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PROPERTIES OF UNIRRADIATED HTGR
CORE SUPPORT AND PERMANENT
SIDE REFLECTOR GRAPHITES:
PGX, HLM, 2020, AND H-440N

by
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ABSTRACT

Candidate materials for HTGR core supports and permanent side reflectors -- graphite grades 2020 (Stackpole Carbon Company), H-440N (Great Lakes Carbon Corporation), PGX (Union Carbide Corporation), and HLM (Great Lakes Carbon Corporation) -- are described and property data are presented. Properties measured are bulk density; tensile properties including ultimate strength, modulus of elasticity, and strain at fracture; flexural strength; compressive properties including ultimate strength, modulus of elasticity, and strain at fracture; and chemical impurity content. The data presented represent the mean values and standard deviations for single logs. The logs of grades 2020, PGX, and HLM are full-size logs purchased from commercial stock, and the data are indicative of property values to be expected in commercial production. The data on grade H-440N are from an experimental log and do not represent commercial production values.

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1. SUMMARY

Three commercially available graphite grades -- Stackpole Carbon Company's 2020, Union Carbide Corporation's PGX, and Great Lakes Carbon Corporation's HLM -- were evaluated as possible candidate materials for core support posts, core support floor blocks, and permanent side reflectors, respectively, in the Large High-Temperature Gas-Cooled Reactor (LHTGR). Great Lakes Carbon Corporation's grade H-440N, an experimental material, was also evaluated as a possible candidate for core support posts. Bulk density, mechanical properties, including tensile, flexural, and compressive properties, and chemical impurities were determined as a function of location within the graphite logs. Mean values of the properties and chemical impurities of the graphites are summarized in Table 1-1.*

The work reported herein is part of an on-going program at General Atomic Company to select reference materials for LHTGR components.

1.1. GRADE 2020

As a candidate for core support posts, grade 2020 may be characterized as an isostatically molded, medium-grained graphite manufactured as logs 254 mm in diameter by 1829 mm in length with a bulk density of 1.79 Mg/m^3 . In comparison with other commercial graphites, it has intermediate strength and elastic moduli with a uniform distribution within a log but variation between logs. The ash content and other impurities are relatively high when compared with highly purified fuel element graphites (Ref. 1).

*Tables and figures appear at the end of each section.

1.2. GRADE H-440N

As a candidate for core support posts, grade H-440N may be characterized as an isostatically molded, medium-grained graphite manufactured as logs 254 mm in diameter by 1829 mm in length (the piece evaluated in this study was one-half of a prototype log manufactured with a 330 by 330 mm cross section and a 1829-mm length) with a bulk density of 1.72 Mg/m^3 . In comparison with other commercial graphites, it has a relatively low strength and elastic moduli that vary along the longitudinal axis. The ash content and other impurities are relatively low, approaching those of highly purified fuel element graphites (Ref. 1).

1.3. GRADE PGX

As a candidate for core support floor blocks, grade PGX may be characterized as a conventionally molded, medium-grained graphite manufactured as logs 1143 mm in diameter by 1829 mm in length with a bulk density of 1.78 Mg/m^3 . In comparison with other commercial graphites, it has a relatively low strength and elastic moduli which are uniformly distributed within the log. The ash content and other impurities, especially iron and sulfur, are high in comparison with those of highly purified fuel element graphites (Ref. 1).

1.4. GRADE HLM

As a candidate for permanent side reflector blocks, grade HLM may be characterized as an extruded, medium-grained graphite manufactured as logs 1143 mm in diameter by 1829 mm in length with a bulk density of 1.79 Mg/m^3 . In comparison with other commercial graphites, it has a relatively low strength and elastic moduli, with the weakest region at the radial center of a log. The ash content and other impurities are relatively high in comparison with those of highly purified fuel element graphites (Ref. 1).

TABLE 1-1
SUMMARY OF CHARACTERIZATION DATA FOR GRADE 2020, H-440N, PGX, AND HLM GRAPHITES

Property	Graphite Grade							
	2020		H-440N		PGX		HLM	
	Axial	Radial	Axial	Radial	Axial	Radial	Axial	Radial
Bulk density (Mg/m ³)	1.79	--	1.72	--	1.78	--	1.79	--
Tensile properties								
Strength (MPa)	16.0	17.5	11.0	11.5	10.3	9.5	10.0	11.5
Modulus (GPa)	7.5	8.5	6.5	7.5	6.0	7.0	7.0	6.0
Flexural strength (MPa)	25.0	27.5	19.5	21.0	15.5	15.0	18.0	17.5
Compressive properties								
Strength (MPa)	80.5	80.5	51.0	45.0	43.0	41.0	39.0	42.0
Modulus (GPa)	9.5	10.0	5.5	6.0	5.0	5.5	6.0	6.0
Impurity content (ppm)								
Ash	1550	--	600	--	6183	--	2398	--
Si	15	--	19	--	541	--	32	--
Fe	220	--	14	--	>1000	--	>1000	--

2. INTRODUCTION

The LHTGR design utilizes graphite for core support posts, seats, and sleeves, core support and side reflector floor blocks, and permanent side reflectors. Figure 2-1 is a diagram of an HTGR core and support arrangement showing these components.

The core support posts are cylindrical columns with hemispherical ends. Posts are provided to support each core support block. The positions of the posts are fixed by the post seats, which are located in the core support blocks and on the bottom pad of the prestressed concrete reactor vessel (PCRV). The posts are free to pivot so as to follow changes in the position of the core support block. Each post supports a portion of the total weight of a multiple-column fuel assembly, plus the additional loads imposed by the drop in coolant pressure through the core.

The upper seats for the core support posts are provided as a separate insert in the bottom surface of the support blocks. The seats have one concave surface machined to a slightly larger radius than the end of the core support posts. The main functions of the seats are to permit the upper end of the post to follow any horizontal movement of the core support block and to help distribute loads at the contact surface. At the lower end of each post, a similar seat is part of an assembly which is located on the bottom pad. The lower seat is in contact with materials, such as alumina or silica, which form other parts of the assembly.

The core support and side reflector floor blocks are of a prismatic shape. Each block supports a multiple-column assembly of fuel element, hexagonal reflector, or side reflector blocks and is supported by core support posts. The blocks contain channels for the passage of coolant gas and contain separate inserts as seats for the core support posts.

Each of the core support blocks is closely assembled to the adjacent blocks, and the outermost blocks are keyed to the lateral restraint structure. The core support blocks are designed to fix the position of the fuel columns at the bottom of the reactor core.

The permanent side reflectors consist of large blocks which encircle the core and are keyed to the core lateral restraint structure, which is attached to the PCRV.

The primary function of the permanent reflector blocks is to moderate the fast-neutron flux in the reflector region and reflect thermal neutrons back into the core region, thus helping to reduce the neutron flux at the thermal barrier and the PCRV liner. In addition, the permanent reflector blocks form an intermediate support between the PCRV and the keyed plenum elements to help restrict horizontal movement of the core support blocks.

This report describes the initial results of property measurements on three commercial graphite grades which may be utilized for the above-mentioned components: grade 2020, manufactured by Stackpole Carbon Company (SC), for support posts; grade PGX, manufactured by Union Carbide Corporation (UCC), for core support floor blocks; and grade HLM, manufactured by Great Lakes Carbon Corporation (GLCC) for permanent side reflector blocks. These grades are available as commercial products from U.S. graphite manufacturers and are manufactured in sizes that satisfy the LHTGR design.

Data are presented for one log each of grades 2020, PGX, and HLM and a portion of a log of an experimental grade, H-440N, manufactured by GLCC. The purpose of this work is to characterize the materials with regard to properties and chemical impurity content.

Fig. 2-1. HTGR core and support arrangement

3. MATERIALS

The graphites described in this section are produced by major U.S. graphite companies. The raw materials and details of their processing are considered proprietary by the respective manufacturers. However, all grades were fabricated by conventional graphite methods consisting of mixing filler particles of petroleum coke or recycled graphite with a coal tar pitch binder, forming by molding or extrusion, baking to carbonize the binder, with possible impregnation with coal-tar pitch or petroleum pitch to improve the properties, and graphitizing in the range 2873 to 3173 K (2600° to 2900°C).

A description of the graphites is given in Table 3-1.

3.1. CORE SUPPORT POSTS AND SEATS: GRADES 2020 AND H-440N

3.1.1. Grade 2020

Grade 2020 is manufactured by the Stackpole Carbon Company in a variety of sizes for commercial sales. Grade 2020 is formed by isostatic molding followed by conventional baking and graphitizing processes. The product being evaluated in this program is manufactured as logs 254 mm in diameter by 1829 mm in length using petroleum coke as a filler and coal tar pitch as a binder. The logs tested were purchased at different times (see Table 5-1) and thus represent logs manufactured at different times in the Stackpole plant. Log 6484-110 was tested under a characterization program and was systematically sampled; log 6484-137 was compression tested as a full-size log, and a piece that broke out of the log as a result of the test was sampled for testing (see Fig. 5-3); and log 6799-00 was utilized in another study to determine the effect of oxidation on strength. The data from the control specimens of the oxidation study are included in this report.

3.1.2. Grade H-440N

Grade H-440N is a preproduction material manufactured by the Great Lakes Carbon Corporation. GLCC is in the process of commercializing grade H-440N, and the log that was evaluated in this program was formed by iso-static molding. It had a 330-mm by 330-mm cross section and a 1829-mm length and was manufactured with petroleum coke as filler and coal tar pitch as binder. One-half of the log was examined.

3.2. CORE SUPPORT FLOOR BLOCKS: GRADE PGX

Grade PGX is manufactured by the Union Carbide Corporation for commercial sales. Grade PGX is formed by conventional molding followed by conventional baking and graphitizing processes. The product being evaluated in this program was manufactured as a log 1143 mm in diameter by 1829 mm long using recycled graphite as filler and coal tar pitch as binder.

3.3. PERMANENT SIDE REFLECTOR: GRADE HLM

Grade HLM is manufactured by the Great Lakes Carbon Corporation for commercial sales. Grade HLM is formed by conventional extrusion followed by conventional baking and graphitizing processes. The HLM material evaluated in this program was manufactured as a log 1143 mm in diameter by 1829 mm long using calcined petroleum coke and recycle graphite as filler and coal tar pitch as binder.

TABLE 3-1
CORE SUPPORT AND PERMANENT SIDE REFLECTOR GRAPHITES

Grade	Manufacturer	Reactor Component	Filler	Binder	Forming Method
2020	SC	Core support posts	Petroleum coke	Coal tar pitch	Isostatic molding
PGX	UCC	Core support floor	Recycle graphite	Coal tar pitch	Conventional molding
HLM	GLCC	Permanent side reflector	Pet. coke + recycle graphite	Coal tar pitch	Extrusion
H-440N ^(a)	GLCC	Core support posts	Petroleum coke	Coal tar pitch	Isostatic molding

(a) Preproduction log.

4. EXPERIMENTAL METHODS

Details of the experimental methods are given in Ref. 1.

Compressive properties were measured in accordance with ASTM C695, "Compressive Crushing Strength of Graphite," 1976 Annual Book of ASTM Standards, Part 17.

5. EXPERIMENTAL RESULTS

5.1. SAMPLING

Commercial graphite logs of the size used for core support posts and core support floor blocks and permanent side reflector blocks have been shown to have nonuniform distributions of properties within a single log and from log to log within a manufactured lot (Refs. 1-6). Therefore, properties and chemical impurity contents were measured as a function of location within each log. Mechanical properties were measured on specimens taken parallel (axial) and perpendicular (radial) to the longitudinal axis of the parent logs and at several locations in each log as shown in Figs. 5-1 through 5-5.

Only one-half of the H-440N and HLM logs was tested, whereas full logs of grades 2020 and PGX were used.

5.2. PROPERTIES

Complete data sets of the graphite properties are given in Appendices A, B, C, and D. The data are presented in summary form in this section.

The following properties were measured on grades 2020, PGX, HLM, and H-440N: (1) bulk density, tensile properties including ultimate tensile strength, strain at fracture, and modulus of elasticity; (2) flexural strength; (3) compressive properties including ultimate compressive strength, strain at fracture, and modulus of elasticity; and (4) chemical impurity content. Thermal expansivity and thermal conductivity data will be reported later.

The physical, mechanical, and chemical property data are presented in Tables 5-1 through 5-13. The various graphite grades being evaluated in

this characterization program are generically similar; i.e., they are manufactured from the same basic raw materials and processes. However, they are different in detail (see Table 3-1). The various grades for each reactor component are manufactured in different sizes and by different manufacturers, and therefore each grade is expected to have unique properties. Gradients within logs were also expected depending upon the raw materials, processing, and log size. Thus, the data are presented as mean values of specimens taken from various regions of each log. A detailed inspection of data in the summary tables will reveal the axial and radial property gradients characteristic of each grade. The data in Tables 5-1 and 5-9 reveal differences in bulk density, strength, and elastic modulus among logs of grade 2020 that were purchased at different times from Stackpole Carbon Company. The data for grades H-440N, PGX, and HLM are confined to a single log.

5.2.1. Grade 2020

The mechanical property data for grade 2020 are given in Tables 5-1, 5-5, and 5-6 and the chemical impurity content data in Table 5-10. The strengths and elastic modulus values varied among the three logs tested. Log 6799-00, purchased in 1974, was significantly stronger than the log purchased in 1976. However, differences in strength along the longitudinal and radial axes were not excessive. The scatter among specimens at a single location in a log was not excessive. A summary of the tensile strength and elastic modulus values for each log is given below:

Log No.	UTS (MPa)		E (GPa)	
	Axial	Radial	Axial	Radial
6484-110	14.9	17.4	7.2	7.8
6484-137	15.5	17.0	8.1	9.4
6799-00	18.0	18.8	--	--

The ash content was higher at the end of log 6484-110 than at the middle by a factor of 1.7 (1900 ppm and 1100 ppm, respectively). This gradient was also reflected in the iron and silicon contents, but was reversed for titanium.

5.2.2. Grade H-440N

The mechanical property data for grade H-440N are given in Tables 5-2, 5-5, and 5-7 and the chemical impurity content data in Table 5-11. The strengths and elastic modulus were higher at the end of the log than at the middle. The overall strength of grade H-440N was only about 75% of the strength of the weakest grade 2020 log.

The ash content of log 6484-81 averaged about 600 ppm, and other impurity elements were relatively low. There were no gradients within the log. Grade H-440N is much purer than grade 2020, approaching but not equaling highly purified fuel element graphites (Ref. 1).

5.2.3. Grade PGX

Mechanical property data for grade PGX are given in Tables 5-3, 5-5, and 5-8 and chemical impurity content data in Table 5-12. Strength and elastic moduli were quite uniform along the longitudinal and radial axes of log 6484-112, with the bottom of the log slightly weaker than the top and middle. A summary of the mean tensile strength and elastic modulus values for each slab is given below:

Slab	UTS (MPa)		E (GPa)	
	Axial	Radial	Axial	Radial
End-1	11.0	10.2	6.3	6.9
Middle-6	10.8	10.2	6.4	7.4
Bottom-12	9.2	8.6	6.1	7.1

The ash content was high, ranging from about 800 to 11,000 ppm. Other impurity elements, such as iron, calcium, and sulfur, were also high. The middle region of the log was purer than the top or bottom.

5.3.4. Grade HLM

Mechanical property data for grade HLM are given in Tables 5-4, 5-5, and 5-9 and the chemical impurity content data in Table 5-13. The axial tensile strengths and modulus values and the axial flexural strengths were highest at the edge of the log, whereas the radial strength and modulus values and the compressive properties were more uniform. A summary of the mean tensile strength and modulus values for each slab is given below:

Slab	UTS (MPa)		E (GPa)	
	Axial	Radial	Axial	Radial
End-1	10.3	11.9	7.1	6.2
Middle-6	9.8	11.0	7.1	6.3

The ash content of grade HLM ranged from about 700 to 4900 ppm. The iron content was relatively high, being somewhat higher at the end of the log than in the middle.

TABLE 5-1
BULK DENSITY, ULTIMATE TENSILE STRENGTH, AND MODULUS OF ELASTICITY OF GRADE 2020

Log Number	Lot No.	Date Received	Location in Log	Orientation of Specimens	Mean Density (Mg/m ³)			Mean Tensile Strength (MPa)			Mean Elastic Modulus (GPa)		
					$\bar{\rho}$	σ	N(a)	$\bar{S}$	σ	N(a)	$\bar{E}$	σ	N(a)
6484-110 ↓	728 ↓	May 1976 ↓	End slab 1(b) }	Axial	1.787	0.006	12	14.1	1.9	36	7.3	0.2	12
				Radial	1.789	0.002	8	15.8	1.4	20	7.9	0.2	8
			Middle slab 6 }	Axial	1.790	0.009	12	15.8	2.4	36	7.1	0.2	12
				Radial	1.796	0.002	8	18.9	1.5	20	7.6	0.1	8
6484-137 ↓	-- ↓	Oct. 1974 ↓	Middle slab 1(c) }	Axial	--	--	--	15.5	1.2	10	8.1	0.1	4
				Radial	--	--	--	16.4	1.5	10	9.3	0.1	4
				Tangential	--	--	--	20.2	1.6	10	9.5	0.2	4
			Middle slab 2 }	Radial	--	--	--	17.6	2.0	10	9.5	0.1	4
				Tangential	--	--	--	14.6	1.4	10	10.1	0.2	4
6799-00 ↓	-- ↓	Dec. 1974 ↓	End slab 1(d) }	Axial	1.784	0.004	8	18.5	1.1	8	--	--	--
				Radial	1.780	0.003	8	18.8	1.7	8	--	--	--
			Middle slab 3 }	Axial	1.789	0.002	8	17.4	0.6	8	--	--	--
				Radial	1.783	0.003	8	18.6	1.1	8	--	--	--
			End slab 5 }	Axial	1.799	0.005	8	18.2	1.2	8	--	--	--
				Radial	1.805	0.004	8	19.1	1.1	8	--	--	--

(a) N = number of replicates tested.

(b) See Fig. 5-1 for location in log.

(c) See Fig. 5-2 for location in log.

(d) See Fig. 5-3 for location in log.

TABLE 5-2
BULK DENSITY, ULTIMATE TENSILE STRENGTH, AND MODULUS OF ELASTICITY OF
GRADE H-440N, LOG 6484-81

Location in Log ^(a)	Orientation of Specimens	Mean Density (Mg/m ³)			Mean Tensile Strength (MPa)			Mean Elastic Modulus (GPa)		
		$\bar{\rho}$	σ	N ^(b)	$\bar{S}$	σ	N ^(b)	$\bar{E}$	σ	N ^(b)
End slab 1	Axial	1.746	0.004	12	11.2	1.5	34	7.1	0.3	12
End slab 1	Radial	1.740	0.007	8	13.1	1.1	20	8.0	0.7	8
Middle slab 6	Axial	1.706	0.029	12	10.9	1.3	34	6.0	1.0	12
Middle slab 6	Radial	1.700	0.018	8	10.4	1.3	20	7.0	0.8	8

(a) See Figs. 5-4 and 5-1(b) for location in log.

(b) N = number of replicates tested.

TABLE 5-3
BULK DENSITY, ULTIMATE TENSILE STRENGTH, AND MODULUS OF ELASTICITY OF
GRADE PGX, LOG 6484-112, LOT 8D5-3

Location in Log ^(a)		Orientation of Specimens	Mean Density (Mg/m ³)			Mean Tensile Strength (MPa)			Mean Elastic Modulus (GPa)		
Slab	Section		$\bar{\rho}$	σ	N ^(b)	$\bar{S}$	σ	N ^(b)	$\bar{E}$	σ	N ^(b)
End-1 ↓	AC-BC	Axial	1.781	0.005	8	10.5	2.0	24	6.5	0.3	7
	AC-BC	Radial	1.776	0.006	8	9.6	0.7	20	6.7	0.2	8
	AY-BY	Axial	1.774	0.003	8	11.1	0.5	24	6.2	0.2	8
	AY-BY	Radial	1.774	0.002	8	10.2	0.8	20	6.8	0.3	8
	AE-BE	Axial	1.790	0.016	8	11.4	0.6	24	6.3	0.2	8
	AE-BE	Radial	1.790	0.002	8	10.9	0.6	20	7.2	0.2	8
Middle-6 ↓	AC-BC	Axial	1.779	0.008	8	10.0	0.7	24	6.2	0.2	8
	AC-BC	Radial	1.778	0.005	8	9.2	0.8	20	7.1	0.2	8
	AY-BY	Axial	1.780	0.003	8	10.9	0.7	24	6.5	0.2	8
	AY-BY	Radial	1.783	0.004	8	10.3	0.7	20	7.3	0.2	8
	AE-BE	Axial	1.790	0.004	8	11.4	0.6	24	6.6	0.1	8
	AE-BE	Radial	1.791	0.002	8	11.0	0.9	20	7.7	0.2	8
Bottom-12 ↓	AC-BC	Axial	1.783	0.009	8	9.1	0.9	24	6.2	0.5	8
	AC-BC	Radial	1.777	0.004	8	8.9	1.1	20	7.4	0.3	8
	AY-BY	Axial	1.773	0.005	8	9.1	0.6	24	6.0	0.2	8
	AY-BY	Radial	1.777	0.005	8	8.1	1.4	20	6.9	0.2	8
	AE-BE	Axial	1.780	0.010	8	9.4	0.7	24	6.1	0.2	8
	AE-BE	Radial	1.775	0.003	8	8.8	0.9	20	6.9	0.3	8

(a) See Fig. 5-5 for location in log.

(b) N = number of replicates tested.

TABLE 5-4
BULK DENSITY, ULTIMATE TENSILE STRENGTH, AND MODULUS OF ELASTICITY
OF GRADE HLM, LOG 6484-78, LOT 367

Location in Log ^(a)		Orientation of Specimens	Mean Density (Mg/m ³)			Mean Tensile Strength (MPa)			Mean Elastic Modulus (GPa)		
Slab	Section		$\bar{\rho}$	σ	N ^(b)	$\bar{S}$	σ	N ^(b)	$\bar{E}$	σ	N ^(b)
End-1 ↓	AC-BC	Axial	1.784	0.008	8	7.8	2.1	24	6.9	0.1	3
	AC-BC	Radial	1.780	0.007	8	11.9	1.8	20	6.6	0.3	7
	AY-BY	Axial	1.774	0.008	8	9.4	1.0	24	7.0	0.3	7
	AY-BY	Radial	1.774	0.007	8	12.0	0.7	20	6.2	0.2	8
	AE-BE	Axial	1.772	0.009	8	13.8	1.2	24	7.4	0.6	8
	AE-BE	Radial	1.771	0.008	8	11.9	1.1	20	5.8	0.4	7
Middle-6 ↓	AC-BC	Axial	1.796	0.006	8	6.8	1.0	24	6.5	0.5	5
	AC-BC	Radial	1.796	0.003	8	9.9	1.3	20	6.6	0.2	8
	AY-BY	Axial	1.798	0.005	8	9.3	2.2	24	7.2	0.8	4
	AY-BY	Radial	1.795	0.006	8	10.6	1.7	20	6.2	0.4	7
	AE-BE	Axial	1.794	0.004	8	13.3	1.8	24	7.7	0.5	8
	AE-BE	Radial	1.794	0.006	8	12.4	0.8	20	6.1	0.3	8

(a) See Fig. 5-5 for location in log.

(b) N = number of replicates tested.

TABLE 5-5
FLEXURAL STRENGTH OF GRADES 2020, H-440N, PGX, AND HLM

Graphite Grade	Log No.	Lot No.	Location in Log		Orientation of Specimens	Mean Flexural Strength (MPa)		
			Slab	Radial Section		$\bar{S}$	σ	N(a)
2020	6484-110	728	End-1	-- (b)	Axial	25.0	2.4	42
↓	↓	↓	End-1		Radial	27.4	0.9	20
↓	↓	↓	Middle-6	--	Axial	25.2	0.8	42
↓	↓	↓	Middle-6		Radial	27.2	0.8	20
H-440N	6484-81	--	End-1	-- (c)	Axial	20.5	1.1	42
↓	↓	--	End-1		Radial	21.8	1.4	20
↓	↓	--	Middle-6	--	Axial	18.5	1.8	42
↓	↓	--	Middle-6		Radial	20.1	1.6	20
PGX	6484-112	8D5-3	End-1	AC-BC (d)	Axial	15.8	1.2	24
↓	↓	↓	End-1	AC-BC (d)	Radial	15.1	1.8	20
↓	↓	↓	End-1	AY-BY	Axial	16.1	1.0	20
↓	↓	↓	End-1	AY-BY	Radial	15.5	1.8	20
↓	↓	↓	End-1	AE-BE	Axial	16.0	0.9	20
↓	↓	↓	End-1	AE-BE	Radial	16.6	1.2	20
PGX	6484-112	8D5-3	Middle-6	AC-BC	Axial	15.3	0.9	24
↓	↓	↓	Middle-6	AC-BC	Radial	14.3	2.2	20
↓	↓	↓	Middle-6	AY-BY	Axial	15.9	0.8	20
↓	↓	↓	Middle-6	AY-BY	Radial	15.7	1.5	20
↓	↓	↓	Middle-6	AE-BE	Axial	16.8	0.8	20
↓	↓	↓	Middle-6	AE-BE	Radial	17.1	1.6	20
PGX	6484-112	8D5-3	End-12	AC-BC	Axial	14.1	1.3	24
↓	↓	↓	End-12	AC-BC	Radial	14.1	1.7	20
↓	↓	↓	End-12	AY-BY	Axial	13.3	1.0	20
↓	↓	↓	End-12	AY-BY	Radial	13.9	1.1	20
↓	↓	↓	End-12	AE-BE	Axial	14.3	1.1	20
↓	↓	↓	End-12	AE-BE	Radial	13.5	1.9	20
HLM	6484-78	367	End-1	AC-BC (d)	Axial	16.3	1.9	24
↓	↓	↓	End-1	AC-BC (d)	Radial	17.9	1.7	20
↓	↓	↓	End-1	AY-BY	Axial	16.9	1.8	20
↓	↓	↓	End-1	AY-BY	Radial	17.7	1.6	20
↓	↓	↓	End-1	AE-BE	Axial	20.8	1.5	20
↓	↓	↓	End-1	AE-BE	Radial	16.6	1.4	20
HLM	6484-78	367	Middle-6	AC-BC	Axial	13.8	2.6	24
↓	↓	↓	Middle-6	AC-BC	Radial	17.5	2.1	20
↓	↓	↓	Middle-6	AY-BY	Axial	18.0	1.7	20
↓	↓	↓	Middle-6	AY-BY	Radial	17.4	1.7	20
↓	↓	↓	Middle-6	AE-BE	Axial	20.8	1.4	20
↓	↓	↓	Middle-6	AE-BE	Radial	17.9	1.3	20

(a) N = number of replicates tested.

(b) See Fig. 5-1 for location in log.

(c) See Figs. 5-4 and 5-1 for location in log.

(d) See Fig. 5-5 for location in log.

TABLE 5-6
ULTIMATE COMPRESSIVE STRENGTH AND MODULUS OF ELASTICITY OF GRADE 2020

Log Number	Lot No.	Location in Log ^(a)	Orientation of Specimens	Mean Compressive Strength (MPa)			Mean Elastic Modulus (GPa)		
				$\bar{S}$	σ	N ^(b)	$\bar{E}$	σ	N ^(b)
6484-110	728	Slab 2	Axial	78.6	3.1	4	10.0	0.6	4
6410-110	728	Slab 2	Radial	78.5	1.5	4	9.9	0.9	4
6484-137	--	Middle slab 1	Axial	75.5	1.9	10	8.7	0.3	9
↓	--	Middle slab 1	Radial	74.3	1.5	10	9.4	0.6	10
	--	Middle slab 1	Tangential	74.2	2.0	10	9.5	0.5	10
	--	Middle slab 2	Radial	77.0	1.9	10	10.1	0.5	10
	--	Middle slab 2	Tangential	79.5	2.0	10	10.0	0.5	10
6799-00	--	End slab 1	Axial	84.0	2.5	8	--	--	--
↓	--	End slab 1	Radial	82.0	2.2	8	--	--	--
	--	Middle slab 3	Axial	80.0	1.6	8	--	--	--
	--	Middle slab 3	Radial	81.2	2.7	8	--	--	--
	--	End slab 5	Axial	85.4	3.0	8	--	--	--
	--	End slab 5	Radial	88.9	4.1	8	--	--	--

(a) See Fig. 5-1 for location in log.

(b) N = number of replicates tested.

TABLE 5-7
 ULTIMATE COMPRESSIVE STRENGTH AND MODULUS OF ELASTICITY OF
 GRADE H-440N, LOG 6484-81

Location in Log (a)	Orientation of Specimens	Mean Compressive Strength (MPa) (b)		Mean Modulus of Elasticity (GPa) (b)	
		$\bar{S}$	σ	$\bar{E}$	σ
End slab 1	Axial	52.2	2.9	5.7	0.4
End slab 1	Radial	49.9	2.3	7.2	0.4
Middle slab 6	Axial	49.7	5.2	5.2	0.9
Middle slab 6	Radial	40.3	1.6	5.2	0.5

(a) See Figs. 5-4 and 5-1(b) for location in log.

(b) Number of replicates tested = 8.

TABLE 5-8
ULTIMATE COMPRESSIVE STRENGTH AND MODULUS OF ELASTICITY OF
GRADE PGX, LOG 6484-112, LOT 85D-3

Location in Log ^(a)		Orientation of Specimens	Mean Compressive Strength (MPa) ^(b)		Mean Elastic Modulus (GPa) ^(b)	
Slab	Section		$\bar{S}$	σ	$\bar{E}$	σ
End-1 ↓	AC-BC	Axial	44.7	0.9	5.6	0.2
	AC-BC	Radial	42.2	2.7	5.4	0.3
	AY-BY	Axial	43.9	2.8	5.2	0.3
	AY-BY	Radial	41.1	2.8	5.3	0.5
	AE-BE	Axial	45.7	1.6	5.4	0.3
	AE-BE	Radial	42.5	1.5	5.4	0.3
Middle-6 ↓	AC-BC	Axial	41.7	2.2	5.0	0.3
	AC-BC	Radial	40.2	2.2	6.0	0.7
	AY-BY	Axial	44.8	2.0	5.9	0.3
	AY-BY	Radial	41.8	1.5	6.4	0.1
	AE-BE	Axial	45.5	1.9	5.4	0.1
	AE-BE	Radial	43.3	1.7	5.5	0.4
End-12 ↓	AC-BC	Axial	41.7	0.8	4.9	0.2
	AC-BC	Radial	40.2	1.4	5.8	0.4
	AY-BY	Axial	40.3	1.9	4.5	0.2
	AY-BY	Radial	39.1	1.1	5.5	0.3
	AE-BE	Axial	40.7	2.1	4.7	0.2
	AE-BE	Radial	38.3	1.8	5.3	0.1

(a) See Fig. 5-5 for location in log.

(b) Number of replicates tested = 8.

