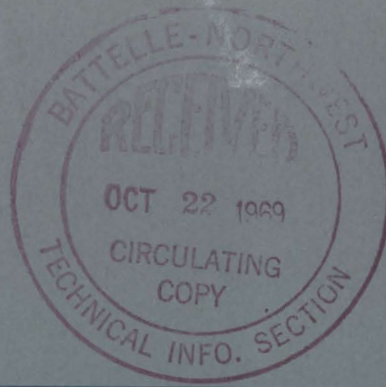




BNWL-1056B
UC-25

3-
869

IRRADIATION OF GRAPHITE
AT TEMPERATURES OF 300 TO 1200 °C

August 1969

AEC RESEARCH &
DEVELOPMENT REPORT

FILE NO.	LOCATION	FILE'S ROUTE	DATE
<i>Rad Res Div 63011</i>	<i>2B</i>	DEC 3	1969
<i>J. P. Stewart</i>		DEC 4	1969

BNWL-1056B

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

PACIFIC NORTHWEST LABORATORY

RICHLAND, WASHINGTON

operated by

BATTELLE MEMORIAL INSTITUTE

for the

UNITED STATES ATOMIC ENERGY COMMISSION UNDER CONTRACT AT(45-1)-1830

3 3679 00061 6203

BNWL-1056B

UC-25, Metals,
Ceramics, and Materials

IRRADIATION OF GRAPHITE AT TEMPERATURES
OF 300 TO 1200 °C

By
J. W. Helm*

Metallurgy and Ceramics Department
Chemistry and Metallurgy Division

August 1969

*Presently with FFTF Division

BATTELLE MEMORIAL INSTITUTE
PACIFIC NORTHWEST LABORATORIES
RICHLAND, WASHINGTON 99352

Printed in the United States of America
Available from
Clearinghouse for Federal Scientific and Technical Information
National Bureau of Standards, U.S. Department of Commerce
Springfield, Virginia 22151
Price: Printed Copy \$3.00; Microfiche \$0.65

IRRADIATION OF GRAPHITE AT TEMPERATURES
OF 300 TO 1200 °C

J. W. Helm

ABSTRACT

Irradiations of a large variety of graphites have been conducted at temperatures from 300 to 1200 °C to maximum neutron fluences of 2.7×10^{22} nvt ($E > 0.18$ MeV). As temperatures and neutron fluences increase, bulk expansion of the graphite becomes the controlling behavior in all orientations. Materials which are well graphitized, highly crystalline, isotropic, and have a high CTE show the lowest contraction at moderate fluences. This document, BNWL-1056B, comprises the appendices to BNWL-1056A and details sample selections, experimental procedure, experimental results, and supplemental figures.

CONTENTS

LIST OF FIGURES	.vii
LIST OF TABLES.	xiii
INTRODUCTION	1
APPENDIX A: Sample Selection	A-1
APPENDIX B: Experimental Procedure	B-1
APPENDIX C: Experimental Results	C-1
APPENDIX D: Curve Equations	D-1
APPENDIX E: Supplemental Figures	E-1
APPENDIX F: Overlay Graphs	F-1

FIGURES

A1	Sampling Scheme - Rectangular Extrusion	A-2
A2	Sampling Scheme - TSX Graphite	A-3
A3	Sampling Scheme - NC7 and NC8 Graphites	A-4
A4	Sampling Scheme - Cylindrical Extrusion	A-5
A5	Sampling Scheme - Cylindrical Molding	A-6
A6	Sampling Scheme - Rectangular Molding	A-7
E1	Length Change of Developmental Graphites (Transverse)	E-2
E2	Length Change of Developmental Graphites (Parallel)	E-3
E3	Length Change of Developmental Graphites (Transverse)	E-4
E4	Length Change of Developmental Graphites (Parallel)	E-5
E5	Length Change of Reactor Grade Graphites (Transverse)	E-6
E6	Length Change of Reactor Grade Graphites (Parallel)	E-7
E7	Length Change of CSF Graphite - Sample Irradiation Temperature Changed	E-8
E8	Length Change of NC8 Graphite - Sample Irradiation Temperature Changed	E-9
E9	Length Change of TSGBF and Raw-Coke Graphites - Sample Irradiation Temperature Changed	E-10
E10	Volume Change of Additive Graphites	E-11
E11	Volume Change of Raw-Coke Graphites	E-12
E12	Volume Change of Raw-Coke Graphites	E-13
E13	Volume Change of Coking Temperature Series Graphites	E-14
E14	Volume Change of Experimental Graphites	E-15

E15	Volume Change of Nuclear-Grade Graphites	E-16
E16	Volume Change of Developmental Graphites	E-17
E17	Volume Change of Developmental Graphites	E-18
E18	Volume Change of Reactor Grade Graphites	E-19
E19	Coefficient of Thermal Expansion of TSX and TSGBF Graphites (Transverse)	E-20
E20	Coefficient of Thermal Expansion of TSX and TSGBF Graphites (Parallel)	E-21
E21	Coefficient of Thermal Expansion of Additive Graphites (Transverse)	E-22
E22	Coefficient of Thermal Expansion of Additive Graphites (Parallel)	E-23
E23	Coefficient of Thermal Expansion of Nuclear-Grade Graphites (Transverse)	E-24
E24	Coefficient of Thermal Expansion of Nuclear-Grade Graphites (Parallel)	E-25
E25	Coefficient of Thermal Expansion of Experimental Graphites (Transverse)	E-26
E26	Coefficient of Thermal Expansion of Experimental Graphites (Parallel)	E-27
E27	Coefficient of Thermal Expansion of Raw-Coke Graphites (Transverse)	E-28
E28	Coefficient of Thermal Expansion of Raw-Coke Graphites (Parallel)	E-29
E29	Coefficient of Thermal Expansion of Coking Temperature Series Graphites (Transverse)	E-30
E30	Coefficient of Thermal Expansion of Coking Temperature Series Graphites (Parallel)	E-31
E31	Coefficient of Thermal Expansion of Isotropic Graphites (Transverse)	E-32
E32	Coefficient of Thermal Expansion of Isotropic Graphites (Parallel)	E-33

E33	Coefficient of Thermal Expansion of Specialty Graphites (Transverse)	E-34
E34	Coefficient of Thermal Expansion of Specialty Graphites (Parallel)	E-35
E35	Electrical Resistivity of TSX and TSGBF Graphites (Transverse)	E-36
E36	Electrical Resistivity of TSX and TSGBF Graphites (Parallel)	E-37
E37	Electrical Resistivity of Additive Graphites (Transverse)	E-38
E38	Electrical Resistivity of Additive Graphites (Parallel)	E-39
E39	Electrical Resistivity of Raw-Coke Graphites (Transverse)	E-40
E40	Electrical Resistivity of Raw-Coke Graphites (Parallel)	E-41
E41	Electrical Resistivity of Raw-Coke Graphites (Transverse)	E-42
E42	Electrical Resistivity of Raw-Coke Graphites (Parallel)	E-43
E43	Electrical Resistivity of Coking Temperature Series Graphites (Transverse)	E-44
E44	Electrical Resistivity of Coking Temperature Series Graphites (Parallel)	E-45
E45	Electrical Resistivity of Isotropic Graphites (Transverse)	E-46
E46	Electrical Resistivity of Isotropic Graphites (Parallel)	E-47
E47	Electrical Resistivity of Isotropic Graphites (Transverse)	E-48
E48	Electrical Resistivity of Isotropic Graphites (Parallel)	E-49
E49	Electrical Resistivity of Experimental Graphites (Transverse)	E-50

E50	Electrical Resistivity of Experimental Graphites (Parallel)	E-51
E51	Electrical Resistivity of Nuclear-Grade Graphites (Transverse)	E-52
E52	Electrical Resistivity of Nuclear-Grade Graphites (Parallel)	E-53
E53	Electrical Resistivity of Developmental Graphites (Transverse)	E-54
E54	Electrical Resistivity of Developmental Graphites (Parallel)	E-55
E55	Young's Modulus of Elasticity of TSX and TSGBF Graphites (Transverse)	E-56
E56	Young's Modulus of Elasticity of TSX and TSGBF Graphites (Parallel)	E-57
E57	Young's Modulus of Elasticity of Coking Temperature Series Graphites (Transverse)	E-58
E58	Young's Modulus of Elasticity of Coking Temperature Series Graphites (Parallel)	E-59
E59	Young's Modulus of Elasticity of Isotropic Graphites (Transverse)	E-60
E60	Young's Modulus of Elasticity of Isotropic Graphites (Parallel)	E-61
E61	Young's Modulus of Elasticity of Isotropic Graphites (Transverse)	E-62
E62	Young's Modulus of Elasticity of Isotropic Graphites (Parallel)	E-63
E63	Crystallite Layer Spacing ($\underline{c}$) of NC8 Graphite	E-64
E64	Crystallite Layer Spacing ($\underline{c}$) of NC7 Graphite	E-65
E65	Crystallite Layer Spacing ($\underline{c}$) of TSX and TSGBF Graphites	E-66
E66	Apparent Crystallite Size (L_c) of NC8 Graphite	E-67
E67	Apparent Crystallite Size (L_c) of NC7 Graphite	E-68

E68	Apparent Crystallite Size (L_c) of TSX and TSGBF Graphites	E-69
E69	Unit Cell Spacing (a) of NC8 Graphite	E-70
E70	Unit Cell Spacing (a) of TSX and TSGBF Graphites	E-71
E71	Apparent Crystallite Size (L_a) of NC8 Graphite	E-72
E72	Apparent Crystallite Size (L_a) of TSX and TSGBF Graphites	E-73

TABLES

B1	Capsule History	B-2
C1	H-3-1 Experimental Results	C-2
C2	H-3-2 Experimental Results	C-3
C3	H-3-3 Experimental Results	C-4
C4	H-3-4 Experimental Results	C-5
C5	H-3-5 Experimental Results	C-6
C6	H-3-6 Experimental Results	C-7
C7	H-3-7 Experimental Results	C-8
C8	H-3-8 Experimental Results	C-9
C9	H-3-9 Experimental Results	C-10
C10	H-3-10 Experimental Results	C-11
C11	H-3-11 Experimental Results	C-12
C12	H-3-12 Experimental Results	C-13
C13	H-3-13 Experimental Results	C-14
C14	H-3-15 Experimental Results	C-15
C15	H-3-21 Experimental Results	C-17
C16	H-3-22 Experimental Results	C-20
C17	H-3-23 Experimental Results	C-23
C18	H-3-24 Experimental Results	C-27
C19	H-3-25 Experimental Results	C-31
C20	H-4-1 Experimental Results	C-35
C21	H-5-1 Experimental Results	C-36
C22	H-6 1 Experimental Results	C-37
C23	H-4-2 Experimental Results	C-38
C24	H-5-2 Experimental Results	C-39

C25	H-6-2 Experimental Results	C-40
C26	H-4-3 Experimental Results	C-41
C27	H-5-3 Experimental Results	C-42
C28	H-6-3 Experimental Results	C-43
C29	H-4-4 Experimental Results	C-44
C30	H-5-4 Experimental Results	C-45
C31	H-6-4 Experimental Results	C-46
C32	H-4-5 Experimental Results	C-47
C33	H-5-5 Experimental Results	C-48
C34	H-6-5 Experimental Results	C-49
C35	GEH-13-5 Experimental Results	C-50
C36	GEH-13-8 Experimental Results	C-51
C37	GEH-13-10 Experimental Results	C-52
C37a	GEH-13-10 Supplemental Results	C-53
C38	GEH-13-11 Experimental Results	C-54
C39	H-1 Experimental Results	C-55
C40	Hot Test Hole Experimental Results	C-56
C41	General Atomics Experimental Results	C-59
C42	Thermal Conductivity Experimental Results	C-60
D1	Curve Equations - Length Change-CSF	D-2
D2	Curve Equations - Length Change-NC8, NC7	D-2
D3	Curve Equations - Length Change-TSX	D-3
D4	Curve Equations - Length Change-TSGBF	D-3
D5	Curve Equations - Length Change- 61-70 through 66-11	D-4
D6	Curve Equations - Coefficient of Thermal Expansion-CSF, NC8	D-6

- | | | |
|----|--|-----|
| D7 | Curve Equations - Electrical Resistivity-CSF,
NC8, TSX, TSGBF | D-6 |
| D8 | Curve Equations - Young's Modulus-CSF, NC8,
TSX, TSGBF | D-7 |

IRRADIATION OF GRAPHITE AT TEMPERATURES
OF 300 TO 1200 °C

J. W. Helm

INTRODUCTION

BNWL-1056B presents Appendices A through F of the document BNWL-1056A, and includes sample selection, experimental procedure, experimental results, curve equations, supplemental figures, and overlay graphs for CSF graphite.

APPENDIX A

SAMPLE SELECTION

APPENDIX A

SAMPLE SELECTION

Samples were taken from the original blocks as shown in Figures A1 through A6. The appropriate figure number is given in Table 1 (BNWL-1056A) for each material. All samples having numbers less than 200 are transverse⁽¹⁾ and all having numbers greater than 200 are parallel with the following exceptions:

- NC7 and NC8 sample numbers 1 through 29 are parallel samples
- 63-19 ≥ 200 are $\perp$, <200 are $\parallel$ - Wrong molding direction
- 63-50 ≥ 200 are $\perp$, <200 are $\parallel$ - Molded, not extruded
- 65-11 ≥ 200 are $\perp$, - Wrong molding direction
- 65-20 < 200 are $\parallel$ - Second parallel direction
- 65-30 1, 2 are $\parallel$, 201-203 are $\perp$ - Molded, not extruded
- 65-42 ≥ 200 are $\perp$, <200 are $\parallel$ - Isostatically molded
- 66-4 ≥ 200 are $\perp$, <200 are $\parallel$ - Isostatically molded
- 66-5 ≥ 200 are $\perp$, <200 are $\parallel$ - Wrong molding direction
- 66-6 1-12 are $\parallel$, 200-203 are $\perp$ - Wrong molding direction
- 66-10 ≥ 200 are $\perp$, <200 are $\parallel$ - Molded not extruded

1. $\perp$ denotes transverse orientation and $\parallel$, parallel.

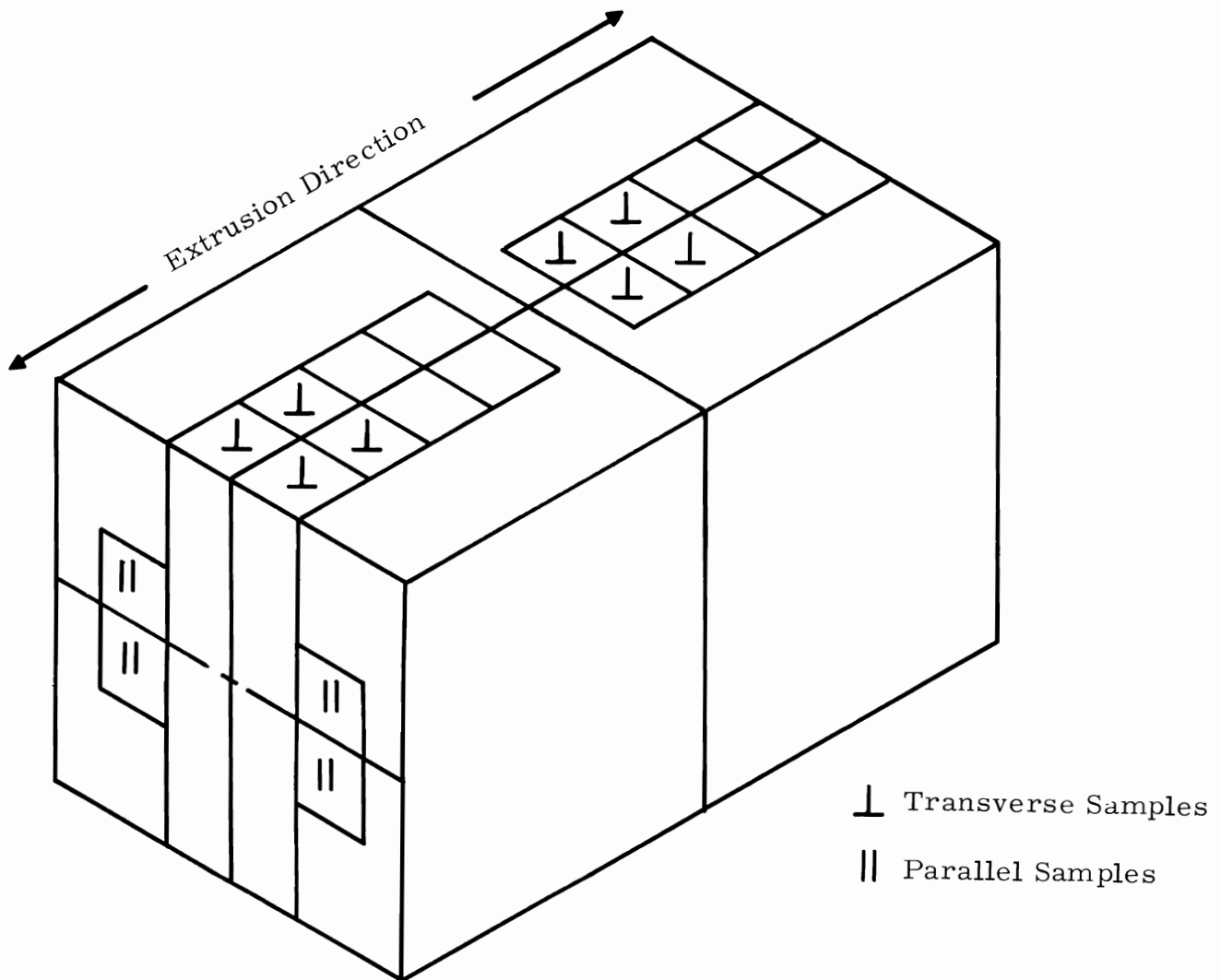
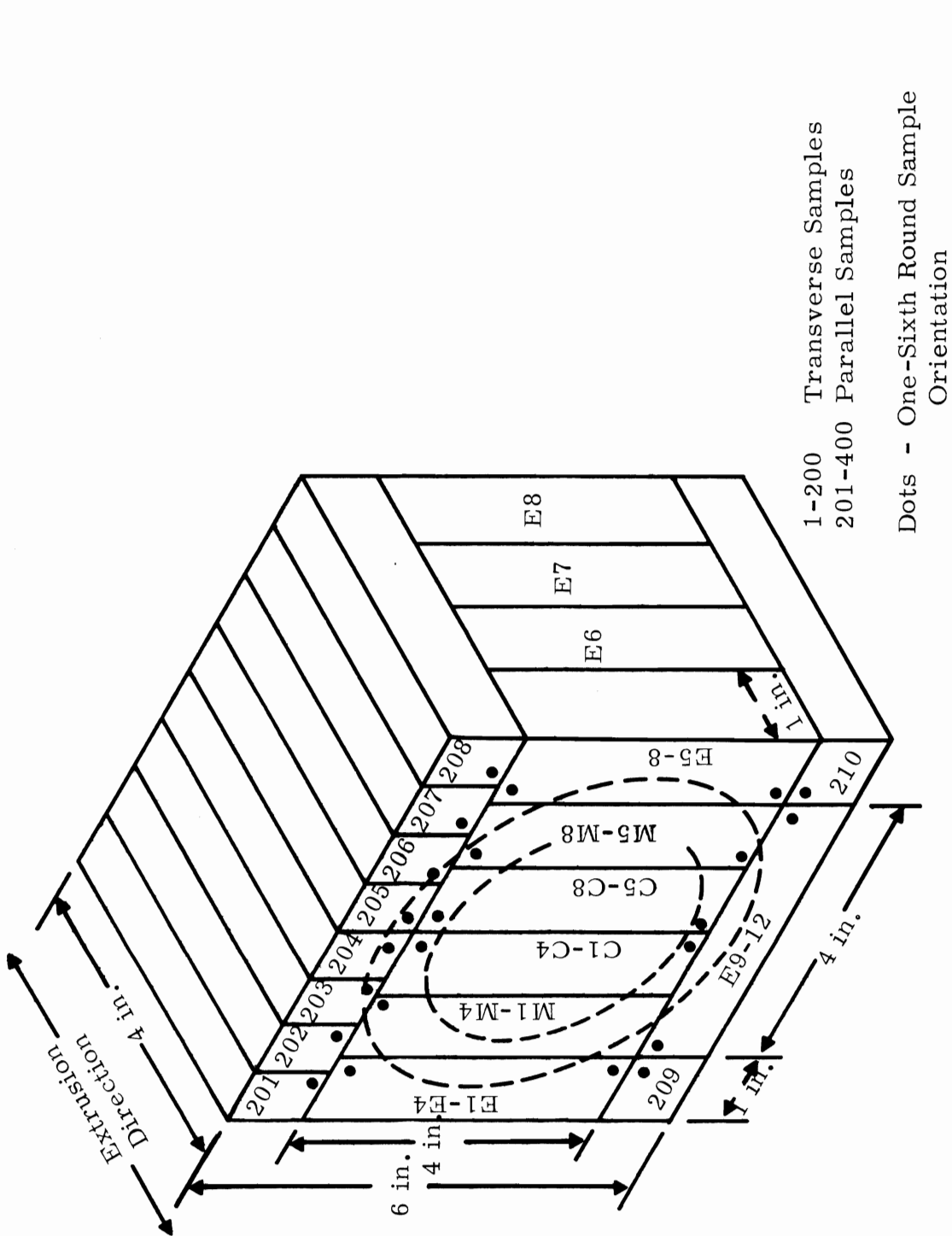


