3.129E-01	1.934E+10
BW1-03	**1U4**	1949.75	3.680E+03	1.916E+03	1.910E+03	1.913E+03	2.64043E+10	7.135E+09	3.149E-01	1.876E+10
BW2-01	**2S2**	1960.87	3.502E+03	1.901E+03	1.912E+03	1.907E+03	2.40481E+10	7.127E+09	2.894E-01	1.838E+10
BW2-02	**2S11**	1949.04	3.589E+03	1.898E+03	2.117E+03	2.008E+03	2.51054E+10	7.855E+09	2.723E-01	1.999E+10
BW2-03	**2U2**	1958.97	3.729E+03	2.131E+03	2.131E+03	2.131E+03	2.72403E+10	8.896E+09	2.575E-01	2.237E+10
BW3-01	**2U11**	1935.83	3.800E+03	1.971E+03	1.971E+03	1.971E+03	2.79534E+10	7.520E+09	3.160E-01	1.979E+10
BW3-02	**3S2**	1952.34	3.635E+03	1.946E+03	1.946E+03	1.946E+03	2.57967E+10	7.393E+09	2.991E-01	1.921E+10
BW3-03	**3S11**	1950.74	3.403E+03	1.951E+03	1.981E+03	1.966E+03	2.25904E+10	7.540E+09	2.495E-01	1.884E+10
BW5-01	**3S14**	1941.45	3.454E+03	2.027E+03	1.854E+03	1.941E+03	2.31617E+10	7.311E+09	2.694E-01	1.856E+10
BW5-02	**3U2**	1942.83	3.738E+03	2.127E+03	2.129E+03	2.128E+03	2.71465E+10	8.798E+09	2.603E-01	2.218E+10
BW5-03	**3U11**	1943.30	3.861E+03	2.173E+03	2.175E+03	2.174E+03	2.89694E+10	9.185E+09	2.679E-01	2.329E+10
BW7-01	**3U13**	1927.95	3.800E+03	2.155E+03	2.155E+03	2.155E+03	2.78396E+10	8.953E+09	2.630E-01	2.262E+10
BW7-02	**4S5**	1942.04	3.428E+03	2.045E+03	2.045E+03	2.045E+03	2.28213E+10	8.122E+09	2.237E-01	1.988E+10
BW7-03	**4S14**	1908.86	3.612E+03	2.082E+03	2.070E+03	2.076E+03	2.49040E+10	8.227E+09	2.534E-01	2.062E+10
BW8-01	**4U5**	1943.21	3.844E+03	2.167E+03	2.167E+03	2.167E+03	2.87135E+10	9.125E+09	2.671E-01	2.312E+10
BW8-02	**4U7**	1924.74	3.891E+03	2.197E+03	2.191E+03	2.194E+03	2.91403E+10	9.265E+09	2.669E-01	2.348E+10
BW9-01	**5S8**	1943.44	3.434E+03	1.857E+03	2.035E+03	1.946E+03	2.29177E+10	7.360E+09	2.635E-01	1.860E+10
BW9-02	**5S15**	1934.67	3.462E+03	2.050E+03	2.050E+03	2.050E+03	2.31879E+10	8.130E+09	2.300E-01	2.000E+10
BW9-03	**5U5**	1915.71	3.594E+03	2.093E+03	2.093E+03	2.093E+03	2.47449E+10	8.392E+09	2.434E-01	2.087E+10
BW10-01	**5U8**	1943.17	3.815E+03	2.153E+03	2.156E+03	2.155E+03	2.82813E+10	9.020E+09	2.659E-01	2.284E+10
BW10-02	**5U14**	1928.15	3.851E+03	2.160E+03	2.160E+03	2.160E+03	2.85949E+10	8.996E+09	2.705E-01	2.286E+10
BW10-03	**6S6**	1956.65	3.485E+03	2.122E+03	2.100E+03	2.111E+03	2.37640E+10	8.719E+09	2.102E-01	2.110E+10
BW11-01	**6S13**	1962.26	3.511E+03	2.093E+03	2.087E+03	2.090E+03	2.41890E+10	8.571E+09	2.256E-01	2.101E+10
BW11-02	**6U3**	1907.32	3.778E+03	2.137E+03	2.137E+03	2.137E+03	2.72237E+10	8.710E+09	2.648E-01	2.203E+10
BW12-01	**6U12**	1938.51	3.758E+03	2.146E+03	2.146E+03	2.146E+03	2.73767E+10	8.927E+09	2.581E-01	2.246E+10
BW12-02	**Spare 1W**	1912.94	3.625E+03	2.105E+03	2.101E+03	2.103E+03	2.51372E+10	8.460E+09	2.464E-01	2.109E+10
BW12-03	**Spare 2W**	1940.68	3.477E+03	1.871E+03	1.857E+03	1.864E+03	2.34619E+10	6.743E+09	2.983E-01	1.751E+10

Table 25 PIE sonic elastic constants data for NBG-18 graphite (WG)

Young's Modulus, Shear Modulus and Poisson's Ratio by Sonic Velocity (WG)										
			Sonic Velocities, v [m/s]							
Specimen Number	Specimen Location	Density,ρ kg/m^3	Longituginal	Shear 0°	Shear 90°	Average Shear Velocity	Elastic Modulus, [Pa] $E=\rho v_l^2$	Shear Modulus, [Pa] $G=\rho v_s^2$	Poisson's Ratio $\mu=(1-[2(v_s/v_l)^2])/(2-[2(v_s/v_l)^2])$	Elastic Modulus, [Pa] $E=\rho v_l^2[(1+\mu)(1-2\mu)/(1-\mu)]$
BL6-02	**2S12**	1952.88	3.746E+03	2.127E+03	2.135E+03	2.131E+03	2.74038E+10	8.868E+09	2.608E-01	2.236E+10
BL6-03	**3S12**	1952.08	3.427E+03	1.877E+03	1.883E+03	1.880E+03	2.29259E+10	6.899E+09	2.847E-01	1.773E+10
BL7-01	**4S7**	1916.31	3.590E+03	2.086E+03	2.083E+03	2.085E+03	2.46976E+10	8.327E+09	2.457E-01	2.074E+10
BL7-02	**5S5**	1909.85	3.827E+03	2.105E+03	2.103E+03	2.104E+03	2.79715E+10	8.455E+09	2.834E-01	2.170E+10

The NBG-18 elastic constants are plotted to assist in the identification of outliers in Figure 37 through Figure 39 for the AG orientation and Figure 40 through Figure 42 for the WG orientation.

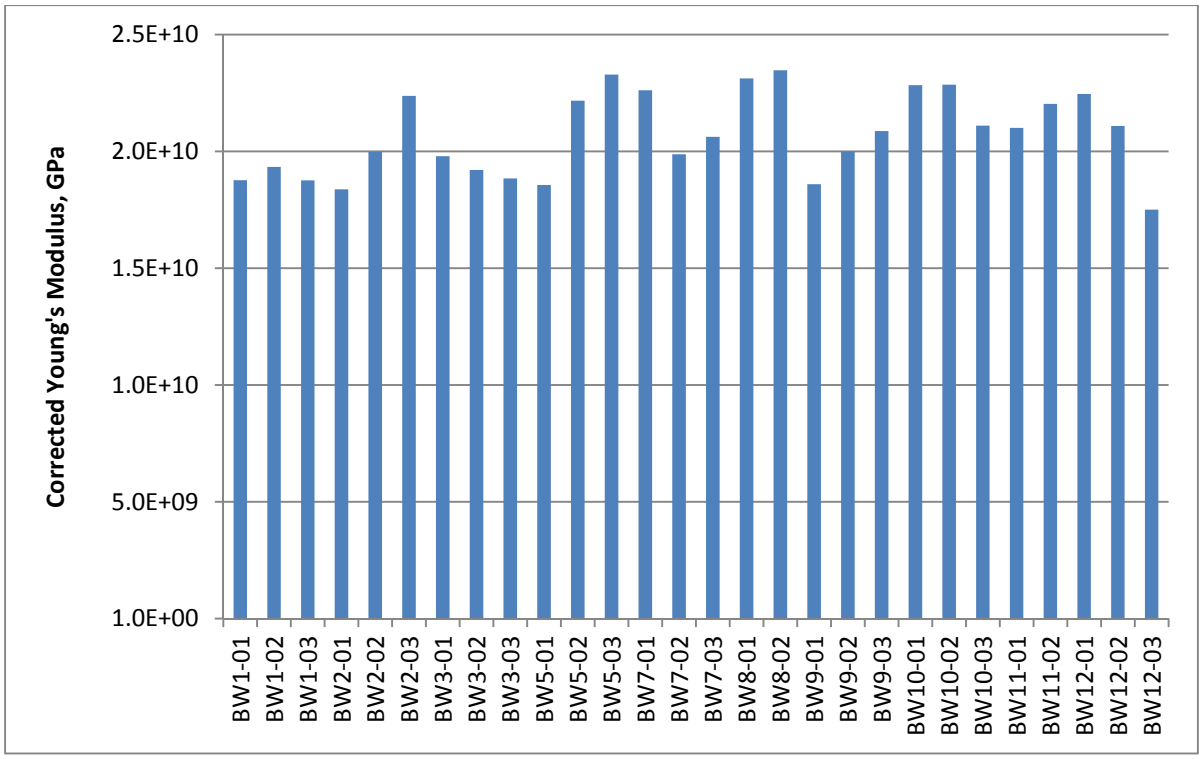


Figure 37 PIE data for Longitudinal Dynamic Young's modulus (from sonic velocity) for NBG-18 (AG) creep and control specimens

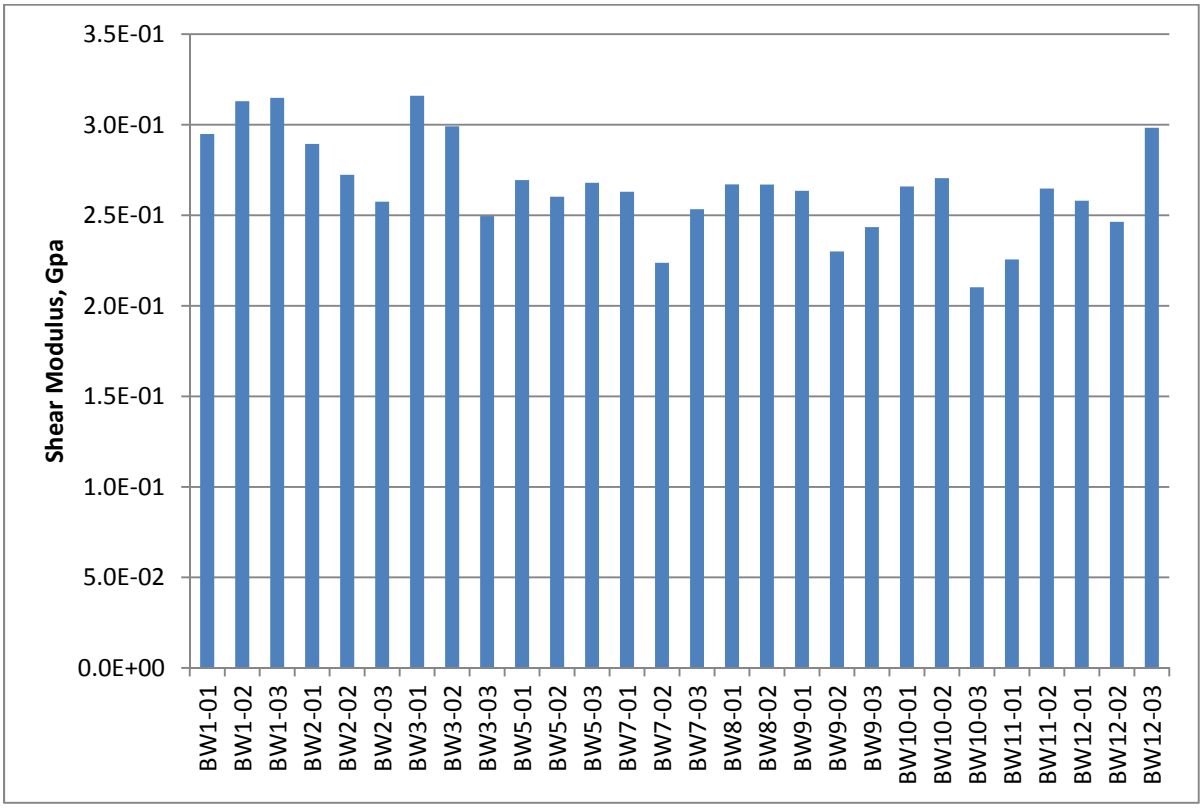


Figure 38 PIE data for Shear modulus (from sonic velocity) for NBG-18 (AG) creep and control specimens

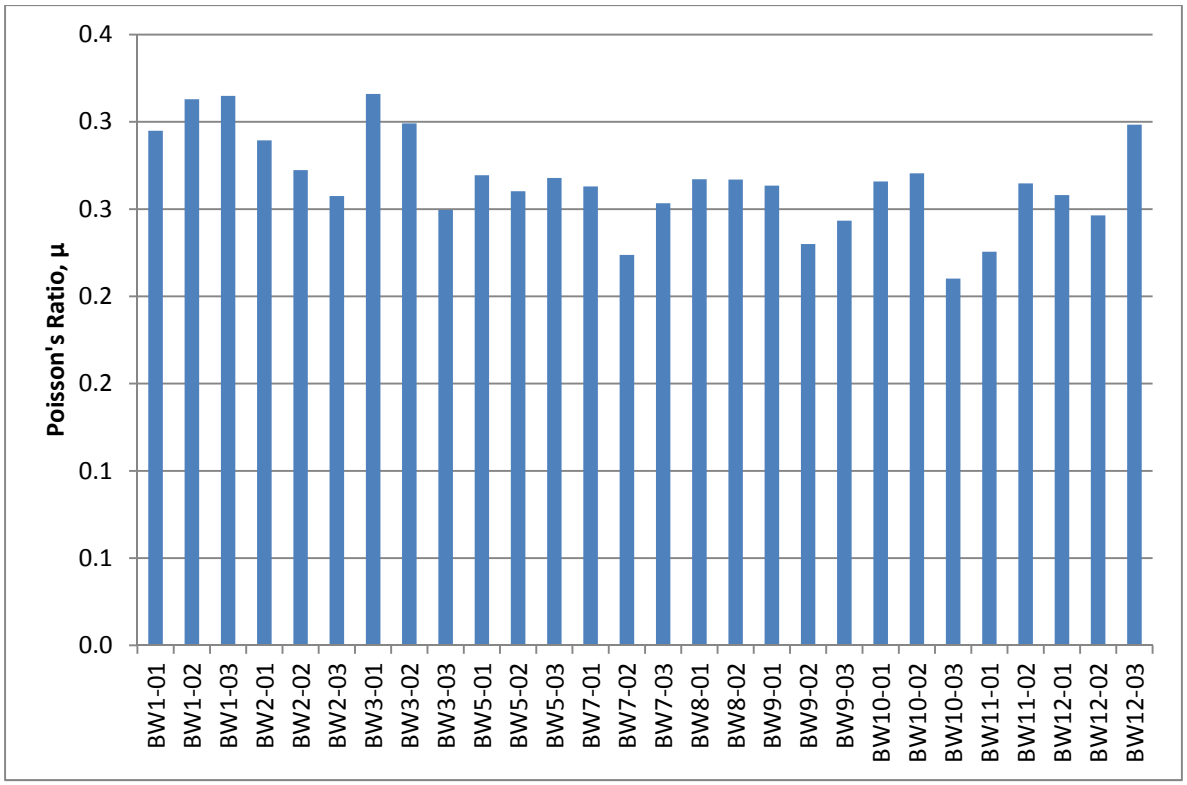


Figure 39 PIE data for Poison's Ratio (from sonic velocity) for NBG-18 (AG) creep and control specimens

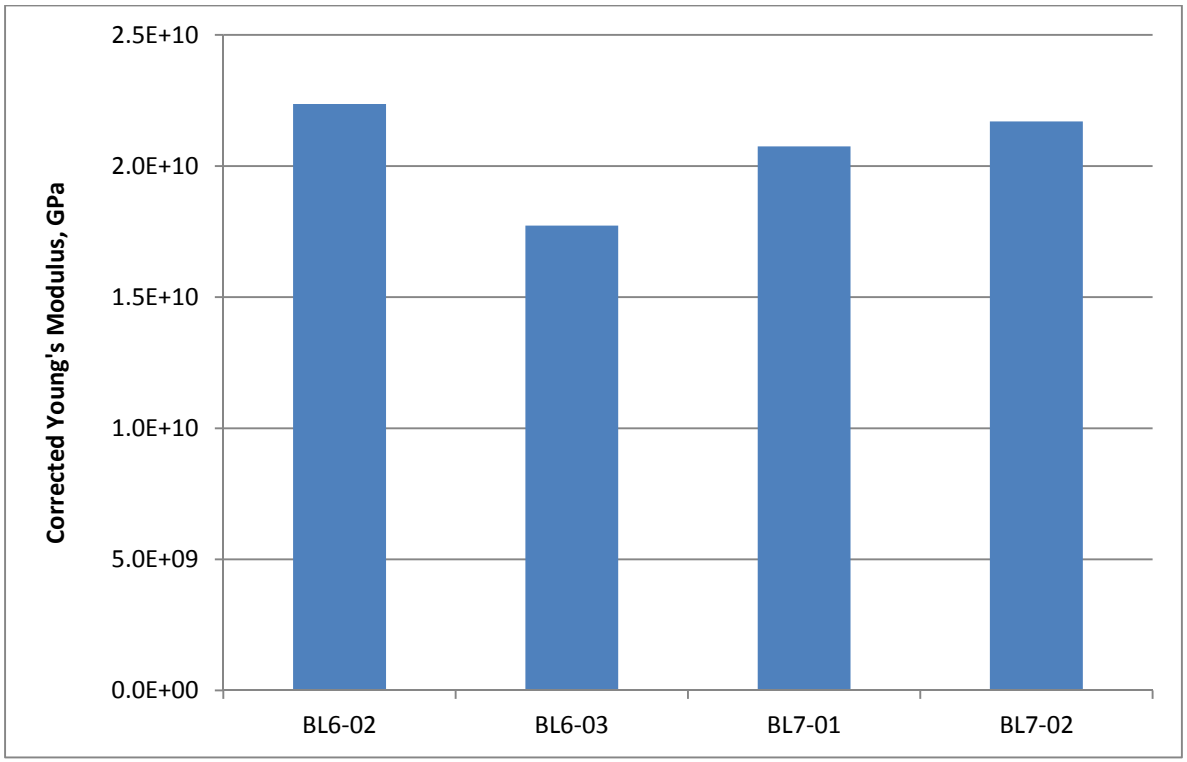


Figure 40 PIE data for Longitudinal Dynamic Young's modulus (from sonic velocity) for NBG-18 (WG) creep and control specimens

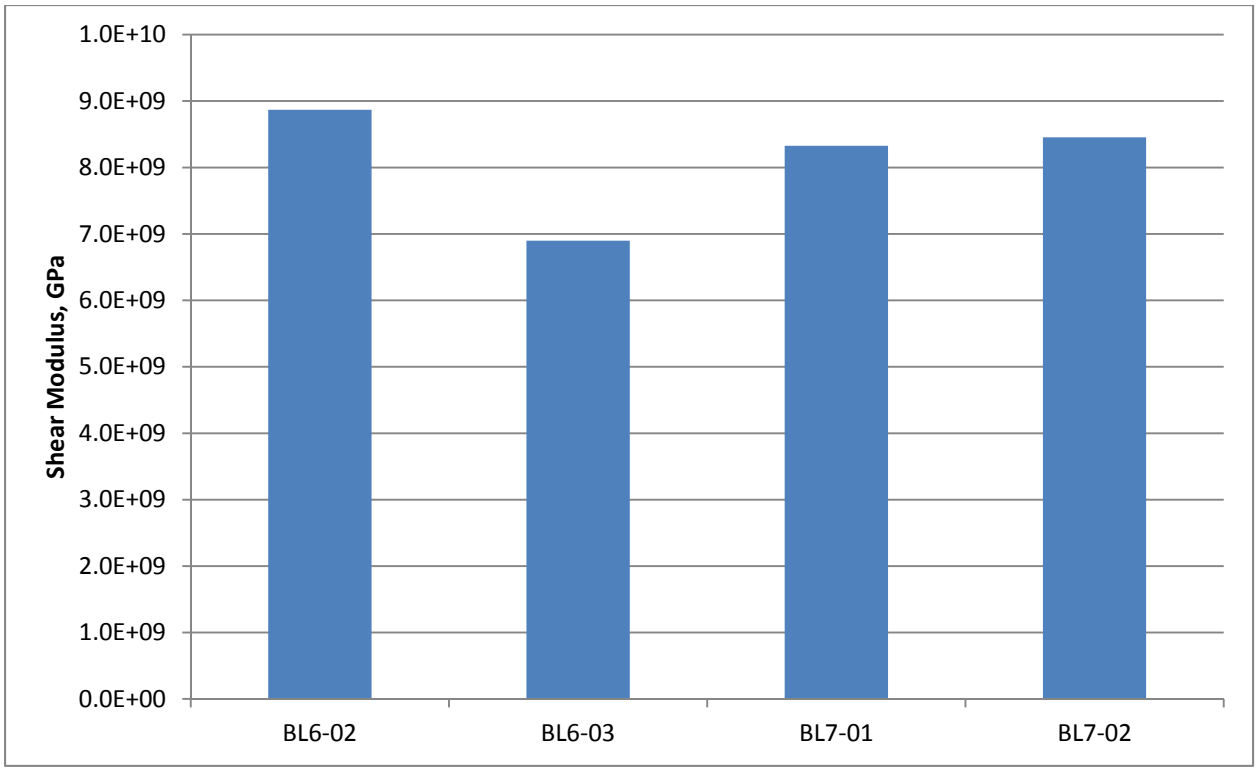


Figure 41 PIE data for Shear modulus (from sonic velocity) for NBG-18 (WG) creep and control specimens

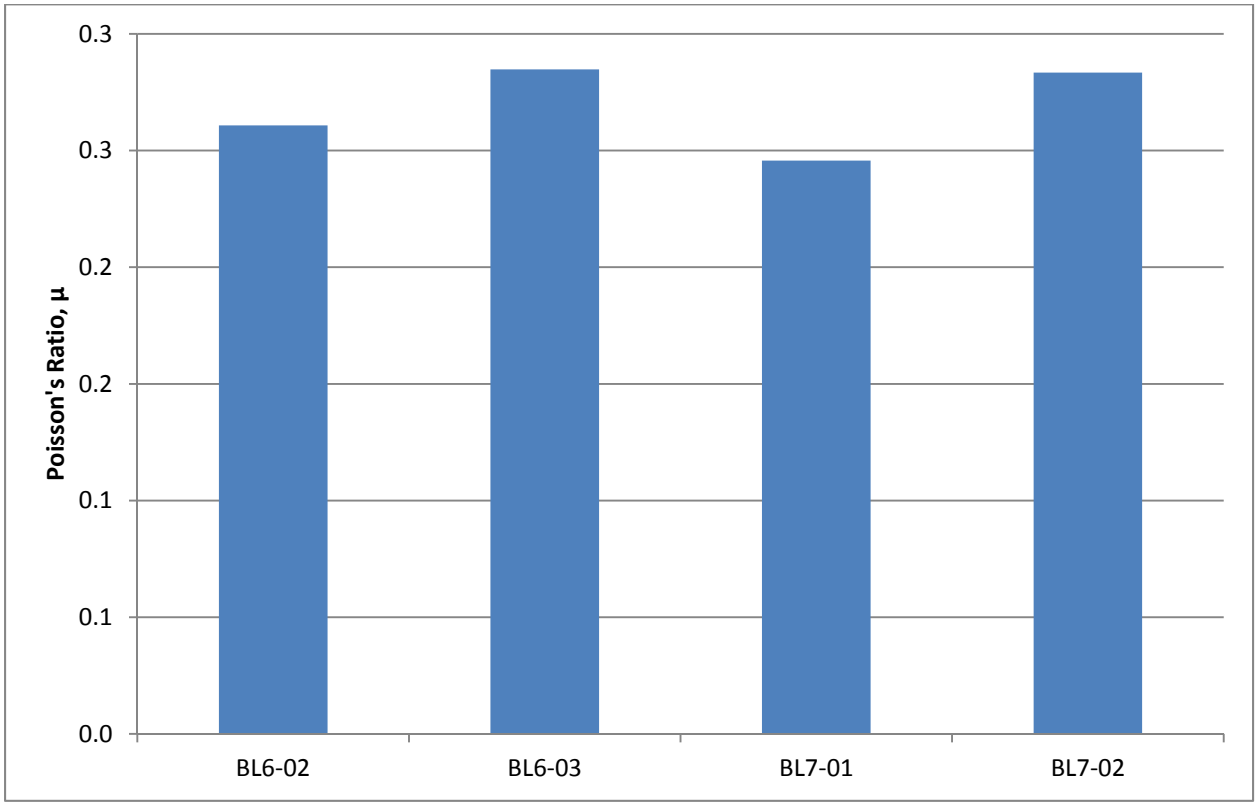


Figure 42 PIE data for Poison's Ratio (from sonic velocity) for NBG-18 (WG) creep and control specimens

Data for the sonic elastic constants for H-451(AG) are given in Table 26.

Table 26 PIE sonic elastic constants data for H451 graphite (WG)

Young's Modulus, Shear Modulus and Poisson's Ratio by Sonic Velocity (WG)										
			Sonic Velocities, v [m/s]							
Specimen Number	Specimen Location	Density,ρ kg/m^3	Longituginal	Shear 0◦	Shear 90◦	Average Shear Velocity	Elastic Modulus, [Pa] E=ρvl^2	Shear Modulus, [Pa] G=ρvs^2	Poisson's Ratio μ=(1-[2(vs/vl)^2])/(2-[2(vs/vl)^2])	Elastic Modulus, [Pa] E=ρvl^2[(1+μ)(1-2μ)/(1-μ)]
CW7-01	**1S8**	1805.94	3.290E+03	1.749E+03	1.735E+03	1.742E+03	1.95477E+10	5.480E+09	3.052E-01	1.431E+10
CW7-03	**1S15**	1778.40	3.330E+03	1.801E+03	1.858E+03	1.830E+03	1.97205E+10	5.952E+09	2.838E-01	1.528E+10
CW8-02	**1U8**	1791.97	3.497E+03	1.857E+03	1.857E+03	1.857E+03	2.19140E+10	6.180E+09	3.036E-01	1.611E+10
CW8-03	**1U14**	1766.18	3.450E+03	1.823E+03	1.823E+03	1.823E+03	2.10220E+10	5.870E+09	3.063E-01	1.534E+10
CW9-01	**2S13**	1795.50	3.223E+03	1.752E+03	1.749E+03	1.751E+03	1.86512E+10	5.502E+09	2.908E-01	1.420E+10
CW9-03	**3S1**	1801.09	3.026E+03	1.695E+03	1.701E+03	1.698E+03	1.64920E+10	5.193E+09	2.702E-01	1.319E+10
CW10-01	**3S10**	1796.47	3.133E+03	1.744E+03	1.735E+03	1.740E+03	1.76336E+10	5.436E+09	2.772E-01	1.389E+10
CW10-02	**3U1**	1790.66	3.518E+03	2.014E+03	2.014E+03	2.014E+03	2.21618E+10	7.263E+09	2.562E-01	1.825E+10
CW10-03	**3U10**	1792.72	3.598E+03	2.069E+03	2.069E+03	2.069E+03	2.32078E+10	7.674E+09	2.530E-01	1.923E+10
CW11-01	**4S2**	1769.52	3.328E+03	2.001E+03	1.968E+03	1.985E+03	1.95985E+10	6.969E+09	2.241E-01	1.706E+10
CW11-02	**4S13**	1765.90	3.311E+03	1.723E+03	1.723E+03	1.723E+03	1.93591E+10	5.242E+09	3.143E-01	1.378E+10
CW12-02	**5S7**	1769.90	3.218E+03	1.713E+03	1.780E+03	1.747E+03	1.83282E+10	5.399E+09	2.912E-01	1.394E+10
CW13-01	**5U7**	1768.82	3.642E+03	2.069E+03	2.069E+03	2.069E+03	2.34619E+10	7.572E+09	2.617E-01	1.911E+10
CW13-02	**6S5**	1814.52	3.264E+03	1.747E+03	1.747E+03	1.747E+03	1.93313E+10	5.538E+09	2.993E-01	1.439E+10
CW13-03	**6S9**	1795.73	3.283E+03	2.016E+03	2.023E+03	2.020E+03	1.93545E+10	7.324E+09	1.956E-01	1.751E+10
CW14-01	**6U5**	1773.97	3.347E+03	1.783E+03	1.778E+03	1.781E+03	1.98727E+10	5.624E+09	3.027E-01	1.465E+10
CW14-02	**6U9**	1768.44	3.594E+03	1.872E+03	1.872E+03	1.872E+03	2.28426E+10	6.197E+09	3.138E-01	1.628E+10

The H-451 elastic constants are plotted to assist in the identification of outliers in Figure 43 through Figure 45 for the WG orientation.

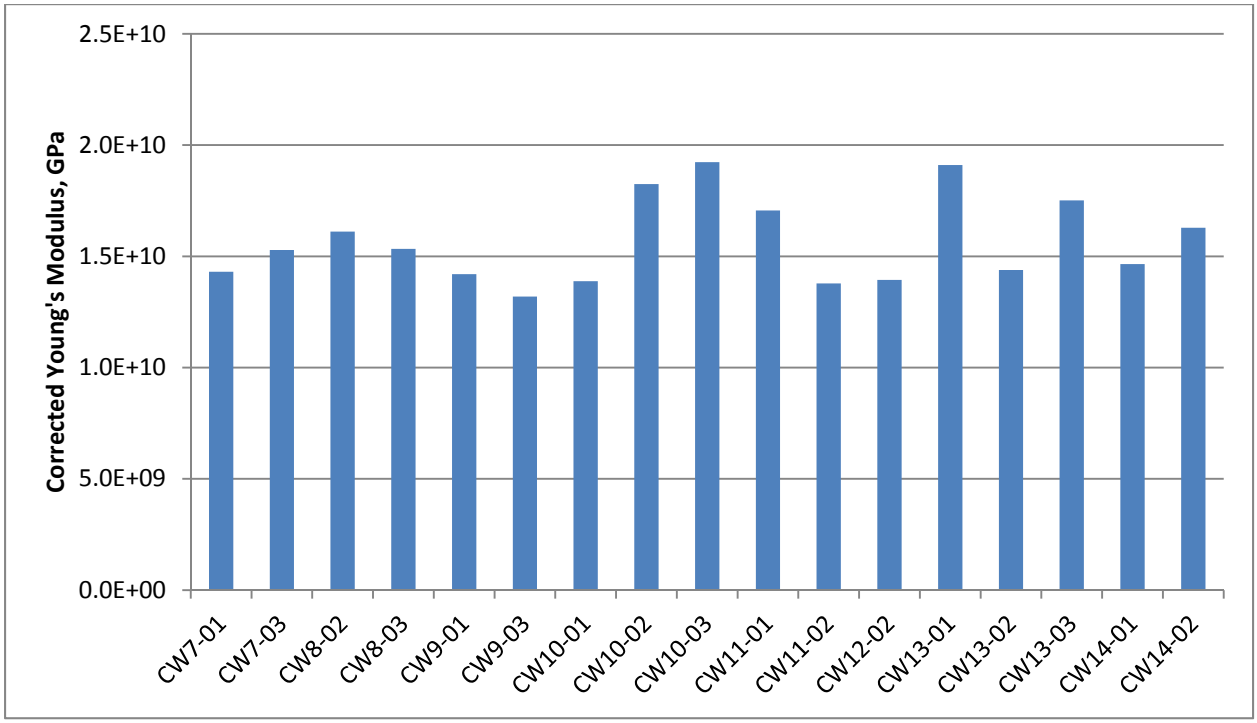


Figure 43 PIE data for Longitudinal Dynamic Young's modulus (from sonic velocity) for H-451 (WG) creep and control specimens

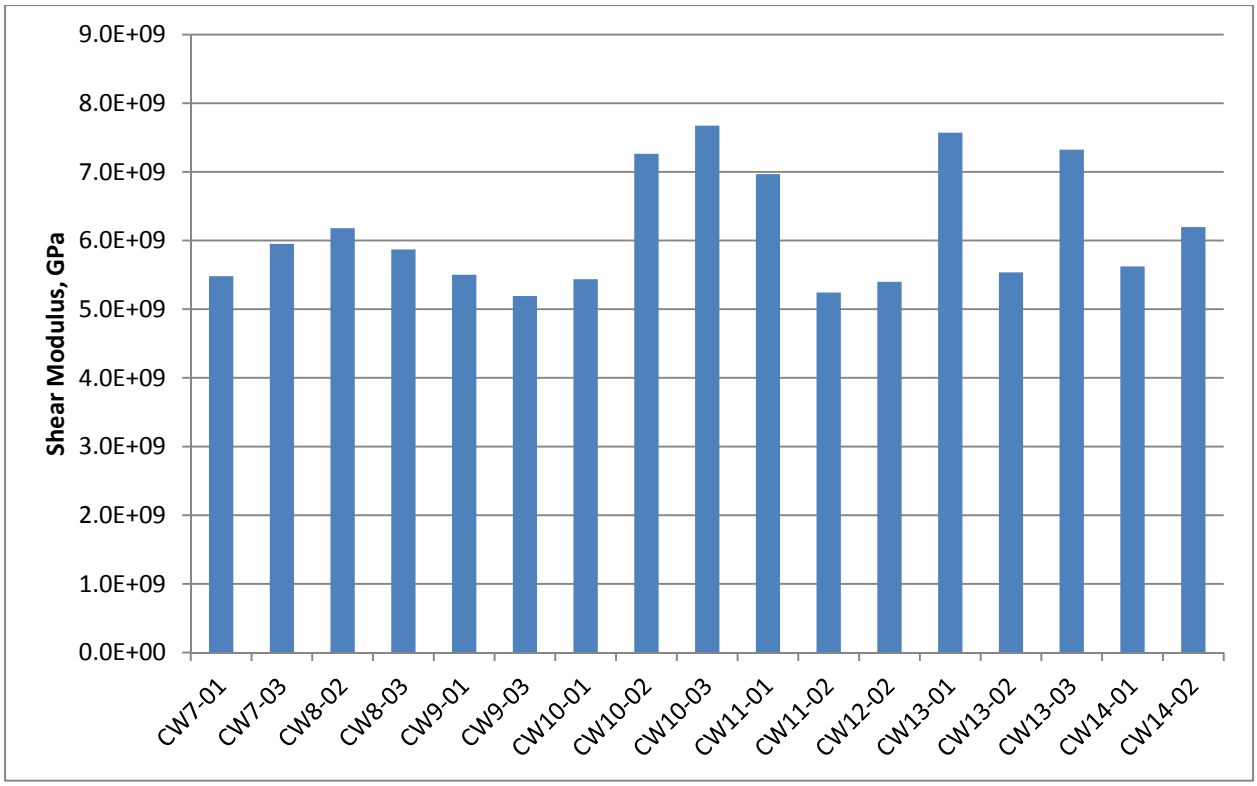


Figure 44 PIE data for Shear modulus (from sonic velocity) for H-451 (WG) creep and control specimens

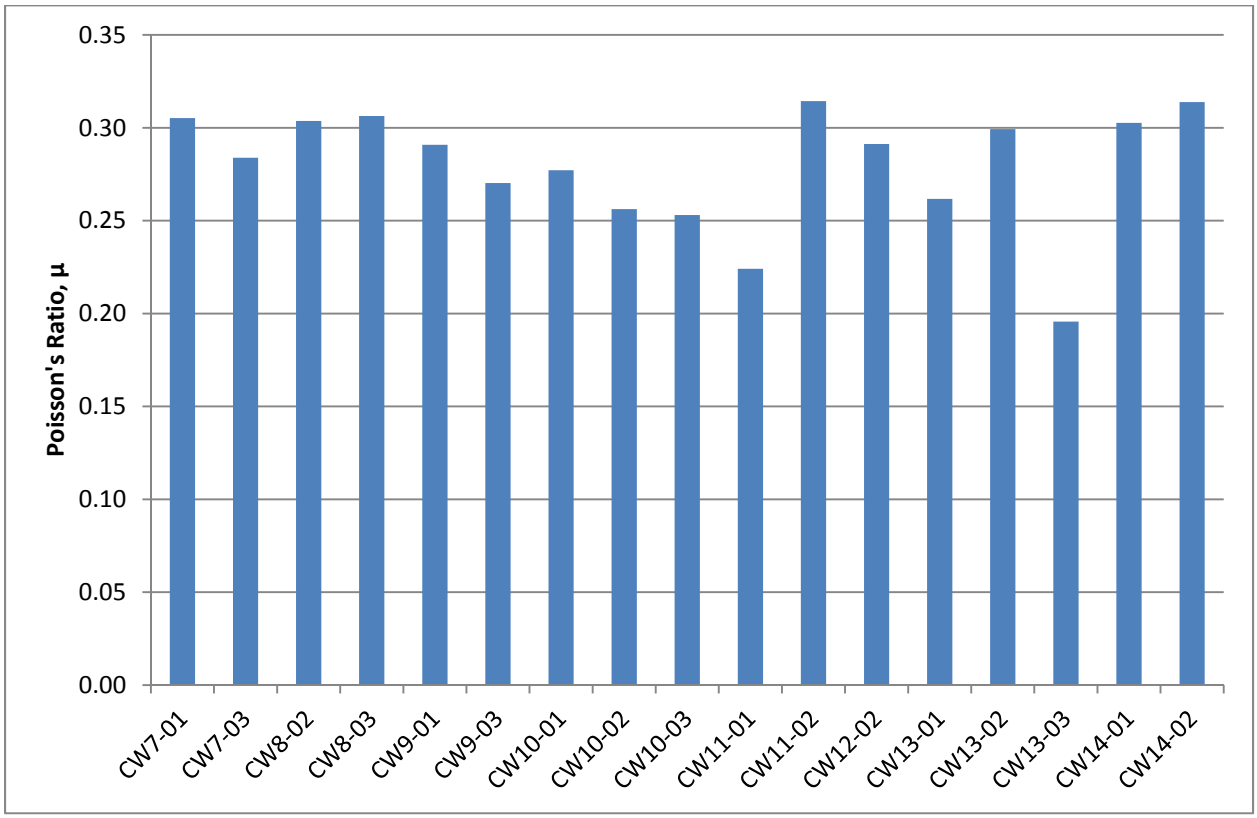


Figure 45 PIE data for Poison's Ratio (from sonic velocity) for H-451 (WG) creep and control specimens

PIE data for the sonic elastic constants for PCEA are given in Table 27 and Table 28 for the WG and AG orientations, respectively.

Table 27 PIE sonic elastic constants data for PCEA graphite (WG)

Young's Modulus, Shear Modulus and Poisson's Ratio by Sonic Velocity (WG)										
			Sonic Velocities, v [m/s]							
Specimen Number	Specimen Location	Density,ρ kg/m^3	Longituginal	Shear 0◦	Shear 90◦	Average Shear Velocity	Elastic Modulus, [Pa] E=ρvl^2	Shear Modulus, [Pa] G=ρvs^2	Poisson's Ratio μ=(1-[2(vs/vl)^2])/(2-[2(vs/vl)^2])	Elastic Modulus, [Pa] E=ρvl^2[(1+μ)(1-2μ)/(1-μ)]
DW1-01	**1S2**	1919.27	3.386E+03	2.032E+03	2.032E+03	2.032E+03	2.20044E+10	7.925E+09	2.186E-01	1.931E+10
DW1-02	**1S6**	1915.33	3.296E+03	1.958E+03	1.967E+03	1.963E+03	2.08074E+10	7.377E+09	2.254E-01	1.808E+10
DW1-03	**1S14**	1865.78	3.384E+03	2.043E+03	2.043E+03	2.043E+03	2.13659E+10	7.787E+09	2.132E-01	1.890E+10
DW2-01	**1U2**	1911.73	3.581E+03	2.055E+03	2.037E+03	2.046E+03	2.45152E+10	8.003E+09	2.577E-01	2.013E+10
DW2-02	**1U6**	1894.93	3.638E+03	2.052E+03	2.066E+03	2.059E+03	2.50795E+10	8.034E+09	2.644E-01	2.031E+10
DW2-03	**1U13**	1854.83	3.670E+03	2.062E+03	2.084E+03	2.073E+03	2.49825E+10	7.971E+09	2.657E-01	2.018E+10
DW3-01	**2S1**	1925.36	3.323E+03	2.035E+03	1.786E+03	1.911E+03	2.12605E+10	7.028E+09	2.531E-01	1.761E+10
DW3-02	**2S8**	1903.32	3.351E+03	1.852E+03	1.833E+03	1.843E+03	2.13728E+10	6.461E+09	2.833E-01	1.658E+10
DW3-03	**2S14**	1870.43	3.340E+03	2.052E+03	1.829E+03	1.941E+03	2.08658E+10	7.043E+09	2.452E-01	1.754E+10
DW4-01	**2U8**	1882.37	3.668E+03	2.115E+03	2.102E+03	2.109E+03	2.53258E+10	8.369E+09	2.532E-01	2.098E+10
DW4-03	**2U1**	1911.54	3.617E+03	2.051E+03	2.086E+03	2.069E+03	2.50081E+10	8.179E+09	2.570E-01	2.056E+10
DW5-01	**2U13**	1839.56	3.603E+03	2.065E+03	2.060E+03	2.063E+03	2.38804E+10	7.825E+09	2.563E-01	1.966E+10
DW5-02	**3S15**	1891.06	3.220E+03	1.790E+03	1.785E+03	1.788E+03	1.96073E+10	6.042E+09	2.773E-01	1.544E+10
DW5-03	**3U6**	1895.74	3.686E+03	2.125E+03	2.104E+03	2.115E+03	2.57567E+10	8.476E+09	2.548E-01	2.127E+10
DW6-01	**3U14**	1874.81	3.761E+03	2.128E+03	2.104E+03	2.116E+03	2.65194E+10	8.394E+09	2.684E-01	2.130E+10
DW6-02	**4S15**	1898.67	3.299E+03	1.785E+03	1.780E+03	1.783E+03	2.06640E+10	6.033E+09	2.938E-01	1.561E+10
DW6-03	**4U1**	1905.27	3.272E+03	1.770E+03	1.786E+03	1.778E+03	2.03978E+10	6.023E+09	2.905E-01	1.555E+10
DW7-01	**4U6**	1906.39	3.634E+03	1.916E+03	1.913E+03	1.915E+03	2.51757E+10	6.988E+09	3.079E-01	1.828E+10
DW7-02	**4U14**	1881.33	3.768E+03	1.965E+03	1.944E+03	1.955E+03	2.67108E+10	7.187E+09	3.159E-01	1.891E+10
DW7-03	**5S4**	1913.61	3.278E+03	1.800E+03	1.800E+03	1.800E+03	2.05623E+10	6.200E+09	2.842E-01	1.592E+10
DW8-01	**5S9**	1897.74	3.229E+03	1.790E+03	1.808E+03	1.799E+03	1.97867E+10	6.142E+09	2.749E-01	1.566E+10
DW8-02	**5S12**	1869.23	3.304E+03	1.818E+03	1.815E+03	1.817E+03	2.04053E+10	6.168E+09	2.834E-01	1.583E+10
DW8-03	**5U4**	1909.33	3.620E+03	1.920E+03	2.087E+03	2.004E+03	2.50206E+10	7.664E+09	2.792E-01	1.961E+10
DW9-01	**5U9**	1876.56	3.689E+03	2.021E+03	2.021E+03	2.021E+03	2.55376E+10	7.665E+09	2.856E-01	1.971E+10
DW9-03	**6S4**	1929.28	3.276E+03	1.853E+03	1.797E+03	1.825E+03	2.07054E+10	6.426E+09	2.750E-01	1.639E+10
DW10-01	**6S11**	1870.46	3.249E+03	1.996E+03	2.026E+03	2.011E+03	1.97446E+10	7.564E+09	1.895E-01	1.800E+10
DW10-02	**6U11**	1854.28	3.641E+03	2.086E+03	2.083E+03	2.085E+03	2.45820E+10	8.057E+09	2.562E-01	2.024E+10
DW11-01	**Spare 1W**	1910.65	3.200E+03	1.97E+03	1.97E+03	1.970E+03	1.95651E+10	7.415E+09	1.949E-01	1.772E+10

Table 28 PIE sonic elastic constants data for PCEA graphite (AG)

Young's Modulus, Shear Modulus and Poisson's Ratio by Sonic Velocity (AG)										
			Sonic Velocities, v [m/s]							
Specimen Number	Specimen Location	Density,ρ kg/m^3	Longituginal	Shear 0◦	Shear 90◦	Average Shear Velocity	Elastic Modulus, [Pa] E=ρvl^2	Shear Modulus, [Pa] G=ρvs^2	Poisson's Ratio μ=(1-[2(vs/vl)^2])/(2-[2(vs/vl)^2])	Elastic Modulus, [Pa] E=ρvl^2[(1+μ)(1-2μ)/(1-μ)]
DA601	**3S6**	1924.26	3.234E+03	1.932E+03	1.751E+03	1.842E+03	2.01254E+10	6.525E+09	2.601E-01	1.645E+10
DA602	**4S1**	1877.41	3.124E+03	1.771E+03	1.771E+03	1.771E+03	1.83224E+10	5.888E+09	2.632E-01	1.488E+10
DA701	**4S6**	1828.14	3.057E+03	1.937E+03	1.76E+03	1.850E+03	1.70844E+10	6.257E+09	2.111E-01	1.515E+10
DA702	**-**	1851.54	3.669E+03	2.089E+03	2.089E+03	2.089E+03	2.49246E+10	8.080E+09	2.602E-01	2.036E+10

The PCEA elastic constants are plotted to assist in the identification of outliers Figure 46 through Figure 48 for the WG orientation and Figure 49 through Figure 51 for the AG orientation.

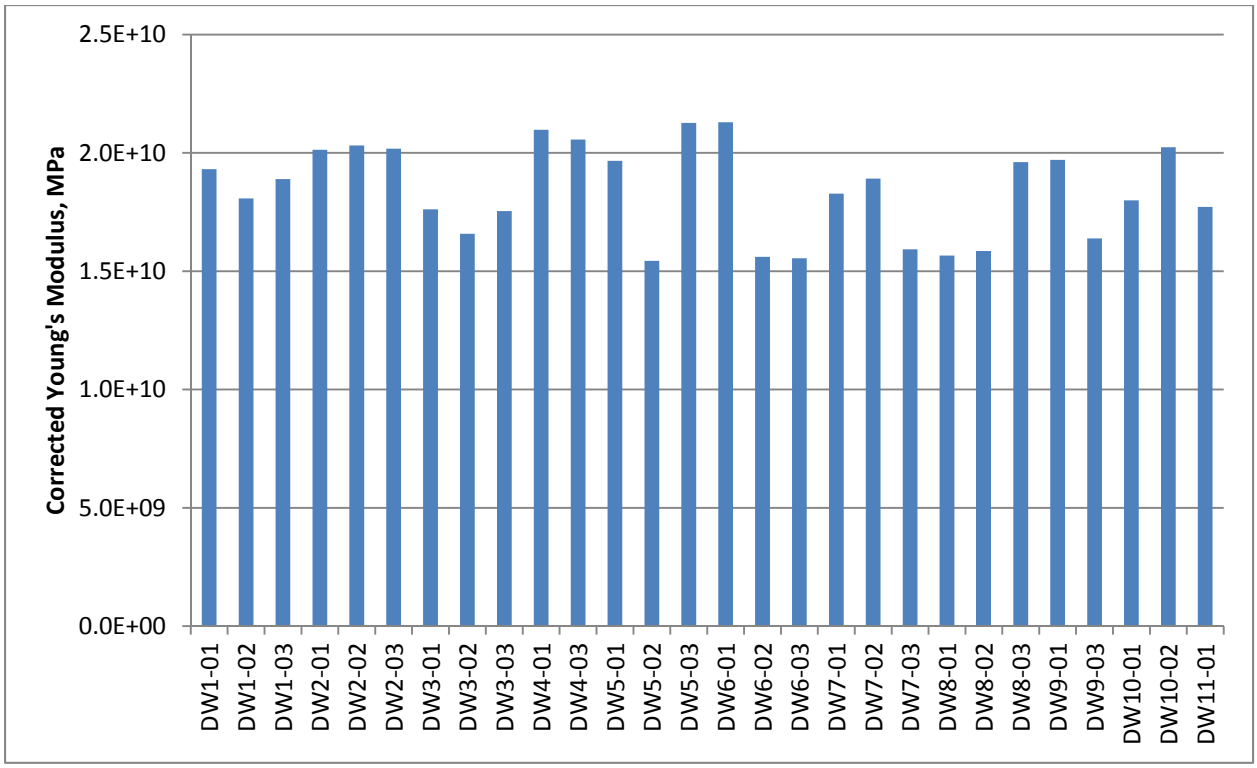


Figure 46 PIE data for Longitudinal Dynamic Young's modulus (from sonic velocity) for PCEA (WG) creep and control specimens

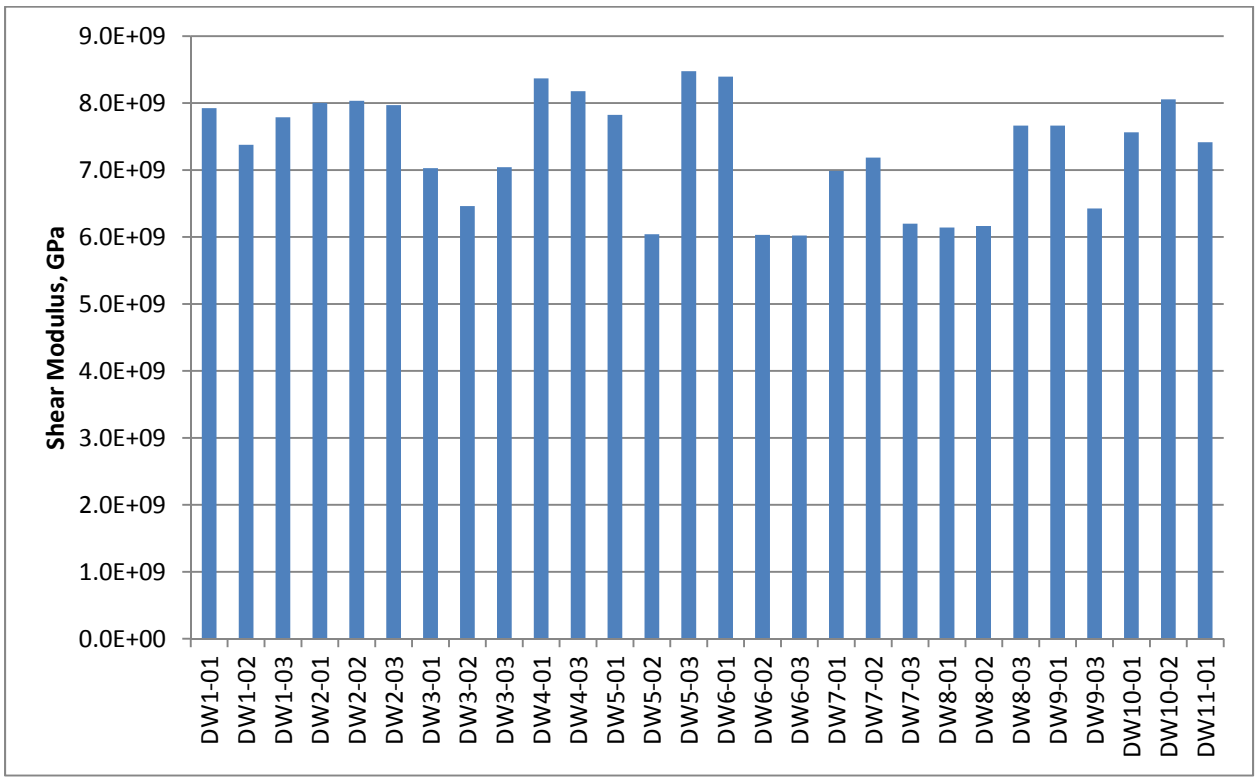


Figure 47 PIE data for Shear modulus (from sonic velocity) for PCEA (WG) creep and control specimens

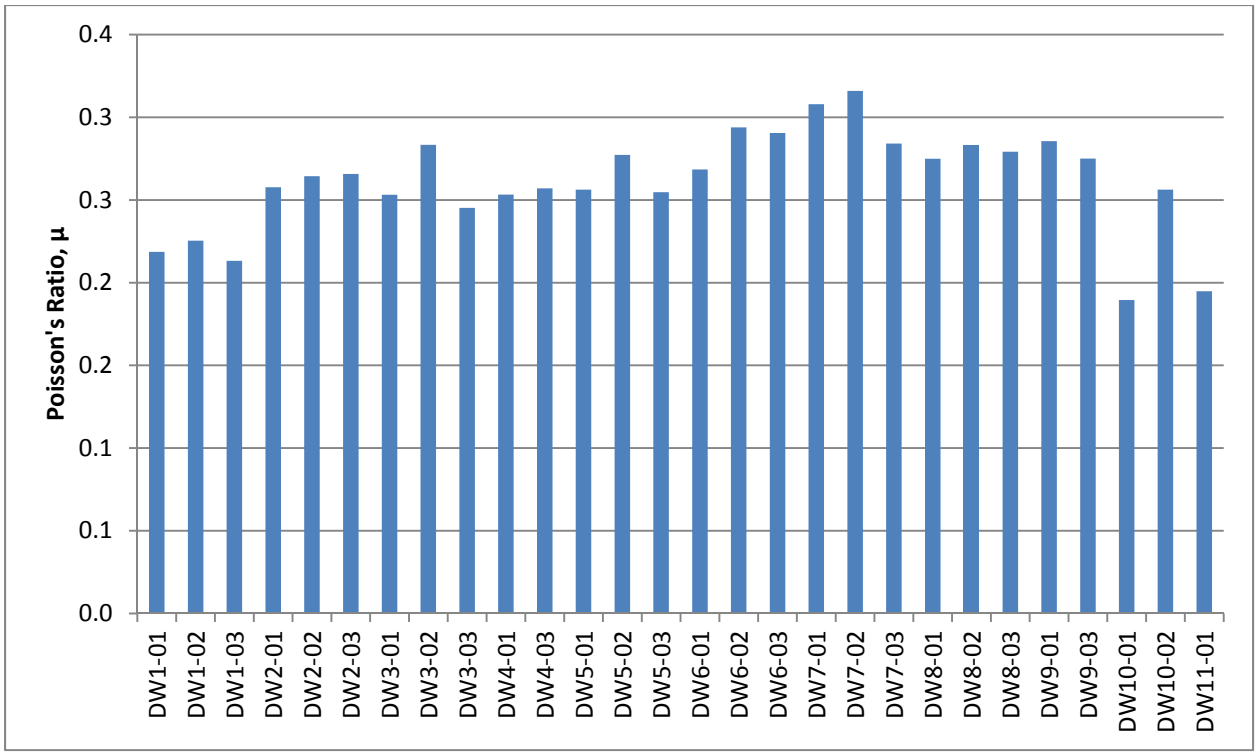


Figure 48 PIE data for Poison's Ratio (from sonic velocity) for PCEA (WG) creep and control specimens

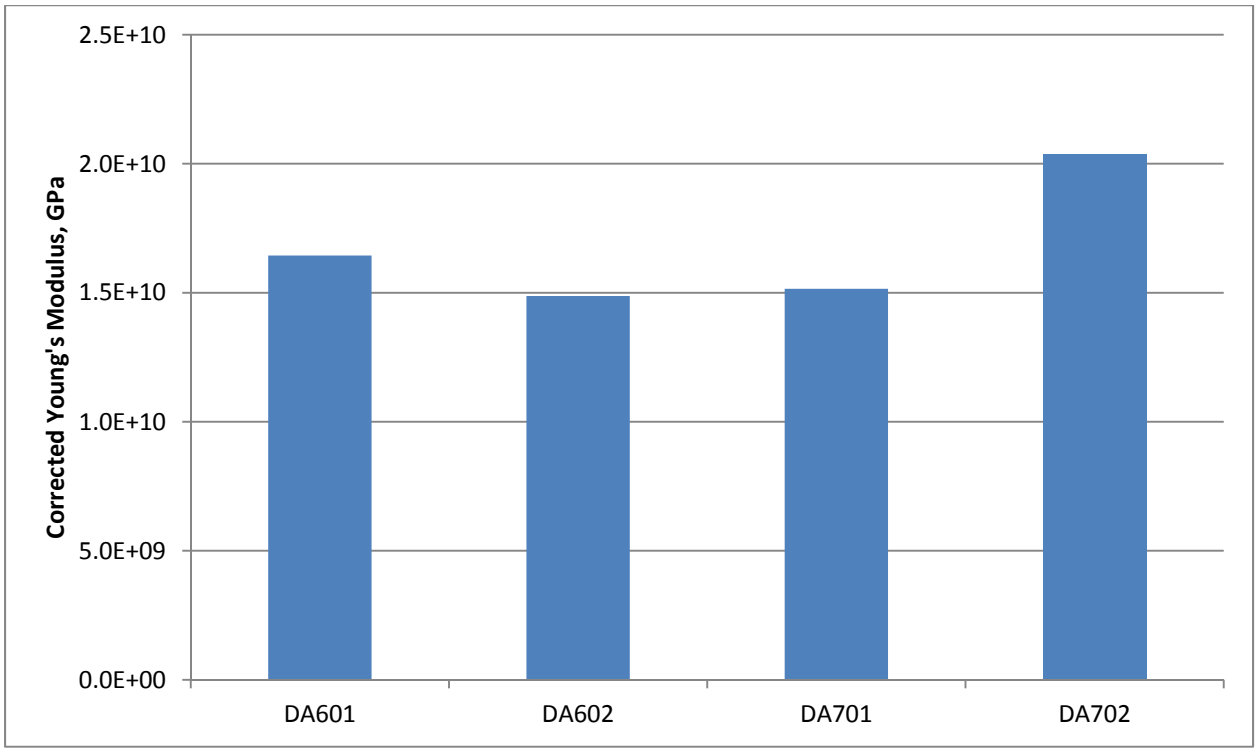


Figure 49 PIE data for Longitudinal Dynamic Young's modulus (from sonic velocity) for PCEA (AG) creep and control specimens

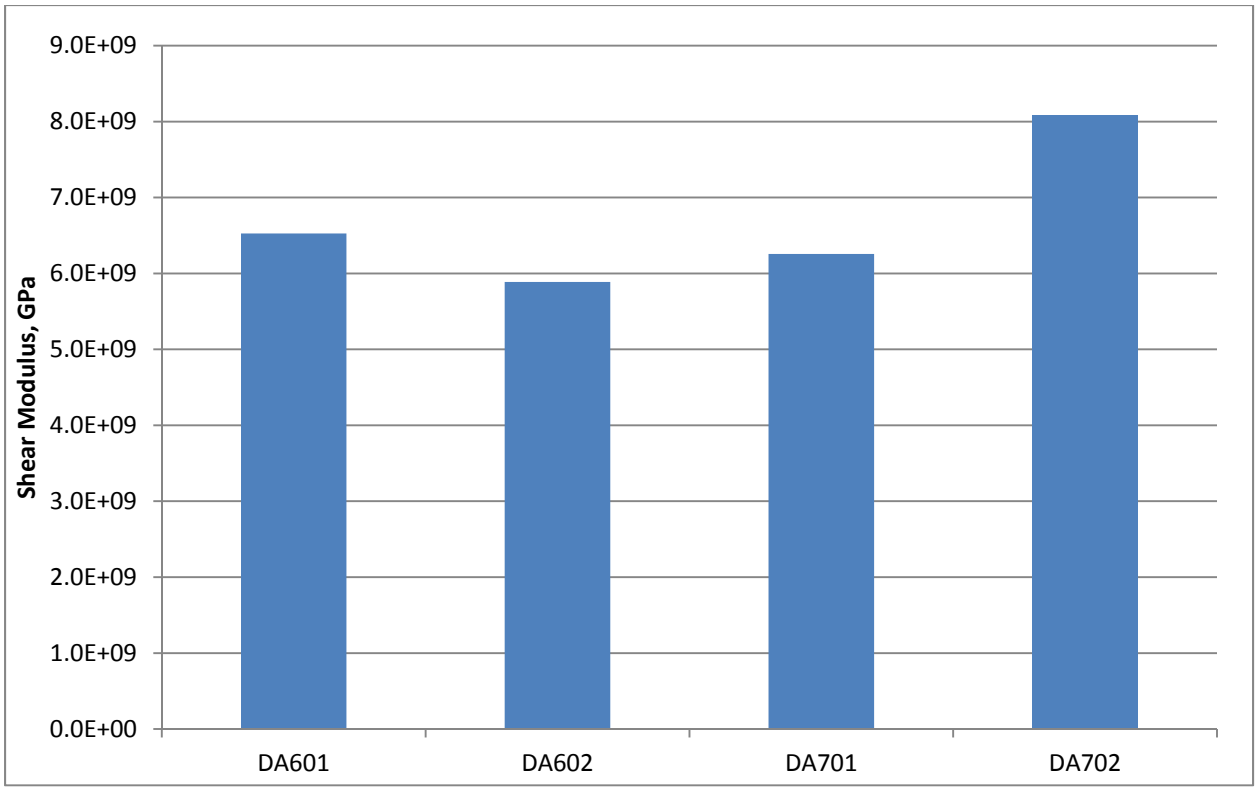


Figure 50 PIE data for Shear modulus (from sonic velocity) for PCEA (AG) creep and control specimens

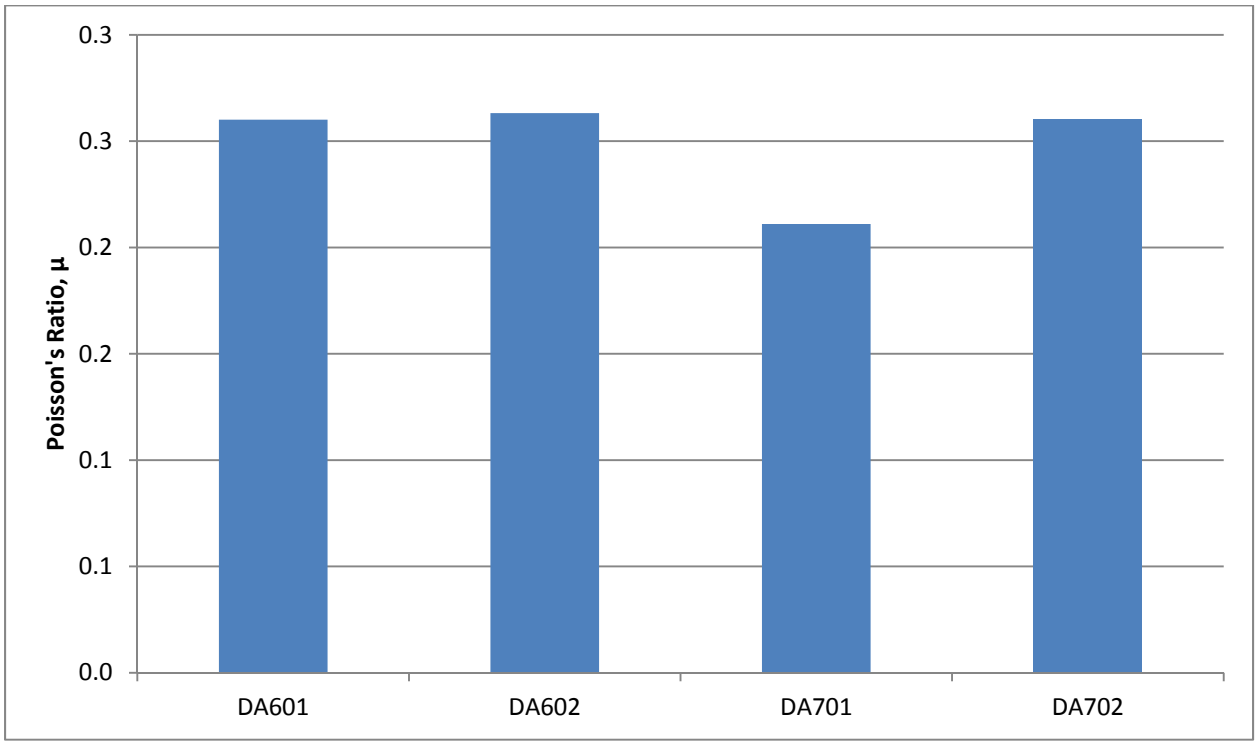


Figure 51 PIE data for Poison's Ratio (from sonic velocity) for PCEA (AG) creep and control specimens

PIE data for the sonic elastic constants for IG-110 are given in Table 29 for IG-110 graphite

Table 29 PIE sonic elastic constants data for IG-110 graphite

Young's Modulus, Shear Modulus and Poisson's Ratio by Sonic Velocity											
			Sonic Velocities, v [m/s]							
Specimen Number	Specimen Location	Density,ρ kg/m^3	Longituginal	Shear 0◦	Shear 90◦	Average Shear Velocity	Elastic Modulus, [Pa] $E=\rho v_l^2$	Shear Modulus, [Pa] $G=\rho v_s^2$	Poisson's Ratio $\mu=(1-[2(v_s/v_l)^2])/(2-[2(v_s/v_l)^2])$	Elastic Modulus, [Pa] $E=\rho v_l^2[(1+\mu)(1-2\mu)/(1-\mu)]$
EW2-01	**1S7**	1821.29	3.215E+03	2.013E+03	2.010E+03	2.012E+03	1.88253E+10	7.369E+09	0.1784	1.737E+10
EW2-02	**1S9**	1816.86	3.240E+03	2.012E+03	2.041E+03	2.027E+03	1.90727E+10	7.461E+09	0.1787	1.759E+10
EW2-03	**1U7**	1811.70	3.283E+03	2.029E+03	2.049E+03	2.039E+03	1.95267E+10	7.532E+09	0.1860	1.787E+10
EW4-01	**1U9**	1825.83	3.118E+03	1.973E+03	1.984E+03	1.979E+03	1.77506E+10	7.147E+09	0.1630	1.662E+10
EW4-02	**2S5**	1855.80	3.099E+03	2.002E+03	1.992E+03	1.997E+03	1.78227E+10	7.401E+09	0.1449	1.695E+10
EW5-01	**2S7**	1843.49	3.171E+03	1.997E+03	2.023E+03	2.010E+03	1.85367E+10	7.448E+09	0.1642	1.734E+10
EW5-02	**2U5**	1835.16	3.342E+03	2.063E+03	2.044E+03	2.054E+03	2.04968E+10	7.739E+09	0.1967	1.852E+10
EW5-03	**2U7**	1832.21	3.376E+03	2.082E+03	2.051E+03	2.067E+03	2.08824E+10	7.824E+09	0.2004	1.878E+10
EW6-01	**3S9**	1829.09	3.139E+03	1.983E+03	1.969E+03	1.976E+03	1.80226E+10	7.142E+09	0.1718	1.674E+10
EW6-03	**4S4**	1854.74	3.230E+03	2.031E+03	2.031E+03	2.031E+03	1.93503E+10	7.651E+09	0.1730	1.795E+10
EW7-01	**4S9**	1843.92	3.173E+03	2.000E+03	1.989E+03	1.995E+03	1.85645E+10	7.335E+09	0.1734	1.721E+10
EW8-01	**4U9**	1838.74	3.391E+03	2.046E+03	2.070E+03	2.058E+03	2.11435E+10	7.788E+09	0.2084	1.882E+10
EW8-02	**5S1**	1843.39	3.171E+03	2.016E+03	2.036E+03	2.026E+03	1.85357E+10	7.567E+09	0.1551	1.748E+10
EW8-03	**5S13**	1809.67	3.165E+03	1.990E+03	1.992E+03	1.991E+03	1.81279E+10	7.174E+09	0.1726	1.682E+10
EW9-01	**5U1**	1846.54	3.359E+03	2.033E+03	2.029E+03	2.031E+03	2.08343E+10	7.617E+09	0.2119	1.846E+10
EW9-02	**5U12**	1802.59	3.380E+03	2.042E+03	2.062E+03	2.052E+03	2.05935E+10	7.590E+09	0.2081	1.834E+10
EW9-03	**6S14**	1844.12	3.169E+03	1.967E+03	1.967E+03	1.967E+03	1.85197E+10	7.135E+09	0.1866	1.693E+10
EW10-01	**6U13**	1824.96	3.385E+03	2.072E+03	2.035E+03	2.054E+03	2.09108E+10	7.696E+09	0.2088	1.861E+10
EW10-02	**Spare 1**	1852.10	3.141E+03	2.005E+03	1.984E+03	1.995E+03	1.82726E+10	7.368E+09	0.1622	1.713E+10
EW10-03	**Spare 2**	1845.35	3.420E+03	2.044E+03	2.088E+03	2.066E+03	2.15840E+10	7.877E+09	0.2127	1.910E+10

The IG-110 elastic constants are plotted to assist in the identification of outliers in Figure 52 through Figure 54.