TABLE 5-9
ULTIMATE COMPRESSIVE STRENGTH AND MODULUS OF ELASTICITY OF
GRADE HLM, LOG 6484-78, LOT 367

Location in Log ^(a)		Orientation of Specimens	Mean Compressive Strength (MPa) (b)		Mean Elastic Modulus (GPa) (b)	
Slab	Section		$\bar{S}$	σ	$\bar{E}$	σ
End-1 ↓	AC-BC	Axial	38.1	0.9	5.1	0.4
	AC-BC	Radial	43.0	1.1	5.9	0.3
	AY-BY	Axial	35.0	1.5	5.0	0.6
	AY-BY	Radial	41.0	1.8	5.7	0.4
	AE-BE	Axial	39.8	1.5	6.7	0.3
	AE-BE	Radial	41.6	2.4	5.3	0.3
Middle-6 ↓	AC-BC	Axial	35.3	2.2	5.3	0.6
	AC-BC	Radial	40.5	1.6	5.9	0.4
	AY-BY	Axial	45.4	3.1	5.7	0.8
	AY-BY	Radial	42.6	1.5	5.8	0.4
	AE-BE	Axial	41.1	1.8	7.1	0.7
	AE-BE	Radial	44.7	1.0	5.9	0.2

(a) See Fig. 5-5 for location in log.

(b) Number of replicates tested = 8.

TABLE 5-10
DISTRIBUTION OF IMPURITY CONTENT WITHIN GRADE 2020, LOG 6484-110, LOT 728

Sample Number	Location in Log ^(a)		Element (ppm)																		
	Slab	Radial Location	Ash	S	Al	B	Ba	Ca	Cu	Fe	K	Li	Mg	Mn	Na	Ni	Pb	Si	Sr	Ti	V
L16B	End-1	Edge	2000	23	60	4	40	600	<1	400	80	<1	4	2	10	<4	<6	200	40	40	20
L28B	End-1	Edge	1900	13	60	2	40	600	<1	400	60	<1	2	1	10	<4	<6	200	<40	20	10
L64B	Middle-6	Edge	1100	11	20	4	40	400	<1	20	20	<1	4	<1	10	<4	<6	20	<40	100	20
L76B	Middle-6	Edge	1200	12	60	4	20	400	<1	60	60	8	4	<1	20	<4	<6	100	<40	100	20

(a) See Fig. 5-1 for location in log.

TABLE 5-11
DISTRIBUTION OF IMPURITY CONTENT WITHIN GRADE H-440N, LOG 6484-81

Sample Number	Location in Log(a)		Circumferential Location (rad)	Element (ppm)																		
	Slab	Radial		Ash	S	Al	B	Ba	Ca	Cu	Fe	K	Li	Mg	Mn	Na	Ni	Pb	Si	Sr	Ti	V
L2	(b)	Edge	0	590	104	<1	2	20	60	<1	10	10	<0.5	4	<1	<40	<4	<6	80	<40	40	60
L3	(b)	Edge	0.78	680	114	<1	2	20	60	<1	8	6	<0.5	1	<1	<40	<4	<6	80	<40	20	40
L21	(b)	Edge	2.36	680	9	<1	2	20	60	<1	10	8	<0.5	10	<1	<40	<4	<6	80	<40	20	20
L16	(b)	Edge	3.14	660	5	<1	2	20	60	<1	10	6	<0.5	10	<1	<40	<4	<6	80	<40	20	20
L40	(b)	Edge	3.14	620	11	<1	2	20	60	<1	20	8	<0.5	10	<1	<40	<4	<6	80	<40	40	20
L39	(b)	Edge	3.92	620	<2	<1	2	8	60	<1	<20	10	<0.5	10	<1	<40	<4	<6	80	<40	20	40
L57	(b)	Edge	5.49	550	<2	<1	2	10	60	<1	10	6	<0.5	2	<1	<40	<4	<6	80	<40	20	20
L10	(b)	Center	--	700	20	<1	2	20	60	<1	10	6	<0.5	10	<1	<40	<4	<6	80	<40	20	40
L52	(c)	Edge	0	520	4	<1	2	20	60	<1	10	6	<0.5	20	<1	<40	<4	<6	80	<40	20	10
L76	(c)	Edge	0	520	<2	<1	2	10	60	<1	20	4	<0.5	10	<1	<40	<4	<6	80	<40	40	40
L75	(c)	Edge	0.78	590	<3	<1	2	10	60	<1	10	4	<0.5	20	<1	<40	<4	<6	80	<40	20	40
L93	(c)	Edge	2.36	610	12	<1	2	10	60	<1	10	4	<0.5	10	<1	<40	<4	<6	80	<40	40	40
L64	(c)	Edge	3.14	500	<4	<1	2	10	60	<1	10	8	<0.5	20	<1	<40	<4	<6	80	<40	20	10
L88	(c)	Edge	3.14	580	11	<1	2	10	60	<1	20	8	<0.5	10	<1	<40	<4	<6	80	<40	40	40
L111	(c)	Edge	3.92	570	<2	<1	2	10	60	<1	20	8	<0.5	10	<1	<40	<4	<6	80	<40	40	40
L129	(c)	Edge	5.49	540	13	<1	2	10	40	<1	20	8	<0.5	20	<1	<40	<4	<6	80	<40	40	40
L82	(c)	Center	--	630	14	<1	2	10	60	<1	10	<4	<0.5	10	<1	<40	<4	<6	80	<40	10	20
L58	(c)	Center	--	570	12	<1	2	10	60	<1	20	6	<0.5	10	<1	<40	<4	<6	80	<40	20	20

(a) See Figs. 5-4 and 5-1(b) for location in log.

(b) End-1.

(c) Middle-6.

TABLE 5-12
DISTRIBUTION OF IMPURITY CONTENT WITHIN GRADE PGX, LOG 6484-112, LOT 8D5-3

Sample Number	Location in Log ^(a)		Element (ppm)																		
	Slab	Radial Location	Ash	S	Al	B	Ba	Ca	Cu	Fe	K	Li	Mg	Mn	Na	Ni	Pb	Si	Sr	Ti	V
E70B	Top-1	E-A	6740	110	80	2	40	80	10	1000	10	1	1	10	<10	20	<6	100	<40	40	10
E40B	Top-1	EC-A	6890	355	80	2	40	80	10	1000	60	6	10	10	10	20	<6	40	<40	20	10
E16B	Top-1	C-A	7600	540	100	2	40	100	10	>1000	20	2	40	40	<10	40	<6	40	<40	40	20
E88B	Top-1	C-B	6800	570	80	2	40	80	10	1000	20	6	40	20	20	20	<6	20	<40	40	20
E124B	Top-1	EC-B	7440	430	80	2	40	80	20	1000	20	2	10	20	<10	20	<6	80	<40	40	20
E154B	Top-1	E-B	7160	1005	100	2	60	>1000	8	600	<10	<1	6	1	<10	<4	<6	80	<40	40	20
M70B	Middle-6	E-A	5310	150	80	2	40	8	10	1000	80	2	8	10	20	20	<6	60	<40	80	40
M40B	Middle-6	EC-A	8070	310	80	2	40	100	10	1000	20	2	2	10	10	20	<6	80	<40	40	20
M16B	Middle-6	C-A	7010	325	100	2	40	80	10	>1000	20	1	10	40	<10	20	<6	40	<40	40	20
M100B	Middle-6	C-B	2779	430	80	2	40	200	20	>1000	<10	2	20	40	<10	20	<6	40	<40	40	20
M122B	Middle-6	EC-B	893	455	100	2	40	>1000	10	>1000	10	2	1	40	<10	20	<6	100	<40	40	20
M152B	Middle-6	E-B	880	125	80	<0.5	40	60	6	40	10	<1	<0.5	<1	<10	<4	<6	40	<40	40	4
B70B	Bottom-12	E-A	11070	720	200	2	60	>1000	20	>1000	20	1	4	40	<10	20	<6	400	<40	40	40
B40B	Bottom-12	EC-A	10440	610	60	2	40	200	20	>1000	10	2	10	40	<10	20	<6	80	<40	40	20
B4B	Bottom-12	C-A	7150	875	60	2	40	200	20	>1000	10	2	40	40	<10	20	<6	20	<40	40	20
B88B	Bottom-12	C-B	7270	1096	100	2	40	100	20	>1000	40	2	60	60	10	20	<6	40	<40	40	20
B124B	Bottom-12	EC-B	845	695	80	2	40	80	20	>1000	40	1	20	40	10	20	<6	60	<40	40	20
B154B	Bottom-12	E-B	6990	945	80	2	40	>1000	20	>1000	60	1	10	40	<10	20	<6	60	<40	40	20

(a) See Fig. 5-5 for location in log.

TABLE 5-13
DISTRIBUTION OF IMPURITY CONTENT WITHIN GRADE HLM, LOG 6484-78, LOT 367

Sample Number	Location in Log ^(a)		Element (ppm)																		
	Slab	Radial Location	Ash	S	Al	B	Ba	Ca	Cu	Fe	K	Li	Mg	Mn	Na	Ni	Pb	Si	Sr	Ti	V
E70B	Top-1	E-A	2400	176	60	2	60	400	<1	1000	20	<1	2	<1	10	20	<6	100	<40	60	60
E40B	Top-1	EC-A	4900	<4	60	2	40	200	<1	>1000	10	1	6	4	10	40	<6	80	<40	40	40
E16B	Top-1	C-A	4500	<4	80	20	40	200	<1	>1000	10	<1	2	4	10	40	<6	60	<40	40	40
E88B	Top-1	C-B	4600	58	40	2	40	200	<1	>1000	60	2	4	4	40	40	<6	60	<40	40	40
E124B	Top-1	EC-B	4500	18	20	2	40	200	<1	>1000	<10	1	2	4	<10	40	<6	60	<40	40	60
E154B	Top-1	E-B	1200	16	<1	2	40	100	<1	800	<10	<1	4	<1	<10	10	<6	80	<40	40	20
M70B	Middle-6	E-A	670	45	<1	2	40	80	<1	100	10	2	2	<1	<10	<4	<6	60	<40	20	10
M40B	Middle-6	EC-A	1900	<4	60	2	40	200	<1	800	<10	1	4	2	<10	20	<6	100	<40	40	40
M16B	Middle-6	C-A	1000	<4	80	2	40	100	<1	>1000	<10	6	4	100	<10	>1000	<6	200	<40	80	20
M100B	Middle-6	C-B	1100	23	40	2	20	100	<1	100	<10	1	4	20	<10	200	<6	80	<40	20	20
M122B	Middle-6	EC-B	1100	22	100	2	40	100	<1	400	10	1	2	<1	<10	10	<6	80	<40	20	20
M152B	Middle-6	E-B	900	9	<1	2	40	80	<1	80	<10	<1	2	<1	<10	10	<6	80	<40	20	20

(a) See Fig. 5-5 for location in log.

Fig. 5-1(a). Slab diagram for core support post graphite grade 2020,
log 6484-110

Fig. 5-1(b). Core sampling plan of a slab of grade 2020, log 6484-110

Fig. 5-2(a). Slab diagram for core support post graphite grade 2020 (fracture piece taken for test, log 6484-137)

SLAB 1
6484-137-1

Fig. 5-2(b). Core sampling and specimen orientation of grade 2020, log 6484-137; axial, radial, and tangential specimens parallel to flex

Fig. 5-2(c). Core sampling and specimen orientation of grade 2020, log 6484-137; radial and tangential specimens perpendicular to flex

Fig. 5-3(a). Slab diagram for core support post graphite grade 2020, log 6799-00

Fig. 5-3(b). Core sampling plan of slab 1 of grade 2020, log 6799-00; axial (core sampling of slabs 3 and 5 was the same as for slab 1)

Fig. 5-3(c). Core sampling plan of slab 1 of grade 2020, log 6799-00; radial (core sampling of slabs 3 and 5 was the same as for slab 1)

Fig. 5-4. Slab diagram for core support post graphite preproduction grade H-440N

Fig. 5-5(a). Slab diagram for core support floor block and permanent side reflector block graphites (PGX, log 6484-112, or HLM, log 6484-78)

Fig. 5-5(b). Sectioning of core support floor block and permanent side reflector block graphites (PGX, log 6484-112, or HLM, log 6484-78)

Fig. 5-5(c). Center section: AC

Fig. 5-5(d). Middle section: AY

Fig. 5-5(e). Edge section: AE

6. CONCLUSIONS

Three grades of commercially available candidate graphites -- 2020 for core support posts, PGX for core support floor blocks, and HLM for permanent side reflectors -- have undergone preliminary characterization tests to determine their mechanical properties and chemical impurity contents. An additional experimental grade, H-440N, was also evaluated as a candidate for core support posts. The data were collected in a systematic pattern that revealed property and impurity gradients within the individual logs. As expected, each grade was different with respect to properties and gradients. The data assembled in this report will serve as a portion of the data base required to select reference grades for LHTGR components. Other properties, such as thermal expansivity, thermal conductivity, oxidation resistance, fatigue, and irradiation behavior, which are not reported here will also be considered in the overall evaluation of these graphites. However, the data sets reported here will be analyzed and used initially to determine tentative design configurations and to calculate allowable stress margins.

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APPENDIX A
GRADE 2020 DATA

This appendix contains complete data sets for the bulk density, tensile properties, flexural strength, compressive properties, and chemical impurity content of grade 2020 graphite.

TABLE A-1
TENSILE PROPERTIES OF 2020 GRAPHITE

LOT NO. 728 SPEC. DIA. 12.8 MM
LOG NO. 6484-110 SPEC. LENGTH 70. MM
LOG DENSITY 1.803 MG/CM**3

SPECIMEN NUMBER	ORIENT- ATION	LICA- TIO	DENSITY (KG/CM**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
1A=L6A	AX	END	1.787	7.3	.012	.242	15.2
=L6A	AX	END	1.781	7.3	.015	.231	14.1
=L10A	AX	END	1.776	7.1	.015	.175	10.7
=L14A	AX	END	1.792	7.4	.012	.198	12.6
=L20A	AX	END	1.784	7.3	.015	.207	12.5
=L22A	AX	END	1.783	7.0	.010	.176	11.3
1A=L30A	AX	END	1.791	7.9	.010	.157	11.0
=L34A	AX	END	1.784	7.5	.012	.179	11.7
=L38A	AX	END	1.782	7.3	.011	.219	13.9
=L38A	AX	END	1.793	7.3	.011	.228	14.0
=L44A	AX	END	1.795	7.4	.010	.214	13.7
=L46A	AX	END	1.792	7.4	.012	.236	15.0
1A=L6H	AX	END					13.0
=L8H	AX	END					16.7
=L12A	AX	END					14.4
=L12H	AX	END					14.0
=L14H	AX	END					14.6
=L18A	AX	END					14.5
=L18H	AX	END					15.6
=L20H	AX	END					14.4
=L22A	AX	END					12.1
=L24A	AX	END					15.7
=L24H	AX	END					14.7
1A=L30H	AX	END					12.4
=L32A	AX	END					11.6
=L32H	AX	END					13.7
=L36A	AX	END					15.3
=L38H	AX	END					15.8
=L42A	AX	END					13.7
=L42H	AX	END					15.5
=L44H	AX	END					17.2
=L46A	AX	END					14.4
=L48A	AX	END					16.4
=L48H	AX	END					19.7

MEAN			1.787	7.3	.012	.205	14.1
				(1.06 MPa)			(2051 PSI)

STD. DEV.			.006	.2	.002	.028	1.9
				(.03 MPa)			(279 PSI)

TABLE A-1 (Continued)

.....								
LOT NO. 728			SPEC. DIA.			12.8 MM		
LOG NO. 6484-110			SPEC. LENGTH			70. MM		
LOG DENSITY 1.803			MG/M**3					
.....								
SPECIMEN	ORIENT	LOCA	DENSITY	YOUNGS	PERM	FRAC	TENSILE	
NUMBER	ATION	TION	(KG/M**3)	MODULUS	ANENT	TURE	STRENGTH	
				(GPA)	SET	STRAIN	(MPA)	
					(PCT)	(PCT)		
.....								
1A-	L7	RAD	END	1.786	7.7	.010	.238	15.7
-	L11	RAD	END	1.788	7.5	.013	.241	15.6
-	L25	RAD	END	1.788	8.1	.010	.241	16.2
-	L29	RAD	END	1.789	8.0	.010	.184	13.6
1B-	L43	RAD	END	1.791	7.8	.010	.235	16.1
-	L47	RAD	END	1.789	8.0	.007	.214	15.1
1B-	L61	RAD	END	1.792	8.0	.008	.260	17.8
-	L65	RAD	END	1.791	8.0	.011	.269	18.0
1A-	L5	RAD	END					16.1
-	L9	RAD	END					17.0
1A-	L13	RAD	END					15.3
-	L23	RAD	END					16.8
-	L27	RAD	END					17.1
-	L31	RAD	END					13.1
1B-	L41	RAD	END					12.7
-	L45	RAD	END					15.7
-	L49	RAD	END					17.2
1B-	L59	RAD	END					15.4
-	L63	RAD	END					16.9
-	L67	RAD	END					15.1
.....								
MEAN			1.789	7.9	.010	.235	15.8	
			(1.15 MPa)				(2295 PSI)	
.....								
STD. DEV.			.002	.2	.002	.026	1.4	
			(.03 MPa)				(210 PSI)	
.....								

TABLE A-1 (Continued)

LOT NO. 728 SPEC. DIA. 12.8 MM
 LOG NO. 6484-110 SPEC. LENGTH 70. MM
 LOG DENSITY 1.803 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (KG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
6A-L54A	AX	ML	1.795	7.0	.014	.206	12.7
-L56A	AX	ML	1.779	6.9	.010	.239	14.1
-L58A	AX	ML	1.775	6.8	.011	.260	15.1
-L62A	AX	ML	1.794	7.2	.013	.204	12.9
-L68A	AX	ML	1.793	7.2	.010	.209	13.0
-L70A	AX	ML	1.792	7.2	.010	.236	14.8
6B-L78A	AX	ML	1.795	7.4	.014	.226	14.3
-L82A	AX	ML	1.781	6.8	.012	.239	14.2
-L84A	AX	ML	1.781	6.9	.010	.217	13.3
-L86A	AX	ML	1.794	7.4	.012	.145	9.7
-L92A	AX	ML	1.803	7.2	.010	.250	15.2
-L94A	AX	ML	1.798	7.3	.011	.224	14.1
6A-L50A	AX	ML					13.5
-L50A	AX	ML					17.0
-L54A	AX	ML					15.5
-L56A	AX	ML					13.0
-L60A	AX	ML					17.4
-L60A	AX	ML					17.6
-L66A	AX	ML					15.4
-L66A	AX	ML					18.3
-L68A	AX	ML					16.6
-L70A	AX	ML					15.4
-L72A	AX	ML					18.9
-L72A	AX	ML					19.2
6B-L74A	AX	ML					18.3
-L74A	AX	ML					20.2
-L78A	AX	ML					16.1
-L80A	AX	ML					17.1
-L80A	AX	ML					18.4
-L84A	AX	ML					14.2
-L86A	AX	ML					15.4
-L90A	AX	ML					17.2
-L90A	AX	ML					19.1
-L92A	AX	ML					12.3
-L94A	AX	ML					19.6
-L96A	AX	ML					16.5
-L96A	AX	ML					18.1
MEAN			1.790	7.1 (1.03 MPsi)	.011	.221	15.8 (2288 PSI)
STD. DEV.			.009	.2 (.03 MPsi)	.002	.030	2.4 (354 PSI)

TABLE A-1 (Continued)

LOT NO. 728 SPEC. DIA. 12.8 mm
 LOG NO. 6481-110 SPEC. LENGTH 70. mm
 LOG DENSITY 1.793 MG/CM³

SPECIMEN NUMBER	ORIENT- ATION	TYPE	DENSITY (MG/CM ³)	YOUNG'S MODULUS (GPA)	PERME- ABENT SEI (PGI)	FRAC- TURE STRAIN (PGI)	TENSILE STRENGTH (MPA)
6A=L79	RAD	ML	1.795	7.6	.011	.254	16.5
= L83	RAD	ML	1.793	7.4	.012	.300	18.6
= L97	RAD	ML	1.795	7.5	.014	.284	18.0
6A=L101	RAD	ML	1.794	7.5	.011	.301	19.2
6H=L115	RAD	ML	1.796	7.6	.011	.285	18.2
=L119	RAD	ML	1.797	7.5	.012	.274	17.5
=L133	RAD	ML	1.799	7.8	.012	.256	16.9
=L137	RAD	ML	1.796	7.6	.015	.271	17.2
6A=L77	RAD	ML					18.5
= L81	RAD	ML					19.2
= L85	RAD	ML					18.2
6A=L95	RAD	ML					21.0
= L99	RAD	ML					18.8
=L103	RAD	ML					19.1
6H=L113	RAD	ML					20.3
=L117	RAD	ML					17.2
6H=L121	RAD	ML					21.5
=L131	RAD	ML					20.7
=L135	RAD	ML					21.5
=L139	RAD	ML					19.7
MEAN			1.796	7.6 (1.10 MPsi)	.012	.278	18.9 (2735, PSI)
STD. DEV.			.002	.1 (.02 MPsi)	.001	.018	1.5 (214, PSI)

TABLE A-2
TENSILE PROPERTIES OF 2020 GRAPHITE

LOT NO. --			SPEC. DIA.		12.8 MM		
LOG NO. 6484-137			SPEC. LENGTH		70. MM		
LOG DENSITY --			MG/M**3				

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)

SLAB 1	- 2 AX	ML		8.3	.001		13.6
	- 4 AX	ML		8.1	.001		15.8
	- 6 AX	ML		8.0	.004		16.6
	- 8 AX	ML		8.0	.004		17.2
	-10 AX	ML					15.8
	-12 AX	ML					14.8
	-14 AX	ML					15.4
	-16 AX	ML					15.1
	-18 AX	ML					14.0
	-20 AX	ML					17.1

MEAN				8.1	.003		15.5
				(1.18 MPSI)			(2251.PSI)

STD. DEV.				.1	.002		1.2
				(.02 MPSI)			(174.PSI)

TABLE A-2 (Continued)

LOT NO. --		SPEC. DIA.		12.8 MM			
LOG NO. 6484-137		SPEC. LENGTH		70. MM			
LOG DENSITY --		MG/M**3					

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)

- 1 RAD	ML			9.1	.003		15.8
- 3 RAD	ML			9.4	.004		15.1
- 5 RAD	ML			9.4	.002		14.1
- 7 RAD	ML			9.4	.001		17.1
- 9 RAD	ML						17.2
-11 RAD	ML						17.9
-13 RAD	ML						19.4
-15 RAD	ML						16.1
-17 RAD	ML						16.0
-19 RAD	ML						15.3

MEAN				9.3	.002		16.4
				(1.35 MPsi)			(2380.PSI)

STD. DEV.				.1	.001		1.5
				(.02 MPsi)			(224.PSI)

TABLE A-2 (Continued)

LOT NO. --		SPEC. DIA.		12.8 MM			
LOG NO. 6484-137		SPEC. LENGTH		70. MM			
LOG DENSITY --		MG/M**3					

SPECIMEN	ORIENT-	LOCA-	DENSITY	YOUNGS	PERM-	FRAC-	TENSILE
NUMBER	ATION	TION	(MG/M**3)	MODULUS	ANENT	TURE	STRENGTH
				(GPA)	SET	STRAIN	(MPA)
					(PCT)	(PCT)	

SLAB 1	-21 TAN	ML		9.1	.004		21.1
	-23 TAN	ML		9.4	.004		21.4
	-25 TAN	ML					21.1
	-27 TAN	ML		9.5	.003		21.2
	-29 TAN	ML					22.7
	-31 TAN	ML		9.4	.003		20.5
	-33 TAN	ML					18.0
	-35 TAN	ML					18.1
	-37 TAN	ML					19.0
	-39 TAN	ML					19.0

MEAN				9.3	.003		20.2
				(1.36 MPa)			(2929.PSI)

STD. DEV.				.2	.001		1.6
				(.03 MPa)			(229.PSI)

TABLE A-2 (Continued)

LOT NO. --		SPEC. DIA. 12.8 MM					
LOG NO. 6464-137		SPEC. LENGTH 70. MM					
LOG DENSITY --		MG/M**3					
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
SLAB 2	-41 RAD	ML		9.5	.003		17.7
	43 RAD	ML		9.4	.005		20.7
	45 RAD	ML		9.7	.002		17.2
	47 RAD	ML		9.4	.004		18.2
	49 RAD	ML					19.8
	51 RAD	ML					19.6
	53 RAD	ML					16.5
	55 RAD	ML					14.9
	57 RAD	ML					15.1
SLAB 2	-59 RAD	ML					16.3
MEAN				9.5 (1.38 MPsi)	.003		17.6 (2553.PSI)
STD. DEV.				.1 (.02 MPsi)	.001		2.0 (288.PSI)

TABLE A-2 (Continued)

LOT NO. --		SPEC. DIA.		12.8 MM			
LOG NO. 6484-137		SPEC. LENGTH		70. MM			
LOG DENSITY --		MG/M**3					

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)

-61	TAN	ML		10.0	.006	.168	14.8
-63	TAN	ML		10.0	.005	.198	16.7
-65	TAN	ML		10.0	.008	.175	14.8
-67	TAN	ML		10.3	.003	.161	14.7
-69	TAN	ML					12.0
-71	TAN	ML					13.0
-73	TAN	ML					16.1
-75	TAN	ML					14.8
-77	TAN	ML					14.0
-79	TAN	ML					15.6

MEAN				10.1	.005	.175	14.6
				(1.46 MPsi)			(2125.PSI)

STD. DEV.				.2	.002	.016	1.4
				(.02 MPsi)			(201.PSI)

TABLE A-3
TENSILE PROPERTIES OF GRADE 2020 GRAPHITE (LOG 6799-00)

Specimen No.	Location in Log	Orientation of Specimens	Bulk Density (Mg/m ³)	Ultimate Tensile Strength (MPa)
202	End slab 1 ↓	Axial ↓	1.787	19.1
212			1.784	19.1
214			1.789	19.4
220			1.780	19.0
226			1.788	16.5
230			1.785	19.4
238			1.780	18.1
240			<u>1.781</u>	<u>17.4</u>
Mean			1.784	18.5
Std. dev.			0.004	1.1
3	End slab 1 ↓	Radial ↓	1.778	19.3
6			1.785	18.4
11			1.780	20.3
14			1.777	21.5
19			1.778	19.3
22			1.779	17.0
31			1.783	16.6
34			<u>1.781</u>	<u>17.7</u>
Mean			1.780	18.8
Std. dev.			0.003	1.7
246	Middle slab 3 ↓	Axial ↓	1.790	16.2
248			1.788	18.1
252			1.790	17.4
256			1.789	17.4
264			1.792	17.3
270			1.791	17.6
278			1.787	18.3
280			<u>1.786</u>	<u>17.0</u>
Mean			1.789	17.4
Std. dev.			0.002	0.6
38	Middle slab 3 ↓	Radial ↓	1.784	18.6
39			1.783	19.3
46			1.789	19.8
47			1.779	19.3
58			1.780	18.3
59			1.781	19.3
66			1.786	17.9
67			<u>1.785</u>	<u>16.5</u>
Mean			1.783	18.6
Std. dev.			0.003	1.1

TABLE A-3 (Continued)

Specimen No.	Location in Log	Orientation of Specimens	Bulk Density (Mg/m ³)	Ultimate Tensile Strength (MPa)
284	End slab 5 ↓	Axial ↓	1.801	18.1
290			1.798	18.6
296			1.799	18.6
300			1.798	19.0
306			1.803	17.1
310			1.802	20.0
312			1.803	16.2
316			<u>1.803</u>	<u>17.6</u>
Mean			1.799	18.2
Std. dev.			0.005	1.2
70	End slab 5 ↓	Radial ↓	1.802	19.0
71			1.799	17.1
78			1.805	20.1
79			1.801	20.8
90			1.807	18.4
91			1.805	18.6
98			1.812	18.8
99			<u>1.810</u>	<u>19.6</u>
Mean			1.805	19.1
Std. dev.			0.004	1.1

TABLE A-4
FLEXURAL PROPERTIES OF 2020 GRAPHITE

LOT NO. 728 SPEC. DIA. 6.4 MM
LOG NO. 6484-110 SPEC. LENGTH 51. MM
LOG DENSITY 1.803 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (KG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1A	2A AX	END		34.3	25.7
	2B AX	END		36.2	26.4
	4A AX	END		34.5	25.8
	4B AX	END		35.0	26.0
	6A AX	END		35.7	26.2
	6B AX	END		31.7	24.7
	10A AX	END		35.8	26.3
	10B AX	END		33.5	25.4
	12A AX	END		13.5	12.5
	12B AX	END		22.2	19.1
	14A AX	END		33.9	25.6
	14B AX	END		27.3	22.3
	18A AX	END		32.1	24.8
	18B AX	END		36.0	26.3
	20A AX	END		35.4	26.1
	20B AX	END		31.6	24.6
	22A AX	END		33.0	25.2
	22B AX	END		34.2	25.7
	30A AX	END		32.0	24.8
1A	30B AX	END		33.2	25.3
	32A AX	END		32.0	24.8
	32B AX	END		38.4	26.9
1B	34A AX	END		32.0	24.8
	34B AX	END		31.9	25.6
	36A AX	END		34.5	25.8
	36B AX	END		35.2	26.1
	40A AX	END		31.4	24.5
	40B AX	END		32.3	24.9
	42A AX	END		32.2	24.9
	42B AX	END		33.0	25.2
	44A AX	END		34.8	25.9
	44B AX	END		32.9	25.2
	50A AX	END		32.7	25.1
	50B AX	END		35.5	26.1
	52A AX	END		34.4	25.8
	52B AX	END		35.2	26.1
	56A AX	END		36.7	26.5
	56B AX	END		34.3	25.7
1B	58A AX	END		29.0	23.3
	58B AX	END		39.3	27.1
	60A AX	END		39.3	27.1
	60B AX	END		33.9	25.6
MEAN				33.2 MPA (4814, PSI)	25.0 MPA (3632, PSI)
STD. DEV.				4.3 MPA (622, PSI)	2.4 MPA (348, PSI)

TABLE A-4 (Continued)

LOT NO. 728 SPEC. DIA. 6.4 MM
 LUG NO. 6484-110 SPEC. LENGTH 51. MM
 LUG DENSITY 1.803 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (KG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1A	7 RAD	END		32.0	25.6
	9 RAD	END		35.9	27.4
	13 RAD	END		35.0	27.0
	15 RAD	END		38.0	28.2
	19 RAD	END		34.2	26.7
	33 RAD	END		33.8	26.5
	35 RAD	END		35.2	27.1
	39 RAD	END		35.3	27.1
	41 RAD	END		35.0	27.0
	45 RAD	END		33.8	26.5
1B	59 RAD	END		39.3	28.6
	61 RAD	END		38.4	28.4
	65 RAD	END		38.3	28.3
	67 RAD	END		33.2	26.2
	71 RAD	END		35.8	27.4
	85 RAD	END		38.1	28.2
	87 RAD	END		39.6	28.7
	91 RAD	END		34.7	26.9
	93 RAD	END		36.8	27.8
1C	97 RAD	END		39.5	28.7
MEAN				36.1 MPA (5235. PSI)	27.4 MPA (3975. PSI)
STD. DEV.				2.3 MPA (329. PSI)	.9 MPA (132. PSI)

TABLE A-4 (Continued)