FIGURE A1. Sampling Scheme - Rectangular Extrusion



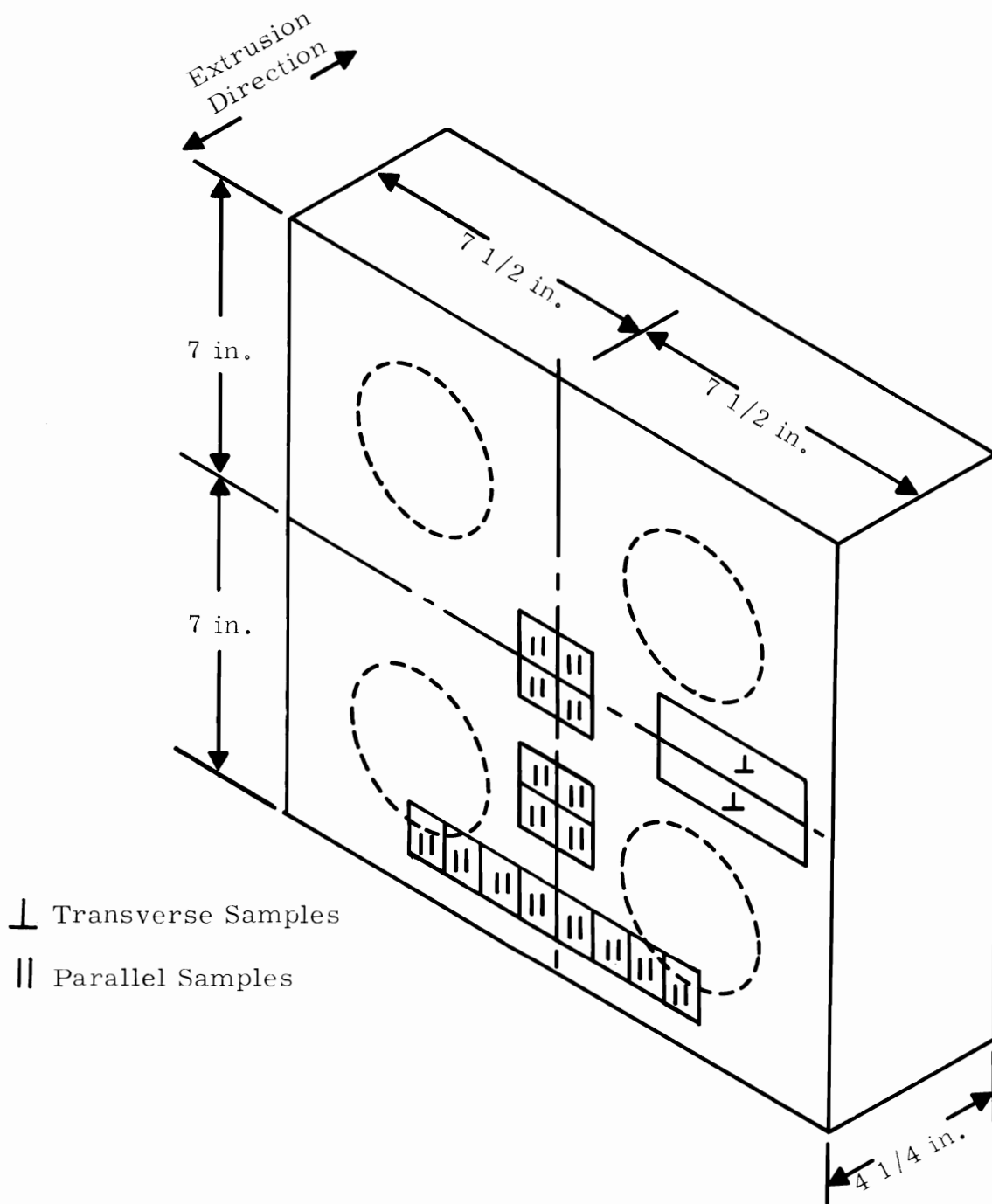


FIGURE A3. Sampling Scheme - NC7 and NC8 Graphites

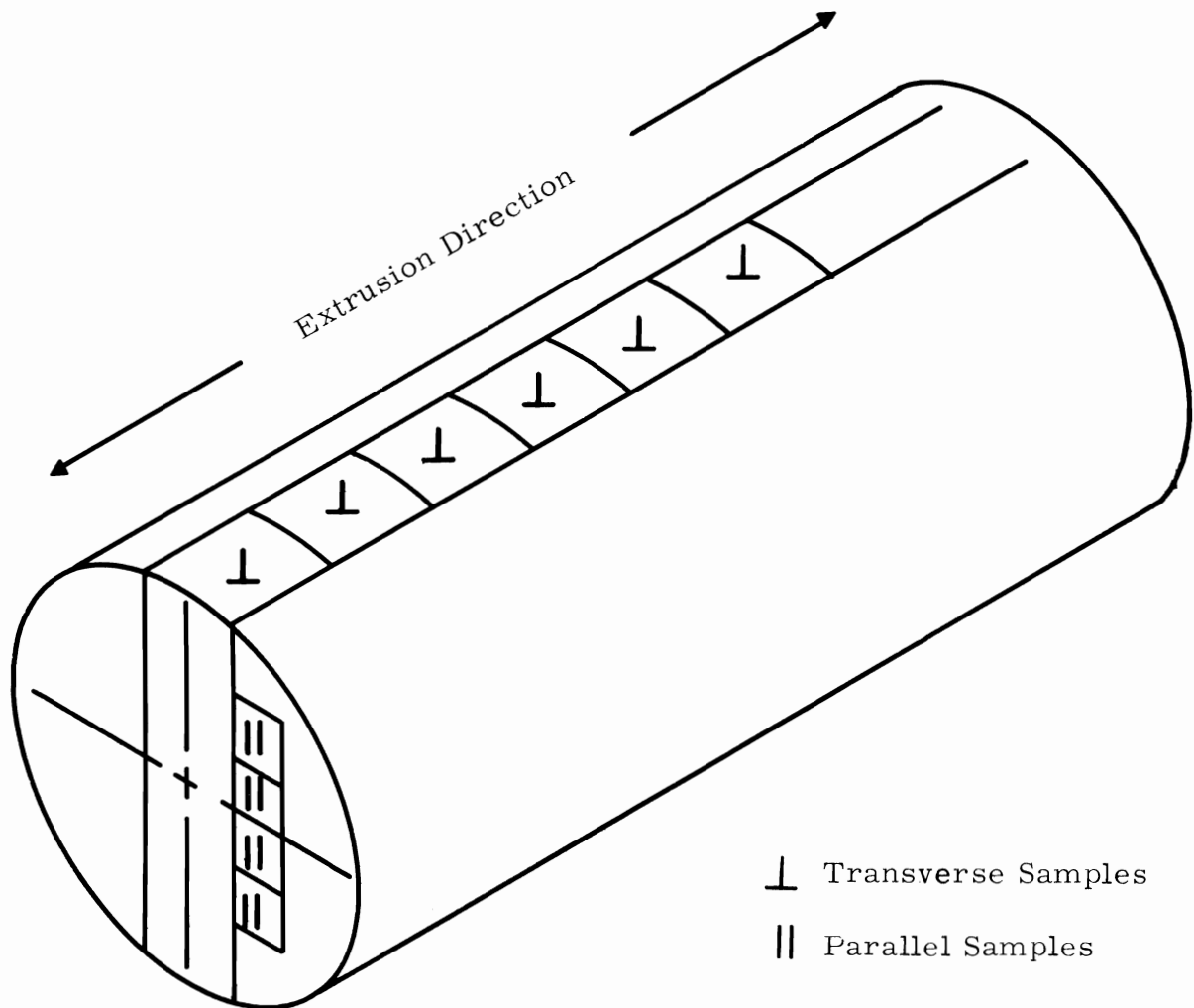


FIGURE A4. *Sampling Scheme - Cylindrical Extrusion*

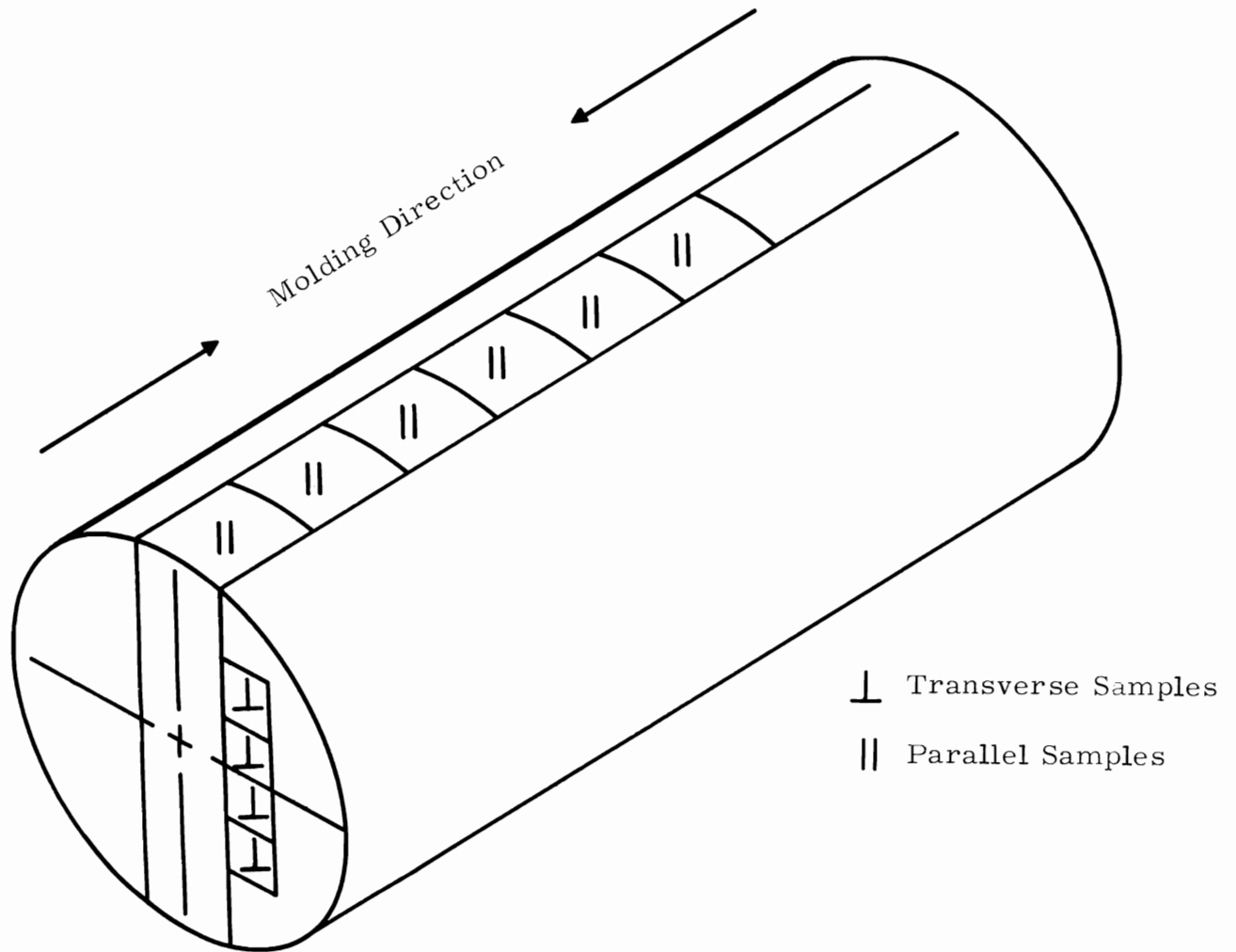


FIGURE A5. Sampling Scheme - Cylindrical Molding

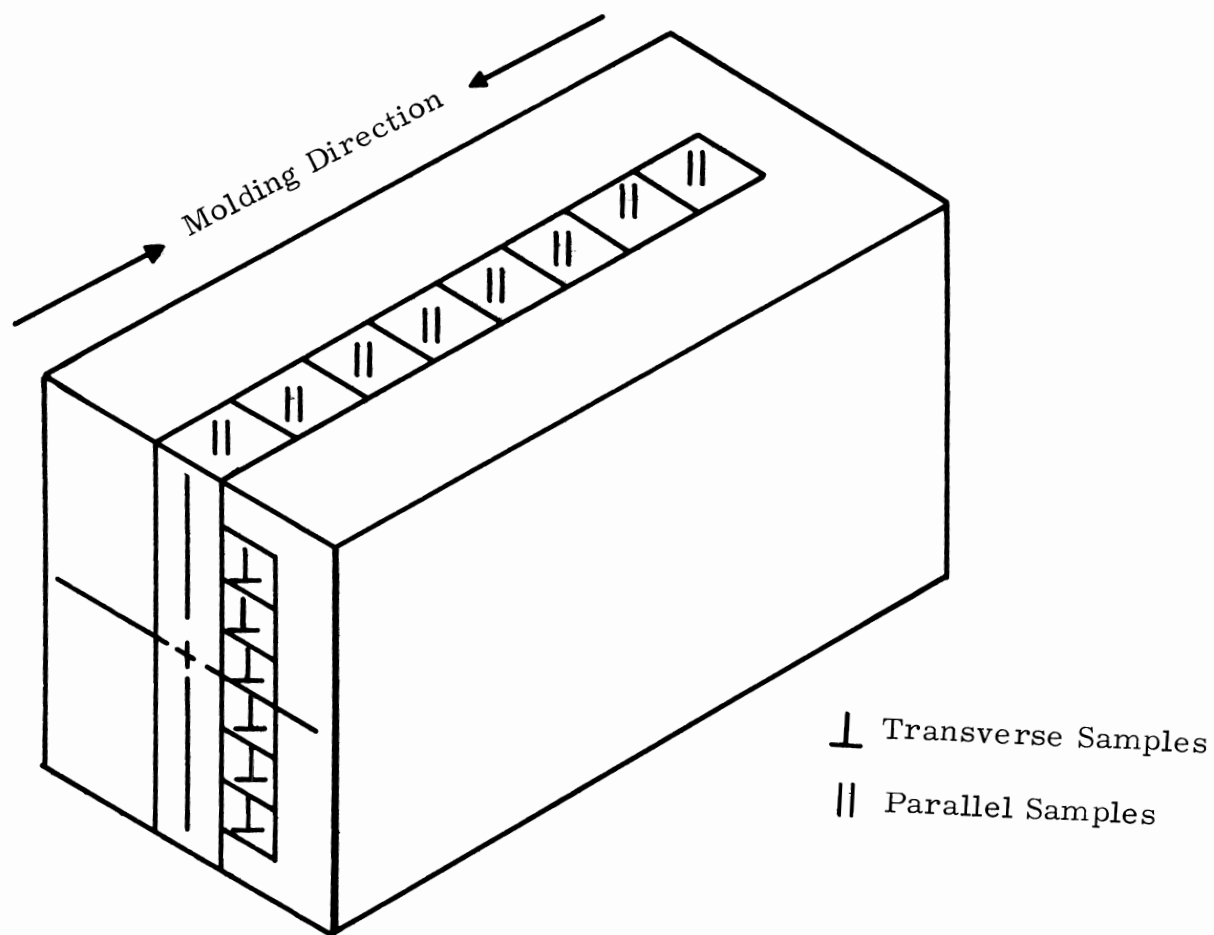


FIGURE A6. *Sampling Scheme - Rectangular Molding*

APPENDIX B

EXPERIMENTAL PROCEDURE

APPENDIX B

EXPERIMENTAL PROCEDURECAPSULE DESIGN

The basic capsule design has been discussed previously.^(1,3) The design was modified for some of the positions in the H-3-12, and H-3-23 capsules. A solid graphite cylinder with blind axial holes, called a telephone-dial, was used for these positions. The samples, 0.250 in. diam rods, of 1-3/4 in. length were positioned in the holes.

SAMPLE MEASUREMENTS

Sample measurements were made in the same manner as discussed previously.⁽²⁾

INSTALLATION, IRRADIATION, AND DISASSEMBLY

Installation, irradiation, and disassembly proceeded as detailed in previous documents.^(1,3,5)

CAPSULE DETAILS

The pertinent details on the several irradiation capsules from which data were obtained are given in Table B.1 of this appendix.

THERMOCOUPLE CALIBRATION AND SAMPLE TEMPERATURES

Details and results of thermocouple calibrations have been presented.^(5,14) Sample temperatures were based on thermocouple indications.⁽¹⁾

NEUTRON FLUENCE DETERMINATIONS

Neutron exposures or fluences were determined from the equations discussed previously^(1,3) using the activation cross section data presented in BNW-112.⁽⁵⁾

TABLE B1. *Capsule History*

<u>Capsule Number</u>	<u>Reactor Position</u>	<u>Installation Date</u>	<u>Reactor Cycles</u>	<u>Effective Days*</u>	<u>Removal Date</u>
H-1	GETR E5	Sept. 1959	5-8	75.6	Dec. 1959
H-3-1	GETR E7	May 1960	13-16	81.1	Oct. 1960
H-3-2	GETR E7	Nov. 1960	18-23	110.6	June 1961
H-3-3	GETR E7	July 1961	25-28	106.7	Nov. 1961
H-3-4	GETR E7	Feb. 1962	31-35	105.5	July 1962
H-3-5	GETR E7	Sept. 1962	37-41	84.1	Feb. 1963
H-3-6	GETR E7	April 1963	43-46	88.5	Aug. 1963
H-3-7	GETR E7	Sept. 1963	48-51	95.2	Feb. 1964
H-3-8	GETR E7	March 1964	53-56	100.3	Aug. 1964
H-3-9	GETR E7	Sept. 1964	58-61	105.5	Jan. 1965
H-3-10	GETR E7,D7	March 1965	63-66	109.5	July 1965
H-3-11	GETR D7	Aug. 1965	68-71	92.4	Jan. 1966
H-3-12	GETR D7	Feb. 1966	73-76	125.9	July 1966
H-3-13	GETR D7	Aug. 1966	78-81	97.0	Dec. 1966
H-3-14	GETR D7	Feb. 1967	83	6.3	Feb. 1967
H-3-15	GETR D7	March 1967	84-87	101.8	July 1967
H-3-21	GETR F7	July 1965	67	20.1	Aug. 1965
H-3-22	GETR E5	Nov. 1965	70-73	116.3	March 1966
H-3-23	GETR E5	April 1966	75-77	125.9	Aug. 1966
H-3-24	GETR E5	Oct. 1966	80-82	83.9	Jan. 1967
H-3-25	GETR E5	March 1967	84-86	76.9	June 1967
H-4-1	GETR D7	Nov. 1961	29-31	72.0	March 1962
H-4-2	GETR F7	May 1962	34-40	103.9	Jan. 1963
H-4-3	GETR D7	April 1963	43-47	108.0	Sept. 1963
H-4-4	GETR F7	Jan. 1964	51-55	113.4	June 1964
H-4-5	GETR D7	Sept. 1964	58-62	126.4	March 1965
H-5-1	GETR F7	Jan. 1962	30-33	90.4	May 1962
H-5-2	GETR D7	Sept. 1962	37-42	111.7	April 1963
H-5-3	GETR F7	July 1963	46-50	115.2	Jan. 1964
H-5-4	GETR D7	March 1964	53-57	127.3	Sept. 1964
H-5-5	GETR F7	Nov. 1964	60-65	159.6	June 1965
H-6-1	GETR D7	March 1962	32-36	86.6	Aug. 1962
H-6-2	GETR F7	Jan. 1963	41-45	114.0	July 1963
H-6-3	GETR D7	Sept. 1963	48-52	115.8	March 1964
H-6-4	GETR F7	July 1964	56-59	102.2	Nov. 1964
H-6-5	GETR D7	March 1965	63-65	80.6	June 1965
GEH-13-5	ETR N5	Sept. 1960	32-35	88.0	March 1961
GEH-13-8	ETR N5	Feb. 1962	44-47C	87.8	July 1962
GEH-13-10	ETR K7	Jan. 1964	61-65	127.1	Aug. 1964
GEH-13-11	ETR K7	Jan. 1965	69-74	119.6	Sept. 1965

* at full power

APPENDIX C

EXPERIMENTAL RESULTS

APPENDIX C

EXPERIMENTAL RESULTS

The irradiation results from all the samples are presented by capsule number in the following Appendix C Tables C.1 through C.42. Length changes are based on the end-to-end measurements⁽²⁾ with the exception of five samples from H-4-2 and GEH-13-10 capsules as indicated. Sample weights did not change more than 0.3% during the irradiation period. Symbols $\perp$ and $\parallel$ appearing in the following tables denote samples oriented in the transverse and parallel directions, respectively.