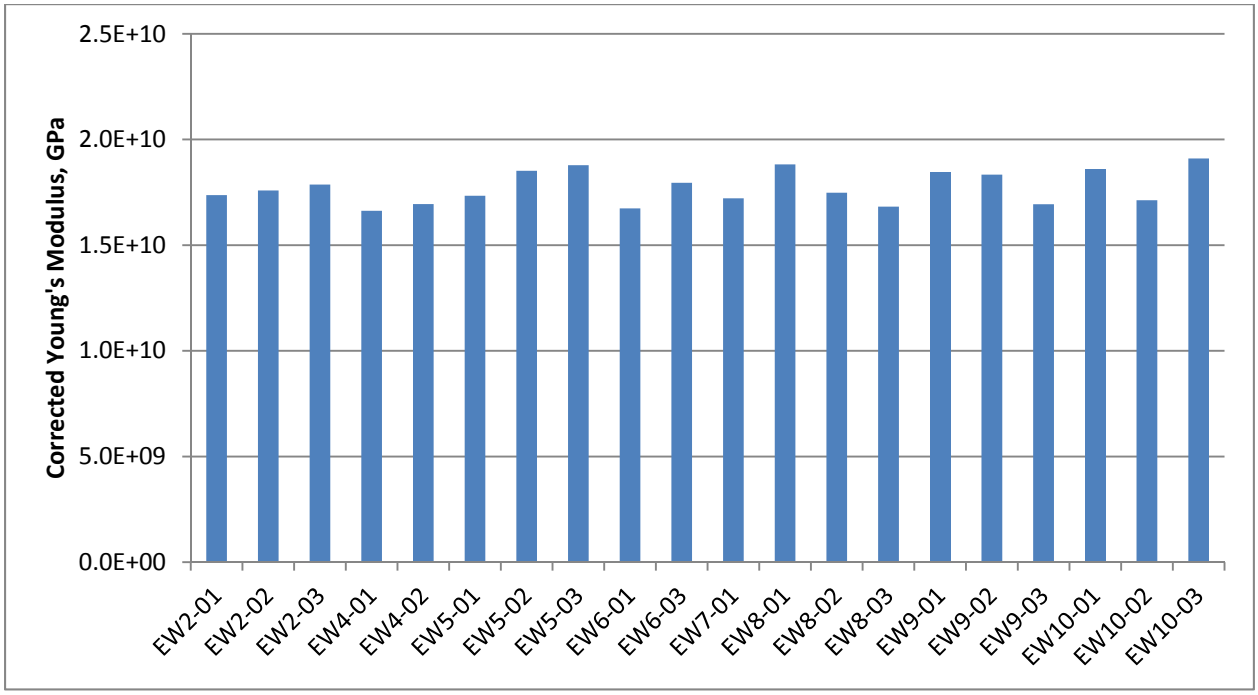


Figure 52 PIE data for Longitudinal Dynamic Young's modulus (from sonic velocity) for IG-110 creep and control specimens

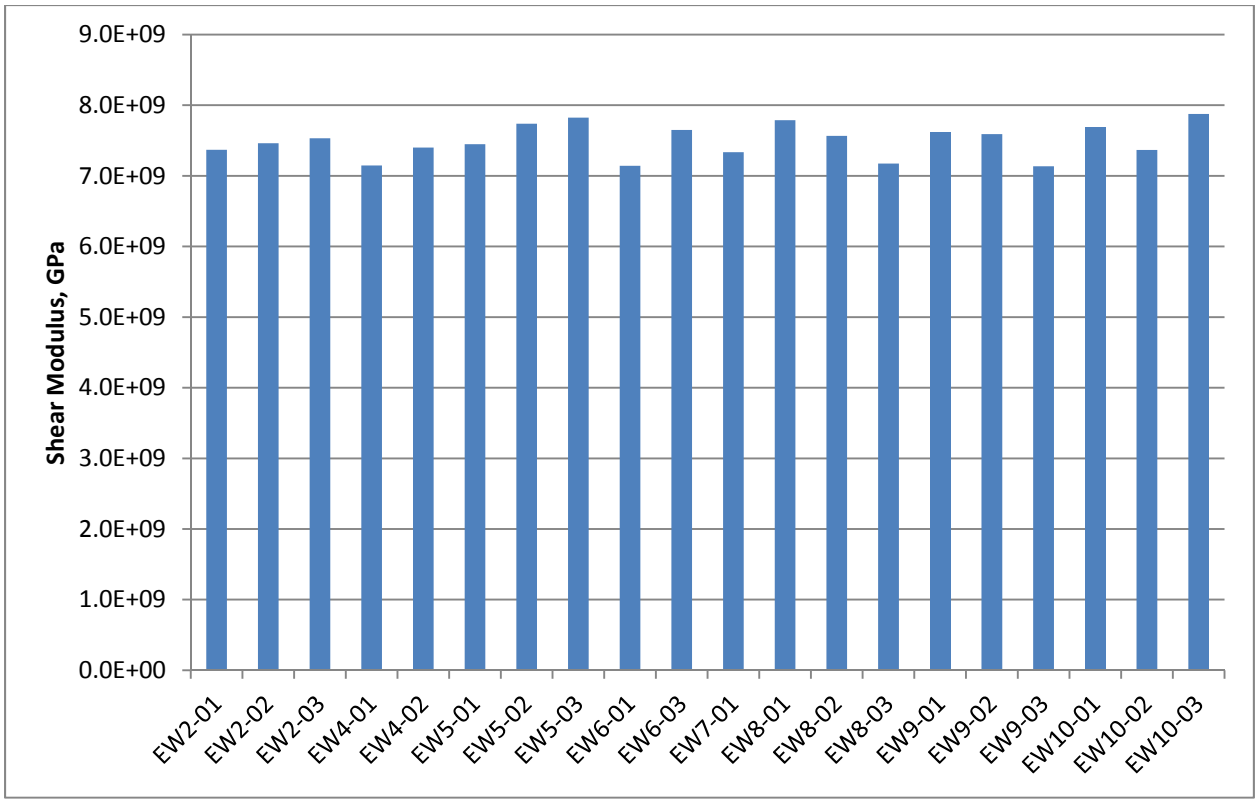


Figure 53 PIE data for Shear modulus (from sonic velocity) for IG-110 creep and control specimens

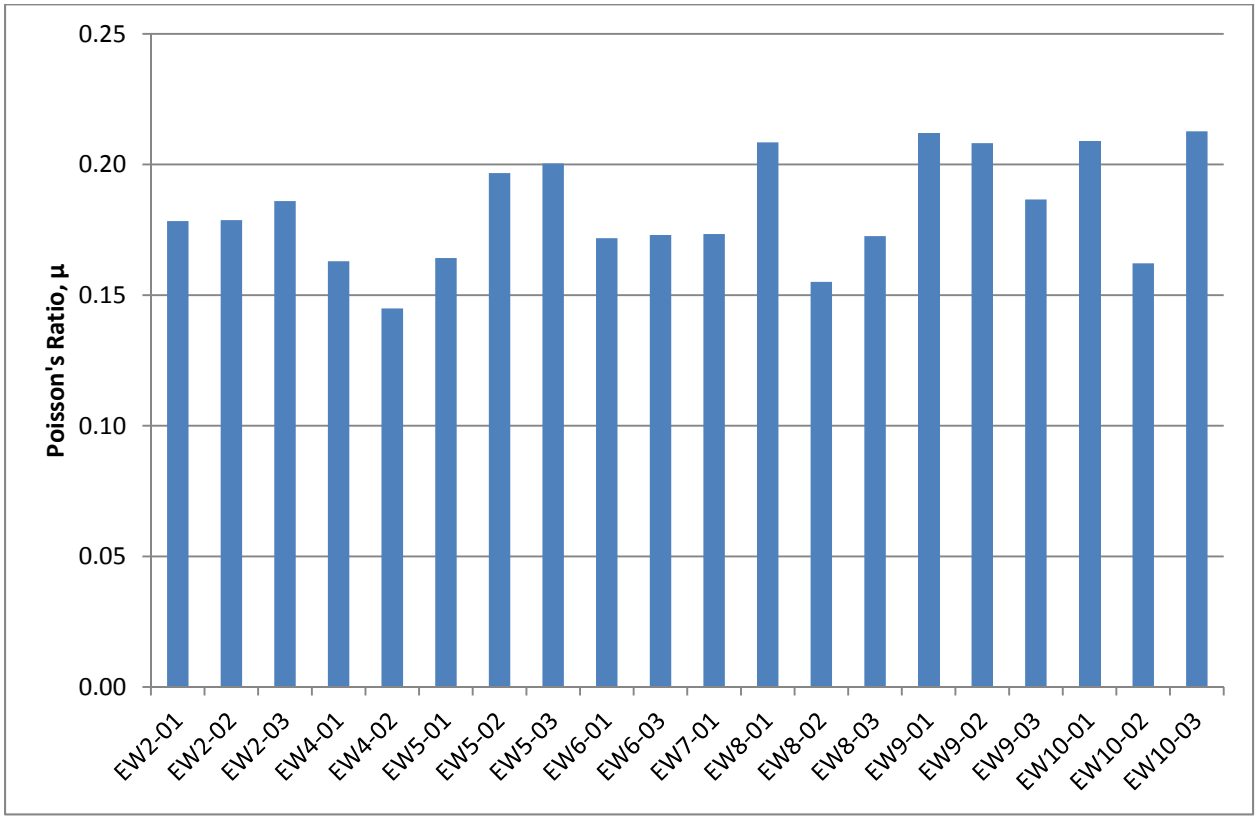


Figure 54 PIE data for Poison's Ratio (from sonic velocity) for IG-110 creep and control specimens

Data for the sonic elastic constants for IG-430 are given in Table 30 for IG-430 graphite

Table 30 PIE sonic elastic constants data for IG-430 graphite

Young's Modulus, Shear Modulus and Poisson's Ratio by Sonic Velocity										
			Sonic Velocities, v [m/s]							
Specimen Number	Specimen Location	Density,ρ kg/m^3	Longituginal	Shear 0◦	Shear 90◦	Average Shear Velocity	Elastic Modulus, [Pa] E=ρvl^2	Shear Modulus, [Pa] G=ρvs^2	Poisson's Ratio μ=(1-[2(vs/vl)^2])/(2-[2(vs/vl)^2])	Elastic Modulus, [Pa] E=ρvl^2[(1+μ)(1-2μ)/(1-μ)]
FW1-01	**1S5**	1877.70	3.228E+03	2.026E+03	2.026E+03	2.026E+03	1.957E+10	7.707E+09	1.750E-01	1.811E+10
FW1-03	**1U5**	1876.83	3.315E+03	2.044E+03	2.041E+03	2.043E+03	2.062E+10	7.830E+09	1.940E-01	1.870E+10
FW2-01	**1U10**	1865.25	3.409E+03	2.116E+03	2.066E+03	2.091E+03	2.168E+10	8.155E+09	1.984E-01	1.955E+10
FW2-02	**2S3**	1881.02	3.231E+03	2.031E+03	2.008E+03	2.020E+03	1.964E+10	7.672E+09	1.794E-01	1.810E+10
FW2-03	**2S9**	1869.54	3.355E+03	2.094E+03	2.094E+03	2.094E+03	2.104E+10	8.198E+09	1.809E-01	1.936E+10
FW3-01	**2S15**	1864.95	3.394E+03	2.094E+03	2.096E+03	2.095E+03	2.148E+10	8.185E+09	1.922E-01	1.952E+10
FW3-02	**2U3**	1869.48	3.359E+03	2.073E+03	2.073E+03	2.073E+03	2.109E+10	8.034E+09	1.924E-01	1.916E+10
FW3-03	**2U9**	1861.21	3.399E+03	2.105E+03	2.105E+03	2.105E+03	2.150E+10	8.247E+09	1.889E-01	1.961E+10
FW4-01	**2U14**	1836.44	3.303E+03	2.083E+03	2.061E+03	2.072E+03	2.004E+10	7.884E+09	1.756E-01	1.854E+10
FW4-02	**3S3**	1868.78	3.153E+03	1.982E+03	1.990E+03	1.986E+03	1.858E+10	7.371E+09	1.712E-01	1.726E+10
FW4-03	**3S4**	1883.27	3.102E+03	1.991E+03	1.983E+03	1.987E+03	1.812E+10	7.435E+09	1.521E-01	1.713E+10
FW5-01	**3S5**	1862.13	3.324E+03	2.039E+03	2.039E+03	2.039E+03	2.057E+10	7.742E+09	1.984E-01	1.855E+10
FW5-02	**3S7**	1885.97	3.333E+03	2.039E+03	2.039E+03	2.039E+03	2.095E+10	7.841E+09	2.010E-01	1.883E+10
FW5-03	**3U3**	1882.79	3.623E+03	2.197E+03	2.177E+03	2.187E+03	2.471E+10	9.005E+09	2.134E-01	2.185E+10
FW7-01	**3U4**	1878.37	3.466E+03	2.103E+03	2.103E+03	2.103E+03	2.257E+10	8.307E+09	2.087E-01	2.008E+10
FW7-02	**3U5**	1852.67	3.353E+03	2.092E+03	2.073E+03	2.083E+03	2.083E+10	8.035E+09	1.860E-01	1.906E+10
FW7-03	**3U7**	1843.13	3.317E+03	2.063E+03	2.071E+03	2.067E+03	2.028E+10	7.875E+09	1.826E-01	1.863E+10
FW8-01	**4S3**	1873.77	3.176E+03	2.009E+03	2.019E+03	2.014E+03	1.890E+10	7.600E+09	1.637E-01	1.769E+10
FW8-02	**4S10**	1864.79	3.178E+03	2.004E+03	2.001E+03	2.003E+03	1.883E+10	7.478E+09	1.708E-01	1.751E+10
FW9-01	**4U10**	1868.39	3.652E+03	2.193E+03	2.185E+03	2.189E+03	2.492E+10	8.953E+09	2.196E-01	2.184E+10
FW9-02	**5S2**	1876.85	3.131E+03	2.018E+03	2.008E+03	2.013E+03	1.840E+10	7.605E+09	1.477E-01	1.746E+10
FW9-03	**5S10**	1879.81	3.115E+03	2.002E+03	1.974E+03	1.988E+03	1.824E+10	7.429E+09	1.564E-01	1.718E+10
FW10-01	**5U2**	1878.39	3.404E+03	2.068E+03	2.075E+03	2.072E+03	2.177E+10	8.060E+09	2.059E-01	1.944E+10
FW10-02	**5U10**	1883.38	3.496E+03	2.094E+03	2.126E+03	2.110E+03	2.302E+10	8.385E+09	2.135E-01	2.035E+10
FW10-03	**6S2**	1890.86	3.205E+03	1.996E+03	2.021E+03	2.009E+03	1.942E+10	7.628E+09	1.767E-01	1.795E+10
FW11-01	**6S7**	1874.52	3.328E+03	2.078E+03	2.049E+03	2.064E+03	2.076E+10	7.982E+09	1.877E-01	1.896E+10
FW11-02	**6S10**	1870.26	3.328E+03	2.044E+03	2.081E+03	2.063E+03	2.071E+10	7.956E+09	1.882E-01	1.891E+10
FW11-03	**6U2**	1877.66	3.285E+03	2.041E+03	2.041E+03	2.041E+03	2.026E+10	7.822E+09	1.856E-01	1.855E+10
FW12-01	**6U7**	1843.59	3.274E+03	2.035E+03	2.044E+03	2.040E+03	1.976E+10	7.669E+09	1.829E-01	1.814E+10
FW13-01	**Spare 1**	1881.69	3.519E+03	2.151E+03	2.151E+03	2.151E+03	2.330E+10	8.706E+09	2.017E-01	2.093E+10

The IG-430 elastic constants are plotted to assist in the identification of outliers in **Error! Reference source not found.** through Figure 57.

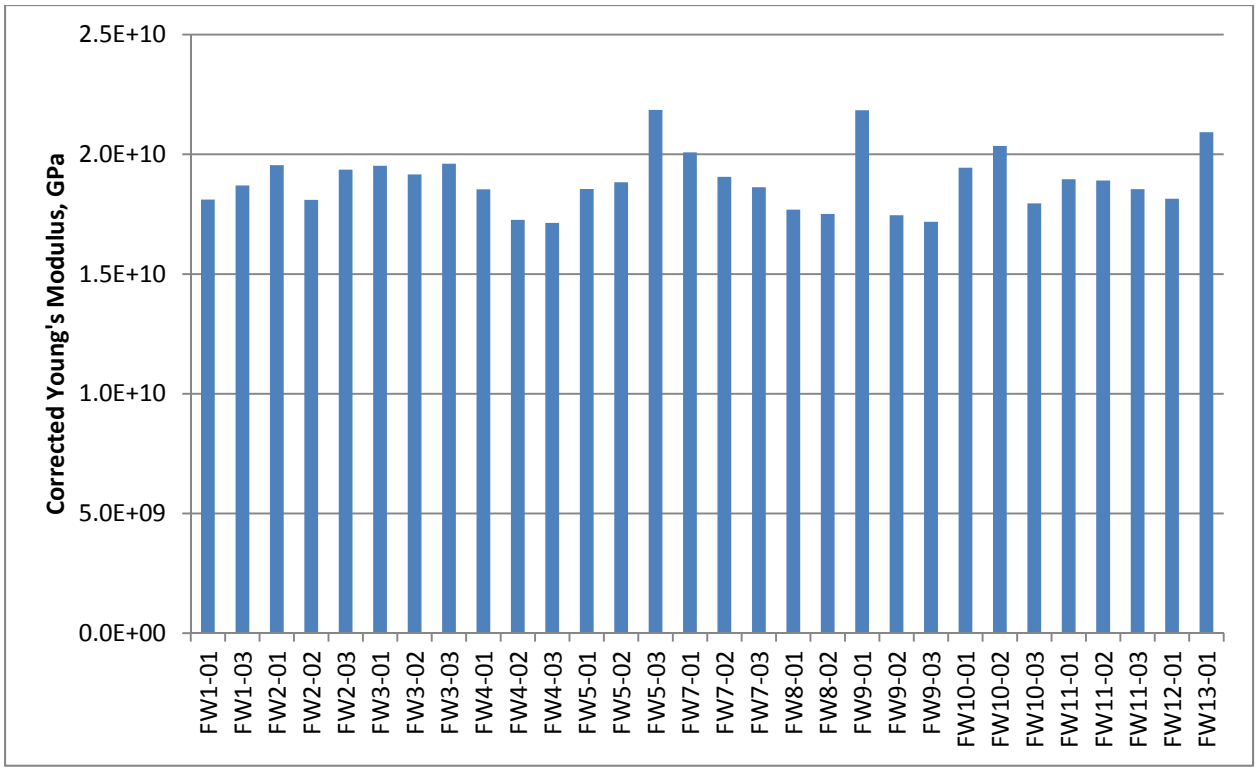


Figure 55 PIE data for Longitudinal Dynamic Young's modulus (from sonic velocity) for IG-430 creep and control specimens

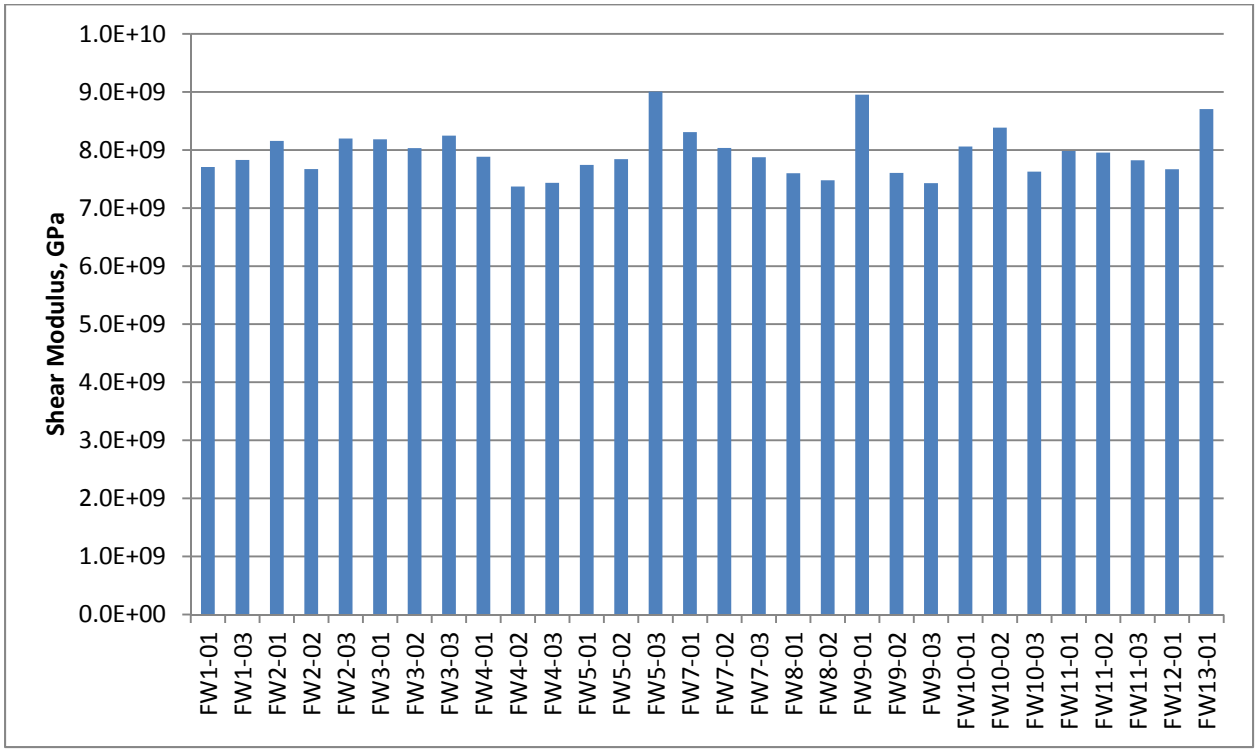


Figure 56 PIE data for Shear modulus (from sonic velocity) for IG-430 creep and control specimens

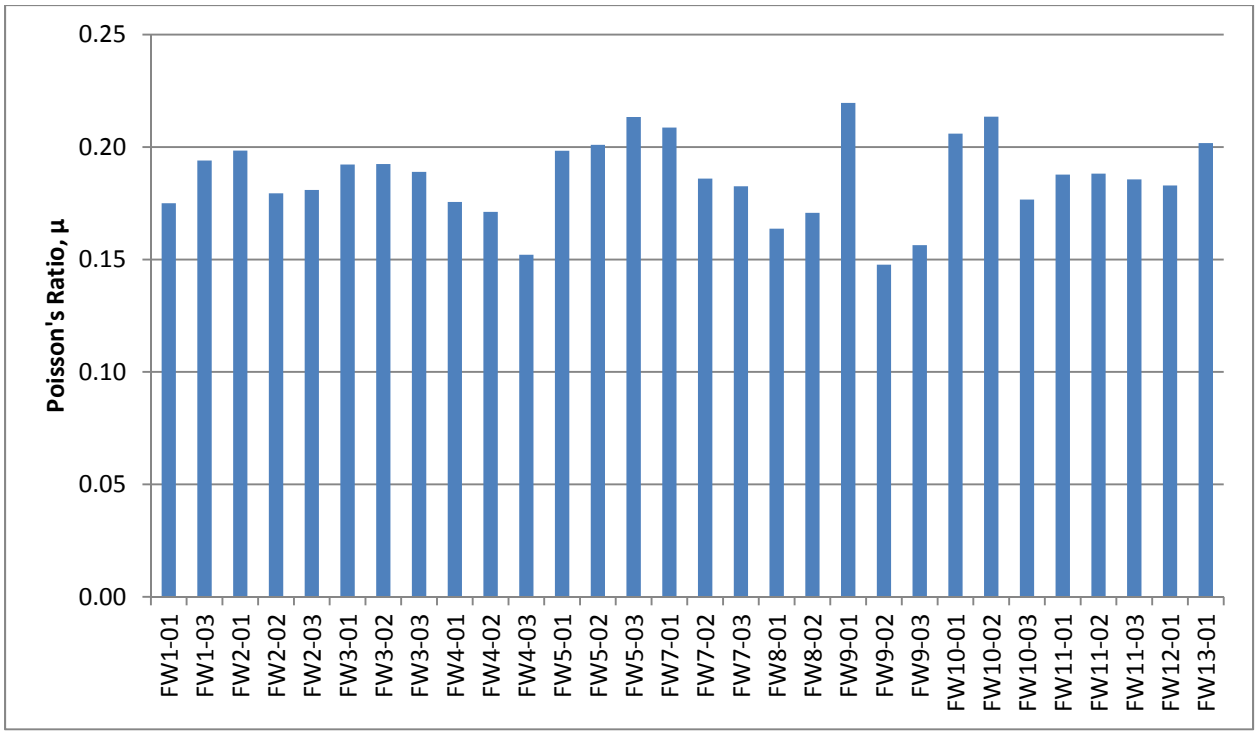


Figure 57 PIE data for Poison's Ratio (from sonic velocity) for IG-430 creep and control specimens

3.6.Thermal Expansion

The PIE data for the thermal expansion, instantaneous coefficient of thermal expansion, and average coefficient of thermal expansion over the temperature range 100 to 550°C for all the major grades in AGC-1 as follows:

- NBG-17 (AG) are given in Table 62 through Table 71 (Section 8 Appendices)
- NBG-17 (WG) are given in Table 72 and Table 73 (Section 8 Appendices)
- NBG-18 (AG) are given in Table 74 through Table 83 (Section 8 Appendices)
- NBG-18 (WG) are given in Table 84 and Table 85 (Section 8 Appendices)
- H-451 (WG) are given in Table 86 through Table 93 (Section 8 Appendices)
- PCEA (WG) are given in Table 94 through Table 104 (Section 8 Appendices)
- PCEA (AG) are given in Table 105 and Table 106 (Section 8 Appendix)
- IG-110 are given in Table 107 through Table 114 (Section 8 Appendices)
- IG-430 are given in Table 115 through Table 126 (Section 8 Appendices).

The upper measurement temperature was limited to 550°C to ensure displacement damage was not annealed out of the specimens. The blank tables (highlighted yellow) are where specimens were either not used in AGC-1 (spare specimens that underwent pre-irradiation testing in case the original specimens were damaged during handling or loading in the capsule) or not returned to ORNL after

irradiation due to more extensive testing to ascertain fundamental irradiation damage mechanisms in nuclear graphite material (a maximum of two specimens for each major grade of graphite).

3.7.Electrical Resistivity

The electrical resistivity before and after irradiation and the fractional change in electrical resistivity (on irradiation), are reported for all the major grades in AGC-1 as follows:

- NBG-17 (AG and WG orientations) in Table 127 through Table 129 (Section 8 Appendices)
- NBG-18 (AG and WG orientations) in Table 130 through Table 132 (Section 8 Appendices)
- H-451 in Table 133 and Table 134 (Section 8 Appendices)
- PCEA (AG and WG orientations) in Table 135 through Table 137 (Section 8 Appendices)
- IG-110 in Table 140 and Table 141 (Section 8 Appendices)
- IG-430 in Table 142 through Table 144 (Section 8 Appendices).

4. General Discussion

Data have been reported here from the Post Irradiation Examination of the stressed and unstressed AGC-1 creep and control samples and dimensional change data from the piggyback specimens. Specifically, 2,576 dimensional measurements and 161 mass measurements have been taken to allow density calculations. All of the specimen dimensions (post-irradiation) showed a dimensional shrinkage, as expected. The magnitude of the stress induced dimensional change (creep) increased with applied compressive stress as expected. Further analysis of the creep strain data, including prediction and modeling, is planned. The flexural Young's Modulus was determined from the specimen's fundamental frequency of vibration. A total of 1610 frequency measurements were made to fully elucidate flexural modulus changes after irradiation. As expected, the flexural modulus was observed to increase between 60 and 120%. Further analysis is required to determine if the magnitude of the creep strain influences the flexural modulus.

Dynamic Young's Modulus, Shear modulus, and Poisson's Ratio were determined from sonic velocity (time of flight). A total of 1449 velocity determinations were made during AGC-1 PIE. The Moduli were observed to markedly increase upon neutron irradiation, in agreement with the flexural moduli data (from fundamental frequency of vibration). The data should be further analyzed to determine if creep strain influences the magnitude of moduli change. Some 2574 electrical resistivity measurements were made on the irradiated AGC-1 specimens. Irradiation increased the electrical resistivity by a factor of 2-3 as previously reported.[9]

The thermal expansion behavior has been measured on each of the irradiated AGC-1 creep specimens (161) over the temperature range 100-550°C. A detailed study of the effects of creep strain on CTE is required. Previously the CTE has been used in the modeling of creep strain to correct the creep strain data[10,11].

Glued-end tensile strength mechanical testing will be the final testing to be conducted on the AGC-1 specimens because it is a destructive test (scheduled for 2014). Previously, glued end tensile strength tests were performed on sister specimens[12] to establish baseline strengths for each of the six grades represented here, each determined using the glued-end technique.

Calculated capsule dose and average temperature data are analyzed by channel in Table 31. Close to the reactor mid-plane the creep and control specimen temperature are comparable. However, the disparity increases substantially as the capsule periphery is approached where the disparity between the creep and control specimen pairs exceeds 120°C. Thus, the creep strain data will have to be sub-divided into groups with similar irradiation temperatures. Similarly, the dose disparity increases as the specimen pair's move progressively away from the reactor mid-plane position.

The central channel of the AGC-1 creep capsule contained a series of SiC irradiation temperature monitors. These monitors respond to the prevailing irradiation conditions at the end of irradiation.

Based upon the analysis of the SiC temperature monitors electrical resistivity data several observations can be made regarding the capsules FINAL centerline temperatures (
Figure 22):

1. Capsule final centerline temperature varied from 700 - 770°C (±25°C)
2. Capsule was cooler at the top and bottom 20cm at the end of operation.
3. There is generally good agreement between the SiC temperatures and the TC measured capsule final cycle temperatures for the central 40cm of the capsule (Figure 22).

The advent of further data from the AGC-2 to AGC-6 capsules will yield the final variable, i.e., the variation of creep strain with irradiation temperature.

Table 31 Maximum and minimum AGC-1 channel temperatures and doses for the creep and control specimens

AGC-1 creep & control specimen fluence and temperature ranges (within each channel)								
Channel	Ave. Compressive load, lbs.	Ave. Compressive Stress, ksi	Specimen Fluence Range, dpa		Specimen Temperature Range (°C)		Min T , ΔT	Max T, ΔT
			Min	Max	Min	Max	(Capsule Ends)	(Mid capsule)
S1 Compressed, North Channel	377	1.92	3.47	6.84	589	708	121	34
S1 Uncompressed, North Channel	No Load	Unstressed	2.87	6.70	468	674		
S2 Compressed, North-East	467	2.38	3.49	6.92	592	711	122	34
S2 Uncompressed, North-East	No Load	Unstressed	2.86	6.77	470	677		
S3,Compressed South-East	565	2.88	3.42	6.81	594	714	122	33
S3,Uncompressed South-East	No Load	Unstressed	2.79	6.66	472	681		
S4 Compressed, South	359	1.83	3.32	6.63	594	716	121	34
S4 Uncompressed, South	No Load	Unstressed	2.73	6.49	473	682		
S5 Compressed, South-West	474	2.41	3.37	6.77	593	714	121	33
S5 Uncompressed, South-West	No Load	Unstressed	2.78	6.62	472	681		
S6 Compressed, North-West	558	2.84	3.51	6.87	593	710	123	33
S6 Uncompressed, North-West	No Load	Unstressed	2.85	6.73	470	677		

5. Quality Assurance

The activities described here were conducted in accordance with the applicable requirements of the ASME/NQA-1-2000 national standard entitled *Quality Assurance Requirements for Nuclear Facility Applications.* Project and activity-specific information concerning ORNL's application of the standard's requirements is provided in Document #QAP-ORNL-NGNP-01[13] entitled *Quality Assurance Plan for the Next Generation Nuclear Plant Materials Program at Oak Ridge National Laboratory*

6. Conclusions

The post irradiation examination of specimen from creep capsule AGC-1 has been completed (except destructive glued end tensile testing) and is reported here. Over 8500 individual physical property tests have been conducted and the effects of irradiation investigated over the dose range 2.73 - 6.92 dpa and temperature range 470 - 716 °C for the AGC-1 creep and control specimens. The large temperature disparity between creep and control specimens within a single channel (approximately 122°C) complicates the analysis of creep strain and property effects. Similarly, the dose disparity increases as the specimen pairs move progressively away from the reactor mid-plane position. Given that this was the prototype for the AGC series the design problems are not unexpected and have been designed out of subsequent AGC capsules.

SiC monitor temperature data for the final AGC-1 centerline temperature was in good agreement with the observed AGC-1 capsule thermocouples temperature data for the central 40 cm of the capsule. Temperatures estimated at the lower doses and temperatures for the top and bottom 20 cm do not agree very well.

The PIE data reported here included: specimen dimensions and hence the dimensional change upon irradiation (a comparison of these data for specimen matched pairs will yield the creep strain); mass and volume, hence density; elastic constants (Young's modulus, shear modulus and Poisson's ratio) from ultrasonic time of flight (TOF) and velocity measurements; Young's modulus from the fundamental frequency of vibration; electrical resistivity; and thermal expansion from 100-550°C (hence coefficient of thermal expansion). Over 8500 individual physical measurement have been made and the data were reduced and reported here.

Glued-end tensile strength testing has yet to be accomplished and will the final testing to be conducted on the AGC-1 specimens because it is a destructive test (scheduled for FY-14). Previously, glued end tensile strength tests were performed on sister specimens[12] to establish baseline strengths for each of the six grades represented here.

Further analysis of the data is needed to allow:

1. Determination of the creep strain for the specimen pairs.

2. Improved fits to the existing models of graphite irradiation induced creep strain.

3. With the eventual advent of temperature dependency data from the additional AGC series of capsules, and microstructural data from piggy back specimens in AGC capsules, the development of new and improved models for the development of irradiation induced creep strain in graphite is anticipated.

4. An Investigation into the effects of creep strain on the physical properties of irradiated graphite.

7. Acknowledgements

The author wishes to thank Ashli Clarke for her diligence in making the PIE measurements.

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8. Appendices

Table 32 Voltage, current and resistivity data for SiC Temperature Monitor No. 1

Resistivity																	
Specimen Number			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.2500E-06	1.0000E-06	1.0000E-06	8.0000E-07	5.0000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	1.407	1.544	1.966	1.949	2.005	2.052	1.483	1.304	1.551	1.589	2.2335	1.8525	2.3066	2.208	1.9833
Forward current:		2	1.410	1.544	1.977	1.955	1.998	2.018	1.475	1.300	1.548	1.606	2.2256	1.846	2.3038	2.2129	1.9776
Voltage readings, V		3	1.388	1.550	1.981	1.956	1.977	2.011	1.472	1.277	1.546	1.610	2.2239	1.8482	2.3082	2.2133	1.9773
		4	1.379	1.553	1.980	1.956	1.950	2.010	1.470	1.287	1.544	1.612	2.223	1.8464	2.3051	2.2132	1.9748
Reverse current:		5	1.388	1.562	1.982	1.953	1.943	2.009	1.474	1.294	1.540	1.611	2.2205	1.8448	2.3002	2.2135	1.9753
Average voltage, V	V		1.394	1.551	1.977	1.954	1.975	2.020	1.475	1.292	1.546	1.606	2.225	1.848	2.305	2.212	1.978
Average resistance, R=V/I	Ω		6.97E+05	7.75E+05	9.89E+05	9.77E+05	9.87E+05	1.01E+06	9.83E+05	8.61E+05	1.03E+06	1.07E+06	1.78E+06	1.85E+06	2.30E+06	2.77E+06	3.96E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A*	cm^2		0.02200	0.02200	0.02200	0.02200	0.02200	0.02200	0.02200	0.02200	0.02200	0.02200	0.02200	0.02200	0.02200	0.02200	0.02200
Resistivity, p=(R*A)/L	Ωcm		6118.05	6803.33	8674.95	8572.54	8663.63	8862.48	8627.88	7559.97	9042.67	9393.22	15622.37	16213.31	20225.43	24266.04	34709.63

Table 33 Voltage, current and resistivity data for SiC Temperature Monitor No.2

Resistivity																	
Specimen Number			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
			17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.2500E-06	1.2500E-06	1.0000E-06	8.0000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	0.523	0.607	1.140	1.064	1.236	1.275	0.840	0.845	1.029	1.045	1.8163	1.9141	2.1601	2.0587	2.1722
Forward current:		2	0.521	0.608	1.147	1.142	1.223	1.281	0.883	0.834	1.026	1.062	1.8987	1.9064	2.1598	2.0546	2.1716
Voltage readings, V		3	0.532	0.606	1.149	1.172	1.227	1.281	0.899	0.830	1.024	1.066	1.8983	1.9004	2.1425	2.0522	2.1692
		4	0.531	0.606	1.150	1.183	1.223	1.281	0.928	0.831	1.020	1.061	1.8961	1.8962	2.1419	2.0501	2.1682
Reverse current:		5	0.530	0.608	1.149	1.193	1.213	1.280	0.925	0.830	1.021	1.060	1.8931	1.8926	2.1447	2.0459	2.1673
Average voltage, V	V		0.527	0.607	1.147	1.151	1.224	1.279	0.895	0.834	1.024	1.059	1.881	1.902	2.150	2.052	2.170
Average resistance, R=V/I	Ω		2.64E+05	3.04E+05	5.74E+05	5.75E+05	6.12E+05	6.40E+05	5.97E+05	5.56E+05	6.83E+05	7.06E+05	1.25E+06	1.52E+06	1.72E+06	2.05E+06	2.71E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A*	cm^2		0.02232	0.02232	0.02232	0.02232	0.02232	0.02232	0.02232	0.02232	0.02232	0.02232	0.02232	0.02232	0.02232	0.02232	0.02232
Resistivity, p=(R*A)/L	Ωcm		2346.98	2702.49	5106.10	5123.10	5448.87	5694.78	5310.96	4950.92	6077.35	6283.20	11161.70	13546.75	15312.16	18272.13	24146.71

Table 34 Voltage, current and resistivity data for SiC Temperature Monitor No 3

Resistivity																	
Specimen Number			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
			16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.1500E-06	1.0000E-06	8.0000E-07	6.0000E-07	4.0000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	1.043	1.212	1.818	1.731	1.801	1.860	1.289	1.303	1.490	1.514	1.6586	1.7295	2.1011	1.9649	2.1571
Forward current:		2	1.046	1.511	1.824	1.732	1.790	1.870	1.339	1.287	1.486	1.519	1.6531	1.7294	2.0964	1.9537	2.1468
Voltage readings, V		3	1.040	1.221	1.825	1.747	1.792	1.873	1.351	1.282	1.484	1.518	1.6556	1.7278	2.096	1.9554	2.1407
		4	1.039	1.220	1.825	1.759	1.793	1.873	1.360	1.278	1.483	1.521	1.6637	1.731	2.0912	1.9555	2.1385
Reverse current:		5	1.032	1.222	1.826	1.774	1.795	1.874	1.340	1.274	1.483	1.520	1.6713	1.7181	2.0912	1.955	2.1387
Average voltage, V	V		1.040	1.277	1.823	1.749	1.794	1.870	1.336	1.285	1.485	1.518	1.660	1.727	2.095	1.957	2.144
Average resistance, R=V/I	Ω		5.20E+05	6.39E+05	9.12E+05	8.74E+05	8.97E+05	9.35E+05	8.91E+05	8.56E+05	9.90E+05	1.01E+06	1.44E+06	1.73E+06	2.62E+06	3.26E+06	5.36E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *	cm^2		0.02320	0.02320	0.02320	0.02320	0.02320	0.0232	0.0232	0.0232	0.0232	0.0232	0.0232	0.0232	0.0232	0.0232	0.0232
Resistivity, p=(R*A)/L	Ωcm		4811.65	5910.13	8438.27	8093.12	8303.97	8652.82	8242.75	7926.94	9164.14	9369.50	13364.30	15986.31	24240.80	30187.91	49619.61

Table 35 Voltage, current and resistivity data for SiC Temperature Monitor No. 7

Resistivity																	
Specimen Number			7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	9.0000E-07	6.0000E-07	4.5000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	0.725	0.706	0.785	0.707	0.777	0.890	0.672	0.686	0.963	1.100	1.9691	2.1008	1.8814	1.7052	2.0101
Forward current:		2	0.727	0.740	0.786	0.729	0.773	0.895	0.687	0.680	0.962	1.102	1.9844	2.0948	1.9129	1.7007	2.0068
Voltage readings, V		3	0.727	0.750	0.784	0.740	0.771	0.897	0.693	0.677	0.961	1.106	1.9827	2.0908	1.9015	1.6996	2.005
		4	0.692	0.753	0.787	0.742	0.771	0.897	0.697	0.674	0.960	1.109	1.9787	2.0917	1.9272	1.6974	2.0019
Reverse current:		5	0.685	0.757	0.785	0.743	0.770	0.897	0.702	0.672	0.959	1.112	1.9736	2.0947	1.9296	1.6964	2.001
Average voltage, V	V		0.711	0.741	0.785	0.732	0.772	0.895	0.690	0.678	0.961	1.106	1.978	2.095	1.911	1.700	2.005
Average resistance, R=V/I	Ω		3.56E+05	3.71E+05	3.93E+05	3.66E+05	3.86E+05	4.48E+05	4.60E+05	4.52E+05	6.41E+05	7.37E+05	1.32E+06	1.40E+06	2.12E+06	2.83E+06	4.46E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *	cm^2		0.0223	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223
Resistivity, p=(R*A)/L	Ωcm		3167.53	3301.26	3498.70	3261.61	3440.07	3987.47	4098.75	4026.29	5709.72	6567.53	11746.96	12441.07	18913.21	25241.68	39696.25

Table 36 Voltage, current and resistivity data for SiC Temperature Monitor No. 8

Resistivity																	
Specimen Number			8 6	8 6	8 6	8 6	8 6	8 6	8 6	8 6	8 6	8 6	8 6	8 6	8 6	8 6	8 6
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.2500E-06	1.1500E-06	9.0000E-07	9.0000E-07	6.0000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	1.729	1.728	1.883	1.756	1.802	1.802	1.228	1.274	1.424	1.346	2.0661	2.1154	1.9453	2.1539	1.9645
Forward current:		2	1.732	1.808	1.889	1.750	1.788	1.811	1.274	1.254	1.419	1.355	2.0748	2.1126	1.9342	2.1445	1.9596
Voltage readings, V		3	1.731	1.822	1.888	1.763	1.783	1.811	1.295	1.237	1.418	1.367	2.0752	2.1109	1.9327	2.1423	1.9572
		4	1.732	1.826	1.884	1.769	1.780	1.812	1.301	1.231	1.417	1.372	2.0768	2.1093	1.9306	2.1427	1.9542
Reverse current:		5	1.728	1.838	1.891	1.774	1.780	1.813	1.306	1.232	1.416	1.375	2.0764	2.0784	1.9287	2.1406	1.9513
Average voltage, V	V		1.730	1.804	1.887	1.762	1.787	1.810	1.281	1.246	1.419	1.363	2.074	2.105	1.934	2.145	1.957
Average resistance, R=V/I	Ω		8.65E+05	9.02E+05	9.44E+05	8.81E+05	8.93E+05	9.05E+05	8.54E+05	8.30E+05	9.46E+05	9.09E+05	1.66E+06	1.83E+06	2.15E+06	2.38E+06	3.26E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *	cm^2		0.02197	0.02197	0.02197	0.02197	0.02197	0.02197	0.02197	0.02197	0.02197	0.02197	0.02197	0.02197	0.02197	0.02197	0.02197
Resistivity, p=(R*A)/L	Ωcm		7583.70	7907.67	8270.30	7724.39	7829.66	7932.48	7483.63	7279.58	8290.51	7964.21	14542.51	16046.86	18838.71	20888.83	28594.95

Table 37 Voltage, current and resistivity data for SiC Temperature Monitor No. 9

Resistivity																	
Specimen Number			9 1	9 1	9 1	9 1	9 1	9 1	9 1	9 1	9 1	9 1	9 1	9 1	9 1	9 1	9 1
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.2500E-06	1.0000E-06	6.0000E-07	4.5000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	0.723	0.766	0.809	0.723	0.801	0.800	0.599	0.639	0.812	0.933	1.741	1.7617	2.1741	1.5674	1.874
Forward current:		2	0.715	0.775	0.813	0.735	0.795	0.795	0.620	0.639	0.814	0.940	1.736	1.7579	2.1654	1.5596	1.87
Voltage readings, V		3	0.751	0.778	0.813	0.744	0.792	0.797	0.624	0.717	0.811	0.944	1.734	1.7537	2.1309	1.5576	1.868
		4	0.715	0.779	0.813	0.748	0.792	0.797	0.621	0.641	0.813	0.944	1.731	1.7513	2.0701	1.5572	1.8669
Reverse current:		5	0.712	0.782	0.810	0.750	0.792	0.797	0.615	0.634	0.812	0.945	1.729	1.7492	2.037	1.5523	1.8663
Average voltage, V	V		0.723	0.776	0.811	0.740	0.795	0.797	0.616	0.654	0.813	0.941	1.734	1.755	2.116	1.559	1.869
Average resistance, R=V/I	Ω		3.62E+05	3.88E+05	4.06E+05	3.70E+05	3.97E+05	3.99E+05	4.11E+05	4.36E+05	5.42E+05	6.27E+05	1.16E+06	1.40E+06	2.12E+06	2.60E+06	4.15E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *	cm^2		0.02220	0.02220	0.02220	0.02220	0.02220	0.02220	0.02220	0.02220	0.02220	0.02220	0.02220	0.02220	0.02220	0.02220	0.02220
Resistivity, p=(R*A)/L	Ωcm		3201.72	3435.74	3591.84	3274.77	3517.55	3528.62	3635.84	3860.03	4795.96	5555.29	10234.96	12429.43	18730.81	23003.20	36774.74

Table 38 Voltage, current and resistivity data for SiC Temperature Monitor No. 10

Resistivity																	
Specimen Number			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.2500E-06	1.1500E-06	9.0000E-07	5.0000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	0.845	0.856	0.921	0.833	0.917	0.888	0.718	0.754	0.834	0.895	1.683	1.6905	2.2937	2.1554	1.9224
Forward current:		2	0.822	0.869	0.927	0.824	0.909	0.891	0.712	0.751	0.833	0.897	1.673	1.6862	2.2846	2.1473	1.9197
Voltage readings, V		3	0.814	0.979	0.928	0.826	0.906	0.891	0.710	0.754	0.832	0.895	1.668	1.6827	2.2426	2.1413	1.9124
		4	0.809	0.884	0.929	0.813	0.904	0.891	0.708	0.754	0.830	0.882	1.664	1.68	2.2872	2.1436	1.9159
Reverse current:		5	0.804	0.885	0.928	0.814	0.901	0.891	0.706	0.755	0.829	0.873	1.662	1.6781	2.2968	2.1451	1.9152
Average voltage, V	V		0.819	0.895	0.927	0.822	0.907	0.890	0.711	0.753	0.832	0.888	1.670	1.684	2.281	2.147	1.917
Average resistance, R=V/I	Ω		4.09E+05	4.47E+05	4.63E+05	4.11E+05	4.54E+05	4.45E+05	4.74E+05	5.02E+05	5.54E+05	5.92E+05	1.11E+06	1.35E+06	1.98E+06	2.39E+06	3.83E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *	cm^2		0.02249	0.02249	0.02249	0.02249	0.02249	0.02249	0.02249	0.02249	0.02249	0.02249	0.02249	0.02249	0.02249	0.02249	0.02249
Resistivity, p=(R*A)/L	Ωcm		3672.61	4012.91	4157.45	3686.33	4070.60	3994.43	4250.82	4506.70	4973.49	5314.07	9988.73	12083.51	17795.65	21398.66	34400.87

Table 39 Voltage, current and resistivity data for SiC Temperature Monitor No. 11

Resistivity																	
Specimen Number			11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
			7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
							1.5	1.5									
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.1500E-06	1.1500E-06	1.0000E-06	6.5000E-07	6.0000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	2.769	2.744	2.984	2.767	2.164	2.082	2.150	2.142	2.287	2.044	1.982	2.146	2.109	1.5156	1.757
Forward current:		2	2.707	2.844	2.999	2.755	2.152	2.086	2.143	2.117	2.278	2.105	1.988	2.1372	2.1046	1.5109	1.7518
Voltage readings, V		3	2.824	2.881	2.987	2.760	2.154	2.088	2.157	2.103	2.279	2.087	1.989	2.136	2.103	1.5112	1.7508
		4	2.819	2.847	2.988	2.770	2.145	2.088	2.163	2.102	2.277	2.087	1.989	2.1334	2.1014	1.5107	1.7497
Reverse current:		5	2.776	2.888	2.988	2.782	2.142	2.088	2.170	2.100	2.270	2.085	1.989	2.1382	2.1015	1.5109	1.7487
Average voltage, V	V		2.779	2.841	2.989	2.767	2.151	2.086	2.156	2.113	2.278	2.082	1.987	2.138	2.104	1.512	1.752
Average resistance, R=V/I	Ω		1.39E+06	1.42E+06	1.49E+06	1.38E+06	1.43E+06	1.39E+06	1.44E+06	1.41E+06	1.52E+06	1.39E+06	1.73E+06	1.86E+06	2.10E+06	2.33E+06	2.92E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *	cm^2		0.02236	0.02236	0.02236	0.02236	0.02236	0.02236	0.02236	0.02236	0.02236	0.02236	0.02236	0.02236	0.02236	0.02236	0.02236
Resistivity, p=(R*A)/L	Ωcm		12392.00	12666.42	13328.68	12338.76	12791.54	12403.18	12821.15	12561.45	13543.52	12376.55	15411.41	16581.32	18762.98	20743.16	26035.17

Table 40 Voltage, current and resistivity data for SiC Temperature Monitor No. 12

Resistivity																	
Specimen Number			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
			8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.5000E-06	1.2500E-06	1.2500E-06	1.0000E-06	1.0000E-06	8.0000E-07	8.5000E-07	6.5000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	3.245	3.159	3.414	3.211	2.489	2.479	2.436	2.488	2.170	2.180	2.021	2.1351	1.9583	2.304	2.3283
Forward current:		2	3.330	3.224	3.425	3.219	2.446	2.473	2.444	2.468	2.167	2.186	2.016	2.1337	1.9482	2.297	2.321
Voltage readings, V		3	3.255	3.256	3.420	3.238	2.439	2.472	2.449	2.459	2.164	1.189	2.134	2.1361	1.945	2.2928	2.314
		4	3.234	3.276	3.419	3.235	2.442	2.472	2.447	2.456	2.163	2.192	2.122	2.1368	1.9462	2.2953	2.3129
Reverse current:		5	3.194	3.256	3.420	3.238	2.439	2.471	2.467	2.454	2.161	2.195	2.116	2.1107	1.9438	2.296	2.311
Average voltage, V	V		3.252	3.234	3.419	3.228	2.451	2.473	2.449	2.465	2.165	1.988	2.082	2.130	1.948	2.297	2.317
Average resistance, R=V/I	Ω		1.63E+06	1.62E+06	1.71E+06	1.61E+06	1.63E+06	1.65E+06	1.63E+06	1.64E+06	1.73E+06	1.59E+06	2.08E+06	2.13E+06	2.44E+06	2.70E+06	3.57E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *	cm^2		0.02257	0.02257	0.02257	0.02257	0.02257	0.02257	0.02257	0.02257	0.02257	0.02257	0.02257	0.02257	0.02257	0.02257	0.02257
Resistivity, p=(R*A)/L	Ωcm		14638.44	14559.66	15393.23	14532.55	14711.58	14845.08	14697.89	14795.62	15593.11	14322.78	18744.25	19182.38	21927.59	24331.61	32101.12

Table 41 Voltage, current and resistivity data for SiC Temperature Monitor No. 13

Resistivity																	
Specimen Number			13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
			11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.5000E-06	1.5000E-06	1.1500E-06	1.2500E-06	1.2500E-06	1.2500E-06	1.0000E-06	1.0000E-06	8.0000E-07	8.5000E-07	5.0000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	3.323	3.069	3.339	3.235	2.552	2.241	2.075	2.221	2.339	2.297	2.130	2.2003	1.9338	2.2064	1.5789
Forward current:		2	3.229	3.110	3.343	3.289	2.543	2.225	2.056	2.227	2.335	2.304	2.121	2.1663	1.922	2.2026	1.5772
Voltage readings, V		3	3.184	3.165	3.306	3.289	2.543	2.227	2.062	2.231	2.330	2.307	2.119	2.1583	1.9209	2.2007	1.5789
		4	3.181	3.129	3.306	3.292	2.539	2.227	2.062	2.240	2.329	2.309	2.116	2.1555	1.9023	2.198	1.5765
Reverse current:		5	3.184	3.145	3.314	3.288	2.540	2.227	2.061	2.244	2.328	2.311	2.114	2.1513	1.9053	2.1916	1.5747
Average voltage, V	V		3.220	3.124	3.321	3.279	2.544	2.229	2.063	2.233	2.332	2.306	2.120	2.166	1.917	2.200	1.577
Average resistance, R=V/I	Ω		1.61E+06	1.56E+06	1.66E+06	1.64E+06	1.70E+06	1.49E+06	1.79E+06	1.79E+06	1.87E+06	1.84E+06	2.12E+06	2.17E+06	2.40E+06	2.59E+06	3.15E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *	cm^2		0.02239	0.02239	0.02239	0.02239	0.02239	0.02239	0.02239	0.02239	0.02239	0.02239	0.02239	0.02239	0.02239	0.02239	0.02239
Resistivity, p=(R*A)/L	Ωcm		14379.91	13948.53	14832.55	14640.71	15144.70	13273.77	16022.99	15952.24	16662.89	16474.69	18933.92	19348.33	21400.17	23114.95	28173.75

Table 42 Voltage, current and resistivity data for SiC Temperature Monitor No. 14