LOT NO. 72R SPEC. DIA. 6.4 MM
 LOG NO. 6484-110 SPEC. LENGTH 51. MM
 LOG DENSITY 1.803 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (KG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6A	66A AX	ML		33.8	25.2
	66B AX	ML		37.0	26.1
	68A AX	ML		34.5	25.4
	68B AX	ML		32.2	24.6
	70A AX	ML		35.8	25.8
	70B AX	ML		34.0	25.3
	74A AX	ML		34.8	25.5
	74B AX	ML		34.3	25.3
	76A AX	ML		31.7	24.4
	76B AX	ML		32.7	24.8
	78A AX	ML		34.5	25.4
	78B AX	ML		35.1	25.6
	82A AX	ML		32.7	24.8
	82B AX	ML		34.2	25.3
	84A AX	ML		32.9	24.8
6A	84B AX	ML		34.7	25.5
	86A AX	ML		30.0	23.6
	86B AX	ML		33.6	25.1
	92A AX	ML		31.8	24.4
	92B AX	ML		29.2	23.2
	94A AX	ML		33.0	24.9
	94B AX	ML		35.7	25.8
6B	98A AX	ML		34.8	25.5
	98B AX	ML		34.2	25.3
	100A AX	ML		35.3	25.7
	100B AX	ML		29.3	23.2
	104A AX	ML		37.0	26.1
	104B AX	ML		37.2	26.1
	106A AX	ML		32.7	24.8
	106B AX	ML		34.0	25.3
	108A AX	ML		32.6	24.7
	108B AX	ML		33.6	25.1
	114A AX	ML		31.7	24.3
	114B AX	ML		31.3	24.2
6B	116A AX	ML		38.6	26.4
	116B AX	ML		41.4	26.8
	120A AX	ML		34.6	25.5
	120B AX	ML		36.9	26.1
	122A AX	ML		34.0	25.3
	122B AX	ML		36.2	25.9
	128A AX	ML		38.1	26.3
	128B AX	ML		34.3	25.3
MEAN				34.2 MPA (4960, PSI)	25.2 MPA (3655, PSI)
STD. DEV.				2.4 MPA (353, PSI)	.8 MPA (115, PSI)

TABLE A-4 (Continued)

LOT NO, 728 SPEC. DIA. 6.4 MM
 LOG NO, 6484-110 SPEC. LENGTH 51. MM
 LOG DENSITY 1.803 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (KG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6A	111 RAD	ML		38.8	27.7
	113 RAD	ML		39.6	27.9
	117 RAD	ML		39.5	27.9
	119 RAD	ML		39.7	27.9
	123 RAD	ML		40.6	28.1
	137 RAD	ML		37.3	27.3
	139 RAD	ML		35.2	26.6
	143 RAD	ML		33.2	25.7
	145 RAD	ML		35.3	26.6
	149 RAD	ML		37.0	27.2
6B	163 RAD	ML		34.8	26.4
	165 RAD	ML		40.6	28.1
	169 RAD	ML		37.3	27.3
	171 RAD	ML		36.9	27.2
	175 RAD	ML		35.0	26.5
	189 RAD	ML		36.1	26.9
	191 RAD	ML		39.7	27.9
	195 RAD	ML		39.5	27.9
6B	197 RAD	ML		37.6	27.4
	201 RAD	ML		31.6	25.0
MEAN				37.3 MPA (5404, PSI)	27.2 MPA (3939, PSI)
STD. DEV.				2.5 MPA (367, PSI)	.8 MPA (122, PSI)

TABLE A-5
COMPRESSIVE PROPERTIES OF 2020 GRAPHITE

LOT NO. 728				SPEC. DIA.		12.8 MM	
LOG NO. 6484-110				SPEC. LENGTH		25. MM	
LOG DENSITY 1.803 MG/M**3							

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)

2A	L02C	AX	END	9.2	.050	1.621	76.3
	L12C	AX	END	10.1	.060	1.800	76.3
2B	L32C	AX	END	10.6	.060	1.847	78.7
	L42C	AX	END	10.1	.070	2.084	83.0

MEAN				10.0 (1.45 MPsi)	.060	1.838	78.6 (11396, PSI)
STD. DEV.				.6 (.09 MPsi)	.008	.191	3.1 (455, PSI)

2A	L01B	RAD	END	10.2	.060	1.819	77.4
	L19B	RAD	END	8.6	.070	1.969	78.8
2B	L37B	RAD	END	10.8	.050	1.602	77.2
	L55B	RAD	END	10.2	.070	1.922	80.5

MEAN				9.9 (1.44 MPsi)	.062	1.828	78.5 (11383, PSI)
STD. DEV.				.9 (.13 MPsi)	.010	.163	1.5 (223, PSI)

TABLE A-6
COMPRESSIVE PROPERTIES OF 2020 GRAPHITE

LOT NO. --		SPEC. DIA. 12.8 MM				
LOG NO. 6484-137		SPEC. LENGTH 23. MM				
LOG DENSITY --		MG/M**3				

SPECIMEN NUMBER	OPIENT- ATION	LOCA- TION (MG/M**3)	DENSITY YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)

1C	2B AX	ML			2.019	74.9
	4B AX	ML	8.8	.065	2.284	75.3
	6B AX	ML	8.5	.065	2.254	75.1
	8B AX	ML	9.0	.076	2.284	75.1
	10B AX	ML	8.1	.055	1.936	71.8
	12B AX	ML	8.8	.033	2.121	75.1
	14B AX	ML	9.0	.033	2.129	78.2
	16B AX	ML	8.8	.054	2.136	74.2
	18B AX	ML	8.3	.033	2.310	77.1
	20B AX	ML	8.8	.044	2.330	77.9

MEAN			8.7	.051	2.180	75.5
			(1.26 MPsi)			(10946.PSi)

STD. DEV.			.3	.016	.133	1.9
			(.05 MPsi)			(271.PSi)

TABLE A-6 (Continued)

LOT NO. --		SPEC. DIA. 12.8 MM				
LOG NO. 6484-137		SPEC. LENGTH 23. MM				
LOG DENSITY --		MG/M**3				

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)

1C	1B RAD	ML	9.3	.033	1.887	72.8
	3B RAD	ML	9.6	.065	2.110	76.0
	5B RAD	ML	9.6	.076	2.034	74.5
	7B RAD	ML	8.3	.065	2.243	76.5
	9B RAD	ML	9.0	.065	1.898	74.4
	11B RAD	ML	9.3	.065	1.930	73.6
	13B RAD	ML	9.3	.065	2.081	75.8
	15B RAD	ML	10.5	.076	1.891	73.8
	17B RAD	ML	9.5	.066	1.941	73.8
	19B RAD	ML	9.3	.065	1.796	71.8

MEAN			9.4	.064	1.981	74.3
			(1.36 MPsi)			(10778.PSI)

STD. DEV.			.6	.012	.134	1.5
			(.08 MPsi)			(212.PSI)

TABLE A-6 (Continued)

LOT NO. --		SPEC. DIA. 12.8 MM	
LOG NO. 6484-137		SPEC. LENGTH 23. MM	
LOG DENSITY --		MG/M**3	

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY YOUNGS PERM- FRAC- COMPR. (MG/M**3)MODULUS ANENT TURE STRENGTH (GPA) SET STRAIN (MPA) (PCT) (PCT)

1C	21B TAN	ML	9.3 .065 1.873 72.6
	23B TAN	ML	9.6 .055 1.832 73.0
	25B TAN	ML	9.3 .055 1.944 74.9
	27B TAN	ML	9.5 .076 2.059 76.0
	29B TAN	ML	9.9 .055 1.881 74.8
	31B TAN	ML	9.6 .076 2.131 78.2
	33B TAN	ML	10.2 .065 1.986 74.9
	35B TAN	ML	9.0 .065 1.726 70.7
	37B TAN	ML	8.5 .044 1.928 73.8
	39B TAN	ML	10.2 .065 1.881 73.4

MEAN		9.5 .062 1.924 74.2	
		(1.38 MPsi)	(10764.PSI)

STD. DEV.		.5 .010 .115 2.0	
		(.07 MPsi)	(296.PSI)

TABLE A-6 (Continued)

LOT NO. --		SPEC. DIA. 12.8 MM				
LOG NO. 6484-137		SPEC. LENGTH 23. MM				
LOG DENSITY --		MG/M**3				

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION (MG/M**3)	DENSITY YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)

2C	41B RAD	ML	10.9	.055	1.791	75.6
	43B RAD	ML	10.5	.065	1.865	75.6
	45B RAD	ML	10.5	.055	1.904	75.3
	47B RAD	ML	10.2	.055	2.077	78.9
	49B RAD	ML	10.5	.065	2.074	79.0
	51B RAD	ML	10.2	.065	2.120	78.2
	53B RAD	ML	9.9	.055	1.999	77.7
	55B RAD	ML	9.6	.055	2.180	79.9
	57B RAD	ML	9.3	.055	1.951	75.7
	59B RAD	ML	9.6	.065	2.031	74.2

MEAN			10.1 (1.47 MPsi)	.059	1.999	77.0 (11168. PSI)

STD. DEV.			.5 (.08 MPsi)	.006	.121	1.9 (281. PSI)

TABLE A-6 (Continued)

LOT NO. --		SPEC. DIA. 12.8 MM				
LOG NO. 6484-137		SPEC. LENGTH 23. MM				
LOG DENSITY --		MG/M**3				
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY YOUNGS (MG/M**3)MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)
2C	61B TAN	ML	9.6	.044	2.180	81.2
	63B TAN	ML	10.5	.055	1.973	73.5
	65B TAN	ML	10.5	.065	2.191	81.2
	67B TAN	ML	9.6	.065	1.819	75.0
	69B TAN	ML	10.5	.065	1.923	77.5
	71B TAN	ML	10.2	.055	2.106	80.4
	73B TAN	ML	10.2	.055	2.032	80.2
	75B TAN	ML	9.6	.055	2.072	79.8
	77B TAN	ML	9.3	.055	2.062	79.9
	79B TAN	ML	9.9	.065	2.143	81.5
MEAN			10.0 (1.45 MPsi)	.058	2.050	79.5 (11532.PSi)
STD. DEV.			.5 (.07 MPsi)	.007	.118	2.0 (292.PSi)

TABLE A-7
COMPRESSIVE PROPERTIES OF GRADE 2020 GRAPHITE (LOG 6799-00)

Specimen No.	Location in Log	Orientation of Specimens	Bulk Density (Mg/m ³)	Ultimate Compressive Strength (MPa)
202	End slab 1 ↓	Axial ↓	1.780	79.7
210			1.780	84.8
218			1.782	85.5
220			1.783	84.1
222			1.791	88.2
228			1.782	82.7
234			1.781	89.8
240			<u>1.779</u>	<u>82.0</u>
Mean			1.782	84.0
Std. dev.			0.004	2.5
3	End slab 1 ↓	Radial ↓	1.774	83.4
6			1.765	80.7
11			1.772	83.4
14			1.767	80.0
23			1.782	84.1
26			1.776	83.4
31			1.779	82.7
34			<u>1.776</u>	<u>77.9</u>
Mean			1.773	82.0
Std. dev.			0.006	2.2
246	Middle slab 3 ↓	Axial ↓	1.779	80.7
256			1.778	80.7
260			1.782	79.3
262			1.781	79.3
265			1.781	79.3
272			1.784	80.7
278			1.776	77.2
280			<u>1.779</u>	<u>82.7</u>
Mean			1.780	80.0
Std. dev.			0.003	1.6
35	Middle slab 3 ↓	Radial ↓	1.767	81.4
38			1.765	78.6
43			1.770	83.4
46			1.768	84.8
55			1.772	80.7
58			1.766	82.7
63			1.778	76.5
66			<u>1.770</u>	<u>81.3</u>
Mean			1.769	21.2
Std. dev.			0.004	2.7

TABLE A-7 (Continued)

Specimen No.	Location in Log	Orientation of Specimens	Bulk Density (Mg/m ³)	Ultimate Compressive Strength (MPa)
290	End slab 5 ↓	Axial ↓	1.784	83.4
292			1.779	81.0
298			1.784	85.5
300			1.787	88.2
302			1.787	84.8
318			1.786	89.6
322			1.786	88.2
326			<u>1.785</u>	<u>82.7</u>
Mean			1.784	85.4
Std. dev.			0.003	3.0
71	End slab 5 ↓	Radial ↓	1.790	80.0
74			1.784	87.6
79			1.790	93.1
82			1.789	89.6
87			1.793	91.7
90			1.790	88.9
95			1.800	91.7
98			<u>1.800</u>	<u>88.2</u>
Mean			1.792	88.9
Std. dev.			0.006	4.1

TABLE A-8
IMPURITY CONTENT OF 2020 GRAPHITE
LOG NO. 6484-110, SPECTROCHEMICAL ANALYSIS

LAB. NO. 44389		REPORT TO: GLEN ENGLE		DATE: 8-3-76				
SAMPLE: 6484-110 2020 116H GRAP		PROJECT NO. H3224146005		DILUTION: 1.0000				
PLATE NO. 76-71								
ELEMENT		CONCENTRATION, PPM	ELEMENT		CONCENTRATION, PPM			
AG	<	.50	AL	60.00	B	4.00		
BA		40.00	BE	<	.50	BI	<	2.00
CA		600.00	CD	<	10.00	CE	<	80.00
CU	<	4.00	CR	<	10.00	CS	<	100.00
EU	<	1.00	DY	<	20.00	ER	<	6.00
FE	<	10.00	FE		400.00	GD	<	10.00
HF	<	20.00	HD	<	10.00	IN	<	1.00
K		80.00	LA	<	10.00	LI	<	1.00
LU	<	.50	MG		4.00	MN		2.00
NI	<	1.00	NA		10.00	NR	<	6.00
NO	<	200.00	NI	<	4.00	P	<	100.00
PH	<	6.00	PR	<	100.00	RB	<	40.00
SR	<	8.00	SC	<	1.00	SI		200.00
SM	<	100.00	SN	<	6.00	SR		40.00
TA	<	40.00	TB	<	40.00	TI		40.00
TL	<	20.00	TM	<	4.00	V		20.00
W	<	40.00	VB	<	10.00	ZN	<	20.00
ZP	<	.50						

LAB. NO. 44389		REPORT TO: GLEN ENGLE		DATE: 8-3-76		
SAMPLE: 6484-110 2020 L28B GRAP		PROJECT NO. H3224146005		DILUTION: 1.0000		
PLATE NO. 76-71						
ELEMENT		CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	<	.50	AL	60.00	B	2.00
BA		40.00	BE	<	BI	<
CA		600.00	CD	<	CF	<
CG	<	4.00	CR	<	CS	<
CU	<	1.00	DY	<	ER	<
FJ	<	10.00	FE	400.00	GD	<
HF	<	20.00	HD	<	IN	<
K		60.00	LA	<	LI	<
LU	<	.50	MG	2.00	MN	1.00
NI	<	1.00	NA	10.00	NR	<
NO	<	200.00	NI	<	P	<
PH	<	6.00	PR	<	RB	<
SR	<	8.00	SC	<	SI	200.00
SM	<	100.00	SN	<	SR	<
TA	<	40.00	TB	<	TI	20.00
TL	<	20.00	TM	<	V	10.00
W	<	40.00	VB	<	ZN	<
ZP	<	.50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
> MEANS GREATER THAN
< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE A-8 (Continued)

LAB. NO. 44349		REPORT TO: GLEN ENGLE		DATE: 8-3-76	
SAMPLE: 64R4-110 2020 1.64H GRAP		PROJECT NO. H3224146005		DILUTION: 1.0000	
PLATE NO. 76-71					
ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	20.00	B	4.00
BA	40.00	BE	< .50	BI	< 2.00
CA	400.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	< 1.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	20.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	20.00	LA	< 10.00	LI	< 1.00
LU	< .50	MG	4.00	MN	< 1.00
MO	< 1.00	NA	10.00	NB	< 6.00
ND	< 200.00	NI	< 4.00	P	< 100.00
PR	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	20.00
SA	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	100.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

LAB. NO. 44389		REPORT TO: GLEN ENGLE		DATE: 8-3-76	
SAMPLE: 64R4-110 2020 1.76H GRAP		PROJECT NO. H3224146005		DILUTION: 1.0000	
PLATE NO. 76-71					
ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	60.00	B	4.00
BA	20.00	BE	< .50	BI	< 2.00
CA	400.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	< 1.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	60.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	60.00	LA	< 10.00	LI	8.00
LU	< .50	MG	4.00	MN	< 1.00
MO	< 1.00	NA	20.00	NB	< 6.00
ND	< 200.00	NI	< 4.00	P	< 100.00
PR	< 6.00	PR	< 100.00	RE	< 40.00
SB	< 8.00	SC	< 1.00	SI	100.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	100.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 10.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
 > MEANS GREATER THAN
 < MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
 RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

APPENDIX B
GRADE H-440N DATA

This appendix contains complete data sets for the bulk density, tensile properties, flexural strength, compressive properties, and chemical impurity content of grade H-440N graphite.

TABLE B-1
TENSILE STRENGTH AND MODULUS OF ELASTICITY DATA FOR GRADE H-440N

LOT NO.	SPEC. DIA. 12.8 MM
LOG NO. 6484-81	SPEC. LENGTH 70. MM
LOG DENSITY --	MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TUPE STRAIN (PCT)	TENSILE STRENGTH (MPA)

SLAB1A-L- 6A	AX	END	1.747	7.4	.018	.221	12.4
- 8A	AX	END	1.752	6.5	.016	.234	11.9
-10B	AX	END	1.743	6.7	.017	.265	12.8
-14A	AX	END	1.744	7.2	.020	.245	12.9
-20A	AX	END	1.741	7.3	.020	.265	13.7
-22B	AX	END	1.737	7.1	.020	.241	12.5
- 6B	AX	END					11.3
- 8B	AX	END					11.1
-12A	AX	END					10.5
-12B	AX	END					9.9
-14B	AX	END					11.4
-18A	AX	END					7.2
-18B	AX	END					10.1
-20B	AX	END					9.3
-22A	AX	END					6.9
-24A	AX	END					9.7
-24B	AX	END					10.9
SLAB1B-L-30A	AX	END	1.748	7.6	.017	.200	11.3
-34B	AX	END	1.751	6.9	.016	.206	11.0
-36A	AX	END	1.746	6.7	.025	.241	12.2
-38A	AX	END	1.746	7.3	.017	.209	11.5
-44A	AX	END	1.750	7.1	.020	.209	11.0
-46B	AX	END	1.748	7.2	.020	.240	12.4
-30B	AX	END					12.1
-32A	AX	END					10.2
-32B	AX	END					10.5
-36B	AX	END					10.9
-38B	AX	END					10.6
SLAB1B-L-42A	AX	END					12.2
-42B	AX	END					12.6
-44B	AX	END					12.6
-46A	AX	END					11.0
-48A	AX	END					11.3
-48B	AX	END					11.7

MEAN			1.746	7.1	.019	.231	11.2
			(1.03 MPsi)		(1621.PSI)		
STD. DEV.			.004	.3	.003	.022	1.5
			(.05 MPsi)		(211.PSI)		

TABLE B-1 (Continued)

LOT NO. SPEC. DIA. 12.8 MM
 LOG NO. 6484-81 SPEC. LENGTH 70. MM
 LOG DENSITY -- MG/M**3 --

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
SLAB6A-L-54A	AX	ML	1.726	6.7	.019	.176	9.4
56A	AX	ML	1.673	5.3	.035	.160	7.4
58P	AX	ML	1.676	5.6	.030	.241	10.0
SLAB6A-L-62A	AX	ML	1.737	8.3	.005	.168	11.4
68A	AX	ML	1.676	5.0	.070	.275	10.0
-L-70B	AX	ML	1.742	6.7	.022	.231	11.7
-50A	AX	ML					10.4
-50B	AX	ML					10.2
-54B	AX	ML					12.5
-56B	AX	ML					9.9
-60A	AX	ML					9.8
-60B	AX	ML					11.2
-66A	AX	ML					11.3
-66B	AX	ML					11.7
-68B	AX	ML					8.4
-70A	AX	ML					11.5
-72A	AX	ML					11.7
-72B	AX	ML					10.6
SLAB6B-L-78A	AX	ML	1.724	6.0	.019	.190	9.3
-82B	AX	ML	1.671	5.0	.030	.237	9.0
-84	AX	ML	1.676	5.2	.026	.228	9.3
-86A	AX	ML	1.718	6.1	.019	.230	11.0
-92A	AX	ML	1.735	6.5	.021	.194	9.7
-94B	AX	ML	1.725	6.3	.023	.268	12.3
-74A	AX	ML					11.6
-74B	AX	ML					12.6
-78B	AX	ML					11.2
-80A	AX	ML					11.3
-80B	AX	ML					10.7
-84B	AX	ML					10.1
-86B	AX	ML					12.7
SLAB6B-L-90A	AX	ML					12.0
-90B	AX	ML					12.6
-92B	AX	ML					10.5
-94A	AX	ML					12.0
-96A	AX	ML					13.5
-96B	AX	ML					12.1
MEAN			1.706	6.0	.023	.218	10.9
				(.88 MPa)			(1579.PSI)
STD. DEV.			.029	1.0	.008	.036	1.3
				(.14 MPa)			(194.PSI)

TABLE B-1 (Continued)

LOT NO. SPEC. DIA. 12.8 MM
 LOG NO. 6484-81 SPEC. LENGTH 70. MM
 LOG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCI)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
SLAB1A L-	7 RAD	END	1.733	7.9	.015	.223	13.0
-	11 RAD	END	1.742	9.0	.010	.223	15.0
SLAB 1A-L-	25 RAD	END	1.745	8.2	.015	.210	13.0
-	29 RAD	END	1.737	8.2	.016	.213	12.8
-	5 RAD	END					12.5
-	9 RAD	END					14.1
-	13 RAD	END					13.5
-	23 RAD	END					11.0
-	27 RAD	END					12.7
-	31 RAD	END					12.3
SLAB1B-L-	43 RAD	END	1.748	7.6	.019	.239	13.5
-	47 RAD	END	1.749	7.9	.015	.195	11.9
-	61 RAD	END	1.738	8.5	.015	.265	15.8
-	65 RAD	END	1.729	6.7	.018	.251	12.4
-	41 RAD	END					13.0
-	45 RAD	END					13.0
-	49 RAD	END					12.4
-	59 RAD	END					13.1
-	63 RAD	END					13.5
-	67 RAD	END					14.0
MEAN			1.740	8.0	.015	.227	13.1
				(1.16 MPsi)			(1905 PSI)
STD. DEV.			.007	.7	.003	.023	1.1
				(.10 MPsi)			(153 PSI)

TABLE B-1 (Continued)

LOT NO.			SPEC. DIA.		12.8 MM		
LOG NO. 6484-81			SPEC. LENGTH		70. MM		
LOG DENSITY --			MG/M**3				
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
SLAB6A L-79	RAD	ML	1.720			.140	8.5
-83	RAD	ML	1.714	7.2	.016	.189	10.8
-97	RAD	ML	1.720	8.5	.015	.149	9.8
101	RAD	ML	1.713	7.2	.018	.169	9.7
SLAB6A-L-77	RAD	ML					11.8
-81	RAD	ML					12.5
-85	RAD	ML					11.9
-95	RAD	ML					13.3
-99	RAD	ML					11.2
103	RAD	ML					10.3
SLAB6B L115	RAD	ML	1.684	6.4	.019	.193	9.9
119	RAD	ML	1.678	6.2	.015	.204	10.3
133	RAD	ML	1.686	6.7	.016	.170	9.3
137	RAD	ML	1.688	6.5	.020	.218	11.0
113	RAD	ML					9.9
117	RAD	ML					8.6
121	RAD	ML					9.3
131	RAD	ML					9.3
135	RAD	ML					10.2
139	RAD	ML					10.1
MEAN			1.700	7.0	.017	.179	10.4
				(1.01 MPsi)			(1506.PSI)
STD. DEV.			.018	.8	.002	.027	1.3
				(.11 MPsi)			(182.PSI)

TABLE B-2
FLEXURAL STRENGTH DATA FOR GRADE H-440N

LIST NO.			SPEC. DIA.		6.4 MM
LOG NO. 6484-61			SPEC. LENGTH		51. MM
LOG DENSITY --			MG/M**3		
SPECIMEN NUMBER	ORIENTATION	LUCA-TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
SLAB1A	2A	AX	END	26.5	21.7
	2B	AX	END	23.9	20.1
	4A	AX	END	26.5	21.7
	4B	AX	END	21.4	18.4
	6A	AX	END	26.4	21.7
	6B	AX	END	24.6	20.6
	10A	AX	END	24.3	20.4
	10B	AX	END	22.6	19.2
	12A	AX	END	24.3	20.4
	12B	AX	END	24.8	20.7
	14A	AX	END	23.9	20.1
	14B	AX	END	22.8	19.4
	16A	AX	END	27.2	22.1
	16B	AX	END	25.8	21.3
	20A	AX	END	26.7	21.8
	20B	AX	END	27.1	22.1
	22A	AX	END	22.9	19.4
	22B	AX	END	23.2	19.7
	30A	AX	END	24.7	22.9
	30B	AX	END	24.2	20.2
SLAB1A	32A	AX	END	26.2	21.5
	32B	AX	END	24.3	20.3
SLAB1B	34A	AX	END	25.7	21.2
	34B	AX	END	23.5	19.8
	36A	AX	END	24.0	20.1
	36B	AX	END	26.6	21.7
	40A	AX	END	23.5	19.8
	40B	AX	END	23.3	19.7
	42A	AX	END	20.7	17.9
	42B	AX	END	24.9	20.7
	44A	AX	END	23.5	19.8
	44B	AX	END	24.9	20.7
	50A	AX	END	24.6	20.6
	50B	AX	END	24.1	20.2
	52A	AX	END	23.8	20.0
	52B	AX	END	26.2	21.5
	56A	AX	END	26.8	21.8
	56B	AX	END	20.4	17.7
SLAB1B	58A	AX	END	24.1	20.2
	58B	AX	END	24.4	20.4
	60A	AX	END	25.9	21.3
	60B	AX	END	25.2	20.9
MEAN				24.6 MPA (3572. PSI)	20.5 MPA (2976. PSI)
STD. DEV.				1.8 MPA (256. PSI)	1.1 MPA (162. PSI)

TABLE B-2 (Continued)

LOT NO.			SPEC. DIA.		6.4 MM
LOG NO. 6484-51			SPEC. LENGTH		51. MM
LOG DENSITY --			MG/M**3		

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)

SLAH1A	7 RAD	END		25.3	21.6
	9 RAD	END		25.0	21.4
	13 RAD	END		23.0	20.0
	15 RAD	END		22.4	19.5
	19 RAD	END		25.5	21.7
	33 RAD	END		24.9	21.3
	35 RAD	END		29.1	24.0
	39 RAD	END		27.0	22.7
	41 RAD	END		22.2	19.4
	45 RAD	END		23.6	20.4
SLAH1B	59 RAD	END		24.3	20.9
	61 RAD	END		25.4	21.6
	65 RAD	END		27.2	22.6
	67 RAD	END		26.8	22.5
	71 RAD	END		29.0	23.9
	85 RAD	END		26.2	22.1
	91 RAD	END		29.4	24.2
	93 RAD	END		26.3	22.2
SLAH1B	97 RAD	END		26.0	22.0
SLAH1B	87 RAD	END		26.1	22.1

MEAN				25.7 MPA (3733. PSI)	21.8 MPA (3165. PSI)
STD. DEV.				2.1 MPA (297. PSI)	1.4 MPA (197. PSI)

TABLE B-2 (Continued)

LOT NO.				SPEC. DIA.	6.4 MM
LOG NO. 6484-81				SPEC. LENGTH	51. MM
LOG DENSITY --				MG/M**3	
SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
SL486A	66A	AX	ML	24.5	19.6
	66B	AX	ML	24.9	19.8
	68A	AX	ML	25.0	19.8
	68B	AX	ML	24.3	19.5
	70A	AX	ML	24.3	19.5
	70B	AX	ML	26.0	20.3
	74A	AX	ML	16.8	14.7
	74B	AX	ML	19.6	16.6
	76A	AX	ML	21.8	18.0
	76B	AX	ML	18.4	15.9
	78A	AX	ML	19.0	16.2
	78B	AX	ML	18.4	15.8
	82A	AX	ML	24.5	19.6
	82B	AX	ML	24.3	19.5
SL486A	84A	AX	ML	24.9	19.8
	84B	AX	ML	24.4	19.5
	86A	AX	ML	27.4	20.9
	86B	AX	ML	25.1	19.9
	92A	AX	ML	27.3	20.9
	92B	AX	ML	25.1	19.9
	94A	AX	ML	28.0	21.2
	94B	AX	ML	25.9	20.3
SL486B	98A	AX	ML	25.5	20.1
	98B	AX	ML	25.1	19.9
	100A	AX	ML	23.5	19.0
	100B	AX	ML	21.8	18.1
	104A	AX	ML	19.5	16.6
	104B	AX	ML	17.9	15.5
	106A	AX	ML	18.6	16.0
	106B	AX	ML	18.8	16.1
SL486B	108A	AX	ML	17.9	15.5
	108B	AX	ML	19.3	16.4
	114A	AX	ML	24.1	19.3
	114B	AX	ML	24.0	19.3
	116A	AX	ML	26.5	20.6
	116B	AX	ML	25.7	20.2
	120A	AX	ML	23.2	18.9
	120B	AX	ML	23.1	18.8
	122A	AX	ML	21.2	17.7
	122B	AX	ML	21.6	17.9
SL486B	128A	AX	ML	20.8	17.4
	128B	AX	ML	22.9	18.7
MEAN				22.9 MPA (3318. PSI)	18.5 MPA (2689. PSI)
STD. DEV.				3.0 MPA (441. PSI)	1.8 MPA (260. PSI)

TABLE B-2 (Continued)

LOT NO.				SPEC. DIA.	6.4 MM
LOG NO. 6484-81				SPEC. LENGTH	51. MM
LOG DENSITY --				MG/M**3	
SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
SLAB6A	111	RAD	ML	24.7	20.5
	113	RAD	ML	25.4	21.0
	117	RAD	ML	26.7	21.7
	119	RAD	ML	26.2	21.4
	123	RAD	ML	25.1	20.7
	137	RAD	ML	27.4	22.1
	139	RAD	ML	28.1	22.5
	143	RAD	ML	26.3	21.5
	145	RAD	ML	25.7	21.1
	149	RAD	ML	27.1	21.9
SLAB6B	163	RAD	ML	22.3	18.9
	165	RAD	ML	23.4	19.7
	169	RAD	ML	24.6	20.4
	171	RAD	ML	21.9	18.7
	175	RAD	ML	21.6	18.5
	189	RAD	ML	21.1	18.1
SLAB6B	191	RAD	ML	21.2	18.2
	195	RAD	ML	20.3	17.6
	197	RAD	ML	21.8	18.6
	201	RAD	ML	20.6	17.8
MEAN				24.1 MPA (3493. PSI)	20.1 MPA (2908. PSI)
STD. DEV.				2.5 MPA (368. PSI)	1.6 MPA (231. PSI)

TABLE B-3
COMPRESSIVE STRENGTH AND MODULUS OF ELASTICITY FOR GRADE H-440N

L.T. NO.				SPEC. DIA. 12.5 MM			
LOG NO. 6484-81				SPEC. LENGTH 25. MM			
LOG DENSITY --				MG/M**3			

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPRESSIVE STRENGTH (MPA)

1A	L60	AX	END	6.0	.150	2.084	47.0
	L80	AX	END	5.2	.180	3.289	53.8
	L120	AX	END	6.1	.110	2.176	48.7
	L140	AX	END	6.0	.150	3.104	53.4
1B	L300	AX	END	6.0	.180	2.850	52.4
	L320	AX	END	5.3	.160	3.404	54.7
	L360	AX	END	5.5	.180	3.484	54.8
	L380	AX	END	5.5	.200	3.238	53.1

MEAN				5.7 (.83 MPsi)	.164	2.953	52.2 (7574.Psi)
STD. DEV.				.4 (.05 MPsi)	.028	.544	2.9 (414.Psi)

1A	L50	RAD	END	6.7	.130	2.345	52.6
	L9	RAD	END	6.9	.130	2.186	50.6
	L130	RAD	END	7.4	.120	1.669	46.6
	L230	RAD	END	7.2	.140	1.836	48.0
1B	L410	RAD	END	7.9	.130	2.711	52.3
	L450	RAD	END	7.1	.130	2.178	50.0
	L490	RAD	END	6.9	.140	1.956	48.1
	L590	RAD	END	7.2	.120	1.778	47.2

MEAN				7.2 (1.04 MPsi)	.130	2.032	49.4 (7168.Psi)
STD. DEV.				.4 (.05 MPsi)	.008	.257	2.3 (333.Psi)

TABLE B-3 (Continued)

LOT NO.				SPEC. DIA.		12.2 MM	
LOG NO. 6484-81				SPEC. LENGTH		25. MM	
LOG DENSITY --				MG/M**3			
SPECIMEN NUMBER	ORIENT- TION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)
6A	L500	AX	ML	6.2	.160	3.221	53.6
	L540	AX	ML	5.8	.120	2.990	52.3
	L560	AX	ML	4.4	.180	2.983	43.7
	L600	AX	ML	5.8	.150	3.027	52.0
6B	L740	AX	ML	6.0	.130	3.461	55.4
	L780	AX	ML	5.6	.160	3.502	53.8
	L800	AX	ML	3.9	.129	2.999	43.1
	L840	AX	ML	4.3	.150	3.043	43.9
MEAN				5.2 (.76 MPsi)	.148	3.153	49.7 (7212.Psi)
STD. DEV.				.9 (.13 MPsi)	.020	.217	5.2 (753.Psi)
6A	L770	RAD	ML	5.6	.170	1.765	39.2
	L810	RAD	ML	5.4	.160	1.991	41.4
	L850	RAD	ML	4.5	.180	2.214	39.4
	L950	RAD	ML	6.1	.140	1.638	40.8
6B	L1130	RAD	ML	5.2	.130	1.904	37.9
	L1170	RAD	ML	5.0	.120	2.650	42.8
	L1210	RAD	ML	5.2	.100	2.316	41.7
	L1310	RAD	ML	4.6	.180	2.167	39.0
MEAN				5.2 (.75 MPsi)	.148	2.080	40.3 (5843.Psi)
STD. DEV.				.5 (.07 MPsi)	.030	.325	1.6 (237.Psi)

TABLE B-4
SPECTROCHEMICAL ANALYSES FOR GRADE H-440N

LAB. NO. 48012

REPORT TO: G. F. L. F.