TABLE C1. H-3-1 Experimental Results

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E>0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Crystallite Parameters, A										Young's Modulus,		Electrical Resistivity,	
						C		L _C		a		L _a		Δa/a ₀ , %		psi × 10 ⁻⁶		ohm-cm × 10 ⁴	
						Initial	Final	ΔC/C ₀ , %	Initial	Final	ΔL _C /L _{C0} , %	Initial	Final	ΔL _a /L _{a0} , %	Initial	Final	ΔE/E ₀ , %	Initial	Final
1	450	0.58	CSF ⊥	141-1	1	-0.058 ±0.001	6.718	6.732	+0.208	700	320	-54.3							
	450	0.58	NC7 ⊥	NC7-31	1	-0.040 ±0.001	6.722	6.735	+0.193	645	320	-50.4							
	450	0.58	CSF	141-201	1	-0.105 ±0.001	6.722	6.733	+0.163	720	305	-57.6							
	450	0.58	NC7	NC7-1	1	-0.112 ±0.001	6.732	6.732	0	610	310	-49.2							
2	575	0.94	CSF ⊥	141-2	1	-0.067 ±0.001	6.718	6.728	+0.149	685	475	-30.7							
	575	0.94	NC7 ⊥	NC7-2	1	-0.114 ±0.001	6.715	6.725	+0.149	685	365	-46.6							
	575	0.94	NC7	NC7-11	1	-0.123 ±0.002	6.717	6.732	+0.213	720	420	-41.7							
	575	0.94	NC7	NC7-21	1	-0.124 ±0.001	6.702	6.730	+0.418	440	355	-19.3			2.61				
3	725	1.28	CSF ⊥	141-3	1	-0.044 ±0.001	6.707	6.721	+0.208	600	325	-45.8			1.20			37.79	
	725	1.28	NC7 ⊥	NC7-32	1	-0.021 ±0.001	6.717	6.722	+0.074	700	330	-53.0							
	725	1.28	CSF	141-202	1	-0.099 ±0.001	6.720	6.726	+0.089	680	320	-53.0			2.65				
	725	1.28	NC7	NC7-3	1	-0.113 ±0.001	6.717	6.719	+0.030	675	315	-53.3			2.62				
4	825	1.54	CSF ⊥	141-4	1	-0.054 ±0.001	6.724	6.718	-0.089	600	315	-47.5			2.51				
	825	1.54	NC7	NC7-4	1	-0.159 ±0.001	6.736	6.721	-0.223	650	303	-53.4							
	825	1.54	NC7	NC7-12	1	-0.140 ±0.002	6.736	6.725	-0.163	620	280	-54.8							
	825	1.54	NC7	NC7-22	1	-0.146 ±0.001	6.756	6.722	-0.503	600	303	-49.5							
5	850	1.54	CSF ⊥	141-5	1	-0.064 ±0.001	6.739	6.718	-0.312	630	315	-50.0							
	850	1.54	NC7 ⊥	NC7-33	1	-0.042 ±0.001	6.722	6.723	+0.015	645	390	-39.6							
	850	1.54	CSF	141-204	1	-0.164 ±0.001	6.734	6.711	-0.342	580	249	-57.1							
	850	1.54	NC7	NC7-5	1	-0.166 ±0.001	6.732	6.718	-0.208	720	310	-57.0							
6	625	1.15	CSF ⊥	141-6	1	-0.067 ±0.001	6.722	6.730	+0.119	595	360	-39.5							
	625	1.15	NC7 ⊥	NC7-34	1	-0.041 ±0.001	6.736	6.728	-0.119	700	465	-33.6							
	625	1.15	CSF	141-208	1	-0.365 ±0.001	6.722	6.725	+0.045	685	335	-51.1							
	625	1.15	NC7	NC7-6	1	-0.095 ±0.001	6.736	6.730	-0.089	635	450	-29.1							

TABLE C2. H-3-2 Experimental Results

Capsule Position	Temp, °C	Fluence, ²¹ nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite										Young's Modulus										Electrical Resistivity																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
							C		L _C		ΔC/L _C , %		a		Δa/a ₀ , %		L _a		ΔL _a /L _{a0} , %		Psi × 10 ⁻⁶		ΔE/E ₀ , %		ohm-cm × 10 ⁴		Δρ/ρ ₀ , %																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
1	475	1.50	CSF ⊥	141-1	2	-0.223 ±0.001	6.718	6.758	+0.595	700	199	-71.6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													</

TABLE C3. H-3-3 Experimental Results

Capsule Position	Temp, °C	Fluence, 21 nvt × 10-21 (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L0, %	Crystallite				Parameters, Å				Young's Modulus				Electrical Resistivity			
							C		Lc		ΔLc/Lc0, %		La		Δa/a0, %		ΔLa/La0, %		psi × 10-6		qhm-cm × 104	
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	475	2.42	CSF ⊥	141-1	3	-0.426 ±0.001	6.718	6.744	+0.387	700	175	-75.0										
	475	2.42	NC7 ⊥	NC7-31	3	-0.377 ±0.001	6.722	6.749	+0.401	645	200	-69.0										
	475	1.50	CSF	141-201	2	-0.373 ±0.001	6.722			720												
	475	2.42	NC7	NC7-1	3	-0.684 ±0.001	6.732	6.749	+0.252	610	188	-69.2	400									
2	600	3.82	CSF ⊥	141-2	3	-0.492 ±0.001	6.718			685												
	625	1.42	NC8 ⊥	NC8-34	1	-0.069 ±0.001	6.720	6.728	+0.119	748	322	-57.0										
	600	2.36	NC7	NC7-11	2	-0.416 ±0.001	6.717			720												
	600	2.88	NC8	NC8-11	2	-0.473 ±0.001	6.719			595												
3	725	3.69	CSF ⊥	141-7	2	-0.319 ±0.001	6.725			560												
	725	3.07	NC7 ⊥	NC7-32	2	-0.170 ±0.002	6.717	6.737	+0.297	700	235	-66.4										
	725	3.69	NC8 ⊥	NC8-31	2	-0.334 ±0.002	6.722	6.712	-0.149	762	245	-67.8										
	725	3.69	NC8	NC8-1	2	-0.590 ±0.001	6.725			680												
4	800	3.52	CSF ⊥	141-4	2	-0.256 ±0.001	6.724	6.731	+0.104	600	235	-60.8										
	800	1.98	NC8 ⊥	NC8-32	1	-0.044 ±0.001	6.718	6.722	+0.059	469	300	-36.1										
	800	4.08	NC8	NC8-2	2	-0.640 ±0.001	6.723	6.723	0	735	212	-71.1										
	800	5.62	NC7	NC7-22	3	-1.260 ±0.001	6.756	6.733	-0.340	600	188	-68.7								22.46		
5	775	5.44	CSF ⊥	141-5	3	-0.551 ±0.001	6.739	6.727	-0.178	630	202	-67.9										
	775	5.44	NC7 ⊥	NC7-33	3	-0.323 ±0.002	6.722			645												
	775	5.44	CSF	141-204	3	-1.248 ±0.001	6.734	6.720	-0.208	580	210	-63.8										
	775	5.44	NC7	NC7-5	3	-1.233 ±0.001	6.732	6.728	-0.059	720	195	-72.9								25.16		
6	625	4.02	CSF ⊥	141-6	3	-0.476 ±0.001	6.722	6.732	+0.148	595	231	-61.2										
	625	4.02	NC7 ⊥	NC7-34	3	-0.427 ±0.002	6.736	6.729	-0.104	700	278	-60.3										
	625	4.02	CSF	141-208	3	-1.021 ±0.001	6.722	6.738	+0.238	685	229	-66.6										
	625	4.02	NC7	NC7-6	3	-0.764 ±0.001	6.736			635												

TABLE C4. H-3-4 Experimental Results

Capsule Position	Temp, °C	Fluence ^{e,21} nvt x 10 (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L _o , %	Crystallite Parameters, Å										Young's Modulus,				Electrical Resistivity,																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
							C		ΔC/C _o , %	L _c		ΔL _c /L _c , %	a		Δa/a _o , %	L _a		ΔL _a /L _a , %	psi × 10 ⁻⁶		ΔE/E _o , %	ohm-cm × 10 ⁴		Δρ/ρ _o , %																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
							Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
1	475	3.11	CSF ⊥	141-1	4	-0.588 ±0.001	6.718	6.777	+0.877	700	160	-77.1	2.4643																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

TABLE C5. H-3-5 Experimental Results

Capsule Position	Temp, °C	Fluence ₂₁ nvt x 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change		Crystallite Parameters, Å				Young's Modulus		Electrical Resistivity	
						ΔL/L _o , %		L _c		ΔL _c /L _c , %		Δa/a _o , %		psi x 10 ⁻⁶	
						Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	450	3.77	CSF	┘	141-1	5	-0.754 ±0.001	6.718	6.754	+0.535	700	158	-77.5		
	425	1.35	NC8	┘	NC8-33	2	-0.236 ±0.002	6.720	6.727	+0.104	695	220	-68.3		
	450	2.85	CSF		141-201	4	-0.837 ±0.001	6.722	6.749	+0.402	720	170	-76.4		
	425	1.35	NC8		NC8-3	2	-0.355 ±0.002	6.730	6.744	+0.208	545	200	-63.4		
2	575	2.22	CSF	┘	141-8	2	-0.301 ±0.002	6.738	6.733	-0.074	530	235	-55.6	2.462	2.462
	600	3.64	NC8	┘	NC8-34	3	-0.550 ±0.002	6.720	6.741	+0.312	748	205	-72.6		
	575	2.22	CSF		142-220	2	-0.481 ±0.001	6.733	6.731	-0.028	510	205	-59.8	2.464	2.460
	600	3.95	NC8		NC8-11	3	-0.818 ±0.002	6.719	6.719	0	595	210	-64.7		
3	725	5.14	CSF	┘	141-7	3	-0.522 ±0.001	6.725	6.737	+0.179	560	188	-66.4		
	725	6.68	NC8	┘	NC8-31	4	-0.742 ±0.001	6.722	6.738	+0.238	762	182	-76.1		
	725	3.35	CSF		141-207	2	-0.546 ±0.001	6.730	6.716	-0.208	420	205	-51.2		2.68
	750	1.45	NC8		NC8-221	1	-0.121 ±0.001	6.746	6.716	-0.445	451	240	-46.7	2.4653	2.4619
4	800	1.64	CSF	┘	142-49	1	-0.064 ±0.001	6.759	6.714	-0.665	418	212	-49.4	1.47	2.24
	800	1.64	NC8	┘	NC8-62	1	-0.053 ±0.001	6.750	6.731	-0.282	566	300	-47.0		20.12
	800	7.50	NC8		NC8-2	4	-1.742 ±0.002	6.723	6.738	+0.223	735	175	-76.2		20.67
	775	3.42	NC8		NC8-6	1	-0.582 ±0.001	6.719	6.727	+0.119	700	200	-71.4	2.54	24.53
5	775	8.80	CSF	┘	141-5	5	-0.822 ±0.001	6.739	6.743	+0.059	630	157	-75.0		40.21
	775	8.80	NC7	┘	NC7-33	5	-0.218 ±0.001	6.722	6.739	+0.253	645	158	-75.5		
	775	8.80	CSF		141-204	5	-2.688 ±0.001	6.734	6.740	+0.089	580	165	-71.6		26.97
	800	1.60	NC8		NC8-4	1	-0.149 ±0.001	6.727	6.727	0	531	278	-47.7	1.67	2.55
6	675	2.63	CSF	┘	141-11	2	-0.309 ±0.001	6.734	6.742	+0.124	620	248	-60.0		20.68
	650	1.24	NC8	┘	NC8-57	1	-0.084 ±0.001	6.746	6.755	+0.134	555	275	-50.4	0.79	1.25
	675	2.63	NC8		NC8-8	2	-0.462 ±0.001	6.729	6.728	-0.015	509	238	-53.3		35.10
	650	1.24	NC8		NC8-216	1	-0.149 ±0.001	6.749	6.729	-0.297	468	332	-29.1	1.47	2.30

TABLE C6. H-3-6 Experimental Results

Capsule Position	Temp. °C	Fluence, ϕ_{21} nvt x 10^{18} MeV (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change $\Delta L/L_o$, %	Crystallite Parameters, Å										Young's Modulus,				Electrical Resistivity,							
							$\bar{c}$		L_c		$\Delta \bar{c}/\bar{c}_o$, %		$\bar{a}$		$\Delta \bar{a}/\bar{a}_o$, %		L_a		$\Delta L/L_a$, %		$\psi_i \times 10^{-6}$		$\Delta E/E_o$, %		$\rho_{ohm-cm} \times 10^4$		$\Delta \rho/\rho_o$, %	
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	475	4.45	CSF $\perp$	141-1	6	-0.903 $\pm$ 0.001	6.718		700																			
	450	2.03	NC8 $\perp$	NC8-33	3	-0.414 $\pm$ 0.003	6.720		695																			
	475	3.10	NC7 $\parallel$	NC7-1	4	-0.981 $\pm$ 0.001	6.732		610				2.461							400						23.88		
	450	2.03	NC8 $\parallel$	NC8-3	3	-0.608 $\pm$ 0.001	6.730		545																			
2	600	4.91	CSF $\perp$	141-2	4	-0.722 $\pm$ 0.002	6.718		685																			
	600	4.73	NC8 $\perp$	NC8-34	4	-0.782 $\pm$ 0.002	6.720		748																			
	600	3.31	CSF $\parallel$	142-220	3	-0.851 $\pm$ 0.001	6.733	6.734	510	198	-61.2		2.464	2.4584	-0.227		486	512	+5.33						24.33			
	600	5.04	NC8 $\parallel$	NC8-11	4	-1.197 $\pm$ 0.002	6.719		595																			
3	725	6.58	CSF $\perp$	141-7	4	-0.758 $\pm$ 0.001	6.725		560																			
	725	8.12	NC8 $\perp$	NC8-31	5	-0.902 $\pm$ 0.001	6.722		762																			
	725	5.13	NC8 $\parallel$	NC8-1	3	-1.064 $\pm$ 0.001	6.725		680																			
	750	2.89	NC8 $\parallel$	NC8-221	2	-0.457 $\pm$ 0.001	6.746		451				2.4653				758			1.47	2.39	+62.6		6.65	22.37	+236.4		
4	775	10.40	CSF $\perp$	141-5	6	-0.800 $\pm$ 0.001	6.739	6.723	630	168	-73.3															41.04		
	775	10.40	NC7 $\perp$	NC7-33	6	+0.095 $\pm$ 0.002	6.722	6.759	645	158	-75.5															27.86		
	775	10.40	CSF $\parallel$	141-204	6	-3.534 $\pm$ 0.002	6.734	6.738	580	180	-69.0																	
	775	9.10	NC8 $\parallel$	NC8-2	5	-2.486 $\pm$ 0.002	6.723	6.724	735	160	-78.2															24.70		
5	475	1.51	CSF $\perp$	142-44	1	-0.268 $\pm$ 0.001	6.763	6.753	421	223	-47.0		2.4654	2.4587	-0.271		661	435	-34.2		0.77	1.38	+79.2		12.01	36.15	+201.0	
	475	1.51	NC8 $\perp$	NC8-53	1	-0.269 $\pm$ 0.001	6.751	6.734	550	220	-60.0		2.4658	2.4603	-0.223		905	625	-30.9		0.81	1.42	+75.3		11.02	36.16	+228.1	
	475	1.51	NC8 $\parallel$	NC8-214	1	-0.400 $\pm$ 0.001	6.755	6.729	520	240	-53.8		2.4655	2.4596	-0.239		867	478	-44.9		1.48	2.33	+57.4		6.34	24.10	+278.7	
	475	1.51	NC8 $\parallel$	NC8-222	1	-0.408 $\pm$ 0.001	6.728	6.723	532	215	-59.6		2.4632	2.4603	-0.117		1000	465	-53.5		1.25	2.34	+87.2		7.45	27.02	+262.7	
6	400	1.10	CSF $\perp$	142-56	1	-0.149 $\pm$ 0.001	6.728	6.732	523	220	-57.9		2.4616	2.4581	-0.142		635	263	-58.6		0.76	1.26	+65.8		13.12	39.86	+203.8	
	400	1.10	NC8 $\perp$	NC8-55	1	-0.155 $\pm$ 0.001	6.746	6.736	512	230	-55.1		2.4665	2.4587	-0.316		747	325	-56.5		0.81	1.45	+79.0		10.94	34.86	+218.6	
	400	1.10	CSF $\parallel$	142-235	1	-0.295 $\pm$ 0.001	6.739	6.739	212	212			2.4573					233			1.72	2.65	+54.1		7.12	24.22	+240.2	
	400	1.10	NC8 $\parallel$	NC8-223	1	-0.316 $\pm$ 0.001	6.755	6.736	502	193	-61.6		2.4652	2.4584	-0.275		1520	505	-66.8		1.40	2.29	+63.6		6.91	24.77	+258.5	

TABLE C7. H-3-7 Experimental Results

Capsule Position	Temp, °C	Fluence, ²¹ nvt x 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity			
							$\bar{c}$		$\bar{c}/\bar{c}_0$, %	$\bar{l}_c$		$\Delta \bar{l}_c/\bar{l}_c$, %	$\bar{a}$		$\Delta \bar{a}/\bar{a}_0$, %	$\bar{l}_a$		$\Delta \bar{l}_a/\bar{l}_a$, %	$\bar{\psi}$ x 10 ⁻⁶		$\Delta E/E_0$	ohm-cm x 10 ⁴		$\Delta \rho/\rho_0$, %
							Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final	
1	450	2.14	CSF ⊥	142-44	2	-0.397 ±0.001	6.763	6.747	-0.236	421	225	-46.6	2.4654	2.4588	-0.268	661	430	0.77	1.44	+87.0	12.01	40.35	+236.0	
	450	2.14	NC8 ⊥	NC8-53	2	-0.411 ±0.001	6.751	6.746	-0.074	550	230	-58.2	2.4658	2.4569	-0.361	905	482	0.81	1.41	+74.1	11.02	37.94	+244.3	
	450	3.48	CSF	141-201	5	-1.067 ±0.002	6.722	6.749	+0.402	720	200	-72.2												
	450	2.14	NC8	NC8-222	2	-0.618 ±0.001	6.728	6.730	+0.030	532	232	-56.4	2.4632	2.4514	-0.479	1000	395	1.25	2.20	+76.0	7.45	30.43	+308.4	
2	600	3.29	CSF ⊥	141-8	3	-0.551 ±0.001	6.738	6.732	-0.089	530	230	-56.6	2.462	2.4607	-0.053	950	440			-53.7				
	600	5.80	NC8 ⊥	NC8-34	5	-0.979 ±0.001	6.720	6.731	+0.164	748	205	-72.6												
	600	4.38	CSF	142-220	4	-1.259 ±0.001	6.733	6.735	+0.030	510	192	-62.4	2.464	2.4593	-0.191	486	365			-24.9				
	575	3.68	NC8	NC8-21	3	-0.866 ±0.001	6.707	6.738	+0.462	485	235	-51.5	2.462	2.4589	-0.126	485	362			-25.4				
3	750	8.10	CSF ⊥	141-7	5	-0.941 ±0.001	6.725	6.734	+0.134	560	183	-67.3												
	725	9.64	NC8 ⊥	NC8-31	6	-0.973 ±0.001	6.722	6.731	+0.136	762	192	-74.8												
	725	4.34	CSF	141-202	3	-0.842 ±0.001	6.720	6.726	+0.089	680	210	-69.1												
	750	6.65	NC8	NC8-1	4	-1.619 ±0.001	6.725	6.734	+0.134	680	185	-72.8												
4	775	12.24	CSF ⊥	141-5	7	-0.517 ±0.006	6.739	6.737	-0.030	630	158	-74.9												
	775	12.24	NC7 ⊥	NC7-33	7	+0.866 ±0.004	6.722	6.742	+0.298	645	132	-79.5												
	775	12.24	CSF	141-204	7	-4.537 ±0.001	6.734	6.741	+0.104	580	149	-74.3												
	800	10.94	NC8	NC8-2	6	-3.390 ±0.005	6.723	6.732	+0.134	735	152	-79.3												
5	475	6.18	CSF ⊥	141-1	7	-1.200 ±0.001	6.718	6.746	+0.417	700	146	-79.1												
	475	3.76	NC8 ⊥	NC8-33	4	-0.936 ±0.002	6.720	6.743	+0.342	695	175	-74.8												
	475	3.76	NC8	NC8-3	4	-1.420 ±0.001	6.730	6.733	+0.044	545	179	-67.2												
	525	3.24	NC8	NC8-214	2	-1.115 ±0.001	6.755	6.732	-0.340	520	175	-66.3	2.4655	2.4595	-0.244	867	255	1.48	2.48	+67.5	6.34	25.63	+304.2	
6	425	2.45	CSF ⊥	142-56	2	-0.512 ±0.001	6.728	6.749	+0.312	523	200	-61.8	2.4616	2.4587	-0.118	635	300	0.76	1.46	+92.1	13.12	41.46	+216.0	
	425	2.45	NC8 ⊥	NC8-55	2	-0.507 ±0.002	6.746	6.751	+0.074	512	218	-57.4	2.4665	2.4580	-0.345	747	370	0.81	1.70	+109.9	10.94	35.98	+228.9	
	425	2.45	CSF	142-235	2	-0.818 ±0.001																		
	425	2.45	NC8	NC8-223	2	-0.811 ±0.001	6.755	6.748	-0.104	502	190	-62.2	2.4652	2.4595	-0.231	1520	732	1.40	2.46	+75.7	6.91	28.43	+311.4	