Resistivity																	
Specimen Number			14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
							1.15	1.15									
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.1500E-06	1.1500E-06	1.1000E-06	1.1500E-06	1.1500E-06	1.0000E-06	8.0000E-07	8.0000E-07	7.0000E-07	4.0000E-07	4.0000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	3.714	3.888	4.192	4.133	2.295	2.581	2.493	2.572	2.532	2.245	2.2145	2.0992	2.0472	1.2484	1.6821
Forward current:		2	3.911	3.922	4.185	4.139	2.298	2.575	2.478	2.568	2.547	2.232	2.1167	2.0995	2.0421	1.2472	1.6806
Voltage readings, V		3	3.867	3.934	4.175	4.137	2.302	2.569	2.470	2.566	2.632	2.237	2.1121	2.0981	2.0406	1.2454	1.6843
		4	3.681	3.942	4.153	4.135	2.304	2.566	2.433	2.563	2.557	2.257	2.1095	2.0945	2.0383	1.2444	1.6833
Reverse current:		5	3.644	3.954	4.160	4.145	2.303	2.563	2.479	2.558	2.630	2.268	2.1039	2.0926	2.0359	1.2416	1.682
Average voltage, V	V		3.763	3.928	4.173	4.138	2.301	2.571	2.470	2.565	2.579	2.248	2.131	2.097	2.041	1.245	1.682
Average resistance, R=V/I	Ω		1.88E+06	1.96E+06	2.09E+06	2.07E+06	2.00E+06	2.24E+06	2.25E+06	2.23E+06	2.24E+06	2.25E+06	2.66E+06	2.62E+06	2.92E+06	3.11E+06	4.21E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *	cm^2		0.02224	0.02224	0.02224	0.02224	0.02224	0.02224	0.02224	0.02224	0.02224	0.02224	0.02224	0.02224	0.02224	0.02224	0.02224
Resistivity, p=(R*A)/L	Ωcm		16694.83	17424.74	18511.66	18354.80	17748.23	19833.87	19925.63	19789.59	19899.45	19942.91	23636.85	23253.58	25866.26	27623.32	37317.43

Table 43 Voltage, current and resistivity data for SiC Temperature Monitor No. 15

Resistivity																	
Specimen Number			15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
			13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I	A		2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.1500E-06	1.1500E-06	1.1000E-06	1.1500E-06	1.1500E-06	1.0000E-06	1.0000E-06	1.0000E-06	8.0000E-07	5.0000E-07	4.0000E-07
Compl. Voltage	V		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	2.564	2.659	2.824	2.834	1.611	1.714	1.680	1.745	1.791	1.531	1.5774	1.7817	1.8176	1.4387	1.6659
Forward current:		2	2.518	2.666	2.816	2.832	1.602	1.703	1.670	1.736	1.785	1.522	1.574	1.7863	1.8071	1.4406	1.6945
Voltage readings, V		3	2.517	2.677	2.811	2.831	1.600	1.699	1.665	1.730	1.780	1.522	1.5686	1.7909	1.8102	1.4392	1.6923
		4	2.519	2.686	2.808	2.829	1.599	1.694	1.661	1.728	1.762	1.523	1.5681	1.7925	1.8129	1.4396	1.6909
Reverse current:		5	2.503	2.684	2.808	2.830	1.598	1.691	1.658	1.724	1.768	1.525	1.567	1.7852	1.8242	1.438	1.6915
Average voltage, V	V		2.524	2.674	2.813	2.831	1.602	1.700	1.667	1.732	1.777	1.525	1.571	1.787	1.814	1.439	1.687
Average resistance, R=V/I	Ω		1.26E+06	1.34E+06	1.41E+06	1.42E+06	1.39E+06	1.48E+06	1.52E+06	1.51E+06	1.55E+06	1.52E+06	1.57E+06	1.79E+06	2.27E+06	2.88E+06	4.22E+06
Potential Contact Distance, L	cm		2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *	cm^2		0.02292	0.02292	0.02292	0.02292	0.02292	0.02292	0.02292	0.02292	0.02292	0.02292	0.02292	0.02292	0.02292	0.02292	0.02292
Resistivity, p=(R*A)/L	Ωcm		11537.19	12223.72	12858.68	12939.22	12733.53	13514.93	13850.68	13771.37	14127.96	13937.11	14361.45	16338.76	20732.88	26313.21	38554.66

Table 44 Voltage, current and resistivity data for SiC Temperature Monitor No. 17

Resistivity																	
Specimen Number			17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
			14 or 4	14 or 4	14 or 4	14 or 4	14 or 4	14 or 4	14 or 4	14 or 4	14 or 4	14 or 4	14 or 4	14 or 4	14 or 4	14 or 4	14 or 4
Anealing Temperature			**As Received**	**400**	**450**	**500**	**550**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**850**	**900**
Applied current, I		A	2.0000E-06	2.0000E-06	2.0000E-06	2.0000E-06	1.1500E-06	1.1500E-06	1.1000E-06	1.1500E-06	1.1500E-06	1.0000E-06	8.0000E-07	8.0000E-07	5.0000E-07	4.5000E-07	3.5000E-07
Compl. Voltage		V	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Initial Orientation:		1	1.956	2.293	2.526	2.530	1.415	1.468	1.436	1.497	1.553	1.371	1.3402	1.6008	1.3511	1.5407	1.8057
Forward current:		2	1.935	2.280	2.514	2.516	1.400	1.457	1.420	1.476	1.539	1.367	1.3399	1.5971	1.3779	1.5418	1.8025
Voltage readings, V		3	1.915	2.283	2.509	2.502	1.399	1.450	1.415	1.475	1.534	1.367	1.3406	1.5883	1.3843	1.5405	1.8
		4	1.898	2.290	2.504	2.499	1.391	1.448	1.410	1.470	1.530	1.365	1.3428	1.5877	1.3819	1.5385	1.798
Reverse current:		5	1.888	2.296	2.502	2.492	1.383	1.446	1.408	1.468	1.528	1.364	1.3499	1.607	1.3812	1.5378	1.7917
Average voltage, V		V	1.919	2.288	2.511	2.508	1.397	1.454	1.418	1.477	1.537	1.367	1.343	1.596	1.375	1.540	1.800
Average resistance, R=V/I		Ω	9.59E+05	1.14E+06	1.26E+06	1.25E+06	1.22E+06	1.26E+06	1.29E+06	1.28E+06	1.34E+06	1.37E+06	1.68E+06	2.00E+06	2.75E+06	3.42E+06	5.14E+06
Potential Contact Distance, L		cm	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070	2.5070
Average area, A *		cm^2	0.02283	0.02283	0.02283	0.02283	0.02283	0.02283	0.02283	0.02283	0.02283	0.02283	0.02283	0.02283	0.02283	0.02283	0.02283
Resistivity, p=(R*A)/L		Ωcm	8734.79	10418.62	11431.27	11417.98	11065.31	11509.36	11736.82	11694.64	12167.51	12445.20	15282.64	18168.03	25045.93	31159.09	46818.67

Table 45 Dimensions, Mass, Density and Dimensional Change for Grade NBG-17

	Specimen	Thickness Measurements, mm.				Outside Diameter Measurements,mm.								Hole Diameter ,mm.				Weight	Thickness	Diameter	Cross-section	2- hole Volume	Density	Density	Dimensioal Change, %	
	Number	T1	T2	T3	T4	D1	D2	D3	D4	$D1^{90}$	$D2^{90}$	$D3^{90}$	$D4^{90}$	H1	H2	H1'	H2'	g	m	m	m^2	m^3	kg/m^3	g/cm^3	$\Delta L/L_0$(%)	$\Delta D/D_0$(%)
																									ΔDIM = IRR-UNIRR	
Pre-Irradiation	**AL6-01**	25.372	25.366	25.366	25.370	12.738	12.736	12.730	12.737	12.738	12.737	12.729	12.729	3.175	3.172	3.162	3.162	5.9342	2.537E-02	1.273E-02	1.274E-04	5.20564E-08	1866.75	1.8667		
Post-Irradiation		25.034	25.030	25.033	25.036	12.590	12.597	12.597	12.592	12.594	12.595	12.579	12.585	3.316	3.321	3.321	3.326	5.93358	2.503E-02	1.259E-02	1.245E-04	5.72069E-08	1939.21	1.9392	-1.321	-1.124
Pre-Irradiation	**AL6-02**	25.367	25.368	25.371	25.368	12.739	12.734	12.728	12.727	12.736	12.736	12.730	12.727	3.185	3.183	3.162	3.165	5.9218	2.537E-02	1.273E-02	1.273E-04	5.22447E-08	1863.59	1.8636		
Post-Irradiation		24.622	24.624	24.623	24.632	12.672	12.671	12.673	12.673	12.684	12.687	12.690	12.694	3.270	3.274	3.256	3.269	5.92101	2.463E-02	1.268E-02	1.263E-04	5.53733E-08	1938.45	1.9384	-2.930	-0.405
Pre-Irradiation	**AL8-01**	25.354	25.357	25.356	25.356	12.737	12.732	12.724	12.724	12.737	12.710	12.724	12.724	3.175	3.170	3.175	3.170	5.9178	2.536E-02	1.273E-02	1.272E-04	5.22023E-08	1864.94	1.8649		
Post-Irradiation		24.785	24.781	24.792	24.784	12.694	12.692	12.697	12.704	12.682	12.674	12.685	12.693	3.268	3.270	3.269	3.269	5.9166	2.479E-02	1.269E-02	1.265E-04	5.54271E-08	1921.32	1.9213	-2.248	-0.286
Pre-Irradiation	**AL8-02**	25.377	25.377	25.373	25.382	12.733	12.741	12.738	12.730	12.738	12.738	12.737	12.733	3.162	3.162	3.167	3.172	5.9359	2.538E-02	1.274E-02	1.274E-04	5.19937E-08	1866.04	1.8660		
Post-Irradiation		25.172	25.163	25.167	25.171	12.625	12.627	12.636	12.632	12.626	12.627	12.635	12.634	3.310	3.301	3.296	3.292	5.93496	2.517E-02	1.263E-02	1.253E-04	5.64657E-08	1916.45	1.9164	-0.824	-0.831
Pre-Irradiation	**AW1-01**	25.378	25.377	25.381	25.378	12.732	12.736	12.733	12.722	12.733	12.733	12.732	12.730	3.160	3.157	3.175	3.170	5.8614	2.538E-02	1.273E-02	1.273E-04	5.1973E-08	1843.91	1.8439		
Post-Irradiation		24.740	24.749	24.760	24.747	12.632	12.620	12.615	12.624	12.628	12.623	12.624	12.635	3.274	3.274	3.270	3.274	5.85945	2.475E-02	1.263E-02	1.252E-04	5.55672E-08	1925.74	1.9257	-2.481	-0.834
Pre-Irradiation	**AW1-02**	25.373	25.375	25.372	25.372	12.736	12.742	12.742	12.737	12.737	12.744	12.742	12.738	3.180	3.180	3.167	3.162	5.9043	2.537E-02	1.274E-02	1.275E-04	5.22027E-08	1855.47	1.8555		
Post-Irradiation		24.827	24.825	24.830	24.827	12.653	12.652	12.652	12.645	12.650	12.650	12.648	12.640	3.274	3.275	3.266	3.274	5.90304	2.483E-02	1.265E-02	1.257E-04	5.55456E-08	1926.47	1.9265	-2.151	-0.714
Pre-Irradiation	**AW1-03**	25.372	25.372	25.363	25.368	12.747	12.743	12.739	12.738	12.743	12.738	12.739	12.738	3.170	3.167	3.172	3.167	5.9168	2.537E-02	1.274E-02	1.275E-04	5.20979E-08	1859.32	1.8593		
Post-Irradiation		25.055	25.061	25.064	25.063	12.711	12.701	12.704	12.712	12.704	12.705	12.709	12.705	3.261	3.269	3.269	3.269	5.91571	2.506E-02	1.271E-02	1.268E-04	5.53625E-08	1894.57	1.8946	-1.215	-0.270
Pre-Irradiation	**AW2-01**	25.377	25.378	25.373	25.373	12.742	12.742	12.736	12.734	12.742	12.739	12.738	12.741	3.170	3.165	3.175	3.170	5.9366	2.538E-02	1.274E-02	1.275E-04	5.21188E-08	1865.53	1.8655		
Post-Irradiation		25.107	25.104	25.106	25.110	12.584	12.586	12.596	12.597	12.587	12.593	12.590	12.589	3.298	3.298	3.316	3.308	5.93583	2.511E-02	1.259E-02	1.245E-04	5.66616E-08	1934.09	1.9341	-1.059	-1.169
Pre-Irradiation	**AW2-02**	25.377	25.377	25.377	25.375	12.738	12.738	12.734	12.734	12.738	12.736	12.733	12.732	3.188	3.185	3.183	3.180	5.9269	2.538E-02	1.274E-02	1.274E-04	5.25792E-08	1863.81	1.8638		
Post-Irradiation		25.120	25.110	25.119	25.122	12.596	12.599	12.597	12.601	12.594	12.598	12.602	12.606	3.293	3.296	3.280	3.274	5.92573	2.512E-02	1.260E-02	1.247E-04	5.59996E-08	1926.75	1.9268	-1.020	-1.070
Pre-Irradiation	**AW2-03**	25.375	25.377	25.375	25.373	12.723	12.720	12.727	12.723	12.724	12.720	12.722	12.723	3.170	3.167	3.200	3.198	5.9217	2.537E-02	1.272E-02	1.271E-04	5.25804E-08	1866.08	1.8661		
Post-Irradiation		25.250	25.249	25.252	25.251	12.661	12.663	12.664	12.665	12.665	12.665	12.664	12.673	3.260	3.246	3.268	3.268	5.92098	2.525E-02	1.267E-02	1.260E-04	5.5137E-08	1894.16	1.8942	-0.490	-0.454
Pre-Irradiation	**AW4-01**	25.375	25.373	25.375	25.375	12.741	12.737	12.738	12.733	12.738	12.738	12.742	12.738	3.175	3.172	3.180	3.178	5.9331	2.537E-02	1.274E-02	1.274E-04	5.23279E-08	1864.98	1.8650		
Post-Irradiation		24.827	24.828	24.837	24.822	12.673	12.671	12.669	12.671	12.672	12.671	12.670	12.674	3.239	3.275	3.287	3.285	5.93195	2.483E-02	1.267E-02	1.261E-04	5.55135E-08	1928.76	1.9288	-2.151	-0.524
Pre-Irradiation	**AW4-02**	25.372	25.372	25.372	25.373	12.736	12.736	12.737	12.733	12.742	12.738	12.738	12.737	3.178	3.172	3.180	3.178	5.9364	2.537E-02	1.274E-02	1.274E-04	5.23488E-08	1866.50	1.8665		
Post-Irradiation		25.029	25.030	25.028	25.030	12.716	12.707	12.709	12.713	12.716	12.716	12.713	12.718	3.255	3.246	3.264	3.270	5.93533	2.503E-02	1.271E-02	1.269E-04	5.50834E-08	1900.95	1.9010	-1.352	-0.184
Pre-Irradiation	**AW4-03**	25.385	25.385	25.383	25.385	12.747	12.746	12.742	12.738	12.746	12.746	12.744	12.739	3.170	3.165	3.165	3.165	5.9319	2.538E-02	1.274E-02	1.275E-04	5.19936E-08	1862.04	1.8620		
Post-Irradiation		25.161	25.164	25.164	25.163	12.623	12.632	12.634	12.639	12.623	12.634	12.632	12.639	3.306	3.301	3.298	3.308	5.93021	2.516E-02	1.263E-02	1.253E-04	5.6596E-08	1914.86	1.9149	-0.872	-0.875
Pre-Irradiation	**AW5-01**	25.373	25.375	25.375	25.373	12.739	12.741	12.741	12.746	12.739	12.739	12.737	12.748	3.170	3.170	3.167	3.172	5.9411	2.537E-02	1.274E-02	1.275E-04	5.21188E-08	1866.44	1.8664		
Post-Irradiation		25.259	25.261	25.261	25.256	12.683	12.686	12.685	12.685	12.684	12.686	12.685	12.685	3.279	3.293	3.283	3.285	5.93993	2.526E-02	1.268E-02	1.264E-04	5.59775E-08	1894.00	1.8940	-0.452	-0.443
Pre-Irradiation	**AW5-02**	25.375	25.371	25.373	25.381	12.725	12.720	12.725	12.743	12.724	12.722	12.729	12.743	3.175	3.170	3.175	3.172	5.9287	2.537E-02	1.273E-02	1.273E-04	5.22233E-08	1866.18	1.8662		
Post-Irradiation		24.991	24.990	24.980	24.982	12.729	12.723	12.706	12.708	12.738	12.726	12.708	12.713	3.260	3.265	3.265	3.274	5.92798	2.499E-02	1.272E-02	1.271E-04	5.53303E-08	1900.47	1.9005	-1.534	-0.080
Pre-Irradiation	**AW5-03**	25.375	25.378	25.377	25.375	12.732	12.730	12.736	12.743	12.732	12.732	12.737	12.741	3.170	3.170	3.170	3.162	5.9198	2.538E-02	1.274E-02	1.274E-04	5.20562E-08	1861.34	1.8613		
Post-Irradiation		25.142	25.143	25.147	25.138	12.609	12.611	12.610	12.607	12.612	12.610	12.604	12.604	3.282	3.303	3.260	3.265	5.91835	2.514E-02	1.261E-02	1.249E-04	5.57191E-08	1919.38	1.9194	-0.921	-0.996
Pre-Irradiation	**AW6-01**	25.377	25.381	25.375	25.376	12.737	12.741	12.741	12.748	12.737	12.734	12.739	12.746	3.178	3.172	3.185	3.183	5.9383	2.538E-02	1.274E-02	1.275E-04	5.24326E-08	1865.80	1.8658		
Post-Irradiation		25.269	25.268	25.265	25.263	12.687	12.686	12.686	12.680	12.690	12.689	12.686	12.689	3.264	3.274	3.283	3.274	5.93716	2.527E-02	1.269E-02	1.264E-04	5.55888E-08	1891.82	1.8918	-0.437	-0.421
Pre-Irradiation	**AW6-02**	25.378	25.376	25.378	25.378	12.730	12.738	12.734	12.741	12.730	12.733	12.737	12.738	3.200	3.198	3.185	3.183	5.9258	2.538E-02	1.274E-02	1.274E-04	5.28315E-08	1863.56	1.8636		
Post-Irradiation		24.920	24.918	24.914	24.918	12.689	12.679	12.673	12.676	12.688	12.680	12.676	12.678	3.260	3.265	3.265	3.260	5.92491	2.492E-02	1.268E-02	1.263E-04	5.5212E-08	1916.66	1.9167	-1.814	-0.435
Pre-Irradiation	**AW6-03**	25.382	25.381	25.387	25.382	12.723	12.729	12.730	12.734	12.728	12.729	12.729	12.736	3.190	3.185	3.190	3.190	5.9126	2.538E-02	1.273E-02	1.273E-04	5.27471E-08	1860.57	1.8606		
Post-Irradiation		25.097	25.100	25.101	25.101	12.716	12.706	12.698	12.698	12.715	12.702	12.700	12.694	3.249	3.254	3.249	3.255	5.91163	2.510E-02	1.270E-02	1.267E-04	5.48365E-08	1890.79	1.8908	-1.117	-0.206
Pre-Irradiation	**AW7-01**	25.375	25.375	25.370	25.370	12.743	12.739	12.737	12.734	12.744	12.739	12.737	12.736	3.170	3.167	3.183	3.180	5.9322	2.537E-02	1.274E-02	1.275E-04	5.22862E-08	1864.64	1.8646		
Post-Irradiation		25.173	25.179	25.178	25.180	12.631	12.637	12.639	12.644	12.632	12.637	12.638	12.645	3.293	3.288	3.298	3.294	5.93151	2.518E-02	1.264E-02	1.254E-04	5.62593E-08	1912.14	1.9121	-0.767	-0.792
Pre-Irradiation	**AW7-03**	25.377	25.377	25.375	25.376	12.744	12.741	12.738	12.728	12.739	12.738	12.736	12.733	3.165	3.162	3.193	3.195	5.9369	2.538E-02	1.274E-02	1.274E-04	5.24128E-08	1866.36	1.8664		
Post-Irradiation		24.690	24.697	24.681	24.681	12.682	12.686	12.686	12.704	12.681	12.686	12.687	12.680	3.280	3.259	3.293	3.297	5.91989	2.469E-02	1.269E-02	1.264E-04	5.58808E-08	1931.58	1.9316	-2.715	-0.398
Pre-Irradiation	**AW9-01**	25.378	25.377	25.376	25.380	12.725	12.729	12.730	12.734	12.728	12.728	12.733	12.738	3.162	3.160	3.172	3.172	5.9210	2.538E-02	1.273E-02	1.273E-04	5.20146E-08	1862.90	1.8629		
Post-Irradiation		24.740	24.751	24.751	24.749	12.699	12.678	12.677	12.675	12.691	12.680	12.671	12.660	3.296	3.296	3.321	3.322	5.93087	2.475E-02	1.268E-02	1.263E-04	5.6782E-08	1933.28	1.9333	-2.483	-0.408
Pre-Irradiation	**AW9-03**	25.377	25.376	25.377	25.375	12.733	12.738	12.739	12.742	12.730	12.733	12.737	12.743	3.170	3.167	3.185	3.183	5.9321	2.538E-02	1.274E-02	1.274E-04	5.23281E-08	1864.85	1.8648		
Post-Irradiation		25.103	25.100	25.094	25.101	12.585	12.583	12.584	12.576	12.585	12.582	12.580	12.571	3.298	3.293	3.298	3.298	5.92697	2.510E-02	1.258E-02	1.243E-04	5.63787E-08	1934.56	1.9346	-1.090	-1.227
Pre-Irradiation	**AW10-01**	25.376	25.382	25.382	25.378	12.724	12.725	12.728	12.736	12.727	12.725	12.730	12.737	3.175	3.175	3.178	3.175	5.9287	2.538E-02	1.273E-02	1.273E-04	5.23069E-08	1865.87	1.8659		
Post-Irradiation		25.121	25.123	25.126	25.125	12.596	12.598	12.588	12.591	12.596	12.596	12.586	12.583	3.231	3.259	3.274	3.279	5.93569	2.512E-02	1.259E-02	1.245E-04	5.51483E-08	1931.29	1.9313	-1.008	-1.079
Pre-Irradiation	**AW10-02**	25.377	25.376	25.375	25.376	12.734	12.738	12.738	12.746	12.738	12.739	12.739	12.746	3.193	3.185	3.167	3.162	5.9365	2.538E-02	1.274E-02	1.275E-04	5.23495E-08	1865.42	1.8654		
Post-Irradiation		24.597	24.597	24.610	24.599	12.693	12.684	12.678	12.686	12.698	12.682	12.678	12.680	3.268	3.264	3.245	3.249	5.9355	2.460E-02	1.268E-02	1.264E-04	5.49978E-08	1943.56	1.9436	-3.055	-0.431
Pre-Irradiation	**AW10-03**	25.373	25.372	25.377	25.375	12.736	12.732	12.733	12.739	12.733	12.734	12.734	12.739	3.167	3.165	3.183	3.180	5.9260	2.537E-02	1.274E-02	1.274E-04	5.22445E-08	1863.59	1.8636		
Post-Irradiation		24.643	24.643	24.645	24.646	12.692	12.681	12.676	12.675	12.693	12.676	12.675	12.678	3.260	3.260	3.260	3.272	5.92511	2.464E-02	1.268E-02	1.263E-04	5.52227E-08	1938.09	1.9381	-2.877	-0.427
Pre-Irradiation	**AW12-01**	25.357	25.353	25.354	25.356	12.743	12.737	12.737	12.736	12.746	12.741	12.741	12.734	3.165	3.162	3.183	3.178	5.9283	2.535E-02	1.274E-02	1.275E-04	5.21818E-08	1864.50	1.8645		
Post-Irradiation		24.963	24.966	24.962	24.955	12.729	12.727	12.728	12.732	12.729	12.723	12.720	12.730	3.293	3.293	3.298	3.296	5.92711	2.496E-02	1.273E-02	1.272E-04	5.63135E-08	1900.13	1.9001	-1.552	-0.094
Pre-Irradiation	**AW12-03**	25.352	25.352	25.353	25.352	12.733	12.725	12.725	12.729	12.733	12.724	12.723	12.725	3.165	3.162	3.167	3.162	5.9277	2.535E-02	1.273E-02	1.272E-04	5.1931E-08	1867.92	1.8679		
Post-Irradiation		25.102	25.100	25.104	25.103	12.588	12.599	12.594	12.601	12.601	12.594	12.596	12.601	3.274	3.273	3.239	3.250	5.92652	2.510E-02	1.260E-02	1.246E-04	5.50842E-08	1928.39	1.9284	-0.985	-1.026
Pre-Irradiation	**AW13-01**	25.376	25.372	25.370	25.371	12.741	12.727	12.730	12.728	12.741	12.728	12.727	12.728	3.165	3.165	3.178	3.175	5.9277	2.537E-02	1.273E-02	1.273E-04	5.21399E-08	1865.41	1.8654		
Post-Irradiation		25.250	25.252	25.258	25.256	12.676	12.683	12.679	12.696	12.671	12.684	12.681	12.694	3.269	3.269	3.289	3.288	5.92154	2.525E-02	1.268E-02	1.263E-04	5.57619E-08	1888.98	1.8890	-0.465	-0.378
Pre-Irradiation	**AW13-02**	25.364	25.370	25.366	25.367	12.734	12.733	12.738	12.738	12.730	12.733	12.737	12.741	3.188	3.190	3.198	3.190	5.9269	2.537E-02	1.274E-02	1.274E-04	5.28312E-08	1864.65	1.8646		
Post-Irradiation		24.660	24.664	24.661	24.668	12.698	12.690	12.695	12.700	12.700	12.690	12.696	12.699	3.233	3.258	3.241	3.252	5.92546	2.466E-02	1.270E-02	1.266E-04	5.46542E-08	1931.60	1.9316	-2.773	-0.311

Table 46 Dimensions, Mass, Density and Dimensional Change for Grade NBG-18

	Specimen	Thickness Measurements, mm.				Outside Diameter Measurements,mm.								Hole Diameter ,mm.				Weight	Thickness	Diameter	Cross-section	2- hole Volume	Density	Density	Dimensioal Change, %	
	Number	T1	T2	T3	T4	D1	D2	D3	D4	$D1^{90}$	$D2^{90}$	$D3^{90}$	$D4^{90}$	H1	H2	H1'	H2'	g	m	m	m^2	m^3	kg/m^3	g/cm^3	$\Delta L/L_0$ (%)	$\Delta D/D_0$ (%)
																									$\Delta DIM = IRR-UNIRR$	
Pre-Irradiation	**BL6-02**	25.372	25.367	25.368	25.371	12.741	12.738	12.737	12.728	12.743	12.736	12.736	12.728	3.241	3.244	3.239	3.239	5.9668	2.537E-02	1.274E-02	1.274E-04	5.44624E-08	1877.90	1.8779		
Post-Irradiation		25.053	25.063	25.067	25.061	12.563	12.570	12.572	12.578	12.573	12.573	12.573	12.578	3.293	3.293	3.298	3.301	5.96582	2.506E-02	1.257E-02	1.241E-04	5.6357E-08	1952.88	1.9529	-1.216	-1.282
Pre-Irradiation	**BL6-03**	25.370	25.375	25.372	25.373	12.741	12.739	12.739	12.741	12.741	12.739	12.738	12.742	3.239	3.241	3.239	3.239	5.9625	2.537E-02	1.274E-02	1.275E-04	5.44197E-08	1875.02	1.8750		
Post-Irradiation		24.535	24.536	24.540	24.541	12.710	12.699	12.698	12.701	12.708	12.698	12.694	12.703	3.274	3.266	3.247	3.247	5.96165	2.454E-02	1.270E-02	1.267E-04	5.50838E-08	1952.08	1.9521	-3.289	-0.303
Pre-Irradiation	**BL7-01**	25.368	25.368	25.367	25.366	12.743	12.738	12.738	12.741	12.743	12.742	12.739	12.742	3.241	3.246	3.246	3.249	5.9751	2.537E-02	1.274E-02	1.275E-04	5.46333E-08	1879.26	1.8793		
Post-Irradiation		24.946	24.966	24.947	24.950	12.732	12.720	12.718	12.723	12.737	12.725	12.722	12.713	3.264	3.264	3.246	3.246	5.97459	2.495E-02	1.272E-02	1.272E-04	5.49548E-08	1916.31	1.9163	-1.636	-0.134
Pre-Irradiation	**BL7-02**	25.363	25.364	25.366	25.368	12.734	12.742	12.741	12.738	12.738	12.736	12.741	12.734	3.244	3.241	3.246	3.246	5.9591	2.537E-02	1.274E-02	1.274E-04	5.45905E-08	1875.20	1.8752		
Post-Irradiation		25.218	25.218	25.219	25.219	12.665	12.670	12.675	12.672	12.670	12.676	12.674	12.669	3.294	3.293	3.269	3.246	5.95809	2.522E-02	1.267E-02	1.261E-04	5.56548E-08	1906.85	1.9069	-0.579	-0.523
Pre-Irradiation	**BW1-01**	25.372	25.371	25.376	25.376	12.741	12.741	12.738	12.733	12.737	12.741	12.738	12.737	3.244	3.241	3.244	3.244	5.9653	2.537E-02	1.274E-02	1.274E-04	5.45478E-08	1876.45	1.8765		
Post-Irradiation		24.721	24.725	24.724	24.727	12.645	12.641	12.642	12.644	12.639	12.636	12.643	12.649	3.294	3.288	3.258	3.288	5.96433	2.472E-02	1.264E-02	1.255E-04	5.58693E-08	1956.95	1.9569	-2.559	-0.751
Pre-Irradiation	**BW1-02**	25.372	25.364	25.367	25.372	12.737	12.739	12.744	12.743	12.742	12.742	12.746	12.746	3.228	3.228	3.233	3.233	5.9715	2.537E-02	1.274E-02	1.275E-04	5.41427E-08	1877.24	1.8772		
Post-Irradiation		25.222	25.222	25.221	25.221	12.676	12.675	12.674	12.675	12.673	12.677	12.676	12.674	3.269	3.255	3.255	3.263	5.97086	2.522E-02	1.268E-02	1.262E-04	5.51367E-08	1909.28	1.9093	-0.581	-0.529
Pre-Irradiation	**BW1-03**	25.367	25.368	25.373	25.367	12.728	12.732	12.734	12.737	12.729	12.733	12.737	12.734	3.236	3.233	3.246	3.249	5.9608	2.537E-02	1.273E-02	1.273E-04	5.44839E-08	1876.88	1.8769		
Post-Irradiation		25.068	25.064	25.060	25.061	12.583	12.575	12.571	12.570	12.582	12.576	12.573	12.571	3.298	3.289	3.291	3.294	5.95953	2.506E-02	1.258E-02	1.242E-04	5.62484E-08	1949.75	1.9497	-1.205	-1.240
Pre-Irradiation	**BW2-01**	25.371	25.364	25.363	25.363	12.742	12.742	12.741	12.738	12.743	12.739	12.742	12.741	3.239	3.239	3.239	3.239	5.9707	2.537E-02	1.274E-02	1.275E-04	5.43984E-08	1877.83	1.8778		
Post-Irradiation		24.611	24.630	24.631	24.614	12.669	12.654	12.654	12.660	12.672	12.659	12.656	12.662	3.254	3.266	3.275	3.265	5.96975	2.462E-02	1.266E-02	1.259E-04	5.5298E-08	1960.87	1.9609	-2.933	-0.630
Pre-Irradiation	**BW2-02**	25.368	25.368	25.363	25.366	12.746	12.744	12.744	12.737	12.744	12.742	12.743	12.736	3.244	3.244	3.244	3.246	5.9706	2.537E-02	1.274E-02	1.275E-04	5.45905E-08	1877.51	1.8775		
Post-Irradiation		24.761	24.769	24.764	24.770	12.662	12.662	12.660	12.664	12.666	12.662	12.661	12.660	3.261	3.277	3.274	3.274	5.97009	2.477E-02	1.266E-02	1.259E-04	5.55132E-08	1949.04	1.9490	-2.367	-0.627
Pre-Irradiation	**BW2-03**	25.362	25.370	25.359	25.364	12.730	12.733	12.734	12.732	12.730	12.732	12.736	12.732	3.241	3.244	3.244	3.241	5.9744	2.536E-02	1.273E-02	1.273E-04	5.45264E-08	1881.76	1.8818		
Post-Irradiation		25.058	25.056	25.052	25.056	12.557	12.567	12.566	12.563	12.558	12.564	12.561	12.563	3.298	3.293	3.288	3.298	5.97338	2.506E-02	1.256E-02	1.239E-04	5.62918E-08	1958.97	1.9590	-1.216	-1.335
Pre-Irradiation	**BW3-01**	25.367	25.364	25.367	25.366	12.746	12.743	12.741	12.739	12.743	12.742	12.741	12.739	3.244	3.246	3.241	3.241	5.9657	2.537E-02	1.274E-02	1.275E-04	5.45478E-08	1876.06	1.8761		
Post-Irradiation		25.115	25.116	25.117	25.111	12.609	12.608	12.613	12.614	12.616	12.610	12.614	12.614	3.293	3.287	3.298	3.293	5.96511	2.511E-02	1.261E-02	1.249E-04	5.62376E-08	1935.83	1.9358	-0.991	-1.016
Pre-Irradiation	**BW3-02**	25.378	25.376	25.380	25.381	12.728	12.729	12.730	12.732	12.727	12.728	12.729	12.733	3.241	3.246	3.239	3.241	5.9512	2.538E-02	1.273E-02	1.273E-04	5.45051E-08	1874.18	1.8742		
Post-Irradiation		24.791	24.793	24.789	24.796	12.631	12.624	12.622	12.617	12.634	12.629	12.621	12.624	3.291	3.270	3.282	3.274	5.95069	2.479E-02	1.263E-02	1.252E-04	5.57719E-08	1952.34	1.9523	-2.311	-0.819
Pre-Irradiation	**BW3-03**	25.364	25.371	25.368	25.368	12.734	12.742	12.741	12.746	12.733	12.743	12.742	12.748	3.251	3.251	3.241	3.241	5.9714	2.537E-02	1.274E-02	1.275E-04	5.46548E-08	1877.96	1.8780		
Post-Irradiation		24.639	24.641	24.638	24.633	12.689	12.687	12.684	12.702	12.689	12.688	12.680	12.699	3.260	3.269	3.260	3.268	5.97072	2.464E-02	1.269E-02	1.265E-04	5.52657E-08	1950.74	1.9507	-2.878	-0.403
Pre-Irradiation	**BW5-01**	25.366	25.363	25.362	25.364	12.738	12.741	12.739	12.730	12.739	12.741	12.742	12.730	3.246	3.249	3.246	3.249	5.9693	2.536E-02	1.274E-02	1.274E-04	5.46974E-08	1878.68	1.8787		
Post-Irradiation		24.723	24.724	24.731	24.745	12.691	12.685	12.690	12.696	12.699	12.690	12.691	12.700	3.260	3.272	3.260	3.268	5.96794	2.473E-02	1.269E-02	1.265E-04	5.52871E-08	1941.45	1.9415	-2.496	-0.352
Pre-Irradiation	**BW5-02**	25.370	25.368	25.364	25.372	12.744	12.741	12.741	12.738	12.741	12.739	12.737	12.737	3.236	3.236	3.239	3.239	5.9594	2.537E-02	1.274E-02	1.275E-04	5.43557E-08	1874.39	1.8744		
Post-Irradiation		25.076	25.083	25.086	25.087	12.587	12.587	12.593	12.593	12.588	12.589	12.595	12.594	3.293	3.287	3.284	3.280	5.95867	2.508E-02	1.259E-02	1.245E-04	5.60101E-08	1942.83	1.9428	-1.126	-1.169
Pre-Irradiation	**BW5-03**	25.364	25.362	25.368	25.367	12.739	12.738	12.741	12.737	12.739	12.739	12.738	12.737	3.241	3.244	3.239	3.241	5.9704	2.537E-02	1.274E-02	1.274E-04	5.44837E-08	1878.50	1.8785		
Post-Irradiation		25.100	25.100	25.097	25.094	12.587	12.595	12.598	12.593	12.589	12.591	12.594	12.597	3.274	3.293	3.287	3.293	5.96579	2.510E-02	1.259E-02	1.246E-04	5.60315E-08	1943.30	1.9433	-1.055	-1.143
Pre-Irradiation	**BW7-01**	25.371	25.370	25.366	25.370	12.739	12.737	12.738	12.737	12.739	12.738	12.738	12.737	3.246	3.246	3.228	3.228	5.9624	2.537E-02	1.274E-02	1.274E-04	5.43561E-08	1875.83	1.8758		
Post-Irradiation		25.153	25.153	25.153	25.152	12.618	12.622	12.622	12.628	12.623	12.624	12.624	12.629	3.266	3.268	3.293	3.293	5.96184	2.515E-02	1.262E-02	1.252E-04	5.58055E-08	1927.95	1.9279	-0.852	-0.897
Pre-Irradiation	**BW7-02**	25.375	25.375	25.375	25.373	12.738	12.738	12.741	12.741	12.739	12.738	12.739	12.741	3.246	3.246	3.233	3.236	5.9578	2.537E-02	1.274E-02	1.275E-04	5.46625E-08	1873.62	1.8736		
Post-Irradiation		24.784	24.787	24.790	24.790	12.668	12.658	12.663	12.658	12.670	12.668	12.662	12.669	3.255	3.246	3.269	3.265	5.95707	2.479E-02	1.266E-02	1.260E-04	5.50834E-08	1942.04	1.9420	-2.312	-0.588
Pre-Irradiation	**BW7-03**	25.366	25.366	25.362	25.364	12.732	12.734	12.727	12.744	12.730	12.729	12.727	12.739	3.244	3.244	3.244	3.244	5.9619	2.536E-02	1.273E-02	1.273E-04	5.45692E-08	1877.66	1.8777		
Post-Irradiation		25.061	25.063	25.069	25.068	12.717	12.712	12.704	12.698	12.718	12.707	12.702	12.689	3.255	3.261	3.272	3.265	5.96118	2.507E-02	1.271E-02	1.268E-04	5.52336E-08	1908.86	1.9089	-1.180	-0.212
Pre-Irradiation	**BW8-01**	25.381	25.380	25.383	25.385	12.742	12.738	12.736	12.737	12.739	12.736	12.736	12.738	3.246	3.246	3.244	3.246	5.9639	2.538E-02	1.274E-02	1.274E-04	5.46333E-08	1875.56	1.8756		
Post-Irradiation		25.097	25.102	25.096	25.101	12.590	12.586	12.592	12.593	12.590	12.589	12.595	12.590	3.291	3.292	3.288	3.292	5.96327	2.510E-02	1.259E-02	1.245E-04	5.61617E-08	1943.21	1.9432	-1.116	-1.154
Pre-Irradiation	**BW8-02**	25.378	25.372	25.371	25.376	12.736	12.739	12.737	12.732	12.736	12.741	12.738	12.733	3.244	3.246	3.244	3.244	5.9649	2.537E-02	1.274E-02	1.274E-04	5.45905E-08	1876.83	1.8768		
Post-Irradiation		25.159	25.181	25.191	25.174	12.623	12.630	12.634	12.632	12.629	12.623	12.641	12.631	3.284	3.280	3.292	3.289	5.96354	2.518E-02	1.263E-02	1.253E-04	5.6021E-08	1924.74	1.9247	-0.780	-0.832
Pre-Irradiation	**BW9-01**	25.373	25.380	25.381	25.380	12.738	12.742	12.729	12.733	12.739	12.741	12.727	12.732	3.249	3.251	3.228	3.228	5.9733	2.538E-02	1.274E-02	1.274E-04	5.44203E-08	1879.44	1.8794		
Post-Irradiation		24.715	24.728	24.718	24.728	12.704	12.685	12.687	12.697	12.693	12.689	12.693	12.689	3.246	3.242	3.264	3.272	5.97195	2.472E-02	1.269E-02	1.265E-04	5.49873E-08	1943.44	1.9434	-2.586	-0.337
Pre-Irradiation	**BW9-02**	25.368	25.361	25.367	25.372	12.725	12.722	12.729	12.728	12.730	12.720	12.730	12.728	3.241	3.241	3.241	3.241	5.9530	2.537E-02	1.273E-02	1.272E-04	5.44837E-08	1876.47	1.8765		
Post-Irradiation		24.791	24.789	24.790	24.784	12.690	12.684	12.677	12.680	12.689	12.684	12.676	12.681	3.269	3.265	3.259	3.259	5.95168	2.479E-02	1.268E-02	1.263E-04	5.52228E-08	1934.67	1.9347	-2.280	-0.346
Pre-Irradiation	**BW9-03**	25.376	25.377	25.383	25.381	12.725	12.725	12.730	12.723	12.723	12.727	12.727	12.725	3.241	3.241	3.233	3.236	5.9693	2.538E-02	1.273E-02	1.272E-04	5.43771E-08	1880.90	1.8809		
Post-Irradiation		25.008	25.013	25.015	25.018	12.713	12.700	12.701	12.698	12.711	12.706	12.700	12.701	3.242	3.242	3.260	3.266	5.96865	2.501E-02	1.270E-02	1.268E-04	5.48799E-08	1915.71	1.9157	-1.442	-0.173
Pre-Irradiation	**BW10-01**	25.382	25.376	25.378	25.382	12.742	12.741	12.741	12.742	12.741	12.739	12.738	12.742	3.244	3.244	3.244	3.246	5.9741	2.538E-02	1.274E-02	1.275E-04	5.45905E-08	1878.03	1.8780		
Post-Irradiation		25.098	25.102	25.100	25.103	12.597	12.598	12.602	12.604	12.600	12.598	12.594	12.601	3.292	3.285	3.280	3.269	5.97249	2.510E-02	1.260E-02	1.247E-04	5.58588E-08	1943.17	1.9432	-1.099	-1.110
Pre-Irradiation	**BW10-02**	25.375	25.373	25.377	25.377	12.737	12.718	12.727	12.736	12.737	12.715	12.727	12.736	3.246	3.246	3.236	3.236	5.9621	2.538E-02	1.273E-02	1.273E-04	5.44839E-08	1878.03	1.8780		
Post-Irradiation		25.144	25.145	25.140	25.146	12.624	12.619	12.629	12.630	12.619	12.619	12.629	12.631	3.279	3.275	3.293	3.296	5.96113	2.514E-02	1.263E-02	1.252E-04	5.59996E-08	1928.15	1.9282	-0.913	-0.816
Pre-Irradiation	**BW10-03**	25.377	25.373	25.377	25.377	12.737	12.729	12.734	12.739	12.733	12.728	12.734	12.738	3.244	3.244	3.236	3.236	5.9708	2.538E-02	1.273E-02	1.274E-04	5.44411E-08	1879.12	1.8791		
Post-Irradiation		24.560	24.565	24.578	24.564	12.700	12.680	12.678	12.683	12.704	12.681	12.685	12.691	3.246	3.260	3.265	3.259	5.96974	2.457E-02	1.269E-02	1.264E-04	5.50402E-08	1956.65	1.9566	-3.190	-0.364
Pre-Irradiation	**BW11-01**	25.373	25.371	25.375	25.373	12.739	12.742	12.738	12.739	12.738	12.741	12.738	12.742	3.246	3.246	3.239	3.239	5.9612	2.537E-02	1.274E-02	1.275E-04	5.45265E-08	1874.72	1.8747		
Post-Irradiation		24.647	24.647	24.652	24.654	12.590	12.591	12.594	12.592	12.698	12.684	12.682	12.682	3.265	3.259	3.256	3.259	5.96049	2.465E-02	1.264E-02	1.255E-04	5.51153E-08	1962.26	1.9623	-2.850	-0.789
Pre-Irradiation	**BW11-02**	25.373	25.370	25.377	25.376	12.736	12.739	12.744	12.733	12.736	12.737	12.746	12.733	3.231	3.226	3.241	3.241	5.9666	2.537E-02	1.274E-02	1.274E-04	5.42706E-08	1876.72	1.8767		
Post-Irradiation		25.235	25.235	25.234	25.238	12.669	12.677	12.673	12.673	12.670	12.676	12.674	12.670	3.269	3.274	3.258	3.256	5.96569	2.524E-02	1.267E-02	1.261E-04	5.5266E-08	1907.32	1.9073	-0.546	-0.512
Pre-Irradiation	**BW12-01**	25.372	25.368	25.371	25.372	12.737	12.743	12.742	12.736	12.738	12.741	12.741	12.738	3.241	3.241	3.241	3.241	5.9644	2.537E-02	1.274E-02	1.275E-04	5.44837E-08	1875.97	1.8760		
Post-Irradiation		25.108	25.107	25.103	25.105	12.598	12.606	12.604	12.606	12.600	12.608	12.610	12.602	3.298	3.298	3.299	3.289	5.96324	2.511E-02	1.260E-02	1.248E-04	5.63569E-08	1938.51	1.9385	-1.045	-1.061
Pre-Irradiation	**BW12-02**	25.377	25.375	25.377	25.380	12.738	12.739	12.742	12.742	12.739	12.738	12.742	12.741	3.246	3.246	3.236	3.236	5.9721	2.538E-02	1.274E-02	1.275E-04	5.44839E-08	1877.67	1.8777		
Post-Irradiation		25.045	25.050	25.050	25.048	12.708	12.705	12.707	12.700	12.712	12.711	12.703	12.703	3.259	3.261	3.254	3.259	5.97036	2.505E-02	1.271E-02	1.268E-04	5.50617E-08	1912.94	1.9129	-1.296	-0.267
Pre-Irradiation	**BW12-03**	25.359	25.358	25.363	25.364	12.748	12.742	12.746	12.744	12.751	12.746	12.747	12.743	3.228	3.228	3.231	3.231	5.9791	2.536E-02	1.275E-02	1.276E-04	5.41001E-08	1879.13	1.8791		
Post-Irradiation		24.587	24.852	24.857	24.854	12.700	12.686	12.684	12.686	12.697	12.695	12.684	12.685	3.245	3.249	3.264	3.249	5.97738	2.479E-02	1.269E-02	1.265E-04	5.48365E-08	1940.68	1.9407	-2.262	-0.441

Table 47 Dimensions, Mass, Density and Dimensional Change for Grade H-451

	Specimen	Thickness Measurements, mm.				Outside Diameter Measurements,mm.								Hole Diameter ,mm.				Weight	Thickness	Diameter	Cross-section	2- hole Volume	Density	Density	Dimensioal Change, %	
	Number	T1	T2	T3	T4	D1	D2	D3	D4	$D1^{90}$	$D2^{90}$	$D3^{90}$	$D4^{90}$	H1	H2	H1'	H2'	g	m	m	m^2	m^3	kg/m^3	g/cm^3	$\Delta L/L_0$(%)	$\Delta D/D_0$(%)
																									ΔDIM = IRR-UNIRR	
Pre-Irradiation	**CW7-01**	25.348	25.373	25.361	25.339	12.713	12.709	12.709	12.711	12.718	12.717	12.717	12.713	3.251	3.251	3.256	3.259	5.4271	2.536E-02	1.271E-02	1.269E-04	5.4933E-08	1715.45	1.7154		
Post-Irradiation		24.398	24.409	24.410	24.433	12.630	12.632	12.631	12.630	12.629	12.631	12.646	12.634	3.274	3.283	3.298	3.277	5.42503	2.441E-02	1.263E-02	1.253E-04	5.59016E-08	1805.94	1.8059	-3.718	-0.632
Pre-Irradiation	**CW7-03**	25.361	25.358	25.363	25.366	12.718	12.725	12.720	12.718	12.719	12.727	12.723	12.725	3.244	3.244	3.236	3.233	5.4328	2.536E-02	1.272E-02	1.271E-04	5.44198E-08	1714.12	1.7141		
Post-Irradiation		24.704	24.692	24.718	24.715	12.669	12.658	12.666	12.654	12.648	12.657	12.660	12.651	3.236	3.250	3.261	3.268	5.4316	2.471E-02	1.266E-02	1.258E-04	5.4912E-08	1778.40	1.7784	-2.581	-0.503
Pre-Irradiation	**CW8-02**	25.361	25.368	25.340	25.367	12.719	12.725	12.722	12.711	12.715	12.724	12.718	12.722	3.251	3.249	3.256	3.254	5.4300	2.536E-02	1.272E-02	1.271E-04	5.48687E-08	1714.32	1.7143		
Post-Irradiation		24.894	24.899	24.892	24.902	12.557	12.563	12.570	12.559	12.561	12.566	12.565	12.554	3.301	3.293	3.293	3.284	5.42857	2.490E-02	1.256E-02	1.239E-04	5.62376E-08	1791.97	1.7920	-1.823	-1.239
Pre-Irradiation	**CW8-03**	25.344	25.370	25.363	25.362	12.720	12.725	12.723	12.723	12.728	12.728	12.724	12.720	3.251	3.254	3.246	3.246	5.4286	2.536E-02	1.272E-02	1.272E-04	5.47617E-08	1712.56	1.7126		
Post-Irradiation		25.045	25.052	25.050	25.045	12.598	12.609	12.616	12.615	12.605	12.616	12.615	12.623	3.302	3.308	3.289	3.302	5.42704	2.505E-02	1.261E-02	1.249E-04	5.64982E-08	1766.18	1.7662	-1.229	-0.879
Pre-Irradiation	**CW9-01**	25.368	25.367	25.368	25.368	12.700	12.717	12.723	12.727	12.718	12.720	12.720	12.722	3.259	3.261	3.256	3.251	5.4090	2.537E-02	1.272E-02	1.270E-04	5.50188E-08	1707.51	1.7075		
Post-Irradiation		24.354	24.377	24.368	24.361	12.675	12.656	12.660	12.642	12.670	12.662	12.658	12.660	3.266	3.274	3.280	3.274	5.40747	2.437E-02	1.266E-02	1.259E-04	5.55888E-08	1795.50	1.7955	-3.954	-0.455
Pre-Irradiation	**CW9-03**	25.354	25.349	25.354	25.349	12.720	12.732	12.722	12.725	12.717	12.730	12.725	12.720	3.246	3.246	3.254	3.254	5.4137	2.535E-02	1.272E-02	1.272E-04	5.47831E-08	1708.42	1.7084		
Post-Irradiation		24.120	24.118	24.114	24.113	12.714	12.720	12.709	12.714	12.713	12.708	12.708	12.700	3.278	3.283	3.236	3.255	5.41216	2.412E-02	1.271E-02	1.269E-04	5.52241E-08	1801.09	1.8011	-4.873	-0.104
Pre-Irradiation	**CW10-01**	25.366	25.356	25.372	25.363	12.700	12.705	12.711	12.699	12.723	12.719	12.715	12.706	3.254	3.254	3.256	3.259	5.4191	2.536E-02	1.271E-02	1.269E-04	5.49759E-08	1713.25	1.7132		
Post-Irradiation		24.269	24.295	24.283	24.269	12.689	12.677	12.684	12.687	12.697	12.692	12.692	12.710	3.282	3.282	3.260	3.265	5.41762	2.428E-02	1.269E-02	1.265E-04	5.55353E-08	1796.47	1.7965	-4.278	-0.148
Pre-Irradiation	**CW10-02**	25.367	25.359	25.358	25.354	12.713	12.720	12.724	12.720	12.722	12.723	12.724	12.710	3.261	3.261	3.254	3.254	5.4214	2.536E-02	1.272E-02	1.271E-04	5.50403E-08	1711.66	1.7117		
Post-Irradiation		24.909	24.903	24.905	24.912	12.563	12.563	12.556	12.550	12.542	12.556	12.561	12.551	3.320	3.325	3.321	3.324	5.41927	2.491E-02	1.256E-02	1.238E-04	5.72507E-08	1790.66	1.7907	-1.784	-1.292
Pre-Irradiation	**CW10-03**	25.353	25.362	25.358	25.354	12.725	12.724	12.715	12.713	12.725	12.724	12.723	12.710	3.261	3.261	3.259	3.251	5.4368	2.536E-02	1.272E-02	1.271E-04	5.50617E-08	1716.60	1.7166		
Post-Irradiation		24.929	24.931	24.933	24.938	12.558	12.569	12.564	12.563	12.551	12.555	12.559	12.562	3.321	3.298	3.316	3.324	5.43593	2.493E-02	1.256E-02	1.239E-04	5.69882E-08	1792.72	1.7927	-1.672	-1.257
Pre-Irradiation	**CW11-01**	25.357	25.357	25.357	25.368	12.717	12.719	12.720	12.722	12.722	12.715	12.715	12.709	3.246	3.246	3.249	3.254	5.4335	2.536E-02	1.272E-02	1.270E-04	5.47402E-08	1715.93	1.7159		
Post-Irradiation		24.781	24.790	24.790	24.801	12.675	12.676	12.676	12.670	12.665	12.665	12.664	12.663	3.266	3.274	3.261	3.265	5.43215	2.479E-02	1.267E-02	1.261E-04	5.53518E-08	1769.52	1.7695	-2.244	-0.378
Pre-Irradiation	**CW11-02**	25.364	25.354	25.362	25.367	12.727	12.733	12.733	12.729	12.734	12.730	12.729	12.724	3.249	3.249	3.254	3.256	5.4356	2.536E-02	1.273E-02	1.273E-04	5.48473E-08	1713.01	1.7130		
Post-Irradiation		24.798	24.811	24.797	24.791	12.685	12.686	12.684	12.684	12.674	12.679	12.680	12.683	3.278	3.265	3.259	3.269	5.43396	2.480E-02	1.268E-02	1.263E-04	5.5384E-08	1765.90	1.7659	-2.218	-0.378
Pre-Irradiation	**CW12-02**	25.352	25.367	25.359	25.359	12.703	12.713	12.715	12.715	12.695	12.705	12.708	12.708	3.244	3.246	3.256	3.256	5.4069	2.536E-02	1.271E-02	1.268E-04	5.48046E-08	1710.23	1.7102		
Post-Irradiation		24.644	24.650	24.646	24.651	12.682	12.673	12.673	12.674	12.678	12.674	12.665	12.664	3.261	3.256	3.260	3.275	5.40484	2.465E-02	1.267E-02	1.261E-04	5.52334E-08	1769.90	1.7699	-2.806	-0.273
Pre-Irradiation	**CW13-01**	25.359	25.357	25.333	25.354	12.727	12.725	12.713	12.723	12.723	12.723	12.710	12.718	3.259	3.256	3.251	3.251	5.4562	2.535E-02	1.272E-02	1.271E-04	5.4933E-08	1723.03	1.7230		
Post-Irradiation		25.086	25.099	25.098	25.094	12.614	12.620	12.627	12.623	12.617	12.621	12.627	12.628	3.297	3.298	3.285	3.275	5.45485	2.509E-02	1.262E-02	1.251E-04	5.61078E-08	1768.82	1.7688	-1.012	-0.771
Pre-Irradiation	**CW13-02**	25.363	25.361	25.352	25.364	12.718	12.725	12.728	12.728	12.720	12.729	12.727	12.727	3.261	3.261	3.246	3.244	5.4695	2.536E-02	1.273E-02	1.272E-04	5.48905E-08	1725.16	1.7252		
Post-Irradiation		24.344	24.343	24.363	24.347	12.675	12.659	12.666	12.657	12.676	12.668	12.672	12.668	3.266	3.277	3.275	3.283	5.46742	2.435E-02	1.267E-02	1.260E-04	5.56427E-08	1814.52	1.8145	-3.986	-0.453
Pre-Irradiation	**CW13-03**	25.354	25.364	25.363	25.370	12.722	12.722	12.717	12.715	12.720	12.715	12.714	12.704	3.246	3.246	3.249	3.249	5.4530	2.536E-02	1.272E-02	1.270E-04	5.46974E-08	1722.19	1.7222		
Post-Irradiation		24.495	24.495	24.490	24.496	12.683	12.665	12.662	12.674	12.673	12.675	12.676	12.693	3.269	3.269	3.259	3.255	5.45086	2.449E-02	1.268E-02	1.262E-04	5.52229E-08	1795.73	1.7957	-3.426	-0.322
Pre-Irradiation	**CW14-01**	25.352	25.348	25.347	25.354	12.717	12.723	12.725	12.729	12.729	12.732	12.733	12.736	3.246	3.246	3.241	3.241	5.4557	2.535E-02	1.273E-02	1.272E-04	5.45692E-08	1720.57	1.7206		
Post-Irradiation		24.737	24.735	24.722	24.736	12.703	12.690	12.687	12.681	12.708	12.695	12.694	12.691	3.244	3.241	3.269	3.268	5.45483	2.473E-02	1.269E-02	1.266E-04	5.4966E-08	1773.97	1.7740	-2.436	-0.270
Pre-Irradiation	**CW14-02**	25.353	25.348	25.349	25.353	12.730	12.727	12.722	12.713	12.725	12.725	12.724	12.723	3.241	3.239	3.251	3.249	5.4374	2.535E-02	1.272E-02	1.271E-04	5.4612E-08	1715.96	1.7160		
Post-Irradiation		25.047	25.055	25.052	25.056	12.596	12.614	12.621	12.618	12.608	12.611	12.608	12.610	3.287	3.269	3.279	3.265	5.4353	2.505E-02	1.261E-02	1.249E-04	5.56316E-08	1768.44	1.7684	-1.177	-0.887