DATE: 2-23-77

SAMPLE: Hg 440-4404-41-124 G.P.D.

PROJECT: 322-148025

DILUTION: 1.0000

PLATE NO. 77-014

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	P	2.00
BA	10.00	AR	< .50	BI	< 1.00
CA	40.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CH	< 4.00	CS	< 10.00
CU	< 1.00	DY	< 20.00	ER	< 6.00
EJ	< 200.00	EE	20.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	8.00	LA	< 10.00	LI	.50
LU	< .50	MG	20.00	MN	< 1.00
MO	< 1.00	NA	< 40.00	NB	< 6.00
ND	< 60.00	NI	< 4.00	P	< 600.00
PR	< 6.00	PR	< 60.00	RB	< 6.00
SE	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	40.00
W	< 40.00	YB	< 10.00	ZN	< 10.00
ZR	4.00				

B-12

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
> MEANS GREATER THAN
< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE B-4 (Continued)

LAB. NO. 45002

REPORT TO: C. F. F. F.

DATE: 2-23-77

SAMPLE: 44400 6484-01-L111 WMP

PROJECT NO. 3224145005

DILUTION: 1.0000

PLATE NO. 77-014

ELEMENT		CONCENTRATION, PP	ELEMENT		CONCENTRATION, PPM	ELEMENT		CONCENTRATION, PPM
B-13	AG	< .50	AL	< 1.00		B	2.00	
	HA	10.00	BE	< .50		BI	< 1.00	
	CA	50.00	CD	< 10.00		CE	< 80.00	
	CU	< 4.00	CR	< 4.00		CS	< 10.00	
	CU	< 1.00	DY	< 20.00		ER	< 6.00	
	FU	< 200.00	EE	< 20.00		GD	< 10.00	
	HF	< 20.00	HO	< 10.00		IN	< 1.00	
	K	8.00	LA	< 10.00		LI	< .50	
	LI	< .50	MG	10.00		MN	< 1.00	
	MO	< 1.00	VA	< 40.00		NH	< 6.00	
	NO	< 50.00	NI	< 4.00		P	< 600.00	
	PR	< 6.00	PR	< 60.00		RB	< 6.00	
	SB	< 6.00	SC	< 1.00		SI	80.00	
	SH	< 100.00	SN	< 6.00		SR	< 40.00	
	TA	< 40.00	TB	< 40.00		TI	40.00	
	TL	< 20.00	TM	< 4.00		V	40.00	
	W	< 40.00	VB	< 10.00		ZN	< 10.00	
	ZR	2.00						

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE B-4 (Continued)

LAB. NO. 46002

REPORT TO: G. F. GLE

DATE: 2-23-77

SAMPLE: H4401 648A-B1-193 GRAP

PROJECT NO. 3226165025

DILUTION: 1.0000

PLATE NO. 77-01A

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	B	2.00
BA	10.00	BE	< .50	B1	< 1.00
CA	60.00	CU	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 4.00	CS	< 10.00
CH	< 1.00	DY	< 20.00	ER	< 6.00
FU	< 200.00	FE	10.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	8.00	LA	< 10.00	LI	< .50
LU	< .50	MG	10.00	MN	< 1.00
MO	< 1.00	NA	< 40.00	NB	< 6.00
ND	< 60.00	NI	< 4.00	P	< 600.00
PH	< 6.00	PR	< 60.00	RB	< 6.00
SE	< 8.00	SC	< 1.00	SI	80.00
SH	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TH	< 4.00	V	40.00
W	< 40.00	YB	< 10.00	ZN	< 10.00
ZR	2.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% ± (ONE STANDARD DEVIATION)

TABLE B-4 (Continued)

LAB. NO. 46912

REPORT NO. 3224145JL5

DATE: 2-23-77

SAMPLE: 13411 6414-B1-L-2 324P

PROJECT

DILUTION: 1,200X

PLATE NO. 77-014

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	B	2.00
BA	10.00	BE	< .50	BI	< 1.00
CA	60.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CH	< 4.00	CS	< 10.00
CU	< 1.00	UY	< 20.00	ER	< 6.00
EU	< 200.00	FE	20.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	8.00	LA	< 10.00	LI	< .50
LU	< .50	MG	10.00	MN	< 1.00
MO	< 1.00	VA	< 40.00	NB	< 6.00
NJ	< 60.00	NI	< 4.00	P	< 600.00
PH	< 6.00	PR	< 60.00	RB	< 6.00
SH	< 5.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TR	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	40.00
W	< 40.00	YB	< 10.00	ZN	< 10.00
ZR	2.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

B-15

TABLE B-4 (Continued)

LAB. NO. 45002

REPORT TO: G. FAGLE

DATE: 2-23-77

SAMPLE: 4440 6484-41-LR2 WOLF

PROJECT: 322-146005

DILUTION: 1.6000

PLATE NO. 77-01A

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	AR	2.00
BA	10.00	AR	< .50	BI	< 1.00
CA	60.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CP	< 4.00	CS	< 10.00
CI	< 1.00	DY	< 20.00	ER	< 6.00
EJ	< 200.00	FE	10.00	GO	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	< 4.00	LA	< 10.00	LI	< .50
LU	< .50	MG	10.00	MN	< 1.00
NJ	< 1.00	NA	< 40.00	NB	< 6.00
NU	< 60.00	NI	< 4.00	P	< 600.00
PI	< 6.00	PR	< 60.00	RB	< 6.00
SP	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TR	< 40.00	TI	10.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 10.00
ZR	2.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE B-4 (Continued)

LAB. NO. 46002

REPORT TO: G. E. GLE

DATE: 2-23-77

SAMPLE: H4403-54E4-61-L76-6FAP

PROJECT NO. 3224145005

DILUTION: 1.0000

PLATE NO. 77-014

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

AG < .50

AL < 1.00

B 2.00

BA 10.00

BE < .50

BI < 1.00

CA 60.00

CO < 10.00

CE < 80.00

CU < 4.00

CR < 4.00

CS < 10.00

CY < 1.00

DY < 20.00

ER < 6.00

EU < 200.00

EE < 20.00

GD < 10.00

HF < 20.00

HO < 10.00

IN < 1.00

K 4.00

LA < 10.00

LI < .50

LU < .50

MG 40.00

MN < 1.00

MO < 1.00

NA < 40.00

NB < 6.00

NU < 60.00

NI < 4.00

P < 600.00

PB < 6.00

PR < 60.00

RB < 6.00

SH < 8.00

SC < 1.00

SI 80.00

SM < 100.00

SN < 6.00

SR < 40.00

TA < 40.00

TB < 40.00

TI 40.00

TL < 20.00

TM < 4.00

V 40.00

W < 40.00

YB < 10.00

ZN < 10.00

ZB 2.00

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

B-17

TABLE B-4 (Continued)

LAB. NO. 44002

REPORT NO. 3 EMBLE

DATE: 2-23-77

SAMPLE: 44002-44002-51-175-0800

PROJECT NO. 322414005

DILUTION: 1.0000

PLATE NO. 77-014

ELEMENT		CONCENTRATION, PPM	ELEMENT		CONCENTRATION, PPM	ELEMENT		CONCENTRATION, PPM
AG	<	.50	AL	<	1.00	R	<	2.00
BA	<	10.00	BE	<	.50	BI	<	1.00
CA	<	60.00	CD	<	10.00	CE	<	80.00
CU	<	4.00	CH	<	4.00	CS	<	10.00
CO	<	1.00	DY	<	20.00	ER	<	6.00
EU	<	200.00	FE	<	10.00	GO	<	10.00
HF	<	20.00	HU	<	10.00	IN	<	1.00
K	<	4.00	LA	<	10.00	LI	<	.50
LU	<	.50	MO	<	20.00	MN	<	1.00
MG	<	1.00	NA	<	40.00	NB	<	6.00
NO	<	60.00	NI	<	4.00	P	<	600.00
PA	<	6.00	PR	<	60.00	RB	<	6.00
SH	<	8.00	SC	<	1.00	SI	<	80.00
SM	<	100.00	SN	<	6.00	SR	<	40.00
TA	<	40.00	TB	<	40.00	TI	<	20.00
TL	<	20.00	TM	<	4.00	V	<	40.00
W	<	40.00	YB	<	10.00	ZN	<	10.00
ZP	<	2.00						

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

B-18

TABLE B-4 (Continued)

LAB. NO. 48072

REPORT T: G.F.F.L.S.

DATE: 2-23-77

SAMPLE: H460 5484-H1-154 ZAP

PROJECT: 2224145015

DILUTION: 1.000

PLATE NO. 77-014

B-19	ELEMENT		CONCENTRATION, PPM		ELEMENT		CONCENTRATION, PPM		ELEMENT		CONCENTRATION, PPM	
	AG	<	0.50		AL	<	1.00		B		2.00	
	BA		10.00		ME	<	0.50		BI	<	1.00	
	CA		50.00		CU	<	10.00		CE	<	80.00	
	CO	<	4.00		CR	<	4.00		CS	<	10.00	
	CU	<	1.00		DY	<	20.00		ER	<	6.00	
	EU	<	200.00		FE		10.00		GD	<	10.00	
	HF	<	20.00		HO	<	10.00		IN	<	1.00	
	K		6.00		LA	<	10.00		LI	<	0.50	
	LU	<	0.50		MG		20.00		MN	<	1.00	
	MO	<	1.00		NA	<	40.00		NB	<	6.00	
	NO	<	60.00		NI	<	4.00		P	<	600.00	
	PH	<	6.00		PR	<	60.00		RB	<	6.00	
	SH	<	6.00		SC	<	1.00		SI		80.00	
	SM	<	100.00		SN	<	6.00		SR	<	40.00	
	TA	<	40.00		TH	<	40.00		TI		20.00	
	TL	<	20.00		TM	<	4.00		V		10.00	
	W	<	40.00		YB	<	10.00		ZN	<	10.00	
	ZR		2.00									

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE B-4 (Continued)

LAB. NO. 46002

REPORT TO: G. F. HILL

DATE: 2-23-77

SAMPLE: H44-31-158 GRAP

PROJECT NO. 3224146005

DILUTION: 1.0000

PLATE NO. 77-014

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	B	2.00
HA	10.00	BE	< .50	BI	< 1.00
CA	40.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 4.00	CS	< 10.00
CU	< 1.00	DY	< 20.00	ER	< 6.00
FU	< 200.00	FE	20.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	6.00	LA	< 10.00	LI	< .50
LU	< .50	MA	10.00	MN	< 1.00
MO	< 1.00	NA	< 40.00	NB	< 6.00
NO	< 60.00	NI	< 4.00	P	< 600.00
PH	< 6.00	PP	< 60.00	RB	< 6.00
SB	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	20.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 10.00
ZR	2.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

B-20

TABLE B-4 (Continued)

LAB. NO. 40002

REPORT TO: C. F. NIEL

DATE: 2-23-77

SAMPLE: H8401 6484-K1-157 304F

PROJECT: 3224146005

DILUTION: 1.3000

PLATE NO. 77-01A

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	AR	2.00
BA	10.00	BE	< .50	BI	< 1.00
CA	60.00	CF	< 10.00	CE	< 80.00
CU	< 4.00	CR	< 4.00	CS	< 10.00
CO	< 1.00	CY	< 20.00	ER	< 6.00
FU	< 200.00	FE	10.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	6.00	LA	< 10.00	LI	< .50
LU	< .50	MG	20.00	MN	< 1.00
MO	< 1.00	NA	< 40.00	NB	< 6.00
ND	< 60.00	NI	< 4.00	P	< 600.00
PH	< 6.00	PR	< 60.00	RB	< 6.00
SB	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	20.00
TL	< 20.00	TH	< 4.00	V	20.00
V	< 40.00	YB	< 10.00	ZN	< 10.00
ZR	2.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

B-21

TABLE B-4 (Continued)

LAB. NO. 45002

REPORT TO: (ENGL)

DATE: 2-23-77

SAMPLE: H440A 6494-a)-152 GPAP

PROJECT NO. 3224145005

DILUTION: 1.0000

PLATE NO. 77-014

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	B	2.00
BA	20.00	BE	< .50	BI	< 1.00
CA	60.00	CU	< 10.00	CE	< 80.00
CD	< 4.00	CR	< 4.00	CS	< 10.00
CU	< 1.00	DY	< 20.00	ER	< 6.00
EU	< 200.00	FE	10.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	6.00	LA	< 10.00	LI	< .50
LU	< .50	MO	20.00	MN	< 1.00
MO	< 1.00	NA	< 40.00	NB	< 6.00
ND	< 60.00	NI	< 4.00	P	< 600.00
PH	< 6.00	PR	< 60.00	RB	< 6.00
SE	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	20.00
TL	< 20.00	TM	< 4.00	V	10.00
W	< 40.00	YB	< 10.00	ZN	< 10.00
ZH	2.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

B-22

TABLE B-4 (Continued)

LAB. NO. 45002

REF. WT. 1.5 G

DATE: 2-23-77

SAMPLE: 6424-51-130 S.F.P. PROJECT: J. 3224145015 DILUTION: 1.0000

PLATE NO. 77-014

B-23	ELEMENT		CONCENTRATION, PP-	ELEMENT		CONCENTRATION, PPM	ELEMENT		CONCENTRATION, PPM
	AG	<	0.50	AL	<	1.00	B	<	2.00
	BA	<	5.00	BE	<	0.50	BI	<	1.00
	CA	<	50.00	CD	<	10.00	CE	<	80.00
	CU	<	4.00	CP	<	4.00	CS	<	10.00
	CO	<	1.00	DY	<	20.00	ER	<	6.00
	EU	<	200.00	FE	<	10.00	GD	<	10.00
	HF	<	20.00	HO	<	10.00	IN	<	1.00
	K	<	10.00	LA	<	10.00	LI	<	0.50
	LU	<	0.50	MB	<	10.00	MN	<	1.00
	MO	<	1.00	MA	<	40.00	NB	<	6.00
	NI	<	60.00	NI	<	4.00	P	<	600.00
	PH	<	5.00	PR	<	60.00	RB	<	6.00
	SE	<	8.00	SC	<	1.00	SI	<	80.00
	SM	<	100.00	SN	<	6.00	SR	<	40.00
	TA	<	40.00	TD	<	40.00	TI	<	20.00
	TL	<	20.00	TM	<	4.00	V	<	40.00
	W	<	40.00	YR	<	10.00	ZN	<	10.00
	ZR	<	2.00						

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE B-4 (Continued)

LAB. NO. 46002

REPORT TO: 3 FILE

DATE: 2-23-77

SAMPLE: H440X 6424-H1-147 2460

PROJECT NO. 322419BCUS

DILUTION: 1.0000

PLATE NO. 77-014

ELEMENT	CONCENTRATION, PPB	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	H	2.00
BA	20.00	BE	< .50	HI	< 1.00
CA	40.00	CD	< 10.00	CE	< 80.00
CO	< .50	CH	< .50	CS	< 10.00
CU	< 1.00	DY	< 20.00	ER	< 6.00
FJ	< 200.00	FE	20.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	8.00	LA	< 10.00	LI	.50
LJ	< .50	MG	10.00	MN	< 1.00
MJ	< 1.00	NA	< 40.00	NB	< 6.00
ND	< 60.00	NI	< 4.00	P	< 600.00
PO	< 6.00	PR	< 60.00	RB	< 6.00
SR	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YE	< 10.00	ZN	< 10.00
ZR	2.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE B-4 (Continued)

LAB. NO. 40302

SAMPLE NO. 64E4-01-121

SHIP NAME

S-105

DILUTION 1:1000

DATE: 2-23-77

PLATE NO. 77-014

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

B-25	AL	< 1.0	AL	< 1.0	AL	2.00
	AS	< 1.0	AS	< 1.0	AS	1.00
	CA	< 10.00	CA	< 10.00	CE	< 80.00
	CU	< 4.00	CH	< 4.00	CS	< 10.00
	CI	< 1.00	CI	< 20.00	ER	< 6.00
	EL	< 2.00	FE	< 10.00	GD	< 10.00
	HF	< 20.00	HU	< 10.00	IN	< 1.00
	K	< 8.00	LA	< 10.00	LI	< 1.00
	LI	< 1.00	AS	< 10.00	MIN	< 1.00
	NI	< 60.00	NI	< 4.00	NH	< 6.00
	P	< 5.00	PP	< 60.00	P	< 600.00
	S	< 5.00	SC	< 1.00	RB	< 6.00
	S	< 10.00	SI	< 6.00	SI	< 60.00
	TA	< 40.00	TH	< 40.00	SR	< 40.00
	TL	< 20.00	TI	< 4.00	T1	20.00
	V	< 40.00	YH	< 10.00	V	20.00
	ZP	< 2.00			ZN	< 10.00

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE B-4 (Continued)

LAB. NO. 4-002

REPORT TO: C ENGLF

DATE: 2-23-77

SAMPLE: H641N 6A24-H1-L16 GRAP

FEDWELL NO.

3224146005

DILUTION:

1.0000

PLATE NO. 77-014

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

AG < .50
 AL 20.00
 CA 40.00
 C) < 4.00
 CU < 1.00
 EU < 200.00
 HF < 20.00
 K 6.00
 LU < .50
 LO < 1.00
 ND < 60.00
 PE < 6.00
 SP < 6.00
 SH < 100.00
 TA < 40.00
 TL < 20.00
 W < 40.00
 ZF 2.00

AL < 1.00
 BE < .50
 CO < 10.00
 CR < 4.00
 DY < 20.00
 FE 10.00
 HO < 10.00
 LA < 10.00
 MG 10.00
 NA < 40.00
 NI < 4.00
 PR < 60.00
 SC < 1.00
 SN < 6.00
 TB < 40.00
 TM < 4.00
 YB < 10.00

B 2.00
 BI < 1.00
 CE < 80.00
 CS < 10.00
 ER < 6.00
 GC < 10.00
 IN < 1.00
 LI < .50
 MN < 1.00
 NB < 6.00
 P < 600.00
 RB < 6.00
 SI 80.00
 SR < 40.00
 TI 20.00
 V 20.00
 ZN < 10.00

B-26

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE B-4 (Continued)

LAB. NO. 46002

REPORT TO: G. EAGLE

DATE: 2-23-77

SAMPLE: FAWN 6434-b1-L11 WAF

PROJECT NO. 322414005

DILUTION: 1.000

PLATE NO. 77-014

ELEMENT	CONCENTRATION, PPB	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	B	2.00
BA	20.00	AR	< .50	BI	< 1.00
CA	60.00	CU	< 10.00	CE	< 80.00
CD	< 4.00	CR	< 4.00	CS	< 10.00
CU	< 1.00	DY	< 20.00	ER	< 6.00
EU	< 200.00	FE	< 10.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	< 6.00	LA	< 10.00	LI	.50
LU	< .50	MG	10.00	MN	< 1.00
MO	< 1.00	NA	< 40.00	NB	< 6.00
ND	< 60.00	NI	< 4.00	P	< 600.00
PS	< 0.60	PR	< 60.00	RB	< 6.00
SB	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	20.00
TL	< 20.00	TM	< 4.00	V	40.00
W	< 40.00	YB	< 10.00	ZN	< 10.00
ZP	2.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

B-27

TABLE B-4 (Continued)

LAB. NO. 46002

REPORT TO: G ENGLF

DATE: 2-23-77

SAMPLE: F 440N 6484-R1-13 W-4P

PROJECT NO. 3224146005

DILUTION: 1.0000

PLATE NO. 77-014

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	B	2.00
BA	< 20.00	BE	< .50	BI	< 1.00
CA	< 60.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CP	< 4.00	CS	< 10.00
CU	< 1.00	DY	< 20.00	ER	< 6.00
EU	< 200.00	EE	< 8.00	GO	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	< 4.00	LA	< 10.00	LI	< .50
LU	< .50	MG	< 1.00	MN	< 1.00
MO	< 1.00	NA	< 40.00	NB	< 6.00
NO	< 60.00	NI	< 4.00	P	< 600.00
PR	< 5.00	PR	< 60.00	RB	< 6.00
SB	< 8.00	SC	< 1.00	SI	< 80.00
SH	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	< 20.00
TI	< 20.00	TM	< 4.00	Y	< 40.00
W	< 40.00	YB	< 10.00	ZN	< 10.00
ZR	< 2.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE B-4 (Continued)

LAB. NO. 44012

REPORT TO: R. FOGLE

DATE: 2-23-77

SAMPLE: M 44012 6484-M1-L2 23-E

PROJECT NO. 322-146015

DILUTION: 1.0001

PLATE NO. 77-014

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AS	< .5	AL	< 1.00	R	2.00
BA	20.00	BE	< .50	BI	< 1.00
CA	60.00	CU	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 4.00	CS	< 10.00
GO	< 1.00	DY	< 20.00	ER	< 6.00
EU	< 200.00	FE	< 10.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	10.00	LA	< 10.00	LI	< .50
LU	< .50	MG	< 4.00	MN	< 1.00
MO	< 1.00	NA	< 40.00	NB	< 6.00
NU	< 60.00	NI	< 4.00	P	< 600.00
PS	< 6.00	PR	< 60.00	Rb	< 6.00
SB	< 8.00	SC	< 1.00	SI	80.00
SN	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TR	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	60.00
W	< 40.00	YR	< 10.00	ZN	< 10.00
ZR	2.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% ± (ONE STANDARD DEVIATION)

B-29

APPENDIX C
GRADE PGX DATA

This appendix contains complete data sets for the bulk density, tensile properties, flexural strength, compressive properties, and chemical impurity content of grade PGX graphite.

TABLE C-1
TENSILE PROPERTIES OF PGX GRAPHITE

LOT NO. 805-3 SPEC. DIA. 12.8 MM
LOG NO. 6484-112 SPEC. LENGTH 63. MM
LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
1AC-E-	10A AX	EC	1.784	6.2	.020	.205	10.6
-	12A AX	EC	1.787	6.5	.027	.213	10.5
-	22A AX	EC	1.786	7.1	.024	.163	9.2
-	24A AX	EC	1.785	6.5	.030	.212	10.3
-	06A AX	EC					11.9
-	08A AX	EC					12.0
-	10B AX	EC					11.4
-	12B AX	EC					11.0
-	18A AX	EC					9.9
-	20B AX	EC					10.6
-	22B AX	EC					7.3
-	24B AX	EC					12.0
1BC-E-	106B AX	EC	1.777	6.4	.025	.219	10.6
-	108B AX	EC	1.778				3.3
-	94B AX	EC	1.776	6.3	.020	.216	10.8
-	96B AX	EC	1.774	6.3	.022	.218	11.7
-	102A AX	EC					7.2
-	104B AX	EC					11.8
-	106A AX	EC					11.9
-	108A AX	EC					11.3
1BC-E-	90A AX	EC					12.0
-	92B AX	EC					11.5
-	94A AX	EC					11.6
-	96A AX	EC					12.0
MEAN			1.781	6.5 (.94 MPsi)	.024	.207	10.5 (1525.PSI)
STD. DEV.			.005	.3 (.04 MPsi)	.004	.020	2.0 (296.PSI)

TABLE C-1 (Continued)

LOT NO. ADS-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
1AC-E-31	RAD	EC	1.779	6.7	.019	.174	9.5
-27	RAD	EC	1.779	7.0	.017	.160	9.3
-11	RAD	EC	1.779	6.9	.021	.180	10.2
-07	RAD	EC	1.784			.174	9.7
-05	RAD	EC		6.7	.023	.187	9.8
-09	RAD	EC					9.3
-23	RAD	EC					9.9
-25	RAD	EC					7.8
-29	RAD	EC					8.3
-03	RAD	EC					9.6
1HC-F-113	RAD	EC	1.770	6.5	.025	.185	9.6
-117	RAD	EC	1.772	6.5	.021	.192	10.0
-133	RAD	EC	1.772	6.8	.020	.175	9.6
-137	RAD	EC	1.769	6.6	.022	.153	10.6
-111	RAD	EC					9.5
-115	RAD	EC					10.1
1bC-E-119	RAD	EC					9.6
-131	RAD	EC					8.4
-135	RAD	EC					10.3
-139	RAD	EC					10.2

MEAN			1.776	6.7 (.97 MPa)	.021	.176	9.6 (1389 PSI)

STD. DEV.			.006	.2 (.03 MPa)	.002	.013	.7 (102 PSI)

TABLE C-1 (Continued)

LOT NO. AD5-3 SPEC. DIA. 12.8 MM
 LUG NO. 6444-112 SPEC. LENGTH 63. MM
 LUG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
1AY-E-30B	AX	EM	1.771	6.2	.025	.237	11.3
-34A	AX	EM	1.772	6.4	.029	.223	10.6
-46B	AX	EM	1.774	6.0	.026	.222	10.3
-54A	AX	EM	1.769	6.0	.023	.231	10.6
-30A	AX	EM					11.0
-34B	AX	EM					11.0
-42A	AX	EM					10.7
-42H	AX	EM					11.4
-46A	AX	EM					11.0
-54B	AX	EM					11.4
1BY-E-114B	AX	EM	1.773	6.3	.020	.239	11.7
-118A	AX	EM	1.773	6.4	.019	.239	11.7
-130B	AX	EM	1.778	6.3	.025	.226	11.0
-138A	AX	EM	1.779	6.4	.025	.227	11.0
-114A	AX	EM					11.6
-118B	AX	EM					10.5
1BY-E-126A	AX	EM					10.3
-126B	AX	EM					12.3
-130A	AX	EM					11.3
-138B	AX	EM					12.0
MEAN			1.774	6.2 (.91 MPaI)	.024	.230	11.1 (1614, PSI)
STD. DEV.			.003	.2 (.03 MPaI)	.003	.007	.5 (79, PSI)

TABLE C-1 (Continued)

LOT NO. 405-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
1AY-F-45	RAD	EM	1.772	6.3	.018	.193	9.8
-49	RAD	EM	1.772	6.5	.021	.186	9.7
-63	RAD	EM	1.775	7.2	.016	.130	10.6
-67	RAD	EM	1.776	7.0	.015	.201	11.3
-43	RAD	EM					9.3
-47	RAD	EM					9.3
-51	RAD	EM					8.3
-61	RAD	EM					10.3
-65	RAD	EM					11.0
-69	RAD	EM					10.0
1BY-F-153	RAD	EM	1.774	7.1	.018	.159	9.2
-157	RAD	EM	1.773	7.0	.021	.209	11.3
-171	RAD	EM	1.776	6.8	.018	.191	10.5
-175	RAD	EM	1.775	6.8	.020	.184	10.1
-151	RAD	EM					11.0
-155	RAD	EM					11.0
1FY-E-159	RAD	E1					10.2
-169	RAD	EM					10.9
-173	RAD	EM					9.9
-177	RAD	EM					9.7
MEAN			1.774	6.8	.018	.182	10.2
				(.99 MPsi)			(1475, PSI)
STD. DEV.			.002	.3	.002	.025	.8
				(.04 MPsi)			(115, PSI)

TABLE C-1 (Continued)

LOT NO. 805-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
1AF-E-60B AX	EF		1.773	6.1	.028	.250	11.4
- 64A AX	EE		1.795	6.3	.020	.223	11.0
- 76B AX	EE		1.782	6.1	.020	.219	10.8
- 84A AX	EE		1.786	6.3	.022	.219	10.7
- 60A AX	EE						11.3
- 64B AX	EE						10.3
- 72A AX	EE						11.8
- 72B AX	EE						11.0
- 76A AX	EE						12.0
- 84B AX	EE						10.7
1BE-E-144B AX	EE		1.785	6.4	.020	.259	12.3
- 148A AX	EE		1.825	6.8	.024	.240	12.2
- 160B AX	EE		1.792	6.4	.027	.254	11.9
- 168A AX	EE		1.781	6.2	.027	.247	11.5
- 144A AX	EE						12.0
- 148B AX	EE						11.9
1HE-E-156A AX	EE						11.7
- 156B AX	EE						11.0
- 160A AX	EE						10.7
- 168B AX	EE						11.6
MEAN			1.790	6.3	.023	.239	11.4
				(.91 MPsi)			(1654 PSI)
STD. DEV.			.016	.2	.003	.016	.6
				(.03 MPsi)			(85 PSI)