TABLE C8. H-3-8 Experimental Results

Capsule Position	Temp, °C	Fluence ^e , nvt x 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Crystallite Parameters, Å										Young's Modulus,				Electrical Resistivity,											
						Length Change ΔL/L _o , %		c		Δc/c _o , %		L _c		ΔL _c /L _c , %		a		Δa/a _o , %		L _a		ΔL _a /L _a , %		psi x 10 ⁻⁶		ΔE/E _o , %		ohm-cm x 10 ⁴		Δρ/ρ _o , %	
						Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	325	0.71	CSF ⊥	142-55	1	-0.087	±0.001	6.719	6.761	+0.625		490	208	-57.6	2.4616	2.4561	-0.223		1670	482	-71.1	0.76	1.41	+85.5		13.59	36.76	+170.5			
	325	0.71	NC8 ⊥	NC8-54	1	-0.090	±0.001	6.755	6.751	-0.059		442	240	-45.7	2.4659	2.4544	-0.466		1010	520	-48.5	0.80	1.52	+90.0		11.57	34.52	+198.4			
	325	0.71	CSF	142-230	1	-0.220	±0.001	6.724	6.746	+0.327		505	218	-56.8	2.4614	2.4556	-0.236		1050	658	-37.3	1.69			7.35	24.04	+227.1				
	325	0.71	NC8	NC8-228	1	-0.218	±0.001	6.728	6.748	+0.297		465	200	-57.0	2.4625	2.4549	-0.309		1000	695	-30.5	1.50			6.83	24.59	+260.0				
2	600	6.20	CSF ⊥	141-2	5	-0.932	±0.001	6.718	6.742	+0.357		685	170	-75.2		2.4596				575			1.41			37.85					
	600	7.09	NC8 ⊥	NC8-34	6	-1.124	±0.001	6.720	6.742	+0.327		748	185	-75.3		2.4604				540			1.54			33.00					
	600	5.67	CSF	142-220	5	-1.724	±0.001	6.733	6.749	+0.238		510	185	-63.7	2.464	2.4593	-0.191		486			2.76			23.84						
	600	6.33	NC8	NC8-11	5	-1.625	±0.001	6.719	6.745	+0.387		595	220	-63.0		2.4591				525			2.70			23.66					
3	750	9.80	CSF ⊥	141-7	6	-1.032	±0.002	6.725	6.747	+0.327		560	168	-70.0								1.31				38.76					
	750	11.34	NC8 ⊥	NC8-31	7	-0.895	±0.001	6.722	6.737	+0.223		762	210	-72.4		2.4589				280			1.41			36.14					
	750	8.35	NC8	NC8-1	5	-2.320	±0.001	6.725	6.739	+0.208		680	189	-72.2		2.4600				200			2.48			23.96					
	750	4.59	NC8	NC8-221	3	-0.936	±0.001	6.746	6.736	-0.148		451	228	-49.4	2.4653	2.4598	-0.223		758	465	-38.7	1.47		+59.9	6.65	22.81	+243.0				
4	775	14.15	CSF ⊥	141-5	8	+0.091	±0.006	6.739	6.750	+0.163		630	138	-78.1		2.4575				181			1.38			41.99					
	775	14.15	NC7 ⊥	NC7-33	8	+2.251	±0.004	6.722	6.740	+0.268		645	145	-77.5		2.4534				350			1.60			48.64					
	775	14.15	CSF	141-204	8	-5.496	±0.001	6.734	6.759	+0.371		580	140	-75.9		2.4595				395			2.33			29.06					
	800	12.85	NC8	NC8-2	7	-4.374	±0.011	6.723	6.736	+0.193		735	138	-81.2								2.32				25.63					
5	475	7.93	CSF ⊥	141-1	8	-1.433	±0.001	6.718	6.746	+0.417		700	157	-77.6		2.4608				525			1.80			35.67					
	475	5.51	NC8 ⊥	NC8-33	5	-1.248	±0.001	6.720	6.748	+0.417		695	159	-77.1		2.4587				610			1.70			34.90					
	475	5.23	CSF	141-201	6	-1.896	±0.002	6.722	6.754	+0.476		720	150	-79.2		2.4577				930						21.50					
	475	5.51	NC8	NC8-3	5	-2.166	±0.001	6.730	6.759	+0.431		545	146	-73.2												22.88					
6	450	3.77	CSF ⊥	142-56	3	-0.846	±0.001	6.728	6.759	+0.461		523	180	-65.6	2.4616	2.4614	-0.008		635	380	-40.2	0.76			13.12	38.03	+189.9				
	450	3.77	NC8 ⊥	NC8-55	3	-0.856	±0.001	6.746	6.745	-0.015		512	160	-68.8	2.4665	2.4581	-0.341		747	422	-43.5	0.81			10.94	33.45	+205.8				
	450	3.77	CSF	142-235	3	-1.382	±0.001	6.736	6.736			250				2.4579						1.72			23.80						
	450	3.77	NC8	NC8-223	3	-1.380	±0.001	6.755	6.756	+0.015		502	172	-65.7	2.4652	2.4597	-0.223		1520	815	-46.4	1.40			25.35						

TABLE C9. H-3-9 Experimental Results

Capsule Position	Temp, °C	Fluence, ²¹ nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change Δl/L ₀ , %	Crystallite Parameters, Å						Young's Modulus			Electrical Resistivity		
							C		L _c		a		I _a		ΔE/E ₀ , %	ohm-cm × 10 ⁴		Δρ/ρ ₀ , %
							Initial	Final	Initial	Final	Initial	Final	Initial	Final		Initial	Final	
1	325	1.37	CSF ⊥	142-55	2	-0.172 ±0.009	6.719	6.764	+0.670	490	157	-68.0	2.4616	1670	+93.4	13.59	38.21	+181.2
	325	1.37	NC8 ⊥	NC8-54	2	-0.192 ±0.015	6.755	6.760	+0.074	442	162	-63.3	2.4659	1010	+86.2	11.57	36.10	+212.0
	325	1.37	CSF	142-230	2	-0.419 ±0.016	6.724	6.763	+0.580	505	162	-67.9	2.4614	1050	+69.2	7.35	25.15	+242.2
	325	1.37	NC8	NC8-228	2	-0.434 ±0.013	6.728	6.765	+0.550	465	148	-68.2	2.4625	1000		6.83	25.90	+279.2
2	600	7.31	CSF ⊥	141-2	6	-1.128 ±0.002	6.718	6.748	+0.447	685	167	-75.6			1.43		39.75	
	600	8.20	NC8 ⊥	NC8-34	7	-1.281 ±0.002	6.720	6.744	+0.357	748	162	-78.3			1.64		34.22	
	600	6.78	CSF	142-220	6	-2.191 ±0.001	6.733	6.753	+0.297	510	160	-68.6	2.464	486	2.90		25.07	
	600	7.44	NC8	NC8-11	6	-2.037 ±0.001	6.719	6.738	+0.283	595	183	-69.2			2.50		25.57	
3	750	11.31	CSF ⊥	141-7	7	-1.077 ±0.001	6.725	6.745	+0.297	560	125	-77.7			1.38		41.49	
	725	12.85	NC8 ⊥	NC8-31	8	-0.769 ±0.005	6.722	6.729	+0.104	762	146	-80.8			1.57		38.33	
	750	9.86	NC8	NC8-1	6	-3.045 ±0.001	6.725	6.741	+0.238	680	157	-76.9			2.59		25.02	
	750	6.10	NC8	NC8-221	4	-1.490 ±0.001	6.746	6.744	-0.030	451	166	-63.2	2.4653	758	1.47	6.65	24.14	+263.0
4	775	15.90	CSF ⊥	141-5	9	+0.996 ±0.008	6.739	6.757	+0.267	630	115	-81.7					46.56	
	775	15.90	NC7 ⊥	NC7-33	9	+4.318 ±0.001	6.722	6.765	+0.640	645	119	-81.6			1.40		59.27	
	775	15.90	CSF	141-204	9	-6.290 ±0.002	6.734	6.757	+0.342	580	125	-78.4			2.15		31.90	
	800	14.60	NC8	NC8-2	8	-5.230 ±0.011	6.723	6.748	+0.372	735	122	-83.4			2.05		29.69	
5	575	4.95	CSF ⊥	141-8	4	-0.913 ±0.001	6.738	6.745	+0.104	530	183	-65.5	2.462	950	1.50		36.83	
	550	2.90	NC8 ⊥	NC8-57	2	-0.443 ±0.001	6.746	6.739	-0.104	555	210	-62.2	2.4653	746	0.79	11.75	36.19	+208.0
	550	5.34	NC8	NC8-21	4	-1.445 ±0.002	6.707	6.740	+0.492	485	195	-59.8	2.462	485	2.78		24.23	
	600	4.29	NC8	NC8-8	3	-1.046 ±0.001	6.729	6.742	+0.193	509	255	-49.9			2.66		21.70	
6	475	9.15	CSF ⊥	141-1	9	-1.543 ±0.002	6.718	6.760	+0.625	700	135	-80.7			1.99		36.73	
	475	6.73	NC8 ⊥	NC8-33	6	-1.404 ±0.001	6.720	6.757	+0.551	695	145	-79.1			1.90		36.24	
	450	6.45	CSF	141-201	7	-2.386 ±0.001	6.722	6.755	+0.491	720	137	-81.0					22.94	
	475	6.73	NC8	NC8-3	6	-2.631 ±0.003	6.730	6.759	+0.431	545	146	-73.2			2.77		23.74	

TABLE C10. H-3-10 Experimental Results

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L _o , %	Crystallite Parameters, Å										Young's Modulus			Electrical Resistivity		Coefficient of Thermal											
							C		ΔC/C _o , %	L _c		ΔL _c /L _c , %	a		Δa/a _o , %	L _a		ΔL _a /L _a , %	psi × 10 ⁻⁶		ΔE/E _o , %	ohm-cm × 10 ⁴		Δρ/ρ _o , %	Expansion 10 ⁻⁶ per °C (α)								
							Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final		125	225	325	425					
1	300	2.07	CSF ⊥	142-55	3	-0.359 ±0.002	6.719	6.789	+1.042	490	140	-71.4	2.4616			1670		0.76	1.51	+98.7	13.59	38.34	+182.1										
	300	2.07	NC8 ⊥	NC8-54	3	-0.389 ±0.002	6.755	6.778	+0.340	442	162	-63.3	2.4659			1010		0.80			11.57	35.46	+206.5										
	300	2.07	CSF	142-230	3	-0.717 ±0.003	6.724	6.781	+0.848	505	137	-72.9	2.4614			1050		1.69	3.19	+88.8	7.35	25.14	+242.0										
	300	2.07	NC8	NC8-228	3	-0.717 ±0.002	6.728	6.776	+0.713	465	145	-68.8	2.4625			1000		1.50			6.83	25.97	+280.2										
2	600	8.52	CSF ⊥	141-2	7	-1.289 ±0.003	6.718	6.766	+0.714	685	149	-78.2						1.39				39.74			3.18	3.58							
	600	9.41	NC8 ⊥	NC8-34	8	-1.365 ±0.002	6.720	6.756	+0.536	748	132	-82.4						1.59				33.86				3.19							
	600	7.99	CSF	142-220	7	-2.726 ±0.001	6.733	6.778	+0.668	510	151	-70.4	2.464			486					24.36					1.60							
	600	8.65	NC8	NC8-11	7	-2.504 ±0.001	6.719	6.754	+0.521	595	155	-73.9						2.44				24.61					1.33						
3	725	12.95	CSF ⊥	141-7	8	-0.923 ±0.006	6.725	6.769	+0.654	560	127	-77.3						1.33				41.52					4.33						
	725	14.49	NC8 ⊥	NC8-31	9	-0.378 ±0.004	6.722	6.744	+0.327	762	136	-82.2						2.92				39.57					4.25						
	725	5.98	CSF	141-202	4	-1.469 ±0.001	6.720	6.752	+0.476	680	150	-77.9						2.57				24.86					1.61						
	725	11.50	NC8	NC8-1	7	-3.806 ±0.001	6.725	6.759	+0.506	680	147	-78.4										25.28					1.39						
4	775	17.71	CSF ⊥	141-5	10	+2.343 ±0.008	6.739	6.774	+0.519	630	115	-81.7										51.67					4.24	5.33	5.59	5.86			
	775	17.71	NC7 ⊥	NC7-33	10	+6.657 ±0.001	6.722	6.794	+1.071	645	113	-82.5										68.97					7.23						
	775	17.71	CSF	141-204	10	-6.877 ±0.002	6.734	6.776	+0.624	580	126	-78.3						1.84				35.17					1.62	2.03	2.18				
	800	16.41	NC8	NC8-2	9	-5.964 ±0.013	6.723	6.781	+0.863	735	118	-83.9										31.21						2.05					
5	475	10.79	CSF ⊥	141-1	10	-1.583 ±0.001	6.718	6.764	+0.685	700	140	-80.0						1.79				36.31											
	475	8.37	NC8 ⊥	NC8-33	7	-1.486 ±0.001	6.720	6.752	+0.476	695	143	-79.4										34.59											
	450	8.09	CSF	141-201	8	-3.112 ±0.001	6.722	6.761	+0.580	720	131	-81.8										23.82											
	475	8.37	NC8	NC8-3	7	-3.294 ±0.002	6.730	6.774	+0.654	545	140	-74.3										23.62											
6	425	4.91	CSF ⊥	142-56	3	-1.048 ±0.001	6.728	6.756	+0.416	523	127	-75.7	2.4616			635		0.76	1.67	+119.7	13.12	38.73	+195.2										
	425	4.91	NC8 ⊥	NC8-55	4	-1.027 ±0.001	6.746	6.759	+0.193	512	143	-72.1	2.4465			747		0.81	1.96	+142.0	10.94	36.53	+233.9										
	425	4.91	NC8	NC8-223	4	-1.799 ±0.001	6.755	6.759	+0.059	502	146	-70.9	2.4652			1520		1.40	2.74	+95.7	6.91	24.30	+251.7										
	475	4.38	NC8	NC8-214	3	-1.519 ±0.001	6.755	6.789	+0.503	520	138	-73.5	2.4655			867		1.48	2.87	+93.9	6.34	24.51	+286.6										

(a) Mean CTE, 25 °C to the temperature tabulated. Final after irradiation.

TABLE C11. H-3-11 Experimental Results

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å				Young's Modulus				Electrical Resistivity				Coefficient of Thermal Expansion 10 ⁻⁶ per °C(a)																	
							c		a		L _c		ΔL _c /L _{c0} , %		Δa/L _{a0} , %		L _a		ΔE/E ₀ , %		ohm-cm × 10 ⁴		Expansion 10 ⁻⁶ per °C(a)													
							Initial	Final	Δc/c ₀ , %	Initial	Final	ΔL _c /L _{c0} , %	Initial	Final	Δa/L _{a0} , %	Initial	Final	Initial	Final	Initial	Final	125	225	325	425											
1	300	2.61	CSF ⊥	142-55	4	-0.386 ± 0.002	6.719	6.749	+0.446	-74.9	2.4616	490	123	-74.9	1.61	+111.8	13.59	39.47	+190.4	1.06	1.59	2.51	0.94	1.73	2.97	0.38	0.42	1.31	2.08	0.29	0.45	0.85	1.80	1.08	1.68	
	300	2.61	NC8 ⊥	NC8-54	4	-0.406 ± 0.001	6.755	6.749	-0.089	-73.8	2.4659	442	116	-73.8	0.76	+112.5	11.57	34.92	+201.8	0.94	1.73	2.97	0.80	1.70	2.97	0.38	0.42	1.31	2.08	0.29	0.45	0.85	1.80	1.08	1.68	
	300	2.61	CSF	142-230	4	-0.929 ± 0.003	6.724	6.771	+0.699	-74.7	2.4614	505	128	-74.7	1.69	+82.2	7.35	24.68	+235.8	0.38	0.42	1.31	0.36	0.41	0.59	0.36	0.41	0.59	1.51	0.26	0.30	0.54	1.42	0.98	1.55	2.54
	300	2.61	NC8	NC8-228	4	-0.914 ± 0.003	6.728	6.737	+0.134	-74.2	2.4625	465	120	-74.2	1.50	+96.7	6.83	25.94	+279.8	0.29	0.45	0.85	0.79	1.44	2.42	0.43	0.43	0.60	1.56	0.14	0.27	1.42	1.41	0.14	0.27	1.42
2	600	9.52	CSF ⊥	141-2	8	-1.401 ± 0.003	6.718	6.751	+0.491	-78.4		685	148	-78.4	1.42																					
	600	10.41	NC8 ⊥	NC8-34	9	-1.403 ± 0.001	6.720	6.746	+0.387	-79.8		748	151	-79.8	1.67																					
	600	8.99	CSF	142-220	8	-3.172 ± 0.001	6.733	6.739	+0.089	-74.3	2.464	510	131	-74.3	2.64																					
	600	9.65	NC8	NC8-11	8	-2.902 ± 0.001	6.719	6.749	+0.402	-74.4		595	152	-74.4	2.50																					
3	750	14.40	CSF ⊥	141-7	9	-0.600 ± 0.006	6.725	6.734	+0.134	-76.6		560	131	-76.6	1.42																					
	725	15.94	NC8 ⊥	NC8-31	10	+0.191 ± 0.012	6.722	6.764	+0.625	-81.0		762	145	-81.0	1.28																					
	725	7.43	CSF	141-202	5	-2.084 ± 0.002	6.720	6.746	+0.387	-77.1		680	156	-77.1	2.87																					
	725	12.95	NC8	NC8-1	8	-4.482 ± 0.001	6.725	6.749	+0.357	-78.2		680	148	-78.2	2.48																					
4	775	19.37	CSF ⊥	141-5	11	+3.969 ± 0.012	6.739	6.756	+0.252	-82.7		630	109	-82.7	1.69																					
	775	19.37	NC7 ⊥	NC7-33	11	+9.433 ± 0.007	6.722	6.766	+0.654	-82.5		645	113	-82.5	1.32																					
	775	19.37	CSF	141-204	11	-7.356 ± 0.004	6.734	6.824	+1.356	-80.5		580	113	-80.5	1.87																					
	800	18.07	NC8	NC8-2	10	-6.608 ± 0.012	6.723					735			2.06																					
5	475	12.35	CSF ⊥	141-1	11	-1.514 ± 0.001	6.718	6.734	+0.238	-82.7		700	121	-82.7	1.57																					
	475	9.93	NC8 ⊥	NC8-33	8	-1.459 ± 0.001	6.720	6.754	+0.506	-80.0		695	139	-80.0	1.70																					
	475	9.65	CSF	141-201	9	-3.840 ± 0.001	6.722	6.764	+0.625	-78.8		720	153	-78.8	2.22																					
	475	9.93	NC8	NC8-3	8	-3.961 ± 0.005	6.730	6.754	+0.357	-75.8		545	132	-75.8	2.43																					
6	450	6.09	CSF ⊥	142-56	4	-1.238 ± 0.002	6.728	6.732	+0.059	-75.9	2.4616	523	126	-75.9	0.76	+127.6	13.12	39.47	+200.8	1.33	2.19	3.35	0.81	1.46	+80.2	11.02	35.78	+224.7	0.84	1.38	2.03	0.56	0.56	1.31	1.99	
	450	3.32	NC8 ⊥	NC8-53	3	-0.695 ± 0.001	6.751	6.749	-0.030	-68.9	2.4648	550	171	-68.9	0.81	+80.2	11.02	35.78	+224.7	0.84	1.38	2.03	0.81	1.46	+80.2	11.02	35.78	+224.7	0.84	1.38	2.03	0.56	0.56	1.31	1.99	
	450	6.09	NC8	NC8-223	5	-2.228 ± 0.001	6.755	6.739	-0.237	-74.1	2.4652	502	130	-74.1	1.40	+102.1	6.91	22.94	+236.9	0.56	0.69	1.42	1.40	2.83	+102.1	6.91	22.94	+236.9	0.56	0.56	1.31	1.99	0.27	0.34	0.62	1.39
	450	3.32	NC8	NC8-222	3	-1.016 ± 0.001	6.728	6.744	+0.238	-72.2	2.4632	532	148	-72.2	1.25	+100.0	7.45	28.94	+288.4	0.27	0.34	0.62	1.25	2.50	+100.0	7.45	28.94	+288.4	0.27	0.34	0.62	1.39	0.27	0.34	0.62	1.39

(a) Mean CTE, 25 °C to the temperature tabulated. Final after irradiation.