Table 48 Dimensions, Mass, Density and Dimensional Change for Grade PCEA

	Specimen	Thickness Measurements, mm.				Outside Diameter Measurements,mm.								Hole Diameter ,mm.				Weight	Thickness	Diameter	Cross-section	2- hole Volume	Density	Density	Dimensioal Change, %	
	Number	T1	T2	T3	T4	D1	D2	D3	D4	$D1^{90}$	$D2^{90}$	$D3^{90}$	$D4^{90}$	H1	H2	H1'	H2'	g	m	m	m^2	m^3	kg/m^3	g/cm^3	$\Delta L/L_0$(%)	$\Delta D/D_0$(%)
																									ΔDIM = IRR-UNIRR	
Pre-Irradiation	**DA601**	25.387	25.391	25.391	25.389	12.722	12.727	12.729	12.734	12.725	12.727	12.730	12.734	3.195	3.195	3.195	3.195	5.6611	2.539E-02	1.273E-02	1.272E-04	5.29574E-08	1781.45	1.7814		
Post-Irradiation		24.997	24.002	24.003	24.005	12.538	12.538	12.536	12.531	12.550	12.541	12.542	12.563	3.254	3.258	3.259	3.274	5.65962	2.425E-02	1.254E-02	1.236E-04	5.51583E-08	1924.26	1.9243	-4.481	-1.463
Pre-Irradiation	**DA602**	25.389	25.390	25.390	25.385	12.732	12.727	12.727	12.727	12.736	12.729	12.728	12.728	3.200	3.195	3.198	3.193	5.6454	2.539E-02	1.273E-02	1.273E-04	5.29995E-08	1776.49	1.7765		
Post-Irradiation		24.522	24.523	24.527	24.523	12.613	12.594	12.591	12.612	12.619	12.600	12.601	12.619	3.242	3.244	3.218	3.235	5.64458	2.452E-02	1.261E-02	1.248E-04	5.42706E-08	1877.41	1.8774	-3.405	-0.966
Pre-Irradiation	**DA701**	25.391	25.390	25.387	25.389	12.725	12.725	12.728	12.733	12.728	12.728	12.730	12.733	3.198	3.195	3.185	3.185	5.6448	2.539E-02	1.273E-02	1.273E-04	5.28103E-08	1776.17	1.7762		
Post-Irradiation		24.884	24.887	24.886	24.891	12.689	12.679	12.675	12.671	12.692	12.671	12.668	12.667	3.216	3.222	3.218	3.217	5.6439	2.489E-02	1.268E-02	1.262E-04	5.37178E-08	1828.14	1.8281	-1.978	-0.412
Pre-Irradiation	**DA702**	25.375	25.372	25.373	25.375	12.751	12.743	12.734	12.730	12.751	12.746	12.736	12.732	3.239	3.226	3.195	3.198	5.7624	2.537E-02	1.274E-02	1.275E-04	5.35923E-08	1811.44	1.8114		
Post-Irradiation		25.163	25.170	25.171	25.168	12.642	12.651	12.665	12.668	12.644	12.658	12.663	12.669	3.230	3.241	3.266	3.256	5.76233	2.517E-02	1.266E-02	1.258E-04	5.47302E-08	1851.54	1.8515	-0.810	-0.650
Pre-Irradiation	**DW1-01**	25.383	25.383	25.385	25.386	12.719	12.723	12.729	12.737	12.719	12.723	12.728	12.733	3.203	3.205	3.200	3.200	5.7468	2.538E-02	1.273E-02	1.272E-04	5.31892E-08	1809.56	1.8096		
Post-Irradiation		24.478	24.485	24.487	24.487	12.601	12.586	12.578	12.574	12.617	12.591	12.582	12.589	3.239	3.233	3.237	3.232	5.7457	2.448E-02	1.259E-02	1.245E-04	5.42917E-08	1919.27	1.9193	-3.546	-1.073
Pre-Irradiation	**DW1-02**	25.382	25.382	25.383	25.381	12.719	12.725	12.729	12.736	12.719	12.723	12.730	12.734	3.200	3.198	3.205	3.198	5.7516	2.538E-02	1.273E-02	1.272E-04	5.31259E-08	1811.01	1.8110		
Post-Irradiation		24.347	24.350	24.356	24.368	12.637	12.640	12.636	12.638	12.674	12.637	12.627	12.639	3.227	3.218	3.250	3.226	5.75084	2.436E-02	1.264E-02	1.255E-04	5.41213E-08	1915.33	1.9153	-4.046	-0.676
Pre-Irradiation	**DW1-03**	25.382	25.383	25.383	25.383	12.715	12.724	12.730	12.736	12.719	12.728	12.728	12.739	3.205	3.211	3.200	3.195	5.7604	2.538E-02	1.273E-02	1.272E-04	5.32104E-08	1813.62	1.8136		
Post-Irradiation		24.912	24.902	24.901	24.902	12.688	12.674	12.665	12.657	12.693	12.672	12.668	12.659	3.230	3.226	3.218	3.213	5.75981	2.490E-02	1.267E-02	1.261E-04	5.38347E-08	1865.78	1.8658	-1.887	-0.436
Pre-Irradiation	**DW2-01**	25.377	25.377	25.376	25.376	12.719	12.722	12.727	12.733	12.719	12.723	12.729	12.737	3.195	3.195	3.203	3.198	5.7565	2.538E-02	1.273E-02	1.272E-04	5.30416E-08	1813.20	1.8132		
Post-Irradiation		24.893	24.894	24.890	24.882	12.529	12.520	12.517	12.512	12.534	12.533	12.523	12.517	3.246	3.260	3.260	3.260	5.75572	2.489E-02	1.252E-02	1.232E-04	5.5008E-08	1911.73	1.9117	-1.918	-1.594
Pre-Irradiation	**DW2-02**	25.376	25.375	25.376	25.377	12.723	12.725	12.727	12.736	12.718	12.723	12.730	12.738	3.200	3.198	3.203	3.198	5.7443	2.538E-02	1.273E-02	1.272E-04	5.31048E-08	1809.02	1.8090		
Post-Irradiation		24.956	24.958	24.961	24.957	12.560	12.553	12.545	12.546	12.556	12.546	12.537	12.538	3.261	3.256	3.242	3.246	5.74423	2.496E-02	1.255E-02	1.237E-04	5.48368E-08	1894.93	1.8949	-1.647	-1.413
Pre-Irradiation	**DW2-03**	25.375	25.376	25.376	25.375	12.737	12.728	12.727	12.724	12.737	12.725	12.722	12.719	3.198	3.200	3.195	3.195	5.7447	2.538E-02	1.273E-02	1.272E-04	5.30206E-08	1809.19	1.8092		
Post-Irradiation		25.136	25.140	25.139	25.138	12.621	12.630	12.635	12.652	12.616	12.629	12.644	12.646	3.233	3.239	3.235	3.242	5.74467	2.514E-02	1.263E-02	1.254E-04	5.43557E-08	1854.83	1.8548	-0.934	-0.732
Pre-Irradiation	**DW3-01**	25.380	25.380	25.377	25.378	12.719	12.722	12.730	12.736	12.717	12.722	12.727	12.730	3.228	3.228	3.233	3.231	5.7568	2.538E-02	1.273E-02	1.272E-04	5.41214E-08	1813.98	1.8140		
Post-Irradiation		24.340	24.364	24.371	24.363	12.649	12.609	12.604	12.608	12.642	12.611	12.596	12.604	3.261	3.258	3.275	3.269	5.75586	2.436E-02	1.262E-02	1.250E-04	5.53197E-08	1925.36	1.9254	-4.016	-0.863
Pre-Irradiation	**DW3-02**	25.378	25.378	25.377	25.381	12.739	12.730	12.723	12.718	12.742	12.732	12.724	12.722	3.200	3.195	3.200	3.200	5.7597	2.538E-02	1.273E-02	1.273E-04	5.30838E-08	1813.29	1.8133		
Post-Irradiation		24.562	24.558	24.560	24.561	12.623	12.629	12.627	12.655	12.643	12.627	12.636	12.655	3.232	3.226	3.236	3.235	5.75979	2.456E-02	1.264E-02	1.254E-04	5.41853E-08	1903.32	1.9033	-3.225	-0.722
Pre-Irradiation	**DW3-03**	25.378	25.378	25.378	25.377	12.717	12.723	12.728	12.738	12.719	12.722	12.729	12.738	3.205	3.195	3.205	3.200	5.7625	2.538E-02	1.273E-02	1.272E-04	5.3168E-08	1814.86	1.8149		
Post-Irradiation		24.813	24.811	24.818	24.808	12.705	12.686	12.677	12.673	12.701	12.681	12.670	12.666	3.223	3.226	3.227	3.232	5.76176	2.481E-02	1.268E-02	1.263E-04	5.40151E-08	1870.43	1.8704	-2.229	-0.348
Pre-Irradiation	**DW4-01**	25.389	25.390	25.390	25.391	12.719	12.722	12.730	12.739	12.719	12.719	12.725	12.736	3.205	3.198	3.200	3.200	5.7407	2.539E-02	1.273E-02	1.272E-04	5.3147E-08	1807.27	1.8073		
Post-Irradiation		25.015	25.016	25.013	25.015	12.578	12.573	12.567	12.565	12.575	12.575	12.566	12.566	3.266	3.260	3.250	3.259	5.74024	2.501E-02	1.257E-02	1.241E-04	5.50832E-08	1882.37	1.8824	-1.477	-1.222
Pre-Irradiation	**DW4-03**	25.382	25.383	25.383	25.383	12.718	12.719	12.725	12.733	12.715	12.718	12.720	12.730	3.205	3.203	3.205	3.198	5.7429	2.538E-02	1.272E-02	1.271E-04	5.32102E-08	1809.58	1.8096		
Post-Irradiation		24.886	24.882	24.880	24.882	12.526	12.512	12.510	12.509	12.524	12.512	12.505	12.501	3.275	3.268	3.265	3.275	5.74246	2.488E-02	1.251E-02	1.230E-04	5.54917E-08	1911.54	1.9115	-1.972	-1.651
Pre-Irradiation	**DW5-01**	25.382	25.382	25.383	25.382	12.713	12.720	12.723	12.734	12.720	12.722	12.728	12.736	3.198	3.203	3.200	3.195	5.6963	2.538E-02	1.272E-02	1.272E-04	5.30837E-08	1794.28	1.7943		
Post-Irradiation		25.146	25.155	25.156	25.152	12.634	12.630	12.626	12.623	12.638	12.629	12.627	12.626	3.239	3.241	3.244	3.236	5.69586	2.515E-02	1.263E-02	1.253E-04	5.4441E-08	1839.56	1.8396	-0.907	-0.749
Pre-Irradiation	**DW5-02**	25.381	25.381	25.378	25.382	12.718	12.723	12.723	12.737	12.723	12.725	12.729	12.738	3.203	3.200	3.198	3.198	5.7316	2.538E-02	1.273E-02	1.272E-04	5.31049E-08	1804.82	1.8048		
Post-Irradiation		24.465	24.463	24.475	24.478	12.697	12.665	12.660	12.649	12.693	12.668	12.655	12.664	3.211	3.232	3.218	3.235	5.73131	2.447E-02	1.267E-02	1.261E-04	5.39084E-08	1891.06	1.8911	-3.587	-0.457
Pre-Irradiation	**DW5-03**	25.381	25.380	25.380	25.382	12.722	12.724	12.730	12.744	12.722	12.725	12.729	12.743	3.200	3.200	3.200	3.200	5.7596	2.538E-02	1.273E-02	1.273E-04	5.31259E-08	1812.77	1.8128		
Post-Irradiation		24.988	25.003	24.995	24.984	12.561	12.550	12.544	12.546	12.561	12.556	12.554	12.542	3.244	3.251	3.251	3.249	5.75881	2.499E-02	1.255E-02	1.237E-04	5.47402E-08	1895.74	1.8957	-1.529	-1.400
Pre-Irradiation	**DW6-01**	25.381	25.380	25.381	25.381	12.720	12.722	12.728	12.739	12.724	12.725	12.734	12.743	3.203	3.198	3.195	3.200	5.7612	2.538E-02	1.273E-02	1.273E-04	5.30837E-08	1813.39	1.8134		
Post-Irradiation		25.088	25.095	25.080	25.078	12.604	12.603	12.590	12.592	12.607	12.608	12.597	12.591	3.273	3.265	3.232	3.245	5.76032	2.509E-02	1.260E-02	1.247E-04	5.49126E-08	1874.81	1.8748	-1.164	-1.025
Pre-Irradiation	**DW6-02**	25.377	25.377	25.378	25.378	12.741	12.734	12.727	12.723	12.743	12.736	12.728	12.724	3.200	3.200	3.205	3.195	5.7631	2.538E-02	1.273E-02	1.273E-04	5.31259E-08	1813.53	1.8135		
Post-Irradiation		24.644	24.646	24.651	24.645	12.628	12.617	12.623	12.635	12.643	12.625	12.633	12.657	3.226	3.230	3.218	3.241	5.76255	2.465E-02	1.263E-02	1.253E-04	5.40679E-08	1898.67	1.8987	-2.882	-0.780
Pre-Irradiation	**DW6-03**	25.376	25.377	25.377	25.378	12.746	12.741	12.733	12.725	12.746	12.741	12.733	12.725	3.195	3.198	3.198	3.195	5.7397	2.538E-02	1.274E-02	1.274E-04	5.29995E-08	1804.91	1.8049		
Post-Irradiation		24.503	24.510	24.515	24.506	12.622	12.606	12.606	12.625	12.618	12.608	12.620	12.665	3.237	3.216	3.230	3.236	5.73902	2.451E-02	1.262E-02	1.251E-04	5.40998E-08	1905.27	1.9053	-3.423	-0.903
Pre-Irradiation	**DW7-01**	25.378	25.381	25.380	25.377	12.723	12.728	12.733	12.742	12.724	12.724	12.734	12.742	3.205	3.203	3.200	3.200	5.7650	2.538E-02	1.273E-02	1.273E-04	5.31892E-08	1814.26	1.8143		
Post-Irradiation		24.926	24.928	24.940	24.934	12.554	12.550	12.535	12.537	12.546	12.537	12.532	12.525	3.265	3.261	3.283	3.247	5.7644	2.493E-02	1.254E-02	1.235E-04	5.52649E-08	1906.39	1.9064	-1.761	-1.506
Pre-Irradiation	**DW7-02**	25.380	25.378	25.380	25.380	12.724	12.728	12.732	12.738	12.724	12.724	12.730	12.741	3.200	3.198	3.203	3.195	5.7628	2.538E-02	1.273E-02	1.273E-04	5.30837E-08	1813.80	1.8138		
Post-Irradiation		25.026	25.061	25.077	25.061	12.592	12.587	12.585	12.580	12.595	12.589	12.587	12.583	3.244	3.269	3.233	3.250	5.76287	2.506E-02	1.259E-02	1.244E-04	5.47506E-08	1881.33	1.8813	-1.273	-1.123
Pre-Irradiation	**DW7-03**	25.381	25.381	25.382	25.382	12.723	12.728	12.732	12.739	12.724	12.727	12.732	12.743	3.198	3.198	3.203	3.198	5.7567	2.538E-02	1.273E-02	1.273E-04	5.30838E-08	1811.49	1.8115		
Post-Irradiation		24.422	24.437	24.407	24.417	12.661	12.630	12.623	12.631	12.663	12.636	12.624	12.623	3.227	3.259	3.232	3.222	5.75683	2.442E-02	1.264E-02	1.254E-04	5.42807E-08	1913.61	1.9136	-3.786	-0.743
Pre-Irradiation	**DW8-01**	25.381	25.382	25.382	25.382	12.722	12.728	12.733	12.743	12.724	12.729	12.733	12.742	3.205	3.203	3.198	3.193	5.7662	2.538E-02	1.273E-02	1.273E-04	5.31049E-08	1814.24	1.8142		
Post-Irradiation		24.564	24.580	24.586	24.574	12.684	12.656	12.641	12.657	12.674	12.650	12.639	12.650	3.226	3.209	3.227	3.226	5.76539	2.458E-02	1.266E-02	1.258E-04	5.3845E-08	1897.74	1.8977	-3.175	-0.592
Pre-Irradiation	**DW8-02**	25.381	25.382	25.381	25.382	12.722	12.725	12.734	12.744	12.725	12.728	12.736	12.747	3.195	3.198	3.198	3.195	5.7745	2.538E-02	1.273E-02	1.273E-04	5.29995E-08	1816.54	1.8165		
Post-Irradiation		24.836	24.850	24.845	24.855	12.707	12.694	12.683	12.678	12.715	12.695	12.681	12.672	3.226	3.219	3.213	3.242	5.77386	2.485E-02	1.269E-02	1.265E-04	5.39507E-08	1869.23	1.8692	-2.108	-0.330
Pre-Irradiation	**DW8-03**	25.383	25.382	25.385	25.383	12.742	12.734	12.725	12.727	12.742	12.736	12.732	12.727	3.203	3.198	3.205	3.198	5.7800	2.538E-02	1.273E-02	1.273E-04	5.3147E-08	1818.12	1.8181		
Post-Irradiation		24.929	24.939	24.952	24.942	12.532	12.538	12.547	12.554	12.530	12.543	12.551	12.557	3.274	3.249	3.250	3.272	5.77973	2.494E-02	1.254E-02	1.236E-04	5.51576E-08	1909.33	1.9093	-1.745	-1.484
Pre-Irradiation	**DW9-01**	25.385	25.385	25.383	25.385	12.728	12.730	12.734	12.746	12.728	12.730	12.734	12.743	3.200	3.200	3.198	3.198	5.7479	2.538E-02	1.273E-02	1.274E-04	5.30838E-08	1807.55	1.8076		
Post-Irradiation		25.038	25.052	25.056	25.045	12.596	12.583	12.584	12.583	12.598	12.592	12.585	12.584	3.250	3.246	3.250	3.260	5.74695	2.505E-02	1.259E-02	1.245E-04	5.48365E-08	1876.56	1.8766	-1.326	-1.148
Pre-Irradiation	**DW9-03**	25.385	25.385	25.385	25.385	12.725	12.725	12.724	12.728	12.725	12.723	12.725	12.728	3.195	3.205	3.198	3.195	5.7734	2.538E-02	1.273E-02	1.272E-04	5.30626E-08	1818.07	1.8181		
Post-Irradiation		24.312	24.270	24.267	24.261	12.657	12.634	12.628	12.660	12.661	12.621	12.620	12.625	3.207	3.211	3.214	3.227	5.77266	2.428E-02	1.264E-02	1.254E-04	5.36014E-08	1929.38	1.9294	-4.362	-0.686
Pre-Irradiation	**DW10-01**	25.383	25.385	25.385	25.383	12.718	12.717	12.717	12.724	12.715	12.717	12.715	12.722	3.193	3.203	3.200	3.203	5.7473	2.538E-02	1.272E-02	1.270E-04	5.31048E-08	1812.13	1.8121		
Post-Irradiation		24.753	24.753	24.752	24.764	12.699	12.675	12.675	12.671	12.694	12.677	12.672	12.678	3.218	3.219	3.231	3.222	5.74659	2.476E-02	1.268E-02	1.263E-04	5.38664E-08	1870.46	1.8705	-2.476	-0.297
Pre-Irradiation	**DW10-02**	25.382	25.385	25.387	25.382	12.717	12.715	12.718	12.723	12.717	12.714	12.717	12.720	3.200	3.198	3.200	3.200	5.7395	2.538E-02	1.272E-02	1.270E-04	5.31048E-08	1809.81	1.8098		
Post-Irradiation		25.156	25.159	25.160	25.163	12.622	12.619	12.621	12.627	12.626	12.625	12.627	12.629	3.251	3.249	3.236	3.242	5.73852	2.516E-02	1.262E-02	1.252E-04	5.46013E-08	1854.28	1.8543	-0.885	-0.731
Pre-Irradiation	**DW11-01**	25.383	25.385	25.383	25.385	12.724	12.715	12.717	12.715	12.724	12.717	12.717	12.717	3.195	3.198	3.195	3.195	5.7456	2.538E-02	1.272E-02	1.270E-04	5.29785E-08	1811.47	1.8115		
Post-Irradiation		24.339	24.357	24.352	24.359	12.652	12.626	12.625	12.664	12.668	12.643	12.643	12.673	3.232	3.255	3.237	3.250	5.74273	2.435E-02	1.265E-02	1.257E-04	5.45687E-08	1910.65	1.9107	-4.067	-0.541

Table 49 Dimensions, Mass, Density and Dimensional Change for Grade IG-110

	Specimen	Thickness Measurements, mm.				Outside Diameter Measurements,mm.								Hole Diameter ,mm.				Weight	Thickness	Diameter	Cross-section	2- hole Volume	Density	Density	Dimensional Change, %	
	Number	T1	T2	T3	T4	D1	D2	D3	D4	$D1^{90}$	$D2^{90}$	$D3^{90}$	$D4^{90}$	H1	H2	H1'	H2'	g	m	m	m^2	m^3	kg/m^3	g/cm^3	$\Delta L/L_0$ (%)	$\Delta D/D_0$ (%)
																									ΔDIM = IRR-UNIRR	
Pre-Irradiation	EW2-01	25.381	25.381	25.361	25.385	12.725	12.727	12.730	12.725	12.722	12.725	12.728	12.717	3.200	3.216	3.211	3.213	5.5838	2.538E-02	1.272E-02	1.272E-04	5.34425E-08	1759.31	1.7593		
Post-Irradiation		24.826	24.813	24.806	24.825	12.654	12.646	12.646	12.646	12.646	12.651	12.652	12.649	3.233	3.246	3.252	3.263	5.57996	2.482E-02	1.265E-02	1.257E-04	5.47405E-08	1821.29	1.8213	-2.204	-0.599
Pre-Irradiation	EW2-02	25.387	25.389	25.383	25.378	12.718	12.725	12.730	12.724	12.720	12.723	12.727	12.730	3.205	3.205	3.205	3.205	5.5901	2.538E-02	1.272E-02	1.272E-04	5.32947E-08	1760.72	1.7607		
Post-Irradiation		24.842	24.854	24.851	24.868	12.658	12.663	12.661	12.658	12.675	12.663	12.659	12.663	3.249	3.240	3.227	3.233	5.58771	2.485E-02	1.266E-02	1.259E-04	5.43559E-08	1816.86	1.8169	-2.091	-0.489
Pre-Irradiation	EW2-03	25.386	25.386	25.383	25.385	12.730	12.727	12.725	12.717	12.725	12.727	12.724	12.720	3.208	3.211	3.203	3.205	5.5930	2.539E-02	1.272E-02	1.272E-04	5.3337E-08	1761.71	1.7617		
Post-Irradiation		25.163	25.161	25.161	25.161	12.594	12.605	12.609	12.609	12.597	12.608	12.610	12.610	3.249	3.237	3.246	3.242	5.5899	2.516E-02	1.261E-02	1.248E-04	5.45691E-08	1811.70	1.8117	-0.881	-0.937
Pre-Irradiation	EW4-01	25.370	25.377	25.358	25.366	12.695	12.710	12.718	12.722	12.708	12.711	12.706	12.715	3.205	3.208	3.208	3.203	5.5908	2.537E-02	1.271E-02	1.269E-04	5.33158E-08	1766.13	1.7661		
Post-Irradiation		24.657	24.669	24.667	24.667	12.686	12.685	12.681	12.679	12.689	12.638	12.688	12.688	3.211	3.223	3.227	3.228	5.58784	2.467E-02	1.268E-02	1.263E-04	5.38558E-08	1825.83	1.8258	-2.770	-0.247
Pre-Irradiation	EW4-02	25.371	25.378	25.370	25.376	12.724	12.720	12.718	12.700	12.723	12.722	12.715	12.714	3.200	3.205	3.205	3.208	5.5921	2.537E-02	1.272E-02	1.270E-04	5.32736E-08	1764.30	1.7643		
Post-Irradiation		24.353	24.361	24.362	24.365	12.676	12.656	12.656	12.675	12.659	12.656	12.646	12.650	3.232	3.223	3.225	3.233	5.58979	2.436E-02	1.266E-02	1.259E-04	5.40575E-08	1855.80	1.8558	-3.994	-0.454
Pre-Irradiation	EW5-01	25.370	25.368	25.368	25.373	12.713	12.717	12.720	12.710	12.715	12.720	12.722	12.720	3.203	3.203	3.203	3.203	5.5756	2.537E-02	1.272E-02	1.270E-04	5.32103E-08	1759.28	1.7593		
Post-Irradiation		24.528	24.546	24.536	24.552	12.630	12.630	12.622	12.634	12.645	12.637	12.636	12.643	3.231	3.225	3.237	3.231	5.57224	2.454E-02	1.263E-02	1.254E-04	5.41427E-08	1843.49	1.8435	-3.269	-0.649
Pre-Irradiation	EW5-02	25.377	25.372	25.359	25.372	12.718	12.713	12.710	12.717	12.701	12.709	12.713	12.699	3.200	3.205	3.205	3.205	5.5834	2.537E-02	1.271E-02	1.269E-04	5.32525E-08	1763.80	1.7638		
Post-Irradiation		25.061	25.058	25.064	25.064	12.531	12.554	12.563	12.559	12.538	12.536	12.525	12.519	3.258	3.237	3.254	3.244	5.58045	2.506E-02	1.254E-02	1.235E-04	5.47185E-08	1835.16	1.8352	-1.216	-1.331
Pre-Irradiation	EW5-03	25.382	25.375	25.373	25.376	12.706	12.701	12.706	12.703	12.720	12.718	12.718	12.713	3.205	3.203	3.203	3.200	5.5845	2.538E-02	1.271E-02	1.269E-04	5.32103E-08	1763.45	1.7635		
Post-Irradiation		25.080	25.086	25.086	25.088	12.545	12.545	12.550	12.555	12.529	12.542	12.553	12.553	3.265	3.251	3.246	3.266	5.5815	2.509E-02	1.255E-02	1.236E-04	5.50291E-08	1832.21	1.8322	-1.149	-1.291
Pre-Irradiation	EW6-01	25.368	25.375	25.378	25.372	12.706	12.706	12.706	12.708	12.703	12.711	12.709	12.710	3.203	3.200	3.200	3.198	5.5918	2.537E-02	1.271E-02	1.268E-04	5.31259E-08	1766.83	1.7668		
Post-Irradiation		24.605	24.601	24.613	24.609	12.690	12.687	12.682	12.675	12.675	12.686	12.686	12.684	3.203	3.208	3.223	3.208	5.58862	2.461E-02	1.268E-02	1.263E-04	5.34637E-08	1829.09	1.8291	-3.020	-0.192
Pre-Irradiation	EW6-03	25.373	25.372	25.376	25.377	12.701	12.710	12.711	12.709	12.706	12.710	12.713	12.713	3.203	3.200	3.205	3.203	5.6009	2.537E-02	1.271E-02	1.269E-04	5.32103E-08	1769.17	1.7692		
Post-Irradiation		24.576	24.579	24.573	24.584	12.601	12.606	12.607	12.608	12.629	12.635	12.628	12.615	3.231	3.235	3.244	3.227	5.59804	2.458E-02	1.262E-02	1.250E-04	5.4249E-08	1854.74	1.8547	-3.139	-0.732
Pre-Irradiation	EW7-01	25.368	25.376	25.378	25.380	12.715	12.715	12.715	12.701	12.701	12.718	12.720	12.709	3.208	3.203	3.205	3.205	5.5902	2.538E-02	1.271E-02	1.269E-04	5.32947E-08	1765.01	1.7650		
Post-Irradiation		24.622	24.632	24.619	24.630	12.628	12.623	12.624	12.622	12.622	12.631	12.641	12.633	3.213	3.227	3.250	3.228	5.58736	2.463E-02	1.263E-02	1.252E-04	5.41001E-08	1843.92	1.8439	-2.955	-0.660
Pre-Irradiation	EW8-01	25.380	25.378	25.378	25.371	12.687	12.703	12.697	12.708	12.701	12.705	12.705	12.706	3.205	3.203	3.203	3.200	5.5829	2.538E-02	1.270E-02	1.267E-04	5.32103E-08	1765.48	1.7655		
Post-Irradiation		25.088	25.091	25.091	25.088	12.520	12.522	12.516	12.513	12.530	12.531	12.528	12.526	3.269	3.259	3.265	3.255	5.58098	2.509E-02	1.252E-02	1.232E-04	5.51904E-08	1838.74	1.8387	-1.132	-1.404
Pre-Irradiation	EW8-02	25.373	25.366	25.370	25.371	12.713	12.710	12.708	12.704	12.710	12.708	12.708	12.699	3.198	3.198	3.193	3.193	5.5862	2.537E-02	1.271E-02	1.268E-04	5.29574E-08	1765.26	1.7653		
Post-Irradiation		24.403	24.425	24.401	24.424	12.622	12.620	12.634	12.641	12.634	12.654	12.671	12.689	3.209	3.214	3.213	3.202	5.55367	2.441E-02	1.265E-02	1.256E-04	5.3432E-08	1843.39	1.8434	-3.771	-0.485
Pre-Irradiation	EW8-03	25.373	25.377	25.376	25.385	12.695	12.695	12.701	12.709	12.666	12.700	12.703	12.710	3.198	3.203	3.208	3.203	5.5817	2.538E-02	1.270E-02	1.266E-04	5.32103E-08	1766.24	1.7662		
Post-Irradiation		24.871	24.887	24.881	24.881	12.676	12.671	12.677	12.672	12.678	12.668	12.663	12.656	3.207	3.227	3.222	3.217	5.57956	2.488E-02	1.267E-02	1.261E-04	5.37176E-08	1809.67	1.8097	-1.961	-0.214
Pre-Irradiation	EW9-01	25.364	25.378	25.381	25.381	12.605	12.705	12.703	12.709	12.709	12.709	12.703	12.700	3.203	3.198	3.200	3.198	5.5981	2.538E-02	1.269E-02	1.265E-04	5.31048E-08	1772.80	1.7728		
Post-Irradiation		25.055	25.061	25.062	25.064	12.525	12.530	12.528	12.536	12.494	12.511	12.520	12.518	3.241	3.245	3.252	3.255	5.59619	2.506E-02	1.252E-02	1.231E-04	5.47297E-08	1846.54	1.8465	-1.244	-1.359
Pre-Irradiation	EW9-02	25.368	25.386	25.386	25.370	12.710	12.714	12.705	12.704	12.711	12.713	12.710	12.703	3.203	3.200	3.203	3.203	5.5911	2.538E-02	1.271E-02	1.269E-04	5.31892E-08	1766.00	1.7660		
Post-Irradiation		25.213	25.210	25.213	25.215	12.614	12.624	12.623	12.614	12.614	12.620	12.632	12.624	3.235	3.236	3.225	3.226	5.58796	2.521E-02	1.262E-02	1.251E-04	5.41215E-08	1802.59	1.8026	-0.649	-0.693
Pre-Irradiation	EW9-03	25.375	25.371	25.377	25.376	12.678	12.700	12.697	12.700	12.699	12.705	12.709	12.710	3.205	3.203	3.203	3.203	5.5902	2.537E-02	1.270E-02	1.267E-04	5.32314E-08	1768.45	1.7685		
Post-Irradiation		24.519	24.525	24.535	24.537	12.644	12.634	12.640	12.643	12.663	12.671	12.668	12.663	3.222	3.236	3.236	3.228	5.58822	2.453E-02	1.265E-02	1.257E-04	5.41319E-08	1844.12	1.8441	-3.332	-0.367
Pre-Irradiation	EW10-01	25.381	25.376	25.376	25.378	12.691	12.696	12.692	12.678	12.696	12.703	12.711	12.713	3.205	3.205	3.200	3.198	5.5822	2.538E-02	1.270E-02	1.266E-04	5.31892E-08	1766.30	1.7663		
Post-Irradiation		25.117	25.118	25.117	25.119	12.559	12.554	12.548	12.542	12.562	12.570	12.572	12.566	3.265	3.241	3.241	3.260	5.57855	2.512E-02	1.256E-02	1.239E-04	5.48467E-08	1824.96	1.8250	-1.025	-1.091
Pre-Irradiation	EW10-02	25.377	25.377	25.377	25.377	12.703	12.705	12.703	12.689	12.700	12.705	12.711	12.701	3.198	3.200	3.203	3.208	5.5845	2.538E-02	1.270E-02	1.267E-04	5.31892E-08	1765.82	1.7658		
Post-Irradiation		24.324	24.331	24.353	24.354	12.674	12.665	12.673	12.662	12.677	12.667	12.652	12.667	3.227	3.228	3.225	3.213	5.58141	2.434E-02	1.267E-02	1.260E-04	5.38876E-08	1852.10	1.8521	-4.085	-0.275
Pre-Irradiation	EW10-03	25.375	25.376	25.376	25.376	12.713	12.703	12.699	12.699	12.691	12.701	12.697	12.704	3.203	3.200	3.203	3.200	5.5923	2.538E-02	1.270E-02	1.267E-04	5.31681E-08	1768.74	1.7687		
Post-Irradiation		25.039	25.038	25.036	25.040	12.507	12.530	12.541	12.540	12.502	12.522	12.527	12.515	3.249	3.275	3.255	3.275	5.58907	2.504E-02	1.252E-02	1.232E-04	5.52435E-08	1845.35	1.8453	-1.329	-1.400

Table 50 Dimensions, Mass, Density and Dimensional Change for Grade IG-430

	Specimen	Thickness Measurements, mm.				Outside Diameter Measurements,mm.								Hole Diameter ,mm.				Weight	Thickness	Diameter	Cross-section	2- hole Volume	Density	Density	Dimensional Change, %	
	Number	T1	T2	T3	T4	D1	D2	D3	D4	$D1^{90}$	$D2^{90}$	$D3^{90}$	$D4^{90}$	H1	H2	H1'	H2'	g	m	m	m^2	m^3	kg/m^3	g/cm^3	$\Delta L/L_0$(%)	$\Delta D/D_0$(%)
																									ΔDIM = IRR-UNIRR	
Pre-Irradiation	FW1-01	25.371	25.372	25.371	25.370	12.710	12.717	12.711	12.692	12.710	12.705	12.705	12.701	3.208	3.205	3.208	3.213	5.7233	2.537E-02	1.271E-02	1.268E-04	5.34003E-08	1809.00	1.8090		
Post-Irradiation		24.786	24.797	24.782	24.808	12.618	12.609	12.614	12.622	12.625	12.616	12.620	12.620	3.258	3.239	3.240	3.245	5.71889	2.479E-02	1.262E-02	1.250E-04	5.46224E-08	1877.70	1.8777	-2.276	-0.697
Pre-Irradiation	FW1-03	25.376	25.368	25.381	25.375	12.717	12.714	12.715	12.715	12.717	12.715	12.715	12.713	3.208	3.211	3.208	3.203	5.7574	2.537E-02	1.272E-02	1.270E-04	5.33581E-08	1816.96	1.8170		
Post-Irradiation		25.230	25.227	25.226	25.229	12.561	12.556	12.549	12.538	12.556	12.566	12.574	12.570	3.250	3.247	3.242	3.259	5.76253	2.523E-02	1.256E-02	1.239E-04	5.47721E-08	1876.83	1.8768	-0.579	-1.229
Pre-Irradiation	FW2-01	25.373	25.376	25.376	25.375	12.706	12.703	12.697	12.697	12.695	12.695	12.705	12.706	3.211	3.208	3.211	3.208	5.7255	2.537E-02	1.270E-02	1.267E-04	5.34215E-08	1811.11	1.8111		
Post-Irradiation		25.175	25.183	25.179	25.184	12.557	12.571	12.576	12.573	12.566	12.572	12.560	12.559	3.258	3.254	3.259	3.240	5.72318	2.518E-02	1.257E-02	1.240E-04	5.48685E-08	1865.25	1.8653	-0.767	-1.054
Pre-Irradiation	FW2-02	25.362	25.363	25.376	25.375	12.705	12.709	12.711	12.710	12.694	12.695	12.701	12.696	3.216	3.208	3.205	3.211	5.7308	2.537E-02	1.270E-02	1.267E-04	5.34426E-08	1812.64	1.8126		
Post-Irradiation		24.713	24.723	24.715	24.724	12.648	12.651	12.646	12.649	12.622	12.624	12.623	12.621	3.236	3.231	3.237	3.232	5.7283	2.472E-02	1.264E-02	1.254E-04	5.42491E-08	1881.02	1.8810	-2.563	-0.529
Pre-Irradiation	FW2-03	25.373	25.380	25.366	25.380	12.708	12.705	12.709	12.711	12.699	12.705	12.703	12.699	3.211	3.208	3.213	3.205	5.7428	2.537E-02	1.270E-02	1.268E-04	5.34214E-08	1815.40	1.8154		
Post-Irradiation		24.891	24.890	24.887	24.909	12.661	12.652	12.643	12.650	12.643	12.633	12.621	12.623	3.218	3.222	3.252	3.233	5.73952	2.489E-02	1.264E-02	1.255E-04	5.41644E-08	1869.54	1.8695	-1.893	-0.504
Pre-Irradiation	FW3-01	25.380	25.378	25.377	25.371	12.699	12.695	12.695	12.700	12.703	12.703	12.703	12.696	3.200	3.205	3.211	3.211	5.7337	2.538E-02	1.270E-02	1.267E-04	5.3337E-08	1814.00	1.8140		
Post-Irradiation		24.873	24.883	24.880	24.883	12.646	12.642	12.644	12.650	12.655	12.655	12.659	12.655	3.244	3.240	3.225	3.226	5.73113	2.488E-02	1.265E-02	1.257E-04	5.42282E-08	1864.95	1.8650	-1.958	-0.380
Pre-Irradiation	FW3-02	25.373	25.375	25.378	25.377	12.713	12.714	12.704	12.700	12.717	12.715	12.715	12.658	3.205	3.203	3.200	3.205	5.7257	2.538E-02	1.270E-02	1.268E-04	5.32314E-08	1809.89	1.8099		
Post-Irradiation		25.176	25.196	25.196	25.194	12.538	12.553	12.548	12.547	12.545	12.558	12.563	12.549	3.269	3.269	3.251	3.252	5.72258	2.519E-02	1.255E-02	1.237E-04	5.51372E-08	1869.48	1.8695	-0.730	-1.215
Pre-Irradiation	FW3-03	25.381	25.370	25.372	25.378	12.717	12.713	12.715	12.706	12.713	12.714	12.714	12.706	3.203	3.205	3.208	3.208	5.7546	2.538E-02	1.271E-02	1.269E-04	5.33158E-08	1816.86	1.8169		
Post-Irradiation		25.219	25.220	25.219	25.216	12.592	12.601	12.600	12.604	12.595	12.606	12.602	12.601	3.236	3.242	3.236	3.242	5.7514	2.522E-02	1.260E-02	1.247E-04	5.44196E-08	1861.21	1.8612	-0.618	-0.882
Pre-Irradiation	FW4-01	25.380	25.381	25.382	25.380	12.718	12.713	12.714	12.710	12.713	12.710	12.713	12.709	3.203	3.203	3.203	3.205	5.7339	2.538E-02	1.271E-02	1.269E-04	5.32314E-08	1809.84	1.8098		
Post-Irradiation		25.264	25.269	25.276	25.273	12.642	12.646	12.651	12.651	12.645	12.651	12.651	12.647	3.240	3.225	3.235	3.236	5.73115	2.527E-02	1.265E-02	1.256E-04	5.42383E-08	1836.44	1.8364	-0.434	-0.506
Pre-Irradiation	FW4-02	25.382	25.373	25.382	25.377	12.717	12.699	12.699	12.710	12.713	12.714	12.715	12.711	3.203	3.208	3.203	3.200	5.7458	2.538E-02	1.271E-02	1.269E-04	5.32314E-08	1814.51	1.8145		
Post-Irradiation		24.875	24.882	24.876	24.876	12.656	12.651	12.642	12.658	12.656	12.652	12.651	12.645	3.235	3.240	3.231	3.236	5.74276	2.488E-02	1.265E-02	1.257E-04	5.42917E-08	1868.78	1.8688	-1.976	-0.459
Pre-Irradiation	FW4-03	25.370	25.373	25.376	25.357	12.717	12.717	12.717	12.709	12.706	12.713	12.718	12.718	3.203	3.203	3.203	3.200	5.7692	2.537E-02	1.271E-02	1.270E-04	5.31892E-08	1821.30	1.8213		
Post-Irradiation		24.647	24.667	24.674	24.667	12.670	12.692	12.693	12.684	12.694	12.676	12.677	12.676	3.219	3.237	3.236	3.222	5.76617	2.466E-02	1.268E-02	1.263E-04	5.40679E-08	1883.27	1.8833	-2.780	-0.247
Pre-Irradiation	FW5-01	25.378	25.381	25.363	25.366	12.718	12.720	12.711	12.717	12.723	12.719	12.714	12.713	3.203	3.200	3.200	3.205	5.7637	2.537E-02	1.272E-02	1.270E-04	5.31892E-08	1818.55	1.8185		
Post-Irradiation		24.891	24.896	24.903	24.892	12.696	12.689	12.691	12.690	12.677	12.679	12.684	12.694	3.240	3.222	3.241	3.208	5.76041	2.490E-02	1.269E-02	1.264E-04	5.40354E-08	1862.13	1.8621	-1.878	-0.231
Pre-Irradiation	FW5-02	25.385	25.385	25.385	25.385	12.728	12.727	12.725	12.728	12.730	12.732	12.727	12.729	3.205	3.208	3.200	3.205	5.7849	2.538E-02	1.273E-02	1.272E-04	5.32736E-08	1821.03	1.8210		
Post-Irradiation		24.962	24.964	24.964	24.962	12.711	12.702	12.703	12.706	12.710	12.705	12.708	12.718	3.204	3.208	3.218	3.228	5.77683	2.496E-02	1.271E-02	1.268E-04	5.36016E-08	1855.97	1.8560	-1.661	-0.160
Pre-Irradiation	FW5-03	25.386	25.380	25.386	25.383	12.728	12.728	12.738	12.733	12.730	12.729	12.729	12.734	3.203	3.205	3.198	3.200	5.7923	2.538E-02	1.273E-02	1.273E-04	5.31681E-08	1822.49	1.8225		
Post-Irradiation		25.183	25.179	25.185	25.183	12.588	12.575	12.580	12.578	12.585	12.579	12.578	12.578	3.247	3.252	3.264	3.259	5.78984	2.518E-02	1.258E-02	1.243E-04	5.4976E-08	1882.79	1.8828	-0.793	-1.187
Pre-Irradiation	FW7-01	25.387	25.382	25.385	25.386	12.738	12.733	12.738	12.738	12.738	12.732	12.738	12.736	3.205	3.203	3.203	3.208	5.7641	2.539E-02	1.274E-02	1.274E-04	5.32736E-08	1812.11	1.8121		
Post-Irradiation		25.199	25.190	25.197	25.201	12.560	12.571	12.563	12.570	12.568	12.555	12.552	12.552	3.255	3.251	3.255	3.270	5.7619	2.520E-02	1.256E-02	1.239E-04	5.50509E-08	1878.37	1.8784	-0.742	-1.374
Pre-Irradiation	FW7-02	25.381	25.380	25.377	25.377	12.734	12.734	12.736	12.738	12.733	12.732	12.733	12.737	3.198	3.200	3.205	3.203	5.7693	2.538E-02	1.273E-02	1.274E-04	5.31681E-08	1814.65	1.8147		
Post-Irradiation		25.245	25.245	25.246	25.246	12.638	12.635	12.636	12.637	12.635	12.641	12.642	12.633	3.245	3.241	3.226	3.235	5.76571	2.525E-02	1.264E-02	1.254E-04	5.43345E-08	1852.67	1.8527	-0.525	-0.765
Pre-Irradiation	FW7-03	25.387	25.386	25.387	25.382	12.736	12.733	12.736	12.734	12.738	12.734	12.736	12.736	3.203	3.198	3.200	3.205	5.7559	2.539E-02	1.274E-02	1.274E-04	5.31681E-08	1809.75	1.8098		
Post-Irradiation		25.269	25.281	25.272	25.267	12.647	12.646	12.650	12.653	12.651	12.645	12.646	12.655	3.241	3.230	3.236	3.233	5.75341	2.527E-02	1.265E-02	1.257E-04	5.4281E-08	1843.13	1.8431	-0.447	-0.676
Pre-Irradiation	FW8-01	25.383	25.377	25.381	25.377	12.709	12.708	12.713	12.718	12.710	12.710	12.714	12.717	3.205	3.203	3.208	3.205	5.7551	2.538E-02	1.271E-02	1.269E-04	5.32947E-08	1816.68	1.8167		
Post-Irradiation		24.826	24.842	24.850	24.829	12.660	12.646	12.635	12.642	12.668	12.658	12.671	12.668	3.227	3.240	3.261	3.227	5.75263	2.484E-02	1.266E-02	1.258E-04	5.44083E-08	1873.77	1.8738	-2.139	-0.442
Pre-Irradiation	FW8-02	25.380	25.383	25.381	25.383	12.709	12.708	12.710	12.717	12.713	12.713	12.713	12.720	3.205	3.208	3.208	3.205	5.7571	2.538E-02	1.271E-02	1.269E-04	5.33369E-08	1817.03	1.8170		
Post-Irradiation		24.944	24.954	24.952	24.950	12.666	12.657	12.643	12.656	12.669	12.658	12.660	12.656	3.232	3.217	3.226	3.213	5.75462	2.495E-02	1.266E-02	1.258E-04	5.38449E-08	1864.79	1.8648	-1.702	-0.429
Pre-Irradiation	FW9-01	25.387	25.392	25.390	25.386	12.719	12.718	12.717	12.717	12.723	12.718	12.718	12.718	3.211	3.203	3.205	3.200	5.7732	2.539E-02	1.272E-02	1.270E-04	5.32736E-08	1819.95	1.8200		
Post-Irradiation		25.193	25.202	25.199	25.197	12.596	12.600	12.602	12.606	12.602	12.599	12.608	12.610	3.246	3.247	3.252	3.242	5.77081	2.520E-02	1.260E-02	1.247E-04	5.46867E-08	1868.39	1.8684	-0.753	-0.907
Pre-Irradiation	FW9-02	25.386	25.389	25.386	25.387	12.725	12.717	12.717	12.718	12.724	12.715	12.715	12.713	3.211	3.208	3.208	3.208	5.7547	2.539E-02	1.272E-02	1.270E-04	5.34003E-08	1814.42	1.8144		
Post-Irradiation		24.738	24.733	24.738	24.740	12.661	12.671	12.685	12.704	12.669	12.645	12.655	12.670	3.246	3.226	3.233	3.214	5.75206	2.474E-02	1.267E-02	1.261E-04	5.41104E-08	1876.85	1.8768	-2.559	-0.377
Pre-Irradiation	FW9-03	25.382	25.380	25.381	25.381	12.717	12.714	12.711	12.718	12.718	12.718	12.715	12.719	3.203	3.203	3.203	3.203	5.7710	2.538E-02	1.272E-02	1.270E-04	5.32103E-08	1820.40	1.8204		
Post-Irradiation		24.767	24.765	24.769	24.770	12.678	12.662	12.662	12.678	12.671	12.664	12.659	12.673	3.226	3.230	3.225	3.228	5.76706	2.477E-02	1.267E-02	1.260E-04	5.4015E-08	1879.81	1.8798	-2.416	-0.376
Pre-Irradiation	FW10-01	25.394	25.394	25.392	25.392	12.723	12.723	12.723	12.723	12.722	12.719	12.718	12.722	3.205	3.205	3.200	3.205	5.7745	2.539E-02	1.272E-02	1.271E-04	5.32525E-08	1819.13	1.8191		
Post-Irradiation		25.184	25.188	25.187	25.188	12.565	12.570	12.570	12.572	12.573	12.577	12.579	12.582	3.250	3.256	3.252	3.255	5.77124	2.519E-02	1.257E-02	1.242E-04	5.49008E-08	1878.39	1.8784	-0.812	-1.163
Pre-Irradiation	FW10-02	25.390	25.390	25.390	25.387	12.722	12.723	12.724	12.723	12.723	12.725	12.722	12.720	3.208	3.208	3.208	3.208	5.7841	2.539E-02	1.272E-02	1.271E-04	5.33792E-08	1822.13	1.8221		
Post-Irradiation		25.171	25.167	25.168	25.168	12.566	12.562	12.563	12.567	12.583	12.584	12.580	12.574	3.245	3.264	3.245	3.250	5.7814	2.517E-02	1.257E-02	1.241E-04	5.48149E-08	1883.38	1.8834	-0.869	-1.182
Pre-Irradiation	FW10-03	25.382	25.382	25.382	25.383	12.720	12.719	12.719	12.722	12.723	12.723	12.722	12.724	3.208	3.208	3.203	3.208	5.7886	2.538E-02	1.272E-02	1.271E-04	5.33369E-08	1824.38	1.8244		
Post-Irradiation		24.605	24.609	24.612	24.616	12.704	12.687	12.687	12.705	12.699	12.671	12.676	12.708	3.232	3.227	3.208	3.209	5.78597	2.461E-02	1.269E-02	1.265E-04	5.37502E-08	1890.86	1.8909	-3.042	-0.230
Pre-Irradiation	FW11-01	25.383	25.383	25.382	25.383	12.724	12.718	12.720	12.722	12.725	12.720	12.724	12.724	3.203	3.205	3.205	3.205	5.7770	2.538E-02	1.272E-02	1.271E-04	5.32736E-08	1820.41	1.8204		
Post-Irradiation		24.837	24.829	24.820	24.825	12.700	12.673	12.670	12.677	12.691	12.666	12.673	12.679	3.221	3.245	3.219	3.231	5.77438	2.483E-02	1.268E-02	1.263E-04	5.40784E-08	1874.52	1.8745	-2.188	-0.343
Pre-Irradiation	FW11-02	25.389	25.383	25.383	25.385	12.727	12.723	12.722	12.723	12.729	12.725	12.719	12.729	3.205	3.203	3.205	3.203	5.7712	2.539E-02	1.272E-02	1.272E-04	5.32525E-08	1817.74	1.8177		
Post-Irradiation		24.826	24.826	24.834	24.830	12.683	12.675	12.678	12.696	12.692	12.692	12.681	12.690	3.217	3.227	3.245	3.236	5.76812	2.483E-02	1.269E-02	1.264E-04	5.41536E-08	1870.26	1.8703	-2.191	-0.304
Pre-Irradiation	FW11-03	25.386	25.386	25.386	25.385	12.729	12.722	12.724	12.729	12.725	12.719	12.720	12.725	3.205	3.200	3.200	3.205	5.7713	2.539E-02	1.272E-02	1.272E-04	5.32102E-08	1817.79	1.8178		
Post-Irradiation		25.262	25.255	25.268	25.269	12.555	12.557	12.555	12.551	12.551	12.560	12.555	12.551	3.266	3.258	3.240	3.274	5.76861	2.526E-02	1.255E-02	1.238E-04	5.51038E-08	1877.66	1.8777	-0.481	-1.335
Pre-Irradiation	FW12-01	25.387	25.389	25.385	25.389	12.729	12.728	12.727	12.725	12.729	12.725	12.725	12.724	3.200	3.198	3.200	3.203	5.7506	2.539E-02	1.273E-02	1.272E-04	5.31259E-08	1810.42	1.8104		
Post-Irradiation		25.037	25.050	25.047	25.045	12.692	12.697	12.703	12.701	12.703	12.695	12.691	12.699	3.226	3.208	3.237	3.218	5.74748	2.504E-02	1.270E-02	1.266E-04	5.38554E-08	1843.59	1.8436	-1.349	-0.228
Pre-Irradiation	FW13-01	25.385	25.381	25.381	25.383	12.730	12.728	12.730	12.730	12.725	12.724	12.725	12.727	3.205	3.208	3.200	3.205	5.7910	2.538E-02	1.273E-02	1.272E-04	5.32736E-08	1823.30	1.8233		
Post-Irradiation		24.909	24.904	24.911	24.920	12.651	12.647	12.653	12.651	12.650	12.644	12.640	12.643	3.213	3.241	3.230	3.246	5.78689	2.491E-02	1.265E-02	1.256E-04	5.41954E-08	1881.69	1.8817	-1.858	-0.630

Table 51 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for NBG-17 graphite

Modulus by Resonant Frequency

Specimen number - Post-Irrad in Red			AW1-01	AW1-01	AW1-02	AW1-02	AW1-03	AW1-03	AL6-01	AL6-01	AW2-01	AW2-01	AW2-02	AW2-02	AW2-03	AW2-03	AL6-02	AL6-02	AW4-01	AW4-01	AL6-03	AW4-02	AW4-02	AW4-03	AW4-03	AW5-01	AW5-01	AL8-01	AL8-01	AW5-02	AW5-02	AW5-03	AW5-03	AW6-01	AW6-01	AW6-02	AW6-02
Sample location (engraved id)			1S3		1S11		1S12		1S13		1U3		1U11		1U12		2S4		2S6		2S10	2U4		2U6		2U10		3S8		3S13		3U8		3U12		4S8	
mass of bar	m	[g]	5.8614	5.85945	5.9043	5.90304	5.9168	5.91571	5.9342	5.93358	5.9366	5.93583	5.9269	5.92573	5.9217	5.92098	5.9218	5.92101	5.9331	5.93195	5.9401	5.9364	5.93533	5.9319	5.93021	5.9411	5.93993	5.9178	5.9166	5.9287	5.92798	5.9198	5.91835	5.9383	5.93716	5.9258	5.92491
length of bar	L	[mm]	25.37936	24.749	25.37333	24.827	25.37079	25.061	25.36889	25.033	25.37619	25.107	25.37714	25.118	25.37841	25.251	25.37143	24.625	25.37651	24.829	25.36063	25.37587	25.029	25.38825	25.163	25.37682	25.259	25.35873	24.786	25.37492	24.986	25.37555	25.143	25.37841	25.266	25.37746	24.918
diameter of bar	D	[mm]	12.73127	12.625	12.73969	12.649	12.74080	12.706	12.73429	12.591	12.73921	12.590	12.73540	12.599	12.72270	12.665	12.73207	12.681	12.73810	12.671	12.73683	12.73699	12.714	12.74350	12.632	12.74128	12.685	12.72651	12.690	12.72905	12.719	12.73524	12.608	12.74032	12.687	12.73524	12.680
Poisson's ratio	μ		0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
average resonant frequency	f_{avg}	[Hz]	29655	40810	29779	41190	29749	39960	30515	42140	29880	40700	29894	41200	30001	40620	30569	41730	29949	40900	30509	30012	39900	29877	41250	30020	40600	30360	40410	30009	39600	29937	42230	30019	40450	29914	39500
frequency data	f_i	1	29662	40800	29777	41200	29800	39900	30549	42100	29420	40700	29927	41200	29975	40600	30573	41700	29932	40600	30536	30007	39900	29876	41200	30052	40600	30362	40400	30010	39400	29941	42200	30043	40400	29914	39500
(specimen number		2	29650	40800	29783	41200	29807	39900	30520	42100	29918	40700	29956	41200	30017	40600	30572	41600	29937	40900	30512	30009	39900	29907	41300	29773	40600	30265	40500	30009	39400	29932	42200	30018	40500	29924	39500
oriented up in fixture)		3	29662	40900	29669	41200	29800	40000	30519	42100	29934	40700	29924	41200	30030	40600	30578	41900	29926	40900	30508	30022	39900	29883	41200	30048	40600	30368	40400	30012	39300	29936	42200	30040	40400	29906	39500
		4	29670	40800	29780	41200	29793	40000	30522	42100	29922	40700	29598	41200	30030	40600	30568	41700	29944	40900	30504	30009	39900	29886	41400	30048	40600	30368	40400	30009	39700	29932	42300	30017	40400	29916	39500
		5	29666	40800	29786	41300	29539	40000	30517	42200	29924	40700	29924	41200	30023	40600	30571	41700	29962	40900	30512	30013	39900	29863	41400	30039	40600	30371	40400	30010	39700	29938	42200	30036	40500	29914	39500
		6	29658	40800	29771	41200	29794	40000	30507	42100	29920	40700	29934	41200	29971	40700	30566	41800	29961	40900	30509	30015	39900	29883	41200	30044	40600	30383	40400	30003	39700	29943	42300	30020	40400	29930	39500
		7	29647	40800	29828	41200	29795	39900	30515	42300	29984	40700	29915	41200	29984	40600	30566	41700	29930	41000	30504	30012	39900	29886	41200	30050	40600	30371	40400	30007	39700	29942	42300	30029	40500	29921	39500
		8	29654	40800	29776	41200	29794	39900	30504	42100	29933	40700	29920	41200	29990	40600	30560	41800	29958	41000	30504	30008	39900	29876	41200	30047	40600	30367	40400	30000	39700	29932	42200	29993	40500	29901	39500
		9	29648	40800	29815	41000	29575	40000	30500	42100	29925	40700	29923	41200	29995	40600	30567	41700	29962	40900	30503	30013	39900	29861	41200	30049	40600	30370	40400	30009	39700	29941	42200	29992	40500	29913	39500
		10	29634	40800	29804	41200	29794	40000	30498	42200	29921	40700	29917	41200	29990	40700	30565	41700	29974	41000	30501	30008	39900	29852	41200	30049	40600	30374	40400	30018	39700	29931	42200	29997	40400	29904	39500
correction factor for rod		T_1	2.11268	2.147387	2.114512	2.144688	2.114895	2.134644	2.114005	2.118118	2.114206	2.111989	2.113519	2.112532	2.111384	2.112418	2.113445	2.167263	2.114003	2.148331	2.115077	2.113876	2.138426	2.113923	2.114176	2.114486	2.114909	2.113576	2.155099	2.112681	2.14294	2.113622	2.112021	2.114205	2.114625	2.113468	2.142238
modulus of elasticity **		E	1.09E+10	2.01E+10	1.10E+10	2.06E+10	1.10E+10	1.96E+10	1.17E+10	2.24E+10	1.12E+10	2.10E+10	1.12E+10	2.15E+10	1.13E+10	2.07E+10	1.17E+10	2.07E+10	1.12E+10	2.03E+10	1.16E+10	1.13E+10	1.95E+10	1.12E+10	2.14E+10	1.13E+10	2.07E+10	1.15E+10	1.96E+10	1.13E+10	1.91E+10	1.12E+10	2.25E+10	1.13E+10	2.06E+10	1.12E+10	1.90E+10
T_1 correction factor			2.28643	2.330332	2.288743	2.326911	2.289226	2.314193	2.288103	2.293298	2.288357	2.285558	2.28749	2.286243	2.284795	2.286099	2.287396	2.355549	2.2881	2.331528	2.289456	2.28794	2.318981	2.287999	2.288319	2.28871	2.289245	2.287561	2.340109	2.286431	2.324697	2.287619	2.285598	2.288356	2.288886	2.287425	2.323808
calculation of individual			0.030921	0.033067	0.031032	0.032897	0.031055	0.03227	0.031001	0.031252	0.031014	0.030879	0.030972	0.030912	0.030842	0.030905	0.030967	0.034333	0.031001	0.033127	0.031066	0.030993	0.032505	0.030996	0.031012	0.031031	0.031056	0.030975	0.033555	0.030921	0.032788	0.030978	0.030881	0.031013	0.031039	0.030969	0.032744
terms			0.324996	0.347557	0.326166	0.345772	0.326411	0.339175	0.325842	0.328475	0.32597	0.324556	0.325532	0.324902	0.32417	0.324829	0.325484	0.360858	0.32584	0.348182	0.326527	0.325759	0.341651	0.325789	0.325951	0.326149	0.32642	0.325568	0.352685	0.324997	0.344619	0.325597	0.324576	0.32597	0.326238	0.325499	0.344156
			2.275419	2.318945	2.277713	2.315554	2.278192	2.302944	2.277078	2.282228	2.27733	2.274555	2.27647	2.275234	2.273798	2.275091	2.276377	2.343947	2.277075	2.320132	2.278419	2.276916	2.307691	2.276975	2.277292	2.27768	2.27821	2.276541	2.328639	2.275421	2.313359	2.276598	2.274584	2.277329	2.277854	2.276406	2.312477
resultant T_1		T_1	2.11268	2.147387	2.114512	2.144688	2.114895	2.134644	2.114005	2.118118	2.114206	2.111989	2.113519	2.112532	2.111384	2.112418	2.113445	2.167263	2.114003	2.148331	2.115077	2.113876	2.138426	2.113923	2.114176	2.114486	2.114909	2.113576	2.155099	2.112681	2.14294	2.113622	2.112021	2.114205	2.114625	2.113468	2.142238
modulus of elasticity *	E	[Pa]	1.09E+10	2.01E+10	1.10E+10	2.06E+10	1.10E+10	1.96E+10	1.17E+10	2.24E+10	1.12E+10	2.10E+10	1.12E+10	2.15E+10	1.13E+10	2.07E+10	1.17E+10	2.07E+10	1.12E+10	2.03E+10	1.16E+10	1.13E+10	1.95E+10	1.12E+10	2.14E+10	1.13E+10	2.07E+10	1.15E+10	1.96E+10	1.13E+10	1.91E+10	1.12E+10	2.25E+10	1.13E+10	2.06E+10	1.12E+10	1.90E+10
Fractional change	$(E_i-E_0)/E$	%		84.52		87.04		77.39		92.06		88.12		92.15		83.95		77.57		81.25				72.82		92.20		83.61		70.58		69.15		101.26		82.23		70.21

Table 52 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for NBG-17 graphite (cont.)