TABLE C-1 (Continued)

LOT NO. 8D5-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
1AE-E-85	RAD	EE	1.787	7.2	.018	.197	11.3
-81	RAD	EE	1.787	7.3	.021	.198	11.3
-99	RAD	EE	1.789	7.4	.012	.175	10.9
-103	RAD	EE	1.788	7.5	.022	.196	11.4
-79	RAD	EE					10.9
-83	RAD	EE					11.0
-87	RAD	EE					10.8
-97	RAD	EE					10.4
-101	RAD	EE					10.9
-105	RAD	EE					11.5
1BE-E-189	RAD	EE	1.794	7.2	.021	.201	11.3
-193	RAD	EE	1.792	7.3	.015	.176	10.7
-207	RAD	EE	1.789	6.7	.020	.180	10.0
-211	RAD	EE	1.789	7.2	.020	.195	11.0
-187	RAD	EE					11.9
-191	RAD	EE					11.9
1HE-E-195	RAD	EE					10.4
-205	RAD	EE					9.4
-209	RAD	EE					11.1
-213	RAD	EE					10.6
MEAN			1.790	7.2 (1.05 MPsi)	.019	.190	10.9 (1586, PSI)
STD. DEV.			.002	.2 (.03 MPsi)	.003	.011	.6 (88, PSI)

TABLE C-1 (Continued)

LOT NO. 805-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
6AC-M-	10B AX	MLC	1.785	6.3	.019	.181	9.4
-	12B AX	MLC	1.781	6.1	.024	.227	10.8
-	22A AX	MLC	1.792	6.3	.024	.192	9.8
-	24A AX	MLC	1.784	6.5	.021	.174	9.1
-	10A AX	MLC					10.7
-	08B AX	MLC					9.9
-	06B AX	MLC					9.9
-	12A AX	MLC					9.7
-	18A AX	MLC					9.2
-	20A AX	MLC					10.1
-	22B AX	MLC					11.2
-	24B AX	MLC					9.9
6BC-M-	94B AX	MLC	1.769	6.0	.023	.215	10.3
-	96A AX	MLC	1.771	5.8	.017	.204	10.1
-	98A AX	MLC	1.780	6.3	.019	.220	10.9
6BC-M-	104B AX	MLC					9.5
-	106B AX	MLC	1.770	6.0	.022	.218	10.6
-	92A AX	MLC					11.0
-	94A AX	MLC					9.4
-	96B AX	MLC					10.0
-	98B AX	MLC					10.1
-	106A AX	MLC					8.5
MEAN			1.779	6.2 (.90 MPa)	.021	.204	10.0 (1451, PSI)
STD. DEV.			.008	.2 (.03 MPa)	.003	.020	.7 (98, PSI)

TABLE C-1 (Continued)

LOT NO. 405-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/CM³

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/CM ³)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
64C-M-07	RAD	MLC	1.782	7.0	.021	.146	8.6
-11	RAD	MLC	1.784	6.9	.020	.141	8.2
-25	RAD	MLC	1.781	7.5	.021	.162	9.7
-29	RAU	MLC	1.779	7.3	.019	.130	8.1
-05	RAD	MLC					10.1
-09	RAU	MLC					8.8
-13	RAD	MLC					8.7
-23	RAD	MLC					9.2
-27	RAD	MLC					7.6
-31	RAD	MLC					9.9
68C-M-115	RAD	MLC	1.779	7.1	.020	.144	8.4
-119	RAD	MLC	1.771	7.2	.024	.156	8.9
68C-M-133	RAD	MLC	1.775	7.0	.017	.177	10.0
-137	RAU	MLC	1.773	7.0	.017	.190	10.7
-113	RAD	MLC					9.3
-117	RAU	MLC					8.4
-121	RAD	MLC					9.7
-131	RAD	MLC					9.5
-135	RAD	MLC					10.1
-139	RAD	MLC					9.3
MEAN			1.778	7.1 (1.03 MPsi)	.020	.156	9.2 (1329 PSI)
STD. DEV.			.005	.2 (.03 MPsi)	.002	.020	.8 (116 PSI)

TABLE C-1 (Continued)

LOT NO. 8D5-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
6AY-M-30H	AX	MLM	1.782	6.4	.021	.200	10.4
-34A	AX	MLM	1.783	6.3	.025	.225	10.8
-46B	AX	MLM	1.778	6.4	.022	.211	10.8
-52A	AX	MLM	1.775	6.3	.021	.224	11.3
-30A	AX	MLM					11.1
-34B	AX	MLM					12.0
-42A	AX	MLM					10.6
-42B	AX	MLM					11.9
-46A	AX	MLM					11.2
-52B	AX	MLM					10.3
6BY-M-112B	AX	MLM	1.781	6.7	.026	.208	10.7
-116A	AX	MLM	1.782	6.5	.021	.216	10.8
6BY-M-128H	AX	MLM	1.781	6.5	.026	.242	11.7
-134A	AX	MLM	1.779	6.7	.022	.207	10.5
-124A	AX	MLM					9.4
-124B	AX	MLM					12.0
6BY-M-128A	AX	MLM					10.5
-134B	AX	MLM					11.0
MEAN			1.780	6.5	.023	.217	10.9
				(.94 MPsi)			(1587, PSI)
STD. DEV.			.003	.2	.002	.013	.7
				(.02 MPsi)			(.99, PSI)

TABLE C-1 (Continued)

LOT NO. 8D5-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
DAY-M-45	RAD	MLM	1.789	7.8	.021	.151	9.3
-49	RAD	MLM	1.787	7.2	.020	.162	9.4
-63	RAD	MLM	1.783	7.2	.021	.161	9.7
-67	RAD	MLM	1.785	7.2	.020	.159	9.5
-43	RAD	MLM					9.9
-47	RAD	MLM					10.3
-51	RAD	MLM					10.4
-61	RAD	MLM					10.1
-65	RAD	MLM					9.9
-69	RAD	MLM					10.3
DAY-M-153	RAD	MLM	1.780	7.0	.020	.216	11.7
-157	RAD	MLM	1.778	7.4	.019	.217	11.5
-171	RAD	MLM	1.783	7.3	.020	.186	10.7
-175	RAD	MLM	1.781	7.2	.021	.184	10.5
-151	RAD	MLM					9.6
-155	RAD	MLM					11.3
DAY-M-159	RAD	MLM					10.3
-169	RAD	MLM					10.5
-173	RAD	MLM					11.1
-177	RAD	MLM					10.7
MEAN			1.783	7.3 (1.06 MPaSI)	.020	.179	10.3 (1500, PSI)
STD. DEV.			.004	.2 (.03 MPaSI)	.001	.026	.7 (98, PSI)

TABLE C-1 (Continued)

LOT NO. AD5-3 SPEC. DIA. 12.8 MM
 LOG NO. 6444-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
6AE-M-60B	AX	MLE	1.790	6.5	.020	.241	11.9
-64A	AX	MLE	1.792	6.6	.013	.208	11.3
-76B	AX	MLE	1.792	6.7	.022	.206	10.8
-84A	AX	MLE	1.789	6.6	.020	.204	10.6
-60A	AX	MLE					11.5
-64B	AX	MLE					10.3
-72A	AX	MLE					11.3
-72B	AX	MLE					11.7
-76A	AX	MLE					11.3
-84B	AX	MLE					11.6
6HE-M-142B	AX	MLE	1.792	6.7	.020	.241	12.0
-146A	AX	MLE	1.787	6.7	.024	.258	12.8
-158B	AX	MLE	1.798	6.5	.019	.198	10.7
-164A	AX	MLE	1.784	6.4	.024	.254	12.0
-142A	AX	MLE					11.6
-146B	AX	MLE					11.8
6HE-M-154A	AX	MLE					11.0
-154B	AX	MLE					11.3
-158A	AX	MLE					11.1
-164B	AX	MLE					11.7
MEAN			1.790	6.6	.020	.226	11.4
				(.96 MPa)			(1656 PSI)
STD. DEV.			.004	.1	.003	.025	.6
				(.02 MPa)			(84 PSI)

TABLE C-1 (Continued)

LOT NO. 8D5-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
6AE-M-81	RAD	MLE	1.794	7.6	.016	.149	8.9
-85	RAD	MLE	1.789	7.7	.020	.201	12.1
-99	RAD	MLE	1.790	7.5	.018	.168	10.3
-103	RAD	MLE	1.790	7.7	.011	.184	11.5
-79	RAD	MLE					11.0
-83	RAD	MLE					10.6
-87	RAD	MLE					10.8
-97	RAD	MLE					10.7
-101	RAD	MLE					11.6
-105	RAD	MLE					11.4
6BE-M-189	RAD	MLE	1.791	7.9	.013	.145	10.0
-193	RAD	MLE	1.789	7.7	.016	.198	12.0
-207	RAD	MLE	1.791	7.8	.015	.189	11.7
-211	RAD	MLE	1.793	7.6	.020	.197	11.8
-187	RAD	MLE					11.6
-191	RAD	MLE					9.2
6BE-M-195	RAD	MLE					11.4
-205	RAD	MLE					10.3
-209	RAD	MLE					12.0
-213	RAD	MLE					11.4
MEAN			1.791	7.7 (1.12 MPa)	.016	.179	11.0 (1598 PSI)
STD. DEV.			.002	.2 (.02 MPa)	.003	.022	.9 (131 PSI)

TABLE C-1 (Continued)

LOT NO. ADS-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
12AC-B-	10B AX	EC	1.786	6.0	.025	.188	8.8
-	12B AX	EC	1.777	5.7	.031	.197	8.8
-	22B AX	EC	1.771	7.3	.022	.152	8.7
-	24B AX	EC	1.775	5.8	.030	.209	9.0
-	06A AX	EC					9.7
-	08B AX	EC					8.2
-	10A AX	EC					10.0
-	12A AX	EC					9.7
-	18A AX	EC					10.0
-	20B AX	EC					9.0
-	22A AX	EC					9.0
-	24A AX	EC					10.1
12BC-B-	94B AX	EC	1.791	6.3	.031	.171	8.3
-	96B AX	EC	1.795	6.6	.026	.188	9.1
-	106B AX	EC	1.789	6.1	.019	.170	8.5
-	108B AX	EC	1.777	5.9	.030	.203	9.0
12BC-B-	96A AX	EC					10.2
-	90A AX	EC					10.2
-	92B AX	EC					7.6
-	94A AX	EC					9.6
-	102A AX	EC					6.5
-	104B AX	EC					9.0
-	106A AX	EC					9.2
-	108A AX	EC					9.8
MEAN			1.783	6.2 (.90 MPsi)	.027	.185	9.1 (1317, PSI)
STD. DEV.			.009	.5 (.08 MPsi)	.005	.019	.9 (127, PSI)

TABLE C-1 (Continued)

LOT NO. RD5-3				SPEC. DIA.		12.8 MM	
LOG NO. 6484-112				SPEC. LENGTH		63. MM	
LOG DENSITY 1.78 MG/M**3							

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)

12AC-B-05	RAD	EC	1.769	7.0	.026	.186	9.7
-09	RAD	EC	1.782	7.4	.020	.152	8.7
-27	RAD	EC	1.778	7.1	.023	.150	8.3
-03	RAD	EC					9.9
-07	RAD	EC					9.5
-11	RAD	EC					7.4
-21	RAD	EC					8.8
-25	RAD	EC					8.6
-29	RAD	EC					8.5
12BC-B-111	RAD	EC					9.1
-115	RAD	EC					10.4
12BC-B-119	RAD	EC					8.7
-129	RAD	EC					6.3
-133	RAD	EC					9.3
-137	RAD	EC					7.5
12BC-B-113	RAD	EC	1.780	7.0	.021	.149	8.4
-117	RAD	EC	1.779	7.6	.021	.160	9.0
-131	RAD	EC	1.776	7.6	.023	.187	10.3
-135	RAD	EC	1.774	7.7	.019	.180	10.6

MEAN			1.777	7.4 (1.07 MPaSI)	.022	.160	8.9 (1292, PSI)

STD. DEV.			.004	.3 (.05 MPaSI)	.002	.017	1.1 (159, PSI)

TABLE C-1 (Continued)

LOT NO. AD5-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
12AY-B-30B	AX	EM	1.770	5.7	.032	.231	9.3
-34A	AX	EM	1.767	6.0	.031	.189	8.7
-46B	AX	EM	1.776	5.8	.027	.212	9.1
-54A	AX	EM	1.769	5.8	.030	.186	8.4
-30A	AX	EM					9.3
-34B	AX	EM					8.8
-42A	AX	EM					9.4
-42B	AX	EM					9.2
-46A	AX	EM					9.6
-54B	AX	EM					9.3
12BY-B-114B	AX	EM	1.771	5.9	.028	.210	9.2
-118A	AX	EM	1.771	6.1	.029	.224	9.9
-130B	AX	EM	1.775				6.8
-138A	AX	EM	1.782	6.4	.030	.184	8.8
-114A	AX	EM					9.0
-118B	AX	EM					9.3
12BY-B-126A	AX	EM					9.5
-126B	AX	EM					9.8
-130A	AX	EM					9.1
-138B	AX	EM					9.1
MEAN			1.773	6.0	.030	.205	9.1
				(.87 MPa)			(1316 PSI)
STD. DEV.			.005	.2	.002	.019	.6
				(.03 MPa)			(93 PSI)

TABLE C-1 (Continued)

LOT NO. 8D5-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
12AY-B-45	RAD	EM	1.776	6.8	.026	.179	9.1
-49	RAD	EM	1.776	6.6	.026	.150	7.9
-63	RAD	EM	1.774	6.9	.020	.168	8.7
-67	RAD	EM	1.773	6.9	.022	.159	8.4
-43	RAD	EM					7.1
-47	RAD	EM					7.8
-51	RAD	EM					8.1
-61	RAD	EM					9.3
-65	RAD	EM					8.0
-69	RAD	EM					8.9
12BY-B-153	RAD	EM	1.775				6.1
-157	RAD	EM	1.772	7.0	.019	.180	9.5
-171	RAD	EM	1.788	7.2	.024	.147	8.0
-175	RAD	EM	1.782	7.2	.020	.147	8.3
-151	RAD	EM					9.5
-155	RAD	EM					7.0
12BY-B-159	RAD	EM					9.0
-169	RAD	EM					3.6
-173	RAD	EM					9.3
-177	RAD	EM					9.0
MEAN			1.777	6.9 (1.01 MPaSI)	.022	.161	8.1 (1181, PSI)
STD. DEV.			.005	.2 (.03 MPaSI)	.003	.014	1.4 (202, PSI)

TABLE C-1 (Continued)

LOT NO. 805-3 SPEC. DIA. 12.8 MM
 LOG NO. 6484-112 SPEC. LENGTH 63. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)

12AF-H-	60B AX	EE	1.764	5.6	.040	.205	8.4
-	64A AX	EE	1.776	5.9	.025	.211	9.4
-	76B AX	EE	1.796	6.1	.029	.200	9.0
-	84A AX	EE	1.785	6.0	.026	.214	9.8
-	60A AX	EF					9.5
-	64B AX	EE					8.7
-	72A AX	EE					9.3
-	72B AX	EE					9.6
-	76A AX	EE					9.1
-	84B AX	EE					7.9
12BE-B-	144B AX	EE	1.769	5.9	.025	.217	9.6
-	148A AX	EE	1.786	6.1	.028	.192	9.0
-	160B AX	EE	1.785	6.4	.024	.206	9.7
-	168A AX	EE	1.780	6.3	.030	.231	10.0
-	144A AX	EE					9.5
-	148B AX	EE					10.2
12BE-H-	156A AX	EE					10.3
-	156B AX	EE					9.5
-	160A AX	EE					10.0
-	168B AX	EE					10.0

MEAN			1.780	6.1	.028	.209	9.4
			(.88 MPaSI)		(1367 PSI)		

STD. DEV.			.010	.2	.005	.012	.6
			(.04 MPaSI)		(88 PSI)		

TABLE C-1 (Continued)

LOT NO. 805-3				SPEC. DIA. 12.8 MM			
LOG NO. 6484-112				SPEC. LENGTH 63. MM			
LOG DENSITY 1.78 MG/M**3							
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
12AE-B-81	RAD	EE	1.771	6.8	.029	.203	10.0
-85	RAD	EE	1.776	6.8	.029	.150	7.9
-90	RAD	EE	1.778	7.3	.026	.177	9.1
-103	RAD	EE	1.778	7.0	.015	.179	9.7
-79	RAD	EF					9.6
-83	RAD	EE					9.3
-87	RAD	EE					9.0
-97	RAD	EE					8.2
-101	RAD	EE					9.5
-105	RAD	EE					9.2
12BE-B-189	RAD	EE	1.773	6.7	.024	.135	7.3
-193	RAD	EE	1.773	6.6	.021	.131	7.3
-207	RAD	EE	1.776	7.3	.024	.180	9.4
-211	RAD	EE	1.774	6.8	.025	.131	7.2
-187	RAD	EE					8.7
-191	RAD	EE					9.3
12BE-B-195	RAD	EE					7.9
-205	RAD	EE					9.3
-209	RAD	EE					8.9
-213	RAD	EE					8.5
MEAN			1.775	6.9	.024	.161	8.8
				(1.00 MPa)			(1270 PSI)
STD. DEV.			.003	.3	.005	.028	.9
				(.04 MPa)			(124 PSI)

TABLE C-2
FLEXURAL STRENGTH OF PGX GRAPHITE

LOT NO. 8D5-3 SPEC. DIA. 6.4 MM
LOG NO. 6484-112 SPEC. LENGTH 51. MM
LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1AC	12A AX	EC		19.1	16.5
	12B AX	EC		18.6	16.1
	10A AX	EC		15.8	14.1
	10B AX	EC		19.1	16.5
	16A AX	EC		18.6	16.1
	16B AX	EC		21.1	17.8
	24A AX	EC		17.4	15.2
	24B AX	EC		16.7	14.8
	26A AX	EC		14.6	13.2
	26B AX	EC		18.7	16.2
	32A AX	EC		16.9	14.9
	32P AX	EC		18.8	16.3
1BC	88A AX	EC		16.9	14.9
	88B AX	EC		19.7	16.9
	86A AX	EC		16.9	14.9
	86B AX	EC		21.4	18.0
	80A AX	EC		17.5	15.4
1BC	80B AX	EC		16.5	14.6
	96A AX	EC		16.9	14.9
	96B AX	EC		18.8	16.3
	102A AX	EC		19.1	16.5
	102B AX	EC		20.1	17.2
	104A AX	EC		18.9	16.4
	104B AX	EC		16.8	14.8
MEAN				18.1 MPA (2628. PSI)	15.8 MPA (2289. PSI)
STD. DEV.				1.6 MPA (237. PSI)	1.2 MPA (172. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3			SPEC. DIA.	6.4 MM
LOG NO. 6484-112			SPEC. LENGTH	51. MM
LOG DENSITY 1.78			MG/M**3	

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1BC	163 RAD	EC		15.8	14.1
	165 RAD	EC		15.8	14.1
	169 RAD	EC		17.8	15.7
	171 RAD	EC		17.2	15.2
	175 RAD	EC		11.5	10.7
	189 RAD	EC		15.4	13.8
	191 RAD	EC		19.7	17.0
	195 RAD	EC		15.7	14.1
1BC	197 RAD	EC		21.1	18.0
	201 RAD	EC		16.3	14.5
1AC	7 RAD	EC		16.8	14.9
	9 RAD	EC		15.0	13.5
	13 RAD	EC		18.8	16.4
	15 RAD	EC		18.0	15.8
	19 RAD	EC		20.3	17.5
	33 RAD	EC		21.8	18.4
	35 RAD	EC		14.4	13.0
	39 RAD	EC		16.1	14.4
	41 RAD	EC		16.6	14.8
	45 RAD	EC		17.5	15.5
MEAN				17.1 MPA (2478. PSI)	15.1 MPA (2185. PSI)
STD. DEV.				2.4 MPA (354. PSI)	1.8 MPA (266. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3			SPEC. DIA. 6.4 MM	
LOG NO. 6484-112			SPEC. LENGTH 51. MM	
LOG DENSITY 1.78			MG/M**3	

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1AY	36A	AX	EM	16.7	14.7
	36B	AX	EM	22.0	18.3
	38A	AX	EM	19.5	16.7
	38B	AX	EM	19.4	16.6
	42A	AX	EM	17.1	15.0
	42B	AX	EM	16.4	14.5
	48A	AX	EM	18.9	16.3
	48B	AX	EM	19.2	16.5
	50A	AX	EM	19.6	16.7
	50B	AX	EM	19.4	16.6
1BY	108A	AX	EM	19.5	16.7
	108B	AX	EM	19.8	16.9
	110A	AX	EM	18.1	15.7
	110B	AX	EM	18.3	15.8
	114A	AX	EM	17.5	15.3
	114P	AX	EM	20.7	17.5
	120A	AX	EM	19.5	16.7
	120B	AX	EM	17.9	15.6
1BY	122A	AX	EM	15.8	14.0
	122B	AX	EM	18.0	15.6

MEAN			18.7 MPA (2707. PSI)	16.1 MPA (2333. PSI)
STD. DEV.			1.5 MPA (217. PSI)	1.0 MPA (152. PSI)

TABLE C-2 (Continued)

LCT NO. 8D5-3 SPEC. DIA. 6.4 MM
 LOG NO. 6484-112 SPEC. LENGTH 51. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1PY	215 RAD	EM		15.2	13.7
	219 RAD	EM		17.7	15.6
	221 RAD	EM		20.2	17.5
	225 RAD	EM		19.9	17.2
	227 RAD	EM		18.4	16.1
	241 RAD	EM		16.7	14.9
	245 RAD	EM		19.5	17.0
	247 RAD	EM		19.4	16.9
	251 RAD	EM		17.2	15.3
	253 RAD	EM		17.4	15.4
1AY	59 RAD	EM		16.6	14.8
	63 RAD	EM		16.4	14.6
	65 RAD	EM		14.9	13.5
	69 RAD	EM		12.4	11.4
1AY	71 RAD	EM		13.0	11.9
	85 RAD	EM		19.4	16.9
	89 RAD	EM		20.0	17.3
	91 RAD	EM		19.8	17.2
	95 RAD	EM		18.3	16.1
	97 RAD	EM		18.2	16.0
MEAN				17.5 MPA (2543. PSI)	15.5 MPA (2243. PSI)
STD. DEV.				2.3 MPA (332. PSI)	1.8 MPA (255. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3 SPEC. DIA. 6.4 MM
 LOG NO. 6484-112 SPEC. LENGTH 51. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1AE	56A AX	EE		19.7	16.8
	56B AX	EE		17.5	15.3
	58A AX	EE		16.7	14.7
	58B AX	EE		18.0	15.6
	62A AX	EE		17.4	15.2
	62B AX	EE		17.1	15.0
	68A AX	EE		18.6	16.1
	68B AX	EE		18.3	15.9
	70A AX	EE		17.3	15.1
	70B AX	EE		16.8	14.8
1BE	128A AX	EE		19.0	16.3
	128B AX	EE		17.7	15.4
	130A AX	EE		20.3	17.2
	130B AX	EE		20.3	17.2
	134A AX	EE		21.1	17.7
	134B AX	EE		19.6	16.7
	140A AX	EE		19.6	16.7
	140B AX	EE		19.9	17.0
	142A AX	EE		16.8	14.8
1BE	142B AX	EE		18.8	16.2
MEAN				18.5 MPA (2688. PSI)	16.0 MPA (2320. PSI)
STD. DEV.				1.4 MPA (196. PSI)	.9 MPA (137. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3			SPEC. DIA. 6.4 MM	
LOG NO. 6484-112			SPEC. LENGTH 51. MM	
LOG DENSITY 1.78			MG/M**3	
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1AE	111 RAD	EE	18.0	16.0
	115 RAD	EE	19.8	17.4
	117 RAD	EE	16.2	14.6
	121 RAD	EE	16.6	14.9
	123 RAD	EE	19.0	16.8
	137 RAD	EE	19.5	17.1
	141 RAD	EE	18.3	16.2
	143 RAD	EE	16.4	14.8
	147 RAD	EE	17.6	15.7
	149 RAD	EE	21.3	18.4
1BE	267 RAD	EE	21.2	18.3
	271 RAD	EE	18.8	16.6
	273 RAD	EE	20.5	17.9
	277 RAD	EE	21.0	18.2
	279 RAD	EE	19.6	17.2
	293 RAD	EE	19.6	17.2
	297 RAD	EE	17.9	15.9
	299 RAD	EE	15.9	14.4
	303 RAD	EE	19.2	16.9
	305 RAD	EE	19.3	17.0
MEAN			18.8 MPA (2726. PSI)	16.6 MPA (2404. PSI)
STD. DEV.			1.6 MPA (239. PSI)	1.2 MPA (180. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3			SPEC. DIA. 6.4 MM		
LOG NO. 6484-112			SPEC. LENGTH 51. MM		
LOG DENSITY 1.78			MG/M**3		

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)

6AC	154A	AX	MLC	16.8	14.8
	154B	AX	MLC	19.1	16.4
	156A	AX	MLC	16.5	14.5
	156B	AX	MLC	17.0	14.9
	160A	AX	MLC	17.7	15.4
	160B	AX	MLC	19.5	16.7
	174A	AX	MLC	14.2	12.6
	174B	AX	MLC	16.9	14.8
	176A	AX	MLC	18.6	16.0
	176B	AX	MLC	18.6	16.0
	168A	AX	MLC	18.9	16.2
	168B	AX	MLC	18.7	16.1
6BC	224A	AX	MLC	17.4	15.2
	224B	AX	MLC	15.1	13.5
	226A	AX	MLC	17.8	15.4
	226B	AX	MLC	18.2	15.7
	232A	AX	MLC	18.2	15.8
6BC	232B	AX	MLC	16.9	14.8
	236A	AX	MLC	17.2	15.0
	236B	AX	MLC	17.3	15.1
	238A	AX	MLC	16.9	14.8
	238B	AX	MLC	18.9	16.2
	244A	AX	MLC	18.5	15.9
	244B	AX	MLC	17.0	14.9

MEAN			17.6 MPA (2550. PSI)	15.3 MPA (2218. PSI)	
STD. DEV.			1.3 MPA (181. PSI)	.9 MPA (133. PSI)	

TABLE C-2 (Continued)

LOT NO. 8D5-3			SPEC. DIA.	6.4 MM
LOG NO. 6484-112			SPEC. LENGTH	51. MM
LOG DENSITY 1.78			MG/M**3	
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6AC	319 RAD	MLC	13.8	12.6
	321 RAD	MLC	19.0	16.7
	325 RAD	MLC	12.4	11.5
	327 RAD	MLC	17.4	15.5
	331 RAD	MLC	17.1	15.3
	345 RAD	MLC	9.7	9.1
	347 RAD	MLC	18.6	16.4
	351 RAD	MLC	10.1	9.5
	353 RAD	MLC	17.6	15.6
	357 RAD	MLC	17.7	15.7
6BC	471 RAD	MLC	17.2	15.3
	473 RAD	MLC	14.5	13.2
	475 RAD	MLC	16.3	14.6
	477 RAD	MLC	14.2	13.0
	481 RAD	MLC	16.8	15.1
6BC	483 RAD	MLC	18.6	16.4
	485 RAD	MLC	14.4	13.1
	487 RAD	MLC	17.8	15.8
	489 RAD	MLC	17.6	15.6
	493 RAD	MLC	17.7	15.7
MEAN			15.9 MPA (2310. PSI)	14.3 MPA (2072. PSI)
STD. DEV.			2.7 MPA (396. PSI)	2.2 MPA (321. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3		SPEC. DIA. 6.4 MM	
LOG NO. 6484-112		SPEC. LENGTH 51. MM	
LOG DENSITY 1.78		MG/M**3	

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION (MG/M**3)	DENSITY	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6AY	180A AX	MLM		19.8	17.5
	180B AX	MLM		19.8	17.5
	182A AX	MLM		19.3	16.7
	182B AX	MLM		16.2	14.4
	186A AX	MLM		18.8	16.3
	186B AX	MLM		18.4	16.0
	192A AX	MLM		18.9	16.4
	192B AX	MLM		18.1	15.8
	194A AX	MLM		18.6	16.2
	194B AX	MLM		16.6	14.7
6BY	250A AX	MLM		18.6	16.1
	250B AX	MLM		17.6	15.4
	252A AX	MLM		18.0	15.7
	252B AX	MLM		16.9	14.9
	256A AX	MLM		17.4	15.3
	256B AX	MLM		18.7	16.2
	262A AX	MLM		16.7	14.8
	262B AX	MLM		18.6	16.2
6FY	264A AX	MLM		17.7	15.5
	264B AX	MLM		19.1	16.5

MEAN		18.2 MPA (2639. PSI)	15.9 MPA (2300. PSI)
STD. DEV.		1.0 MPA (152. PSI)	.8 MPA (111. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3			SPEC. DIA.	6.4 MM	
LOG NO. 6484-112			SPEC. LENGTH	51. MM	
LOG DENSITY 1.78			MG/M**3		

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)

6AY	371 RAD	MLM		18.1	16.1
	375 RAD	MLM		18.7	16.3
	377 RAD	MLM		14.3	13.1
	381 RAD	MLM		16.1	14.5
	383 RAD	MLM		18.5	16.4
	397 RAD	MLM		18.1	16.1
	401 RAD	MLM		19.1	16.8
6AY	403 RAD	MLM		18.2	16.2
	407 RAD	MLM		12.0	11.2
	409 RAD	MLM		19.0	16.7
6BY	501 RAD	MLM		17.4	15.6
	505 RAD	MLM		19.4	17.0
	507 RAD	MLM		17.6	15.7
	511 RAD	MLM		18.2	16.2
	513 RAD	MLM		19.2	16.9
	527 RAD	MLM		19.3	17.0
	531 RAD	MLM		18.4	16.3
	533 RAD	MLM		17.6	15.7
	537 RAD	MLM		17.9	15.9
	539 RAD	MLM		15.7	14.2

MEAN				17.6 MPA (2557. PSI)	15.7 MPA (2277. PSI)