TABLE C12. H-3-12 Experimental Results

Capsule Position	Temp. °C	Fluence ^a , nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L _o , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity							
							C		L _c		ΔC/C _o , %		a		Δa/a _o , %		L _a		ΔL _a /L _a o, %		psi × 10 ⁻⁶		ΔE/E _o , %		ohm-cm × 10 ⁴		Δρ/ρ _o , %	
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	300	3.19	CSF ⊥	142-55	5	-0.699 ± 0.002	6.719	490				2.4616				1670		0.76	1.43	+88.2		13.59	39.02	+187.1				
	300	3.19	NC8 ⊥	NC8-54	5	-0.719 ± 0.002	6.755	442				2.4659				1010		0.80	1.52	+90.0		11.57	36.20	+212.9				
	300	3.19	CSF	142-230	5	-1.270 ± 0.003	6.724	505				2.4614				1050		1.69	3.23	+91.1		7.35	24.74	+236.6				
	300	3.19	NC8	NC8-228	5	-1.270 ± 0.002	6.728	465				2.4625				1000		1.50	2.30	+53.3		6.83	26.03	+281.1				
	600	10.58	CSF ⊥	141-2	9	-1.439 ± 0.002	6.718	685										1.51					33.10					
2	600	11.47	NC8 ⊥	NC8-34	10	-1.293 ± 0.001	6.720	748										1.52					24.38					
	600	10.05	CSF	142-220	9	-3.740 ± 0.001	6.733	510				2.464				486							24.58					
	600	10.71	NC8	NC8-11	9	-3.364 ± 0.001	6.719	595										2.33					24.58					
	750	15.99	CSF ⊥	141-7	10	+0.058 ± 0.007	6.725	560										1.35					43.25					
3	725	17.53	NC8 ⊥	NC8-31	11	+1.156 ± 0.011	6.722	762										1.66					42.35					
	725	9.02	CSF	141-202	6	-2.922 ± 0.001	6.720	680										2.71					24.58					
	725	14.54	NC8	NC8-1	9	-5.321 ± 0.001	6.725	680										2.31					26.26					
	775	21.26	CSF ⊥	141-5	12	+6.840 ± 0.012	6.739	630										1.44					66.14					
4	775	21.26	NC7 ⊥	NC7-33	12	+14.048 ± 0.001	6.722	645										2.72					43.43					
	775	21.26	CSF	141-204	12	-7.731 ± 0.006	6.734	580										2.32					40.82					
	800	19.96	NC8	NC8-2	11	-7.099 ± 0.013	6.723	735										1.73					42.67					
	500	14.19	CSF ⊥	141-1	12	-1.012 ± 0.005	6.718	700										1.38					34.91					
5	500	11.77	NC8 ⊥	NC8-33	9	-1.014 ± 0.015	6.720	695															21.26					
	475	11.49	CSF	141-201	10	-4.808 ± 0.002	6.722	720															23.08					
	500	11.77	NC8	NC8-3	9	-4.784 ± 0.005	6.730	545																				
	500	3.72	CSF ⊥	142-27	5	-0.915 ± 0.001	6.733	480				2.465				622		1.11	1.62	+45.9		12.83	41.77	+225.6				
6	525	4.80	NC8 ⊥	NC8-53	4	-0.941 ± 0.001	6.751	550				2.4648				905		0.81	1.45	+79.0		11.02	35.68	+223.8				
	525	5.86	NC8	NC8-214	4	-2.084 ± 0.001	6.755	520				2.4655				867		1.48	2.62	+77.0		6.34	23.95	+277.8				
	525	4.80	NC8	NC8-222	4	-1.619 ± 0.001	6.728	532				2.4632				1000		1.25	2.06	+64.8		7.45	27.26	+265.9				
	A	325	0.30	TSX	DIAL A-L	1	-0.118 ± 0.017																					
			TSX ⊥	DIAL A-D	1	+0.006 ± 0.006																						
			CSF ⊥	142-151	1	-0.023 ± 0.002																						
			CSF	142-290	1	-0.118 ± 0.001																						
			CSF	222-216	1	-0.104 ± 0.002																						
			NC8 ⊥	NC8-159	1	-0.059 ± 0.001																						
			NC8	NC8-250	1	-0.157 ± 0.002																						
			TSGBF ⊥	225-29	1	+0.026 ± 0.001																						
			TSGBF	225-216	1	-0.029 ± 0.002																						
			JO2 ⊥	65-18-67	1	+0.044 ± 0.003																						
			JO2	65-18-265	1	-0.275 ± 0.004																						
			SX5 ⊥	65-22-2	1	+0.045 ± 0.001																						
			SX5	65-22-203	1	+0.019 ± 0.001																						
			H319 ⊥	GLY-2	1	-0.038 ± 0.003																						
			H319	GLY-204	1	-0.014 ± 0.002																						
			H205	63-50-14	1	-0.056 ± 0.002																						
			H205	63-50-16	1	-0.053 ± 0.001																						

TABLE C13. H-3-13 Experimental Results

Capsule Position	Temp., °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Young's Modulus		Electrical Resistivity,	
							psi × 10 ⁻⁶		ohm-cm × 10 ⁴	
							Initial	Final	Initial	Final
1	300	4.19	CSF ⊥	142-55	6	-0.919			13.59	41.15
			NC8 ⊥	NC8-54					11.57	36.70
			CSF	142-230					7.35	25.60
			NC8	NC8-228					6.83	27.76
2	600	12.27	CSF ⊥	141-2	10	-1.429				41.13
			NC8 ⊥	NC8-54						34.95
			CSF	142-220					25.79	
			NC8	NC8-11					25.81	
3	750	18.32	CSF ⊥	141-7	11	+1.166				47.64
			NC8 ⊥	NC8-31						48.64
			CSF	141-202					25.99	
			NC8	NC8-1					29.06	
4	800	23.89	CSF ⊥	141-5	13	+10.326			80.44	
			NC7 ⊥	NC7-53					126.05	
			CSF	141-204					57.45	
			NC8	NC8-2					56.49	
5	500	16.57	CSF ⊥	141-1	13	-0.412			39.81	
			NC8 ⊥	NC8-53					38.45	
			CSF	141-201					23.05	
			NC8	NC8-3					24.90	
6A	575	1.91	CSF ⊥	233-38	1	-0.248	0.60	1.48	+146.7	13.45
			CSF	233-243			1.39	2.69	+93.5	50.59
			NC8 ⊥	NC8-178			0.75	1.58	+110.7	33.66
			NC8 ⊥	NC8-22A			0.79	1.53	+93.7	45.75
			NC8	NC8-323			1.34	6.59	+363.9	30.57
			NC8	NC8-519			1.40	6.52	+347.5	29.18
			Raw ⊥	63-16-6			1.40	1.64	+17.1	38.77
			Raw ⊥	63-16-10			1.38	1.93	+39.8	41.29
			Raw	63-16-213			1.44	2.01	+39.6	40.21
			H-313 ⊥	64-17-7			0.89	10.98		39.69
			H-313	64-17-212			1.33	13.79		47.49
			JO2 ⊥	65-18-79			0.99	2.11	+113.1	40.10
			JO2	65-18-290			1.31	1.49	+13.7	40.10
			CSF ⊥	233-34			1.23	1.23		35.83
			CSF	233-246			1.40	2.89	+106.4	48.80
			NC8 ⊥	NC8-186			0.70	1.55	+92.8	30.93
			NC8 ⊥	NC8-189			0.72	1.33	+84.7	42.93
			NC8	NC8-324			1.29	10.82		44.93
			NC8	NC8-526			1.56	6.63		28.54
			Raw ⊥	63-16-16			1.57	6.92		30.62
6B	600	1.60	CSF ⊥	233-34	1	-0.122	1.40	1.87	+19.1	40.84
			CSF	233-246			1.40	1.96	+38.0	40.84
			NC8 ⊥	NC8-186			0.70	1.55	+92.8	38.70
			NC8 ⊥	NC8-189			0.72	1.33	+84.7	38.70
			NC8	NC8-324			1.29	15.70		38.70
			NC8	NC8-526			1.56	16.08		39.79
			Raw ⊥	63-16-16			1.57	16.27		38.70
			Raw	63-16-207			1.42	1.96	+38.0	146.5
			Raw	63-16-218			1.48	1.96	+32.4	147.4
			H-313 ⊥	64-17B-8			1.07	1.37	+28.0	47.59
			H-313	64-17-216			1.34	1.35	+0.7	46.64
			RP4 ⊥	65-21-7			1.14	2.21	+93.8	33.33

TABLE C14. (contd)

Capsule Position	Temp, °C	Fluence, nvt x 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change $\Delta L/L_0, \%$		Young's Modulus $\psi \times 10^{-6}$		$\Delta E/E_0, \%$		Electrical Resistivity $\text{ohm-cm} \times 10^4$		Coeff. of Thermal Expansion $10^{-6} \text{ per } ^\circ\text{C} (a)$	
						Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
6A	600	4.07	CSF	233-243	3	-0.925		1.39	2.73	+96.4		7.99	26.38	1.87	1.15
	600		NC8	NC8-178	3	-0.672		0.75	1.43	+90.7		10.75	36.83	3.32	3.34
	600		NC8	NC8-323	3	-0.945		1.34	2.50	+86.6		6.59	24.51	1.49	1.24
	625	2.16		63-30-6	2	-0.419						65.10			-16.8
	625			63-30-202	2	-0.749						16.04	32.77		+104.3
				63-31-6		-0.580						38.22	70.39		+84.2
				63-31-213		-1.247						18.76	55.80		+90.8
				63-32-6		-0.510						74.20			
				63-32-213		-0.773						17.21	53.76		+96.2
				63-33-1		-0.302						31.95	62.24		+94.8
				63-33-200		-0.407						17.26	55.87		+107.8
				63-34-7		-0.418						41.86			
				63-34-213		-0.394						16.00	46.78		+192.4
				63-35-5		-0.274						20.83	60.04		+188.2
				63-35-204		-0.404						10.98	29.04		+164.5
				63-36-9		-0.411						29.21	58.50		+100.3
				63-36-202		-0.303						9.96	29.04		+191.6
				65-22-36		-0.109		1.36				9.97	25.03	5.18	5.39
				65-22-217		-0.114		1.31				9.82	24.70	4.82	4.92
															+2.1
6B	625	3.75	CSF	233-38	3	-0.495		0.60	1.27	+111.7		13.45	38.00	3.94	3.51
	650	3.44	NC8	NC8-186	3	-0.345		0.70	1.35	+92.8		10.48	34.15	3.20	2.88
	650	3.44	NC8	NC8-324	3	-0.497		1.29	2.35	+82.2		6.63	23.83	1.58	1.32
	625	3.75		63-16-6	3	0		1.40	2.08	+48.6		16.04	30.94	6.80	6.21
	700	1.84		63-16-213	2	-0.068			1.89			31.22			-8.7
				64-13B-33		-0.050						24.04			6.08
				64-13B-209		-0.149						21.21	45.90		4.85
				64-14A-1		+0.083		0.60				12.18	28.92	3.52	3.21
				64-14A-207		+0.032						12.09	27.84		-8.8
				64-15A-1		+0.029						33.82			
				64-15A-207		-0.040						26.90	60.44		+124.7
				64-16A-2		+0.096			0.57			13.58	27.99		+106.1
				64-16A-207		+0.006						11.97	24.41		+103.9
	625	3.75		64-17-7	3	-0.376		0.89	1.70	+91.0		10.98	31.11	4.64	5.10
	625	3.75		64-17-212	3	-0.111		1.33	1.54	+0.7		13.79	36.86		+183.3
	650	3.44		65-21-7	3	-0.284		1.14	2.20	+93.0		9.76	26.78	6.41	6.65
	650	3.44		65-21-211	3	-0.373		1.40	2.37	+69.3		9.10	24.90	4.76	4.79
	625	3.75		65-18-79	3	+0.008		0.99	2.07	+109.1		12.72	30.54	4.31	3.86
	625	3.75		65-18-290	3	-0.175		1.31	2.01	+53.4		11.46	27.71	6.46	7.20
														5.79	5.91

a. Mean CTE, 25 to 425 °C.

TABLE C14. H-3-15 Experimental Results

Capsule Position	Temp, °C	Fluence, ²¹ nvt x 10 ¹⁶ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change $\Delta L/L$, %	Young's Modulus $\psi \times 10^{-6}$		Electrical Resistivity $\rho_{\text{ohm-cm}} \times 10^4$		Coeff. of Thermal Expansion $10^{-6} \text{ per } ^\circ\text{C(a)}$	
							Initial	Final	Initial	Final	Initial	Final
1	325	5.34	CSF	142-55	8	-1.012	13.59	40.81	13.59	40.81	+200.3	5.12
	325	5.34	NC8	NC8-54	8	-0.950	11.57	58.82	11.57	58.82	+233.6	5.64
	325	5.34	CSF	142-230	8	-2.046	7.35	25.78	7.35	25.78	+250.7	2.02
	325	5.34	NC8	NC8-228	8	-1.960	6.83	27.87	6.83	27.87	+308.0	2.31
2	600	13.85	CSF	141-2	12	-1.373						4.77
	600	13.05	NC8	NC8-34	13	-0.816						4.54
	600	13.32	CSF	142-220	12	-5.217						1.66
	600	13.98	NC8	NC8-11	12	-4.611						1.30
3	750	20.71	CSF	141-7	13	+2.484						5.25
	750	9.60	TSX	160-E5	7	-1.294						3.52
	750	13.74	CSF	141-202	9	-5.147						1.87
	750	19.26	NC8	NC8-1	12	-7.050						2.43
4	800	26.57	CSF	141-5	15	+15.646						6.58
	800	9.69	TSX	160-M4	6	-0.580						3.67
	800	26.57	CSF	141-204	15	-6.940						3.93
	800	25.27	NC8	NC8-2	14	-6.437						4.20
5	525	19.28	CSF	141-1	15	+0.660						4.68
	525	16.86	NC8	NC8-33	12	+0.488						4.28
	500	16.58	CSF	141-201	13	-6.835						1.43
	525	16.86	NC8	NC8-3	12	-6.630						1.37

TABLE C15. H-3-21 Experimental Results

Capsule Position	Temp, °C	Fluence ²¹ nvt × 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å						Young's Modulus				Electrical Resistivity									
							c		L _c		a		L _a		Psi × 10 ⁻⁶		ΔE/E ₀ , %		Δρ/ρ ₀ , %		Coeff. of Thermal Expansion					
							Initial	Final	Δc/Co, %	Initial	Final	ΔL _c /L _{c0} , %	Initial	Final	Δa/a ₀ , %	Initial	Final	ΔL _a /L _{a0} , %	Initial	Final	ΔE/E ₀ , %	Initial	Final	Δρ/ρ ₀ , %	10 ⁻⁶ per °C (a)	ΔCTE/CTE ₀ , %
							Initial	Final	Δc/Co, %	Initial	Final	ΔL _c /L _{c0} , %	Initial	Final	Δa/a ₀ , %	Initial	Final	ΔL _a /L _{a0} , %	Initial	Final	ΔE/E ₀ , %	Initial	Final	Δρ/ρ ₀ , %	10 ⁻⁶ per °C (a)	ΔCTE/CTE ₀ , %
1A	375	0.07	CSF ⊥	222-23	1	+0.000 ±0.002	6.744																			
	375	0.07	TSGBF ⊥	225-11	1	+0.033 ±0.002	6.789																			
	375	0.07	J02 ⊥	65-18-57	1	+0.026 ±0.004	6.734																			
	375	0.07	J02	65-18-250	1	+0.001 ±0.003	6.757																			
	375	0.07	63-19 ⊥	63-19-12	1	+0.012 ±0.003																				
375	0.07	63-38 ⊥	63-38-12	1	+0.015 ±0.003	6.769																				
1B	425	0.10	CSF	222-208	1	-0.011 ±0.002	6.737																			
	425	0.10	TSGBF	225-213	1	+0.030 ±0.003	6.773																			
	425	0.10	J02 ⊥	65-18-56	1	+0.012 ±0.003																				
	425	0.10	J02	65-18-259	1	+0.002 ±0.002	6.746																			
	425	0.10	65-9	65-9-205	1	-0.007 ±0.001	6.761																			
425	0.10	Cr ₂ C ₃	61-69-213	1	-0.026 ±0.002	6.739																				
2A	525	0.14	TSX ⊥	167-171	1	+0.013 ±0.001	6.742																			
	525	0.14	J02 ⊥	65-18-55	1	+0.008 ±0.001	6.734																			
	525	0.14	J02	65-18-252	1	+0.014 ±0.002	6.744																			
	525	0.14	65-9 ⊥	65-9-48	1	-0.008 ±0.002	6.751																			
	525	0.14	⊥	61-56-24	1	+0.022 ±0.003	6.774																			
525	0.14	Al ₄ C ₃ ⊥	61-73-12	1	+0.026 ±0.003	6.749																				
2B	600	0.18	TSX	167-210	1	+0.018 ±0.003	6.739																			
	600	0.18	TSGBF	225-203	1	+9.069 ±0.002	6.790																			
	600	0.18	J02	65-18-255	1	+0.021 ±0.001	6.756																			
	600	0.18	V ₂ O ₅	61-70-215	1	-0.015 ±0.001	6.737																			
	600	0.18		61-56-212	1	+0.013 ±0.001	6.739																			
600	0.18	Al ₄ C ₃	61-73-214	1	+0.015 ±0.002	6.744																				
3A	700	0.23	CSF ⊥	222-14	1	+0.034 ±0.002																				
	700	0.23	TSGBF ⊥	225-13	1	+0.106 ±0.002	6.759																			
	700	0.23	J02 ⊥	65-18-54	1	+0.058 ±0.001	6.754																			
	700	0.23	63-19 ⊥	63-19-13	1	+0.043 ±0.002	6.759																			
	700	0.23	Cr ₂ C ₃ ⊥	61-69-11	1	+0.037 ±0.003	6.737																			
700	0.23	V ₂ O ₅ ⊥	61-70-11	1	+0.037 ±0.002	6.737																				

(a) Mean CTE, 25-425 °C.