AL8-02	AL8-02	AW6-03	AW6-03	AW7-01	AW7-01	AW7-02	AL8-03	AW7-03	AW7-03	AW9-01	AW9-01	AW9-02	AW9-03	AW9-03	AW10-01	AW10-01	AW10-02	AW10-02	AW10-03	AW10-03	AW12-01	AW12-01	AW12-02	AW12-03	AW12-03	AW13-01	AW13-01	AL7-01	AL7-02	AW13-02	AW13-02	AW13-03
4S11		4S12		4U8		4U11	5S3	5S6		5S14		5U3	5U6		5U13		6S1		6S8		6S15		6U1	6U8		6U14		Spare 1A	Spare 2A	Spare 1W		Spare 2W
5.9359	5.93496	5.9126	5.91163	5.9322	5.93151	5.9339	5.9307	5.9369	5.91989	5.9210	5.93087	5.9283	5.9321	5.92697	5.9287	5.93569	5.9365	5.9355	5.9260	5.92511	5.9283	5.92711	5.9355	5.9277	5.92652	5.9277	5.92154	5.9224	5.9248	5.9269	5.92546	5.9357
25.38095	25.168	25.38317	25.100	25.37460	25.178	25.37587	25.36889	25.37936	24.687	25.37936	24.748	25.38032	25.37873	25.100	25.38286	25.124	25.37841	24.601	25.37746	24.644	25.35650	24.962	25.37524	25.35746	25.102	25.37238	25.254	25.36857	25.36444	25.36730	24.663	25.36381
12.73604	12.630	12.72985	12.704	12.73874	12.638	12.73778	12.73556	12.73715	12.687	12.73080	12.679	12.73270	12.73699	12.581	12.72905	12.592	12.73985	12.685	12.73508	12.681	12.73921	12.727	12.73223	12.72731	12.597	12.73112	12.683	12.72159	12.73080	12.73556	12.696	12.73604
0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
29882	41300	29846	39600	29919	41400	30009	30475	30061	39590	29730	40900	29972	29953	41870	29934	40630	29893	40841	29818	40490	29980	39614	29893	29958	41358	29877	40318	30551	30558	29980	39916	30013
29884	41300	29846	39600	29915	41400	30008	30483	30055	39600	29731	40900	29983	29952	41900	29948	40700	29879	40830	29760	40490	29953	39620	29997	29954	41350	29882	40320	30601	30616	29976	39910	30018
29883	41300	29841	39600	29918	41400	30013	30474	30071	39600	29733	40900	29971	29949	41800	29941	40600	29879	40830	29747	40490	29978	39620	29974	29961	41360	29874	40310	30600	30597	29977	39920	30008
29888	41300	29845	39600	29911	41400	30013	30476	30062	39600	29732	40900	29969	29945	41900	29938	40600	29877	40820	29748	40490	29989	39610	30002	29960	41360	29886	40320	30604	30595	30061	39910	30006
29882	41300	29845	39600	29908	41400	30009	30475	30058	39400	29735	40900	29963	29948	41900	29932	40700	29895	40850	29745	40490	29980	39620	30007	29963	41370	29884	40310	30611	30561	29976	39910	30009
29885	41300	29836	39600	29919	41400	30013	30474	30061	39400	29732	40900	29976	29954	41800	29936	40600	29894	40840	29741	40490	29978	39610	29913	29954	41360	29879	40320	30605	30497	29986	39930	30015
29879	41300	29843	39600	29917	41400	30015	30472	30062	39700	29727	40900	29975	29952	41900	29938	40600	29896	40850	29955	40490	29989	39620	30003	29958	41350	29878	40320	30626	30505	29954	39910	30010
29876	41300	29845	39600	29915	41400	30005	30475	30058	39600	29724	40900	29959	29952	41800	29934	40600	29902	40850	29907	40500	29977	39610	29904	29956	41370	29876	40310	30578	30694	29991	39920	30015
29875	41300	29855	39600	29917	41400	30007	30470	30061	39600	29734	40900	29982	29961	41900	29920	40700	29884	40850	29806	40490	29987	39600	30019	29955	41350	29881	40320	30604	30529	29966	39930	30021
29880	41300	29849	39600	29924	41400	30001	30474	30062	39700	29724	40900	29975	29957	41900	29931	40600	29909	40840	29880	40480	29982	39610	29840	29964	41360	29867	40320	30097	30453	29961	39910	30014
29890	41300	29854	39600	29941	41400	30003	30476	30056	39700	29731	40900	29968	29958	41900	29920	40600	29912	40850	29892	40490	29983	39620	29270	29959	41350	29867	40330	30581	30531	29954	39910	30014
2.113315	2.113468	2.112145	2.130971	2.114258	2.113949	2.114003	2.114209	2.11362	2.162913	2.112604	2.156447	2.112832	2.113646	2.11104	2.112044	2.110854	2.114129	2.170128	2.113443	2.16566	2.115791	2.146353	2.113164	2.113805	2.113406	2.113216	2.115032	2.111996	2.113803	2.114336	2.16658	2.114694
1.12E+10	2.15E+10	1.11E+10	1.93E+10	1.12E+10	2.16E+10	1.13E+10	1.16E+10	1.13E+10	1.87E+10	1.11E+10	2.02E+10	1.12E+10	1.12E+10	2.22E+10	1.12E+10	2.10E+10	1.12E+10	1.99E+10	1.11E+10	1.96E+10	1.12E+10	1.90E+10	1.12E+10	1.12E+10	2.16E+10	1.12E+10	2.04E+10	1.17E+10	1.17E+10	1.12E+10	1.90E+10	1.13E+10
2.287232	2.287424	2.285755	2.309545	2.288422	2.288032	2.2881	2.28836	2.287617	2.350026	2.286334	2.341819	2.286622	2.28765	2.28436	2.285627	2.284124	2.28826	2.359188	2.287393	2.353513	2.290358	2.32902	2.287041	2.28785	2.287347	2.287106	2.289399	2.285567	2.287848	2.288521	2.354681	2.288972
0.030959	0.030969	0.030888	0.032042	0.031017	0.030998	0.031001	0.031014	0.030978	0.034054	0.030916	0.033641	0.03093	0.03098	0.030821	0.030882	0.03081	0.031009	0.034517	0.030967	0.03423	0.03111	0.033002	0.03095	0.030989	0.030965	0.030953	0.031064	0.030879	0.030989	0.031021	0.034289	0.031043
0.325401	0.325499	0.324655	0.33678	0.326003	0.325806	0.325841	0.325972	0.325596	0.357923	0.324948	0.353585	0.325093	0.325613	0.323951	0.324591	0.323832	0.325921	0.362798	0.325483	0.359775	0.326984	0.346872	0.325305	0.325714	0.32546	0.325338	0.326498	0.32456	0.325713	0.326054	0.360396	0.326282
2.276214	2.276405	2.27475	2.298336	2.277394	2.277008	2.277075	2.277333	2.276596	2.338471	2.275324	2.330334	2.27561	2.276629	2.273367	2.274623	2.273134	2.277233	2.347555	2.276374	2.341928	2.279314	2.317645	2.276025	2.276828	2.276328	2.27609	2.278363	2.274564	2.276825	2.277493	2.343086	2.27794
2.113315	2.113468	2.112145	2.130971	2.114258	2.113949	2.114003	2.114209	2.11362	2.162913	2.112604	2.156447	2.112832	2.113646	2.11104	2.112044	2.110854	2.114129	2.170128	2.113443	2.16566	2.115791	2.146353	2.113164	2.113805	2.113406	2.113216	2.115032	2.111996	2.113803	2.114336	2.16658	2.114694
1.12E+10	2.15E+10	1.11E+10	1.93E+10	1.12E+10	2.16E+10	1.13E+10	1.16E+10	1.13E+10	1.87E+10	1.11E+10	2.02E+10	1.12E+10	1.12E+10	2.22E+10	1.12E+10	2.10E+10	1.12E+10	1.99E+10	1.11E+10	1.96E+10	1.12E+10	1.90E+10	1.12E+10	1.12E+10	2.16E+10	1.12E+10	2.04E+10	1.17E+10	1.17E+10	1.12E+10	1.90E+10	1.13E+10
	92.56		73.12		93.04			65.52		82.37			98.17		86.68		77.54		75.99		69.58			92.60		82.27					68.99	

Table 53 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for NBG-18 graphite

Modulus by Resonant Frequency

Specimen number -Post Irrad in Red			BL6-01	BW1-01	BW1-01	BW1-02	BW1-02	BW1-03	BW1-03	BW2-01	BW2-01	BW2-02	BW2-02	BL6-02	BL6-02	BW2-03	BW2-03	BW3-01	BW3-01	BW3-02	BW3-02	BW3-03	BW3-03	BL6-03	BL6-03	BW5-01	BW5-01	BW5-02	BW5-02	BW5-03	BW5-03	BW7-01	BW7-01	BW7-02	BW7-02	BL7-01	BL7-01
Sample location (engraved id)			1S1	1S4		1U1		1U4		2S2		2S11		2S12		2U2		2U11		3S2		3S11		3S12		3S14		3U2		3U11		3U13		4S5		4S7	
mass of bar	m	[g]	5.9514	5.9653	5.96433	5.9715	5.97086	5.9608	5.95953	5.9707	5.96975	5.9706	5.97009	5.9668	5.96582	5.9744	5.97338	5.9657	5.96511	5.9512	5.95069	5.9714	5.97072	5.9625	5.96165	5.9693	5.96794	5.9594	5.95867	5.9704	5.96579	5.9624	5.96184	5.9578	5.95707	5.9751	5.97459
length of bar	L	[mm]	25.3705	25.3736	24.724	25.3689	25.222	25.3689	25.063	25.3654	24.622	25.3663	24.766	25.3695	25.061	25.3638	25.056	25.3660	25.115	25.3787	24.792	25.3679	24.638	25.3724	24.538	25.3638	24.731	25.3686	25.083	25.3654	25.098	25.3689	25.153	25.3743	24.788	25.3673	24.952
diameter of bar	D	[mm]	12.7356	12.7381	12.642	12.7424	12.675	12.7330	12.575	12.7410	12.661	12.7421	12.662	12.7357	12.573	12.7324	12.562	12.7418	12.612	12.7295	12.625	12.7411	12.690	12.7400	12.701	12.7376	12.693	12.7397	12.591	12.7386	12.593	12.7380	12.624	12.7394	12.665	12.7408	12.724
Poisson's ratio	μ		0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
average resonant frequency	$f_{av,0}$	[Hz]	31596	31028	41410	31153	41437	31071	40827	31109	41187	31256	41407	31001	41799	31258	41739	31078	42006	31086	41727	31146	40411	31088	40823	31086	40135	31204	41592	31238	42735	30893	41702	31187	40019	31767	40603
frequency data	f	1	31592	31029	41400	31154	41450	31067	40820	31106	41180	31283	41410	31002	41800	31261	41720	31100	42020	31084	41720	31141	40410	31084	40820	31094	40120	31189	41600	31239	42760	30889	41710	31151	40020	31766	40620
(specimen number		2	31603	31026	41420	31156	41450	31119	40820	31111	41180	31314	41410	31003	41810	31247	41730	31042	42040	31094	41730	31138	40420	31090	40820	31122	40130	31143	41580	31244	42750	30890	41720	31173	40020	31765	40610
oriented up in fixture)		3	31600	31065	41410	31158	41460	31098	40860	31116	41180	31306	41400	31002	41790	31258	41730	31081	42000	31082	41720	31172	40450	31082	40830	31136	40130	31190	41570	31229	42740	30900	41690	31178	40020	31766	40610
		4	31591	31019	41410	31154	41440	31042	40820	31099	41190	31110	41410	31000	41800	31249	41720	31084	42000	31088	41730	31132	40410	31085	40820	31053	40140	31203	41620	31240	42750	30898	41690	31177	40010	31761	40600
		5	31600	31034	41410	31159	41440	31102	40830	31119	41200	31207	41400	31000	41790	31261	41760	31071	42000	31090	41740	31142	40410	31080	40820	31056	40140	31191	41620	31236	42730	30891	41710	31208	40020	31764	40610
		6	31597	31018	41410	31154	41430	31092	40850	31104	41190	31224	41410	31001	41803	31261	41740	31080	42000	31073	41730	31191	40400	31088	40840	31051	40123	31226	41590	31239	42720	30884	41690	31139	40010	31765	40600
		7	31595	31006	41410	31147	41430	31010	40820	31114	41180	31271	41410	31001	41800	31259	41740	31093	42000	31089	41730	31146	40400	31084	40820	31056	40140	31234	41580	31237	42730	30894	41720	31271	40020	31767	40580
		8	31601	31033	41400	31154	41420	31006	40810	31107	41190	31274	41410	30997	41800	31267	41760	31077	42000	31086	41720	31133	40420	31095	40820	31120	40150	31261	41570	31242	42720	30896	41690	31192	40010	31768	40580
		9	31587	31024	41410	31150	41420	31093	40820	31102	41190	31281	41400	30999	41800	31259	41750	31072	42000	31084	41710	31136	40400	31102	40830	31121	40140	31219	41580	31238	42730	30894	41680	31204	40020	31769	40620
		10	31596	31027	41420	31153	41430	31085	40820	31109	41190	31292	41410	31004	41800	31261	41740	31076	42000	31091	41740	31129	40390	31086	40810	31051	40140	31186	41610	31238	42720	30894	41720	31180	40040	31774	40600
correction factor for rod		T_f	2.11408086	2.11423244	2.1523646	2.11530258	2.11637388	2.11380158	2.1130732	2.11535476	2.16426495	2.11545621	2.15209855	2.1141829	2.11283064	2.11410842	2.11163651	2.11543088	2.11489669	2.11245146	2.14374804	2.11517568	2.1677366	2.11463983	2.17840143	2.11494812	2.16021976	2.11489555	2.11399926	2.11497504	2.11316469	2.11459217	2.11367415	2.11438483	2.15064452	2.11517591	2.14655309
modulus of elasticity **		E	1.25E+10	1.21E+10	2.09E+10	1.22E+10	2.17E+10	1.21E+10	2.12E+10	1.22E+10	2.05E+10	1.23E+10	2.09E+10	1.21E+10	2.23E+10	1.23E+10	2.23E+10	1.21E+10	2.24E+10	1.22E+10	2.14E+10	1.22E+10	1.96E+10	1.21E+10	1.97E+10	1.22E+10	1.94E+10	1.22E+10	2.20E+10	1.23E+10	2.33E+10	1.20E+10	2.21E+10	1.22E+10	1.95E+10	1.27E+10	2.01E+10
T_f correction factor			2.28819863	2.28839003	2.33664149	2.28974135	2.2910943	2.28784601	2.28692638	2.28980725	2.35174168	2.28993537	2.33630412	2.28832748	2.28662015	2.28823343	2.28511269	2.28990338	2.28923259	2.28614145	2.32572204	2.28958111	2.35615053	2.28890444	2.36970489	2.28929374	2.34660657	2.28922736	2.28809602	2.28932774	2.28704189	2.28884426	2.28768511	2.28858245	2.33446053	2.2895814	2.32927452
calculation of individual			0.03100592	0.03101514	0.03338173	0.03108023	0.03114547	0.03098895	0.03094471	0.03108341	0.03414023	0.03108958	0.03336489	0.03101213	0.03092999	0.0310076	0.03085755	0.03108804	0.03105572	0.03090697	0.03283847	0.03107251	0.0343633	0.03103991	0.03505363	0.03105866	0.03388133	0.03105547	0.031000965	0.0310603	0.03095027	0.03103701	0.03098121	0.0310244	0.03327289	0.03107252	0.03301478
terms			0.32589042	0.32598727	0.35086157	0.32667144	0.32735717	0.32571203	0.32524702	0.32670483	0.35883379	0.32676974	0.35068448	0.32595562	0.32509225	0.32590803	0.32433092	0.32675353	0.32641377	0.32485039	0.34515153	0.32659028	0.36117836	0.32624763	0.3684342	0.32644474	0.35611264	0.32641113	0.32583829	0.32646716	0.32633041	0.32621716	0.32563065	0.32608465	0.34971752	0.32659042	0.34700464
			2.27717286	2.27736262	2.32920109	2.27870237	2.28004375	2.27682325	2.27591149	2.2767677	2.34017203	2.27889473	2.32486661	2.27730061	2.27560788	2.27720736	2.27411333	2.27686301	2.27619797	2.27513328	2.31437348	2.2785435	2.34454315	2.27877263	2.3579815	2.27625859	2.33580898	2.27819278	2.27707071	2.2762923	2.27602601	2.27781296	2.27666373	2.2775534	2.3230388	2.27854379	2.31789718
resultant T_f		T_f	2.11408086	2.11423244	2.1523646	2.11530258	2.11637388	2.11380158	2.1130732	2.11535476	2.16426495	2.11545621	2.15209855	2.1141829	2.11283064	2.11410842	2.11163651	2.11543088	2.11489669	2.11245146	2.14374804	2.11517568	2.1677366	2.11463983	2.17840143	2.11494812	2.16021976	2.11489555	2.11399926	2.11497504	2.11316469	2.11459217	2.11367415	2.11438483	2.15064452	2.11517591	2.14655309
modulus of elasticity *	E	[Pa]	1.25E+10	1.21E+10	2.09E+10	1.22E+10	2.17E+10	1.21E+10	2.12E+10	1.22E+10	2.05E+10	1.23E+10	2.09E+10	1.21E+10	2.23E+10	1.23E+10	2.23E+10	1.21E+10	2.24E+10	1.22E+10	2.14E+10	1.22E+10	1.96E+10	1.21E+10	1.97E+10	1.22E+10	1.94E+10	1.22E+10	2.20E+10	1.23E+10	2.33E+10	1.20E+10	2.21E+10	1.22E+10	1.95E+10	1.27E+10	2.01E+10
Fractional change	$(E_f-E_0)/E$	%			72.87		77.65		74.91		68.19		70.38		84.37		81.13		84.65		76.15		60.61		62.62		60.04		79.90		89.51		84.02		59.84		58.62

Table 54 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for NBG-18 graphite (cont.)

BW7-03	BW7-03	BW8-01	BW8-01	BW8-02	BW8-02	BW8-03	BL7-02	BL7-02	BW9-01	BW9-01	BW9-02	BW9-02	BW9-03	BW9-03	BW10-01	BW10-01	BW10-02	BW10-02	BL7-03	BW10-03	BW10-03	BW11-01	BW11-01	BW11-02	BW11-02	BW11-03	BW12-01	BW12-01	BL8-01	BL8-02	BW12-02	BW12-02	BW12-03	BW12-03
4S14		4U5		4U7		4U13	5S5		5S8		5S15		5U5		5U8		5U14		6S3	6S6		6S13		6U3		6U6	6U12		Spare 1A	Spare 2A	Spare 1W		Spare 2W	
5.9619	5.96118	5.9639	5.96327	5.9649	5.96354	5.9588	5.9591	5.95809	5.9733	5.97195	5.9530	5.95168	5.9693	5.96865	5.9741	5.97249	5.9621	5.96113	5.9632	5.9708	5.96974	5.9612	5.96049	5.9666	5.96569	5.9674	5.9644	5.96324	5.9728	5.9868	5.9721	5.97036	5.9791	5.97738
25.3644	25.065	25.3822	25.099	25.3743	25.176	25.3594	25.3654	25.219	25.3784	24.722	25.3670	24.789	25.3794	25.014	25.3797	25.101	25.3755525	25.14375	25.3892	25.3762	24.567	25.3730	24.650	25.3740	25.236	25.3721	25.3708	25.106	25.3756	25.3549	25.3771	25.048	25.3613	24.788
12.7329	12.706	12.7376	12.591	12.7364	12.630	12.7322	12.7379	12.671	12.7351	12.692	12.7267	12.683	12.7257	12.704	12.7406	12.599	12.7288925	12.625	12.7384	12.7341	12.688	12.7397	12.639	12.7379	12.673	12.7383	12.7394	12.604	12.7437	12.7616	12.7402	12.706	12.7459	12.690
0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
31228	40448	31061	42330	31087	42448	30973	31467	42033	31019	39849	31176	40034	31199	40408	31011	41874	31113.8	41825	31642	31104	41244	31090	40901	31205	41482	31079	31018	41547	31747	31658	31093	40581	31058	39903
31234	40460	31055	42340	31085	42460	30985	31462	42050	31010	39870	31156	40040	31201	40410	31015	41890	31118	41840	31675	31094	41250	31125	40910	31210	41490	31076	31017	41550	31787	31619	31093	40580	31039	39910
31229	40470	31064	42340	31085	42470	30985	31466	42040	31023	39850	31164	40010	31201	40410	31013	41880	31121	41800	31672	31103	41250	31043	40910	31205	41490	31074	31003	41540	31750	31661	31093	40580	31059	39910
31225	40460	31062	42320	31082	42460	30981	31461	42030	31014	39850	31161	40030	31196	40400	31006	41880	31113	41820	31675	31115	41250	31079	40910	31206	41490	31080	31016	41550	31745	31638	31093	40580	31054	39900
31229	40450	31062	42320	31087	42450	30970	31469	42070	31017	39820	31185	40040	31198	40410	31016	41870	31117	41820	31678	31097	41250	31098	40910	31201	41470	31079	31018	41550	31747	31688	31093	40580	31053	39910
31225	40450	31056	42310	31084	42450	30983	31469	42000	31011	39860	31164	40040	31191	40410	31003	41880	31120	41840	31667	31107	41250	31085	40910	31213	41470	31084	31017	41550	31748	31645	31091	40580	31058	39910
31232	40420	31065	42340	31095	42420	30975	31469	41990	31021	39810	31216	40030	31182	40410	31014	41890	31118	41850	31675	31104	41250	31111	40900	31185	41470	31077	31016	41540	31737	31682	31088	40580	31071	39900
31226	40420	31069	42330	31088	42420	30898	31469	42010	31015	39880	31158	40050	31198	40410	31006	41880	31092	41800	31371	31113	41240	31090	40890	31224	41490	31078	31012	41550	31751	31695	31090	40580	31067	39900
31223	40450	31057	42340	31087	42450	30990	31469	42060	31042	39840	31180	40030	31199	40410	31005	41850	31118	41800	31669	31103	41230	31082	40890	31208	41490	31088	31005	41540	31737	31658	31097	40580	31055	39900
31222	40450	31056	42320	31088	42450	30970	31469	42040	31016	39860	31196	40030	31233	40400	31027	41870	31112	41840	31671	31105	41220	31075	40890	31176	41470	31080	31012	41550	31739	31679	31089	40590	31076	39900
31232	40450	31062	42340	31093	42450	30988	31469	42040	31018	39850	31183	40040	31192	40410	31009	41850	31109	41840	31669	31097	41250	31110	40890	31223	41490	31078	31059	41550	31733	31613	31098	40580	31050	39890
2.11413366	2.13418942	2.11346705	2.1126787	2.11390164	2.11283982	2.11444065	2.11487122	2.11603232	2.11336649	2.16084491	2.11293751	2.15359512	2.11179072	2.13813946	2.11415421	2.11393289	2.11260475	2.11460647	2.11464091	2.11339256	2.17357648	2.11453787	2.15817733	2.11418147	2.11487733	2.11438557	2.11466581	2.11433609	2.11496942	2.11951223	2.11428217	2.13563967	2.11647658	2.1548454
1.23E+10	2.02E+10	1.21E+10	2.28E+10	1.22E+10	2.29E+10	1.21E+10	1.24E+10	2.23E+10	1.21E+10	1.92E+10	1.22E+10	1.94E+10	1.23E+10	2.01E+10	1.21E+10	2.23E+10	1.2194E+10	2.22E+10	1.26E+10	1.22E+10	2.03E+10	1.21E+10	2.03E+10	1.22E+10	2.17E+10	1.21E+10	1.21E+10	2.19E+10	1.27E+10	1.26E+10	1.22E+10	2.03E+10	1.21E+10	1.94E+10
2.2882653	2.31361751	2.28742363	2.28642832	2.28797234	2.28663173	2.28865294	2.28919663	2.29066293	2.28729667	2.34740001	2.28675506	2.33820196	2.28530735	2.3186174	2.28829125	2.2880118	2.28633497	2.28886232	2.28890581	2.28732958	2.36357071	2.28877569	2.34401471	2.28832568	2.28920434	2.28858338	2.28893725	2.28852091	2.28932064	2.29505869	2.28845282	2.31545296	2.29122401	2.3397877
0.03100913	0.03224162	0.03096863	0.03092076	0.03099503	0.03093054	0.0310278	0.03105399	0.03112467	0.03096252	0.03392127	0.03093647	0.03345972	0.0308669	0.03248752	0.03101038	0.03099693	0.03091628	0.03103788	0.03103998	0.0309641	0.03474036	0.03103371	0.03375103	0.03101204	0.03105436	0.03102445	0.03104149	0.03102144	0.03105996	0.03133704	0.03101816	0.03233178	0.03115173	0.0335391
0.32592415	0.33887832	0.32549842	0.32499532	0.32577593	0.32509811	0.32612032	0.32639556	0.32713846	0.32543422	0.35653241	0.32516044	0.35168128	0.32442918	0.3414629	0.32593728	0.3257959	0.32494816	0.32622631	0.32624832	0.32545086	0.36514155	0.32618245	0.35474311	0.3259547	0.32639947	0.32608512	0.32626424	0.3260535	0.32645836	0.3293706	0.32601904	0.33862597	0.32742295	0.3525152
2.27723896	2.30237417	2.27640449	2.2754177	2.27694851	2.27561937	2.27762328	2.27816231	2.27961607	2.27627861	2.33586753	2.27574164	2.3267482	2.27430632	2.30733127	2.27726468	2.27698763	2.27532515	2.27783086	2.27787398	2.27631124	2.35189983	2.27774498	2.33251121	2.27729882	2.27816996	2.27755431	2.27790515	2.27749238	2.27828526	2.2839742	2.27742487	2.30419391	2.28017234	2.3283203
2.11413366	2.13418942	2.11346705	2.1126787	2.11390164	2.11283982	2.11444065	2.11487122	2.11603232	2.11336649	2.16084491	2.11293751	2.15359512	2.11179072	2.13813946	2.11415421	2.11393289	2.11260475	2.11460647	2.11464091	2.11339256	2.17357648	2.11453787	2.15817733	2.11418147	2.11487733	2.11438557	2.11466581	2.11433609	2.11496942	2.11951223	2.11428217	2.13563967	2.11647658	2.1548454
1.23E+10	2.02E+10	1.21E+10	2.28E+10	1.22E+10	2.29E+10	1.21E+10	1.24E+10	2.23E+10	1.21E+10	1.92E+10	1.22E+10	1.94E+10	1.23E+10	2.01E+10	1.21E+10	2.23E+10	1.2194E+10	2.2168E+10	1.26E+10	1.22E+10	2.03E+10	1.21E+10	2.03E+10	1.22E+10	2.17E+10	1.21E+10	1.21E+10	2.19E+10	1.27E+10	1.26E+10	1.22E+10	2.03E+10	1.21E+10	1.94E+10
	64.81		88.02		88.16			79.13		58.08		58.99		63.71		84.36					66.46		67.17		77.47			81.37				67.20		59.66

Table 55 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for H-451 graphite

Modulus by Resonant Frequency

Specimen number - Post-Irrad in Red			CW7-01	CW7-01	CW7-03	CW7-03	CW8-02	CW8-02	CW8-03	CW8-03	CW9-01	CW9-01	CW9-02	CW9-03	CW9-03	CW10-01	CW10-01	CW10-02	CW10-02	CW10-03	CW10-03	CW11-01	CW11-01	CW11-02	CW11-02	CW11-03	CW12-01	CW12-02	CW12-02	CW13-01	CW13-01	CW13-02	CW13-02	CW13-03	CW13-03	CW14-01	CW14-01	CW14-02	CW14-02	CW15-01	CW15-02
Sample location (engraved id)			1S8		1S15		1U8		3U14		2S13		2U12	3S1		3S10		3U1		3U10		4S2		4S13		4U2	4U12	5S7		5U7		6S5		6S9		6U5		6U9		Spare 1	Spare 2
mass of bar	m	[g]	5.4271	5.42503	5.4328	5.4316	5.4300	5.42857	5.4286	5.42704	5.4090	5.40747	5.4109	5.4137	5.41216	5.4191	5.41762	5.4214	5.41927	5.4368	5.43593	5.4335	5.43215	5.4356	5.43396	5.4380	5.4304	5.4069	5.40484	5.4562	5.45485	5.4695	5.46742	5.4530	5.45086	5.4557	5.45483	5.4374	5.4353	5.4467	5.4146
length of bar	L	[mm]	25.3552	24.413	25.3619	24.707	25.3590	24.897	25.3597	25.048	25.3679	24.365	25.3806	25.3517	24.116	25.3641	24.279	25.3597	24.907	25.3568	24.933	25.3597	24.791	25.3619	24.795	25.3540	25.3578	25.3594	24.648	25.3508	25.094	25.3600	24.349	25.3629	24.494	25.3502	24.733	25.3508	25.053	25.3562	25.3492
diameter of bar	D	[mm]	12.7132	12.633	12.7219	12.658	12.7195	12.562	12.7240	12.612	12.7183	12.660	12.7133	12.7240	12.711	12.7098	12.691	12.7195	12.555	12.7200	12.560	12.7173	12.669	12.7300	12.682	12.7237	12.7227	12.7076	12.673	12.7202	12.622	12.7252	12.668	12.7160	12.675	12.7279	12.694	12.7237	12.611	12.7273	12.7202
Poisson's ratio	μ		0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
average resonant frequency	f_{avg}	[Hz]	27698	38559	27057	38631	27260	38681	27038	38487	27261	38120	27136	27215	37425	27998	37933	27725	39313	27486	39644	27934	38476	27572	37811	27305	28834	27447	37585	28840	40774	28585	39508	27452	38753	28365	38895	28220	40070	28355	27451
frequency data	f_i	1	27693	38570	27065	38630	27265	38680	27047	38490	27271	38120	27152	27200	37410	27998	37950	27745	39310	27499	39640	27935	38480	27582	37800	27293	28831	27403	37590	28808	40770	28655	39500	27458	38750	28372	38890	28217	40070	28344	27453
(specimen number		2	27700	38570	27049	38630	27262	38680	27040	38490	27264	38120	27142	27281	37410	27992	37940	27758	39310	27486	39650	27935	38480	27571	37810	27344	28833	27431	37590	28839	40770	28572	39500	27461	38750	28362	38890	28227	40070	28347	27447
oriented up in fixture)		3	27700	38560	27055	38630	27256	38680	27040	38490	27257	38120	27133	27193	37410	27988	37950	27757	39300	27493	39650	27941	38480	27574	37810	27291	28834	27433	37600	28878	40780	28570	39510	27452	38760	28360	38900	28223	40070	28391	27478
		4	27705	38560	27059	38640	27254	38680	27038	38490	27253	38120	27128	27211	37430	28004	37930	27762	39310	27496	39640	27931	38480	27572	37810	27308	28840	27474	37580	28843	40760	28575	39510	27444	38770	28365	38900	28214	40070	28351	27427
		5	27697	38550	27061	38650	27259	38680	27050	38490	27270	38120	27126	27185	37430	28092	37930	27756	39310	27482	39650	27931	38490	27572	37820	27306	28831	27484	37580	28836	40770	28616	39510	27456	38750	28355	38890	28219	40070	28350	27440
		6	27700	38560	27055	38630	27266	38680	27035	38480	27272	38120	27131	27203	37440	27948	37930	27754	39330	27481	39640	27929	38470	27577	37810	27300	28826	27456	37590	28864	40770	28560	39510	27441	38750	28366	38900	28212	40070	28344	27482
		7	27700	38560	27062	38630	27260	38680	27023	38480	27254	38120	27128	27198	37440	27968	37920	27760	39320	27481	39640	27948	38460	27568	37810	27295	28836	27440	37580	28833	40780	28581	39510	27455	38750	28369	38900	28224	40070	28354	27460
		8	27693	38550	27058	38610	27256	38680	27031	38490	27270	38120	27143	27177	37450	27988	37930	27751	39320	27484	39640	27937	38470	27570	37820	27309	28831	27447	37580	28838	40790	28555	39510	27459	38750	28372	38890	28230	40070	28352	27447
		9	27695	38550	27048	38630	27262	38680	27050	38490	27247	38120	27132	27242	37400	27996	37920	27460	39310	27476	39640	27922	38480	27560	37810	27305	28848	27435	37570	28833	40770	28586	39510	27459	38750	28364	38900	28216	40070	28364	27444
		10	27692	38560	27056	38630	27264	38690	27029	38480	27252	38120	27145	27264	37430	28002	37930	27744	39310	27479	39650	27926	38470	27577	37810	27303	28831	27462	37590	28834	40780	28575	39510	27439	38750	28365	38890	28214	40070	28352	27430
correction factor for rod		T_r	2.11172	2.177798	2.112583	2.156405	2.112431	2.124569	2.113092	2.120326	2.111514	2.186706	2.111312	2.11373	2.217965	2.110473	2.199683	2.11238	2.122617	2.112686	2.121312	2.112024	2.151201	2.11388	2.152556	2.113501	2.113042	2.110499	2.164034	2.113196	2.11817	2.11327	2.189353	2.111566	2.177811	2.114495	2.160216	2.113756	2.119734	2.113907	2.113324
modulus of elasticity **		E	8.81E+09	1.61E+10	8.41E+09	1.65E+10	8.53E+09	1.72E+10	8.38E+09	1.70E+10	8.51E+09	1.55E+10	8.44E+09	8.47E+09	1.45E+10	9.01E+09	1.52E+10	8.81E+09	1.78E+10	8.68E+09	1.81E+10	8.97E+09	1.64E+10	8.72E+09	1.58E+10	8.56E+09	9.54E+09	8.64E+09	1.54E+10	9.59E+09	1.92E+10	9.44E+09	1.68E+10	8.70E+09	1.63E+10	9.26E+09	1.67E+10	9.14E+09	1.85E+10	9.24E+09	8.62E+09
T_F correction factor			2.285218	2.368938	2.286307	2.341766	2.286116	2.30145	2.28695	2.296087	2.284958	2.38027	2.284703	2.287756	2.420125	2.283644	2.396799	2.286051	2.298982	2.286437	2.297333	2.285602	2.335165	2.287945	2.336884	2.287466	2.286887	2.283677	2.351449	2.287082	2.293363	2.287175	2.38364	2.285023	2.368954	2.288721	2.346602	2.287789	2.295339	2.287979	2.287243
calculation of individual			0.030863	0.035014	0.030915	0.033638	0.030906	0.031647	0.030946	0.031387	0.03085	0.035597	0.030838	0.030985	0.037682	0.030787	0.036454	0.030903	0.031527	0.030921	0.031447	0.030881	0.033308	0.030994	0.033394	0.030971	0.030943	0.030789	0.034125	0.030952	0.031255	0.030957	0.035771	0.030853	0.035015	0.031031	0.033881	0.030986	0.031351	0.030995	0.03096
terms			0.324384	0.368022	0.324934	0.353557	0.324837	0.33263	0.325259	0.329894	0.324253	0.37414	0.324124	0.325667	0.396058	0.32359	0.383154	0.324805	0.331369	0.325	0.330528	0.324578	0.350087	0.325762	0.350989	0.32552	0.325227	0.323607	0.358678	0.325326	0.328509	0.325373	0.375969	0.324286	0.36803	0.326155	0.35611	0.325683	0.329513	0.32578	0.325407
			2.274218	2.357221	2.275298	2.330281	2.275108	2.290311	2.275935	2.284994	2.27396	2.368457	2.273707	2.276734	2.40797	2.272657	2.384844	2.275044	2.287864	2.275427	2.286229	2.274598	2.323738	2.276921	2.325441	2.276447	2.275872	2.27269	2.339882	2.276066	2.282293	2.276158	2.371797	2.274025	2.357237	2.277691	2.335076	2.276766	2.284252	2.276956	2.276225
resultant T_F	T_F		2.11172	2.177798	2.112583	2.156405	2.112431	2.124569	2.113092	2.120326	2.111514	2.186706	2.111312	2.11373	2.217965	2.110473	2.199683	2.11238	2.122617	2.112686	2.121312	2.112024	2.151201	2.11388	2.152556	2.113501	2.113042	2.110499	2.164034	2.113196	2.11817	2.11327	2.189353	2.111566	2.177811	2.114495	2.160216	2.113756	2.119734	2.113907	2.113324
modulus of elasticity *	E	[Pa]	8.81E+09	1.61E+10	8.41E+09	1.65E+10	8.53E+09	1.72E+10	8.38E+09	1.70E+10	8.51E+09	1.55E+10	8.44E+09	8.47E+09	1.45E+10	9.01E+09	1.52E+10	8.81E+09	1.78E+10	8.68E+09	1.81E+10	8.97E+09	1.64E+10	8.72E+09	1.58E+10	8.56E+09	9.54E+09	8.64E+09	1.54E+10	9.59E+09	1.92E+10	9.44E+09	1.68E+10	8.70E+09	1.63E+10	9.26E+09	1.67E+10	9.14E+09	1.85E+10	9.24E+09	8.62E+09
Fractional change	$(E_i-E_0)/E$	%		82.91		96.26		101.37		102.89		82.67			71.47		68.75		101.56		108.85		83.23		81.71				78.42		100.39		78.32		87.45		80.30		102.14		

Table 56 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for PCEA graphite

Modulus by Resonant Frequency

Specimen number - Post-Irrad in Red			DW1-01	DW1-01	DW1-02	DW1-02	DW1-03	DW1-03	DW2-01	DW2-01	DW2-02	DW2-02	DW2-03	DW2-03	DW3-01	DW3-01	DW3-02	DW3-02	DW3-03	DW3-03	DW4-01	DW4-01	DW4-03	DW4-03	DW5-01	DW5-01	DA6-01	DA6-01	DW5-02	DW5-02	DW5-03	DW5-03	DW6-01	DW6-01	DA6-02	DA6-02	DA701	DA701
Sample location (engraved id)			1S2		1S6		1S14		1U2		1U6		1U13		2S1		2S8		2S14		2U8		2U1		2U13		3S6		3S15		3U6		3U14		4S1		4S6	
mass of bar	m	[g]	5.7468	5.7457	5.7516	5.75084	5.7604	5.75981	5.7565	5.75572	5.7443	5.74423	5.7447	5.74467	5.7568	5.75586	5.7597	5.75979	5.7625	5.76176	5.7407	5.74024	5.7429	5.74246	5.6963	5.69586	5.6611	5.65962	5.7316	5.73131	5.7596	5.75881	5.7612	5.76032	5.6454	5.64458	5.6448	5.6439
length of bar	L	[mm]	25.3844	24.484	25.3822	24.355	25.3832	24.904	25.3765	24.890	25.3759	24.958	25.3752	25.138	25.3787	24.360	25.3787	24.560	25.3781	24.813	25.3898	25.015	25.3832	24.883	25.3825	25.152	25.3895	24.252	25.3806	24.470	25.3806	24.993	25.3806	25.085	25.3883	24.524	25.3892	24.887
diameter of bar	D	[mm]	12.7264	12.590	12.7270	12.641	12.7275	12.672	12.7260	12.523	12.7275	12.548	12.7273	12.634	12.7252	12.615	12.7287	12.637	12.7267	12.682	12.7262	12.571	12.7224	12.512	12.7244	12.629	12.7286	12.542	12.7270	12.669	12.7300	12.552	12.7295	12.599	12.7291	12.606	12.7289	12.677
Poisson's ratio	μ		0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
average resonant frequency	f_{avg}	[Hz]	30053	40230	30052	39584	30230	39560	30052	40381	29999	40852	30078	40946	30087	39910	29843	39922	30049	39166	29871	41266	29923	40875	29483	40155	27359	36938	29775	38666	30098	41703	30151	41897	27441	36904	27491	35470
frequency data	f	1	30059	40230	29770	39590	30231	39560	30086	40400	30691	40860	30137	40950	30086	39910	29973	39930	30163	39160	29878	41270	29988	40870	29492	40160	27422	36960	29851	38660	30047	41690	30129	41900	27447	36920	27454	35470
(specimen number		2	30058	40230	30090	39590	30245	39560	30091	40400	29969	40860	30129	40950	30086	39910	29925	39930	30135	39170	29877	41270	29969	40870	29497	40160	27390	36950	29828	38660	30120	41690	30193	41900	27459	36920	27542	35470
oriented up in fixture)		3	30050	40230	30090	39590	30230	39560	30093	40400	29530	40850	30129	40940	30137	39920	29955	39920	30123	39170	29863	41260	29381	40880	29443	40160	27380	36960	29212	38660	30115	41690	30190	41900	27430	36900	27522	35470
		4	30049	40230	30085	39580	30225	39560	30091	40400	29595	40850	30127	40940	30074	39910	29922	39920	29293	39170	29879	41270	29987	40870	29469	40160	27003	36920	29798	38670	30122	41670	29809	41900	27446	36880	27444	35470
		5	30072	40230	30072	39580	30231	39560	30090	40410	29968	40860	30127	40950	30139	39910	29950	39920	30126	39160	29868	41250	29989	40870	29492	40150	27381	36920	29824	38680	30085	41720	30191	41890	27442	36880	27513	35470
		6	30054	40230	30071	39580	30222	39560	30084	40400	30001	40840	30114	40950	30077	39920	29949	39910	30126	39170	29864	41270	29981	40880	29491	40150	27416	36950	29839	38670	30082	41720	30200	41890	27443	36900	27467	35470
		7	30038	40230	30089	39580	30229	39560	30089	40400	30063	40840	30133	40950	30076	39910	29019	39930	30139	39170	29866	41260	29980	40880	29488	40150	27392	36930	29840	38670	30091	41710	30224	41900	27449	36900	27452	35470
		8	30052	40230	30088	39590	30237	39560	30083	40400	30002	40860	29614	40940	30077	39910	29938	39920	30131	39170	29867	41270	29980	40880	29482	40160	27397	36940	29871	38670	30068	41730	30189	41900	27412	36920	27529	35470
		9	30039	40230	30086	39590	30226	39560	29745	40200	30198	40850	30137	40950	30068	39900	29849	39920	30129	39160	29875	41280	29982	40880	29485	40150	27406	36920	29815	38660	30104	41710	30181	41890	27448	36920	27521	35470
		10	30056	40230	30082	39570	30228	39560	30088	40400	29972	40850	30128	40940	30053	39900	29952	39920	30125	39160	29873	41260	29995	40870	29492	40150	27400	36930	29867	38660	30145	41700	30203	41900	27431	36900	27461	35470
correction factor for rod		T_F	2.111485	2.164193	2.111765	2.184255	2.111764	2.142051	2.112071	2.118801	2.112351	2.117197	2.112376	2.11653	2.111765	2.179494	2.112324	2.16555	2.112045	2.151513	2.111027	2.116297	2.110952	2.117639	2.111333	2.114583	2.111433	2.176543	2.111892	2.178838	2.112375	2.115045	2.112299	2.115153	2.111611	2.163529	2.111509	2.144243
modulus of elasticity **		E	1.10E+10	1.89E+10	1.10E+10	1.79E+10	1.11E+10	1.86E+10	1.10E+10	2.00E+10	1.09E+10	2.05E+10	1.10E+10	2.04E+10	1.10E+10	1.83E+10	1.08E+10	1.86E+10	1.10E+10	1.80E+10	1.08E+10	2.08E+10	1.09E+10	2.05E+10	1.05E+10	1.95E+10	8.96E+09	1.56E+10	1.07E+10	1.71E+10	1.10E+10	2.14E+10	1.11E+10	2.15E+10	8.99E+09	1.56E+10	9.02E+09	1.46E+10
T_F correction factor			2.284921	2.351651	2.285274	2.377151	2.285274	2.323571	2.285661	2.294161	2.286014	2.292133	2.286046	2.291291	2.285275	2.371095	2.285981	2.353373	2.285628	2.335562	2.284343	2.290997	2.284248	2.292693	2.284729	2.288833	2.284856	2.367342	2.285435	2.370261	2.286045	2.289416	2.285948	2.289553	2.28508	2.350807	2.284952	2.326348
calculation of individual			0.030848	0.034136	0.030865	0.035436	0.030865	0.032732	0.030884	0.031294	0.030901	0.031196	0.030902	0.031155	0.030865	0.035125	0.030899	0.034223	0.030882	0.033328	0.030821	0.031141	0.030816	0.031223	0.030839	0.031036	0.030845	0.034933	0.030873	0.035082	0.030902	0.031065	0.030898	0.031071	0.030856	0.034093	0.03085	0.03287
terms			0.324234	0.358785	0.324413	0.372451	0.324412	0.344033	0.324608	0.328914	0.324786	0.327884	0.324802	0.327457	0.324413	0.369182	0.324769	0.359701	0.324591	0.350295	0.323942	0.327308	0.323895	0.328168	0.324137	0.326212	0.324201	0.367164	0.324494	0.368733	0.324801	0.326507	0.324753	0.326576	0.324315	0.358338	0.32425	0.345478
			2.273923	2.340082	2.274274	2.365364	2.274273	2.312242	2.274657	2.283084	2.275007	2.281074	2.275039	2.280239	2.274275	2.359359	2.274974	2.34179	2.274625	2.324131	2.27335	2.279947	2.273256	2.281629	2.273733	2.277802	2.273859	2.355639	2.274433	2.358532	2.275037	2.27838	2.274942	2.278515	2.274081	2.339245	2.273954	2.314996
resultant T_F	T_F		2.111485	2.164193	2.111765	2.184255	2.111764	2.142051	2.112071	2.118801	2.112351	2.117197	2.112376	2.11653	2.111765	2.179494	2.112324	2.16555	2.112045	2.151513	2.111027	2.116297	2.110952	2.117639	2.111333	2.114583	2.111433	2.176543	2.111892	2.178838	2.112375	2.115045	2.112299	2.115153	2.111611	2.163529	2.111509	2.144243
modulus of elasticity *	E	[Pa]	1.10E+10	1.89E+10	1.10E+10	1.79E+10	1.11E+10	1.86E+10	1.10E+10	2.00E+10	1.09E+10	2.05E+10	1.10E+10	2.04E+10	1.10E+10	1.83E+10	1.08E+10	1.86E+10	1.10E+10	1.80E+10	1.08E+10	2.08E+10	1.09E+10	2.05E+10	1.05E+10	1.95E+10	8.96E+09	1.56E+10	1.07E+10	1.71E+10	1.10E+10	2.14E+10	1.11E+10	2.15E+10	8.99E+09	1.56E+10	9.02E+09	1.46E+10
Fractional change	$(E_i-E_0)/E$	%		72.05		62.87		66.93		82.23		87.19		85.92		66.22		71.17		64.00		92.18		88.45		86.28		73.66		58.80		94.16		94.51		73.60		61.85

Table 57 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for PCEA graphite (cont.)

DW6-02	DW6-02	DW6-03	DW6-03	DW7-01	DW7-01	DW7-02	DW7-02	DW7-03	DW7-03	DW8-01	DW8-01	DA702	DA702	DW8-02	DW8-02	DW8-03	DW8-03	DW9-01	DW9-01	DW9-02	DW9-03	DW9-03	DW10-01	DW10-01	DA801	DW10-02	DW10-02	DW10-03	DW11-01	DW11-01	DW11-02	DA802	DA901
4S15		4U1		4U6		4U14		5S4		5S9		5S11		5S12		5U4		5U9		5U11	6S4		6S11		6S12	6U11		6U4	Spare 1W		Spare 2W	Spare 1A	Spare 2A
5.7631	5.76255	5.7397	5.73902	5.7650	5.7644	5.7628	5.76287	5.7567	5.75683	5.7662	5.76539	5.7624	5.76233	5.7745	5.77386	5.7800	5.77973	5.7479	5.74695	5.7474	5.7734	5.77266	5.7473	5.74659	5.7665	5.7395	5.73852	5.7473	5.7456	5.74273	5.7520	5.6459	5.6473
25.37778	24.6465	25.37714	24.509	25.3790	24.932	25.3794	25.056	25.3816	24.421	25.3819	24.576	25.3736	25.168	25.3816	24.847	25.3835	24.941	25.3844	25.048	25.3835	25.3848	24.278	25.3841	24.756	25.3851	25.3841	25.160	25.3854	25.3841	24.352	25.3844	25.3867	25.3902
12.73191	12.63263	12.7362	12.621	12.7313	12.540	12.7302	12.587	12.7310	12.636	12.7318	12.656	12.7403	12.658	12.7327	12.691	12.7330	12.544	12.7343	12.588	12.7318	12.7256	12.638	12.7179	12.680	12.7200	12.7175	12.625	12.7165	12.7181	12.649	12.7206	12.7313	12.7321
0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
30273	39291	30091	39046	30042	41149	30044	42356	30210	39384	29975	38916	29970	40892	30182	38797	30225	41086	29930	41482	30071	30276	39890	29958	38616	30445	29851	40905	30029	30154	38796	30162	27486	27334
30268	39300	30172	39050	30124	41150	29808	42400	30209	39380	30105	38910	29946	40890	30206	38860	29832	41090	29975	41500	30087	30284	39880	29732	38610	30443	29677	40900	30053	29023	38800	29994	27486	27165
30267	39290	29787	39030	29752	41150	29858	42400	30220	39380	29449	38920	29962	40890	30205	38800	30275	41090	29513	41490	30057	30277	39870	29226	38610	30446	30139	40910	30034	30960	38800	29983	27483	27305
30306	39300	30163	39060	30093	41150	30171	42100	30227	39390	30075	38930	29979	40890	30177	38760	30269	41080	29949	41480	30066	30258	39900	30089	38610	30440	29243	40910	30027	30367	38800	30371	27488	27357
30265	39300	30152	39040	30117	41150	30184	42200	30220	39380	30114	38910	30003	40900	30198	38810	30271	41080	30071	41470	30086	30075	39900	30063	38610	30454	30111	40910	30021	30457	38790	30325	27484	27368
30257	39280	30141	39040	30103	41160	30168	42390	30227	39380	29396	38919	29965	40900	30220	38810	30211	41090	29924	41470	30076	30530	39900	30065	38620	30449	29257	40910	30020	30558	38790	29716	27489	27362
30272	39300	30275	39040	29660	41140	30165	42390	30153	39390	30030	38910	29919	40890	30178	38790	30276	41080	29942	41480	30043	30265	39890	30101	38620	30441	30114	40930	30016	29273	38800	30371	27481	27473
30266	39290	30177	39060	30235	41140	30192	42430	30205	39380	30087	38930	29946	40890	30256	38770	30265	41090	29961	41490	30066	30253	39880	30061	38620	30444	30109	40900	30015	30454	38790	30404	27491	27369
30270	39290	29761	39080	30136	41150	30166	42410	30207	39390	30119	38920	30000	40890	30221	38770	30283	41090	29943	41500	30081	30260	39880	30101	38620	30452	30105	40890	30043	30981	38800	30370	27486	27290
30312	39280	30153	39020	30116	41160	29521	42420	30211	39380	30041	38910	30002	40890	30319	38810	30293	41080	30008	41480	30063	30255	39900	30080	38620	30444	29660	40900	30014	29073	38800	29750	27485	27310
30245	39280	30131	39040	30082	41140	30211	42420	30222	39390	30332	38900	29979	40890	29840	38790	30272	41090	30012	41460	30085	30302	39900	30060	38620	30432	30094	40890	30043	30391	38790	30333	27491	27345
2.112909	2.157389	2.113647	2.16741	2.112705	2.118004	2.112502	2.11561	2.112451	2.177667	2.112552	2.167472	2.114589	2.117892	2.11273	2.149999	2.112628	2.118041	2.112755	2.116446	2.112425	2.111332	2.190722	2.110165	2.155993	2.110418	2.110088	2.113248	2.109834	2.11019	2.185979	2.110571	2.112094	2.111941
1.12E+10	1.81E+10	1.10E+10	1.77E+10	1.10E+10	2.08E+10	1.10E+10	2.20E+10	1.11E+10	1.78E+10	1.09E+10	1.76E+10	1.09E+10	2.04E+10	1.11E+10	1.78E+10	1.12E+10	2.08E+10	1.09E+10	2.10E+10	1.10E+10	1.12E+10	1.81E+10	1.09E+10	1.74E+10	1.13E+10	1.08E+10	2.04E+10	1.10E+10	1.11E+10	1.71E+10	1.11E+10	9.01E+09	8.92E+09
2.286719	2.343014	2.28765	2.355736	2.286462	2.293153	2.286205	2.29013	2.286141	2.368771	2.286269	2.355814	2.28884	2.293011	2.286493	2.333643	2.286364	2.2932	2.286525	2.291185	2.286108	2.284729	2.385383	2.283255	2.341243	2.283575	2.283159	2.287147	2.282838	2.283287	2.379345	2.283767	2.28569	2.285497
0.030935	0.033701	0.03098	0.034342	0.030922	0.031245	0.03091	0.031099	0.030907	0.035006	0.030913	0.034346	0.031037	0.031238	0.030924	0.033232	0.030918	0.031247	0.030925	0.03115	0.030905	0.030839	0.035861	0.030768	0.033612	0.030784	0.030764	0.030955	0.030748	0.03077	0.035549	0.030793	0.030885	0.030876
0.325142	0.354215	0.325613	0.360958	0.325012	0.328402	0.324883	0.326868	0.32485	0.367932	0.324915	0.360999	0.326215	0.32833	0.325028	0.349289	0.324963	0.328426	0.325044	0.327403	0.324833	0.324137	0.376917	0.323394	0.353282	0.323555	0.323345	0.325359	0.323184	0.32341	0.373639	0.323652	0.324622	0.324525
2.275706	2.331519	2.276629	2.344132	2.275451	2.282085	2.275197	2.279088	2.275132	2.357056	2.275259	2.34421	2.277808	2.281944	2.275482	2.322228	2.275354	2.282131	2.275513	2.280134	2.2751	2.273733	2.373525	2.272271	2.329763	2.272589	2.272176	2.27613	2.271858	2.272303	2.36754	2.27278	2.274686	2.274494
2.112909	2.157389	2.113647	2.16741	2.112705	2.118004	2.112502	2.11561	2.112451	2.177667	2.112552	2.167472	2.114589	2.117892	2.11273	2.149999	2.112628	2.118041	2.112755	2.116446	2.112425	2.111332	2.190722	2.110165	2.155993	2.110418	2.110088	2.113248	2.109834	2.11019	2.185979	2.110571	2.112094	2.111941
1.12E+10	1.81E+10	1.10E+10	1.77E+10	1.10E+10	2.08E+10	1.10E+10	2.20E+10	1.11E+10	1.78E+10	1.09E+10	1.76E+10	1.09E+10	2.04E+10	1.11E+10	1.78E+10	1.12E+10	2.08E+10	1.09E+10	2.10E+10	1.10E+10	1.12E+10	1.81E+10	1.09E+10	1.74E+10	1.13E+10	1.08E+10	2.04E+10	1.10E+10	1.11E+10	1.71E+10	1.11E+10	9.01E+09	8.92E+09
	62.55		61.25		89.46		100.38		60.78		60.73		86.77		59.82		86.55		93.58				61.94		59.33				88.53		54.64			

Table 58 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for IG-110 graphite

Modulus by Resonant Frequency

Specimen number - Post-Irrad in Red			EW2-01	EW2-01	EW2-02	EW2-02	EW2-03	EW2-03	EW4-01	EW4-01	EW4-02	EW4-02	EW5-01	EW5-01	EW5-02	EW5-02	EW5-03	EW5-03	EW6-01	EW6-01	EW6-02
Sample location (engraved id)			1S7		1S9		1U7		1U9		2S5		2S7		2U5		2U7		3S9		3U9
mass of bar	m	[g]	5.5838	5.57996	5.5901	5.58771	5.5930	5.5899	5.5908	5.58784	5.5921	5.58979	5.5756	5.57224	5.5834	5.58045	5.5845	5.5815	5.5918	5.58862	5.5979
length of bar	L	[mm]	25.3768	24.818	25.3844	24.854	25.3851	25.162	25.36762	24.665	25.37365	24.360	25.3698	24.541	25.3702	25.062	25.3765	25.085	25.3733	24.607	25.3803
diameter of bar	D	[mm]	12.7249	12.649	12.7248	12.663	12.7244	12.605	12.71064	12.67925	12.71699	12.659	12.7171	12.635	12.7098	12.541	12.7106	12.547	12.7075	12.683	12.7152
Poisson's ratio	μ		0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
average resonant frequency	f_{avg}	[Hz]	26712	38459	27114	38381	27042	38445	27496	38246	26863	38734	27161	38820	27481	39059	27047	39380	27492	38226	27384
frequency data	f_i	1	26795	38460	27115	38380	27051	38470	27498	38250	26859	38720	27161	38790	27480	39070	27052	39380	27491	38230	27351
(specimen number		2	26703	38460	27114	38380	27038	38450	27497	38250	26859	38740	27165	38830	27464	39050	27051	39380	27497	38230	27391
oriented up in fixture)		3	26698	38470	27119	38380	27049	38440	27498	38240	26870	38740	27163	38820	27476	39070	27050	39380	27493	38250	27394
		4	26705	38460	27094	38380	27046	38460	27499	38260	26863	38740	27147	38830	27498	39050	27044	39380	27489	38220	27388
		5	26705	38460	27118	38380	27035	38450	27498	38260	26852	38760	27164	38820	27467	39060	27047	39380	27493	38220	27386
		6	26712	38460	27117	38380	27048	38460	27494	38240	26869	38750	27173	38830	27492	39040	27041	39380	27493	38220	27380
		7	26701	38460	27108	38380	27034	38440	27488	38240	26870	38710	27172	38850	27491	39060	27045	39380	27491	38230	27394
		8	26711	38450	27121	38380	27046	38440	27500	38240	26852	38730	27152	38820	27486	39080	27051	39380	27496	38230	27391
		9	26690	38460	27118	38390	27043	38400	27495	38240	26858	38740	27156	38820	27477	39070	27045	39380	27490	38200	27390
		10	26704	38450	27112	38380	27033	38440	27492	38240	26873	38710	27160	38790	27480	39040	27040	39380	27484	38230	27378
correction factor for rod		$T_{1'}$	2.11187	2.14551	2.11123	2.14473	2.11113	2.10998	2.11032	2.16362	2.11085	2.18694	2.11118	2.16689	2.10999	2.10761	2.10961	2.10668	2.10935	2.16929	2.11004
modulus of elasticity **		E	8.43E+09	1.70E+10	8.70E+09	1.69E+10	8.66E+09	1.77E+10	8.96E+09	1.65E+10	8.55E+09	1.66E+10	8.71E+09	1.70E+10	8.95E+09	1.83E+10	8.67E+09	1.87E+10	8.97E+09	1.64E+10	8.90E+09
$T_{1'}$ correction factor			2.28540	2.32795	2.28460	2.32696	2.28447	2.28302	2.28345	2.35092	2.28412	2.38056	2.28454	2.35507	2.28303	2.28003	2.28255	2.27885	2.28223	2.35812	2.28310
calculation of individual			0.03087	0.03295	0.03083	0.03290	0.03083	0.03076	0.03078	0.03410	0.03081	0.03561	0.03083	0.03431	0.03076	0.03061	0.03073	0.03056	0.03072	0.03446	0.03076
terms			0.32448	0.34632	0.32407	0.34580	0.32401	0.32328	0.32349	0.35840	0.32383	0.37430	0.32404	0.36060	0.32328	0.32177	0.32304	0.32118	0.32288	0.36223	0.32331
			2.27440	2.31659	2.27361	2.31561	2.27348	2.27204	2.27247	2.33935	2.27313	2.36875	2.27355	2.34347	2.27205	2.26907	2.27157	2.26791	2.27126	2.34650	2.27211
resultant $T_{1'}$		$T_{1'}$	2.11187	2.14551	2.11123	2.14473	2.11113	2.10998	2.11032	2.16362	2.11085	2.18694	2.11118	2.16689	2.10999	2.10761	2.10961	2.10668	2.10935	2.16929	2.11004
modulus of elasticity *	E	[Pa]	8.43E+09	**1.70E+10**	8.70E+09	**1.69E+10**	8.66E+09	**1.77E+10**	8.96E+09	**1.65E+10**	8.55E+09	**1.66E+10**	8.71E+09	**1.70E+10**	8.95E+09	**1.83E+10**	8.67E+09	**1.87E+10**	8.97E+09	**1.64E+10**	8.90E+09
Fractional change	$(E_i-E_0)/E$	%		101.62		94.76		104.15		84.05		94.04		94.65		105.12		115.29		82.65	

Table 59 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for IG-110 graphite (cont.)

EW6-03	EW6-03	EW7-01	EW7-01	EW7-03	EW8-01	EW8-01	EW8-02	EW8-02	EW8-03	EW8-03	EW9-01	EW9-01	EW9-02	EW9-02	EW9-03	EW9-03	EW10-01	EW10-01	EW10-02	EW10-02	EW10-03	EW10-03
4S4		4S9		4U4	4U9		5S1		5S13		5U1		5U12		6S14		6U13		Spare 1		Spare 2	
5.6009	5.59804	5.5902	5.58736	5.5730	5.5829	5.58098	5.5562	5.55367	5.5817	5.57956	5.5981	5.59619	5.5911	5.58796	5.5902	5.58822	5.5822	5.57855	5.5845	5.58141	5.5923	5.58907
25.3746	24.578	25.3756	24.626	25.3765	25.3768	25.090	25.3698	24.413	25.3778	24.880	25.3762	25.061	25.3902	25.213	25.3746	24.529	25.3778	25.118	25.3771	24.341	25.3756	25.038
12.7092	12.616	12.7119	12.628	12.6965	12.7016	12.523	12.7073	12.646	12.6973	12.670	12.6927	12.520	12.7087	12.621	12.6998	12.653	12.6976	12.559	12.7021	12.667	12.7008	12.523
0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
27507	39205	27571	38843	27239	26967	39041	27465	39479	27449	38158	27657	39294	27860	39262	27558	39279	27253	39150	27571	39204	27972	40155
27575	39200	27533	38840	27236	26971	39050	27465	39480	27442	38160	27676	39300	27818	39260	27566	39280	27244	39150	27495	39200	27988	40160
27558	39210	27578	38840	27233	26973	39080	27460	39480	27452	38160	27651	39300	27820	39260	27565	39280	27247	39150	27498	39190	27987	40160
27587	39210	27582	38830	27329	26970	39040	27457	39480	27447	38160	27651	39290	27809	39270	27571	39280	27251	39140	27596	39180	27941	40150
27475	39200	27584	38850	27229	26969	39040	27467	39470	27449	38150	27654	39280	27839	39270	27556	39280	27258	39150	27588	39220	27959	40160
27488	39190	27567	38840	27226	26964	39040	27458	39490	27447	38150	27653	39300	27845	39260	27548	39280	27254	39150	27598	39220	27943	40150
27472	39210	27580	38850	27230	26969	39040	27471	39460	27442	38160	27661	39300	27902	39260	27563	39280	27250	39160	27601	39230	27992	40150
27480	39200	27566	38840	27230	26955	39030	27469	39490	27450	38160	27656	39300	27898	39270	27545	39280	27255	39150	27634	39180	27973	40170
27483	39200	27562	38850	27227	26970	39020	27460	39470	27456	38160	27650	39290	27867	39250	27566	39280	27248	39160	27329	39200	27976	40150
27476	39220	27571	38850	27217	26959	39040	27472	39480	27451	38160	27669	39290	27902	39250	27547	39280	27247	39150	27685	39180	27980	40150
27476	39210	27586	38840	27236	26970	39030	27467	39490	27449	38160	27650	39290	27902	39270	27550	39270	27272	39140	27685	39240	27984	40150
2.10953	2.16052	2.10989	2.15840	2.10735	2.10814	2.10256	2.10961	2.17991	2.10737	2.14378	2.10677	2.10441	2.10821	2.10832	2.10803	2.17104	2.10743	2.10607	2.10819	2.19005	2.10811	2.10666
8.99E+09	1.75E+10	9.01E+09	1.72E+10	8.80E+09	8.63E+09	1.85E+10	8.90E+09	1.73E+10	8.95E+09	1.67E+10	9.13E+09	1.87E+10	9.22E+09	1.84E+10	9.03E+09	1.73E+10	8.83E+09	1.84E+10	9.03E+09	1.69E+10	9.31E+09	1.95E+10
2.28246	2.34698	2.28290	2.34429	2.27970	2.28069	2.27366	2.28255	2.37162	2.27973	2.32576	2.27897	2.27600	2.28079	2.28093	2.28057	2.36034	2.27980	2.27809	2.28076	2.38453	2.28066	2.27883
0.03073	0.03390	0.03075	0.03377	0.03060	0.03065	0.03031	0.03073	0.03515	0.03060	0.03284	0.03056	0.03042	0.03065	0.03066	0.03064	0.03458	0.03060	0.03052	0.03065	0.03582	0.03064	0.03056
0.32299	0.35631	0.32322	0.35489	0.32161	0.32210	0.31858	0.32304	0.36946	0.32162	0.34517	0.32124	0.31975	0.32215	0.32222	0.32204	0.36341	0.32165	0.32080	0.32214	0.37645	0.32209	0.32117
2.27148	2.33546	2.27192	2.33279	2.26875	2.26973	2.26276	2.27158	2.35988	2.26878	2.31441	2.26802	2.26508	2.26983	2.26997	2.26961	2.34870	2.26884	2.26715	2.26980	2.37268	2.26970	2.26788
2.10953	2.16052	2.10989	2.15840	2.10735	2.10814	2.10256	2.10961	2.17991	2.10737	2.14378	2.10677	2.10441	2.10821	2.10832	2.10803	2.17104	2.10743	2.10607	2.10819	2.19005	2.10811	2.10666
8.99E+09	1.75E+10	9.01E+09	1.72E+10	8.80E+09	8.63E+09	1.85E+10	8.90E+09	1.73E+10	8.95E+09	1.67E+10	9.13E+09	1.87E+10	9.22E+09	1.84E+10	9.03E+09	1.73E+10	8.83E+09	1.84E+10	9.03E+09	1.69E+10	9.31E+09	1.95E+10
	94.61		90.46			113.70		93.91		86.77		105.05		99.85		91.73		108.79		87.29		109.18

Table 60 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for IG-430 graphite

Modulus by Resonant Frequency

Specimen number - Post-Irrad in Red			FW1-01	FW1-01	FW1-02	FW1-03	FW1-03	FW2-01	FW2-01	FW2-02	FW2-02	FW2-03	FW2-03	FW3-01	FW3-01	FW3-02	FW3-02	FW3-03	FW3-03	FW4-01	FW4-01	FW4-02	FW4-02	FW4-03	FW4-03	FW5-01	FW5-01	FW5-02	FW5-02	FW5-03	FW5-03
Sample location (engraved id)			1S5		1S10	1U5		1U10		2S3		2S9		2S15		2U3		2U9		2U14		3S3		3S4		3S5		3S7		3U3	
mass of bar	m	[g]	5.7233	5.71889	5.7574	5.7655	5.76253	5.7255	5.72318	5.7308	5.7283	5.7428	5.73952	5.7337	5.73113	5.7257	5.72258	5.7546	5.7514	5.7339	5.73115	5.7458	5.74276	5.7692	5.76617	5.7637	5.76041	5.7849	5.77683	5.7923	5.78984
length of bar	L	[mm]	25.37079	24.793	25.37746	25.37492	25.228	25.37492	25.180	25.36889	24.719	25.3746	24.894	25.37651	24.880	25.37587	25.191	25.37524	25.219	25.38063	25.271	25.37873	24.877	25.36889	24.664	25.37206	24.896	25.38476	24.963	25.38381	25.183
diameter of bar	D	[mm]	12.70651	12.618	12.71127	12.71508	12.559	12.70064	12.567	12.7027	12.636	12.70476	12.641	12.69905	12.651	12.70445	12.550	12.71222	12.600	12.71238	12.648	12.70968	12.651	12.71413	12.683	12.71683	12.688	12.72826	12.708	12.73127	12.580
Poisson's ratio	μ		0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
average resonant frequency	f_{avg}	[Hz]	27490	38844	27466	27713	38552	27715	39853	27426	38881	27461	39892	28596	40803	27747	39179	27754	39669	28127	38996	28034	37932	27836	38429	28028	39824	28487	39904	28007	41548
frequency data	f_i	1	27512	38850	27460	27682	38550	27694	39850	27421	38890	27462	39880	28602	40790	27757	39190	27655	39680	28131	39000	28013	37940	27829	38440	28030	39820	28489	39910	28017	41550
(specimen number		2	27514	38850	27467	27687	38550	27693	39850	27430	38890	27459	39880	28596	40800	27740	39190	27698	39680	28131	38990	28048	37940	27836	38440	28028	39820	28486	39910	28006	41550
oriented up in fixture)		3	27496	38840	27469	27688	38560	27696	39850	27428	38890	27455	39890	28595	40800	27748	39200	27752	39680	28130	39000	28017	37940	27840	38440	28030	39830	28483	39910	28005	41550
		4	27488	38850	27470	27680	38560	27699	39850	27427	38870	27452	39900	28600	40810	27748	39210	27729	39670	28124	38990	28020	37920	27832	38450	28027	39820	28485	39910	28009	41530
		5	27501	38840	27471	27686	38540	27699	39840	27425	38890	27464	39890	28595	40810	27718	39180	27938	39660	28123	39000	28057	37930	27840	38420	28029	39840	28484	39910	28015	41550
		6	27479	38840	27468	27838	38540	27900	39860	27427	38860	27464	39900	28589	40800	27743	39160	27753	39660	28129	38990	28044	37940	27842	38410	28024	39840	28487	39910	28000	41530
		7	27479	38840	27469	27631	38560	27691	39860	27428	38860	27467	39890	28593	40800	27749	39160	27943	39660	28121	39010	28035	37920	27836	38410	28026	39830	28487	39900	28005	41550
		8	27475	38850	27469	27867	38560	27698	39860	27424	38890	27462	39890	28600	40810	27744	39160	27753	39680	28128	39000	27962	37950	27837	38420	28033	39810	28491	39880	28003	41550
		9	27478	38850	27462	27685	38550	27688	39860	27422	38890	27454	39910	28595	40810	27773	39180	27617	39660	28131	38990	28047	37920	27840	38420	28026	39810	28491	39900	28000	41560
		10	27473	38830	27456	27681	38550	27695	39850	27425	38880	27466	39890	28596	40800	27754	39160	27697	39660	28125	38990	28097	37920	27832	38440	28028	39820	28486	39900	28012	41560
correction factor for rod		T_1	2.109405	2.142462	2.109633	2.110445	2.097171	2.108136	2.102271	2.108948	2.151687	2.108821	2.137738	2.107755	2.140602	2.108668	2.098781	2.109963	2.104564	2.109556	2.108076	2.109277	2.140914	2.110777	2.164311	2.110954	2.145345	2.111764	2.143036	2.112323	2.104241
modulus of elasticity **		E	9.18E+09	1.79E+10	9.22E+09	9.39E+09	1.86E+10	9.35E+09	1.97E+10	9.16E+09	1.77E+10	9.20E+09	1.90E+10	9.98E+09	1.97E+10	9.37E+09	1.91E+10	9.40E+09	1.95E+10	9.63E+09	1.86E+10	9.59E+09	1.71E+10	9.47E+09	1.72E+10	9.59E+09	1.88E+10	9.93E+09	1.89E+10	9.60E+09	2.15E+10
T_1 correction factor			2.282296	2.324091	2.282583	2.283609	2.266867	2.280694	2.273297	2.28172	2.335782	2.281559	2.318109	2.280214	2.321735	2.281367	2.268897	2.283	2.276189	2.282487	2.280619	2.282135	2.322131	2.284027	2.3518	2.284251	2.327744	2.285274	2.324818	2.285979	2.275781
calculation of individual			0.030722	0.032758	0.030736	0.030785	0.029988	0.030646	0.030293	0.030695	0.033339	0.030687	0.032462	0.030623	0.032641	0.030678	0.030084	0.030756	0.030431	0.030732	0.030642	0.030715	0.032661	0.030805	0.034143	0.030816	0.032939	0.030865	0.032794	0.030899	0.030411
terms			0.322911	0.344304	0.323055	0.323573	0.315187	0.322105	0.318394	0.322621	0.350411	0.32254	0.3412	0.321863	0.343079	0.322443	0.316198	0.323266	0.319842	0.323007	0.322067	0.32283	0.343285	0.323783	0.358865	0.323896	0.346206	0.324412	0.344682	0.324769	0.319638
			2.271321	2.312758	2.271606	2.272623	2.256024	2.269733	2.262399	2.270749	2.324349	2.27059	2.306828	2.269256	2.310422	2.270399	2.258036	2.272019	2.265266	2.27151	2.269658	2.271161	2.310815	2.273037	2.34023	2.273259	2.316379	2.274273	2.313479	2.274973	2.264861
resultant T_1		T_1	2.109405	2.142462	2.109633	2.110445	2.097171	2.108136	2.102271	2.108948	2.151687	2.108821	2.137738	2.107755	2.140602	2.108668	2.098781	2.109963	2.104564	2.109556	2.108076	2.109277	2.140914	2.110777	2.164311	2.110954	2.145345	2.111764	2.143036	2.112323	2.104241
modulus of elasticity *	E	[Pa]	9.18E+09	1.79E+10	9.22E+09	9.39E+09	1.86E+10	9.35E+09	1.97E+10	9.16E+09	1.77E+10	9.20E+09	1.90E+10	9.98E+09	1.97E+10	9.37E+09	1.91E+10	9.40E+09	1.95E+10	9.63E+09	1.86E+10	9.59E+09	1.71E+10	9.47E+09	1.72E+10	9.59E+09	1.88E+10	9.93E+09	1.89E+10	9.60E+09	2.15E+10
Fractional change	$(E_1-E_0)/E$	%		94.48			98.47		110.12		93.67		106.01		97.77		103.73		107.12		93.39		78.18		81.26		95.51		90.32		124.43

Table 61 Pre-IE and PIE data for AGC-1 specimen Young's Modulus by Fundamental Frequency and the fractional change in Young's Modulus for IG-430 graphite (cont.)