STD. DEV.				1.8 MPA (268. PSI)	1.5 MPA (213. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3				SPEC. DIA.	6.4 MM
LOG NO. 6484-117				SPEC. LENGTH	51. MM
LOG DENSITY 1.78				MG/M**3	
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6AE	200A	AX	MLE	19.2	16.6
	200B	AX	MLE	17.6	15.5
	202A	AX	MLF	21.8	18.4
	202B	AX	MLE	18.1	15.9
	206A	AX	MLE	17.8	15.7
	206B	AX	MLE	19.0	16.5
	212A	AX	MLF	19.7	17.0
	212B	AX	MLE	19.2	16.7
	214A	AX	MLE	19.5	16.9
	214B	AX	MLE	18.6	16.2
6BF	270A	AX	MLF	20.3	17.4
	273B	AX	MLE	19.4	16.8
	272A	AX	MLE	19.1	16.6
	272B	AX	MLE	21.0	17.9
	276A	AX	MLF	19.5	16.9
	276B	AX	MLE	19.9	17.2
	280A	AX	MLE	18.4	16.1
	280B	AX	MLF	20.9	17.9
	282A	AX	MLF	20.0	17.2
6BE	282B	AX	MLE	18.9	16.4
MEAN				19.4 MPA (2815. PSI)	16.8 MPA (2434. PSI)
STD. DEV.				1.1 MPA (157. PSI)	.8 MPA (110. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3			SPEC. DIA. 6.4 MM		
LOG NO. 6484-112			SPEC. LENGTH 51. MM		
LOG DENSITY 1.78			MG/M**3		
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6AE	423 RAD	MLF		18.7	16.7
	427 RAD	MLE		18.9	16.8
	429 PAD	MLE		22.8	19.7
	433 RAD	MLE		18.9	16.8
	435 RAD	MLE		16.6	15.0
	449 RAD	MLE		16.3	14.8
	453 RAD	MLE		20.3	17.9
	455 RAD	MLE		19.2	17.1
	459 RAD	MLF		21.3	18.7
	461 RAD	MLE		23.5	20.2
6BE	557 RAD	MLE		18.3	16.3
	557 RAD	MLE		16.7	15.1
	559 PAD	MLF		17.8	16.0
	563 RAD	MLE		20.6	18.1
	565 PAD	MLE		18.4	16.4
6BE	579 RAD	MLE		22.9	19.8
	583 RAD	MLE		17.1	15.4
	585 RAD	MLE		20.6	18.1
	589 RAD	MLE		19.3	17.1
	591 RAD	MLE		18.9	16.8
MEAN				19.3 MPA (2806. PSI)	17.1 MPA (2486. PSI)
STD. DEV.				2.1 MPA (305. PSI)	1.6 MPA (230. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3 SPEC. DIA. 6.4 MM
 LOG NO. 6484-112 SPEC. LENGTH 51. MM
 LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
12AC	294A AX	EC		15.0	13.3
	294P AX	EC		15.2	13.6
	296A AX	EC		13.6	12.3
	296P AX	EC		17.0	14.9
	300A AX	EC		17.4	15.2
	300B AX	EC		15.5	13.7
	310A AX	EC		17.4	15.2
	310B AX	EC		17.2	15.0
	312A AX	EC		16.0	14.1
	312B AX	EC		13.7	12.4
	316A AX	EC		17.1	14.9
	316P AX	EC		15.6	13.8
12BC	368A AX	EC		14.0	12.6
	368P AX	EC		17.1	15.0
	366A AX	EC		15.3	13.6
	366B AX	EC		15.5	13.8
	372A AX	EC		17.8	15.5
12BC	372B AX	EC		21.3	17.8
	384A AX	EC		15.5	13.8
	384B AX	EC		15.4	13.7
	382A AX	EC		14.2	12.8
	382B AX	EC		13.1	11.9
	388A AX	EC		17.4	15.2
	388B AX	EC		17.7	15.4
MEAN				16.0 MPA (2328. PSI)	14.1 MPA (2052. PSI)
STD. DEV.				1.8 MPA (262. PSI)	1.3 MPA (193. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3			SPEC. DIA.	6.4 MM	
LOG NO. 6484-112			SPEC. LENGTH	51. MM	
LOG DENSITY 1.78			MG/M**3		

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)

12AC	601 RAD	EC		14.2	13.0
	605 RAD	EC		15.7	14.2
	637 RAD	EC		14.2	13.0
	611 RAD	EC		15.2	13.8
	613 RAD	EC		17.6	15.8
	627 RAD	EC		14.4	13.2
	631 RAD	EC		16.8	15.1
	633 RAD	EC		16.1	14.6
	637 RAD	EC		18.9	16.7
	639 RAD	EC		12.2	11.4
12BC	757 RAD	EC		16.6	14.9
	761 RAD	EC		13.7	12.6
	763 RAD	EC		15.9	14.4
12BC	767 RAD	EC		18.2	16.2
	769 RAD	EC		12.8	11.9
	783 RAD	EC		16.5	14.9
	787 RAD	EC		18.5	16.4
	789 RAD	EC		18.3	16.2
	793 RAD	EC		14.1	12.9
	795 RAD	EC		12.1	11.2

MEAN				15.6 MPA (2264. PSI)	14.1 MPA (2048. PSI)
STD. DEV.				2.1 MPA (306. PSI)	1.7 MPA (246. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3			SPEC. DIA.	6.4 MM	
LOG NO. 6484-112			SPEC. LENGTH	51. MM	
LOG DENSITY 1.78			MG/M**3		
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
12AY	320A	AX	EM	16.2	14.2
	320B	AX	EM	13.7	12.3
	322A	AX	EM	16.3	14.3
	322B	AX	EM	15.8	13.9
	326A	AX	EM	13.6	12.2
	326B	AX	EM	14.7	13.1
	332A	AX	EM	14.2	12.7
	332B	AX	EM	15.5	13.7
	334A	AX	EM	12.9	11.7
	334B	AX	EM	13.3	12.0
12BY	392A	AX	EM	16.6	14.5
	392B	AX	EM	15.7	13.9
	394A	AX	EM	13.7	12.3
	394B	AX	EM	13.8	12.4
	398A	AX	EM	14.8	13.2
	398B	AX	EM	13.2	11.9
	404A	AX	EM	16.2	14.2
	404B	AX	EM	15.1	13.4
12BY	406A	AX	EM	17.5	15.1
	406B	AX	EM	16.1	14.2
MEAN				14.9 MPA (2168. PSI)	13.3 MPA (1923. PSI)
STD. DEV.				1.3 MPA (195. PSI)	1.0 MPA (148. PSI)

TABLE C-2 (Continued)

LOT NO. 8D5-3			SPEC. DIA.	6.4 MM	
LOG NO. 6484-112			SPEC. LENGTH	51. MM	
LOG DENSITY 1.78			MG/M**3		
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UN ORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
12AY	657 RAD	EM		14.0	12.8
	661 RAD	EM		16.3	14.6
	663 RAD	EM		14.0	12.8
	667 RAD	EM		16.6	14.8
12AY	669 RAD	EM		14.9	13.5
	683 RAD	EM		14.2	12.9
	687 RAD	EM		15.4	13.9
	689 RAD	EM		15.3	13.8
	693 RAD	EM		14.8	13.4
12BY	695 RAD	EM		14.4	13.1
	813 RAD	EM		14.2	12.9
	817 RAD	EM		17.1	15.2
	819 RAD	EM		12.8	11.8
	823 RAD	EM		15.7	14.1
	825 RAD	EM		17.4	15.5
	839 RAD	EM		15.0	13.5
	843 RAD	EM		18.8	16.5
	845 RAD	EM		14.2	13.0
	849 RAD	EM		16.1	14.5
	851 RAD	EM		16.6	14.8
MEAN				15.4 MPA (2234. PSI)	13.9 MPA (2013. PSI)
STD. DEV.				1.4 MPA (209. PSI)	1.1 MPA (165. PSI)

TABLE C-2 (Continued)

LOT NO. 805-3	SPEC. DIA.	6.4 MM
LOG NO. 6484-112	SPEC. LENGTH	51. MM
LOG DENSITY 1.78	MG/M**3	

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
12AE	340A	AX	EE	17.4	15.1
	340B	AX	EE	14.1	12.7
	342A	AX	EE	14.1	12.7
	342B	AX	EE	15.6	13.8
	346A	AX	EE	17.4	15.1
	346B	AX	EE	16.5	14.5
	352A	AX	EE	15.7	13.9
	352B	AX	EE	14.8	13.2
	354A	AX	EE	15.3	13.6
	354B	AX	EE	18.8	16.1
12BE	412A	AX	EE	18.9	16.1
	412B	AX	EE	15.4	13.6
	414A	AX	EE	17.3	15.0
	414B	AX	EE	14.5	12.9
	418A	AX	EE	17.4	15.2
	418B	AX	EE	14.3	12.8
	424A	AX	EE	16.6	14.5
	424B	AX	EE	18.6	15.9
	426A	AX	EE	17.3	15.0
12BE	426B	AX	EE	16.7	14.6
MEAN				16.3 MPA (2369. PSI)	14.3 MPA (2077. PSI)
STD. DEV.				1.5 MPA (224. PSI)	1.1 MPA (165. PSI)

TABLE C-2 (Continued)

LOT NO. 805-3	SPEC. DIA.	6.4 MM
LOG NO. 6484-112	SPEC. LENGTH	51. MM
LOG DENSITY 1.78	MG/M**3	

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
12AE	709 RAD	EE		14.4	13.1
	713 RAD	EE		17.2	15.3
	715 RAD	EE		10.9	10.2
	719 RAD	EE		12.9	11.9
	721 RAD	EE		14.9	13.5
	735 RAD	EE		17.3	15.4
	739 RAD	EE		11.9	11.0
	741 RAD	EE		12.9	11.9
	745 RAD	EE		16.6	14.8
	747 RAD	EE		16.4	14.6
12BE	865 RAD	EE		17.7	15.7
	869 RAD	EE		14.7	13.3
	871 RAD	EE		11.6	10.8
	875 RAD	EE		14.7	13.3
12BE	877 RAD	EE		14.2	12.9
	891 RAD	EE		18.2	16.0
	895 RAD	EE		12.8	11.8
	897 RAD	EE		17.6	15.5
	901 RAD	EE		13.1	12.0
	903 RAD	EE		19.0	16.6
MEAN				15.0 MPA (2169. PSI)	13.5 MPA (1955. PSI)
STD. DEV.				2.4 MPA (351. PSI)	1.9 MPA (280. PSI)

TABLE C-3
COMPRESSIVE PROPERTIES OF PGX GRAPHITE

LOT NO. 8D5-3 SPEC. DIA. 12.6 MM
LOG NO. 6484-112 SPEC. LENGTH 25. MM
LOG DENSITY 1.78 MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)
1AC	E 6C	AX	EC	5.4	.171	2.030	45.0
	E 8C	AX	EC	5.3	.191	1.986	44.0
	E10C	AX	EC	5.5	.171	1.933	44.8
	E12C	AX	EC	5.8	.151	1.936	46.0
18C	E102C	AX	EC	5.5	.160	1.855	45.1
	E104C	AX	EC	5.6	.171	1.939	45.4
	E106C	AX	EC	6.0	.161	1.709	43.2
	E108C	AX	EC	5.3	.171	2.002	43.9
MEAN				5.6 (.81 MPsi)	.168	1.924	44.7 (6479, PSI)
STD. DEV.				.2 (.03 MPsi)	.012	.102	.9 (130, PSI)
12AL	B 6C	AX	EC	4.8	.175	1.853	40.6
	B 8C	AX	EC	4.7	.180	1.987	41.7
	B10C	AX	EC	4.6	.200	2.192	42.3
	B12C	AX	EC	4.8	.215	2.170	42.7
128C	B90C	AX	EC	5.0	.180	2.024	42.6
	B92C	AX	EC	5.3	.180	1.864	41.8
	B94C	AX	EC	5.1	.185	1.897	41.0
	B96C	AX	EC	4.9	.180	1.850	41.0
MEAN				4.9 (.71 MPsi)	.187	1.980	41.7 (6050, PSI)
STD. DEV.				.2 (.04 MPsi)	.014	.140	.8 (113, PSI)

TABLE C-3 (Continued)

LOT NO. 8D5-3			SPEC. DIA. 12.8 MM				
LOG NO. 6484-112			SPEC. LENGTH 25. MM				
LOG DENSITY 1.78			MG/M**3				
SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)
1AC	E 3B RAD	EC		5.7	.151	1.355	37.7
	F 7B RAD	EC		5.8	.151	1.941	44.8
	E11B RAD	EC		5.4	.171	1.888	41.6
	E23B RAD	EC		5.6	.181	2.056	46.7
1BC	E111B RAD	EC		5.4	.151	1.792	42.1
	E115B RAD	EC		4.8	.161	2.060	42.8
	E119B RAD	EC		5.2	.161	1.860	40.8
	E131B RAD	EC		5.2	.181	1.982	41.5
MEAN				5.4 (.78 MPsi)	.163	1.867	42.2 (6126, PSI)
STD. DEV.				.3 (.05 MPsi)	.013	.227	2.7 (390, PSI)
12AC	B 3B RAD	EC		5.2	.185	1.795	40.6
	H 7B RAD	EC		5.8	.150	1.779	42.7
	B11B RAD	EC		5.5	.160	1.668	39.3
	B21B RAD	EC		5.7	.180	1.819	41.4
12BC	B111B RAD	EC		6.3	.150	1.515	40.3
	B115B RAD	EC		5.7	.130	1.604	40.4
	B119B RAD	EC		6.2	.169	1.393	38.3
	B129B RAD	EC		5.7	.150	1.578	38.7
MEAN				5.8 (.84 MPsi)	.159	1.644	40.2 (5831, PSI)
STD. DEV.				.4 (.05 MPsi)	.018	.150	1.4 (207, PSI)

TABLE C-3 (Continued)

LOT NO. 805-3				SPEC. DIA. 12.8 MM			
LOG NO. 6484-112				SPEC. LENGTH 25. MM			
LOG DENSITY 1.78				MG/M**3			

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)

1AY	E30C	AX	EM	5.2	.181	2.144	44.7
	E34C	AX	EM	5.1	.171	1.925	42.6
	E42C	AX	EM	5.0	.201	1.780	40.1
	E46C	AX	EM	4.8	.181	1.736	39.7
1BY	E114C	AX	EM	5.4	.171	2.175	46.5
	E118C	AX	EM	5.2	.171	2.044	45.4
	E126C	AX	EM	5.4	.171	2.092	45.4
	E130C	AX	EM	5.8	.181	2.164	46.8

MEAN				5.2	.178	2.008	43.9
				(.76 MPsi)		(6368 PSI)	

STD. DEV.				.3	.010	.174	2.8
				(.05 MPsi)		(404 PSI)	

12AY	B30C	AX	EM	4.9	.180	2.140	43.9
	B34C	AX	EM	4.3	.211	1.853	38.4
	B42C	AX	EM	4.3	.150	2.004	39.0
	B46C	AX	EM	4.4	.200	1.887	39.3
12BY	B114C	AX	EM	4.6	.200	1.967	39.8
	B118C	AX	EM	4.5	.180	1.881	38.8
	B126C	AX	EM	4.5	.202	2.188	41.7
	B130C	AX	EM	4.6	.200	1.948	41.2

MEAN				4.5	.190	1.983	40.3
				(.65 MPsi)		(5838 PSI)	

STD. DEV.				.2	.020	.122	1.9
				(.03 MPsi)		(271 PSI)	

TABLE C-3 (Continued)

LOT NO. 8D5-3			SPEC. DIA. 12.8 MM				
LOG NO. 6484-112			SPEC. LENGTH 25. MM				
LOG DENSITY 1.78			MG/M**3				
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)
1AY	E43B	RAD	EM	4.8	.191	1.614	38.3
	E47B	RAD	EM	4.8	.171	1.625	37.5
	E51B	RAD	EM	4.8	.171	1.619	38.0
	E61B	RAD	EM	6.0	.151	1.779	44.3
1BY	E151B	RAD	EM	5.5	.181	2.017	44.3
	E155B	RAD	EM	5.8	.180	1.763	42.4
	E159B	RAD	EM	5.3	.171	1.841	42.1
	E169B	RAD	EM	5.5	.181	1.897	42.2
MEAN				5.3 (.77 MPsi)	.174	1.794	41.1 (5966, PSI)
STD. DEV.				.5 (.07 MPsi)	.012	.133	2.8 (407, PSI)
12AY	B43B	RAD	EM	5.3	.199	1.626	37.4
	B47B	RAD	EM	5.3	.189	1.748	39.4
	B51B	RAD	EM	5.4	.190	1.702	39.2
	B61B	RAD	EM	5.5	.180	1.792	40.0
12BY	B151B	RAD	EM	5.5	.180	1.741	39.8
	B155B	RAD	EM	5.3	.180	1.557	37.5
	B159B	RAD	EM	5.4	.180	1.726	38.8
	B169B	RAD	EM	6.2	.170	1.634	40.5
MEAN				5.5 (.79 MPsi)	.183	1.691	39.1 (5667, PSI)
STD. DEV.				.3 (.04 MPsi)	.009	.078	1.1 (163, PSI)

TABLE C-3 (Continued)

LOT NO. 8D5-3				SPEC. DIA.		12.8 MM	
LOG NO. 6484-112				SPEC. LENGTH		25. MM	
LOG DENSITY 1.78				MG/M**3			
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)
1AE	E60C AX	EE	5.3	.181	2.136	46.1	
	E64C AX	EE	5.5	.201	2.101	45.1	
	E72C AX	EE	5.3	.181	1.973	43.4	
	E76C AX	EE	5.3	.171	2.146	44.1	
1BE	E144C AX	EE	5.5	.140	2.079	46.8	
	E148C AX	EE	6.0	.151	2.004	48.1	
	E156C AX	EE	5.4	.171	2.269	47.0	
	E160C AX	EE	5.0	.191	2.226	44.7	
MEAN			5.4	.173	2.117	45.7	
			(.78 MPaSI)		(6624 PSI)		
STD. DEV.			.3	.020	.101	1.6	
			(.04 MPaSI)		(232 PSI)		
12AE	H60C AX	EE	4.9	.190	2.171	44.3	
	H64C AX	EE	4.3	.180	1.928	39.2	
	B72C AX	EE	4.7	.269	2.170	41.3	
	B76C AX	EE	5.0	.201	2.001	41.2	
12BE	B144C AX	EE	4.6	.192	1.851	40.6	
	B148C AX	EE	4.7	.182	1.839	38.7	
	B156C AX	EE	5.0	.190	1.812	38.0	
	B160C AX	EE	4.7	.210	2.031	42.3	
MEAN			4.7	.202	1.975	40.7	
			(.69 MPaSI)		(5904 PSI)		
STD. DEV.			.2	.029	.143	2.1	
			(.03 MPaSI)		(301 PSI)		

TABLE C-3 (Continued)

LOT NO. 805-3				SPEC. DIA. 12.8 MM			
LOG NO. 6484-112				SPEC. LENGTH 25. MM			
LOG DENSITY 1.78 MG/M**3							
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)
1AE	E79B	RAD	EE	5.4	.181	1.867	40.9
	E83B	RAD	EE	5.4	.161	1.567	40.1
	E87B	RAD	EE	5.4	.161	1.767	41.7
	E97B	RAD	EE	5.8	.161	1.883	43.0
1BE	E187B	RAD	EE	5.9	.161	1.981	44.7
	E191B	RAD	EE	5.4	.181	1.832	42.6
	E195B	RAD	EE	5.2	.151	1.890	43.6
	E205B	RAD	EE	5.0	.181	2.003	43.2
MEAN				5.4 (.79 MPaSI)	.167	1.849	42.5 (6160, PSI)
STD. DEV.				.3 (.04 MPaSI)	.012	.137	1.5 (219, PSI)
12AE	B79B	RAD	EE	5.1	.180	1.572	35.7
	B83B	RAD	EE	5.1	.179	1.824	38.9
	B87B	RAD	EE	5.2	.180	1.841	39.9
	B97B	RAD	EE	5.2	.170	1.482	36.4
12BE	B187B	RAD	EE	5.5	.180	1.635	38.2
	B191B	RAD	EE	5.2	.160	1.590	37.9
	B195B	RAD	EE	5.4	.160	1.615	38.3
	B205B	RAD	EE	5.4	.150	1.889	41.3
MEAN				5.3 (.76 MPaSI)	.170	1.681	38.3 (5559, PSI)
STD. DEV.				.1 (.02 MPaSI)	.012	.149	1.8 (258, PSI)

TABLE C-3 (Continued)

LOT NO. AD5-3			SPEC. DIA. 12.8 MM	
LOG NO. 6484-112			SPEC. LENGTH 25. MM	
LOG DENSITY 1.78			MG/M**3	

SPECIMEN NUMBER	ORIENT- ATION	LOCAL- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)
6AC	M10C AX	MLC		5.3	.170	1.580	39.5
	M8C AX	MLC		5.1	.170	1.599	37.7
	M12C AX	MLC		5.4	.180	1.746	41.1
	M18C AX	MLC		4.9	.200	1.875	41.9
6BC	M92C AX	MLC		4.4	.200	2.184	43.2
	M90C AX	MLC		5.0	.200	1.952	41.9
	M96C AX	MLC		5.0	.190	2.199	44.2
	M98C AX	MLC		5.2	.190	2.152	43.9
MEAN				5.0 (.73 MPaSI)	.187	1.911	41.7 (6046 PSI)
STD. DEV.				.3 (.04 MPaSI)	.013	.254	2.2 (322 PSI)
6AC	M5B RAD	MLC		6.3	.150	1.511	40.2
	M9B RAD	MLC		5.5	.150	1.268	35.0
	M13B RAD	MLC		6.0	.150	1.619	41.0
	M23B RAD	MLC		6.0	.140	1.540	41.5
6BC	M113B RAD	MLC		7.5	.189	1.600	40.7
	M117B RAD	MLC		5.4	.140	1.763	41.3
	M121B RAD	MLC		5.9	.150	1.563	39.8
	M131B RAD	MLC		5.2	.170	1.801	41.9
MEAN				6.0 (.87 MPaSI)	.155	1.583	40.2 (5827 PSI)
STD. DEV.				.7 (.10 MPaSI)	.017	.164	2.2 (320 PSI)

TABLE C-3 (Continued)

LOT NO. AD5-3		SPEC. DIA. 12.6 MM				
LOG NO. 6484-112		SPEC. LENGTH 25. MM				
LOG DENSITY 1.78		MG/M**3				
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION (MG/M**3)	DENSITY YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMP- RESSIVE STRENGTH (MPA)
6AY	M43B RAD	MLM	6.1	.170	1.587	40.4
	M47B RAD	MLM	6.0	.150	1.723	42.6
	M51B RAD	MLM	6.4	.150	1.727	43.9
	M61B RAD	MLM	5.8	.181	1.911	44.0
6BY	M151B RAD	MLM	5.7	.180	1.797	41.0
	M155B RAD	MLM	5.5	.170	1.745	41.6
	M159B RAD	MLM	5.6	.170	1.657	40.9
	M160B RAD	MLM	5.8	.180	1.786	40.3
MEAN			5.9 (.85 MPsi)	.169	1.742	41.8 (6069, PSI)
STD. DEV.			.3 (.04 MPsi)	.013	.097	1.5 (214, PSI)
6AE	M79B RAD	MLE	6.6	.170	1.798	44.6
	M83B RAD	MLE	6.4	.170	1.518	41.8
	M87B RAD	MLE	6.4	.150	1.569	43.1
	M97B RAD	MLE	6.3	.150	1.876	46.1
6BE	M187B RAD	MLE	6.4	.170	1.614	43.1
	M191B RAD	MLE	6.2	.170	1.584	41.7
	M195B RAD	MLE	6.3	.150	1.590	41.5
	M205B RAD	MLE	6.4	.150	1.723	44.6
MEAN			6.4 (.92 MPsi)	.160	1.659	43.3 (6281, PSI)
STD. DEV.			.1 (.02 MPsi)	.011	.126	1.7 (242, PSI)

TABLE C-3 (Continued)

LOT NO. 805-3				SPEC. DIA. 12.8 MM			
LOG NO. 6484-112				SPEC. LENGTH 25. MM			
LOG DENSITY 1.78				MG/M**3			

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)

6AY	M30C	AX	MLM	5.5	.200	1.863	43.4
	M34C	AX	MLM	5.5	.180	2.164	46.0
	M42C	AX	MLM	5.4	.190	1.767	41.7
	M46C	AX	MLM	5.2	.190	2.119	45.0
6BY	M112C	AX	MLM	5.4	.149	2.157	47.2
	M116C	AX	MLM	5.5	.180	2.175	45.7
	M124C	AX	MLM	5.3	.200	2.271	46.7
	M128C	AX	MLM	5.3	.160	1.790	42.6

MEAN				5.4	.181	2.038	44.8
				(.78 MPaSI)			(.6498, PSI)

STD. DEV.				.1	.018	.198	2.0
				(.01 MPaSI)			(.292, PSI)

6AE	M60C	AX	MLE	5.2	.170	2.163	46.8
	M64C	AX	MLE	4.7	.200	1.962	42.9
	M72C	AX	MLE	5.6	.190	1.888	43.1
	M76C	AX	MLE	5.5	.180	1.952	44.2
6BE	M142C	AX	MLE	5.7	.170	2.196	47.7
	M146C	AX	MLE	5.5	.199	2.071	46.6
	M154C	AX	MLE	6.0	.170	2.017	45.6
	M158C	AX	MLE	5.7	.190	2.096	47.2

MEAN				5.5	.184	2.043	45.5
				(.80 MPaSI)			(.6601, PSI)

STD. DEV.				.4	.013	.107	1.9
				(.05 MPaSI)			(.274, PSI)

TABLE C-4
SPECTROCHEMICAL ANALYSES FOR GRADE PGX

LAB. NO. 44976 ✓ REPORT TO: GLEN ENGLE DATE: 1-17-77
SAMPLE: 6484-112 E70H GRAPHITE PROJECT NO. 3224146005 DILUTION: 1.0000 PLATE NO. 76-

C-47

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	80.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	80.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	10.00	DY	< 20.00	ER	< 6.00
EJ	< 10.00	FE	1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	10.00	LA	< 10.00	LI	1.00
LU	< .50	MG	< 1.00	MN	10.00
NI	< 1.00	NA	< 10.00	NB	< 6.00
NO	< 200.00	NI	20.00	P	< 100.00
PH	< 6.00	PR	< 100.00	RB	< 40.00
SH	< 8.00	SC	< 1.00	SI	100.00
SM	< 100.00	SN	< 6.00	SH	< 40.00
TA	< 40.00	TH	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

J-076 6284-112 B88B GRAPHITE		REPORT TO: GLEN ENGLE PROJECT NO. 3224146005		DILUTION: 1.0000		DATE: 1-17-77 PLATE NO. 76-	
ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	100.00	B	2.00		
BA	40.00	BE	< .50	BI	< 2.00		
CA	100.00	CD	< 10.00	CE	< 80.00		
CO	< 4.00	CR	< 10.00	CS	< 100.00		
CU	20.00	DY	< 20.00	ER	< 6.00		
EU	< 10.00	FE	> 1000.00	GD	< 10.00		
HF	< 20.00	HO	< 10.00	IN	< 1.00		
K	40.00	LA	< 10.00	LI	2.00		
LU	< .50	MG	60.00	MN	60.00		
MO	< 1.00	NA	10.00	NB	< 6.00		
ND	< 200.00	NI	20.00	P	< 100.00		
PB	< 6.00	PR	< 100.00	RB	< 40.00		
SB	< 8.00	SC	< 1.00	SI	< 40.00		
SM	< 100.00	SN	< 6.00	SR	< 40.00		
YA	< 40.00	TB	< 40.00	TI	40.00		
YL	< 20.00	TM	< 4.00	V	20.00		
W	< 40.00	YB	< 10.00	ZN	< 20.00		
ZR	< .50						

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
 > MEANS GREATER THAN
 < MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
 RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976 ✓

SAMPLE: 6484-112 B124B GRAPHITE

REPORT TO: GLEN ENGLE

PROJECT NO. 3224146005

DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	80.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	80.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	20.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	40.00	LA	< 10.00	LI	1.00
LU	< .50	MG	20.00	MN	40.00
MO	< 1.00	NA	10.00	NB	< 6.00
NO	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	60.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976		REPORT TO: GLEN ENGLE		DATE: 1-17-77	
SAMPLE: 6484-112 B1548 GRAPHITE		PROJECT NO. 3224146005		DILUTION: 1.0000	
				PLATE NO. 76-	
ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	80.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	> 1000.00	CO	< 10.00	CE	< 80.00
CD	< 4.00	CR	< 10.00	CS	< 100.00
CU	20.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	60.00	LA	< 10.00	LI	1.00
LU	< .50	MG	10.00	MN	40.00
MD	< 1.00	NA	< 10.00	NB	< 6.00
ND	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	60.00
SH	< 100.00	SN	< 6.00	SR	40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
 > MEANS GREATER THAN
 < MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
 RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 B4B GRAPHITE

PROJECT NO. 3224146005

REPORT TO: GLEN ENGLE

DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

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ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	60.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	200.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	20.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	10.00	LA	< 10.00	LI	2.00
LU	< .50	MG	40.00	MN	40.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
NO	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	20.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 B408 GRAPHITE

PROJECT NO. 3224146005

REPORT TO: GLEN ENGLE

DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	60.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	200.00	CD	< 10.00	CE	< 80.00
CD	< 4.00	CR	< 10.00	CS	< 100.00
CU	20.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	10.00	LA	< 10.00	LI	2.00
LU	< .50	MG	10.00	MN	40.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
ND	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

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TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 B70B GRAPHITE

REPORT TO: GLEN ENGLE

PROJECT NO. 3224146005 DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	200.00	B	2.00
BA	60.00	BE	< .50	BI	< 2.00
CA	> 1000.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	20.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	20.00	LA	< 10.00	LI	1.00
LU	< .50	MG	4.00	MN	40.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
ND	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	400.00
SH	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TJ	40.00
TL	< 20.00	TM	< 4.00	V	40.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976 ✓
 SAMPLE: 6484-112 M1008 GRAPHITE

REPORT TO: GLEN ENGLE
 PROJECT NO. 3224146005 DILUTION: 1.0000

DATE: 1-17-77
 PLATE NO. 76-

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ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	80.00	B	2.00
BA	40.00	RE	< .50	BI	< 2.00
CA	200.00	CD	< 10.00	CE	< 80.00
CO	20.00	CR	< 10.00	CS	< 100.00
CU	20.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	< 10.00	LA	< 10.00	LI	2.00
LU	< .50	MG	20.00	MN	40.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
ND	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	40.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
 > MEANS GREATER THAN
 < MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
 RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 M122B GRAPHITE

REPORT TO: GLEN ENGLE

PROJECT NO. 3224146005 DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	100.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	> 1000.00	CD	< 10.00	CE	< 80.00
CD	< 4.00	CR	< 10.00	CS	< 100.00
CU	10.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	10.00	LA	< 10.00	LI	2.00
LU	< .50	MG	1.00	MN	40.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
NO	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	100.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 M152B GRAPHITE

REPORT TO: GLEN ENGLE

PROJECT NO. 3224146005

DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	80.00	B	< .50
BA	40.00	BE	< .50	BI	< 2.00
CA	60.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	6.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	40.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	10.00	LA	< 10.00	LI	< 1.00
LU	< .50	MG	< .50	MN	< 1.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
ND	< 200.00	NI	< 4.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	40.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	4.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976
SAMPLE: 6484-112 M16B GRAPHITE

PROJECT NO. 3224146005 DILUTION: 1.0000

DATE: 1-17-77
PLATE NO. 76-

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	100.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	80.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	10.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	20.00	LA	< 10.00	LI	1.00
LU	< .50	MG	10.00	MN	40.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
ND	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	40.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
> MEANS GREATER THAN
< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

C-57

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 M40B GRAPHITE

PROJECT N7, 3224146005

REPORT TO: GLEN ENGLE

DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	80.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	100.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	10.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	20.00	LA	< 10.00	LI	2.00
LU	< .50	MG	2.00	MN	10.00
MO	< 1.00	NA	10.00	NB	< 6.00
ND	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	80.00
SH	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 M70B GRAPHITE

PROJECT NO. 3224146005

REPORT TO: GLEN ENGLE

DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	80.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	80.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	10.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	80.00	LA	< 10.00	LI	2.00
LU	< .50	MG	8.00	MN	10.00
MO	< 1.00	NA	20.00	NB	< 6.00
ND	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	100.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	80.00
TL	< 20.00	TM	< 4.00	V	40.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40X, (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 E888 GRAPHITE

PROJECT NO. 3224146005

REPORT TO: GLEN ENGLE

DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

AG < .50
 BA 40.00
 CA 80.00
 CD < 4.00
 CU 10.00
 EU < 10.00
 HF < 20.00
 K 80.00
 LU < .50
 MD < 1.00
 NO < 200.00
 PB < 6.00
 SB < 8.00
 SM < 100.00
 TA < 40.00
 TL < 20.00
 W < 40.00
 ZR < .50

AL 80.00
 RE < .50
 CD < 10.00
 CR < 10.00
 DY < 20.00
 FE 1000.00
 HQ < 10.00
 LA < 10.00
 MG 40.00
 NA 20.00
 NI 20.00
 PR < 100.00
 SC < 1.00
 SN < 6.00
 TB < 40.00
 TM < 4.00
 YB < 10.00

B 2.00
 BI < 2.00
 CE < 80.00
 CS < 100.00
 ER < 6.00
 GD < 10.00
 IN < 1.00
 LI 6.00
 MN 20.00
 NB < 6.00
 P < 100.00
 RB < 40.00
 SI 20.00
 SR < 40.00
 TI 40.00
 V 20.00
 ZN < 20.00

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 E124B GRAPHITE

PROJECT NO. 3224146005

REPORT TO: GLEN ENGLE

DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

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ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	80.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	80.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	20.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	1000.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	20.00	LA	< 10.00	LI	2.00
LU	< .50	MG	10.00	MN	20.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
ND	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	80.00
SH	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 E154B GRAPHITE

PROJECT NO. 3224146005

REPORT TO: GLEN ENGLE

DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 76-

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	100.00	B	2.00
BA	60.00	BE	< .50	BI	< 2.00
CA	> 1000.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	8.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	600.00	GD	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	< 10.00	LA	< 10.00	LI	< 1.00
LU	< .50	MG	6.00	MN	1.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
ND	< 200.00	NI	< 4.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 E168 GRAPHITE

PROJECT NO. 3224146005

REPORT TO: GLEN ENGLE

DILUTION: 1.0000

DATE: 1-17-77

PLATE NO. 7b-

C-63

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	1.00	AL	100.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	100.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	10.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HD	< 10.00	IN	< 1.00
K	20.00	LA	< 10.00	LI	2.00
LU	< .50	MG	40.00	MN	40.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
ND	< 200.00	NI	40.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	40.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT

> MEANS GREATER THAN

< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED

RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

TABLE C-4 (Continued)

LAB. NO. 44976

SAMPLE: 6484-112 E408 GRAPHITE

PROJECT NO.