TABLE C15. (contd)

Capsule Position	Temp, °C	Fluence, nvt 0.10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, λ				Young's Modulus		Electrical Resistivity		Coeff. of Thermal Expansion	
							$\frac{c}{a}$		$\frac{l_c}{l_a}$	$\frac{\Delta l_c/l_{c0}}{\Delta l/l_0}$	$\frac{\psi \times 10^{-6}}{\text{psi} \times 10^{-6}}$		$\frac{\text{ohm-cm} \times 10^4}{\text{ohm-cm} \times 10^4}$		$\frac{10^{-6} \text{ per } ^\circ\text{C(a)}}{10^{-6} \text{ per } ^\circ\text{C(a)}}$	
							Initial	Final			Initial	Final	Initial	Final	Initial	Final
3B	750	0.26	CSF	222-212	1	+0.035 ±0.001	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
							6.742		249				7.97			
	750	0.26	J02	65-18-257	1	+0.062 ±0.002	6.749		256		13.99	25.70	13.99	25.70	+83.7	
	750	0.26	P03	65-1-207	1	-0.090 ±0.002	6.756		183		23.24	32.64	23.24	32.64	+40.4	3.83
	750	0.26	65-11 ⊥	65-11-215	1	+0.034 ±0.003	6.739		302				28.12			
	750	0.26	Cr ₂ C ₃	61-69-212	1	+0.025 ±0.003	6.749		230		5.84	13.04	5.84	13.04	+123.3	
4A	750	0.26	65-9	65-9-207	1	-0.008 ±0.002	6.759		220		8.97	14.75	8.97	14.75	+64.4	5.04
	800	0.30	TSX ⊥	167-M2	1	+0.040 ±0.003	6.737		300		16.81	37.87	16.81	37.87	+125.3	
	800	0.30	J02 ⊥	65-18-51	1	+0.061 ±0.001	6.759		258		15.75		15.75			
	800	0.30	61-56 ⊥	61-56-25	1	+0.038 ±0.003	6.744		287		16.67	36.86	16.67	36.86	+121.1	
	800	0.30	Cr ₂ O ₃ ⊥	61-67-12	1	+0.053 ±0.004	6.739		347		20.16	31.20	20.16	31.20	+54.8	
	800	0.30	V ₂ O ₅ ⊥	61-70-12	1	+0.035 ±0.002	6.734		211		18.27		18.27			
4B	800	0.30	Al ₄ C ₃ ⊥	61-73-11	1	+0.036 ±0.003	6.746		239		19.36	41.07	19.36	41.07	+112.1	
	850	0.33	TSX	167-209	1	+0.017 ±0.002	6.739		243		4.70		4.70			
	850	0.33	TSGBF	225-218	1	+0.107 ±0.001	6.786		281		14.48	29.68	14.48	29.68	+105.0	
	850	0.33	61-56	61-56-213	1	+0.020 ±0.002	6.739		299		5.10	14.34	5.10	14.34	+181.2	
	850	0.33	Cr ₂ O ₃	61-67-215	1	+0.026 ±0.003	6.746		257		7.71	17.04	7.71	17.04	+121.0	
	850	0.33	V ₂ O ₅	61-70-216	1	+0.009 ±0.002	6.744		311		6.58	15.48	6.58	15.48	+135.2	1.40
5A	850	0.33	Al ₄ C ₃	61-73-215	1	+0.017 ±0.003					14.12	31.77	14.12	31.77	+125.0	
			CSF ⊥	222-21	1		6.744		246		14.18		14.18		3.43	
			TSGBF ⊥	225-15	1		6.744		280		25.46		25.46		4.71	
			J02 ⊥	65-18-52	1		6.752		239		15.35		15.35			
			P03 ⊥	65-1-5	1		6.746		198						4.02	
			63-19 ⊥	63-19-14	1		6.749		263		16.31		16.31		4.43	
5B			63-38 ⊥	63-38-11	1		6.786		258		41.60		41.60		6.48	
			CSF	222-210	1		6.749		243		6.02		6.02		1.50	
			J02	65-18-256	1		6.756		255		13.45		13.45			
			P03	65-1-206	1		6.752		198		22.63		22.63			
			65-11 ⊥	65-11-214	1		6.736		294							
			63-38	63-38-214	1		6.772		266		36.82		36.82		5.24	
			63-19	63-19-215	1		6.754		229		19.73		19.73			

a. Mean CTE, 25 to 425 °C.

TABLE C15. (contd)

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity				Coeff. of Thermal Expansion																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
							C		L _c		a		L _a		ψ		ΔE/E ₀ , %		ohm-cm × 10 ⁴		10 ⁻⁶ per °C (α)		ΔCTE/CTE ₀ , %																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
							Initial	Final	ΔC/C ₀ , %	Initial	Final	ΔL _c /L _c , %	Initial	Final	ΔL _a /L _a , %	Initial	Final	ΔL _ψ /L _ψ , %	Initial	Final	Δψ/ψ ₀ , %	Initial	Final	ΔCTE/CTE ₀ , %	Initial	Final																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
6A	TSX	└	167-M6	1			6.739					273																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

a. Mean CTE, 25 to 495 °C.

TABLE C16. H-3-22 Experimental Results

Capsule Position	Temp, °C	Fluence, ^a nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Crystallite Parameters, Å						Young's Modulus		Electrical Resistivity		Coeff. of Thermal Expansion				
						C		L _C		a		L _a		psi × 10 ⁻⁶		ohm-cm × 10 ⁴		10 ⁻⁶ per °C (a)		
						Initial	Final	ΔC/C ₀ , %	Initial	Final	ΔL _C /L _{C0} , %	Initial	Final	Δa/a ₀ , %	Initial	Final	ΔL _a /L _{a0} , %	Initial	Final	Δρ/ρ ₀ , %
1A	600	0.54	NC8 ⊥	NC8-150	1	6.724		349						14.34	30.74	+114.4			3.28	
	600	0.54	CSF ⊥	142-154	1	6.732		333						16.61	33.40	+101.1			4.22	
	600	0.54	SX4 ⊥	65-21-4	1	6.742		240						13.08	24.17	+84.8			5.66	+20.5
	600	0.54	DS13 ⊥	65-20-1	1	6.739		201						14.77	20.29	+37.4			3.95	
	600	0.54	H319 ⊥	GLY-1	1	6.729		315						11.17	21.53	+92.7			3.55	+5.2
1B	600	0.54	V ₂ O ₅ ⊥	61-70-14	1	6.724		368						16.62	34.74	+109.0			3.52	
	625	0.85	NC8	NC8-256	1	6.729		327						6.97	20.20	+189.8			1.62	
	625	0.85	CSF	222-205	1	6.734		329						7.52	22.48	+198.9			1.65	
	625	0.85	SX4	65-21-204	1	6.744		265						9.75	20.18	+107.0			4.28	+20.1
	625	0.85	DS13	65-20-250	1	6.739		231						13.95	20.41	+46.3			4.17	
2A	625	0.85	H319	GLY-201	1	6.732		293						11.04	23.24	+110.5			3.54	+14.8
	625	0.85	V ₂ O ₅	61-70-214	1	6.727		319						6.80	22.88	+236.5			1.34	
	675	1.26	TSX ⊥	167-E8	1	6.727		329						11.38	27.96	+145.7			4.96	
	675	1.26	H205	63-50-13	1	6.764		201						15.04					5.58	
	675	1.26	JO2 ⊥	65-18-62	1	6.737		276						15.69	25.21	+60.7			6.92	
2B	675	1.26	MHLM85 ⊥	65-31-1	1	6.734		328						11.58	27.86	+140.6			3.41	+6.2
	675	1.26	H20785 ⊥	GLZ-2	1	6.746		229						13.62	23.71	+74.1			5.76	+8.8
	675	1.26	GN ⊥	65-29-1	1	6.737		250						14.49	26.29	+81.4			2.50	+21.1
	750	1.60	TSX	167-211	1	6.724		367						5.41	18.69	+245.5			1.11	
	750	1.60	H205 ⊥	63-50-215	1	6.764		228						16.61					6.38	
3A	750	1.60	JO2	65-18-260	1	6.737		261						13.36	23.87	+78.7			5.90	
	750	1.60	MHLM85	65-31-201	1	6.729		312						9.45					3.14	
	750	1.60	H20785	GLZ-202	1	6.754		219						11.95	19.27	+61.2			4.76	+19.6
	750	1.60	GN	65-29-200	1	6.737		265						11.20	24.06	+114.8			1.90	+12.5
	875	2.00	NC8 ⊥	NC8-151	1	6.724		373						13.72	33.48	+144.0			3.51	
3B	875	2.00	TSGBF ⊥	225-19	1	6.766		271						25.74	37.92	+47.3			4.11	
	875	2.00	SX4 ⊥	65-21-5	1	6.727		253						13.32	24.84	+86.5			5.25	
	875	2.00	DS13 ⊥	65-20-3	1	6.742		223						16.04	22.77	+41.9			3.95	
	875	2.00	H323 ⊥	65-30-1	1	6.749		237						14.79					4.31	
	875	2.00	H319 ⊥	65-32-1	1	6.727		308						10.16	20.90	+105.7			3.54	+13.6

a. Mean CTE, 25-425 °C.

TABLE C16. (cont'd)

Capsule Position	Temp, °C	Fluence nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Change Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å						Young's Modulus				Electrical Resistivity		Coeff. of Thermal Expansion				
							c		L _c	a		L _a	ΔL/L ₀ , %	psi × 10 ⁻⁶	ΔE/E ₀ , %	ohm-cm × 10 ⁴	Δρ/ρ ₀ , %	10 ⁻⁶ per °C (a)	ΔCTE/CTE ₀ , %				
							Initial	Final		Δc/Co, %	Initial									Final	Δa/a ₀ , %	Initial	Final
3B	925	2.34	NC8	NC8-257	1	-0.751 ±0.001	6.720		393								6.82	21.07	+208.9	1.52			
	925	2.34	TSGBF	225-202	1	-3.297 ±0.001	6.771		260								17.26	27.81	+61.1	2.09			
	925	2.34	SX4	65-21-205	1	-0.553 ±0.001	6.734		264								10.18	22.79	+123.9	3.84			
	925	2.34	DS13	65-20-251	1	-0.605 ±0.002	6.734		244								14.85	21.89	+47.4	3.24			
	925	2.34	H323	65-30-201	1	-0.383 ±0.017	6.746		238								14.63			4.98			
4A	925	2.34	H319	65-32-201	1	-0.553 ±0.001	6.737		295								10.80	20.99	+94.4	3.29	3.72	+13.0	
	925	2.68	CSF ⊥	222-24	1	-0.587 ±0.002	6.720		366								15.04	36.38	+141.9	3.49	3.41	-2.2	
	925	2.68	V2O5 ⊥	61-70-15	1	-0.472 ±0.001	6.724		345								15.88	38.22	+140.7	3.60	3.33	-7.5	
	925	2.68	63-38 ⊥	63-38-18	1	+0.360 ±0.002	6.749		309								41.48			6.68			
	925	2.68	63-16 ⊥	63-16-3	1	+0.316 ±0.001	6.749		243								17.30	26.44	+52.8	6.26	4.32	-30.9	
	925	2.68	A14C3 ⊥	61-73-13	1	-0.585 ±0.001	6.724		323								17.30	46.90	+171.1	2.91	2.93	+0.5	
	925	2.68	SX5 ⊥	65-22-5	1	+0.151 ±0.002	6.737		287								12.56	26.57	+111.5	5.12	5.31	+3.6	
	4B	950	2.91	CSF	222-201	1	-1.331 ±0.001	6.724		340								7.47	23.63	+216.3	1.55		
		950	2.91	V2O5	61-70-217	1	-1.293 ±0.001	6.724		505								7.41	22.78	+207.4	1.01	1.02	+1.8
		950	2.91	63-38	63-38-218	1	-1.180 ±0.003	6.751		276								34.65			4.80		
950		2.91	63-16	63-16-203	1	+0.265 ±0.001	6.746		263								17.08	25.47	+49.1	6.24	4.34	-30.4	
950		2.91	A14C3	61-73-219	1	-1.182 ±0.001	6.727		300								14.84	38.76	+161.2	1.05	0.98	-5.9	
5A	950	2.91	SX5	65-22-205	1	-0.494 ±0.002	6.737		254								10.60	23.13	+118.2	4.05	4.39	+8.3	
		975	3.04	NC8 ⊥	NC8-152	1	-0.701 ±0.001	6.722		352								13.54	32.48	+139.9	3.16	2.68	-15.0
		975	3.04	TSGBF ⊥	225-20	1	+0.327 ±0.001	6.759		278								24.64	39.55	+60.5	4.37	4.95	+13.3
		975	3.04	JO2 ⊥	65-18-63	1	+0.775 ±0.001	6.746		253								16.15	28.85	+78.6	6.15	4.34	-29.4
		975	3.04	MSRE ⊥	65-38-2	1	+0.199 ±0.001	6.720		364								17.24	30.01	+74.1	3.43	3.73	+8.8
975		3.04	GN ⊥	65-29-5	1	-1.100 ±0.002	6.737		270								15.35	28.43	+85.2	2.78	2.55	-8.2	
5B	975	3.04	9567 ⊥	65-37-1	1	-0.606 ±0.001	6.720		423								12.83	35.53	+176.9	3.25	2.80	-13.9	
		1000	3.04	NC8	NC8-258	1	-1.819 ±0.002	6.722		343								6.75	19.28	+185.6	1.42	1.12	-21.3
		1000	3.04	TSGBF	225-214	1	-5.137 ±0.002	6.764		282								17.26	30.14	+74.6	2.74	2.75	+0.2
		1000	3.04	JO2	65-18-261	1	-0.569 ±0.001	6.744		253								13.29	25.25	+90.0	5.52	3.82	-30.9
		1000	3.04	MSRE	65-38-202	1	-3.221 ±0.002	6.732		262								5.67	15.52	+173.7	0.84	0.99	+17.2
1000		3.04	GN	65-29-202	1	-2.250 ±0.001	6.734		262								11.54	22.41	+94.2	1.90	1.99	+4.5	
1000	3.04	9567	65-37-201	1	-4.097 ±0.001	6.724		330								4.82	16.54	+243.2	1.09	1.10	+0.2		

a. Mean CTE, 25-425 °C.

TABLE C16. (contd)

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å						Young's Modulus				Electrical Resistivity		Coeff. of Thermal Expansion															
							C		L _C		ΔL _C /L _{C0} , %		a		Δa/a ₀ , %		L _a		ΔL _a /L _{a0} , %		Psi × 10 ⁻⁶		ΔE/E ₀ , %		ohm-cm × 10 ⁴		Δρ/ρ ₀ , %		10 ⁻⁶ per °C (a)		Initial Final		ΔCTE/CTE ₀ , %	
							Initial	Final	ΔC/C ₀ , %	Initial	Final	ΔL _C /L _{C0} , %	Initial	Final	Δa/a ₀ , %	Initial	Final	ΔL _a /L _{a0} , %	Initial	Final	Psi × 10 ⁻⁶	Initial	Final	ΔE/E ₀ , %	Initial	Final	ohm-cm × 10 ⁴	Initial	Final	Δρ/ρ ₀ , %	Initial	Final	10 ⁻⁶ per °C (a)	Initial
6A	1000	2.88	TSX ⊥	167-M4	1	-0.312 ±0.002	6.729		360														15.61	38.82	+148.7	3.44	3.17	-7.9						
	1000	2.88	65-9 ⊥	65-9-50	1	+0.426 ±0.000	6.751		220													12.97			6.46									
	1000	2.88	SX4 ⊥	65-21-6	1	-0.130 ±0.001	6.734		268													12.96	28.12	+117.0	5.04	4.61	-8.5							
	1000	2.88	DS13 ⊥	65-20-4	1	-1.144 ±0.001	6.742		228													14.52	20.94	+44.2	3.42	2.93	-14.2							
	1000	2.88	H323 ⊥	65-30-2	1	-1.049 ±0.003	6.746		240													14.17			4.67									
6B	1000	2.88	H319 ⊥	65-32-2	1	-1.088 ±0.007	6.732		280													11.22			3.45									
	950	2.58	TSX	167-212	1	-0.922 ±0.002	6.722		335													5.84	18.13	+210.4	1.02	1.00	-1.0							
	950	2.58	65-9	65-9-205A	1	-0.507 ±0.017	6.751		218													11.14			4.64									
	950	2.58	SX4	65-21-206	1	-0.596 ±0.001	6.729		272													10.26	22.09	+115.3	3.52	3.49	-0.9							
	950	2.58	DS13	65-20-253	1	-0.674 ±0.002	6.742		219													14.08	20.31	+44.2	3.37	3.42	+1.4							
7A	950	2.58	H323	65-30-203	1	-0.398 ±0.007	6.746		229													15.01			4.89									
	950	2.58	H319	65-32-202	1	-0.640 ±0.017	6.737		292													10.80			3.46									
	875	2.11	NC8 ⊥	NC8-153	1	-0.221 ±0.001	6.720		333													12.90	30.76	+138.4		3.22								
	875	2.11	CSF ⊥	142-155	1	-0.231 ±0.001	6.729		327													16.04	38.26	+138.5		3.86								
	875	2.11	H309	64-13-2	1	-0.185 ±0.002	6.737		294													28.17	54.38	+93.0	4.89	4.97	+1.6							
7B	875	2.11	H313	64-17-3	1	+0.112 ±0.001	6.737		275													16.55	34.87	+110.7	6.06	6.37	+5.3							
	875	2.11	65-8 ⊥	65-8-3	1	-0.588 ±0.002	6.728		322													20.14	32.90	+63.4	2.35	2.97	+26.7							
	875	2.11	65-5 ⊥	65-5-4	1	-0.851 ±0.004	6.734		253													25.46			2.99									
	775	1.68	NC8	NC8-259	1	-0.163 ±0.001	6.724		352													7.24	20.12	+177.9		1.42								
	775	1.68	TSGBF	225-215	1	-0.651 ±0.001	6.771		260													16.47	26.63	+61.7		2.58								
7C	775	1.68	H309 ⊥	64-13-202	1	-0.233 ±0.002	6.744		278													22.81	43.60	+91.1	3.43	3.37	-1.8							
	775	1.68	H313 ⊥	64-17-203	1	-0.024 ±0.001	6.744		230													12.47	28.25	+126.5	4.68	5.04	+7.8							
	775	1.68	65-8	65-8-203	1	-0.467 ±0.002	6.729		323													8.10	20.48	+152.8	0.92	1.22	+32.4							
	775	1.68	65-5	65-5-204	1	-0.793 ±0.001	6.734		260													10.11	16.78	+66.0	1.38	1.51	+9.1							

a. Mean CTE, 25-425 °C.

TABLE C17. H-3-23 Experimental Results

Capsule Position	Temp, °C	Fluence, ^a nvt × 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus		Electrical Resistivity		Coeff. of Thermal Expansion 10 ⁻⁶ per °C (α) ΔCTE/CTE ₀ , %
							c		L _c		a		L _a		psi × 10 ⁻⁶		ΔE/E ₀ , %	ohm-cm × 10 ⁴			
							Initial	Final	Δc/c ₀ , %	Initial	Final	ΔL _c /L _{c0} , %	Initial	Final	Δa/a ₀ , %	Initial		Final	Δa/Δa ₀ , %	Initial	
1A	600	0.64	TSX	DIAL 1A-L	1	-0.103 ±0.032															
	600	0.64	TSX ⊥	DIAL 1A-D	1	-0.029 ±0.010															
	600	0.64	NC8 ⊥	NC8-154	1	-0.024 ±0.002															
	600	0.64	NC8	NC8-251	1	-0.071 ±0.002															
	600	0.64	CSF ⊥	142-150	1	-0.033 ±0.001															
	600	0.64	CSF	222-235	1	-0.037 ±0.002															
	600	0.64	TSX ⊥	185-151	1	-0.032 ±0.002															
	600	0.64	TSX	185-250	1	-0.081 ±0.001															
	600	0.64	TSGBF ⊥	125-36	1	-0.015 ±0.001															
	600	0.64	TSGBF	125-239	1	-0.053 ±0.001															
	600	0.64	JO2 ⊥	65-18-64	1	+0.043 ±0.002															
	600	0.64	JO2	65-18-262	1	+0.006 ±0.002															
	600	0.64	SX5 ⊥	65-22-1	1	-0.016 ±0.002															
	600	0.64	SX5	65-22-201	1	-0.039 ±0.002															
	600	0.64	H313	64-17-4	1	+0.022 ±0.002															
	1B	625	1.03	TSX	DIAL 1B-L	1	-0.180 ±0.035														
625		1.03	TSX ⊥	DIAL 1B-D	1	-0.064 ±0.015															
625		1.03	NC8	NC8-253	1	-0.111 ±0.002															
625		1.03	CSF ⊥	142-161	1	-0.073 ±0.002															
625		1.03	CSF	142-302	1	-0.150 ±0.001															
625		1.03	TSX ⊥	185-153	1	-0.068 ±0.001															
625		1.03	TSX	185-257A	1	-0.057 ±0.001															
625		1.03	TSGBF ⊥	125-37	1	-0.113 ±0.001															
625		1.03	TSGBF	125-235	1	-0.222 ±0.001															
625		1.03	JO2	65-18-263	1	+0.025 ±0.001															
625		1.03	H207-85 ⊥	GL2-3	1	-0.033 ±0.002															
625		1.03	H207-85	GL2-201	1	-0.086 ±0.002															
625		1.03	9567 ⊥	65-37-3	1	-0.022 ±0.002															
625		1.03	SX5	65-22-202	1	-0.044 ±0.001															
625		1.03	H313 ⊥	64-17-202	1	-0.021 ±0.002															

a. Mean CTE, 25-425 °C.