FW7-01	FW7-01	FW7-02	FW7-02	FW7-03	FW7-03	FW8-01	FW8-01	FW8-02	FW8-02	FW8-03	FW9-01	FW9-01	FW9-02	FW9-02	FW9-03	FW9-03	FW10-01	FW10-01	FW10-02	FW10-02	FW10-03	FW10-03	FW11-01	FW11-01	FW11-02	FW11-02	FW11-03	FW11-03	FW12-01	FW12-01	FW12-02	FW13-01	FW13-01	FW13-02
3U4		3U5		3U7		4S3		4S10		4U3	4U10		5S2		5S10		5U2		5U10		6S2		6S7		6S10		6U2		6U7		6U10	Spare 1		Spare 2
5.7641	5.7619	5.7693	5.76571	5.7559	5.75341	5.7551	5.75263	5.7571	5.75462	5.7267	5.7732	5.77081	5.7547	5.75206	5.7710	5.76706	5.7745	5.77124	5.7841	5.7814	5.7886	5.78597	5.7770	5.77438	5.7712	5.76812	5.7713	5.76861	5.7506	5.74748	5.7608	5.7910	5.78689	5.7909
25.38508	25.197	25.37873	25.246	25.38571	25.272	25.37968	24.837	25.3819	24.950	25.37778	25.38889	25.198	25.38698	24.737	25.38095	24.768	25.39302	25.187	25.38921	25.169	25.38254	24.611	25.38317	24.828	25.38508	24.829	25.38571	25.264	25.3873	25.045	25.38635	25.38254	24.911	25.38063
12.73635	12.561	12.73461	12.637	12.73524	12.649	12.71222	12.656	12.7127	12.658	12.71334	12.71826	12.603	12.71794	12.670	12.71619	12.668	12.72143	12.574	12.7227	12.572	12.72143	12.692	12.72223	12.679	12.72461	12.686	12.72429	12.554	12.72667	12.698	12.72492	12.72762	12.647	12.72842
0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
27443	39549	27656	39373	27399	38550	28108	38460	27658	38044	27585	28302	41864	27641	38261	27755	38023	28578	39782	28504	40550	28040	39218	27494	39510	28104	39912	27654	38213	27514	38849	27829	28340	41733	28179
27446	39550	27688	39380	27397	38550	28119	38460	27670	38050	27617	28165	41860	27650	38270	27756	38050	28569	39780	28513	40600	28024	39220	27497	39510	28103	39910	27656	38220	27518	38850	27833	28337	41800	28177
27447	39570	27683	39380	27399	38550	28109	38460	27654	38050	27616	28348	41860	27644	38270	27744	38010	28582	39780	28502	40600	28072	39220	27503	39510	28097	39910	27642	38220	27520	38850	27827	28339	41800	28179
27444	39550	27689	39380	27399	38550	28114	38460	27652	38050	27609	28153	41860	27639	38270	27765	38010	28571	39780	28500	40600	28028	39210	27500	39510	28096	39910	27635	38220	27511	38850	27828	28316	41800	28182
27437	39560	27681	39380	27398	38550	28116	38460	27658	38040	27319	28388	41870	27635	38260	27749	38040	28555	39780	28507	40600	28028	39220	27490	39500	28108	39920	27636	38220	27518	38850	27822	28291	41100	28180
27441	39550	27688	39370	27397	38550	28105	38460	27660	38030	27614	28337	41840	27636	38260	27761	38010	28583	39790	28506	40600	28036	39220	27495	39500	28118	39910	27636	38210	27515	38850	27833	28334	41790	28177
27444	39540	27676	39370	27402	38540	28106	38470	27656	38050	27613	28326	41850	27651	38250	27760	38000	28576	39790	28486	40600	28036	39220	27491	39520	28105	39920	27643	38200	27516	38840	27822	28380	41810	28179
27444	39540	27686	39370	27402	38550	28106	38460	27652	38040	27617	28324	41860	27646	38260	27750	38060	28587	39770	28507	40100	28022	39210	27489	39520	28106	39900	27684	38210	27512	38850	27831	28375	41820	28178
27444	39540	27696	39360	27402	38550	28095	38460	27659	38050	27617	28315	41890	27645	38250	27751	38020	28586	39770	28511	40600	28071	39220	27490	39510	28106	39910	27664	38210	27505	38850	27834	28318	41810	28175
27439	39540	27679	39370	27395	38550	28107	38450	27660	38030	27612	28332	41890	27636	38260	27755	38020	28579	39780	28506	40600	28038	39220	27498	39510	28102	39910	27670	38220	27514	38850	27830	28317	41800	28184
27442	39550	27389	39370	27402	38560	28106	38460	27663	38050	27615	28333	41860	27627	38260	27757	38010	28590	39800	28504	40600	28041	39220	27488	39510	28103	39920	27672	38200	27512	38850	27831	28393	41800	28178
2.113034	2.100086	2.113265	2.108339	2.112805	2.108116	2.109607	2.145087	2.109505	2.135942	2.109937	2.109834	2.106674	2.109936	2.155863	2.11014	2.15299	2.110011	2.102835	2.110519	2.104119	2.11085	2.170502	2.110926	2.149597	2.111155	2.150694	2.111053	2.093648	2.111306	2.13454	2.111104	2.111841	2.137429	2.112121
9.16E+09	1.95E+10	9.31E+09	1.91E+10	9.12E+09	1.83E+10	9.65E+09	1.75E+10	9.35E+09	1.73E+10	9.24E+09	9.81E+09	2.17E+10	9.32E+09	1.71E+10	9.42E+09	1.70E+10	1.00E+10	1.97E+10	9.95E+09	2.05E+10	9.64E+09	1.78E+10	9.25E+09	1.84E+10	9.65E+09	1.88E+10	9.34E+09	1.84E+10	9.21E+09	1.80E+10	9.44E+09	9.83E+09	2.09E+10	9.72E+09
2.286877	2.270542	2.287168	2.280951	2.286588	2.280669	2.282551	2.327417	2.282422	2.315835	2.282968	2.282838	2.27885	2.282966	2.341079	2.283223	2.337435	2.283061	2.274007	2.283702	2.275627	2.28412	2.359664	2.284216	2.333133	2.284504	2.334524	2.284376	2.262429	2.284696	2.314061	2.28444	2.285371	2.317718	2.285724
0.030942	0.030162	0.030956	0.030658	0.030928	0.030645	0.030735	0.032923	0.030728	0.032351	0.030755	0.030748	0.030558	0.030755	0.033604	0.030767	0.033421	0.030759	0.030327	0.03079	0.030404	0.03081	0.034542	0.030815	0.033207	0.030828	0.033276	0.030822	0.029778	0.030838	0.032263	0.030825	0.03087	0.032443	0.030887
0.325222	0.317018	0.325369	0.322234	0.325076	0.322092	0.323039	0.346035	0.322974	0.340024	0.323249	0.323184	0.321177	0.323248	0.353195	0.323378	0.351278	0.323296	0.31875	0.323619	0.319561	0.32383	0.363052	0.323879	0.349022	0.324024	0.349751	0.323959	0.312982	0.324121	0.339107	0.323991	0.324461	0.340997	0.324639
2.275863	2.259668	2.276151	2.269987	2.275576	2.269708	2.271574	2.316055	2.271446	2.304573	2.271987	2.271858	2.267904	2.271985	3.296	2.27224	2.325987	2.272079	2.263103	2.272715	2.264709	2.273129	2.348027	2.273225	2.321723	2.27351	2.323101	2.273383	2.251624	2.2737	2.302814	2.273446	2.274369	2.306439	2.274719
2.113034	2.100086	2.113265	2.108339	2.112805	2.108116	2.109607	2.145087	2.109505	2.135942	2.109937	2.109834	2.106674	2.109936	2.155863	2.11014	2.15299	2.110011	2.102835	2.110519	2.104119	2.11085	2.170502	2.110926	2.149597	2.111155	2.150694	2.111053	2.093648	2.111306	2.13454	2.111104	2.111841	2.137429	2.112121
9.16E+09	1.95E+10	9.31E+09	1.91E+10	9.12E+09	1.83E+10	9.65E+09	1.75E+10	9.35E+09	1.73E+10	9.24E+09	9.81E+09	2.17E+10	9.32E+09	1.71E+10	9.42E+09	1.70E+10	1.00E+10	1.97E+10	9.95E+09	2.05E+10	9.64E+09	1.78E+10	9.25E+09	1.84E+10	9.65E+09	1.88E+10	9.34E+09	1.84E+10	9.21E+09	1.80E+10	9.44E+09	9.83E+09	2.09E+10	9.72E+09
	113.26		105.14		100.16		81.52		85.03			121.41		83.80		80.52		97.37		106.02		84.97		99.42		94.50		96.87		95.18			112.64	

Table 62 PIE data for thermal expasion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (AG) specimens AW1-01, AW1-02 and AW1-03

	AW1-01			AW1-02			AW1-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.02113	5.361	2.641	0.05103	8.636	6.378	0.05185	6.764	6.481
150	0.05429	7.102	4.176	0.09101	6.46	7	0.0864	6.63	6.646
200	0.07603	4.344	4.224	0.11181	6.061	6.211	0.11205	6.131	6.225
250	0.10465	5.151	4.55	0.14887	4.938	6.473	0.1466	5.935	6.374
300	0.13124	8.107	4.687	0.17063	6.851	6.094	0.17698	6.841	6.321
350	0.17432	7.774	5.282	0.20982	8.393	6.358	0.21158	8.237	6.412
400	0.21041	7.422	5.537	0.25456	8.42	6.699	0.25081	6.897	6.6
450	0.25101	5.757	5.837	0.29108	6.424	6.769	0.28781	6.789	6.693
500	0.27712	7.288	5.773	0.3264	6.855	6.8	0.3252	8.879	6.775
550	0.31863	7.749	6.012	0.36042	6.319	6.8	0.36493	5.788	6.885

Table 63 PIE data for thermal expasion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (AG) specimens AW2-01, AW2-02 and AW2-03

	AW2-01			AW2-02			AW2-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04857	6.976	6.071	0.04076	7.914	5.095	0.05054	8.021	6.318
150	0.08135	5.25	6.258	0.07685	5.999	5.911	0.08725	5.845	6.711
200	0.09793	4.612	5.441	0.0987	5.393	5.483	0.10728	5.527	5.96
250	0.12662	4.109	5.505	0.13104	5.384	5.697	0.13975	4.535	6.076
300	0.14423	5.189	5.151	0.15651	6.287	5.59	0.16184	6.665	5.78
350	0.17379	5.736	5.266	0.18965	6.827	5.747	0.19651	6.907	5.955
400	0.20397	7.181	5.368	0.2226	6.215	5.858	0.23442	8.239	6.169
450	0.24126	5.32	5.611	0.25461	5.258	5.921	0.27282	5.193	6.345
500	0.26351	5.718	5.49	0.28113	6.361	5.857	0.30157	7.433	6.283
550	0.29592	5.737	5.583	0.3151	6.373	5.945	0.33578	5.391	6.336

Table 64 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-17(AG) specimens AW4-01, AW4-02 and AW4-03

	AW4-01			AW4-02			AW4-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05738	8.447	7.172	0.05543	7.068	6.929	0.02728	5.592	3.410
150	0.0958	6.254	7.369	0.09089	6.86	6.991	0.05967	6.822	4.590
200	0.12176	6.97	6.764	0.11952	5.767	6.64	0.08491	5.767	4.717
250	0.15575	4.731	6.772	0.14751	4.974	6.413	0.11538	4.256	5.017
300	0.18291	8.001	6.533	0.17204	6.069	6.144	0.13771	7.045	4.918
350	0.22761	9.095	6.897	0.2106	10.749	6.382	0.17229	5.943	5.221
400	0.27106	7.716	7.133	0.26111	8.046	6.871	0.20573	7.139	5.414
450	0.31025	6.705	7.215	0.30411	6.269	7.072	0.24320	6.730	5.656
500	0.34024	7.784	7.088	0.33344	8.106	6.947	0.27604	7.380	5.751
550	0.38334	7.421	7.233	0.37781	8.206	7.129	0.31080	5.652	5.864

Table 65 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (AG) specimens AW5-01, AW5-02 and AW5-03

	AW5-01			AW5-02			AW5-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05343	6.640	6.679	0.05326	9.291	6.658	0.04782	6.747	5.978
150	0.08686	6.499	6.682	0.09665	7.171	7.435	0.08287	6.686	6.375
200	0.11169	4.977	6.205	0.12015	5.458	6.675	0.10447	4.484	5.804
250	0.13789	4.697	5.995	0.15472	5.647	6.727	0.13289	5.035	5.778
300	0.16279	6.700	5.814	0.18067	7.067	6.453	0.15787	7.389	5.638
350	0.20002	7.287	6.061	0.21830	8.092	6.615	0.20057	8.260	6.078
400	0.23890	7.592	6.287	0.26542	9.482	6.985	0.23775	7.200	6.257
450	0.27210	5.891	6.328	0.30501	6.626	7.093	0.27592	5.758	6.417
500	0.29992	6.394	6.248	0.33993	7.741	7.082	0.30310	7.135	6.315
550	0.33522	6.003	6.325	0.37994	6.811	7.169	0.34040	6.391	6.423

Table 66 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (AG) specimens AW6-01, AW6-02 and AW6-03

	AW6-01			AW6-02			AW6-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04458	7.527	5.572	0.04769	8.152	5.961	0.05044	7.667	6.305
150	0.08266	6.609	6.358	0.08739	6.524	6.723	0.08917	7.045	6.860
200	0.10219	4.108	5.677	0.10673	4.340	5.929	0.11186	4.940	6.215
250	0.12920	4.787	5.617	0.13522	5.052	5.879	0.14223	4.908	6.184
300	0.15363	7.422	5.487	0.16291	8.186	5.818	0.16833	8.245	6.012
350	0.19467	7.947	5.899	0.20470	7.399	6.203	0.21335	8.179	6.465
400	0.23170	6.832	6.097	0.23982	7.851	6.311	0.25076	7.882	6.599
450	0.26860	5.821	6.246	0.27969	5.321	6.504	0.28951	5.815	6.733
500	0.29501	7.126	6.146	0.30671	7.613	6.390	0.32033	7.785	6.674
550	0.33251	6.345	6.274	0.34947	7.985	6.594	0.36392	8.126	6.866

Table 67 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (AG) specimens AW7-01 and AW7-03

	AW7-01			AW7-02			AW7-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05066	8.725	6.333				0.03011	7.647	3.764
150	0.09072	6.541	6.978				0.06523	6.053	5.017
200	0.11120	4.959	6.178				0.08974	5.706	4.985
250	0.14523	5.294	6.314				0.11879	4.335	5.165
300	0.16589	6.089	5.925				0.14278	6.837	5.099
350	0.19982	6.999	6.055				0.17997	8.110	5.454
400	0.23935	8.363	6.299				0.22283	8.081	5.864
450	0.27830	5.565	6.472				0.25881	6.487	6.019
500	0.30645	7.553	6.384				0.29132	6.671	6.069
550	0.34020	4.365	6.419				0.32623	6.240	6.155

Table 68 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (AG) specimens AW9-01 and AW9-03

	AW9-01			AW9-02			AW9-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04553	7.311	5.692				0.01696	6.438	2.120
150	0.08118	6.214	6.244				0.04525	5.140	3.481
200	0.10216	4.516	5.676				0.06579	4.699	3.655
250	0.12600	3.552	5.478				0.09568	5.477	4.160
300	0.14668	6.461	5.238				0.12376	7.313	4.420
350	0.17726	5.032	5.372				0.15779	6.030	4.781
400	0.20587	6.215	5.418				0.19379	7.393	5.100
450	0.23653	5.790	5.501				0.22451	5.135	5.221
500	0.26700	7.172	5.562				0.25307	7.656	5.272
550	0.30020	4.655	5.664				0.29439	6.848	5.554

Table 69 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (AG) specimens AW10-01, AW10-02 and AW10-03

	AW10-01			AW10-02			AW10-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04455	7.382	5.569	0.04935	6.566	6.169	0.05909	8.593	7.386
150	0.08163	6.715	6.279	0.08176	6.170	6.289	0.09904	6.589	7.619
200	0.10446	5.005	5.803	0.10521	5.342	5.845	0.12427	6.415	6.904
250	0.13323	4.321	5.793	0.13810	6.050	6.005	0.15742	4.857	6.845
300	0.15438	6.857	5.514	0.16901	7.829	6.036	0.18391	7.431	6.568
350	0.19008	5.657	5.760	0.20670	7.980	6.264	0.22579	9.251	6.842
400	0.21831	6.383	5.745	0.24820	6.654	6.532	0.27276	8.381	7.178
450	0.25433	6.610	5.915	0.28083	6.082	6.531	0.31064	6.129	7.224
500	0.28466	7.540	5.930	0.31500	9.091	6.563	0.33986	7.319	7.080
550	0.32156	5.247	6.067	0.35965	7.157	6.786	0.37844	6.407	7.140

Table 70 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (AG) specimens AW12-01and AW12-03

	AW12-01			AW12-02			AW12-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05171	6.888	6.463				0.04426	7.587	5.532
150	0.08811	6.939	6.778				0.08160	6.238	6.277
200	0.11404	6.643	6.336				0.10083	4.328	5.602
250	0.15219	6.415	6.617				0.12804	4.737	5.567
300	0.18305	7.487	6.538				0.15176	7.031	5.420
350	0.22575	7.839	6.841				0.19174	8.003	5.810
400	0.26147	7.576	6.881				0.22831	6.653	6.008
450	0.30204	8.034	7.024				0.26396	5.732	6.139
500	0.34326	8.367	7.151				0.29038	6.872	6.050
550	0.38372	7.315	7.240				0.32482	5.451	6.129

Table 71 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (AG) specimens AW13-01, AW13-02 and AW13-03

	AW13-01			AW13-02			AW13-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03930	8.037	4.912	0.05558	8.762	6.947			
150	0.07780	6.895	5.985	0.09702	6.976	7.463			
200	0.10384	5.197	5.769	0.12089	5.919	6.716			
250	0.12984	4.267	5.645	0.15635	5.240	6.798			
300	0.15171	5.219	5.418	0.17986	6.772	6.424			
350	0.17930	10.486	5.433	0.21791	8.319	6.603			
400	0.24401	10.771	6.421	0.26331	8.917	6.929			
450	0.29132	6.559	6.775	0.30336	6.872	7.055			
500	0.32653	8.421	6.803	0.33840	7.365	7.050			
550	0.36554	6.829	6.897	0.37619	6.722	7.098			

Table 72 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (WG) specimens AL6-01, AL6-02 and AL6-03

	AL6-01			AL6-02			AL6-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03696	6.189	4.62	0.049	7.438	6.126			
150	0.06923	6.115	5.325	0.08305	5.622	6.389			
200	0.0875	3.505	4.861	0.10428	5.884	5.793			
250	0.10877	3.577	4.729	0.13505	3.791	5.872			
300	0.1279	5.234	4.568	0.15412	6.326	5.504			
350	0.15692	6.46	4.755	0.18885	7.666	5.723			
400	0.19089	6.581	5.023	0.23003	7.694	6.053			
450	0.22134	4.11	5.148	0.26495	5.243	6.162			
500	0.24222	6.444	5.046	0.29519	7.304	6.15			
550	0.27377	4.479	5.165	0.32621	4.383	6.155			

Table 73 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-17 (WG) specimens AL8-01, AL8-02 and AL8-03

	AL8-01			AL8-02			AL8-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04223	9.438	5.279	0.04649	7.314	5.811			
150	0.08292	5.977	6.378	0.0818	6.753	6.293			
200	0.10072	4.612	5.596	0.10856	5.723	6.031			
250	0.13083	5.05	5.688	0.14052	4.947	6.11			
300	0.15992	8.211	5.711	0.1625	7.207	5.804			
350	0.20009	7.018	6.063	0.20066	5.992	6.081			
400	0.23569	8.405	6.202	0.2328	7.13	6.126			
450	0.27356	4.702	6.362	0.26867	6.165	6.248			
500	0.30083	7.887	6.267	0.30125	7.731	6.276			
550	0.34313	7.203	6.474	0.33476	4.699	6.316			

Table 74 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (AG) specimens BW1-01, BW1-02 and BW1-03

	BW1-01			BW1-02			BW1-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05390	6.763	6.738	0.05147	7.655	6.434	0.04205	6.126	5.256
150	0.08880	6.877	6.831	0.08673	5.712	6.671	0.07240	5.629	5.569
200	0.11297	4.381	6.276	0.10703	5.666	5.946	0.09277	4.720	5.154
250	0.13747	4.703	5.977	0.13781	4.079	5.992	0.12016	4.497	5.224
300	0.16231	6.864	5.797	0.15878	6.421	5.671	0.14108	5.171	5.039
350	0.20203	7.947	6.122	0.19403	7.683	5.880	0.16791	6.203	5.088
400	0.24166	7.365	6.359	0.23579	8.107	6.205	0.20065	5.330	5.280
450	0.27699	6.593	6.442	0.27218	5.757	6.330	0.22611	4.516	5.258
500	0.30441	6.262	6.342	0.30471	7.183	6.348	0.24877	6.441	5.183
550	0.34083	6.026	6.431	0.33741	5.504	6.366	0.28507	6.069	5.379

Table 75 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (AG) specimens BW2-01, BW2-02 and BW2-03

	BW2-01			BW2-02			BW2-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03079	5.152	3.849	0.05373	6.480	6.717	0.04205	6.126	5.256
150	0.06037	6.252	4.644	0.08797	6.687	6.767	0.07240	5.629	5.569
200	0.08659	6.467	4.810	0.11229	6.106	6.239	0.09277	4.720	5.154
250	0.12058	5.553	5.243	0.14936	6.172	6.494	0.12016	4.497	5.224
300	0.14569	6.239	5.203	0.17961	7.147	6.415	0.14108	5.171	5.039
350	0.18323	7.350	5.553	0.21736	8.209	6.587	0.16791	6.203	5.088
400	0.21493	6.592	5.656	0.25398	6.585	6.684	0.20065	5.330	5.280
450	0.25082	6.586	5.833	0.29040	7.079	6.753	0.22611	4.516	5.258
500	0.28638	8.346	5.966	0.32891	8.940	6.852	0.24877	6.441	5.183
550	0.32522	5.850	6.136	0.37008	6.206	6.983	0.28507	-113.520	5.379

Table 76 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (AG) specimens BW3-01, BW3-02 and BW3-03

	BW3-01			BW3-02			BW3-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05207	6.898	6.509	0.01424	7.713	1.780	0.02661	6.921	3.326
150	0.08452	5.645	6.502	0.04767	5.013	3.667	0.05886	6.422	4.528
200	0.10685	5.735	5.936	0.06775	6.246	3.764	0.08766	6.488	4.870
250	0.13584	3.851	5.906	0.10480	6.107	4.556	0.12259	5.369	5.330
300	0.15771	6.390	5.633	0.13538	6.891	4.835	0.14888	7.762	5.317
350	0.19311	7.905	5.852	0.17203	8.177	5.213	0.18733	6.384	5.677
400	0.23416	7.982	6.162	0.20952	6.826	5.514	0.22236	7.610	5.852
450	0.26834	5.541	6.240	0.24492	6.767	5.696	0.26323	7.733	6.122
500	0.29971	6.607	6.244	0.28318	8.922	5.900	0.30018	7.630	6.254
550	0.33199	5.759	6.264	0.32304	5.909	6.095	0.33910	7.274	6.398

Table 77 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (AG) specimens BW5-01, BW5-02 and BW5-03

	BW5-01			BW5-02			BW5-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04803	7.663	6.003	0.04747	6.382	5.934	0.04548	7.297	5.685
150	0.08458	6.508	6.506	0.07860	5.609	6.046	0.07898	5.329	6.075
200	0.11175	6.853	6.208	0.10050	5.163	5.583	0.09699	4.621	5.389
250	0.14909	5.753	6.482	0.12712	3.745	5.527	0.12440	4.724	5.409
300	0.17540	7.653	6.264	0.14641	5.974	5.229	0.15201	7.486	5.429
350	0.21539	6.803	6.527	0.17820	6.668	5.400	0.18957	7.488	5.744
400	0.25174	7.733	6.625	0.21601	7.741	5.684	0.22455	6.508	5.909
450	0.29207	7.695	6.792	0.25074	4.834	5.831	0.25852	4.797	6.012
500	0.33106	8.097	6.897	0.27735	7.278	5.778	0.28293	6.886	5.894
550	0.37159	7.572	7.011	0.30910	4.248	5.832	0.31924	6.532	6.023

Table 78 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (AG) specimens BW7-01, BW7-02 and BW7-03

	BW7-01			BW7-02			BW7-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.02223	6.839	2.779	0.04623	7.128	5.778	0.05014	7.647	6.268
150	0.05388	5.593	4.145	0.07980	5.463	6.138	0.08983	7.243	6.910
200	0.07394	4.815	4.108	0.09871	5.396	5.484	0.11209	4.406	6.227
250	0.10605	5.128	4.611	0.12933	4.024	5.623	0.14116	5.397	6.138
300	0.12609	5.900	4.503	0.14621	5.484	5.222	0.17016	8.327	6.077
350	0.16005	6.788	4.850	0.17836	6.606	5.405	0.21337	7.804	6.466
400	0.19900	8.347	5.237	0.21644	7.871	5.696	0.25002	8.069	6.579
450	0.23750	5.453	5.523	0.25337	5.328	5.892	0.28951	5.408	6.733
500	0.26453	7.540	5.511	0.27802	7.382	5.792	0.31843	7.902	6.634
550	0.29910	4.777	5.643	0.31454	5.093	5.935	0.36148	7.775	6.820

Table 79 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (AG) specimens BW8-01 and BW8-02

	BW8-01			BW8-02			BW8-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04718	6.963	5.897	0.04877	6.793	6.097			
150	0.08049	6.182	6.191	0.08120	5.647	6.246			
200	0.10425	4.985	5.792	0.10225	5.016	5.681			
250	0.13081	4.517	5.687	0.13133	5.423	5.710			
300	0.15384	6.491	5.494	0.16044	7.639	5.730			
350	0.18980	7.713	5.752	0.19791	6.367	5.997			
400	0.23090	7.313	6.076	0.23330	7.518	6.139			
450	0.26335	5.744	6.124	0.26406	4.843	6.141			
500	0.29139	6.386	6.071	0.29155	7.261	6.074			
550	0.32575	5.807	6.146	0.33154	6.883	6.255			

Table 80 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (AG) specimens BW9-01, BW9-02 and BW9-03

	BW9-01			BW9-02			BW9-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04774	7.982	5.968	0.05195	8.176	6.494	0.04863	8.489	6.078
150	0.08360	5.523	6.431	0.08882	5.750	6.832	0.09116	7.682	7.012
200	0.10191	4.856	5.662	0.11002	5.442	6.112	0.11916	5.949	6.620
250	0.13043	4.799	5.671	0.14151	5.970	6.153	0.14921	4.950	6.488
300	0.15894	7.939	5.677	0.17450	8.276	6.232	0.17788	7.151	6.353
350	0.19882	6.972	6.025	0.21402	6.758	6.485	0.21312	7.444	6.458
400	0.23314	7.823	6.135	0.25234	8.132	6.641	0.25467	9.179	6.702
450	0.27016	5.021	6.283	0.28693	5.758	6.673	0.30108	7.137	7.002
500	0.29710	7.285	6.190	0.31924	8.639	6.651	0.33314	8.507	6.940
550	0.33790	7.645	6.375	0.36475	7.494	6.882	0.37397	5.652	7.056

Table 81 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (AG) specimens BW10-01, BW10-02 and BW10-03

	BW10-01			BW10-02			BW10-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.02009	6.409	2.511	0.04392	8.182	5.490	0.01857	5.001	2.322
150	0.05180	6.306	3.985	0.08176	6.000	6.289	0.04674	5.723	3.596
200	0.07386	3.941	4.103	0.09955	4.155	5.531	0.06850	5.294	3.805
250	0.09782	4.531	4.253	0.12739	4.773	5.539	0.09919	5.781	4.313
300	0.12057	6.476	4.306	0.15211	7.385	5.433	0.12983	7.885	4.637
350	0.15794	7.338	4.786	0.19152	7.323	5.804	0.16773	6.712	5.083
400	0.19461	6.898	5.121	0.22601	6.713	5.948	0.20744	7.914	5.459
450	0.22672	5.758	5.273	0.26226	5.598	6.099	0.24051	5.605	5.593
500	0.25366	5.852	5.284	0.28614	6.683	5.961	0.27145	8.480	5.655
550	0.28574	5.653	5.391	0.32269	6.064	6.088	0.31652	7.390	5.972

Table 82 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (AG) specimens BW11-01 and BW11-02

	BW11-01			BW11-02			BW11-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04989	8.544	6.236	0.03854	7.572	4.818			
150	0.09100	6.654	7.000	0.07369	6.140	5.669			
200	0.11053	4.718	6.140	0.09886	6.180	5.492			
250	0.14135	5.509	6.146	0.13290	5.507	5.778			
300	0.17324	8.722	6.187	0.15570	5.378	5.561			
350	0.21644	7.586	6.559	0.19091	7.584	5.785			
400	0.25506	8.588	6.712	0.22552	7.408	5.935			
450	0.29234	5.467	6.799	0.26451	6.977	6.151			
500	0.32361	8.472	6.742	0.30170	8.434	6.286			
550	0.37050	8.266	6.991	0.33914	5.449	6.399			

Table 83 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (AG) specimens BW12-01, BW12-02 and BW12-03

	BW12-01			BW12-02			BW12-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04145	6.444	5.182	0.01913	8.206	2.391	0.04933	6.806	6.166
150	0.07577	6.786	5.829	0.05709	6.998	4.391	0.08144	5.629	6.265
200	0.09756	3.786	5.420	0.08502	5.387	4.723	0.10283	5.067	5.713
250	0.12101	4.373	5.261	0.11413	5.969	4.962	0.13293	5.651	5.779
300	0.14153	6.349	5.055	0.14495	6.792	5.177	0.16192	7.320	5.783
350	0.18059	7.784	5.473	0.18066	7.453	5.475	0.19895	6.825	6.029
400	0.21870	7.032	5.755	0.22220	8.766	5.847	0.23760	8.139	6.253
450	0.25163	5.912	5.852	0.26245	5.734	6.104	0.27096	5.182	6.301
500	0.27925	6.001	5.818	0.29108	8.349	6.064	0.30049	8.302	6.260
550	0.31247	5.916	5.896	0.33049	5.438	6.236	0.34483	7.166	6.506

Table 84 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (WG) specimens BL6-01, BL6-02 and BL6-03

	BL6-01			BL6-02			BL6-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100				0.02150	4.813	2.687	0.04186	6.974	5.233
150				0.04951	6.032	3.808	0.07555	5.931	5.812
200				0.07182	5.048	3.990	0.09785	5.550	5.436
250				0.09900	3.748	4.305	0.12991	5.217	5.648
300				0.11703	5.909	4.180	0.15427	6.314	5.509
350				0.14950	5.582	4.530	0.19004	7.354	5.759
400				0.17707	6.019	4.660	0.22278	6.089	5.863
450				0.20620	4.567	4.795	0.25512	5.806	5.933
500				0.23382	7.752	4.871	0.28790	8.242	5.998
550				0.27114	5.731	5.116	0.32761	6.323	6.181

Table 85 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for NBG-18 (WG) specimens BL7-01 and BL7-02

	BL7-01			BL7-02			BL7-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04943	6.246	6.179	0.04919	6.882	6.148			
150	0.08098	6.015	6.229	0.08305	5.944	6.388			
200	0.10358	5.547	5.754	0.10455	5.505	5.808			
250	0.13850	6.281	6.022	0.13391	4.076	5.822			
300	0.17100	7.714	6.107	0.15616	6.454	5.577			
350	0.20538	7.633	6.224	0.18994	7.499	5.756			
400	0.24617	6.890	6.478	0.23258	8.291	6.121			
450	0.28160	6.528	6.549	0.26767	5.208	6.225			
500	0.31783	9.339	6.621	0.29305	6.136	6.105			
550	0.36128	6.602	6.817	0.32451	5.021	6.123			

Table 86 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for H-451 (WG) specimens CW7-01 and CW7-03

	CW7-01			CW7-02			CW7-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03827	6.921	4.784				0.01967	5.037	2.459
150	0.07353	6.038	5.656				0.05075	6.650	3.903
200	0.09061	3.383	5.034				0.07155	3.691	3.975
250	0.11205	4.006	4.872				0.09322	4.188	4.053
300	0.13266	5.850	4.738				0.11574	6.468	4.133
350	0.16738	7.100	5.072				0.15423	7.506	4.674
400	0.20277	7.061	5.336				0.19055	6.830	5.015
450	0.23362	4.794	5.433				0.22317	6.065	5.190
500	0.26263	6.811	5.471				0.25200	5.984	5.250
550	0.29232	4.615	5.515				0.28353	5.744	5.350

Table 87 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for H-451 (WG) specimens CW8-02 and CW8-03

	CW8-01			CW8-02			CW8-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100				0.03796	5.362	4.745	0.02335	3.904	2.919
150				0.06471	4.639	4.978	0.04574	4.697	3.519
200				0.07843	3.302	4.357	0.06195	3.746	3.442
250				0.10006	3.313	4.350	0.08213	2.754	3.571
300				0.11506	4.785	4.109	0.09416	3.717	3.363
350				0.14300	6.011	4.333	0.11717	4.731	3.55
400				0.17414	5.794	4.583	0.14198	5.651	3.736
450				0.19871	3.272	4.621	0.17213	4.35	4.003
500				0.21828	5.866	4.547	0.19192	5.446	3.998
550				0.24585	3.833	4.639	0.2167	3.253	4.089

Table 88 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for H-451 (WG) specimens CW9-01 and CW9-03

	CW9-01			CW9-02			CW9-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04884	6.792	6.105				0.0377	2.659	4.713
150	0.08097	5.523	6.229				0.05531	5.101	4.254
200	0.10032	4.945	5.573				0.07892	5.188	4.384
250	0.1307	4.512	5.682				0.10627	4.149	4.621
300	0.14976	5.671	5.349				0.13007	7.141	4.645
350	0.18155	6.356	5.502				0.16416	5.761	4.974
400	0.21836	8.267	5.746				0.19767	7.383	5.202
450	0.25778	5.571	5.995				0.23539	6.806	5.474
500	0.28304	7.465	5.897				0.26927	7.667	5.61
550	0.32089	5.404	6.054				0.30473	5.758	5.75

Table 89 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for H-451 (WG) specimens CW10-01, CW10-02 and CW10-03

	CW10-01			CW10-02			CW10-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.01896	4.139	2.37	0.02983	5.105	3.729	0.03145	6.001	3.932
150	0.04271	5.73	3.285	0.05611	4.917	4.316	0.06251	5.445	4.808
200	0.06744	5.227	3.747	0.07196	3.483	3.998	0.07649	2.699	4.249
250	0.09303	3.836	4.045	0.09132	2.679	3.971	0.09396	2.725	4.085
300	0.11522	6.382	4.115	0.10278	3.765	3.671	0.10858	4.711	3.878
350	0.14936	7.337	4.526	0.12635	4.604	3.829	0.13418	5.126	4.066
400	0.18937	7.857	4.983	0.15071	5.622	3.966	0.16281	6.373	4.284
450	0.22294	5.379	5.185	0.17885	4.443	4.159	0.19317	4.253	4.492
500	0.25501	7.166	5.313	0.20084	5.417	4.184	0.21177	4.896	4.412
550	0.28626	4.951	5.401	0.22541	3.26	4.253	0.24099	5.355	4.547

Table 90 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for H-451 (WG) specimens CW11-01 and CW11-02

	CW11-01			CW11-02			CW11-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.01241	5.135	1.551	0.03352	7.503	4.190			
150	0.03959	5.154	3.046	0.06877	5.962	5.290			
200	0.05722	4.12	3.179	0.08877	4.485	4.932			
250	0.08463	4.261	3.679	0.11350	3.568	4.935			
300	0.10017	4.695	3.577	0.13259	6.441	4.735			
350	0.12967	6.15	3.929	0.16636	5.266	5.041			
400	0.16284	7.392	4.285	0.19327	6.277	5.086			
450	0.19754	5.394	4.594	0.22602	5.886	5.256			
500	0.22188	5.872	4.623	0.25650	7.284	5.344			
550	0.25656	6.449	4.841	0.29105	5.174	5.492			

Table 91 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for H-451 (WG) specimen CW12-02

	CW12-01			CW12-02			CW12-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100				0.02742	4.468	3.427			
150				0.05632	6.346	4.332			
200				0.07746	4.590	4.303			
250				0.10258	4.248	4.460			
300				0.12750	6.346	4.554			
350				0.15594	5.509	4.726			
400				0.18863	6.772	4.964			
450				0.22416	6.806	5.213			
500				0.25720	7.017	5.358			
550				0.29084	5.633	5.488			

Table 92 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for H-451 (WG) specimens CW13-01, CW13-02 and CW13-03

	CW13-01			CW13-02			CW13-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03325	5.362	4.157	0.02815	4.119	3.519	0.04034	7.910	5.042
150	0.06222	5.609	4.787	0.05576	6.152	4.289	0.07913	6.892	6.087
200	0.08048	3.459	4.471	0.07783	5.256	4.324	0.10344	5.336	5.747
250	0.09950	2.839	4.326	0.10686	4.551	4.646	0.13090	4.164	5.691
300	0.11390	4.907	4.068	0.12680	4.984	4.529	0.15631	7.082	5.583
350	0.14043	5.148	4.255	0.15727	7.184	4.766	0.18857	5.914	5.714
400	0.17056	6.611	4.488	0.19120	5.719	5.031	0.22311	7.350	5.871
450	0.20145	4.689	4.685	0.22175	5.503	5.157	0.26113	6.946	6.073
500	0.22178	4.925	4.620	0.25163	8.094	5.242	0.29472	7.364	6.140
550	0.24873	4.454	4.693	0.29226	6.639	5.514	0.33113	6.308	6.248

Table 93 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for H-451 (WG) specimens CW14-01, CW14-02 and CW14-03

	CW14-01			CW14-02			CW14-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03827	5.876	4.784	0.02638	6.250	3.297			
150	0.06935	5.899	5.335	0.05713	5.490	4.394			
200	0.08865	4.508	4.925	0.07441	3.335	4.134			
250	0.11756	5.215	5.111	0.09423	3.188	4.097			
300	0.14356	6.701	5.127	0.11130	5.464	3.975			
350	0.17609	5.887	5.336	0.13894	4.567	4.210			
400	0.21165	7.568	5.570	0.16153	5.135	4.251			
450	0.24116	4.539	5.608	0.18808	3.920	4.374			
500	0.26840	7.306	5.592	0.20931	6.210	4.361			
550	0.30804	6.787	5.812	0.24068	4.854	4.541			

Table 94 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW1-01, DW1-02 and DW1-03

	DW1-01			DW1-02			DW1-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04087	7.004	5.109	0.00600	7.824	0.750	0.04443	6.877	5.554
150	0.07664	6.577	5.896	0.04460	5.507	3.431	0.07799	5.996	5.999
200	0.09931	5.340	5.517	0.06147	6.333	3.415	0.09798	5.398	5.443
250	0.12925	4.261	5.620	0.09909	5.904	4.308	0.13259	5.509	5.765
300	0.14987	6.513	5.353	0.12697	6.845	4.535	0.15899	6.583	5.678
350	0.18511	5.953	5.609	0.16569	7.920	5.021	0.18961	6.488	5.746
400	0.21452	6.589	5.645	0.20127	7.349	5.297	0.22715	6.791	5.978
450	0.24776	6.186	5.762	0.24008	7.137	5.583	0.25736	5.192	5.985
500	0.28153	7.991	5.865	0.27934	8.961	5.820	0.28524	7.899	5.943
550	0.31993	5.799	6.036	0.31976	5.766	6.033	0.32703	6.448	6.170

Table 95 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW2-01, DW2-02 and DW2-03

	DW2-01			DW2-02			DW2-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03756	6.941	4.695	0.03825	7.186	4.781	0.04319	6.326	5.399
150	0.07099	5.795	5.461	0.07020	4.931	5.400	0.07293	5.218	5.610
200	0.09039	4.347	5.022	0.08349	3.071	4.638	0.09177	4.726	5.098
250	0.11575	3.844	5.033	0.10570	3.755	4.596	0.11810	3.543	5.135
300	0.13124	4.579	4.687	0.12347	5.743	4.410	0.13386	5.196	4.781
350	0.16024	6.160	4.856	0.15592	6.407	4.725	0.16353	5.978	4.955
400	0.18774	4.899	4.940	0.18864	6.207	4.964	0.19724	7.173	5.191
450	0.21357	4.362	4.967	0.21538	3.986	5.009	0.23166	5.152	5.387
500	0.23559	6.452	4.908	0.24007	6.178	5.001	0.25306	5.873	5.272
550	0.27244	6.139	5.140	0.26608	3.393	5.020	0.28676	5.383	5.411

Table 96 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW3-01, DW3-02 and DW3-03

	DW3-01			DW3-02			DW3-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04961	8.702	6.201	0.04107	5.651	5.134	0.01592	7.559	1.990
150	0.09006	6.625	6.928	0.07068	6.284	5.437	0.04721	4.890	3.632
200	0.11049	4.639	6.139	0.09556	5.792	5.309	0.06621	5.580	3.678
250	0.14147	5.346	6.151	0.12662	4.306	5.505	0.09923	4.536	4.314
300	0.16390	5.833	5.854	0.15016	7.449	5.363	0.11893	6.067	4.248
350	0.19749	6.928	5.985	0.18515	5.639	5.611	0.15296	7.280	4.635
400	0.23477	8.365	6.178	0.21786	7.500	5.733	0.19483	8.573	5.127
450	0.27716	6.497	6.446	0.25708	7.134	5.978	0.23339	5.675	5.428
500	0.30565	7.933	6.368	0.29149	7.404	6.073	0.26581	7.911	5.538
550	0.34449	4.922	6.500	0.32791	6.066	6.187	0.29925	4.748	5.646

Table 97 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW4-01 and DW4-03

	DW4-01			DW4-02			DW4-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03719	6.869	4.648				0.03531	5.223	4.414
150	0.07001	5.531	5.385				0.06179	4.943	4.753
200	0.08879	4.469	4.933				0.07833	4.114	4.352
250	0.11350	3.431	4.935				0.10420	4.101	4.530
300	0.12865	5.136	4.595				0.12329	4.902	4.403
350	0.16004	5.828	4.850				0.14701	4.724	4.455
400	0.18605	5.192	4.896				0.17547	6.006	4.618
450	0.21314	4.285	4.957				0.20022	3.094	4.656
500	0.23781	7.118	4.954				0.21804	5.290	4.543
550	0.27456	6.098	5.180				0.24451	4.109	4.613

Table 98 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW5-01, DW5-02 and DW5-03

	DW5-01			DW5-02			DW5-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03406	6.263	4.258	0.04935	7.779	6.169	0.03960	7.874	4.951
150	0.06495	5.290	4.996	0.08520	5.764	6.554	0.07540	5.853	5.800
200	0.08128	4.325	4.516	0.10596	5.832	5.887	0.09510	4.683	5.283
250	0.10907	4.578	4.742	0.13670	3.845	5.944	0.12202	3.658	5.305
300	0.13214	6.135	4.719	0.15472	5.985	5.526	0.13828	5.640	4.939
350	0.16172	5.416	4.901	0.19026	8.920	5.765	0.17049	5.572	5.166
400	0.19304	6.740	5.080	0.23987	9.099	6.312	0.19546	5.383	5.144
450	0.22106	3.790	5.141	0.28188	7.838	6.555	0.22354	4.495	5.199
500	0.24339	6.202	5.071	0.31925	5.899	6.651	0.24911	7.025	5.190
550	0.27762	6.210	5.238	0.34989	6.073	6.602	0.28481	5.588	5.374

Table 99 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW6-01, DW6-02 and DW6-03

	DW6-01			DW6-02			DA6-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03938	6.926	4.922	0.04849	7.635	6.062	0.01197	5.622	1.496
150	0.07104	5.319	5.465	0.08166	5.269	6.282	0.04592	5.189	3.532
200	0.08955	4.799	4.975	0.10102	5.087	5.612	0.05865	4.727	3.259
250	0.11911	4.934	5.179	0.12907	3.674	5.612	0.08528	3.856	3.708
300	0.14386	5.942	5.138	0.14643	5.609	5.230	0.10562	6.305	3.772
350	0.17117	5.903	5.187	0.17600	6.048	5.333	0.14178	7.686	4.296
400	0.20448	6.050	5.381	0.21176	7.779	5.573	0.17876	7.020	4.704
450	0.23155	4.579	5.385	0.24890	5.375	5.788	0.21006	4.450	4.885
500	0.25454	5.976	5.303	0.27289	6.851	5.685	0.23669	6.979	4.931
550	0.28843	5.690	5.442	0.30894	5.161	5.829	0.26670	3.848	5.032

Table 100 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW7-01, DW7-02 and DW7-03

	DW7-01			DW7-02			DW7-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.01024	5.279	1.280	0.03952	7.873	4.940	0.04276	9.381	5.345
150	0.04059	5.625	3.122	0.07552	5.837	5.809	0.08391	6.717	6.455
200	0.05296	3.819	2.942	0.09534	4.896	5.297	0.10797	4.874	5.998
250	0.08030	4.160	3.491	0.12246	3.536	5.324	0.13383	4.412	5.819
300	0.10027	4.988	3.581	0.13877	5.862	4.956	0.15830	7.252	5.653
350	0.12528	5.365	3.797	0.17100	5.323	5.182	0.19725	8.293	5.977
400	0.15709	6.494	4.134	0.19603	5.514	5.159	0.24331	9.582	6.403
450	0.18359	3.560	4.269	0.22441	4.350	5.219	0.28642	5.362	6.661
500	0.20454	5.880	4.261	0.24936	7.119	5.195	0.31037	7.720	6.466
550	0.23612	5.292	4.455	0.28458	5.277	5.369	0.35140	5.651	6.630

Table 101 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW8-01, DW8-02 and DW8-03

	DW8-01			DW8-02			DW8-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04568	8.019	5.710	0.04452	7.174	5.565	0.04316	7.383	5.395
150	0.08096	5.725	6.227	0.07933	6.041	6.102	0.07718	5.430	5.937
200	0.10354	5.629	5.752	0.09916	5.144	5.509	0.09282	3.420	5.156
250	0.13243	3.882	5.758	0.13176	5.538	5.729	0.11538	3.915	5.016
300	0.15300	6.368	5.464	0.15967	6.806	5.702	0.13514	5.191	4.826
350	0.18701	7.769	5.667	0.19142	6.890	5.801	0.15965	4.931	4.838
400	0.22943	8.046	6.038	0.22919	6.630	6.031	0.18710	5.538	4.924
450	0.26493	5.489	6.161	0.26071	5.271	6.063	0.21463	4.887	4.991
500	0.29699	7.269	6.187	0.28843	8.249	6.009	0.24121	6.934	5.025
550	0.32883	4.887	6.204	0.33262	6.929	6.276	0.27370	4.341	5.164

Table 102 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW9-01 and DW9-03

	DW9-01			DW9-02			DW9-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03653	6.724	4.566				0.05012	7.678	6.265
150	0.06889	5.530	5.299				0.08718	7.039	6.706
200	0.08675	4.536	4.820				0.11231	4.697	6.239
250	0.11411	4.377	4.961				0.13953	5.049	6.066
300	0.13603	6.136	4.858				0.16418	7.354	5.864
350	0.16630	5.725	5.039				0.20693	8.451	6.271
400	0.20031	6.969	5.271				0.24788	7.236	6.523
450	0.22975	4.257	5.343				0.28535	6.467	6.636
500	0.25070	5.917	5.223				0.31339	7.272	6.529
550	0.28577	6.077	5.392				0.35289	6.300	6.658

Table 103 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW10-01 and DW10-02

	DW10-01			DW10-02			DW10-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05515	9.435	6.893	0.04242	7.770	5.302			
150	0.09690	6.475	7.454	0.07770	6.070	5.977			
200	0.11769	5.415	6.538	0.09997	4.795	5.554			
250	0.15177	4.984	6.599	0.12519	3.500	5.443			
300	0.17263	6.549	6.166	0.14330	6.101	5.118			
350	0.20847	7.353	6.317	0.17430	5.235	5.282			
400	0.25116	8.944	6.609	0.20301	6.186	5.342			
450	0.29167	5.574	6.783	0.23316	5.227	5.422			
500	0.32301	8.105	6.729	0.26203	7.415	5.459			
550	0.35813	4.959	6.757	0.29598	4.600	5.585			

Table 104 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (WG) specimens DW11-01

	DW11-01			DW11-02			DW11-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05515	9.435	6.893						
150	0.09690	6.475	7.454						
200	0.11769	5.415	6.538						
250	0.15177	4.984	6.599						
300	0.17263	6.549	6.166						
350	0.20847	7.353	6.317						
400	0.25116	8.944	6.609						
450	0.29167	5.574	6.783						
500	0.32301	8.105	6.729						
550	0.35813	4.959	6.757						

Table 105 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (AG) specimens DA6-01 and DA6-02

	DA6-01			DA6-02			DA6-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03531	6.388	4.413	0.04294	7.543	5.367			
150	0.06769	5.889	5.207	0.07761	5.908	5.970			
200	0.08517	3.226	4.731	0.10145	5.760	5.636			
250	0.10488	3.602	4.560	0.13035	4.106	5.667			
300	0.12483	5.402	4.458	0.15393	6.988	5.497			
350	0.15481	6.543	4.691	0.19220	8.362	5.824			
400	0.18925	6.957	4.980	0.23619	8.076	6.215			
450	0.22014	4.117	5.119	0.27183	6.653	6.322			
500	0.24348	6.876	5.072	0.30478	6.721	6.350			
550	0.27256	3.292	5.143	0.34170	6.813	6.447			

Table 106 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for PCEA (AG) specimens DA7-01 and DA7-02

	DA7-01			DA7-02			DA7-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05182	8.285	6.478	0.04474	7.180	5.592			
150	0.08884	5.866	6.834	0.07819	5.500	6.014			
200	0.10881	5.429	6.045	0.09371	3.361	5.206			
250	0.14038	4.347	6.104	0.11643	4.290	5.062			
300	0.16060	6.210	5.736	0.13804	4.998	4.930			
350	0.19485	7.149	5.905	0.16192	5.310	4.907			
400	0.23633	8.560	6.219	0.19117	5.883	5.031			
450	0.27433	5.692	6.380	0.22304	5.467	5.187			
500	0.30500	7.442	6.354	0.25023	6.588	5.213			
550	0.33928	5.308	6.402	0.27994	4.105	5.282			

Table 107 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-110 specimens EW2-01, EW2-02 and EW2-03

	EW2-01			EW2-02			EW2-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05247	10.547	6.558	0.05054	9.768	6.318	0.04883	8.523	6.103
150	0.09892	7.488	7.609	0.09563	7.641	7.356	0.08523	5.359	6.556
200	0.12616	5.616	7.009	0.12385	6.075	6.881	0.10220	4.787	5.678
250	0.16063	6.583	6.984	0.15505	5.245	6.741	0.13278	5.078	5.773
300	0.18855	6.585	6.734	0.18437	6.256	6.585	0.16053	7.660	5.733
350	0.22631	8.589	6.858	0.21304	6.823	6.456	0.19964	6.906	6.050
400	0.27366	9.756	7.201	0.25146	13.796	6.617	0.23335	7.735	6.141
450	0.31754	7.388	7.385	0.32625	10.612	7.587	0.26965	4.999	6.271
500	0.35554	7.734	7.407	0.37373	9.166	7.786	0.29720	7.390	6.192
550	0.39510	7.027	7.455	0.42158	7.419	7.954	0.33854	7.534	6.388

Table 108 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-110 specimens EW4-01 and EW4-02

	EW4-01			EW4-02			EW4-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04627	9.584	5.784	0.05244	10.378	6.555			
150	0.08865	7.021	6.819	0.09715	6.517	7.473			
200	0.11837	7.613	6.576	0.11887	6.032	6.604			
250	0.15973	6.100	6.945	0.15465	6.208	6.724			
300	0.18754	8.633	6.698	0.18960	9.169	6.771			
350	0.23101	7.141	7.000	0.23270	7.791	7.051			
400	0.26965	9.221	7.096	0.27730	8.242	7.297			
450	0.31979	8.539	7.437	0.31466	6.961	7.318			
500	0.35637	8.568	7.424	0.35373	10.063	7.369			
550	0.40134	6.773	7.572	0.40199	7.476	7.585			

Table 109 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-110 specimens EW5-01, EW5-02 and EW5-03

	EW5-01			EW5-02			EW5-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04867	8.220	6.084	0.04310	5.822	5.387	0.04615	7.764	5.769
150	0.08808	6.997	6.775	0.07326	5.585	5.635	0.08078	5.360	6.214
200	0.11635	7.450	6.464	0.09105	4.244	5.058	0.09840	4.728	5.467
250	0.15703	6.306	6.827	0.11823	4.825	5.141	0.12678	4.369	5.512
300	0.18642	7.835	6.658	0.14222	6.338	5.079	0.15049	7.529	5.375
350	0.22905	7.380	6.941	0.17467	5.818	5.293	0.19131	7.457	5.797
400	0.26557	8.291	6.989	0.20513	7.057	5.398	0.22631	7.290	5.955
450	0.31005	8.266	7.210	0.23714	4.054	5.515	0.26244	4.990	6.103
500	0.35022	8.306	7.296	0.25969	6.360	5.410	0.28829	7.155	6.006
550	0.39211	7.491	7.398	0.29405	6.000	5.548	0.32571	6.306	6.146

Table 110 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-110 specimens EW6-01 and EW6-03

	EW6-01			EW6-02			EW6-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05824	8.926	7.280				0.04538	8.398	5.672
150	0.09724	6.725	7.480				0.08334	6.307	6.411
200	0.12701	6.224	7.056				0.10515	4.603	5.842
250	0.15646	5.144	6.802				0.12976	4.009	5.642
300	0.18496	8.523	6.606				0.15303	6.501	5.465
350	0.23195	8.438	7.029				0.18319	5.181	5.551
400	0.27395	9.111	7.209				0.21307	6.857	5.607
450	0.31876	5.944	7.413				0.24849	6.321	5.779
500	0.34852	8.961	7.261				0.27928	7.327	5.818
550	0.39820	8.917	7.513				0.31320	4.523	5.909

Table 111 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-110 specimens EW7-01

	EW7-01			EW7-02			EW7-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03787	7.112	4.734						
150	0.07034	5.402	5.410						
200	0.09050	5.465	5.028						
250	0.12228	5.043	5.317						
300	0.14697	6.017	5.249						
350	0.17706	7.063	5.365						
400	0.21424	5.844	5.638						
450	0.24230	5.755	5.635						
500	0.27497	8.210	5.729						
550	0.31654	6.756	5.973						

Table 112 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-110 specimens EW8-01, EW8-02 and EW8-03

	EW8-01			EW8-02			EW8-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04932	6.920	6.164	0.04608	9.339	5.759	0.05293	6.842	6.616
150	0.08187	5.852	6.298	0.08806	6.918	6.774	0.08817	6.720	6.782
200	0.10375	4.678	5.764	0.11321	5.365	6.290	0.11197	6.230	6.221
250	0.12874	3.958	5.597	0.14107	4.249	6.133	0.15014	6.403	6.528
300	0.15012	6.142	5.362	0.16688	7.423	5.960	0.18112	7.242	6.469
350	0.18245	7.248	5.529	0.19996	6.058	6.059	0.22028	8.062	6.675
400	0.22350	7.811	5.881	0.23428	7.955	6.165	0.25719	7.703	6.768
450	0.25615	5.177	5.957	0.27643	7.109	6.429	0.29896	7.750	6.952
500	0.28541	6.773	5.946	0.31031	7.235	6.465	0.33905	8.973	7.064
550	0.31789	5.232	5.998	0.34770	6.688	6.560	0.38085	6.160	7.186

Table 113 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-110 specimens EW9-01, EW9-02 and EW9-03