REPORT TO: GLEN ENGLE

3224146005

DILUTION:

1.0000

DATE: 1-17-77

PLATE NO. 76-

C-64

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	80.00	B	2.00
BA	40.00	HE	< .50	BI	< 2.00
CA	80.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CR	< 10.00	CS	< 100.00
CU	10.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	1000.00	GD	< 10.00
HF	< 20.00	HU	< 10.00	IN	< 1.00
K	60.00	LA	< 10.00	LI	6.00
LU	< .50	MG	10.00	MN	10.00
MO	< 1.00	NA	10.00	NB	< 6.00
ND	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PR	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	40.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	20.00
TL	< 20.00	TM	< 4.00	V	10.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
 > MEANS GREATER THAN
 < MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
 RESULTS ARE CORRECT WITHIN A FACTOR OF 40% , (ONE STANDARD DEVIATION)

APPENDIX D
GRADE HLM DATA

This appendix contains complete data sets for the bulk density, tensile properties, flexural strength, compressive properties, and chemical impurity content of grade HLM graphite.

TABLE D-1
TENSILE PROPERTIES OF HLM GRAPHITE

LOT NO. 367			SPEC. DIA.		12.8 MM		
LOG NO. 6484-78			SPEC. LENGTH		71. MM		
LOG DENSITY --			MG/M**3				

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)

1AC-E-10A	AX	EC	1.784	7.0	.020	.161	9.1
-12A	AX	EC	1.788	6.7	.018	.175	9.6
-22A	AX	EC	1.795				8.9
-24A	AX	EC	1.768	7.0	.016	.156	9.1
06A	AX	EC					7.2
08A	AX	EC					9.6
10B	AX	EC					9.8
12B	AX	EC					9.2
18A	AX	EC					6.5
20B	AX	EC					5.1
27B	AX	EC					8.6
-	-	-	-	-	-	-	-
24B	AX	EC					6.1
1BC-E-106B	AX	EC	1.780				5.0
108B	AX	EC	1.784				3.4
94B	AX	EC	1.787				4.3
96B	AX	EC	1.785				7.9
102A	AX	EC					10.2
104B	AX	EC					3.6
106A	AX	EC					9.3
1HCE-108A	AX	EC					8.6
90A	AX	EC					7.7
92B	AX	EC					9.7
94A	AX	EC					9.1
-	-	-	-	-	-	-	-
96A	AX	EC					8.5

MEAN			1.784	6.9	.018	.164	7.8
				(1.00 MPaSI)			(1124,PSI)

STD. DEV.			.008	.1	.002	.010	2.1
				(.02 MPaSI)			(304,PSI)

TABLE D-1 (Continued)

LOT NO. 367 SPEC. DIA. 12.8 MM
 LOG NO. 6484-78 SPEC. LENGTH 71. MM
 LOG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
1ACE-31	RAD	EC	1.772	6.7	.023	.268	12.5
27	RAD	EC	1.773	6.5	.021	.251	12.2
11	RAD	EC	1.777	6.3	.021	.291	13.3
07	RAD	EC	1.770	6.4	.023	.299	13.8
05	RAD	EC					13.2
09	RAD	EC					14.3
23	RAD	EC					13.7
25	RAD	EC					12.7
29	RAD	EC					12.5
1BCE-113	RAD	EC	1.788	6.5	.015	.190	9.9
117	RAD	EC	1.785				12.3
133	RAD	EC	1.784	7.1	.030	.214	10.4
137	RAD	EC	1.786	6.5	.014	.160	8.7
1BCE-111	RAD	EC					12.3
115	RAD	EC					7.5
119	RAD	EC					10.5
131	RAD	EC					12.8
135	RAD	EC					11.7
139	RAD	EC					11.6
MEAN			1.780	6.6	.021	.239	11.9
				(.95 MPa)			(1724, PSI)
STD. DEV.			.007	.3	.005	.053	1.8
				(.04 MPa)			(254, PSI)

TABLE D-1 (Continued)

LOT NO. 367			SPEC. DIA. 12.8 MM				
LOG NO. 6484-78			SPEC. LENGTH 71. MM				
LOG DENSITY --			MG/M**3				
SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
1AYE-308	AX	EM	1.769				9.6
34A	AX	EM	1.778	6.7	.017	.162	9.0
46B	AX	EM	1.771	7.3	.015	.128	8.2
54A	AX	EM	1.785	6.5	.020	.161	8.5
30A	AX	EM					8.9
34B	AX	EM					9.6
42A	AX	EM					9.6
42B	AX	EM					8.8
46A	AX	EM					8.6
54B	AX	EM					8.2
1BYE-114B	AX	EM	1.782	6.8	.020	.200	10.3
118A	AX	EM	1.779	7.4	.019	.176	9.6
130B	AX	EM	1.761	6.9	.021	.201	10.3
1BYE-138A	AX	EM	1.767	7.1	.015	.190	10.6
114A	AX	EM					9.1
118B	AX	EM					9.1
126A	AX	EM					8.2
126B	AX	EM					9.4
130A	AX	EM					11.4
138B	AX	EM					11.4
MEAN			1.774	7.0	.018	.174	9.4
				(1.01 MPa)			(1367 PSI)
STD. DEV.			.008	.3	.002	.026	1.0
				(.05 MPa)			(140 PSI)

TABLE D-1 (Continued)

LOT NO. 367			SPEC. DIA. 12.8 MM				
LOG NO. 6484-78			SPEC. LENGTH 71. MM				
LOG DENSITY --			MG/M**3				

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
-----					-----	-----	-----
1AYE-45	RAD	EM	1.772	6.7	.020	.278	12.1
49	RAD	EM	1.772	6.3	.030	.304	12.7
63	RAD	EM	1.775	6.3	.026	.251	11.8
67	RAD	EM	1.773	6.3	.024	.276	12.6
43	RAD	EM					10.7
47	RAD	EM					10.5
51	RAD	EM					12.7
61	RAD	EM					12.4
65	RAD	EM					12.7
69	RAD	EM					12.0
18YE-153	RAD	EM	1.783	6.1	.026	.264	12.0
157	RAD	EM	1.787	6.2	.025	.249	11.7
18YE-171	RAD	EM	1.766	6.0	.024	.270	12.0
175	RAD	EM	1.766	5.9	.029	.274	11.8
151	RAD	EM					12.9
155	RAD	EM					13.1
159	RAD	EM					12.7
169	RAD	EM					12.0
173	RAD	EM					11.0
177	RAD	EM					11.4
-----					-----	-----	-----
MEAN			1.774	6.2	.025	.271	12.0
			(.90 MP81)				(1745 PSI)
-----					-----	-----	-----
STD. DEV.			.007	.2	.003	.017	.7
			(.03 MP81)				(106 PSI)
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TABLE D-1 (Continued)

LOT NO, 367 SPEC. DIA. 12.8 MM
 LUG NO, 6484-78 SPEC. LENGTH 71, MM
 LOG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)

1AEE-60B	AX	EF	1.769	7.6	.019	.253	14.2
64A	AX	EE	1.770	7.3	.015	.265	14.5
76B	AX	EE	1.757	7.4	.015	.226	12.8
84A	AX	EE	1.771	6.3	.021	.214	10.3
60A	AX	EE					14.6
64B	AX	EF					14.3
72A	AX	EE					13.7
72B	AX	EE					13.4
76A	AX	EE					12.4
84B	AX	FE					11.5
1BEE-144B	AX	EE	1.787				13.6
148A	AX	EE	1.778	7.7	.022	.282	15.0
160B	AX	EE	1.767	7.7	.019	.276	15.1
168A	AX	EE	1.772	7.9	.015	.241	13.9
144A	AX	EF					14.9
148B	AX	EE					14.8
156A	AX	EE					14.7
156B	AX	EE					14.7
160A	AX	EE					14.1
168B	AX	EE					14.1

MEAN			1.772	7.4	.018	.251	13.8
			(1.08 MPaI)		(2006, PSI)		

STD. DEV.			.009	.6	.003	.025	1.2
			(.08 MPaI)		(178, PSI)		

TABLE D-1 (Continued)

LOT NO. 367 SPEC. DIA. 12.8 MM
 LUG NO. 6484-78 SPEC. LENGTH 71. MM
 LUG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
1AEE-85	RAD	EE	1.768	6.7	.031	.293	11.9
81	RAD	EE	1.770	5.5	.029	.319	12.5
99	RAD	EE	1.765	5.6	.039	.209	8.9
103	RAD	EF	1.768	5.8	.025	.224	10.0
79	RAD	EE					12.6
83	RAD	EE					11.4
87	RAD	EE					13.4
97	RAD	EF					12.0
101	RAD	EE					12.7
1AEE-105	RAD	EE					13.1
1BEE-189	RAD	EE	1.785	5.9	.034	.285	11.9
193	RAD	EE	1.783				11.8
207	RAD	EE	1.766	5.6	.039	.293	11.6
211	RAD	EE	1.765	5.6	.035	.294	11.7
187	RAD	EE					12.3
191	RAD	EE					10.6
195	RAD	EE					12.9
205	RAD	EE					11.7
209	RAD	EE					12.8
213	RAD	EE					12.2
MEAN			1.771	5.8	.033	.274	11.9
				(.85 MPB1)			(1724, PSI)
STD. DEV.			.008	.4	.005	.041	1.1
				(.06 MPB1)			(155, PSI)

TABLE D-1 (Continued)

LOT NO. 367
 LOG NO. 6484-78
 LOG DENSITY -- MG/M**3

SPEC. DIA. 12.8 MM
 SPEC. LENGTH 71. MM

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
6ACM	10B AX	MLC	1.791	7.3	.019	.119	7.0
	12B AX	MLC	1.794				4.4
	22A AX	MLC	1.803	6.7	.025	.134	7.2
	24A AX	MLC	1.799	6.2	.022	.156	8.2
	10A AX	MLC					8.6
	08B AX	MLC					5.8
	06B AX	MLC					8.9
	12A AX	MLC					6.2
6ACM	18A AX	MLC					6.7
	20A AX	MLC					6.0
	22B AX	MLC					6.6
	24B AX	MLC					7.5
6BCM	94B AX	MLC	1.787				6.5
	96A AX	MLC	1.795	6.2	.021	.136	6.9
	98A AX	MLC	1.805	6.3	.025	.150	7.7
	106B AX	MLC	1.793				6.2
	92A AX	MLC					5.9
	94A AX	MLC					6.9
	96B AX	MLC					7.5
	98B AX	MLC					6.8
	104B AX	MLC					6.1
	106A AX	MLC					6.5
MEAN			1.796	6.5 (.95 MPa)	.022	.139	6.8 (989, PSI)
STD. DEV.			.006	.5 (.07 MPa)	.003	.015	1.0 (145, PSI)

TABLE D-1 (Continued)

LOT NO. 367 SPEC. DIA. 12.8 MM
 LOG NO. 6484-7A SPEC. LENGTH 71. MM
 LOG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNG'S MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)	
6ACM	07	RAD	MLC	1.800	6.6	.026	.171	8.9
	11	RAD	MLC	1.796	6.7	.024	.244	11.9
	25	RAD	MLC	1.798	7.1	.029	.190	9.7
	29	RAD	MLC	1.797	6.7	.025	.141	7.7
	05	RAD	MLC					11.7
6ACM	09	RAD	MLC					8.2
	13	RAD	MLC					10.8
	23	RAD	MLC					8.3
	27	RAD	MLC					10.3
	31	RAD	MLC					7.0
6BCM	115	RAD	MLC	1.790	6.3	.026	.205	10.0
	119	RAD	MLC	1.794	6.4	.027	.243	11.3
	133	RAD	MLC	1.797	6.4	.025	.180	9.1
	137	RAD	MLC	1.798	6.5	.025	.180	9.3
	113	RAD	MLC					10.9
	117	RAD	MLC					10.3
	121	RAD	MLC					11.0
	131	RAD	MLC					9.7
	135	RAD	MLC					11.0
	139	RAD	MLC					10.2
MEAN			1.796	6.6	.026	.194	9.9	
				(.96 MPsi)			(1431 PSI)	
STD. DEV.			.003	.2	.002	.035	1.3	
				(.04 MPsi)			(195 PSI)	

TABLE D-1 (Continued)

LOT NO. 367			SPEC. DIA. 12.8 MM				
LOG NO. 6484-78			SPEC. LENGTH 71. MM				
LOG DENSITY --			MG/M**3				

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)

6AYM	30B AX	MLM	1.791				
	34A AX	MLM	1.804	6.7	.021	.149	8.3
	46B AX	MLM	1.798				6.0
	52A AX	MLM	1.806				5.4
6AYM	30A AX	MLM					9.2
	34B AX	MLM					10.2
	42A AX	MLM					8.7
	42B AX	MLM					6.6
	46A AX	MLM					13.0
	52B AX	MLM					9.5
6BYM	112B AX	MLM	1.797	6.6	.023	.193	9.8
	116A AX	MLM	1.800	7.6	.027	.166	9.3
	128B AX	MLM	1.792				5.7
	134A AX	MLM	1.795	8.2	.020	.169	10.8
	112A AX	MLM					10.0
	116B AX	MLM					9.0
	124A AX	MLM					12.3
	124B AX	MLM					10.7
	128A AX	MLM					11.6
	134B AX	MLM					11.1

MEAN			1.798	7.2	.023	.169	9.3
				(1.05 MPaSI)			(1352.PSI)
STD. DEV.			.005	.8	.003	.018	2.2
				(.11 MPaSI)			(316.PSI)

TABLE D-1 (Continued)

LOT NO. 367 SPEC. DIA. 12.8 MM
 LOG NO. 6484-7H SPEC. LENGTH 71. MM
 LOG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)	
6AYM	45	RAD	MLM	1.802	6.8	.029	.200	10.0
	49	RAD	MLM	1.795	6.7	.024	.189	9.9
	63	RAD	MLM	1.800	6.5	.026	.205	10.0
6AYM	67	RAD	MLM	1.800				4.5
	43	RAD	MLM					10.8
	47	RAD	MLM					10.5
	51	RAD	MLM					11.3
	61	RAD	MLM					10.3
	65	RAD	MLM					12.1
	69	RAD	MLM					13.2
6BYM	153	RAD	MLM	1.796	6.1	.025	.268	11.9
	157	RAD	MLM	1.788	5.9	.029	.270	11.7
	171	RAD	MLM	1.797	6.1	.028	.207	9.9
	175	RAD	MLM	1.786	5.6	.028	.272	11.0
	151	RAD	MLM					12.0
	155	RAD	MLM					11.8
	159	RAD	MLM					10.0
	169	RAD	MLM					11.1
	173	RAD	MLM					10.3
	177	RAD	MLM					10.6
MEAN				1.795	6.2	.027	.230	10.6
					(.91 MPaSI)			(1542,PSI)
STD. DEV.				.006	.4	.002	.038	1.7
					(.06 MPaSI)			(248,PSI)

TABLE D-1 (Continued)

LOT NO. 307 SPEC. DIA. 12.8 MM
 LOG NO. 6484-78 SPEC. LENGTH 71. MM
 LOG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
6AEM	60B AX	MLE	1.793	7.7	.016	.233	13.5
	64A AX	MLE	1.786	8.8	.015	.254	16.2
6AEM	76B AX	MLE	1.794	7.5	.016	.184	10.8
	84A AX	MLE	1.802	7.6	.020	.188	10.7
	60A AX	MLE					14.3
	64B AX	MLE					14.9
	72A AX	MLE					12.7
	72B AX	MLE					14.4
	76A AX	MLE					8.2
	84B AX	MLE					12.5
6REM	142B AX	MLE	1.794	7.0	.021	.263	13.7
	146A AX	MLE	1.792	7.6	.020	.244	13.4
	158B AX	MLE	1.794	7.8	.020	.247	14.1
	164A AX	MLE	1.794	7.8	.020	.242	14.0
	142A AX	MLE					14.6
	146B AX	MLE					14.1
	154A AX	MLE					14.7
	154B AX	MLE					12.8
	158A AX	MLE					13.3
	164B AX	MLE					12.2
MEAN			1.794	7.7 (1.12 MPsi)	.018	.232	13.3 (1922 PSI)
STD. DEV.			.004	.5 (.07 MPsi)	.002	.030	1.8 (257 PSI)

TABLE D-1 (Continued)

LOT NO. 367
 LOG NO. 6484-78
 LOG DENSITY -- MG/M**3
 SPEC. DIA. ***** MM
 SPEC. LENGTH 71. MM

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	TENSILE STRENGTH (MPA)
6AEM 81	RAD	MLE	1.798	6.4	.013	.279	12.6
85	RAD	MLE	1.801	6.2	.027	.289	12.6
99	RAD	MLE	1.800	6.6	.023	.230	11.4
103	RAD	MLE	1.798	6.2	.022	.214	10.7
79	RAD	MLE					12.0
83	RAD	MLE					12.6
87	RAD	MLE					12.5
97	RAD	MLE					12.3
101	RAD	MLE					12.7
105	RAD	MLE					13.7
6BEM 189	RAD	MLE	1.795	6.1	.029	.270	11.9
193	RAD	MLE	1.792	5.7	.026	.292	12.0
207	RAD	MLE	1.785	5.8	.030	.289	11.9
211	RAD	MLE	1.787	5.9	.029	.300	12.5
187	RAD	MLE					13.0
191	RAD	MLE					12.3
195	RAD	MLE					12.7
205	RAD	MLE					14.5
209	RAD	MLE					13.0
6BEM 213	RAD	MLE					11.8
MEAN			1.794	6.1	.025	.270	12.4
				(.69 MPa)			(1804, PSI)
STD. DEV.			.006	.3	.006	.031	.8
				(.04 MPa)			(116, PSI)

TABLE D-2
FLEXURAL PROPERTIES OF HLM GRAPHITE

LOT NO. 367				SPEC. DIA.	6.4 MM
LOG NO. 6484-78				SPEC. LENGTH	51. MM
LOG DENSITY --				MG/M**3	
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1A	12A	AX	EC	21.8	18.6
	12B	AX	EC	19.5	17.0
	10A	AX	EC	19.7	17.1
	10B	AX	EC	20.0	17.4
	16A	AX	EC	16.1	14.4
	16B	AX	EC	16.4	14.7
	24A	AX	EC	20.4	17.6
	24B	AX	EC	18.2	16.0
	26A	AX	EC	15.9	14.3
	26B	AX	EC	20.9	18.0
	32A	AX	EC	19.5	17.0
	32B	AX	EC	19.6	17.1
1B	88A	AX	EC	19.5	17.0
	88B	AX	EC	21.8	18.6
	86A	AX	EC	14.2	12.9
	86B	AX	EC	15.6	14.0
	80A	AX	EC	19.2	16.7
	80B	AX	EC	20.1	17.4
	96A	AX	EC	21.7	18.5
	96B	AX	EC	20.3	17.6
	102A	AX	EC	19.3	16.8
	102B	AX	EC	11.9	11.0
1B	104A	AX	EC	18.1	16.0
	104B	AX	EC	16.3	14.6
MEAN				18.6 MPA (2695. PSI)	16.3 MPA (2358. PSI)
STD. DEV.				2.5 MPA (368. PSI)	1.9 MPA (279. PSI)

TABLE D-2 (Continued)

LOT NO. 367 SPEC. DIA. 6.4 MM
 LOG NO. 6484-78 SPEC. LENGTH 51. MM
 LOG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1A	7 RAD	EC		19.0	16.5
	9 RAD	EC		24.6	20.1
	13 RAD	EC		24.7	20.2
	15 RAD	EC		18.0	15.8
	19 RAD	EC		23.6	19.5
	33 RAD	EC		20.4	17.4
	35 RAD	EC		22.8	19.0
	39 RAD	EC		22.0	18.5
	41 RAD	EC		23.3	19.4
	45 RAD	EC		22.1	18.6
1B	163 RAD	EC		18.2	15.9
	165 RAD	EC		15.4	13.8
	169 RAD	EC		20.7	17.7
	171 RAD	EC		22.2	18.6
	175 RAD	EC		19.2	16.6
	189 RAD	EC		22.6	18.9
	191 RAD	EC		22.6	18.9
	195 RAD	EC		22.6	18.9
	197 RAD	EC		21.7	18.3
	201 RAD	EC		17.3	15.2
MEAN				21.2 MPA (3068, PSI)	17.9 MPA (2594, PSI)
STD. DEV.				2.5 MPA (370, PSI)	1.7 MPA (251, PSI)

TABLE D-2 (Continued)

LOT NO. 367				SPEC. DIA.	6.4 MM
LOG NO. 6484-78				SPEC. LENGTH	51. MM
LOG DENSITY --				MG/M**3	
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1A	36A AX	EM		20.7	17.9
	36B AX	EM		21.1	18.1
	38A AX	EM		21.7	18.5
	38B AX	EM		21.7	18.5
	42A AX	EM		20.9	18.0
	42B AX	EM		15.6	14.1
	48A AX	EM		15.3	13.8
	48B AX	EM		17.7	15.7
	50A AX	EM		19.2	16.8
1A	50B AX	EM		17.3	15.4
1B	108A AX	EM		20.9	18.0
	108B AX	EM		19.0	16.7
	110A AX	EM		19.0	16.7
	110B AX	EM		22.1	18.8
	114A AX	EM		16.3	14.6
	114B AX	EM		16.0	14.4
	120A AX	EM		17.6	15.6
	120B AX	EM		20.0	17.4
	122A AX	EM		23.3	19.6
	122B AX	EM		22.1	18.8
MEAN				19.4 MPA (2811. PSI)	16.9 MPA (2447. PSI)
STD. DEV.				2.4 MPA (353. PSI)	1.8 MPA (258. PSI)

TABLE D-2 (Continued)

LOT NO. 367			SPEC. DIA. 6.4 MM		
LOG NO. 6484-78			SPEC. LENGTH 51 MM		
LOG DENSITY --			MG/M**3		

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)

1A	59 RAD	EM		19.5	16.6
	63 RAD	EM		23.7	19.3
	65 RAD	EM		25.9	20.5
	69 RAD	EM		25.4	20.2
	71 RAD	EM		23.6	19.2
	85 RAD	EM		21.8	18.2
	89 RAD	EM		23.8	19.3
	91 RAD	EM		18.6	16.0
	95 RAD	EM		20.2	17.1
1A	97 RAD	EM		22.5	18.6
1B	215 RAD	EM		19.8	16.9
	219 RAD	EM		19.3	16.5
	221 RAD	EM		17.3	15.1
	225 RAD	EM		21.1	17.7
	227 RAD	EM		19.4	16.6
	241 RAD	EM		18.0	15.6
	245 RAD	EM		21.8	18.2
	247 RAD	EM		23.1	18.9
	251 RAD	EM		18.9	16.3
	253 RAD	EM		19.4	16.6

MEAN				21.2 MPA	17.7 MPA
				(3070. PSI)	(2562. PSI)

STD. DEV.				2.5 MPA	1.6 MPA
				(362. PSI)	(226. PSI)

TABLE D-2 (Continued)

LOT NO. 367 SPEC. DIA. 6.4 MM
 LOG NO. 6484-78 SPEC. LENGTH 51. MM
 LOG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1A	56A	AX	EE	27.2	22.4
	56B	AX	EE	24.8	20.9
	58A	AX	EE	26.3	21.8
	58B	AX	EE	27.9	22.8
	62A	AX	EE	24.5	20.7
	62B	AX	EE	24.6	20.6
	68A	AX	EE	19.1	16.9
	68B	AX	EE	21.7	18.6
	70A	AX	EE	23.6	20.1
	70B	AX	EE	24.1	20.4
1B	128A	AX	EE	22.7	19.5
	128B	AX	EE	27.9	22.8
	130A	AX	EE	26.0	21.6
	130B	AX	EE	24.8	20.9
	134A	AX	EE	24.8	20.9
	134B	AX	EE	21.9	18.9
	140A	AX	EE	27.8	22.8
	140B	AX	EE	23.9	20.3
	142A	AX	EE	25.5	21.3
1B	142B	AX	EE	25.4	21.3
MEAN				24.7 MPA (3584. PSI)	20.8 MPA (3015. PSI)
STD. DEV.				2.3 MPA (327. PSI)	1.5 MPA (217. PSI)

TABLE D-2 (Continued)

LOT NO. 367
 LOG NO. 6484-78
 LOG DENSITY -- MG/M**3

SPEC. DIA. 6.4 MM
 SPEC. LENGTH 51. MM

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
1A	111 RAD	EE		22.2	18.1
	115 RAD	EE		19.3	16.3
	117 RAD	EE		18.5	15.8
	121 RAD	EF		22.0	18.0
	123 RAD	EE		20.6	17.1
	137 RAD	EE		20.7	17.2
	141 RAD	EE		22.1	18.0
	143 RAD	EE		19.0	16.1
	147 RAD	EE		18.8	16.0
	149 RAD	EE		20.9	17.3
1R	267 RAD	EF		17.9	15.3
	271 RAD	EE		23.6	18.9
	273 RAD	EE		22.1	18.0
	277 RAD	EE		15.7	13.8
	279 RAD	EE		19.8	16.6
	293 RAD	EE		20.7	17.2
	297 RAD	EE		17.0	14.8
	299 RAD	EE		16.3	14.2
	303 RAD	EE		18.9	16.1
	305 RAD	EE		20.3	16.9
MEAN				19.8 MPA (2875, PSI)	16.6 MPA (2407, PSI)
STD. DEV.				2.1 MPA (306, PSI)	1.4 MPA (198, PSI)

TABLE D-2 (Continued)

LOT NO. 367
 LOG NO. 6484-7A
 LOG DENSITY -- MG/M**3

SPEC. DIA. 6.4 MM
 SPEC. LENGTH 51. MM

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6A	154A AX	MLC		18.0	15.8
	154B AX	MLC		17.8	15.6
	156A AX	MLC		11.9	11.0
	156B AX	MLC		14.5	13.0
	160A AX	MLC		20.1	17.3
	160B AX	MLC		18.5	16.1
	174A AX	MLC		12.4	11.4
	174B AX	MLC		18.9	16.4
	176A AX	MLC		15.7	14.0
	176B AX	MLC		8.0	7.6
	168A AX	MLC		17.1	15.1
	168B AX	MLC		17.0	15.0
6B	224A AX	MLC		15.6	14.0
	224B AX	MLC		15.7	14.0
	226A AX	MLC		13.2	12.0
	226B AX	MLC		12.9	11.8
	232A AX	MLC		19.4	16.7
	232B AX	MLC		16.8	14.9
	236A AX	MLC		8.9	8.4
	236B AX	MLC		19.0	16.5
	238A AX	MLC		17.6	15.4
	238B AX	MLC		17.6	15.5
	244A AX	MLC		15.0	13.5
	244B AX	MLC		11.5	10.6
MEAN				15.6 MPA (2256, PSI)	13.8 MPA (2004, PSI)
STD. DEV.				3.3 MPA (475, PSI)	2.6 MPA (378, PSI)

TABLE D-2 (Continued)

LOT NO. 367				SPEC. DIA.	6.4 MM
LOG NO. 6484-7B				SPEC. LENGTH	51. MM
LOG DENSITY --				MG/M**3	
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6A	319 RAD	MLC		24.9	20.3
	321 RAD	MLC		16.7	14.8
	325 RAD	MLC		19.2	16.7
	327 RAD	MLC		15.4	13.8
	331 RAD	MLC		25.6	20.8
	345 RAD	MLC		21.1	18.0
	347 RAD	MLC		22.1	18.6
	351 RAD	MLC		22.7	19.0
	353 RAD	MLC		18.1	15.9
	357 RAD	MLC		19.9	17.2
6B	471 RAD	MLC		21.3	18.1
	473 RAD	MLC		22.7	19.0
	475 RAD	MLC		21.3	18.1
	477 RAD	MLC		23.6	19.6
6B	481 RAD	MLC		18.3	16.0
	483 RAD	MLC		23.7	19.6
	485 RAD	MLC		21.0	17.9
	487 RAD	MLC		16.2	14.4
	489 RAD	MLC		22.3	18.7
	493 RAD	MLC		15.4	13.8
MEAN				20.6 MPA (2984. PSI)	17.5 MPA (2539. PSI)
STD. DEV.				3.1 MPA (446. PSI)	2.1 MPA (308. PSI)

TABLE D-2 (Continued)