TABLE C17. (contd)

Capsule Position	Temp, °C	Fluence, nvt × 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å				Young's Modulus		Electrical Resistivity		Coeff. of Thermal Expansion	
							L _c	ΔL _c /L _{c0} , %	Δg/g ₀ , %	L _a	psi × 10 ⁻⁶	ΔE/E ₀ , %	ohm-cm × 10 ⁴	Δρ/ρ ₀ , %	10 ⁻⁶ per °C (a)	
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
3A	825	3.50	CSF ⊥	142-155	2	-0.541 ±0.001							16.04	33.95	+116.6	
	825	3.59	NC8 ⊥	NC8-151	2	-0.444 ±0.002							13.72	31.36	+128.6	
	700	2.65	TSX ⊥	167-E8	2	-0.356 ±0.001							11.38	24.29	+113.4	
	700	2.65	J02 ⊥	65-18-62	2	+0.247 ±0.002							15.69	24.36	+55.2	
	825	3.50	H313	64-17-3	2	-0.067 ±0.001							16.55	29.72	+79.6	6.06
	700	2.65	H20785 ⊥	GL2-2	2	-0.231 ±0.002							13.62	19.84	+45.7	5.76
3B	850	3.75	NC8 ⊥	NC8-153	2	-0.523 ±0.001							12.90	29.28	+127.0	
	875	3.98	NC8	NC8-257	2	-1.646 ±0.001							6.82	17.20	+152.2	
	775	3.24	TSX	167-211	2	-1.179 ±0.001							5.41	13.31	+146.0	
	875	3.98	TSGBF	225-202	2	-5.229 ±0.001							17.26	22.07	+27.9	
	775	3.24	J02	65-18-260	2	-0.110 ±0.001							13.36	20.75	+55.3	
	775	3.24	H20785	GL2-202	2	-0.710 ±0.001							11.95	16.57	+38.7	4.76
4A	925	4.59	CSF ⊥	222-24	2	-0.914 ±0.002							15.04	32.46	+115.8	
	725	2.45	SX4 ⊥	65-21-4	2	-0.298 ±0.001							13.08	24.55	+87.7	3.49
	925	4.59	SX5 ⊥	65-22-5	2	-0.041 ±0.002							12.56	22.34	+77.9	4.70
	925	4.59	V2O5 ⊥	61-70-15	2	-0.792 ±0.002							15.88	37.09	+133.6	5.12
	925	4.59	Al5C3 ⊥	61-73-13	2	-1.205 ±0.002							17.30	41.50	+139.9	3.60
	925	4.59	63-16 ⊥	63-16-3	2	-0.662 ±0.002							17.30	21.92	+26.7	2.91
4B	950	5.00	CSF	222-201	2	-3.413 ±0.001							7.47	17.92	+139.9	6.26
	775	2.94	SX4	65-21-204	2	-0.915 ±0.002							9.75	18.32	+87.9	1.55
	950	5.00	SX5	65-22-205	2	-1.646 ±0.003							10.60	19.29	+82.0	3.57
	950	5.00	V2O5	61-70-217	2	-3.497 ±0.001							7.41	16.82	+127.0	4.05
	950	5.00	Al4C3	61-75-219	2	-3.344 ±0.001							14.84	32.86	+121.4	1.01
	950	5.00	63-16	63-16-203	2	-0.814 ±0.002							17.08	21.70	+27.0	1.05

a. Mean CTE, 25-425 °C.

TABLE C17. (cont'd)

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L, %	Crystallite Parameters, Å										Young's Modulus		Electrical Resistivity		Coeff. of Thermal Expansion					
							C		L _c		ΔL/C, %		a		L _a		ΔL _a /a, %		psi × 10 ⁻⁶		ΔE/E _o , %		10 ⁻⁶ per °C (a)		ΔCTE/CTE _o , %	
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
5A	975	5.27	NC8 ⊥	NC8-152	2	+0.022 ±0.001																				
	975	5.27	TSCBF ⊥	225-20	2	+11.460 ±0.008																				
	975	5.27	JO2 ⊥	65-18-63	2	+1.281 ±0.001																				
	975	5.27	GN ⊥	65-29-5	2	+0.593 ±0.002																				
	975	5.27	9567 ⊥	65-37-1	2	-0.443 ±0.002																				
5B	975	5.27	MSRE ⊥	65-38-2	2	+2.590 ±0.001																				
	1000	5.35	NC8	NC8-258	2	-4.458 ±0.001																				
	1000	5.35	TSCBF	225-214	2	-3.590 ±0.002																				
	1000	5.35	JO2	65-18-261	2	-2.056 ±0.001																				
	1000	5.35	GN	65-29-202	2	-3.074 ±0.001																				
6A	1000	5.35	9567	65-37-201	2	-6.629 ±0.001																				
	1000	5.35	MSRE	65-38-202	2	-7.299 ±0.001																				
	975	5.20	TSX ⊥	167-M4	2	+0.407 ±0.002																				
	775	2.86	CSF ⊥	142-154	2	-0.763 ±0.001																				
	775	2.86	NC8 ⊥	NC8-150	2	-0.676 ±0.001																				
	975	5.20	DS13 ⊥	65-20-4	2	-2.184 ±0.001																				
	975	5.20	SX4 ⊥	65-21-6	2	-0.077 ±0.001																				
	975	2.32	JO2	65-18-266	1	-0.142 ±0.001																				

a. Mean CTE, 25-425 °C.

TABLE C17. (contd)

			Crystallite Parameters, Å										Electrical Resistivity				Coeff. of Thermal Expansion									
Capsule Position	Temp, °C	Exposure, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	c		L _c		ΔL _c /L _{c0} , %	a		L _a		ΔL _a /L _{a0} , %	Young's Modulus, psi × 10 ⁻⁶		ΔE/E ₀ , %	ohm-cm × 10 ⁻⁴		10 ⁻⁶ per °C (a)		ΔCTE/CTE, %		
							Initial	Final	Initial	Final		Initial	Final	Initial	Final		Initial	Final		Initial	Final	Initial	Final		Initial	Final
6B	950	4.83	TSX	167-212	2	3.055 ±0.002															5.84	11.64	+99.3		1.02	
	750	3.10	CSF	222-205	2	-1.295 ±0.002															7.52	18.90	+151.3			
	750	3.10	NC8	NC8-256	2	-1.192 ±0.002															6.97	16.38	+135.0			
	950	4.83	DS13	65-20-253	2	-1.919 ±0.001																				
	950	4.83	SX4	65-21-206	2	-2.166 ±0.003																14.08	15.90	+12.9	3.37	
	950	2.25	J02	65-18-251	1	-0.128 ±0.001																10.26	17.68	+72.3	3.50	
7A																										
	850	2.02	TSX	DIAL 7A-L	1	-0.458 ±0.086																				
	850	2.02	TSX ⊥	DIAL 7A-D	1	-0.122 ±0.028																				
	850	2.02	NC8	NC8-262	1	-0.204 ±0.002																				
	850	2.02	CSF ⊥	142-154A	1	-0.261 ±0.002																				
	850	2.02	CSF	142-304	1	-0.558 ±0.001																				
	850	2.02	TSX ⊥	185-154	1	-0.275 ±0.002																				
	850	2.02	TSX	185-254	1	-0.597 ±0.001																				
	850	2.02	TSGBF ⊥	125-33	1	-0.551 ±0.001																				
	850	2.02	TSGBF	125-230	1	-2.020 ±0.001																				
	850	2.02	63-16	63-16-202	1	+0.426 ±0.002																				
	850	2.02	63-38 ⊥	63-38-5	1	+0.202 ±0.002																				
	850	2.02	H313	64-17-2	1	-0.068 ±0.002																				
	850	2.02	65-8 ⊥	65-8-2	1	-0.604 ±0.001																				
	850	2.02	J02	65-18-264	1	+0.132 ±0.002																				
	850	2.02	SX5 ⊥	65-22-4	1	+0.078 ±0.001																				
	7B																									
		900	1.55	TSX	DIAL 7B-L	1	-0.301 ±0.036																			
900		1.55	TSX ⊥	DIAL-7B-D	1	-0.082 ±0.025																				
900		1.55	NC8 ⊥	NC8-158	1	-0.177 ±0.001																				
900		1.55	NC8	NC8-264	1	-0.284 ±0.001																				
900		1.55	CSF ⊥	142-163	1	-0.124 ±0.002																				
900		1.55	TSX ⊥	185-155	1	-0.119 ±0.001																				
900		1.55	TSX	185-257	1	-0.277 ±0.002																				
900		1.55	TSGBF ⊥	125-31	1	-0.386 ±0.001																				
900		1.55	TSGBF	125-231	1	-1.048 ±0.001																				
900		1.55	63-16 ⊥	63-16-4	1	+0.340 ±0.001																				
900		1.55	63-16	63-16-204	1	+0.315 ±0.002																				
900		1.55	J02	65-18-268	1	+0.146 ±0.002																				
900		1.55	SX5 ⊥	65-22-6	1	+0.138 ±0.001																				
900		1.55	SX5	65-22-204	1	-0.052 ±0.001																				
900		1.55	9567	65-37-202	1	-0.319 ±0.002																				

(a) Mean CTE, 25-425 °C

TABLE C18. H-3-24 Experimental Results

Capsule Position	Temp, °C	Fluence ²¹ nvt × 10 (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Young's Modulus		Electrical Resistivity		Coeff. of Thermal Expansion				
							psi × 10 ⁻⁶ Initial	Final	ΔE/E ₀ , %	ohm-cm × 10 ⁴ Initial	Final	Δρ/ρ ₀ , %	10 ⁻⁶ per °C (a) Initial	Final	ΔCTE/CTE ₀ , %
1	600	1.42	CSF ⊥	142-150	2	-0.178									
	600	1.81	CSF	142-302	2	-0.413									
	600	1.42	NC8 ⊥	NC8-154	2	-0.176			13.43	34.24	+155.0	3.18			
	600	1.81	NC8	NC8-253	2	-0.360				21.45		1.34			
	600	1.42	TSX ⊥	185-151	2	-0.211				36.26		2.72			
	600	1.42	TSX	185-250	2	-0.356				17.84		0.66			
	600	1.42	TSGBF ⊥	125-36	2	-0.214				38.82		3.93			
	600	1.42	TSGBF	125-239	2	-0.356				25.25		2.73			
	600	1.42	⊥	64-17-4	2	-0.027									
	600	1.81		64-17-202	2	-0.192						3.97			
	600	1.42	⊥	65-18-64	2	+0.060				28.56		6.86			
2	600	1.81		65-18-263	2	-0.084									
	600	1.42		65-18-262	2	-0.044				25.41		5.72			
	600	1.42	⊥	65-22-1	2	-0.062				27.05		5.68			
	600	1.42		65-22-201	2	-0.144									
	600	1.81		65-22-202	2	-0.197				25.36		5.13			
	600	1.81	⊥	65-37-3	2	-0.162				38.31		3.60			
	600	1.81	⊥	GL2-3	2	-0.165				23.00					
	600	1.81		GL2-201	2	-0.281				21.35		4.60			
	750	4.05	CSF ⊥	142-154	3	-0.962			16.61	34.86	+109.9	3.79			
	750	4.29	CSF	222-205	3	-2.090			7.52	19.90	+164.6	1.43			
	750	4.05	NC8 ⊥	NC8-150	3	-0.813			14.34	32.88	+129.3	3.11			
3	750	4.29	NC8	NC8-256	3	-1.917			6.97	16.69	+139.4	1.14			
	725	3.64	⊥	65-21-4	3	-0.483			13.08	25.06	+91.6	4.70		+0.2	
	750	4.13		65-21-204	3	-1.485			9.75	18.19	+86.6	3.57		-5.6	
	825	1.41	JO2 ⊥	DIAL 3-L	1	-0.090									
	875	4.09	TSX ⊥	185-154	2	-0.596				33.29		2.66			
	875	4.09	TSX	185-254	2	-1.765				18.36		0.55			
	875	4.09	TSGBF ⊥	125-33	2	+0.084				36.10		4.30			
	875	4.09	TSGBF	125-230	2	-4.382				26.48		3.82			
	875	4.09		63-16-202	2	-0.011				28.58		3.89			
	900	2.07	⊥	63-30-3	1	-1.219									
	900	2.07		63-30-204	1	-2.862						0.91			
4	900	2.07	⊥	63-36-6	1	-0.655						3.17			
	900	2.07		63-36-200	1	-0.648									
	875	4.09	⊥	63-38-5	2	-0.110				68.86		5.32			
	875	4.09	⊥	64-17-2	2	-0.653									
	875	4.09	⊥	65-8-2	2	-0.400									
	875	4.09		65-18-264	2	-0.452									
	875	4.09	⊥	65-22-4	2	-0.043				27.03		4.71			
	900	2.07	⊥	65-37-11	1	-0.375			8.06	27.95	+246.8	2.28			
	900	2.07		65-37-213	1	-0.561			5.57	17.99	+223.0	1.45		-46.2	
	900	2.07	⊥	66-9-43	1	-0.276				29.64					
	900	2.07	⊥	66-13-2	1	-0.801	0.71		16.66			2.86		-4.5	
900	2.07		66-13-203	1	-1.093				20.67						

a. Mean CTE, 25-425 °C.

TABLE C18. (contd)

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L _o , %		Young's Modulus psi × 10 ⁻⁶		Electrical Resistivity ohm-cm × 10 ⁻⁶		Coeff. of Thermal Expansion 10 ⁻⁶ per °C(a)	
						Initial	Final	Initial	Final	Initial	Final	Initial	Final
5	975	2.48	CSF	233-36	1	-0.544		0.58	0.98	13.50	37.82	3.62	2.99
	975	2.48		63-16-13		+0.562		1.67	1.57	16.19	30.26	6.54	4.96
	975	2.48		63-16-210		+0.383		1.77	1.59	17.26	30.34	6.63	5.43
				63-38-25		+0.144		0.40		39.66	71.77	6.21	5.66
				63-38-222		-0.572				30.12	64.94	4.46	4.46
				64-13B-4		-0.299		0.63	0.53	24.06	56.83	4.98	4.64
				64-13B-202		-1.477		0.59	0.83	21.04	48.69	3.50	2.92
				64-17B-3		+0.112		1.18	1.32	14.53	34.85	6.40	5.41
				64-17B-201		-0.885		1.00		12.22	30.34	5.17	4.24
				65-18-72		+0.870			1.63	14.15	27.01	6.67	5.23
				65-18-279		-0.145		1.30		12.89	26.24	5.69	4.06
				65-21-8		-0.463		1.33	1.50	10.02	25.49	4.94	4.05
				65-21-209		-0.804		1.68	1.93	9.66	24.94	3.99	3.24
				65-22-18		-0.250		1.40	2.11	10.14	24.98	5.33	4.26
				65-22-207		-0.430			1.53	9.41	24.68	5.30	4.19
6	950	7.41	CSF	222-24	3	+0.836		1.99	1.74	16.57	31.42	6.93	7.03
	925	6.80	TSGBF	225-202		-2.625		1.74	1.90	16.32	37.65	6.78	6.14
	950	7.41		61-70-15		+2.216		1.22	1.38	16.56	37.38	6.48	6.41
	950			61-73-13		-0.021				16.56	37.38	6.86	6.57
	950			63-16-3		+0.490				15.04	32.29	3.49	3.09
	950			65-22-5		+0.303				17.26	38.39	3.88	3.88
										15.88	35.84	3.60	3.25
										17.30	40.80	2.91	2.61
										17.30	23.08	6.26	1.91
										12.56	21.03	5.12	1.23
7	975	8.18	CSF	222-201	3	-6.288				7.47	17.81	1.55	1.44
		8.18		61-70-217		-8.070				7.41	18.25	1.01	0.84
		8.18		61-73-219		-7.288				14.84	38.39	1.05	0.56
		8.18		63-16-203		+0.806				17.08	26.17	6.24	1.90
		8.01		65-21-206		-3.413				10.26	16.71	3.50	1.22
		8.18		65-22-205		-2.513				10.60	16.65	4.05	1.23

a. Mean CTE, 25-425 °C

TABLE C18. (cont'd)

Capsule Position	Temp, °C	Fluence ^a , nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Young's Modulus			Electrical Resistivity			Coeff. of Thermal Expansion			
							psi × 10 ⁻⁶ Initial	Final	ΔE/E ₀ , %	ohm-cm × 10 ⁻⁴ Initial	Final	Δρ/ρ ₀ , %	10 ⁻⁶ per °C (a) Initial	Final	ΔCTE/CTE ₀ , %	
8	1000	8.65	NC8 ↓ TSGBF	NC8-152	3	+6.308				13.54	39.52	+191.9	3.16	3.93	+24.4	
				225-20		+34.80					24.64			4.37		
				65-18-63		+5.343					16.15	27.42	+69.8	6.15	0.80	-87.0
				65-29-5		+6.547					15.35	37.56	+144.7	2.78	3.36	+20.9
				65-37-1		+6.082					12.83	45.46	+254.3	3.25	3.59	+10.5
				65-38-2		+10.353					17.24	34.75	+101.6	3.43	4.03	+17.5
											13.20	34.71	+163.0	4.15	2.78	-33.0
											17.43	29.24	+67.8	6.55		
											14.75	28.45	+92.9	6.35	2.32	-63.5
											52.38			4.05		
9	1075	3.49	CSF ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓	233-20	1	-0.791		0.57	0.98	+71.9	20.68	45.09	+118.0	3.67	2.73	-25.6
				63-16-12		-0.106		1.39			14.03	30.29	+115.9	6.40	2.62	-59.1
				63-16-208		-0.550		1.86			13.08	27.91	+113.4	5.39	1.80	-66.6
				64-13B-24		-0.075					39.01	71.19	+82.5	6.40	3.90	-39.1
				64-13B-205		-2.759		0.58	0.84	+44.8	30.50	61.00	+100.0	4.84	2.68	-44.6
				64-17B-2		+0.045		1.21	1.27	+5.0	14.29	26.47	+85.2	6.64	2.92	-56.0
				64-17B-200		-2.344		0.96			13.92	26.66	+91.5	5.60	2.44	-56.4
				63-38-27		+0.512		0.42			30.50	61.00	+100.0	4.84	2.68	-44.6
				63-38-224		-2.850		0.50			14.29	26.47	+85.2	6.64	2.92	-56.0
				65-18-70		+0.937		1.46			13.92	26.66	+91.5	5.60	2.44	-56.4
10	1025	8.57	NC8 ↓ TSGBF	65-18-278	3	-1.330		1.16			9.58	22.66	+91.5	5.60	2.44	-56.4
				65-21-10		-1.053		1.41	1.54	+9.2	10.12	23.87	+135.9	4.92	2.38	-51.6
				65-21-213		-1.802		1.64	1.28	-22.0	9.53	23.28	+144.3	3.91	2.03	-48.1
				65-22-28		-0.877			2.72		9.58	22.69	+136.8	2.14		
				65-22-211		-1.429		1.39			9.60	23.40	+143.8	4.84	2.21	-54.3
				65-42-202		+1.765		1.76			16.31	27.28	+67.2	6.91	5.02	-27.4
				65-42-9		+1.834		1.86	1.69	-9.1	14.53	25.20	+73.4	7.04	4.51	-35.9
				66-4-202		+1.394		1.08	1.64	+51.8	16.01			6.98	5.78	-17.2
				66-4-2		+1.123		1.24	1.38	+11.3	15.99	32.76	+104.9	6.52	5.12	-21.5
				NC8-258		-6.254					6.75	19.00	+181.5	1.42	0.84	-40.8
a. Mean CTE, 25-425 °C																
			TSGBF	225-214		+13.783					17.26			2.74		
				65-18-261		-0.771					13.29	21.59	+62.4	5.52	2.06	-62.7
				65-29-202		-1.455					11.54	24.40	+111.4	1.90	1.92	+1.0
				65-37-201		-9.759					4.82	14.04	+191.3	1.10	1.25	+13.6
				65-38-202		-11.826					5.67	6.75	+19.0	0.84	0.67	-20.2