	EW9-01			EW9-02			EW9-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03798	7.057	4.747	0.04417	6.164	5.521	0.04900	7.863	6.126
150	0.06962	5.074	5.356	0.07640	6.427	5.877	0.08719	6.937	6.707
200	0.08642	4.300	4.801	0.09898	4.469	5.499	0.11238	6.964	6.243
250	0.11340	4.444	4.930	0.12276	3.930	5.337	0.15616	6.990	6.789
300	0.13534	5.806	4.834	0.14520	6.254	5.186	0.18699	7.932	6.678
350	0.16203	5.071	4.910	0.18010	7.234	5.458	0.23103	7.977	7.001
400	0.19354	6.629	5.093	0.21992	8.062	5.787	0.26923	8.358	7.085
450	0.22057	3.771	5.130	0.25341	5.395	5.893	0.31460	8.654	7.316
500	0.24274	6.133	5.057	0.28237	6.686	5.883	0.35658	8.561	7.429
550	0.27598	5.686	5.207	0.31677	5.959	5.977	0.39999	7.784	7.547

Table 114 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-110 specimens EW10-01, EW10-02 and EW10-03

	EW10-01			EW10-02			EW10-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04369	7.023	5.462	0.04307	8.548	5.384	0.04681	6.965	5.851
150	0.07811	6.002	6.009	0.08140	5.905	6.262	0.07969	5.424	6.130
200	0.09781	5.238	5.434	0.10192	6.030	5.662	0.09555	3.664	5.308
250	0.13012	5.333	5.657	0.13460	4.107	5.852	0.12167	4.717	5.290
300	0.15727	6.718	5.617	0.15599	6.718	5.571	0.14155	4.823	5.055
350	0.18913	6.942	5.731	0.19295	7.518	5.847	0.16898	5.925	5.121
400	0.22614	6.229	5.951	0.23597	9.195	6.210	0.20036	7.220	5.273
450	0.25692	5.673	5.975	0.27404	5.396	6.373	0.23756	6.099	5.525
500	0.28772	8.285	5.994	0.30648	7.556	6.385	0.26512	5.904	5.523
550	0.32936	6.403	6.214	0.34239	6.330	6.460	0.29762	5.806	5.615

Table 115 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimens FW1-01 and FW1-03

	FW1-01			FW1-02			FW1-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05771	8.013	7.214				0.04990	7.960	6.237
150	0.09407	6.584	7.236				0.08586	5.708	6.605
200	0.12187	5.851	6.771				0.10277	3.711	5.709
250	0.15063	4.898	6.549				0.12699	4.550	5.521
300	0.17788	7.850	6.353				0.14772	4.380	5.276
350	0.22284	9.164	6.753				0.17429	6.787	5.282
400	0.26537	7.966	6.983				0.20959	7.630	5.515
450	0.30766	6.596	7.155				0.24898	6.461	5.790
500	0.33716	8.081	7.024				0.27875	6.885	5.807
550	0.38363	8.378	7.238				0.31607	6.281	5.964

Table 116 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimens FW2-02 and FW2-03

	FW2-01			FW2-02			FW2-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100				0.01839	8.585	2.299	0.06136	10.692	7.670
150				0.05306	5.267	4.082	0.10861	7.133	8.354
200				0.07714	6.475	4.286	0.13329	7.072	7.405
250				0.11645	7.131	5.063	0.17233	5.221	7.493
300				0.15180	8.789	5.421	0.20067	8.922	7.167
350				0.19599	9.002	5.939	0.25233	10.002	7.646
400				0.23754	8.046	6.251	0.29798	9.055	7.842
450				0.28250	8.971	6.570	0.34387	6.850	7.997
500				0.32878	9.118	6.850	0.37614	9.508	7.836
550				0.37356	7.887	7.048	0.42971	9.124	8.108

Table 117 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimens FW3-01, FW3-02 and FW3-03

	FW3-01			FW3-02			FW3-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.06491	9.816	8.114	0.01989	6.096	2.486	0.05092	9.728	6.365
150	0.10725	6.419	8.250	0.04546	4.137	3.497	0.09440	7.196	7.261
200	0.13266	6.914	7.370	0.06309	4.779	3.505	0.12093	5.242	6.718
250	0.16808	4.998	7.308	0.09027	4.791	3.925	0.14819	5.477	6.443
300	0.19547	8.301	6.981	0.11720	7.459	4.186	0.17826	6.894	6.366
350	0.24305	9.987	7.365	0.15503	6.542	4.698	0.21527	7.541	6.523
400	0.28930	8.562	7.613	0.18797	7.533	4.947	0.25737	9.973	6.773
450	0.33392	6.651	7.766	0.22285	5.028	5.182	0.30393	6.258	7.068
500	0.36531	8.768	7.611	0.25020	7.363	5.212	0.33601	8.474	7.000
550	0.41528	9.133	7.836	0.29062	6.934	5.483	0.37512	5.844	7.078

Table 118 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimens FW4-01, FW4-02 and FW4-03

	FW4-01			FW4-02			FW4-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05343	8.542	6.679	0.04966	6.742	6.207	0.05323	8.800	6.653
150	0.09132	5.725	7.025	0.08393	6.467	6.456	0.09598	7.657	7.383
200	0.10944	4.781	6.080	0.10654	5.974	5.919	0.12101	5.164	6.723
250	0.14025	4.664	6.098	0.14373	5.932	6.249	0.15356	5.657	6.677
300	0.16021	6.182	5.722	0.17154	6.909	6.126	0.18473	9.171	6.598
350	0.19418	6.932	5.884	0.20744	7.895	6.286	0.23135	8.178	7.011
400	0.23435	8.890	6.167	0.24544	6.474	6.459	0.27290	8.907	7.182
450	0.27459	5.481	6.386	0.27962	6.751	6.503	0.31110	6.094	7.235
500	0.30414	7.459	6.336	0.31751	9.232	6.615	0.34707	9.959	7.231
550	0.33758	4.886	6.369	0.35987	6.076	6.790	0.39933	8.067	7.535

Table 119 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimens FW5-01, FW5-02 and FW5-03

	FW5-01			FW5-02			FW5-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.06415	10.896	8.019	0.05406	9.704	6.758	0.05244	9.216	6.555
150	0.10953	6.734	8.425	0.09918	7.280	7.629	0.09441	7.239	7.262
200	0.13658	6.785	7.588	0.12161	5.369	6.756	0.12013	5.172	6.674
250	0.17184	5.486	7.471	0.15732	6.449	6.840	0.15263	5.879	6.636
300	0.20115	8.631	7.184	0.19241	9.499	6.872	0.17633	6.104	6.297
350	0.25091	10.014	7.603	0.23781	7.326	7.206	0.21234	8.469	6.435
400	0.29536	8.784	7.773	0.27967	9.018	7.360	0.25991	9.767	6.840
450	0.33994	6.513	7.906	0.31888	6.552	7.416	0.30358	6.432	7.060
500	0.37349	9.321	7.781	0.35831	10.701	7.465	0.33822	7.625	7.046
550	0.42547	9.098	8.028	0.40668	6.956	7.673	0.37527	6.543	7.080

Table 120 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimens FW7-01, FW7-02 and FW7-03

	FW7-01			FW7-02			FW7-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.04530	8.015	5.662	0.04312	8.143	5.390	0.04405	7.674	5.506
150	0.08264	6.008	6.357	0.08059	6.289	6.199	0.08129	6.853	6.253
200	0.10053	4.349	5.585	0.10486	6.326	5.825	0.10695	5.893	5.942
250	0.12882	4.558	5.601	0.14058	5.662	6.112	0.13968	4.660	6.073
300	0.15030	7.187	5.368	0.16484	5.474	5.887	0.16175	7.348	5.777
350	0.19430	8.328	5.888	0.19525	7.293	5.917	0.19916	6.181	6.035
400	0.23114	7.333	6.083	0.23334	7.591	6.140	0.23401	7.837	6.158
450	0.26957	5.892	6.269	0.27245	7.716	6.336	0.27539	7.659	6.404
500	0.29806	7.342	6.210	0.31413	8.886	6.544	0.31155	7.672	6.491
550	0.33774	6.970	6.372	0.35453	5.951	6.689	0.35137	7.046	6.630

Table 121 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimens FW8-01 and FW8-02

	FW8-01			FW8-02			FW8-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.02248	4.711	2.810	0.04623	8.402	5.778			
150	0.04881	5.494	3.755	0.08519	6.576	6.553			
200	0.06784	4.689	3.769	0.11194	7.134	6.219			
250	0.09891	5.378	4.300	0.15107	5.910	6.568			
300	0.12421	6.790	4.436	0.17623	7.348	6.294			
350	0.15717	5.978	4.763	0.21903	7.122	6.637			
400	0.19309	7.342	5.081	0.25315	8.060	6.662			
450	0.22259	4.725	5.177	0.29751	8.232	6.919			
500	0.25012	8.145	5.211	0.33649	7.874	7.010			
550	0.29414	6.870	5.550	0.37720	7.471	7.117			

Table 122 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimens FW9-01, FW9-02 and FW9-03

	FW9-01			FW9-02			FW9-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.02429	4.684	3.037	0.01905	6.925	2.381	0.05018	8.307	6.273
150	0.05260	6.347	4.046	0.04885	4.602	3.758	0.08989	6.883	6.915
200	0.07585	5.586	4.214	0.06476	4.905	3.598	0.11689	7.043	6.494
250	0.11045	6.200	4.802	0.09570	5.064	4.161	0.15745	6.370	6.846
300	0.14168	7.511	5.060	0.12516	8.542	4.470	0.18408	7.641	6.574
350	0.17773	7.734	5.386	0.16781	7.129	5.085	0.22834	7.428	6.919
400	0.21695	6.847	5.709	0.20314	8.399	5.346	0.26414	8.131	6.951
450	0.25196	6.505	5.860	0.24124	5.058	5.610	0.30989	8.903	7.207
500	0.28786	9.119	5.997	0.26943	8.613	5.613	0.35085	8.139	7.309
550	0.33094	6.276	6.244	0.31754	7.845	5.991	0.39392	8.111	7.432

Table 123 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimens FW10-01, FW10-02 and FW10-03

	FW10-01			FW10-02			FW10-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.03945	6.240	4.932	0.04363	8.445	5.454	0.01016	9.168	1.269
150	0.07063	5.730	5.433	0.08308	6.903	6.391	0.05412	7.590	4.163
200	0.08926	4.464	4.959	0.10918	5.631	6.066	0.07257	4.111	4.032
250	0.11852	5.014	5.153	0.13750	4.202	5.978	0.10283	5.506	4.471
300	0.14331	6.909	5.118	0.16236	7.237	5.799	0.13453	7.353	4.805
350	0.17680	5.840	5.358	0.19602	6.746	5.940	0.17021	7.734	5.158
400	0.21019	7.050	5.531	0.23293	7.657	6.130	0.21557	10.026	5.673
450	0.23974	4.575	5.575	0.27490	7.751	6.393	0.26247	6.846	6.104
500	0.26540	7.149	5.529	0.30889	7.075	6.435	0.29789	8.697	6.206
550	0.30632	7.047	5.780	0.34729	6.612	6.553	0.33575	5.346	6.335

Table 124 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimens FW11-01, FW11-02 and FW11-03

	FW11-01			FW11-02			FW11-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.01615	8.273	2.018	0.05233	9.661	6.541	0.02237	6.316	2.796
150	0.05259	6.970	4.045	0.09355	6.709	7.196	0.05042	4.965	3.879
200	0.08573	8.018	4.763	0.12356	7.786	6.865	0.06827	3.760	3.793
250	0.12687	5.708	5.516	0.16693	6.715	7.258	0.09076	3.965	3.946
300	0.15883	8.975	5.672	0.19602	8.776	7.001	0.11076	5.019	3.956
350	0.20050	8.434	6.076	0.24169	7.524	7.324	0.13377	4.761	4.054
400	0.24893	10.856	6.551	0.28252	9.839	7.435	0.16521	7.022	4.348
450	0.30042	7.491	6.986	0.33382	8.276	7.763	0.20129	6.617	4.681
500	0.33949	8.750	7.073	0.36902	8.972	7.688	0.23380	6.899	4.871
550	0.38014	6.917	7.172	0.41474	6.113	7.825	0.26581	5.041	5.015

Table 125 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimen FW12-01

	FW12-01			FW12-02			FW12-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.05423	9.771	6.779						
150	0.09714	7.120	7.472						
200	0.12749	7.612	7.083						
250	0.16967	6.082	7.377						
300	0.19607	8.276	7.003						
350	0.23821	7.552	7.218						
400	0.27955	9.530	7.357						
450	0.32933	7.882	7.659						
500	0.36470	8.855	7.598						
550	0.40795	5.897	7.697						

Table 126 PIE data for thermal expansion, instantaneous CTE and mean CTE as a function of temperature for IG-430 specimen FW13-01

	FW13-01			FW13-02			FW13-03		
Temp	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average	Expansion	Instantaneous	Average
°C	(%)	CTE	CTE	(%)	CTE	CTE	(%)	CTE	CTE
		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)		(x10-6/C)	(x10-6/C)
100	0.06017	10.255	7.521						
150	0.10488	6.712	8.068						
200	0.12801	6.867	7.111						
250	0.16729	4.901	7.274						
300	0.19173	8.071	6.847						
350	0.23989	10.203	7.269						
400	0.28706	8.094	7.554						
450	0.32933	7.041	7.659						
500	0.35920	8.220	7.483						
550	0.40560	7.701	7.653						

Table 127 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for NBG-17 graphite (both AG and WG orientations)

Resistivity

Specimen Number- Post-Irrad in Red			AW1-01	AW1-01	AW1-02	AW1-02	AW1-03	AW1-03	AL6-01	AL6-01	AW2-01	AW2-01	AW2-02	AW2-02	AW2-03	AW2-03	AL6-02	AL6-02	AW4-01	AW4-01
Sample Location			**1S3**		**1S11**		**1S12**		**1S13**		**1U3**		**1U11**		**1U12**		**2S4**		**2S6**	
Applied current, I	mA		4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
Compl. Voltage	V		2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
ID Orientation:																				
Forward current:																				
Voltage readings, mV		1	0.003864	0.012505	0.003908	0.011704	0.004064	0.012072	0.003767	0.010914	0.004004	0.013000	0.00362	0.012082	0.004086	0.011386	0.003559	0.012236	0.004241	0.013359
		2	0.004122	0.012242	0.003635	0.010702	0.004031	0.011984	0.003731	0.010848	0.004043	0.012372	0.003999	0.011613	0.004219	0.011777	0.003807	0.010628	0.004014	0.012011
		3	0.004248	0.012381	0.004104	0.012256	0.004085	0.012539	0.003808	0.010684	0.004220	0.012842	0.004059	0.012483	0.004009	0.011485	0.003203	0.010422	0.004144	0.011603
		4	0.004104	0.011550	0.003997	0.011894	0.004152	0.012323	0.003745	0.011132	0.003986	0.012095	0.004075	0.012389	0.003857	0.011175	0.0038	0.010759	0.004289	0.012038
Reverse current:																				
Voltage readings, mV		1	0.004074	0.010649	0.004427	0.011711	0.004161	0.011393	0.004025	0.011607	0.004068	0.011127	0.004006	0.011063	0.004139	0.011546	0.003889	0.010635	0.004105	0.011451
		2	0.004145	0.010991	0.003989	0.011690	0.003923	0.011689	0.004048	0.011526	0.004181	0.010544	0.004259	0.010473	0.004117	0.011463	0.003869	0.010720	0.004256	0.011621
		3	0.003820	0.010464	0.004128	0.011709	0.003936	0.011409	0.003833	0.011130	0.004038	0.011292	0.004203	0.011145	0.003746	0.011608	0.003966	0.010608	0.004148	0.011469
		4	0.004039	0.011645	0.003264	0.011935	0.004037	0.011877	0.003451	0.010960	0.004005	0.010525	0.004151	0.011016	0.003314	0.011866	0.004013	0.010756	0.004174	0.010358
End-for-end orientation:																				
Reverse current:																				
Voltage readings, mV		1	0.003981	0.010747	0.004041	0.010598	0.004031	0.011229	0.003667	0.011479	0.003618	0.011467	0.003637	0.010844	0.003553	0.011631	0.003521	0.009147	0.004078	0.010612
		2	0.004363	0.011396	0.004057	0.010741	0.003973	0.011052	0.003742	0.010734	0.004212	0.011225	0.003976	0.011255	0.00392	0.011598	0.003703	0.009166	0.003751	0.010946
		3	0.003435	0.010877	0.003615	0.011461	0.003839	0.011209	0.003118	0.010133	0.003612	0.011040	0.003244	0.011109	0.002618	0.011738	0.004014	0.009163	0.004179	0.011038
		4	0.004285	0.011672	0.003843	0.011818	0.004061	0.011541	0.003587	0.010779	0.004046	0.011245	0.003905	0.011208	0.004103	0.011846	0.003988	0.009174	0.003867	0.011832
Forward current:		1	0.004140	0.011709	0.003997	0.012033	0.003974	0.012235	0.003899	0.012972	0.003597	0.011389	0.004207	0.011985	0.003668	0.011670	0.003892	0.009022	0.003979	0.012144
Voltage readings, mV		2	0.003965	0.011758	0.004109	0.011969	0.003767	0.012085	0.003550	0.013140	0.003941	0.011569	0.003832	0.012279	0.003762	0.011378	0.003366	0.009079	0.003861	0.011660
		3	0.004142	0.011596	0.00352	0.012732	0.004071	0.011592	0.003191	0.012634	0.003992	0.011369	0.003716	0.013077	0.00364	0.011928	0.003761	0.009000	0.004043	0.011680
		4	0.004294	0.011904	0.003721	0.012232	0.004094	0.012200	0.003727	0.012536	0.003801	0.011556	0.004032	0.011250	0.003582	0.011709	0.003591	0.009054	0.004028	0.011901
		0																		
Average voltage, V	mV		0.00406	0.01151	0.00390	0.01170	0.00401	0.01178	0.00368	0.01145	0.00396	0.01154	0.00393	0.01158	0.00377	0.01161	0.00375	0.00997	0.00407	0.01161
Average resistance, R=V/I	Ω		1.01595	2.87634	0.97430	2.92477	1.00311	2.94420	0.92014	2.86263	0.99006	2.88527	0.98314	2.89486	0.94270	2.90319	0.93659	2.49327	1.01808	2.90192
Potential Contact Distance, L	mm		12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586
Average area, A mm^2 *	mm^2		127.3018	125.188	127.4701	125.657	127.4924	126.804	127.3621	124.514	127.4606	124.497	127.3844	124.673	127.1304	125.980	127.3177	126.288	127.4384	126.107
Resistivity, p=(R*A)/L	μΩm		10.25	**28.61**	9.85	**29.20**	10.14	**29.66**	9.29	**28.32**	10.00	**28.54**	9.93	**28.68**	9.50	**29.06**	9.45	**25.02**	10.29	**29.08**
Fractional Change, = $(\rho_i-\rho_0)/\rho_0$	%			179.03		196.58		192.57		204.83		185.28		188.82		205.85		164.64		182.69

Table 128 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for NBG-17 graphite (both AG and WG orientations)-cont.

AL6-03	AW4-02	AW4-02	AW4-03	AW4-03	AW5-01	AW5-01	AL8-01	AL8-01	AW5-02	AW5-02	AW5-03	AW5-03	AW6-01	AW6-01	AW6-02	AW6-02	AL8-02	AL8-02	AW6-03	AW6-03	AW7-01	AW7-01	AW7-02	AL8-03
2S10	2U4		2U6		2U10		3S8		3S13		3U8		3U12		4S8		4S11		4S12		4U8		4U11	5S3
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.004001	0.004203	0.012060	0.004126	0.011428	0.003359	0.012662	0.004154	0.009453	0.003912	0.011581	0.004055	0.011161	0.004283	0.011215	0.004264	0.011343	0.004362	0.012476	0.003911	0.011787	0.003959	0.010885	0.004247	0.004093
0.003874	0.004104	0.010736	0.004297	0.011694	0.004192	0.014207	0.003211	0.009438	0.00392	0.011672	0.004338	0.011178	0.003949	0.011119	0.003919	0.011121	0.004195	0.012294	0.004141	0.011463	0.003961	0.011333	0.004196	0.003957
0.003319	0.004243	0.011892	0.004058	0.012316	0.003492	0.011664	0.004169	0.009392	0.004134	0.012737	0.004149	0.012990	0.004177	0.011658	0.004142	0.011157	0.004115	0.011598	0.004378	0.011643	0.004256	0.010983	0.004105	0.003965
0.00371	0.003841	0.011359	0.003784	0.012034	0.003670	0.011953	0.003807	0.011016	0.004124	0.011704	0.004379	0.013551	0.004101	0.011389	0.004246	0.011058	0.003781	0.011730	0.004034	0.011484	0.004276	0.011161	0.004197	0.004011
0.004308	0.004086	0.011365	0.004091	0.011131	0.004290	0.011665	0.004006	0.009268	0.003795	0.011437	0.003896	0.012316	0.004184	0.011506	0.003869	0.011139	0.004105	0.011056	0.004409	0.011768	0.004088	0.011205	0.004141	0.004104
0.003949	0.003953	0.011602	0.004071	0.011299	0.004069	0.012545	0.003877	0.010823	0.003532	0.012234	0.004339	0.011972	0.004412	0.011340	0.004250	0.011140	0.004360	0.010998	0.004212	0.011652	0.004017	0.011245	0.003637	0.004014
0.003512	0.004165	0.011241	0.004216	0.011157	0.004294	0.010990	0.003938	0.010572	0.004267	0.011228	0.004509	0.011279	0.004140	0.011516	0.004089	0.011194	0.004243	0.011355	0.00401	0.011624	0.004045	0.011278	0.003485	0.003940
0.003429	0.004142	0.011172	0.003718	0.012454	0.003695	0.011957	0.004212	0.010573	0.004168	0.012047	0.003955	0.011517	0.004254	0.011287	0.004304	0.011176	0.003992	0.011354	0.004091	0.011643	0.004129	0.011413	0.004179	0.003806
0.003814	0.004162	0.011491	0.004076	0.011140	0.004108	0.012659	0.004018	0.010773	0.003451	0.011389	0.004535	0.011914	0.004296	0.011605	0.004255	0.011161	0.004417	0.011293	0.003716	0.011456	0.004094	0.011358	0.004011	0.003744
0.00371	0.003376	0.010778	0.004031	0.011912	0.004296	0.012189	0.004029	0.010447	0.003807	0.012058	0.003999	0.012322	0.004177	0.011416	0.004209	0.011183	0.004335	0.011195	0.0041	0.011032	0.003956	0.011278	0.003799	0.003782
0.00373	0.003679	0.010982	0.002901	0.012222	0.004034	0.011931	0.003906	0.010727	0.003949	0.012457	0.004141	0.012461	0.003467	0.011509	0.004189	0.010887	0.003876	0.011301	0.004373	0.011400	0.003844	0.010961	0.004405	0.004023
0.003841	0.003988	0.011250	0.003772	0.011016	0.003965	0.011689	0.003965	0.010981	0.003754	0.012270	0.004328	0.011540	0.004247	0.011416	0.004244	0.011150	0.004234	0.010803	0.004257	0.011531	0.004329	0.011589	0.004281	0.003887
0.003872	0.003777	0.011487	0.004075	0.011577	0.004321	0.012688	0.003741	0.01091	0.004071	0.013644	0.004006	0.012249	0.004007	0.011358	0.004105	0.011254	0.004298	0.012163	0.004278	0.011387	0.003702	0.011366	0.004257	0.004096
0.003826	0.004222	0.012697	0.004124	0.011768	0.004215	0.013948	0.003829	0.010893	0.00438	0.012932	0.003960	0.012682	0.003563	0.011315	0.003951	0.011029	0.004261	0.011869	0.004155	0.011217	0.004248	0.011395	0.004327	0.003752
0.003891	0.004042	0.012248	0.004150	0.011630	0.004414	0.012947	0.004041	0.01104	0.003707	0.012946	0.004063	0.011324	0.004166	0.011081	0.004071	0.011364	0.003958	0.011200	0.004151	0.010578	0.003649	0.011088	0.004056	0.003866
0.003573	0.003549	0.012549	0.003913	0.011775	0.004136	0.012294	0.003852	0.010798	0.004139	0.011972	0.004099	0.011534	0.004173	0.011449	0.004033	0.011029	0.004409	0.011577	0.004261	0.011098	0.003989	0.011270	0.004067	0.003870
0.00377	0.00397	0.01156	0.00396	0.01166	0.00403	0.01237	0.00392	0.01044	0.00394	0.01214	0.00417	0.01200	0.00410	0.01139	0.00413	0.01115	0.00418	0.01152	0.00415	0.01142	0.00403	0.01124	0.00409	0.00393
0.94311	0.99269	2.88920	0.99067	2.91489	1.00859	3.09356	0.98055	2.61100	0.98609	3.03606	1.04298	2.99984	1.02494	2.84655	1.03344	2.78727	1.04595	2.87909	1.03870	2.85567	1.00847	2.80950	1.02172	0.98297
12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.6139
127.4130	127.4161	126.947	127.5464	125.324	127.5019	126.376	127.2066	126.480	127.2574	127.054	127.3812	124.856	127.4828	126.410	127.3812	126.276	127.3971	125.290	127.2732	126.750	127.4511	125.441	127.4320	127.3876
9.53	10.03	29.14	10.02	29.02	10.19	31.06	9.89	26.24	9.95	30.65	10.53	29.76	10.36	28.59	10.44	27.96	10.56	28.66	10.48	28.76	10.19	28.00	10.32	9.93
		190.62		189.75		204.68		165.35		208.08		182.54		176.00		167.96		171.31		174.40		174.80		

Table 129 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for NBG-17 graphite (both AG and WG orientations)-cont.

AW7-03	AW7-03	AW9-01	AW9-01	AW9-02	AW9-03	AW9-03	AW10-01	AW10-01	AW10-02	AW10-02	AW10-03	AW10-03	AW12-01	AW12-01	AW12-02	AW12-03	AW12-03	AW13-01	AW13-01	AL7-01	AL7-02	AW13-02	AW13-02	AW13-03
5S6		5S14		5U3	5U6		5U13		6S1		6S8		6S15		6U1	6U8		6U14		Spare 1A	Spare 2A	Spare 1W		Spare 2W
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.003986	0.011138	0.004193	0.010822	0.003987	0.003903	0.011266	0.004093	0.011035	0.004334	0.011319	0.004007	0.013075	0.004316	0.012345	0.003926	0.004096	0.010955	0.004199	0.011675	0.003731	0.003968	0.003889	0.011538	0.004222
0.003660	0.011355	0.004304	0.010835	0.004227	0.003722	0.011328	0.004151	0.011193	0.004012	0.011830	0.004244	0.013011	0.004039	0.011560	0.004206	0.004309	0.012025	0.004334	0.012657	0.004245	0.004104	0.004174	0.011908	0.004281
0.004197	0.011202	0.004039	0.010790	0.004195	0.004086	0.011257	0.004230	0.011108	0.004142	0.011347	0.004118	0.013044	0.00394	0.013041	0.004201	0.004077	0.011192	0.004191	0.013122	0.003727	0.003900	0.004157	0.011476	0.004216
0.004138	0.011189	0.004149	0.010753	0.004323	0.003979	0.010970	0.003911	0.010752	0.004241	0.011583	0.004148	0.012153	0.004137	0.011997	0.004341	0.003687	0.011622	0.004396	0.011463	0.004087	0.003874	0.004299	0.011868	0.003989
0.003955	0.011368	0.004087	0.010834	0.004375	0.004197	0.011087	0.004376	0.010823	0.004011	0.012476	0.004067	0.011709	0.004292	0.011464	0.003894	0.004301	0.011426	0.004259	0.011174	0.003952	0.004209	0.004327	0.011640	0.004328
0.003834	0.011186	0.003936	0.010753	0.003876	0.004116	0.011442	0.004199	0.011068	0.004129	0.011941	0.004167	0.011502	0.003992	0.011370	0.004232	0.004077	0.011637	0.004267	0.012072	0.004129	0.003989	0.003686	0.011249	0.004288
0.004440	0.011139	0.004180	0.010678	0.004027	0.004199	0.011093	0.004045	0.010653	0.004194	0.011611	0.004172	0.011524	0.004274	0.011810	0.004106	0.004102	0.011235	0.004029	0.011614	0.004229	0.003987	0.003881	0.010958	0.004370
0.004048	0.011342	0.004245	0.010745	0.004224	0.004173	0.011444	0.004051	0.010718	0.004118	0.012348	0.004361	0.011637	0.003956	0.011716	0.004361	0.003969	0.011206	0.004232	0.012495	0.004280	0.003852	0.003539	0.011322	0.003836
0.003892	0.010132	0.004278	0.009768	0.003971	0.003921	0.010412	0.004176	0.011536	0.003928	0.011959	0.003584	0.011694	0.004231	0.012173	0.003997	0.004316	0.011860	0.004147	0.011719	0.004048	0.004024	0.003161	0.012273	0.004263
0.004271	0.010018	0.004351	0.010870	0.003314	0.004151	0.011561	0.004126	0.010833	0.004076	0.011624	0.004237	0.011367	0.004335	0.011288	0.004225	0.004134	0.011077	0.003876	0.011632	0.004220	0.003864	0.004249	0.012329	0.003876
0.004143	0.011066	0.004172	0.010778	0.002983	0.003456	0.010812	0.004169	0.010969	0.004246	0.012785	0.004305	0.011631	0.004209	0.011491	0.003533	0.003987	0.011386	0.004250	0.011368	0.004130	0.004264	0.004312	0.012074	0.004451
0.004122	0.011654	0.003559	0.010633	0.003782	0.004294	0.011189	0.004353	0.011496	0.004233	0.011753	0.004393	0.011844	0.004229	0.011021	0.003955	0.004089	0.011195	0.003887	0.012278	0.004170	0.003911	0.004089	0.011515	0.003823
0.004182	0.011207	0.004031	0.010595	0.004113	0.004276	0.011149	0.003845	0.011310	0.003867	0.011263	0.003776	0.011305	0.003749	0.011816	0.003967	0.003603	0.012022	0.004121	0.013379	0.003792	0.004209	0.003792	0.012931	0.004580
0.003838	0.011154	0.003591	0.010677	0.004297	0.004133	0.011079	0.003992	0.011003	0.004120	0.011264	0.004433	0.011675	0.004215	0.012585	0.003607	0.003727	0.012366	0.003837	0.012043	0.004197	0.003839	0.004039	0.012568	0.004327
0.004108	0.010496	0.004342	0.010721	0.003714	0.003917	0.011444	0.004027	0.011277	0.004119	0.010836	0.004387	0.011352	0.004074	0.011860	0.004275	0.003793	0.012194	0.004045	0.012250	0.003562	0.004239	0.004399	0.013339	0.004234
0.004149	0.010713	0.004219	0.010918	0.004119	0.004291	0.011208	0.004220	0.010781	0.004239	0.011607	0.003219	0.011559	0.004257	0.012550	0.004091	0.004531	0.011775	0.004092	0.011344	0.004071	0.004036	0.003981	0.011967	0.004186
0.00406	0.01102	0.00410	0.01070	0.00397	0.00405	0.01117	0.00412	0.01103	0.00413	0.01172	0.00410	0.01188	0.00414	0.01188	0.00406	0.00405	0.01157	0.00414	0.01202	0.00404	0.00402	0.00400	0.01193	0.00420
1.01505	2.75561	1.02619	2.67453	0.99261	1.01272	2.79283	1.03069	2.75867	1.03139	2.93041	1.02528	2.97003	1.03508	2.97011	1.01433	1.01247	2.89333	1.03378	3.00445	1.00891	1.00420	0.99959	2.98367	1.05109
12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.6139	12.586	12.6139
127.4193	126.408	127.2923	126.256	127.3304	127.4161	124.309	127.2574	124.527	127.4733	126.376	127.3780	126.293	127.4606	127.221	127.3209	127.2225	124.626	127.2986	126.338	127.1082	127.2923	127.3876	126.597	127.3971
10.25	27.68	10.36	26.83	10.02	10.23	27.58	10.40	27.29	10.42	29.42	10.35	29.80	10.46	30.02	10.24	10.21	28.65	10.43	30.16	10.17	10.13	10.09	30.01	10.62
	169.92		159.08			169.65		162.49		182.30		187.85		187.04			180.56		189.07				197.29	

Table 130 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for NBG-18 graphite (both AG and WG orientations)

Resistivity

Specimen Number - Post Irrad in Red		BL6-01	BW1-01	**BW1-01**	BW1-02	**BW1-02**	BW1-03	**BW1-03**	BW2-01	**BW2-01**	BW2-02	**BW2-02**	BL6-02	**BL6-02**	BW2-03	**BW2-03**	BW3-01	**BW3-01**	BW3-02	**BW3-02**
Sample Location		**1S1**	**1S4**		**1U1**		**1U4**		**2S2**		**2S11**		**2S12**		**2U2**		**2U11**		**3S2**	
Applied current, I	mA	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
Compl. Voltage	V	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
ID Orientation:																				
Forward current:																				
Voltage readings, mV	1	0.003648	0.003967	0.011749	0.003759	0.011802	0.003982	0.012487	0.003837	0.011833	0.003907	0.011477	0.003754	0.010875	0.003846	0.012120	0.003880	0.012809	0.003791	0.013191
	2	0.003714	0.003539	0.011661	0.003840	0.010834	0.003974	0.011309	0.004017	0.013415	0.003904	0.014014	0.003786	0.011157	0.003680	0.010937	0.003767	0.012362	0.003838	0.011526
	3	0.003346	0.003072	0.012326	0.003847	0.011031	0.003699	0.012431	0.003798	0.014682	0.003843	0.013062	0.003753	0.010339	0.003415	0.011931	0.003841	0.012976	0.003922	0.011653
	4	0.003684	0.003751	0.011786	0.003805	0.011723	0.003784	0.011519	0.003843	0.013871	0.003995	0.013705	0.003771	0.011008	0.003703	0.012262	0.003536	0.012292	0.003735	0.011376
Reverse current:																				
Voltage readings, mV	1	0.003623	0.003321	0.011330	0.003879	0.011239	0.003971	0.010478	0.004010	0.011591	0.003697	0.011830	0.003869	0.010726	0.003717	0.010520	0.003929	0.010900	0.003911	0.010882
	2	0.003027	0.003745	0.010847	0.003658	0.011097	0.003786	0.010741	0.003809	0.011419	0.003896	0.012169	0.003866	0.010456	0.003634	0.011107	0.003887	0.011571	0.003731	0.011433
	3	0.003738	0.002895	0.011648	0.003675	0.011216	0.003933	0.010824	0.003774	0.011853	0.003852	0.010878	0.004002	0.011531	0.003620	0.010847	0.003722	0.011060	0.004009	0.010846
	4	0.003712	0.003780	0.011030	0.003673	0.011147	0.003651	0.010982	0.003369	0.012016	0.003639	0.012108	0.003994	0.011036	0.003731	0.010989	0.003622	0.011363	0.003961	0.011231
End-for-end orientation:																				
Reverse current:																				
Voltage readings, mV	1	0.003694	0.003635	0.011332	0.003792	0.011240	0.003834	0.010887	0.003755	0.009586	0.004004	0.011147	0.003698	0.010759	0.003737	0.010947	0.003955	0.010977	0.003882	0.010733
	2	0.002855	0.003737	0.011289	0.003982	0.010785	0.003669	0.011158	0.003661	0.011196	0.003874	0.011376	0.003765	0.011411	0.003549	0.011352	0.003706	0.010551	0.003569	0.010277
	3	0.003229	0.003158	0.011063	0.003823	0.010221	0.003907	0.010993	0.003790	0.010865	0.003827	0.010541	0.003895	0.010918	0.003457	0.011022	0.003817	0.010993	0.003883	0.013464
	4	0.003768	0.003794	0.011009	0.003846	0.010449	0.003589	0.011024	0.003983	0.010687	0.003892	0.010860	0.003717	0.010550	0.003823	0.011109	0.003885	0.011482	0.003712	0.011284
Forward current:	1	0.003630	0.003857	0.011869	0.003958	0.010922	0.003844	0.012373	0.003876	0.011891	0.003811	0.011237	0.003747	0.010902	0.003657	0.011784	0.003813	0.012741	0.003782	0.013327
Voltage readings, mV	2	0.003146	0.003500	0.012273	0.004030	0.011424	0.003941	0.012236	0.003929	0.013246	0.003780	0.013091	0.003811	0.010832	0.003658	0.012479	0.003681	0.012760	0.003801	0.013290
	3	0.003678	0.003629	0.012243	0.003947	0.011430	0.003906	0.012282	0.003885	0.011800	0.003778	0.011845	0.003812	0.010902	0.003891	0.011464	0.003837	0.012068	0.003861	0.014403
	4	0.003811	0.003144	0.011419	0.004036	0.011464	0.003967	0.012469	0.003765	0.011596	0.003827	0.010728	0.003951	0.010854	0.003709	0.012463	0.003814	0.012768	0.003848	0.012149
Average voltage, V	mV	0.00352	0.00353	0.01155	0.00385	0.01113	0.00384	0.01151	0.00382	0.01197	0.00385	0.01188	0.00382	0.01089	0.00368	0.01146	0.00379	0.01185	0.00383	0.01194
Average resistance, R=V/I	Ω	0.87973	0.88319	2.88866	0.96172	2.78163	0.95995	2.87802	0.95470	2.99292	0.96134	2.96981	0.95611	2.72275	0.91917	2.86458	0.94831	2.96364	0.95681	2.98539
Potential Contact Distance, L	mm	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586
Average area, A mm^2 *	mm^2	127.3876	127.4384	125.530	127.5241	126.179	127.3367	124.198	127.4956	125.895	127.5178	125.923	127.3907	124.146	127.3240	123.947	127.5114	124.933	127.2669	125.190
Resistivity, ρ=(R*A)/L	μΩm	8.88	8.92	**28.81**	9.72	**27.89**	9.69	**28.40**	9.65	**29.94**	9.72	**29.71**	9.66	**26.86**	9.28	**28.21**	9.59	**29.42**	9.65	**29.70**
Fractional Change, = $(\rho_i-\rho_0)/\rho_0$	%			222.89		186.82		193.07		210.24		205.74		178.14		204.05		206.88		207.60

Table 131 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for NBG-18 graphite (both AG and WG orientations)-cont.

BW3-03	BW3-03	BL6-03	BL6-03	BW5-01	BW5-01	BW5-02	BW5-02	BW5-03	BW5-03	BW7-01	BW7-01	BW7-02	BW7-02	BL7-01	BL7-01	BW7-03	BW7-03	BW8-01	BW8-01	BW8-02	BW8-02	BW8-03	BL7-02	BL7-02
3S11		3S12		3S14		3U2		3U11		3U13		4S5		4S7		4S14		4U5		4U7		4U13	5S5	
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.003799	0.012649	0.003657	0.011259	0.003677	0.012400	0.003258	0.010977	0.003668	0.011373	0.003850	0.011417	0.003906	0.012187	0.003717	0.011851	0.003700	0.011558	0.003810	0.011265	0.003942	0.011571	0.003974	0.003611	0.011931
0.003764	0.011802	0.003561	0.011348	0.003818	0.013251	0.003876	0.011808	0.003638	0.011377	0.003568	0.011776	0.003878	0.012418	0.003576	0.011215	0.003711	0.011268	0.003743	0.011809	0.003912	0.011108	0.003836	0.003615	0.011327
0.003852	0.013867	0.003673	0.012554	0.003864	0.011959	0.003736	0.012012	0.003622	0.012158	0.003844	0.012158	0.003862	0.012384	0.003657	0.011671	0.003924	0.011433	0.003805	0.011687	0.003948	0.011537	0.003782	0.003707	0.011067
0.003792	0.011881	0.003874	0.011136	0.003567	0.013638	0.003931	0.011812	0.003669	0.012602	0.003835	0.012455	0.003882	0.011313	0.003773	0.010930	0.003733	0.011402	0.003485	0.011614	0.004110	0.011535	0.003836	0.003709	0.012620
0.003689	0.011101	0.003605	0.010728	0.003711	0.011831	0.003789	0.010345	0.003734	0.011386	0.003856	0.011825	0.003724	0.010459	0.003501	0.010642	0.003689	0.011020	0.003656	0.010845	0.003827	0.010918	0.003891	0.003741	0.010584
0.003191	0.011451	0.003588	0.010839	0.003764	0.012857	0.003832	0.011224	0.003025	0.011164	0.003942	0.011375	0.003831	0.011044	0.003460	0.011323	0.003757	0.011115	0.003828	0.010559	0.003849	0.011689	0.003603	0.003522	0.010947
0.003704	0.011051	0.003850	0.010873	0.003809	0.012203	0.003857	0.011218	0.003748	0.011126	0.003719	0.011327	0.004002	0.011430	0.003462	0.010882	0.003831	0.010724	0.003557	0.011064	0.003924	0.011078	0.003550	0.003316	0.010713
0.003885	0.011936	0.003643	0.010872	0.003793	0.011942	0.004074	0.011012	0.003621	0.010997	0.003848	0.011460	0.003866	0.011264	0.003844	0.011122	0.003807	0.010817	0.003534	0.010449	0.003922	0.011063	0.003801	0.003556	0.010799
0.003660	0.010922	0.003840	0.010336	0.003774	0.010675	0.003844	0.010226	0.003785	0.010741	0.003794	0.011246	0.003487	0.011375	0.003712	0.011517	0.003529	0.011736	0.003616	0.011042	0.003502	0.011602	0.003729	0.003695	0.011127
0.003873	0.011333	0.003705	0.010934	0.003840	0.011104	0.003986	0.011173	0.003776	0.011109	0.003762	0.011165	0.003877	0.010951	0.003809	0.010463	0.003847	0.011118	0.003581	0.010860	0.003879	0.011742	0.003571	0.003814	0.010854
0.003728	0.012100	0.003573	0.011507	0.003712	0.011911	0.003841	0.011125	0.003692	0.011323	0.003904	0.011153	0.003617	0.011375	0.003826	0.010314	0.003856	0.010763	0.003532	0.011216	0.003770	0.010996	0.003545	0.003314	0.010634
0.003672	0.012107	0.003866	0.011393	0.003753	0.010436	0.003206	0.011148	0.003570	0.010316	0.003829	0.011271	0.003812	0.011587	0.003675	0.011206	0.003828	0.011208	0.003562	0.010485	0.003820	0.010983	0.003816	0.003704	0.010892
0.003653	0.014297	0.003673	0.012778	0.003726	0.013659	0.003839	0.012040	0.003766	0.010490	0.003827	0.012106	0.003991	0.012323	0.003608	0.012059	0.003667	0.011989	0.003522	0.010897	0.003825	0.011128	0.003654	0.003431	0.011188
0.003763	0.014418	0.003707	0.013311	0.003787	0.013876	0.003659	0.011023	0.003729	0.010189	0.003473	0.012361	0.003723	0.011954	0.003686	0.011523	0.003753	0.011948	0.003737	0.010546	0.003487	0.011200	0.003447	0.003738	0.011299
0.003626	0.014627	0.003698	0.012051	0.003794	0.014281	0.003584	0.010731	0.003731	0.010837	0.003950	0.011637	0.003722	0.013057	0.003730	0.011647	0.003702	0.011937	0.003605	0.011457	0.003841	0.011821	0.003565	0.003430	0.011637
0.003803	0.013791	0.003864	0.012977	0.003806	0.011502	0.003656	0.011316	0.003697	0.012219	0.003724	0.012559	0.003600	0.012467	0.003582	0.011722	0.003713	0.011784	0.003616	0.011313	0.003855	0.001118	0.003730	0.003412	0.012378
0.00372	0.01246	0.00371	0.01156	0.00376	0.01235	0.00375	0.01120	0.00365	0.01121	0.00380	0.01171	0.00380	0.01172	0.00366	0.01126	0.00375	0.01136	0.00364	0.01107	0.00384	0.01069	0.00371	0.00358	0.01125
0.92897	3.11458	0.92777	2.88900	0.94055	3.08633	0.93700	2.79984	0.91361	2.80323	0.94883	2.92642	0.94969	2.93106	0.91591	2.81386	0.93823	2.84093	0.90920	2.76731	0.95958	2.67326	0.92703	0.89555	2.81245
12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586
127.4987	126.473	127.4765	126.705	127.4288	126.533	127.4701	124.507	127.4482	124.552	127.4354	125.161	127.4638	125.970	127.4924	127.151	127.3336	126.794	127.4288	124.505	127.4034	125.292	127.3209	127.4352	126.107
9.39	31.30	9.38	29.08	9.50	31.03	9.47	27.70	9.23	27.74	9.59	29.10	9.60	29.34	9.26	28.43	9.47	28.62	9.19	27.38	9.69	26.61	9.36	9.05	28.18
	233.31		210.19		226.56		192.51		200.52		203.59		205.69		207.08		202.18		198.04		174.58			211.46

Table 132 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for NBG-18 graphite (both AG and WG orientations)-cont.

BW9-01	BW9-01	BW9-02	BW9-02	BW9-03	BW9-03	BW10-01	BW10-01	BW10-02	BW10-02	BL7-03	BW10-03	BW10-03	BW11-01	BW11-01	BW11-02	BW11-02	BW11-03	BW12-01	BW12-01	BL8-01	BL8-02	BW12-02	BW12-02	BW12-03	BW12-03
5S8		5S15		5U5		5U8		5U14		6S3	6S6		6S13		6U3		6U6	6U12		Spare 1A	Spare 2A	Spare 1W		Spare 2W	
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.003765	0.011002	0.003780	0.011102	0.003663	0.011574	0.003827	0.011285	0.003878	0.011108	0.003640	0.003755	0.011998	0.003904	0.011127	0.004045	0.011759	0.003928	0.003777	0.010649	0.003868	0.004004	0.003770	0.011312	0.003793	0.011208
0.003882	0.011234	0.003372	0.011285	0.003600	0.011075	0.003792	0.010667	0.004215	0.011483	0.003759	0.003690	0.012216	0.003921	0.011117	0.003958	0.011357	0.003857	0.003552	0.010425	0.003543	0.003820	0.003440	0.010569	0.003816	0.011207
0.003555	0.012875	0.003780	0.010594	0.003709	0.011674	0.004082	0.010194	0.003831	0.011353	0.003851	0.003602	0.010804	0.003761	0.010961	0.003923	0.011273	0.003637	0.003728	0.010374	0.003876	0.003793	0.003581	0.010874	0.003724	0.010896
0.003756	0.012689	0.003579	0.010418	0.003711	0.012120	0.004007	0.010779	0.003766	0.010715	0.003575	0.003627	0.011503	0.003870	0.010970	0.003886	0.011883	0.003786	0.003664	0.010592	0.003826	0.003726	0.003971	0.012812	0.003612	0.010496
0.003685	0.011061	0.003805	0.010325	0.003222	0.011565	0.003935	0.010044	0.003836	0.010804	0.003394	0.003782	0.011980	0.003931	0.011310	0.003681	0.011910	0.003901	0.003802	0.011451	0.003519	0.003522	0.003829	0.012148	0.003869	0.010174
0.003717	0.011090	0.003688	0.010778	0.003290	0.011437	0.003676	0.010437	0.004026	0.010961	0.003656	0.003608	0.012613	0.003903	0.012598	0.003475	0.011763	0.003972	0.003585	0.011092	0.003706	0.003401	0.003525	0.010430	0.003448	0.010329
0.003650	0.011072	0.003859	0.010646	0.003402	0.011247	0.003973	0.010420	0.003832	0.011422	0.003575	0.003696	0.011547	0.003955	0.011628	0.004036	0.011880	0.003905	0.004115	0.011457	0.003805	0.003510	0.003891	0.011033	0.003616	0.010239
0.003638	0.010929	0.003839	0.010933	0.003603	0.011386	0.003882	0.010396	0.004018	0.011952	0.003458	0.003604	0.011483	0.003976	0.012072	0.003743	0.011837	0.003765	0.003616	0.012129	0.003657	0.003643	0.003572	0.010947	0.003572	0.010216
0.003712	0.011216	0.003848	0.010882	0.003545	0.011332	0.003839	0.010534	0.003842	0.011670	0.003710	0.003653	0.011479	0.003565	0.013118	0.003926	0.011226	0.003766	0.003729	0.010957	0.003781	0.004213	0.003838	0.011017	0.003732	0.010923
0.003655	0.011027	0.003776	0.010941	0.003562	0.011177	0.003935	0.011193	0.003751	0.011362	0.003690	0.003791	0.011180	0.003652	0.011594	0.003812	0.011416	0.003646	0.003556	0.011818	0.003580	0.003807	0.003642	0.010561	0.003689	0.011135
0.003659	0.011856	0.003768	0.010922	0.003836	0.010842	0.003655	0.010621	0.003724	0.011545	0.003743	0.003944	0.012738	0.003850	0.011160	0.003710	0.011402	0.003797	0.003715	0.011293	0.003635	0.003618	0.003668	0.010094	0.003728	0.010667
0.003508	0.011207	0.003673	0.010505	0.003727	0.010425	0.004186	0.011463	0.003830	0.011090	0.004006	0.003709	0.012537	0.003650	0.012851	0.003633	0.011874	0.003636	0.003814	0.011515	0.003636	0.003647	0.003641	0.011779	0.003474	0.011193
0.003621	0.012447	0.003817	0.010830	0.003665	0.010741	0.003931	0.011902	0.003689	0.011345	0.003582	0.003717	0.012336	0.003611	0.011516	0.003748	0.011950	0.003920	0.003212	0.010703	0.003709	0.003407	0.003819	0.012263	0.003656	0.011420
0.003596	0.011627	0.003755	0.012201	0.003651	0.011334	0.003820	0.011627	0.003739	0.010599	0.003640	0.003646	0.011251	0.003676	0.012228	0.003692	0.011491	0.003515	0.003723	0.010132	0.003755	0.003453	0.003594	0.013062	0.003984	0.011190
0.003590	0.012543	0.003787	0.010965	0.003882	0.015010	0.003875	0.010942	0.003834	0.011560	0.003859	0.003732	0.011127	0.003611	0.011536	0.003609	0.010783	0.003856	0.003827	0.010897	0.003779	0.003493	0.003587	0.012363	0.003842	0.011031
0.003778	0.011836	0.003726	0.011019	0.003696	0.011351	0.004033	0.011761	0.003961	0.011321	0.003619	0.003519	0.011413	0.003775	0.011686	0.003767	0.011782	0.003846	0.003839	0.010633	0.003792	0.003492	0.003827	0.011712	0.003565	0.011795
0.00367	0.01161	0.00374	0.01090	0.00361	0.01152	0.00390	0.01089	0.00386	0.01127	0.00367	0.00369	0.01176	0.00379	0.01172	0.00379	0.01160	0.00380	0.00370	0.01101	0.00372	0.00366	0.00370	0.01144	0.00370	0.01088
0.91823	2.90173	0.93519	2.72416	0.90256	2.87953	0.97575	2.72289	0.96519	2.81703	0.91808	0.92305	2.94070	0.94705	2.92925	0.94756	2.89978	0.94895	0.92584	2.75183	0.92917	0.91483	0.92492	2.85900	0.92375	2.72061
12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.6139	12.6139	12.586	12.6139	12.586
127.3780	126.520	127.2098	126.331	127.1907	126.752	127.4892	124.675	127.2542	125.185	127.4447	127.3590	126.433	127.4701	125.464	127.4352	126.134	127.4415	127.4638	124.774	127.5496	127.9089	127.4797	126.799	127.5941	126.470
9.27	29.17	9.43	27.34	9.10	29.00	9.86	26.97	9.74	28.02	9.28	9.32	29.54	9.57	29.20	9.57	29.06	9.59	9.36	27.28	9.40	9.28	9.35	28.80	9.34	27.34
	214.58		189.92		218.64		173.50		187.76			216.97		205.11		203.57			191.60				208.14		192.57

Table 133 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for H-451 graphite (WG orientation) – cont.

Resistivity

Specimen Number - Post Irrad in Red		CW7-01	CW7-01	CW7-03	CW7-03	CW8-02	CW8-02	CW8-03	CW8-03	CW9-01	CW9-01	CW9-02	CW9-03	CW9-03	CW10-01	CW10-01	CW10-02	CW10-02	CW10-03	CW10-03
Sample Location		1S8		1S15		1U8		1U14		2S13		2U12	3S1		3S10		3U1		3U10	
Applied current, I	mA	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
Compl. Voltage	V	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
ID Orientation:																				
Forward current:																				
Voltage readings, mV	1	0.002290	0.012471	0.003210	0.013223	0.002700	0.012713	0.003120	0.000713	0.002510	0.013359	0.002980	0.003320	0.012416	0.003160	0.012851	0.002490	0.010927	0.002470	0.012310
	2	0.002430	0.011186	0.003240	0.011734	0.002590	0.011823	0.002520	0.012096	0.002510	0.013456	0.002580	0.002530	0.010594	0.003130	0.011054	0.002480	0.011932	0.002450	0.012968
	3	0.002420	0.011274	0.003290	0.013634	0.002560	0.012639	0.002690	0.011095	0.002570	0.012123	0.003020	0.002520	0.011843	0.003290	0.012984	0.002530	0.011960	0.002440	0.011739
	4	0.002390	0.012741	0.003110	0.012518	0.002490	0.013432	0.002720	0.011274	0.002520	0.011432	0.002710	0.002570	0.013244	0.003300	0.011973	0.002490	0.011973	0.002590	0.011347
Reverse current:																				
Voltage readings, mV	1	0.002400	0.011531	0.003230	0.011968	0.002570	0.012623	0.002670	0.010416	0.002550	0.011776	0.002960	0.002520	0.011901	0.002650	0.011548	0.002560	0.011412	0.002430	0.011204
	2	0.002460	0.010653	0.002590	0.011461	0.002200	0.012391	0.002540	0.012451	0.002530	0.011714	0.002450	0.002560	0.010960	0.002480	0.011466	0.002540	0.010450	0.002440	0.011491
	3	0.002420	0.011080	0.003170	0.012394	0.002690	0.012103	0.002540	0.011134	0.002510	0.011486	0.003200	0.002590	0.013327	0.002530	0.010196	0.002550	0.013115	0.002510	0.011719
	4	0.002370	0.011741	0.003190	0.012001	0.002520	0.011011	0.002570	0.010993	0.002490	0.011650	0.003060	0.002920	0.011432	0.002430	0.011085	0.002540	0.011877	0.002400	0.011659
End-for-end orientation:																				
Reverse current:																				
Voltage readings, mV	1	0.002420	0.010761	0.002580	0.011597	0.003240	0.011602	0.002570	0.012106	0.002480	0.012075	0.003160	0.003360	0.012017	0.002430	0.011546	0.002610	0.011357	0.002900	0.011218
	2	0.002350	0.011351	0.002310	0.012340	0.002550	0.011041	0.002510	0.011262	0.002490	0.011312	0.002500	0.002470	0.011524	0.002460	0.010986	0.002830	0.010810	0.002640	0.012184
	3	0.002370	0.010958	0.002620	0.011174	0.002570	0.011651	0.003100	0.011369	0.002510	0.011077	0.002760	0.002490	0.011489	0.002490	0.012146	0.003140	0.010724	0.002400	0.011434
	4	0.002310	0.010232	0.002590	0.012279	0.002500	0.011362	0.002580	0.011023	0.002520	0.011840	0.002980	0.003070	0.011873	0.002960	0.010529	0.003150	0.011549	0.002580	0.010579
Forward current:	1	0.002390	0.010743	0.002600	0.012304	0.002510	0.011614	0.002570	0.011347	0.002570	0.011865	0.002500	0.003100	0.012683	0.002620	0.011794	0.003120	0.011549	0.002420	0.011447
Voltage readings, mV	2	0.002380	0.011489	0.002440	0.012188	0.002640	0.012263	0.002510	0.012337	0.002580	0.012385	0.003290	0.002510	0.013345	0.002890	0.012307	0.003200	0.011129	0.002990	0.011601
	3	0.002680	0.013271	0.002550	0.012996	0.002480	0.010731	0.003250	0.011235	0.002550	0.011729	0.003050	0.002510	0.013456	0.002390	0.012777	0.002440	0.012251	0.003030	0.012520
	4	0.003150	0.010985	0.002680	0.011878	0.002550	0.012109	0.003090	0.012907	0.002580	0.012282	0.003120	0.002460	0.014096	0.002670	0.012209	0.003090	0.011797	0.003000	0.012530
Average voltage, V	mV	0.00245	0.01140	0.00284	0.01223	0.00259	0.01194	0.00272	0.01086	0.00253	0.01197	0.00290	0.00272	0.01226	0.00274	0.01172	0.00274	0.01155	0.00261	0.01175
Average resistance, R=V/I	Ω	0.61297	2.85105	0.70938	3.05764	0.64625	2.98606	0.68047	2.71497	0.63234	2.99314	0.72375	0.67969	3.06563	0.68563	2.92892	0.68375	2.88769	0.65141	2.93672
Potential Contact Distance, L	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586
Average area, A mm^2 *	mm^2	126.9402	125.342	127.1146	125.838	127.067	123.937	127.1558	124.930	127.0416	125.888	126.9433	127.1558	126.892	126.8736	126.498	127.067	123.806	127.0765	123.902
Resistivity, p=(R*A)/L	μΩm	6.17	28.39	7.15	30.57	6.51	29.40	6.86	26.95	6.37	29.94	7.28	6.85	30.91	6.90	29.44	6.89	28.41	6.56	28.91
Fractional Change, = $(\rho_i-\rho_0)/\rho_0$	%		360.28		327.65		351.68		292.87		370.08			351.10		326.87		312.40		340.54

Table 134 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for H-451 graphite (WG orientation) –cont.