LOT NO. 367 SPEC. DIA. 6.4 MM
 LOG NO. 6484-7R SPEC. LENGTH 51. MM
 LOG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6A	180A	AX	MLM	19.2	16.9
	180B	AX	MLM	23.6	20.0
	182A	AX	MLM	17.6	15.7
	182B	AX	MLM	19.7	17.3
	196A	AX	MLM	21.2	18.4
	196B	AX	MLM	21.0	18.2
	186A	AX	MLM	20.2	17.6
	186B	AX	MLM	18.6	16.4
	192A	AX	MLM	21.4	18.5
	192B	AX	MLM	20.7	18.0
	194A	AX	MLM	16.6	14.9
	194B	AX	MLM	18.3	16.2
6B	250A	AX	MLM	17.5	15.6
	250B	AX	MLM	19.0	16.7
	252A	AX	MLM	20.7	18.0
	252B	AX	MLM	21.2	18.3
	256A	AX	MLM	20.1	17.6
	256B	AX	MLM	24.6	20.6
	262A	AX	MLM	24.7	20.7
	262B	AX	MLM	24.3	20.4
	264A	AX	MLM	25.2	21.0
	264B	AX	MLM	21.2	18.3
MEAN				20.8 MPA (3012, PSI)	18.0 MPA (2608, PSI)
STD. DEV.				2.5 MPA (358, PSI)	1.7 MPA (252, PSI)

TABLE D-2 (Continued)

LOT NO. 367			SPEC. DIA.	6.4 MM	
LOG NO. 6484-78			SPEC. LENGTH	51. MM	
LOG DENSITY --			MG/M**3		

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)

6A	371 RAD	MLM		17.2	15.0
	375 RAD	MLM		20.5	17.4
	377 RAD	MLM		23.1	19.0
	381 RAD	MLM		22.1	18.4
	383 RAD	MLM		24.0	19.5
	397 RAD	MLM		15.3	13.7
	401 RAD	MLM		16.5	14.5
	403 RAD	MLM		18.6	16.0
	407 RAD	MLM		21.3	17.9
	409 RAD	MLM		19.3	16.5
6B	501 RAD	MLM		23.3	19.1
	505 RAD	MLM		21.7	18.1
	507 RAD	MLM		19.6	16.8
	511 RAD	MLM		23.1	19.0
	513 RAD	MLM		20.3	17.2
	527 RAD	MLM		17.6	15.3
	531 RAD	MLM		20.9	17.6
	533 RAD	MLM		22.0	18.3
	537 RAD	MLM		23.2	19.1
	539 RAD	MLM		22.5	18.6

MEAN			20.6 MPA (2989. PSI)	17.4 MPA (2517. PSI)	

STD. DEV.			2.5 MPA (365. PSI)	1.7 MPA (245. PSI)	

TABLE D-2 (Continued)

LOT NO. 367
 LOG NO. 6484-7B
 LOG DENSITY -- MG/M**3

SPEC. DIA. 6.4 MM
 SPEC. LENGTH 51. MM

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6A	200A	AX	MLE	23.4	20.1
	200B	AX	MLE	27.9	23.1
	202A	AX	MLE	27.5	22.8
	202B	AX	MLE	25.0	21.2
	206A	AX	MLE	25.3	21.4
	206B	AX	MLE	25.1	21.3
	212A	AX	MLE	24.5	20.9
	212B	AX	MLE	24.1	20.6
	214A	AX	MLE	25.9	21.8
	214B	AX	MLE	21.8	19.0
6B	270A	AX	MLE	22.8	19.7
	270B	AX	MLE	23.1	19.9
	272A	AX	MLE	28.3	23.3
	272B	AX	MLE	24.2	20.7
	276A	AX	MLE	21.6	18.9
	276B	AX	MLE	24.2	20.7
	280A	AX	MLE	24.9	21.2
	280B	AX	MLE	27.4	22.7
	278A	AX	MLE	22.7	19.6
	278B	AX	MLE	20.4	18.0
MEAN				24.5 MPA (3554 PSI)	20.8 MPA (3022 PSI)
STD. DEV.				2.2 MPA (313 PSI)	1.4 MPA (210 PSI)

TABLE D-2 (Continued)

LOT NO. 367
 LOG NO. 6484-78
 LOG DENSITY -- MG/M**3

SPEC. DIA. 6.4 MM
 SPEC. LENGTH 51. MM

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	MODULUS OF RUPTURE (MPA) (UNCORRECTED)	FLEXURAL STRENGTH (MPA) (CORRECTED)
6A	423 RAD	MLE		23.7	19.2
	427 RAD	MLE		20.3	17.1
	429 RAD	MLE		24.0	19.4
	433 RAD	MLE		18.5	16.0
	435 RAD	MLE		24.5	19.7
	449 RAD	MLE		20.8	17.5
	453 RAD	MLE		23.2	18.9
	455 RAD	MLE		23.0	18.8
	459 RAD	MLE		21.7	18.0
	461 RAD	MLE		21.5	17.9
6B	553 RAD	MLE		21.5	17.9
	557 RAD	MLE		18.8	16.2
	559 RAD	MLF		25.9	20.3
	563 RAD	MLE		19.1	16.4
	565 RAD	MLE		22.6	18.6
	579 RAD	MLE		21.0	17.6
	583 RAD	MLE		19.4	16.5
	585 RAD	MLE		20.9	17.5
	589 RAD	MLE		18.7	16.1
	591 RAD	MLE		22.0	18.2
MEAN				21.6 MPA (3126. PSI)	17.9 MPA (2593. PSI)
STD. DEV.				2.1 MPA (301. PSI)	1.3 MPA (185. PSI)

TABLE D-3
COMPRESSIVE PROPERTIES OF HLM GRAPHITE

LOT NO. 367			SPEC. DIA. 12.8 MM				
LOG NO. 6484-78			SPEC. LENGTH 25. MM				
LOG DENSITY =			MG/M**3				

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)

1AC	E 6C	AX	EC	5.3	.200	2.371	37.9
	E 8C	AX	EC	4.7	.229	2.532	38.9
	E10C	AX	EC	4.9	.210	2.559	38.7
	E12C	AX	EC	5.3	.200	2.148	37.4
1BC	E102C	AX	EC	5.5	.200	2.201	38.5
	E104C	AX	EC	5.3	.200	2.331	38.4
	E106C	AX	EC	4.5	.230	2.377	38.7
	E108C	AX	EC	5.1	.200	1.965	36.2

MEAN			5.1	.208	2.310	38.1	
			(.74 MPa)		(5524, PSI)		

STD. DEV.			.4	.013	.199	.9	
			(.05 MPa)		(133, PSI)		

1AC	E 9B	RAD	EC	5.8	.180	2.370	44.2
	E23B	RAD	EC	6.3	.180	2.327	44.5
	E25B	RAD	EC	6.3	.200	2.252	44.1
	E29B	RAD	EC	6.2	.190	2.073	42.5
1BC	E111B	RAD	EC	6.0	.190	2.048	42.2
	E115B	RAD	EC	5.2	.180	2.253	41.9
	E119B	RAD	EC	5.7	.220	2.179	42.1
	E131B	RAD	EC	5.8	.210	2.288	42.8

MEAN			5.9	.194	2.224	43.0	
			(.86 MPa)		(6241, PSI)		

STD. DEV.			.3	.015	.116	1.1	
			(.05 MPa)		(154, PSI)		

TABLE D-3 (Continued)

LOT NO. 367 SPEC. DIA. 12.8 MM
 LOG NO. 6484-78 SPEC. LENGTH 25. MM
 LOG DENSITY -- MG/M**3

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNG'S MODULUS (GPA)	PERM- ANENT SET (PCT.)	FRAC- TURE STRAIN (PCT.)	COMPR. STRENGTH (MPA)
1AY	E30C	AX	EM	5.0	.210	1.891	34.6
	E34C	AX	EM	5.6	.190	1.735	35.0
	E42C	AX	EM	5.1	.180	2.010	36.7
	E46C	AX	EM	3.9	.210	2.157	33.6
1BY	E114C	AX	EM	5.1	.200	1.852	35.8
	E118C	AX	EM	5.7	.180	2.102	37.1
	E126C	AX	EM	5.2	.200	1.891	34.5
	E130C	AX	EM	4.5	.200	2.015	32.9
MEAN				5.0 (.73 MPaSI)	.196	1.957	35.0 (5078, PSI)
STD. DEV.				.6 (.08 MPaSI)	.012	.140	1.5 (212, PSI)
1AY	E43B	RAD	EM	6.1	.160	2.234	43.6
	E47B	RAD	EM	5.9	.190	2.154	41.7
	E51B	RAD	EM	5.5	.200	2.484	42.4
	E61B	RAD	EM	6.5	.170	1.770	40.2
1BY	E151B	RAD	EM	5.6	.220	2.193	41.1
	E155B	RAD	EM	5.5	.210	2.276	41.7
	E159B	RAD	EM	5.5	.200	1.986	39.6
	E169B	RAD	EM	5.3	.210	1.812	37.7
MEAN				5.7 (.83 MPaSI)	.195	2.114	41.0 (5951, PSI)
STD. DEV.				.4 (.06 MPaSI)	.021	.242	1.8 (265, PSI)

TABLE D-3 (Continued)

LOT NO. 367				SPEC. DIA. 12.8 MM			
LOG NO. 6484-78				SPEC. LENGTH 25. MM			
LOG DENSITY ==				MG/M**3			
=====							
SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT.)	FRAC- TURE STRAIN (PCT.)	COMPR. STRENGTH (MPA)

1AE	E60C	AX	EE	6.3	.200	1.735	38.3
	E64C	AX	EE	7.2	.180	1.846	41.0
	E72C	AX	EE	6.7	.175	1.617	37.7
	E76C	AX	EE	6.9	.160	1.543	39.8
1BE	E144C	AX	EE	6.5	.180	1.907	40.4
	E148C	AX	EE	7.1	.170	1.878	42.3
	E156C	AX	EE	6.5	.190	1.931	40.0
	E160C	AX	EE	6.7	.170	1.661	39.2
=====							
MEAN				6.7	.178	1.765	39.8
				(.98 MPaSI)			(5777.PSI)
STD. DEV.				.3	.012	.146	1.5
				(.05 MPaSI)			(213.PSI)

1AE	E79B	RAD	EE	5.6	.210	2.338	41.6
	E83B	RAD	EE	5.2	.190	2.488	41.8
	E87B	RAD	EE	5.1	.220	1.801	37.3
	E97B	RAD	EE	5.5	.160	1.877	39.1
1BE	E187B	RAD	EE	5.4	.200	2.650	44.5
	E191B	RAD	EE	5.5	.200	2.471	42.7
	E195B	RAD	EE	5.6	.200	2.466	44.2
	E205B	RAD	EE	4.6	.200	2.456	41.6

MEAN				5.3	.197	2.318	41.6
				(.77 MPaSI)			(6033.PSI)
STD. DEV.				.3	.017	.309	2.4
				(.05 MPaSI)			(352.PSI)

TABLE D-3 (Continued)

LOT NO. 367			SPEC. DIA. 12.8 MM				
LOG NO. 6484-78			SPEC. LENGTH 25. MM				
LOG DENSITY --			MG/M**3				

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)

6AC	M10C AX	MLC				1.609	35.5
	M 8C AX	MLC				1.787	33.3
	M12C AX	MLC		5.4	.180	1.996	37.5
	M18C AX	MLC		6.3	.080	1.906	38.3
6BC	M92C AX	MLC		4.7	.200	2.290	37.3
	M94C AX	MLC		4.7	.200	1.807	34.9
	M96C AX	MLC		5.7	.040	1.277	33.4
	M98C AX	MLC		5.0	.189	1.330	32.4

MEAN			5.3	.148	1.750	35.3	
			(.77 MPsi)			(5123.PSI)	
STD. DEV.			.6	.070	.338	2.2	
			(.09 MPsi)			(318.PSI)	

6AC	M 5B RAD	MLC		6.4	.180	1.917	41.8
	M 9B RAD	MLC		5.9	.180	1.898	41.0
	M13B RAD	MLC		6.4	.150	1.929	41.8
	M23B RAD	MLC		6.0	.170	1.822	39.9
6BC	M113B RAD	MLC		5.7	.210	2.230	41.5
	M117B RAD	MLC		6.1	.170	1.794	39.9
	M121B RAD	MLC		5.5	.180	2.146	41.0
	M131B RAD	MLC		5.4	.190	1.735	36.9

MEAN			5.9	.179	1.934	40.5	
			(.86 MPsi)			(5870.PSI)	
STD. DEV.			.4	.017	.171	1.6	
			(.05 MPsi)			(235.PSI)	

TABLE D-3 (Continued)

LOT NO. 367
 LOG NO. 6484-78
 LOG DENSITY -- MG/M**3
 SPEC. DIA. 12.8 MM
 SPEC. LENGTH 25. MM

SPECIMEN NUMBER	ORIENT- ATION	LUCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)
6AY	M30C	AX	MLM	7.3	.160	1.910	40.1
	M34C	AX	MLM	5.6	.180	1.347	32.8
	M42C	AX	MLM	6.1	.160	1.658	36.7
	M46C	AX	MLM	5.2	.180	1.946	37.8
6BY	M112C	AX	MLM	4.4	.220	1.486	31.6
	M116C	AX	MLM	6.1	.180	1.749	37.2
	M124C	AX	MLM	5.3	.190	1.406	32.2
	M128C	AX	MLM	5.8	.180	1.469	34.6
MEAN				5.7 (.83 MPaI)	.181	1.621	35.4 (5130.PaI)
STD. DEV.				.8 (.12 MPaI)	.019	.230	3.1 (446.PaI)
6AY	M43B	RAD	MLM	5.6	.180	2.346	43.2
	M47B	RAD	MLM	6.3	.160	2.426	44.4
	M51B	RAD	MLM	5.9	.180	2.404	44.5
	M61B	RAD	MLM	6.1	.170	1.866	41.9
6BY	M151B	RAD	MLM	5.6	.200	2.016	40.5
	M155B	RAD	MLM	5.1	.200	2.731	42.8
	M159B	RAD	MLM	5.6	.210	2.427	42.6
	M169B	RAD	MLM	5.8	.170	1.941	40.8
MEAN				5.8 (.83 MPaI)	.184	2.269	42.6 (6175.PaI)
STD. DEV.				.4 (.06 MPaI)	.018	.298	1.5 (216.PaI)

TABLE D-3 (Continued)

LOT NO. 367			SPEC. DIA. 12.8 MM				
LOG NO. 6484-78			SPEC. LENGTH 25. MM				
LOG DENSITY --			MG/M**3				

SPECIMEN NUMBER	ORIENT- ATION	LOCA- TION	DENSITY (MG/M**3)	YOUNGS MODULUS (GPA)	PERM- ANENT SET (PCT)	FRAC- TURE STRAIN (PCT)	COMPR. STRENGTH (MPA)

6AE	M60C	AX	MLE	6.4	.180	2.142	41.3
	M64C	AX	MLE	8.6	.110	1.636	43.6
	M72C	AX	MLE	7.2	.150	1.659	38.8
	M76C	AX	MLE	6.9	.150	1.978	42.4
6BE	M142C	AX	MLE	6.7	.170	2.012	42.1
	M146C	AX	MLE	7.3	.180	2.030	41.9
	M154C	AX	MLE	6.9	.180	1.714	38.6
	M158C	AX	MLE	7.0	.200	1.712	39.9

MEAN				7.1	.165	1.861	41.1
				(1.03 MPsi)			(5958,PSI)
STD. DEV.				.7	.028	.200	1.8
				(.10 MPsi)			(261,PSI)

6AE	M79B	RAD	MLE	5.9	.200	2.711	45.6
	M83B	RAD	MLE	5.8	.200	2.479	44.3
	M87B	RAD	MLE	5.9	.180	2.410	44.7
	M97B	RAD	MLE	6.1	.180	2.380	45.7
6BE	M187B	RAD	MLE	5.6	.180	2.677	45.9
	M191B	RAD	MLE	5.7	.210	2.624	44.5
	M195B	RAD	MLE	6.1	.190	2.218	42.7
	M205B	RAD	MLE	5.8	.220	2.498	44.3

MEAN				5.9	.195	2.500	44.7
				(.85 MPsi)			(6485,PSI)
STD. DEV.				.2	.015	.166	1.0
				(.02 MPsi)			(151,PSI)

TABLE D-4
IMPURITY CONTENT OF HLM GRAPHITE
LOG NO. 6484-78, SPECTROGRAPHIC ANALYSIS

LAB. NO. 48247 REPORT TO: G ENGLE DATE: 6-21-76
SAMPLE: GRAPHITE 6484-78-E708 PROJECT NO. 3224146005 DILUTION: 1.0000 PLATE NO. 76-066

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	60.00	B	2.00
BA	60.00	BE	< .50	BI	< 2.00
CA	400.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CH	10.00	CS	< 100.00
CU	< 1.00	DY	< 20.00	EH	< 6.00
EU	< 10.00	FE	1000.00	GU	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	20.00	LA	< 10.00	LI	< 1.00
LU	< .50	MG	2.00	MN	< 1.00
MO	< 1.00	NA	10.00	NB	< 6.00
NO	< 200.00	NI	20.00	P	< 100.00
PB	< 6.00	PH	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	100.00
SM	< 100.00	SN	< 6.00	SK	< 40.00
TA	< 40.00	TB	< 40.00	TI	80.00
TL	< 20.00	TM	< 4.00	V	80.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

LAB. NO. 48247 REPORT TO: G ENGLE DATE: 6-21-76
SAMPLE: GRAPHITE 6484-78-E808 PROJECT NO. 3224146005 DILUTION: 1.0000 PLATE NO. 76-066

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	60.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	200.00	CD	< 10.00	CE	< 80.00
CO	< 4.00	CH	20.00	CS	< 100.00
CU	< 1.00	DY	< 20.00	EH	< 6.00
EU	< 10.00	FE	> 1000.00	GU	< 10.00
HF	< 20.00	HO	< 10.00	IN	< 1.00
K	10.00	LA	< 10.00	LI	< 1.00
LU	< .50	MG	6.00	MN	< 4.00
MO	< 1.00	NA	10.00	NB	< 6.00
NO	< 200.00	NI	40.00	P	< 100.00
PB	< 6.00	PH	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SK	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	40.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	40.00				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
> MEANS GREATER THAN
< MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE D-4 (Continued)

LAB. NO. 44247

SAMPLE: GRAPHITE 6484-78-E16F

PROJECT NO. 3224146005

REPORT TO: G. ENGLE

DILUTION: 1,0000

DATE: 6-21-78

PLATE NO. 78-066

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	80.00	B	20.00
BA	40.00	BE	< .50	BI	< 2.00
CA	200.00	CD	< 10.00	CE	< 80.00
CU	< 4.00	CM	20.00	CS	< 100.00
CU	< 1.00	DY	< 20.00	EM	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HD	< 10.00	IN	< 1.00
K	10.00	LA	< 10.00	LI	< 1.00
LU	< .50	MG	2.00	MN	4.00
MO	< 1.00	NA	10.00	NB	< 6.00
ND	< 200.00	NI	40.00	P	< 100.00
PB	< 6.00	PK	< 100.00	RB	< 40.00
SB	< 6.00	SC	< 1.00	SI	60.00
SM	< 100.00	SN	< 6.00	SH	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	40.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

LAB. NO. 44247

SAMPLE: GRAPHITE 6484-78-E88B

PROJECT NO. 3224146005

REPORT TO: G. ENGLE

DILUTION: 1,0000

DATE: 6-21-78

PLATE NO. 78-066

ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	40.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	200.00	CD	< 10.00	CE	< 80.00
CU	< 4.00	CM	20.00	CS	< 100.00
CU	< 1.00	DY	< 20.00	EM	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	HD	< 10.00	IN	< 1.00
K	60.00	LA	< 10.00	LI	2.00
LU	< .50	MG	4.00	MN	4.00
MO	< 1.00	NA	40.00	NB	< 6.00
ND	< 200.00	NI	40.00	P	< 100.00
PB	200.00	PK	< 100.00	RB	< 40.00
SB	60.00	SC	< 1.00	SI	60.00
SM	< 100.00	SN	< 6.00	SH	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	40.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
 > MEANS GREATER THAN
 < MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
 RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE D-4 (Continued)

LAB. NO. 44247		REPORT TO: ENGLE		DATE: 6-21-76	
SAMPLE: GRAPHITE 6484-78-E124H		PROJECT NO. 3224146005		DILUTION: 1.0000	
PROJECT NO. 3224146005		DILUTION: 1.0000		PLATE NO. 76-066	
ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	20.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	200.00	CD	< 10.00	CE	< 80.00
CU	< 4.00	CK	20.00	CS	< 100.00
GU	< 1.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	> 1000.00	GD	< 10.00
HF	< 20.00	MO	< 10.00	IN	< 1.00
K	< 10.00	LA	< 10.00	LI	1.00
LU	< .50	MG	2.00	MN	4.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
NO	< 200.00	NI	40.00	P	< 100.00
PB	< 6.00	PH	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TB	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	80.00
W	< 40.00	YB	< 10.00	ZN	< 20.00
ZR	40.00				

LAB. NO. 44247		REPORT TO: G ENGLE		DATE: 6-21-76	
SAMPLE: GRAPHITE 6484-78-F154R		PROJECT NO. 3224146005		DILUTION: 1.0000	
PROJECT NO. 3224146005		DILUTION: 1.0000		PLATE NO. 76-066	
ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM	ELEMENT	CONCENTRATION, PPM
AG	< .50	AL	< 1.00	B	2.00
BA	40.00	BE	< .50	BI	< 2.00
CA	100.00	CD	< 10.00	CE	< 80.00
CU	< 4.00	CK	< 10.00	CS	< 100.00
GU	< 1.00	DY	< 20.00	ER	< 6.00
EU	< 10.00	FE	800.00	GD	< 10.00
HF	< 20.00	MO	< 10.00	IN	< 1.00
K	< 10.00	LA	< 10.00	LI	< 1.00
LU	< .50	MG	8.00	MN	< 1.00
MO	< 1.00	NA	< 10.00	NB	< 6.00
NO	< 200.00	NI	10.00	P	< 100.00
PR	< 6.00	PH	< 100.00	RB	< 40.00
SB	< 8.00	SC	< 1.00	SI	80.00
SM	< 100.00	SN	< 6.00	SR	< 40.00
TA	< 40.00	TR	< 40.00	TI	40.00
TL	< 20.00	TM	< 4.00	V	20.00
W	< 40.00	YR	< 10.00	ZN	< 20.00
ZR	< .50				

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
 > MEANS GREATER THAN
 < MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
 RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE D-4 (Continued)

LAB. NO. 44247

SAMPLE: GRAPHITE 6484-78-M705

REPORT TO: G ENGLE

PROJECT NO. 3224146005

DILUTION: 1.0000

DATE: 6-21-76

PLATE NO. 76-066

ELEMENT CONCENTRATION, PPM

AG	< .50
BA	40.00
CA	80.00
CD	< 4.00
CU	< 1.00
EU	< 10.00
HF	< 20.00
K	10.00
LU	< .50
MD	< 1.00
ND	< 200.00
PB	< 6.00
SB	< 8.00
SM	< 100.00
TA	< 40.00
TL	< 20.00
W	< 40.00
ZR	< .50

ELEMENT CONCENTRATION, PPM

AL	< 1.00
BE	< .50
CD	< 10.00
CM	< 10.00
DY	< 20.00
FE	100.00
HD	< 10.00
LA	< 10.00
MG	2.00
NA	< 10.00
NI	< 4.00
PK	< 100.00
SC	< 1.00
SN	< 6.00
TB	< 40.00
TM	< 4.00
YB	< 10.00

ELEMENT CONCENTRATION, PPM

B	2.00
BI	< 2.00
CE	< 80.00
CS	< 100.00
EM	< 6.00
GU	< 10.00
IN	< 1.00
LI	2.00
MN	< 1.00
NB	< 6.00
P	< 100.00
HB	< 40.00
SI	60.00
SH	< 40.00
TI	20.00
V	10.00
ZN	< 20.00

LAB. NO. 44247

SAMPLE: GRAPHITE 6484-78-M408

REPORT TO: G ENGLE

PROJECT NO. 3224146005

DILUTION: 1.0000

DATE: 6-21-76

PLATE NO. 76-066

ELEMENT CONCENTRATION, PPM

AG	< .50
BA	40.00
CA	200.00
CD	< 4.00
CU	< 1.00
EU	< 10.00
HF	< 20.00
K	< 10.00
LU	< .50
MD	< 1.00
ND	< 200.00
PB	< 6.00
SB	< 8.00
SM	< 100.00
TA	< 40.00
TL	< 20.00
W	< 40.00
ZR	10.00

ELEMENT CONCENTRATION, PPM

AL	60.00
BE	< .50
CD	< 10.00
CM	< 10.00
DY	< 20.00
FE	800.00
HD	< 10.00
LA	< 10.00
MG	4.00
NA	< 10.00
NI	20.00
PK	< 100.00
SC	< 1.00
SN	< 6.00
TB	< 40.00
TM	< 4.00
YB	< 10.00

ELEMENT CONCENTRATION, PPM

B	2.00
BI	< 2.00
CE	< 80.00
CS	< 100.00
EM	< 6.00
GU	< 10.00
IN	< 1.00
LI	1.00
MN	2.00
NB	< 6.00
P	< 100.00
HB	< 40.00
SI	100.00
SH	< 40.00
TI	40.00
V	40.00
ZN	< 20.00

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
 > MEANS GREATER THAN
 < MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
 RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE D-4 (Continued)

LAB. NO. 44247

SAMPLE 1 GRAPHITE 6484-78-M108

PROJECT NO. 3224146005

REPORT TO: G. ENGLE

DILUTION: 1.0000

DATE: 8-21-76

PLATE NO. 76-066

ELEMENT CONCENTRATION, PPM

AG	< .50
BA	40.00
CA	100.00
CU	< 4.00
CU	10.00
EU	< 10.00
MF	< 20.00
K	< 10.00
LU	< .50
MO	< 1.00
NO	< 200.00
PB	< 6.00
SB	< 8.00
SM	< 100.00
TA	< 40.00
TL	< 20.00
W	< 40.00
ZR	40.00

ELEMENT CONCENTRATION, PPM

AL	80.00
BE	< .50
CD	< 10.00
CM	> 1000.00
DY	< 20.00
FE	> 1000.00
HO	< 10.00
LA	< 10.00
MG	4.00
NA	< 10.00
NI	> 1000.00
PH	< 100.00
SC	< 1.00
SN	< 6.00
TB	< 40.00
TM	< 4.00
YB	< 10.00

ELEMENT CONCENTRATION, PPM

B	2.00
BI	< 2.00
CE	< 80.00
CS	< 100.00
EM	< 6.00
GU	< 10.00
IN	< 1.00
LI	6.00
MN	100.00
NB	< 6.00
P	< 100.00
MB	< 40.00
SI	200.00
SM	< 40.00
TI	80.00
V	20.00
ZN	< 20.00

LAB. NO. 44247

SAMPLE 1 GRAPHITE 6484-78-M108B

PROJECT NO. 3224146005

REPORT TO: G. ENGLE

DILUTION: 1.0000

DATE: 8-21-76

PLATE NO. 76-066

ELEMENT CONCENTRATION, PPM

AG	< .50
BA	20.00
CA	100.00
CU	< 4.00
CU	< 1.00
EU	< 10.00
MF	< 20.00
K	< 10.00
LU	< .50
MO	< 1.00
NO	< 200.00
PB	200.00
SB	40.00
SM	< 100.00
TA	< 40.00
TL	< 20.00
W	< 40.00
ZR	10.00

ELEMENT CONCENTRATION, PPM

AL	40.00
BE	< .50
CD	< 10.00
CR	200.00
DY	< 20.00
FE	100.00
HO	< 10.00
LA	< 10.00
MG	4.00
NA	< 10.00
NI	200.00
PH	< 100.00
SC	< 1.00
SN	< 6.00
TB	< 40.00
TM	< 4.00
YB	< 10.00

ELEMENT CONCENTRATION, PPM

B	2.00
BI	< 2.00
CE	< 80.00
CS	< 100.00
EM	< 6.00
GU	< 10.00
IN	< 1.00
LI	1.00
MN	20.00
NB	< 6.00
P	< 100.00
MB	< 40.00
SI	80.00
SM	< 40.00
TI	20.00
V	29.00
ZN	< 20.00

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
 > MEANS GREATER THAN
 < MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
 RESULTS ARE CORRECT WITHIN A FACTOR OF 40% (ONE STANDARD DEVIATION)

TABLE D-4 (Continued)

LAB. NO. 44247

SAMPLE: GRAPHITE 6484-78-M122b

PROJECT NO. 3224146005

REPORT TO: G. ENGLE

DILUTION:

1.0000

DATE: 6-21-76

PLATE NO. 76-066

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

AG < .50
 BA 40.00
 CA 100.00
 CD < 4.00
 CU < 1.00
 EU < 10.00
 HF < 20.00
 K 10.00
 LU < .50
 MO < 1.00
 ND < 200.00
 PB < 6.00
 SB < 8.00
 SM < 100.00
 TA < 40.00
 TL < 20.00
 W < 40.00
 ZR < .50

AL 100.00
 BE < .50
 CO < 10.00
 CR < 10.00
 DY < 20.00
 FE 400.00
 HO < 10.00
 LA < 10.00
 MG 2.00
 NA < 10.00
 NI 10.00
 PM < 100.00
 SC < 1.00
 SN < 6.00
 TB < 40.00
 TM < 4.00
 YB < 10.00

B 2.00
 BI < 2.00
 CE < 80.00
 CS < 100.00
 EM < 6.00
 GO < 10.00
 IN < 1.00
 LI < 1.00
 MN < 1.00
 NB < 6.00
 P < 100.00
 RB < 40.00
 SI < 80.00
 SM < 40.00
 TI < 20.00
 V < 20.00
 ZN < 20.00

LAB. NO. 44247

SAMPLE: GRAPHITE 6484-78-M152b

PROJECT NO. 3224146005

REPORT TO: G. ENGLE

DILUTION:

1.0000

DATE: 6-21-76

PLATE NO. 76-066

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

ELEMENT CONCENTRATION, PPM

AG < .50
 BA 40.00
 CA 80.00
 CD < 4.00
 CU < 1.00
 EU < 10.00
 HF < 20.00
 K < 10.00
 LU < .50
 MO < 1.00
 ND < 200.00
 PB < 6.00
 SB < 8.00
 SM < 100.00
 TA < 40.00
 TL < 20.00
 W < 40.00
 ZN < .50

AL < 1.00
 BE < .50
 CO < 10.00
 CR < 10.00
 DY < 20.00
 FE 80.00
 HO < 10.00
 LA < 10.00
 MG 2.00
 NA < 10.00
 NI 10.00
 PM < 100.00
 SC < 1.00
 SN < 6.00
 TB < 40.00
 TM < 4.00
 YB < 10.00

B 2.00
 BI < 2.00
 CE < 80.00
 CS < 100.00
 EM < 6.00
 GO < 10.00
 IN < 1.00
 LI < 1.00
 MN < 1.00
 NB < 6.00
 P < 100.00
 RB < 40.00
 SI < 80.00
 SM < 40.00
 TI < 20.00
 V < 20.00
 ZN < 20.00

CONCENTRATION BASED ON ORIGINAL SAMPLE BEFORE DILUTION WITH DILUENT
 > MEANS GREATER THAN
 < MEANS LESS THAN THE SENSITIVITY OF THE SPECTROGRAPHIC PROCEDURE USED
 RESULTS ARE CORRECT WITHIN A FACTOR OF 40%, (ONE STANDARD DEVIATION)