CW11-01	CW11-01	CW11-02	CW11-02	CW11-03	CW12-01	CW12-02	CW12-02	CW13-01	CW13-01	CW13-02	CW13-02	CW13-03	CW13-03	CW14-01	CW14-01	CW14-02	CW14-02	CW15-01	CW15-02
4S2		4S13		4U2	4U12	5S7		5U7		6S5		6S9		6U5		6U9		Spare 1	Spare 2
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.002320	0.013107	0.002450	0.012934	0.003030	0.002700	0.003210	0.011583	0.002880	0.012687	0.002950	0.012403	0.002590	0.013041	0.003080	0.011789	0.003150	0.012132	0.003090	0.003230
0.002490	0.013590	0.002760	0.013016	0.003140	0.002840	0.003150	0.011877	0.002320	0.011884	0.003040	0.012395	0.002440	0.012665	0.003100	0.011644	0.002780	0.011534	0.003210	0.003220
0.002390	0.011862	0.002440	0.012572	0.002200	0.002430	0.003090	0.011784	0.002330	0.011539	0.003080	0.011873	0.002630	0.012613	0.002870	0.011237	0.002460	0.011661	0.003120	0.003210
0.002380	0.011861	0.002530	0.012577	0.002470	0.002460	0.003110	0.012039	0.002420	0.011610	0.003050	0.012096	0.002840	0.012888	0.003130	0.012073	0.003080	0.012007	0.003210	0.003200
0.002380	0.011521	0.002580	0.011043	0.002490	0.002440	0.003100	0.011597	0.002390	0.011641	0.003080	0.011743	0.002820	0.010784	0.003150	0.011241	0.003090	0.012049	0.003180	0.003250
0.002670	0.011525	0.002530	0.011298	0.002840	0.002500	0.003310	0.010766	0.002710	0.011407	0.003060	0.011692	0.002440	0.011017	0.002850	0.011559	0.003030	0.011372	0.003110	0.003300
0.002400	0.011627	0.002510	0.011466	0.002580	0.002430	0.003270	0.010835	0.002330	0.011532	0.003110	0.011277	0.002400	0.011139	0.002910	0.011038	0.003060	0.011141	0.003120	0.003310
0.002450	0.011686	0.002490	0.010981	0.002580	0.002470	0.003210	0.011059	0.002550	0.011527	0.003090	0.011436	0.002480	0.011432	0.002950	0.010916	0.003080	0.010835	0.003210	0.003270
0.002970	0.010989	0.003110	0.011533	0.002490	0.003070	0.003360	0.011217	0.002950	0.011241	0.003250	0.011692	0.002870	0.011637	0.002900	0.010457	0.002490	0.011772	0.003250	0.003190
0.003020	0.011511	0.002670	0.010736	0.002460	0.002410	0.003460	0.011118	0.002890	0.011277	0.003230	0.012073	0.002840	0.011358	0.002920	0.011137	0.002920	0.010914	0.003450	0.003120
0.002570	0.012023	0.002680	0.011592	0.002370	0.002420	0.003420	0.010944	0.002780	0.011591	0.003010	0.011005	0.002420	0.011479	0.002780	0.011219	0.003080	0.011665	0.003420	0.003150
0.002380	0.010877	0.002510	0.011681	0.002600	0.002460	0.003310	0.011238	0.002910	0.012083	0.003090	0.011432	0.002760	0.011052	0.002580	0.010949	0.002960	0.011361	0.003210	0.003170
0.002390	0.011051	0.002480	0.012116	0.002490	0.002460	0.003530	0.013571	0.002940	0.012116	0.003020	0.012017	0.002850	0.011834	0.002300	0.012111	0.003200	0.012495	0.003440	0.003220
0.002430	0.011644	0.002930	0.012242	0.002470	0.002410	0.003290	0.013092	0.002330	0.012094	0.002840	0.012190	0.002450	0.011599	0.002420	0.012346	0.003240	0.012731	0.003160	0.003140
0.002910	0.011439	0.002990	0.012395	0.002460	0.002450	0.003250	0.011931	0.002290	0.011837	0.003120	0.012384	0.002940	0.012232	0.002350	0.011834	0.003190	0.012656	0.003200	0.003190
0.002330	0.012043	0.002870	0.011872	0.002450	0.002420	0.003450	0.012574	0.002550	0.012552	0.003150	0.011937	0.002420	0.013018	0.002360	0.011796	0.003310	0.011588	0.003310	0.003180
0.00253	0.01177	0.00266	0.01188	0.00257	0.00252	0.00328	0.01170	0.00260	0.01179	0.00307	0.01185	0.00264	0.01186	0.00279	0.01146	0.00301	0.01174	0.00323	0.00321
0.63250	2.94306	0.66453	2.96959	0.64250	0.63078	0.82063	2.92539	0.64953	2.94716	0.76828	2.96320	0.65922	2.96544	0.69766	2.86478	0.75188	2.93614	0.80766	0.80234
12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.6139
127.0226	126.064	127.2764	126.316	127.1495	127.1304	126.8292	126.137	127.0797	125.128	127.1812	126.032	126.9972	126.181	127.2352	126.550	127.14948	124.903	127.2225	127.0797
6.37	29.48	6.71	29.80	6.48	6.36	8.25	29.32	6.54	29.30	7.75	29.67	6.64	29.73	7.04	28.80	7.58	29.14	8.15	8.08
	362.82		344.48				255.32		347.76		283.06		347.94		309.32		284.46		

Table 135 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for PCEA graphite (both AG and WG orientations)

Resistivity

Specimen Number - Post-Irrad in Red		DW1-01	DW1-01	DW1-02	DW1-02	DW1-03	DW1-03	DW2-01	DW2-01	DW2-02	DW2-02	DW2-03	DW2-03	DW3-01	DW3-01	DW3-02	DW3-02	DW3-03	DW3-03
Sample Location		**1S2**		**1S6**		**1S14**		**1U2**		**1U6**		**1U13**		**2S1**		**2S8**		**2S14**	
Applied current, I	mA	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
Compl. Voltage	V	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
ID Orientation:																			
Forward current:																			
Voltage readings, mV	1	0.003290	0.013554	0.003271	0.007886	0.003160	0.008477	0.003191	0.008627	0.003159	0.007985	0.003181	0.008962	0.003126	0.008515	0.003013	0.008815	0.003092	0.009068
	2	0.003261	0.012916	0.003292	0.007810	0.003286	0.00825	0.003324	0.008281	0.003302	0.009502	0.003141	0.007962	0.003168	0.008975	0.002997	0.008537	0.003149	0.008168
	3	0.003308	0.011432	0.003253	0.007684	0.003224	0.008978	0.003183	0.007953	0.003179	0.08293	0.003056	0.007822	0.003147	0.008592	0.003312	0.00817	0.003149	0.008778
	4	0.003170	0.013043	0.003151	0.007792	0.003305	0.008654	0.003233	0.010556	0.003353	0.007946	0.003234	0.007599	0.003221	0.008781	0.003186	0.008251	0.003173	0.009198
Reverse current:																			
Voltage readings, mV	1	0.003004	0.011256	0.003294	0.007797	0.003273	0.008323	0.003252	0.009448	0.003274	0.006943	0.003305	0.009437	0.003064	0.008944	0.003327	0.0085	0.003231	0.009421
	2	0.003112	0.010730	0.003351	0.007772	0.003246	0.008976	0.003141	0.008962	0.003402	0.008055	0.003232	0.008852	0.003364	0.008801	0.003244	0.008447	0.003145	0.008211
	3	0.003358	0.011598	0.003227	0.007768	0.003321	0.007993	0.003173	0.008588	0.003302	0.007944	0.003263	0.008613	0.003139	0.00892	0.003211	0.008512	0.003167	0.008299
	4	0.003189	0.011272	0.003151	0.007755	0.003281	0.008205	0.003232	0.010342	0.003364	0.007949	0.003031	0.007705	0.003167	0.008377	0.003218	0.008661	0.00319	0.008533
End-for-end orientation:																			
Reverse current:																			
Voltage readings, mV	1	0.003062	0.010334	0.003259	0.007919	0.003228	0.009542	0.003226	0.007673	0.00317	0.008973	0.003354	0.010245	0.003144	0.009071	0.003271	0.009305	0.003114	0.00914
	2	0.003062	0.009981	0.003267	0.007823	0.003118	0.007945	0.003165	0.009209	0.003264	0.007736	0.003289	0.009319	0.003208	0.008795	0.003204	0.008414	0.003331	0.008375
	3	0.003154	0.010622	0.003001	0.007854	0.003291	0.008602	0.003214	0.007608	0.003392	0.007631	0.003369	0.008859	0.003204	0.008998	0.003204	0.008654	0.003221	0.008615
	4	0.003179	0.011771	0.003273	0.007763	0.003250	0.008485	0.003095	0.008041	0.003064	0.007709	0.003136	0.006483	0.003281	0.008473	0.003216	0.00871	0.003168	0.008892
Forward current:	1	0.003317	0.013459	0.003110	0.007623	0.003239	0.008327	0.003302	0.006714	0.003144	0.007813	0.003277	0.005948	0.003221	0.00867	0.003069	0.008097	0.0031	0.008664
Voltage readings, mV	2	0.003228	0.012212	0.003174	0.007211	0.003074	0.008272	0.002999	0.008626	0.00317	0.00784	0.003335	0.008968	0.003305	0.008657	0.003233	0.008347	0.003096	0.008373
	3	0.003190	0.012004	0.003277	0.007804	0.003231	0.008739	0.003217	0.007769	0.003169	0.007903	0.003239	0.008725	0.003179	0.008487	0.003118	0.008549	0.003179	0.008354
	4	0.003200	0.011739	0.003278	0.007811	0.003265	0.008761	0.003092	0.007618	0.003068	0.008012	0.003263	0.008723	0.003215	0.008423	0.003188	0.008745	0.003171	0.008262
Average voltage, V	mV	0.00319	0.01175	0.00323	0.00775	0.00324	0.00853	0.00319	0.00850	0.00324	0.01268	0.00323	0.00839	0.00320	0.00872	0.00319	0.00854	0.00317	0.00865
Average resistance, R=V/I	Ω	0.79819	2.93630	0.80670	1.93863	0.80925	2.13327	0.79748	2.12523	0.80900	3.16986	0.80789	2.09722	0.79927	2.17936	0.79705	2.13616	0.79181	2.16173
Potential Contact Distance, L	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586
Average area, A mm^2 *	mm^2	127.2034	124.487	127.2161	125.503	127.2256	126.119	127.1971	123.173	127.2256	123.656	127.2225	125.367	127.1812	124.995	127.2510	125.421	127.2098	126.326
Resistivity, p=(R*A)/L	μΩm	8.05	**29.04**	8.14	**19.33**	8.16	**21.38**	8.04	**20.80**	8.16	**31.14**	8.15	**20.89**	8.06	**21.64**	8.04	**21.29**	7.99	**21.70**
Fractional Change, = $(\rho_i-\rho_0)/\rho_0$	%		260.81		137.60		161.90		158.63		281.67		156.37		168.58		164.74		171.72

Table 136 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for PCEA graphite (both AG and WG orientations)-cont.

DW4-01	DW4-01	DW4-03	DW4-03	DW5-01	DW5-01	DA601	DA601	DW5-02	DW5-02	DW5-03	DW5-03	DW6-01	DW6-01	DA602	DA602	DA701	DA701	DW6-02	DW6-02	DW6-03	DW6-03	DW7-01	DW7-01	DW7-02	DW7-02
2U8		2U1		2U13		3S6		3S15		3U6		3U14		4S1		4S6		4S15		4U1		4U6		4U14	
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.003338	0.008213	0.003347	0.009123	0.003248	0.009233	0.003424	0.012477	0.003354	0.008206	0.003285	0.008286	0.003281	0.008457	0.003566	0.011992	0.003478	0.012291	0.002905	0.006934	0.003028	0.006969	0.003184	0.006939	0.003203	0.008225
0.00322	0.008908	0.003268	0.008726	0.003306	0.009066	0.003664	0.011832	0.00303	0.009166	0.003209	0.007797	0.003266	0.0086	0.003480	0.010947	0.003804	0.010702	0.003117	0.008136	0.003239	0.007764	0.003227	0.007708	0.003243	0.008078
0.00334	0.00926	0.003274	0.008446	0.003253	0.009009	0.003676	0.012073	0.003257	0.009464	0.003328	0.007996	0.003000	0.008652	0.003525	0.011317	0.003690	0.011775	0.003216	0.008092	0.003219	0.007204	0.003251	0.007767	0.003295	0.008147
0.003206	0.008276	0.003146	0.008559	0.003146	0.008907	0.003529	0.011834	0.003306	0.00929	0.003294	0.008127	0.002993	0.008588	0.003598	0.011652	0.003560	0.011228	0.003272	0.007772	0.003239	0.008049	0.003317	0.007743	0.002969	0.008271
0.003347	0.009063	0.003455	0.008536	0.003151	0.008878	0.00356	0.010836	0.003243	0.008865	0.00328	0.007691	0.003343	0.008418	0.003672	0.011393	0.003542	0.010987	0.003234	0.007916	0.003307	0.007547	0.003106	0.007456	0.002952	0.008104
0.003026	0.008873	0.00324	0.00822	0.003027	0.008981	0.003421	0.010721	0.003215	0.009077	0.003233	0.009323	0.003254	0.008356	0.003529	0.010875	0.003822	0.011015	0.003280	0.007814	0.003272	0.007514	0.003351	0.007585	0.003316	0.008111
0.003299	0.008713	0.003021	0.008356	0.003261	0.008652	0.003662	0.010342	0.003207	0.009801	0.003661	0.008043	0.003184	0.008674	0.003814	0.010777	0.003573	0.010884	0.003128	0.008207	0.003046	0.007228	0.003341	0.008178	0.003352	0.008088
0.003196	0.009274	0.00312	0.00804	0.003161	0.009307	0.003564	0.011554	0.003284	0.008743	0.003302	0.007981	0.002981	0.008353	0.003595	0.011013	0.003627	0.011162	0.003284	0.008001	0.003275	0.007800	0.003308	0.00724	0.003024	0.008056
0.003299	0.008447	0.002882	0.008738	0.003136	0.008446	0.003487	0.010971	0.003211	0.0082	0.003284	0.007881	0.003208	0.007821	0.003666	0.010395	0.003638	0.011439	0.003248	0.007997	0.003463	0.008126	0.002934	0.007742	0.003223	0.008009
0.003291	0.009162	0.003026	0.008242	0.00318	0.009251	0.003594	0.012236	0.003287	0.008379	0.003318	0.007778	0.003139	0.008724	0.003609	0.011018	0.003689	0.010722	0.003290	0.007883	0.003227	0.007329	0.002989	0.007524	0.003176	0.008016
0.003305	0.008788	0.00292	0.008333	0.003155	0.009331	0.003699	0.010753	0.003251	0.008513	0.003201	0.007908	0.003241	0.008739	0.003734	0.011001	0.003707	0.010837	0.003216	0.007852	0.003315	0.007741	0.002987	0.007677	0.003179	0.008096
0.00324	0.009361	0.003002	0.00848	0.003178	0.008958	0.003684	0.011009	0.003111	0.008185	0.003233	0.007984	0.003244	0.008865	0.003651	0.010539	0.003607	0.011214	0.003153	0.007978	0.003128	0.007964	0.003247	0.007688	0.003278	0.008126
0.003137	0.009591	0.003289	0.008429	0.003062	0.009015	0.003521	0.011332	0.003105	0.007963	0.003077	0.007968	0.003260	0.009029	0.003837	0.011873	0.003581	0.011829	0.003331	0.007971	0.003317	0.007499	0.003226	0.007118	0.003123	0.008038
0.003329	0.009223	0.00296	0.008888	0.003269	0.009102	0.003226	0.011574	0.003197	0.008156	0.00315	0.007687	0.003367	0.009006	0.003668	0.011434	0.003631	0.012301	0.003199	0.007938	0.003211	0.007041	0.003204	0.00743	0.003136	0.00789
0.003057	0.009455	0.003169	0.008078	0.003452	0.009098	0.003508	0.011609	0.003286	0.008126	0.00307	0.008915	0.003244	0.009318	0.003709	0.012117	0.003719	0.012224	0.003140	0.008003	0.003222	0.007337	0.003149	0.007684	0.003118	0.007159
0.003175	0.008815	0.003081	0.008688	0.003194	0.009143	0.003696	0.012431	0.003205	0.007944	0.003179	0.008234	0.003216	0.008779	0.003640	0.011749	0.003560	0.011861	0.003253	0.007823	0.003151	0.007381	0.003246		0.003268	0.008227
0.00324	0.00896	0.00314	0.00849	0.00320	0.00902	0.00356	0.01147	0.00322	0.00863	0.00326	0.00810	0.00320	0.00865	0.00364	0.01126	0.00364	0.01140	0.00320	0.00789	0.00323	0.00753	0.00319	0.00709	0.00318	0.00804
0.80945	2.24097	0.78438	2.12316	0.79967	2.25589	0.88930	2.86850	0.80545	2.15747	0.81413	2.02498	0.80033	2.16217	0.91083	2.81394	0.90981	2.85111	0.80103	1.97370	0.80717	1.88270	0.79792	1.77311	0.79461	2.01002
12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586
127.2002	124.109	127.1241	122.962	127.1653	125.267	127.2479	123.552	127.2161	126.057	127.2764	123.737	127.2669	124.670	127.2574	124.811	127.2542	126.209	127.3145	125.337	127.4003	125.111	127.3018	123.496	127.2796	124.438
8.16	22.10	7.91	20.74	8.06	22.45	8.97	28.16	8.12	21.61	8.21	19.91	8.07	21.42	9.19	27.90	9.18	28.59	8.08	19.65	8.15	18.72	8.05	17.40	8.02	19.87
	170.72		162.40		178.51		213.88		166.01		142.35		165.24		203.68		211.49		143.11		129.56		116.05		147.86

Table 137 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for PCEA graphite (both AG and WG orientations)-cont.

DW7-03	DW7-03	DW8-01	DW8-01	DA702	DA702	DW8-02	DW8-02	DW8-03	DW8-03	DW9-01	DW9-01	DW9-02	DW9-03	DW9-03	DW10-01	DW10-01	DA801	DW10-02	DW10-02	DW10-03	DW11-01	DW11-01	DW11-02	DA802	DA901
5S4		5S9		5S11		5S12		5U4		5U9		5U11	6S4		6S11		6S12	6U11		6U4	Spare 1W		Spare 2W	Spare 1A	Spare 2A
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.003198	0.007422	0.003208	0.007885	0.003094	0.012743	0.003178	0.007938	0.003194	0.007928	0.003245	0.009173	0.003085	0.00294	0.007095	0.003308	0.008005	0.003342	0.002946	0.008397	0.003208	0.002951	0.007907	0.003308	0.00356	0.003512
0.003297	0.007620	0.00328	0.007601	0.003090	0.013044	0.003311	0.007914	0.002861	0.008732	0.003268	0.00919	0.002993	0.003205	0.008006	0.003269	0.008012	0.003311	0.003191	0.008454	0.003139	0.00319	0.007888	0.003207	0.003689	0.003567
0.003147	0.007582	0.003246	0.007717	0.003227	0.012962	0.003268	0.007710	0.003185	0.007463	0.003124	0.009638	0.003414	0.003174	0.007454	0.003171	0.008006	0.0034	0.003382	0.008479	0.003333	0.003042	0.007913	0.003273	0.003631	0.003509
0.003134	0.007895	0.003256	0.007641	0.003162	0.011894	0.002978	0.007867	0.003308	0.008203	0.003102	0.008863	0.003263	0.002691	0.007429	0.003294	0.007954	0.003211	0.003148	0.008515	0.003143	0.002911	0.007896	0.003189	0.003474	0.003445
0.003247	0.007370	0.003077	0.007895	0.003051	0.011253	0.003304	0.007822	0.003399	0.007789	0.003106	0.010024	0.003209	0.003177	0.007392	0.002785	0.007913	0.003123	0.003287	0.008372	0.003259	0.003115	0.007909	0.00327	0.003484	0.003427
0.003177	0.007713	0.00336	0.007773	0.003146	0.010827	0.003136	0.007881	0.003149	0.009137	0.003169	0.008665	0.003247	0.003222	0.007641	0.003218	0.007942	0.003366	0.003202	0.008379	0.00298	0.003252	0.007911	0.003267	0.003695	0.003631
0.003303	0.007906	0.002994	0.007805	0.002991	0.010662	0.003061	0.007800	0.003169	0.007267	0.003106	0.00867	0.003231	0.003216	0.007235	0.003292	0.007963	0.002822	0.003278	0.008357	0.003132	0.003137	0.008001	0.003184	0.003521	0.003493
0.003136	0.008377	0.003274	0.007721	0.003156	0.011531	0.002908	0.007847	0.003312	0.008205	0.003086	0.009761	0.003212	0.002733	0.007655	0.003257	0.007928	0.00317	0.003139	0.008348	0.003177	0.002968	0.007998	0.003202	0.003479	0.003419
0.003268	0.007534	0.003202	0.007806	0.003281	0.011002	0.003204	0.008042	0.003246	0.00774	0.00301	0.009307	0.003274	0.003211	0.007707	0.003397	0.007918	0.003085	0.003251	0.008333	0.003184	0.003203	0.008101	0.003237	0.003416	0.003525
0.003229	0.007108	0.003107	0.007839	0.003091	0.010875	0.003221	0.008169	0.003037	0.008142	0.003321	0.009513	0.003192	0.003295	0.007458	0.002963	0.007879	0.003044	0.003334	0.008267	0.00293	0.003224	0.008167	0.003072	0.003582	0.003472
0.003333	0.007770	0.003341	0.007924	0.003274	0.010929	0.003111	0.007752	0.003199	0.007731	0.002993	0.008679	0.003172	0.003319	0.007570	0.003106	0.007855	0.003028	0.003224	0.008416	0.003187	0.003049	0.007903	0.003171	0.003368	0.003557
0.003106	0.008029	0.003195	0.007885	0.003216	0.011314	0.003208	0.007982	0.003342	0.008251	0.00314	0.008791	0.003131	0.003073	0.007707	0.00319	0.007971	0.003144	0.003311	0.008434	0.003238	0.003383	0.007904	0.00296	0.003539	0.003583
0.003083	0.007585	0.003327	0.007569	0.003241	0.013471	0.003083	0.007716	0.003119	0.007972	0.003213	0.008759	0.003191	0.003193	0.007365	0.003232	0.007836	0.002985	0.003202	0.008268	0.003003	0.003234	0.007894	0.003161	0.003392	0.003698
0.003078	0.007827	0.003023	0.007817	0.003236	0.013021	0.003070	0.007669	0.003291	0.006966	0.003296	0.008806	0.002933	0.003305	0.007438	0.003128	0.007727	0.003172	0.003284	0.008277	0.002916	0.003208	0.007915	0.003077	0.003373	0.003509
0.003219	0.007751	0.003134	0.007929	0.002931	0.012773	0.003161	0.007913	0.002678	0.008108	0.003319	0.009006	0.003075	0.003204	0.007545	0.003091	0.007958	0.00318	0.002962	0.008293	0.003147	0.003155	0.007935	0.003184	0.003594	0.003538
0.003235	0.007830	0.003205	0.007808	0.003242	0.012590	0.003206	0.007782	0.003303	0.007912	0.003182	0.008984	0.00317	0.003104	0.007532	0.0032082	0.008034	0.003173	0.003352	0.008315	0.003273	0.003392	0.007940	0.003002	0.003516	0.003594
0.00320	0.00771	0.00320	0.00779	0.00315	0.01193	0.00315	0.00786	0.00317	0.00797	0.00317	0.00911	0.00317	0.00313	0.00751	0.00318	0.00793	0.00316	0.00322	0.00837	0.00314	0.00315	0.00795	0.00317	0.00352	0.00353
0.79984	1.92686	0.80045	1.94711	0.78795	2.98267	0.78763	1.96569	0.79363	1.99291	0.79188	2.27858	0.79363	0.78222	1.87858	0.79546	1.98283	0.78994	0.80458	2.09225	0.78514	0.78772	1.98722	0.79319	0.87989	0.88248
12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.6139	12.6139
127.2955	125.411	127.3113	125.809	127.4828	125.831	127.3304	126.490	127.3367	123.584	127.3621	124.455	127.3113	127.1876	125.448	127.0353	126.281	127.0765	127.0258	125.175	127.0067	127.0385	125.667	127.0892	127.3018	127.3177
8.07	19.20	8.08	19.46	7.96	29.82	7.95	19.76	8.01	19.57	8.00	22.53	8.01	7.89	18.72	8.01	19.89	7.96	8.10	20.81	7.91	7.93	19.84	7.99	8.88	8.91
	137.86		140.91		274.46		148.47		144.25		181.80			137.40		148.34			156.82			150.10			

Table 138 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for IG-110 graphite

Resistivity

Specimen Number - Post-Irrad in Red			EW2-01	EW2-01	EW2-02	EW2-02	EW2-03	EW2-03	EW4-01	EW4-01	EW4-02	EW4-02	EW5-01	EW5-01	EW5-02	EW5-02	EW5-03	EW5-03	EW6-01	EW6-01	EW6-02
Sample Location			1S7		1S9		1U7		1U9		2S5		2S7		2U5		2U7		3S9		3U9
Applied current, I		mA	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
Compl. Volttage		V	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
ID Orientation:																					
Forward current:																					
Voltage readings, mV		1	0.004170	0.001094	0.005390	0.011004	0.005280	0.010979	0.005010	0.010772	0.005500	0.010517	0.004920	0.010699	0.004890	0.010661	0.005430	0.010909	0.005220	0.010804	0.005010
		2	0.005110	0.010734	0.005180	0.010899	0.005370	0.010964	0.005380	0.010697	0.005310	0.010487	0.004480	0.010708	0.005320	0.009786	0.005170	0.010780	0.005090	0.010714	0.004810
		3	0.004230	0.010715	0.003920	0.010993	0.005390	0.011006	0.005100	0.010678	0.005360	0.010502	0.004880	0.010687	0.005250	0.008930	0.005010	0.010856	0.005040	0.010631	0.004830
		4	0.005130	0.010937	0.005240	0.010823	0.004800	0.010880	0.005030	0.010746	0.004990	0.010499	0.005050	0.010702	0.005020	0.010286	0.005220	0.010859	0.005170	0.010687	0.004820
Reverse current:																					
Voltage readings, mV		1	0.004300	0.011116	0.005010	0.010309	0.004820	0.010711	0.005010	0.010261	0.005220	0.010315	0.005020	0.010519	0.005100	0.010427	0.005360	0.010751	0.005190	0.009958	0.005080
		2	0.004160	0.011085	0.005420	0.010344	0.004770	0.010805	0.005110	0.010305	0.005310	0.010303	0.005550	0.010706	0.005170	0.009854	0.005110	0.010896	0.005280	0.010077	0.004790
		3	0.004270	0.011081	0.004770	0.010411	0.005040	0.010833	0.004940	0.010418	0.005100	0.010191	0.005280	0.010897	0.005040	0.009811	0.004990	0.010809	0.005180	0.010056	0.004350
		4	0.004280	0.011064	0.004840	0.010377	0.004630	0.010856	0.004910	0.010239	0.005120	0.010311	0.005200	0.010777	0.005120	0.010063	0.004890	0.010632	0.004700	0.010045	0.003850
End-for-end orientation:																					
Reverse current:																					
Voltage readings, mV		1	0.004190	0.011049	0.004870	0.010409	0.005040	0.010823	0.004870	0.010772	0.005170	0.010276	0.005350	0.010552	0.004920	0.010586	0.003970	0.010812	0.005080	0.010296	0.005110
		2	0.004250	0.011138	0.004760	0.010368	0.004390	0.010837	0.004970	0.010213	0.004020	0.010251	0.004190	0.010603	0.005080	0.009411	0.004410	0.010822	0.004920	0.010544	0.003990
		3	0.004410	0.011094	0.005200	0.010379	0.004760	0.010849	0.004360	0.010780	0.005050	0.010212	0.005090	0.010673	0.004710	0.010783	0.004650	0.010842	0.004950	0.010062	0.004380
		4	0.004090	0.011076	0.005080	0.010388	0.004980	0.010798	0.004400	0.010802	0.004060	0.010338	0.005100	0.010638	0.005050	0.010433	0.004340	0.010850	0.005070	0.010033	0.003370
Forward current:		1	0.004130	0.010861	0.004660	0.010868	0.004930	0.010747	0.004700	0.010720	0.004050	0.010883	0.005170	0.010729	0.005100	0.010094	0.003980	0.010781	0.005120	0.010512	0.004520
Voltage readings, mV		2	0.004200	0.010840	0.005060	0.010958	0.005200	0.010726	0.004840	0.010805	0.004150	0.010461	0.005530	0.010679	0.005160	0.010165	0.004100	0.010758	0.004860	0.010697	0.005150
		3	0.004250	0.010951	0.005220	0.010850	0.004760	0.010913	0.004910	0.010860	0.004030	0.010520	0.005150	0.010716	0.004650	0.010121	0.004050	0.010790	0.005110	0.010578	0.004810
		4	0.004240	0.010990	0.004810	0.010869	0.004910	0.010929	0.004710	0.010780	0.004040	0.010468	0.005130	0.010723	0.004980	0.009818	0.003990	0.010926	0.005090	0.010219	0.004640
Average voltage, V		mV	0.00434	0.01036	0.00496	0.01064	0.00494	0.01085	0.00489	0.01062	0.00478	0.01041	0.00507	0.01069	0.00504	0.01008	0.00467	0.01082	0.00507	0.01037	0.00459
Average resistance, R=V/I		Ω	1.08453	2.59101	1.24109	2.66014	1.23547	2.71338	1.22266	2.65388	1.19500	2.60209	1.26703	2.67200	1.25875	2.51920	1.16672	2.70426	1.26672	2.59239	1.14859
Potential Contact Distance, L	12.6139		12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139
Average area, A mm^2 *		mm^2	127.1749	125.657	127.1717	125.930	127.1653	124.794	126.8894	126.264	127.0163	125.866	127.0194	125.376	126.8736	123.518	126.8894	123.633	126.8261	126.341	126.9814
Resistivity, p=(R*A)/L		μΩm	10.93	25.87	12.51	26.62	12.46	26.90	12.30	26.62	12.03	26.02	12.76	26.62	12.66	24.72	11.74	26.56	12.74	26.02	11.56
Fractional Change, = $(\rho_F-\rho_0)/\rho_0$		%		136.58		112.72		116.01		116.47		116.25		108.62		95.27		126.34		104.32	

Table 139 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for IG-110 graphite – cont.

EW6-03	EW6-03	EW7-01	EW7-01	EW7-03	EW8-01	EW8-01	EW8-02	EW8-02	EW8-03	EW8-03	EW9-01	EW9-01	EW9-02	EW9-02	EW9-03	EW9-03	EW10-01	EW10-01	EW10-02	EW10-02	EW10-03	EW10-03
4S4		4S9		4U4	4U9		5S1		5S13		5U1		5U12		6S14		6U13		Spare 1		Spare 2	
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.004800	0.010154	0.005290	0.010574	0.004570	0.004760	0.010684	0.005050	0.010183	0.004700	0.011889	0.005050	0.010066	0.004860	0.010509	0.005290	0.010362	0.004810	0.011001	0.005070	0.009906	0.004900	0.010156
0.004780	0.010176	0.004800	0.010770	0.005280	0.005060	0.010591	0.004550	0.010147	0.004410	0.011816	0.004910	0.010049	0.004770	0.010497	0.005010	0.010385	0.003910	0.010834	0.005080	0.010149	0.004780	0.010024
0.004290	0.010215	0.005110	0.010287	0.005260	0.005240	0.010631	0.005080	0.010109	0.005190	0.011879	0.005000	0.010042	0.005110	0.010462	0.005060	0.010324	0.003940	0.010714	0.005030	0.009765	0.005010	0.010271
0.004850	0.010204	0.005170	0.010217	0.005190	0.005270	0.010859	0.005130	0.010143	0.004940	0.011851	0.004890	0.010026	0.004980	0.010431	0.005050	0.010440	0.003990	0.010725	0.005100	0.010184	0.004890	0.009994
0.004900	0.010003	0.004910	0.009931	0.005170	0.005260	0.010452	0.005170	0.010596	0.004930	0.011231	0.004920	0.009917	0.004510	0.010222	0.005020	0.010077	0.003990	0.010614	0.005040	0.009880	0.004700	0.009718
0.004480	0.009967	0.005060	0.009791	0.005300	0.005200	0.010906	0.004930	0.009975	0.005120	0.011506	0.004700	0.010012	0.004280	0.010207	0.005290	0.009845	0.003880	0.010490	0.004590	0.009837	0.004650	0.009807
0.004790	0.010057	0.005160	0.009815	0.005560	0.004500	0.010846	0.004960	0.009969	0.005090	0.011581	0.003840	0.009952	0.004650	0.010256	0.005120	0.010302	0.004480	0.010514	0.004710	0.010002	0.004710	0.009771
0.003910	0.010064	0.005280	0.009291	0.005170	0.004220	0.010610	0.004870	0.009956	0.004910	0.011607	0.005020	0.009972	0.004440	0.010281	0.005150	0.010261	0.002820	0.010606	0.004980	0.010081	0.004910	0.009633
0.004640	0.010081	0.005260	0.009721	0.005270	0.004650	0.010401	0.005080	0.010001	0.005310	0.011464	0.005100	0.009991	0.004510	0.010256	0.005200	0.010275	0.004310	0.010063	0.005010	0.009833	0.004780	0.009546
0.004020	0.010094	0.004900	0.009935	0.004760	0.004940	0.010373	0.004940	0.010013	0.005490	0.011381	0.005260	0.009972	0.004330	0.010285	0.005050	0.010314	0.004920	0.010685	0.004980	0.010117	0.004810	0.009784
0.004850	0.010106	0.004920	0.009832	0.004930	0.005290	0.010262	0.005070	0.010032	0.004550	0.011570	0.004950	0.009958	0.004460	0.010131	0.004900	0.010269	0.004340	0.010703	0.005110	0.010008	0.004690	0.009804
0.004390	0.010041	0.005150	0.009679	0.005360	0.004560	0.010482	0.005010	0.010016	0.005230	0.011534	0.004960	0.009925	0.004710	0.010089	0.005380	0.010276	0.004010	0.010817	0.004870	0.009906	0.004870	0.009779
0.004360	0.010058	0.004950	0.010183	0.005310	0.005150	0.010505	0.005020	0.010166	0.005250	0.011221	0.004980	0.009937	0.004810	0.010213	0.005390	0.009916	0.004270	0.010605	0.004990	0.010072	0.004680	0.009896
0.003960	0.010090	0.005100	0.010243	0.005380	0.005100	0.010478	0.004930	0.010255	0.005300	0.011732	0.005250	0.010021	0.004620	0.010367	0.005240	0.010269	0.005060	0.010612	0.005060	0.009975	0.004600	0.009911
0.004880	0.010042	0.005040	0.010306	0.005110	0.004950	0.010579	0.004720	0.010293	0.005340	0.011718	0.005040	0.010007	0.004710	0.010371	0.005000	0.010330	0.004960	0.010659	0.004870	0.010185	0.004590	0.009870
0.004030	0.010169	0.004190	0.010358	0.005350	0.005010	0.016940	0.005050	0.010135	0.005210	0.011691	0.005290	0.010038	0.004800	0.010392	0.004860	0.010250	0.004940	0.010615	0.004920	0.010197	0.004720	0.009835
0.00450	0.01010	0.00502	0.01006	0.00519	0.00495	0.01097	0.00497	0.01012	0.00506	0.01160	0.00495	0.00999	0.00466	0.01031	0.00513	0.01024	0.00429	0.01064	0.00496	0.01001	0.00477	0.00986
1.12391	2.52377	1.25453	2.51458	1.29641	1.23688	2.74373	1.24313	2.53108	1.26516	2.90111	1.23688	2.49820	1.16484	2.57764	1.28141	2.56086	1.07234	2.66027	1.24078	2.50152	1.19203	2.46561
12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586
126.8609	125.009	126.9148	125.245	126.6075	126.7088	123.176	126.8229	125.595	126.6233	126.082	126.5315	123.117	126.8514	125.099	126.6740	125.746	126.6297	123.882	126.7183	126.022	126.6930	123.171
11.30	25.07	12.62	25.02	13.01	12.42	26.85	12.50	25.26	12.70	29.06	12.41	24.44	11.71	25.62	12.87	25.59	10.77	26.18	12.46	25.05	11.97	24.13
	121.77		98.24			116.12		102.08		128.83		96.96		118.71		98.82		143.24		100.94		101.54

Table 140 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for IG-110 graphite

Resistivity

Specimen Number - Post-Irrad in Red			EW2-01	EW2-01	EW2-02	EW2-02	EW2-03	EW2-03	EW4-01	EW4-01	EW4-02	EW4-02	EW5-01	EW5-01	EW5-02	EW5-02	EW5-03	EW5-03	EW6-01	EW6-01	EW6-02
Sample Location			1S7		1S9		1U7		1U9		2S5		2S7		2U5		2U7		3S9		3U9
Applied current, I		mA	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
Compl. Volttage		V	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
ID Orientation:																					
Forward current:																					
Voltage readings, mV		1	0.004170	0.001094	0.005390	0.011004	0.005280	0.010979	0.005010	0.010772	0.005500	0.010517	0.004920	0.010699	0.004890	0.010661	0.005430	0.010909	0.005220	0.010804	0.005010
		2	0.005110	0.010734	0.005180	0.010899	0.005370	0.010964	0.005380	0.010697	0.005310	0.010487	0.004480	0.010708	0.005320	0.009786	0.005170	0.010780	0.005090	0.010714	0.004810
		3	0.004230	0.010715	0.003920	0.010993	0.005390	0.011006	0.005100	0.010678	0.005360	0.010502	0.004880	0.010687	0.005250	0.008930	0.005010	0.010856	0.005040	0.010631	0.004830
		4	0.005130	0.010937	0.005240	0.010823	0.004800	0.010880	0.005030	0.010746	0.004990	0.010499	0.005050	0.010702	0.005020	0.010286	0.005220	0.010859	0.005170	0.010687	0.004820
Reverse current:																					
Voltage readings, mV		1	0.004300	0.011116	0.005010	0.010309	0.004820	0.010711	0.005010	0.010261	0.005220	0.010315	0.005020	0.010519	0.005100	0.010427	0.005360	0.010751	0.005190	0.009958	0.005080
		2	0.004160	0.011085	0.005420	0.010344	0.004770	0.010805	0.005110	0.010305	0.005310	0.010303	0.005550	0.010706	0.005170	0.009854	0.005110	0.010896	0.005280	0.010077	0.004790
		3	0.004270	0.011081	0.004770	0.010411	0.005040	0.010833	0.004940	0.010418	0.005100	0.010191	0.005280	0.010897	0.005040	0.009811	0.004990	0.010809	0.005180	0.010056	0.004350
		4	0.004280	0.011064	0.004840	0.010377	0.004630	0.010856	0.004910	0.010239	0.005120	0.010311	0.005200	0.010777	0.005120	0.010063	0.004890	0.010632	0.004700	0.010045	0.003850
End-for-end orientation:																					
Reverse current:																					
Voltage readings, mV		1	0.004190	0.011049	0.004870	0.010409	0.005040	0.010823	0.004870	0.010772	0.005170	0.010276	0.005350	0.010552	0.004920	0.010586	0.003970	0.010812	0.005080	0.010296	0.005110
		2	0.004250	0.011138	0.004760	0.010368	0.004390	0.010837	0.004970	0.010213	0.004020	0.010251	0.004190	0.010603	0.005080	0.009411	0.004410	0.010822	0.004920	0.010544	0.003990
		3	0.004410	0.011094	0.005200	0.010379	0.004760	0.010849	0.004360	0.010780	0.005050	0.010212	0.005090	0.010673	0.004710	0.010783	0.004650	0.010842	0.004950	0.010062	0.004380
		4	0.004090	0.011076	0.005080	0.010388	0.004980	0.010798	0.004400	0.010802	0.004060	0.010338	0.005100	0.010638	0.005050	0.010433	0.004340	0.010850	0.005070	0.010033	0.003370
Forward current:		1	0.004130	0.010861	0.004660	0.010868	0.004930	0.010747	0.004700	0.010720	0.004050	0.010883	0.005170	0.010729	0.005100	0.010094	0.003980	0.010781	0.005120	0.010512	0.004520
Voltage readings, mV		2	0.004200	0.010840	0.005060	0.010958	0.005200	0.010726	0.004840	0.010805	0.004150	0.010461	0.005530	0.010679	0.005160	0.010165	0.004100	0.010758	0.004860	0.010697	0.005150
		3	0.004250	0.010951	0.005220	0.010850	0.004760	0.010913	0.004910	0.010860	0.004030	0.010520	0.005150	0.010716	0.004650	0.010121	0.004050	0.010790	0.005110	0.010578	0.004810
		4	0.004240	0.010990	0.004810	0.010869	0.004910	0.010929	0.004710	0.010780	0.004040	0.010468	0.005130	0.010723	0.004980	0.009818	0.003990	0.010926	0.005090	0.010219	0.004640
Average voltage, V		mV	0.00434	0.01036	0.00496	0.01064	0.00494	0.01085	0.00489	0.01062	0.00478	0.01041	0.00507	0.01069	0.00504	0.01008	0.00467	0.01082	0.00507	0.01037	0.00459
Average resistance, R=V/I		Ω	1.08453	2.59101	1.24109	2.66014	1.23547	2.71338	1.22266	2.65388	1.19500	2.60209	1.26703	2.67200	1.25875	2.51920	1.16672	2.70426	1.26672	2.59239	1.14859
Potential Contact Distance, L	12.6139		12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139
Average area, A mm^2 *		mm^2	127.1749	125.657	127.1717	125.930	127.1653	124.794	126.8894	126.264	127.0163	125.866	127.0194	125.376	126.8736	123.518	126.8894	123.633	126.8261	126.341	126.9814
Resistivity, p=(R*A)/L		μΩm	10.93	25.87	12.51	26.62	12.46	26.90	12.30	26.62	12.03	26.02	12.76	26.62	12.66	24.72	11.74	26.56	12.74	26.02	11.56
Fractional Change, = $(\rho_F-\rho_0)/\rho_0$		%		136.58		112.72		116.01		116.47		116.25		108.62		95.27		126.34		104.32	

Table 141 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for IG-110 graphite – cont.

EW6-03	EW6-03	EW7-01	EW7-01	EW7-03	EW8-01	EW8-01	EW8-02	EW8-02	EW8-03	EW8-03	EW9-01	EW9-01	EW9-02	EW9-02	EW9-03	EW9-03	EW10-01	EW10-01	EW10-02	EW10-02	EW10-03	EW10-03
4S4		4S9		4U4	4U9		5S1		5S13		5U1		5U12		6S14		6U13		Spare 1		Spare 2	
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.004800	0.010154	0.005290	0.010574	0.004570	0.004760	0.010684	0.005050	0.010183	0.004700	0.011889	0.005050	0.010066	0.004860	0.010509	0.005290	0.010362	0.004810	0.011001	0.005070	0.009906	0.004900	0.010156
0.004780	0.010176	0.004800	0.010770	0.005280	0.005060	0.010591	0.004550	0.010147	0.004410	0.011816	0.004910	0.010049	0.004770	0.010497	0.005010	0.010385	0.003910	0.010834	0.005080	0.010149	0.004780	0.010024
0.004290	0.010215	0.005110	0.010287	0.005260	0.005240	0.010631	0.005080	0.010109	0.005190	0.011879	0.005000	0.010042	0.005110	0.010462	0.005060	0.010324	0.003940	0.010714	0.005030	0.009765	0.005010	0.010271
0.004850	0.010204	0.005170	0.010217	0.005190	0.005270	0.010859	0.005130	0.010143	0.004940	0.011851	0.004890	0.010026	0.004980	0.010431	0.005050	0.010440	0.003990	0.010725	0.005100	0.010184	0.004890	0.009994
0.004900	0.010003	0.004910	0.009931	0.005170	0.005260	0.010452	0.005170	0.010596	0.004930	0.011231	0.004920	0.009917	0.004510	0.010222	0.005020	0.010077	0.003990	0.010614	0.005040	0.009880	0.004700	0.009718
0.004480	0.009967	0.005060	0.009791	0.005300	0.005200	0.010906	0.004930	0.009975	0.005120	0.011506	0.004700	0.010012	0.004280	0.010207	0.005290	0.009845	0.003880	0.010490	0.004590	0.009837	0.004650	0.009807
0.004790	0.010057	0.005160	0.009815	0.005560	0.004500	0.010846	0.004960	0.009969	0.005090	0.011581	0.003840	0.009952	0.004650	0.010256	0.005120	0.010302	0.004480	0.010514	0.004710	0.010002	0.004710	0.009771
0.003910	0.010064	0.005280	0.009291	0.005170	0.004220	0.010610	0.004870	0.009956	0.004910	0.011607	0.005020	0.009972	0.004440	0.010281	0.005150	0.010261	0.002820	0.010606	0.004980	0.010081	0.004910	0.009633
0.004640	0.010081	0.005260	0.009721	0.005270	0.004650	0.010401	0.005080	0.010001	0.005310	0.011464	0.005100	0.009991	0.004510	0.010256	0.005200	0.010275	0.004310	0.010063	0.005010	0.009833	0.004780	0.009546
0.004020	0.010094	0.004900	0.009935	0.004760	0.004940	0.010373	0.004940	0.010013	0.005490	0.011381	0.005260	0.009972	0.004330	0.010285	0.005050	0.010314	0.004920	0.010685	0.004980	0.010117	0.004810	0.009784
0.004850	0.010106	0.004920	0.009832	0.004930	0.005290	0.010262	0.005070	0.010032	0.004550	0.011570	0.004950	0.009958	0.004460	0.010131	0.004900	0.010269	0.004340	0.010703	0.005110	0.010008	0.004690	0.009804
0.004390	0.010041	0.005150	0.009679	0.005360	0.004560	0.010482	0.005010	0.010016	0.005230	0.011534	0.004960	0.009925	0.004710	0.010089	0.005380	0.010276	0.004010	0.010817	0.004870	0.009906	0.004870	0.009779
0.004360	0.010058	0.004950	0.010183	0.005310	0.005150	0.010505	0.005020	0.010166	0.005250	0.011221	0.004980	0.009937	0.004810	0.010213	0.005390	0.009916	0.004270	0.010605	0.004990	0.010072	0.004680	0.009896
0.003960	0.010090	0.005100	0.010243	0.005380	0.005100	0.010478	0.004930	0.010255	0.005300	0.011732	0.005250	0.010021	0.004620	0.010367	0.005240	0.010269	0.005060	0.010612	0.005060	0.009975	0.004600	0.009911
0.004880	0.010042	0.005040	0.010306	0.005110	0.004950	0.010579	0.004720	0.010293	0.005340	0.011718	0.005040	0.010007	0.004710	0.010371	0.005000	0.010330	0.004960	0.010659	0.004870	0.010185	0.004590	0.009870
0.004030	0.010169	0.004190	0.010358	0.005350	0.005010	0.016940	0.005050	0.010135	0.005210	0.011691	0.005290	0.010038	0.004800	0.010392	0.004860	0.010250	0.004940	0.010615	0.004920	0.010197	0.004720	0.009835
0.00450	0.01010	0.00502	0.01006	0.00519	0.00495	0.01097	0.00497	0.01012	0.00506	0.01160	0.00495	0.00999	0.00466	0.01031	0.00513	0.01024	0.00429	0.01064	0.00496	0.01001	0.00477	0.00986
1.12391	2.52377	1.25453	2.51458	1.29641	1.23688	2.74373	1.24313	2.53108	1.26516	2.90111	1.23688	2.49820	1.16484	2.57764	1.28141	2.56086	1.07234	2.66027	1.24078	2.50152	1.19203	2.46561
12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586
126.8609	125.009	126.9148	125.245	126.6075	126.7088	123.176	126.8229	125.595	126.6233	126.082	126.5315	123.117	126.8514	125.099	126.6740	125.746	126.6297	123.882	126.7183	126.022	126.6930	123.171
11.30	25.07	12.62	25.02	13.01	12.42	26.85	12.50	25.26	12.70	29.06	12.41	24.44	11.71	25.62	12.87	25.59	10.77	26.18	12.46	25.05	11.97	24.13
	121.77		98.24			116.12		102.08		128.83		96.96		118.71		98.82		143.24		100.94		101.54

Table 142 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for IG-430 graphite

Resistivity

Specimen Number - Post-Irrad in Red		FW1-01	FW1-01	FW1-02	FW1-03	FW1-03	FW2-01	FW2-01	FW2-02	FW2-02	FW2-03	FW2-03	FW3-01	FW3-01	FW3-02	FW3-02	FW3-03	FW3-03
Sample Location		1S5		1S10	1U5		1U10		2S3		2S9		2S15		2U3		2U9	
Applied current, I	mA	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
Compl. Voltage,	V	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
ID Orientation:																		
Forward current:																		
Voltage readings, mV	1	0.004230	0.010308	0.003330	0.004240	0.010466	0.004280	0.010100	0.004190	0.010197	0.004220	0.010595	0.003690	0.009234	0.004090	0.009234	0.003820	0.010462
	2	0.004180	0.010361	0.003280	0.004320	0.010378	0.004030	0.011520	0.004350	0.010141	0.004080	0.017940	0.003850	0.009016	0.004010	0.009016	0.003930	0.010591
	3	0.004140	0.010341	0.003250	0.004300	0.010506	0.004080	0.010250	0.003980	0.010159	0.004010	0.010848	0.003630	0.009137	0.004030	0.009137	0.003600	0.010579
	4	0.004170	0.010338	0.003290	0.004100	0.010551	0.004110	0.010339	0.004360	0.010603	0.004160	0.018110	0.003720	0.009186	0.003850	0.009186	0.003940	0.010562
Reverse current:																		
Voltage readings, mV	1	0.004140	0.009798	0.003240	0.004080	0.010049	0.004120	0.009865	0.004390	0.009835	0.004070	0.010656	0.003730	0.009239	0.003680	0.009239	0.003930	0.010444
	2	0.004210	0.009885	0.003520	0.004150	0.010167	0.004150	0.010036	0.003760	0.009757	0.004130	0.010623	0.003380	0.009309	0.004200	0.009309	0.003780	0.010371
	3	0.004090	0.009863	0.003620	0.003980	0.010326	0.004140	0.010081	0.004070	0.009907	0.004050	0.010605	0.003780	0.009224	0.004120	0.009224	0.003860	0.010290
	4	0.004120	0.009753	0.003440	0.004070	0.010251	0.004110	0.000100	0.003980	0.009818	0.004090	0.010591	0.003700	0.008973	0.004020	0.008973	0.004000	0.010432
End-for-end orientation:																		
Reverse current:																		
Voltage readings, mV	1	0.004000	0.010312	0.003610	0.004250	0.010205	0.004160	0.010013	0.003390	0.009892	0.004140	0.010731	0.003890	0.008893	0.004000	0.008893	0.003300	0.010433
	2	0.004180	0.009778	0.003580	0.003940	0.010292	0.004170	0.010136	0.003340	0.009973	0.004230	0.010739	0.003660	0.009180	0.003840	0.009180	0.003280	0.010492
	3	0.004100	0.009764	0.003690	0.004000	0.010232	0.004290	0.010187	0.003290	0.010068	0.004190	0.010691	0.003710	0.009048	0.004080	0.009048	0.003290	0.016110
	4	0.004050	0.009877	0.003600	0.004140	0.010269	0.004130	0.010073	0.003340	0.009990	0.004130	0.010834	0.003560	0.009362	0.004120	0.009321	0.003310	0.012040
Forward current:	1	0.004170	0.010264	0.003340	0.004050	0.010498	0.004240	0.010177	0.003380	0.010211	0.004250	0.010778	0.003910	0.009474	0.004210	0.009474	0.002700	0.010659
Voltage readings, mV	2	0.003780	0.010271	0.003300	0.004170	0.010543	0.004230	0.010129	0.003280	0.010123	0.004180	0.010364	0.003900	0.009386	0.003980	0.009386	0.003330	0.010696
	3	0.004050	0.010203	0.003280	0.004070	0.010422	0.004090	0.010159	0.003350	0.010094	0.004210	0.010762	0.003870	0.008872	0.004060	0.008872	0.003410	0.010718
	4	0.004100	0.010320	0.003310	0.003960	0.010511	0.004150	0.010211	0.003250	0.010048	0.004240	0.010781	0.003800	0.009197	0.004090	0.009197	0.003210	0.010609
Average voltage, V	mV	0.00411	0.01009	0.00342	0.00411	0.01035	0.00416	0.00959	0.00373	0.01005	0.00415	0.01160	0.00374	0.00917	0.00402	0.00917	0.00354	0.01097
Average resistance, R=V/I	Ω	1.02672	2.52244	0.85438	1.02844	2.58853	1.03875	2.39650	0.93281	2.51275	1.03719	2.90075	0.93406	2.29266	1.00594	2.29202	0.88578	2.74200
Potential Contact Distance, L	12.6139	12.6139	12.6139	12.586	12.6139	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586
Average area, A mm^2 *	mm^2	126.807	125.047	126.9021	126.9782	123.875	126.6898	124.033	126.731	125.394	126.7722	125.498	126.6582	125.697	126.7659	123.705	126.9211	124.693
Resistivity, p=(R*A)/L	μΩm	10.32	**25.06**	8.60	10.35	**25.48**	10.43	**23.62**	9.37	**25.03**	10.42	**28.92**	9.38	**22.90**	10.11	**22.53**	8.91	**27.17**
Fractional Change, = $(\rho_i-\rho_0)/\rho_0$	%		142.81			146.09		126.37		167.12		177.48		144.13		122.84		204.80

Table 143 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for IG-430 graphite – cont.

FW4-01	FW4-01	FW4-02	FW4-02	FW4-03	FW4-03	FW5-01	FW5-01	FW5-02	FW5-02	FW5-03	FW5-03	FW7-01	FW7-01	FW7-02	FW7-02	FW7-03	FW7-03	FW8-01	FW8-01	FW8-02	FW8-02	FW8-03	FW9-01	FW9-01
2U14		3S3		3S4		3S5		3S7		3U3		3U4		3U5		3U7		4S3		4S10		4U3	4U10	
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.004040	0.010378	0.004160	0.009824	0.004010	0.010154	0.004020	0.010038	0.003510	0.010085	0.004120	0.009819	0.004170	0.010672	0.003920	0.010074	0.004190	0.010378	0.003490	0.010272	0.003290	0.009991	0.003530	0.004010	0.011313
0.004050	0.010431	0.004050	0.010027	0.004060	0.010218	0.004190	0.010020	0.003130	0.009721	0.003880	0.009817	0.004070	0.010966	0.004170	0.010655	0.003980	0.010529	0.003820	0.010254	0.003300	0.010372	0.003500	0.004110	0.011332
0.004020	0.010450	0.004060	0.010163	0.004110	0.010203	0.004070	0.009984	0.002980	0.009765	0.003960	0.010003	0.004140	0.010691	0.004050	0.010579	0.004100	0.010522	0.003870	0.010219	0.003280	0.010306	0.003610	0.004020	0.011303
0.004010	0.010323	0.004080	0.010205	0.004060	0.010149	0.004110	0.009976	0.003050	0.010017	0.004010	0.009784	0.004090	0.010511	0.004110	0.010576	0.004070	0.010501	0.003580	0.010227	0.003310	0.010341	0.003770	0.004050	0.011334
0.004010	0.010131	0.003990	0.009498	0.003170	0.010128	0.004190	0.009802	0.003060	0.009681	0.004110	0.009561	0.004120	0.010283	0.004160	0.010436	0.004080	0.010387	0.003910	0.009664	0.003220	0.010287	0.003470	0.004040	0.010821
0.004050	0.010249	0.003810	0.009915	0.003760	0.009638	0.003960	0.009843	0.003140	0.010043	0.003970	0.009689	0.004200	0.010356	0.003780	0.010440	0.003890	0.010416	0.003940	0.009848	0.003210	0.010239	0.003510	0.004060	0.010779
0.003930	0.010263	0.003950	0.009893	0.003180	0.009671	0.003990	0.009468	0.003160	0.009988	0.003990	0.009667	0.004160	0.010499	0.003800	0.010507	0.003810	0.010433	0.003960	0.009773	0.003340	0.010273	0.003390	0.003990	0.011091
0.003860	0.010322	0.003980	0.009787	0.004140	0.009649	0.004040	0.009771	0.002980	0.009691	0.004100	0.009684	0.004290	0.010458	0.003850	0.010333	0.004140	0.010459	0.004140	0.009848	0.003520	0.010291	0.003560	0.004200	0.011107
0.003900	0.009985	0.003170	0.009901	0.003900	0.009507	0.004000	0.009862	0.003900	0.009980	0.003780	0.009719	0.003880	0.009929	0.003960	0.010467	0.003940	0.010437	0.004030	0.010119	0.004080	0.010234	0.004220	0.003960	0.011084
0.003810	0.010132	0.003950	0.009838	0.003780	0.009448	0.003980	0.009892	0.003950	0.010129	0.003980	0.009651	0.004000	0.010487	0.004090	0.010486	0.003730	0.010281	0.004220	0.009745	0.003730	0.010240	0.003940	0.004020	0.011080
0.004000	0.010215	0.003880	0.009955	0.003740	0.009654	0.004020	0.010042	0.003480	0.009653	0.003790	0.009725	0.003600	0.010456	0.004050	0.010495	0.003880	0.010262	0.004020	0.009753	0.003980	0.010265	0.003700	0.004040	0.011091
0.003960	0.010150	0.003900	0.009892	0.003790	0.010132	0.004010	0.009852	0.003730	0.010104	0.004080	0.009680	0.003380	0.010438	0.004000	0.010470	0.003950	0.010284	0.004130	0.009744	0.003490	0.010273	0.003790	0.004050	0.011062
0.003970	0.010309	0.003920	0.010118	0.003830	0.010171	0.004010	0.009967	0.003890	0.010158	0.003990	0.009830	0.003320	0.010692	0.004080	0.010594	0.003760	0.010626	0.004110	0.010219	0.003910	0.010308	0.003800	0.004020	0.011348
0.004040	0.010286	0.004210	0.010224	0.004020	0.010178	0.004030	0.009956	0.003550	0.010090	0.004070	0.009824	0.003230	0.010673	0.004200	0.010579	0.004120	0.010551	0.003980	0.010264	0.003810	0.010321	0.003600	0.003740	0.011375
0.003790	0.010271	0.004050	0.010207	0.003910	0.010165	0.003920	0.009971	0.003650	0.010155	0.004130	0.009821	0.004020	0.010655	0.004160	0.010624	0.004260	0.010503	0.003880	0.010275	0.004130	0.010296	0.003770	0.003840	0.011304
0.004010	0.010324	0.004110	0.009991	0.003880	0.010142	0.003990	0.010031	0.003790	0.010084	0.004020	0.009853	0.004170	0.010654	0.004100	0.010582	0.004190	0.010528	0.003850	0.010261	0.004050	0.010325	0.003610	0.004020	0.011298
0.00397	0.01026	0.00395	0.00996	0.00383	0.00995	0.00403	0.00990	0.00343	0.00996	0.00400	0.00976	0.00393	0.01053	0.00403	0.01049	0.00401	0.01044	0.00393	0.01003	0.00360	0.01027	0.00367	0.00401	0.01117
0.99141	2.56592	0.98859	2.49122	0.95844	2.48761	1.00828	2.47617	0.85859	2.48975	0.99969	2.43948	0.98188	2.63157	1.00750	2.62339	1.00141	2.61089	0.98328	2.50758	0.90078	2.56816	0.91828	1.00266	2.79253
12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586
126.9243	125.642	126.8704	125.709	126.9592	126.333	127.0131	126.428	127.2415	126.834	127.3018	124.297	127.4034	123.927	127.3685	125.426	127.3812	125.664	126.9211	125.801	126.9306	125.843	126.9433	127.0416	124.747
9.98	25.61	9.94	24.88	9.65	24.97	10.15	24.87	8.66	25.09	10.09	24.09	9.92	25.91	10.17	26.14	10.11	26.07	9.89	25.06	9.06	25.68	9.24	10.10	27.68
	156.77		150.24		158.84		144.99		189.69		138.79		161.28		156.98		157.78		153.33		183.29			174.09

Table 144 PIE data for Electrical Resistivity and the fractional change of Electrical Resistivity on irradiation for IG-430 graphite – cont.

FW9-02	FW9-02	FW9-03	FW9-03	FW10-01	FW10-01	FW10-02	FW10-02	FW10-03	FW10-03	FW11-01	FW11-01	FW11-02	FW11-02	FW11-03	FW11-03	FW12-01	FW12-01	FW12-02	FW13-01	FW13-01	FW13-02
5S2		5S10		5U2		5U10		6S2		6S7		6S10		6U2		6U7		6U10	Spare 1		Spare 2
4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000	2.5000
0.004140	0.010231	0.004010	0.010195	0.003460	0.009642	0.003440	0.009474	0.004010	0.009404	0.003990	0.010342	0.003910	0.010098	0.004020	0.010031	0.003670	0.010484	0.003650	0.003750	0.009713	0.003130
0.003990	0.009775	0.004110	0.010234	0.003630	0.009736	0.003710	0.009430	0.004080	0.009463	0.003970	0.010417	0.003610	0.010122	0.003950	0.010254	0.004040	0.010581	0.003230	0.003040	0.009722	0.003110
0.004010	0.009669	0.003470	0.010277	0.003250	0.009699	0.003260	0.009407	0.004170	0.009465	0.004090	0.010116	0.003850	0.009938	0.003910	0.010261	0.004050	0.010473	0.004250	0.002990	0.009720	0.003100
0.004040	0.010236	0.003940	0.010392	0.003360	0.009789	0.003560	0.009457	0.004120	0.009487	0.004020	0.010391	0.003780	0.010174	0.003930	0.010244	0.003960	0.010472	0.003900	0.003040	0.009707	0.003140
0.004030	0.010201	0.003960	0.010231	0.003740	0.009603	0.003600	0.009156	0.004170	0.009282	0.004070	0.009973	0.003770	0.009976	0.003930	0.009998	0.003950	0.010254	0.003960	0.003060	0.009587	0.003090
0.003970	0.010248	0.003980	0.010236	0.003780	0.009539	0.003740	0.009267	0.004040	0.009313	0.004010	0.010166	0.003840	0.010009	0.004350	0.009978	0.003860	0.010222	0.003390	0.003050	0.009624	0.003170
0.003990	0.010305	0.003890	0.010169	0.003680	0.009562	0.003700	0.009254	0.003640	0.009336	0.004100	0.010278	0.003850	0.010023	0.004090	0.009931	0.003830	0.010119	0.003720	0.002990	0.009590	0.003150
0.004050	0.010299	0.004010	0.010139	0.003920	0.009608	0.003690	0.009252	0.003920	0.009031	0.004020	0.010276	0.003790	0.009939	0.004010	0.009927	0.003750	0.010337	0.003880	0.002980	0.009604	0.003030
0.004170	0.010236	0.003920	0.010114	0.003850	0.009605	0.003850	0.009278	0.004150	0.009338	0.004250	0.010301	0.003800	0.009987	0.004030	0.010018	0.004040	0.010336	0.003910	0.003210	0.009642	0.003120
0.003960	0.010245	0.003820	0.010217	0.003860	0.009596	0.003570	0.009284	0.003990	0.009319	0.004370	0.010373	0.003880	0.010059	0.004000	0.010024	0.004120	0.010180	0.004040	0.002980	0.009606	0.003140
0.004060	0.010226	0.003910	0.009939	0.003660	0.009577	0.003780	0.009263	0.004150	0.009319	0.004240	0.010348	0.003780	0.009964	0.003980	0.010039	0.004090	0.009609	0.004010	0.003000	0.009601	0.003160
0.004090	0.010235	0.004010	0.010155	0.003770	0.009372	0.003910	0.009202	0.003970	0.009286	0.004210	0.009958	0.003910	0.009971	0.004010	0.009976	0.003990	0.010330	0.003990	0.003080	0.009655	0.003090
0.003980	0.010241	0.003840	0.010414	0.003800	0.009659	0.003630	0.009455	0.004030	0.009615	0.004240	0.010469	0.003900	0.010090	0.004080	0.010337	0.004120	0.010473	0.004110	0.003010	0.009778	0.003160
0.004050	0.010202	0.003940	0.010401	0.003890	0.009749	0.003750	0.009421	0.004080	0.009426	0.004130	0.010374	0.003880	0.010087	0.003780	0.010294	0.004080	0.010449	0.004130	0.003030	0.009765	0.003130
0.004010	0.010136	0.003890	0.010397	0.003780	0.009729	0.003540	0.009416	0.003970	0.009529	0.004100	0.010384	0.004000	0.010053	0.004050	0.010312	0.004100	0.010465	0.004050	0.002990	0.009772	0.003170
0.003990	0.010215	0.003900	0.010341	0.003880	0.009736	0.003450	0.009406	0.004010	0.009488	0.004110	0.010335	0.003980	0.010147	0.003990	0.010244	0.004130	0.010374	0.004010	0.003090	0.009763	0.003060
0.00403	0.01017	0.00391	0.01024	0.00371	0.00964	0.00364	0.00934	0.00403	0.00938	0.00412	0.01028	0.00385	0.01004	0.00401	0.01012	0.00399	0.01032	0.00389	0.00308	0.00968	0.00312
1.00828	2.54219	0.97813	2.56017	0.92672	2.40939	0.90906	2.33472	1.00781	2.34533	1.03000	2.57033	0.96141	2.50995	1.00172	2.52919	0.99656	2.58059	0.97234	0.77016	2.41952	0.78047
12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.586	12.6139	12.6139	12.586	12.6139
127.0353	126.079	127.0004	126.047	127.1051	124.166	127.1304	124.144	127.1051	126.520	127.1209	126.251	127.1685	126.396	127.1622	123.789	127.2098	126.630	127.1749	127.2288	125.630	127.2447
10.15	**25.47**	9.85	**25.64**	9.34	**23.77**	9.16	**23.03**	10.16	**23.58**	10.38	**25.78**	9.69	**25.21**	10.10	**24.88**	10.05	**25.96**	9.80	7.77	**24.15**	7.87
	150.79		160.35		154.54		151.35		132.16		148.39		160.06		146.33		158.34			210.90	

9. References

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