TABLE C18. (contd)

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Young's Modulus		Electrical Resistivity		Coeff. of Thermal Expansion		ΔCTE/CTE ₀ , %		
							psi × 10 ⁻⁶		ohm-cm × 10 ⁴		10 ⁻⁶ per °C(a)				
							Initial	Final	Initial	Final	Initial	Final			
11	1000	8.07	TSX	167-M4	3	+5.347			15.61	44.19	+183.1	3.44	3.79	+10.2	
	975	7.70	TSX	167-212	3	-7.034			5.84	11.27	+93.0	1.02	0.85	-16.7	
	1000	5.19		65-18-266	2	-2.076				18.36			1.49		
	1000	8.07		65-20-4	3	-1.940			14.52	15.71	+8.2	3.42	1.65	-51.8	
	975	7.70		65-20-253	3	-2.299			14.08	15.69	+11.4	3.37	1.74	-48.4	
	1000	8.07		65-21-6	3	+1.816			12.96	22.28	+71.9	5.04	1.71	-66.1	
12	925	3.92	NC8	NC8-158	2	-0.836				30.67			2.18		
	925	3.92	NC8	NC8-264	2	-2.021				22.33			0.99		
	925	3.92	TSGBF	125-31	2	+1.916				40.02			4.68		
	925	3.92	TSGBF	125-231	2	-4.589				29.01			2.19		
	925	3.92		63-16-4	2	-0.145				26.62			2.21		
	925	3.92		63016-204	2	-0.301				27.22			2.87		
	950	2.37		63-16-14	1	+0.568	1.74		16.51			6.44	3.84	-40.4	
	950	2.37		63-16-215	1	+0.345	1.73		16.25			6.56	3.92	-86.0	
	950	2.37		63-17-5	1	+0.318				24.45			4.28		
	950	2.37		63-17-203	1	+0.250				24.97			4.74		
	950	2.37		63-19-20	1	-0.562							4.00		
	950	2.37		63-19-223	1	+0.192				49.89			5.67		
13	950	2.37		63-38-30	1	+0.211				72.58		6.54	5.38	-17.7	
	950	2.37		63-38-226	1	-0.814			30.38	59.90	+97.8	5.16	4.36	-15.5	
	925	3.92		65-18-268	2	-0.050				25.64			2.80		
	925	3.92		65-22-6	2	+0.103				23.58			2.89		
	925	3.92		65-22-204	2	-1.028									
	950	2.37		65-37-21	1	-0.797			8.50	24.45	+187.6		1.87		
	925	3.92		65-37-202	2	-2.267				18.19			0.68		
	850	3.48		64-13-202	2	-1.690				33.97					
	850	5.30		64-17-3	3	-0.317			16.55	27.41	+65.6	6.06	3.40	-43.9	
	850	3.48		64-17-203	2	-0.943				21.81			3.97		
	800	4.45		65-18-62	3	+0.461			15.69	22.38	+42.6		4.99		
	825	5.04		65-18-260	3	-0.957			13.36	18.86	+41.2		3.33		
825	5.04		GL2-202	3	-1.964			11.95	16.05	+34.3	4.76	2.62	-45.0		

a. Mean CTE, 25-425 °C

TABLE C19. H-3-25 Experimental Results

Change															
Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L _o , %	Young's Modulus		Electrical Resistivity		Coeff. of Thermal Expansion				
							psi × 10 ⁻⁶ Initial	Final	ΔE/E _o , %	ohm-cm × 10 ⁴ Initial	Final	Δρ/ρ _o , %	10 ⁻⁶ per °C (α) Initial	Final	ΔCTE/CTE _o , %
1	575	2.12	NC8	NC8-154	3	-0.399				13.43	35.89			3.36	
	600	2.51	NC8	NC8-253	3	-0.646					22.45			1.40	
	575	2.12	TSX	185-151	3	-0.434					36.57			3.12	
	575	2.12	TSX	185-250	3	-0.670					18.53			0.72	
	575	2.12	TSCBF	125-36	3	-0.432					39.05			4.49	
	575	2.12	TSCBF	125-239	3	-0.786					26.44			2.68	
	575	2.12		65-18-64	3	-0.018					29.50			6.29	
	575	2.12		65-18-262	3	-0.172					26.41			5.59	
	575	2.12		65-22-1	3	-0.173					28.31			5.90	
	575	2.12		65-22-201	3	-0.298					25.53			5.12	
	600	2.51		65-37-3	3	-0.354					39.15			3.74	
	550	0.70		66-7-4	1	-0.137				22.84			3.15		
	550	0.70		66-7-9	1	-0.135							2.77		
	550	0.70		66-7-200	1	-0.170				6.55	15.31	+133.7	5.15	0.98	-81.0
	550	0.70		66-7-205	1	-0.178				6.40	15.49	+142.0	3.21	1.02	-68.2
	600	2.51	GL2	GL2-3	3	-0.308					23.55			5.44	
	600	2.51	GL2	GL2-201	3	-0.462					21.62			4.76	
	550	0.70		D6189		-0.320									
	550	0.70		D6216		-0.265									
	2	725	5.12	NC8	NC8-150	4	-0.846				14.34	29.48	+105.6		2.89
725		5.36	NC8	NC8-256	4	-2.588				6.97	15.14	+117.2		0.87	
725		5.12	CSF	142-154	4	-1.056				16.61	33.00	+98.7		3.39	
725		5.36	CSF	222-205	4	-2.832				7.52	17.95	+138.7		1.14	
725		4.71		65-21-4	4	-0.639				13.08	22.49	+71.9		4.70	-10.4
725		5.20		65-21-204	4	-2.000				9.75	16.98	+74.2		3.11	-12.9
775		1.46		DIAL 3-L	1	-0.018									
875		5.89	TSX	185-154	3	-0.664					34.23			2.76	
875		5.89	TSX	185-254	3	-3.223					18.51			0.69	
875		5.89	TSCBF	125-33	3	+2.637					41.50			4.58	
	875	5.89	TSCBF	125-230	3	-5.066					32.23			2.84	
	875	5.89		63-38-5	3	-0.362					63.22			4.06	
	875	5.89		63-16-202	3	-0.844					26.75			2.20	
	875	5.89		65-22-4	3	-0.249					25.61			3.42	
	875	3.87		65-37-11	2	-0.905				8.06	29.13	+261.4		1.79	
	875	3.87		65-37-218	2	-1.403				5.57	20.10	+260.9		0.94	-35.2
	875	3.87		66-9-43	2	-0.597					31.81			2.79	
	850	1.80		66-9-223	1	-0.405				5.34	17.03	+218.9		0.89	-10.1
	875	3.87		66-13-2	2	-1.631		0.71			16.66			2.86	-14.0
	850	1.80		66-13-200	2	-2.625					22.31			0.67	
	850	1.80		66-14-8	1	-0.224				9.76	26.81	+174.7		2.36	+13.6
	850	1.80		66-14-207	1	-0.251				8.84	23.72	+168.3		2.30	+4.8
	850	1.80		D5613		-0.400									
	850	1.80		D5412		-0.500									
850	1.80		D5814		-0.587										
850	1.80		D7421		-0.742										

a. Mean CTE, 25-425 °C

TABLE C19. (contd)

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %		Young's Modulus psi × 10 ⁻⁶		Electrical Resistivity ohm-cm × 10 ⁴		Coeff. of Thermal Expansion 10 ⁻⁶ per °C (a)		ΔCTE/CTE ₀ , %
								Initial	Final	Initial	Final	Initial	Final	
5	950	4.64	CSF	233-36	2	-0.803		0.58	1.20	+106.9		3.62	2.57	-29.0
	950	4.64		63-16-13	2	-0.277		1.67	2.47	+47.9		6.54	3.59	-45.1
	950	4.64		63-16-210	2	-0.615		1.77	2.37	+33.9		6.63	2.82	-57.5
	950	4.64		63-38-25	2	-0.047		0.40				6.21	3.81	-38.6
	950	4.64		63-38-222	2	-2.238							3.19	
	950	4.64		65-18-72	2	+0.904							3.29	
	950	4.64		65-18-279	2	-1.274		1.30	2.59	+99.2		6.67	2.66	-50.7
	950	4.64		65-21-8	2	-1.146		1.33	1.42	+6.8		5.69	2.66	-53.3
	950	4.64		65-21-209	2	-2.040		1.68	2.54	+51.2		4.94	2.55	-48.4
	950	4.64		65-22-18	2	-0.890		1.40	2.70	+92.8		3.99	1.85	-53.6
	950	4.64		65-22-207	2	-1.509			2.58			5.33	2.31	-56.7
	950	4.64		65-42-2	2	+1.652		1.99	2.26	+13.6		5.30	2.01	-62.1
	950	4.64		65-42-200	2	+1.641		1.74	2.14	+23.0		6.93	4.58	-33.9
	950	4.64		66-4-1	2	+0.926		1.22	1.74	+42.6		6.78	4.27	-37.0
	950	4.64		66-4-201	2	+1.244		1.13				6.48	4.30	-33.6
	925	2.16		67-1-14	1	+0.368		1.33	1.95	+46.6		6.86	4.15	-39.5
	925	2.16		67-1-200	1	-0.066			2.04			5.52	5.33	-3.4
	925	2.16		67-3-4	1	-0.327		1.38	1.76	+27.5		4.92	4.61	-6.3
	925	2.16		67-3-200	1	-0.743			2.23			5.09	4.65	-8.6
	950	9.91	CSF	222-24	4	+5.195						4.04	3.59	-11.1
	950	9.30	TSGBF	225-202	4	+4.777		15.04	39.84	+164.9		3.49	3.57	+2.3
	950	9.91		61-70-15	4	+9.464		17.26	67.11	+288.8		3.79		
	950	9.91		61-73-13	4	+5.000		15.88	54.15	+241.0		3.60	3.73	+3.6
	950	9.91		63-16-3	4	+3.665		17.30	51.12	+195.5		2.91	4.28	+47.1
	950	9.91		65-22-5	4	+1.273		17.30	26.17	+51.3		6.26	1.96	-68.7
	1000	10.94	CSF	222-201	4	-6.348		12.56	20.26	+61.3		5.12	1.44	-71.9
	1000	10.94		61-70-217	4	-9.037		7.47	21.24	+184.3		1.55	2.15	+38.7
	1000	10.94		61-73-219	4	-7.872		7.41	24.21	+226.7		1.01	1.88	+86.1
	1000	10.94		63-16-203	4	+5.261		14.84	54.81	+269.3		1.05	2.03	+93.3
	1000	10.77		65-21-206	4	-2.961		17.08	32.58	+90.7		6.24	1.02	-83.7
	1000	10.94		65-22-205	4	-1.971		10.26	19.02	+85.4		3.50	1.31	-62.6
								10.60	17.68	+66.8		4.05	1.03	-74.6

a. Mean CTE, 25-425 °C

TABLE C19. (contd)

Capsule Position	Temp, °C	Fluence, nvt × 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L _o , %	Young's Modulus		Electrical Resistivity		Coeff. of Thermal Expansion	
							Initial	Final	Initial	Final	Initial	Final
8	1050	2.91	└	65-21-26	1	-0.691	0.76	0.93	+22.4		4.81	
			└	65-21-231		-1.241	1.50	2.23	+48.7		3.93	2.72
			└	65-22-31		-0.423	1.42	1.60	+12.7		5.24	3.30
			└	65-22-214		-0.728	1.35	1.84	+36.3		4.78	3.19
			└	65-37-24		-0.802	1.06	1.52	+43.4			2.05
			└	65-37-210		-1.605	1.79				0.94	0.69
			└	66-9-3		-1.135	1.10	1.59	+44.5		2.66	2.26
			└	66-9-232		-2.741					0.91	0.62
			└	66-10-26		-0.760	1.45	2.66	+83.4		5.47	3.27
			└	66-10-24		-1.213	1.43	2.20	+53.3		5.17	2.90
			└	66-10-226		-0.666		1.96			5.71	3.40
			└	66-14-4		-0.863					24.51	2.17
			└	66-14-204		-1.230	1.24	1.47	+18.5		2.26	1.74
			└	66-15-3		+0.732	0.85				5.34	3.30
			└	66-15-205		+0.829	0.85				6.10	3.34
			└	67-1-10		+1.259	1.36	2.23	+63.9		5.30	3.37
			└	67-1-206		+0.050	1.42	1.56	+9.3		4.78	2.91
			└	67-3-1		-0.668		1.87			4.67	3.30
			└	67-3-203		-2.053	1.67	2.39	+43.1		4.24	2.14
9	1050	2.91	└	233-20	2	+0.958		1.08				2.75
			└	62-21-3	1	-0.202					3.10	2.87
			└	62-21-200	1	-0.842						0.87
			└	64-13B-24	2	+4.486						4.84
			└	64-13B-205	2	-2.861		1.08				2.82
			└	64-17B-2	2	+4.397						3.12
			└	64-17B-200	2	-2.258						2.40
			└	65-21-10	2	-1.231		1.50				1.71
			└	65-21-213	2	-2.958		2.44				
			└	65-22-28	2	-1.113		1.52				1.26
			└	65-22-211	2	-2.325						1.36
			└	65-42-9	2	+1.957		2.95				2.53
			└	65-42-202	2	+1.747		2.76				2.52
			└	66-4-202	2	+0.913						3.14
			└	66-4-2	2	+0.407		1.80				2.83
			└	66-14-6	1	-0.902	1.06	1.50	+41.5		2.80	2.26
			└	66-14-200	1	-0.977					2.32	1.72
			└	D6015		-0.276						-19.3
			└	D6417		-0.750						-25.9

a. Mean CTE, 25-425 °C.

TABLE C19. (contd)

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L, %		Young's Modulus psi × 10 ⁻⁶		Electrical Resistivity ohm-cm × 10 ⁴		Coeff. of Thermal Expansion 10 ⁻⁶ per °C (a)	
						ΔL/L, %	ΔE/E, %	Initial	Final	Initial	Final	Initial	Final
10	1000	11.43	NC8	NC8-152	4	+15.486				13.54	62.55	+362.0	3.16
	1025	11.35	NC8	NC8-258	4	-4.601				6.75	29.47	+336.6	1.42
	1000	11.43		65-29-5	4	+13.131				15.35	50.65	+230.0	2.78
	1000	11.43		65-37-1	4	+16.497				12.83	73.45	+472.5	3.25
	1025	11.35		65-37-201	4	-8.761				4.82	22.73	+371.6	1.10
11	975	10.51	TSX	167-M4	4	+13.603					62.50		5.29
	975	10.14	TSX	167-212	4	-9.685					15.96		1.69
	975	7.63		65-18-266	3	-1.014					21.38		2.31
	975	10.51		65-20-4	4	-1.051					18.34		1.81
	975	10.14		65-20-253	4	-1.577					16.21		1.73
12	975	10.51		65-21-6	4	+5.697					26.77		2.12
	925	5.92	NC8	NC8-158	3	-0.469					32.30		2.40
	925	5.92	NC8	NC8-264	3	-3.759					24.20		1.07
	925	5.92	TSGBF	125-31	3	+9.879					60.85		5.32
	925	5.92	TSGBF	125-231	3	Broken							
13	925	5.92		63-16-4	3	-0.234					25.84		1.86
	925	5.92		63-16-204	3	-0.837					26.14		2.09
	950	4.37		63-17-5	2	-0.526					23.42		2.09
	950	4.37		63-17-203	2	-0.816					24.08		2.46
	950	4.37		63-19-20	2	-2.584							2.59
13	950	4.37		63-19-223	2	-0.192					48.92		4.42
	950	4.37		63-38-30	2	+0.420					72.17		4.20
	950	4.37		63-38-226	2	-3.212					57.16		2.53
	950	2.00		65-21-1	1	0					35.38		2.89
	925	5.92		65-22-6	3	+0.061					24.81		2.24
13	925	5.92		65-22-294	3	-2.005					26.14		2.06
	950	4.37		65-37-21	2	-1.593					25.66		2.02
	925	5.92		65-37-202	3	-4.330					19.58		0.84
	950	2.00		D6618		-0.711							
	950	2.00		D7220		-0.836							
13	875	4.94		64-13-202	3	-3.054					31.86		2.40
	850	6.76		64-17-3	4	+0.078					24.82		2.92
	875	4.94		64-17-203	3	-2.207					19.03		2.94
	825	5.91		65-18-62	4	+0.560					20.37		2.32
	850	6.50		65-18-260	4	-1.875					18.11		1.82
13	850	6.50		GLZ-202	4	-2.672					14.40		

a. Mean CTE, 25-425 °C.

TABLE C20. H-4-1 Experimental Results

Capsule Position	Temp, °C	Fluence, nvt x 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus			Electrical Resistivity						
							C		L _C		ΔC/C ₀ , %		Δ		Δa/Δ ₀ , %		ΔL ₀ /L ₀ , %		ψi x 10 ⁻⁶		ΔE/E ₀ , %		ohm-cm x 10 ⁴		Δρ/ρ ₀ , %	
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	450	0.52	CSF ⊥	142-28	1	-0.030 ±0.001	6.730	6.771	+0.609	583	310	-46.8	2.462	2.4645	+0.101	480	440	-8.3	0.79	1.30	+64.6	12.12	36.14	+198.2		
	450	0.52	TSX ⊥	158-E13	1	-0.032 ±0.001	6.729	6.768	+0.579	581	305	-47.5	2.464	2.4651	+0.044	536	812	+51.5	0.88	1.35	+53.4	11.25	31.84	+183.0		
	450	0.52	TSX ⊥	158-M4	1	-0.025 ±0.001	6.730	6.760	+0.445	593	325	-45.2	2.464	2.4653	+0.052	638	815	+27.7	0.89	1.38	+55.0	11.47	34.16	+197.8		
	450	0.52	TSX ⊥	158-C7	1	-0.027 ±0.001	6.730	6.773	+0.638	590	325	-44.9	2.465	2.4646	-0.016	863	660	-23.5	0.92	1.32	+43.5	11.30	32.90	+191.2		
2	550	0.73	CSF	142-218	1	-0.092 ±0.001	6.724	6.769	+0.669	530	290	-45.3	2.466	2.4657	-0.012	745	493	-33.8	1.79	2.66	+48.6	7.23	21.17	+192.8		
	550	0.73	TSX	158-210	1	-0.091 ±0.001	6.725	6.773	+0.713	580	309	-46.7	2.464	2.4642	+0.008	410	740	+80.5	2.64	3.96	+50.0	5.53	17.30	+212.8		
	550	0.73	TSX ⊥	158-E12	1	-0.042 ±0.001	6.729	6.766	+0.549	695	385	-44.6	2.464	2.4641	+0.004	620	467	-24.7	1.12	1.41	+25.9	12.18	31.37	+157.6		
	550	0.73	TSGBF ⊥	125-4	1	-0.026 ±0.001	6.760	6.787	+0.399	450	350	-22.2	2.464	2.4634	-0.024	420	435	+3.6	0.90	1.01	+12.2	22.18	35.96	+62.1		
3	675	0.98	CSF ⊥	142-23	1	-0.035 ±0.001	6.730	6.768	+0.564	550	330	-40.0	2.464	2.4650	+0.040	500	752	+50.4	0.89	1.21	+36.0	12.43	33.07	+166.0		
	675	0.98	TSX ⊥	158-E11	1	-0.031 ±0.003	6.726	6.767	+0.609	650	332	-48.9	2.464	2.4653	+0.052	555	522	-5.9	0.91	1.37	+50.5	11.25	30.65	+172.4		
	675	0.98	TSX ⊥	158-M2	1	-0.016 ±0.001	6.734	6.756	+0.326	555	405	-27.0	2.464	2.4651	+0.044	505	737	+45.9	0.99	1.28	+29.3	11.45	30.98	+170.6		
	675	0.98	TSX ⊥	158-C6	1	-0.026 ±0.001	6.725	6.757	+0.475	660	370	-43.9	2.465	2.4640	-0.040	508	780	+53.5	0.93	1.50	+61.3	11.37	30.46	+167.9		
4	700	1.11	CSF	142-217	1	-0.066 ±0.001	6.724	6.765	+0.609	515	340	-34.0	2.464	2.4650	+0.040	697	570	-18.2	1.52	2.30	+51.3	7.05	20.58	+191.9		
	700	1.11	TSX	158-209	1	-0.081 ±0.002	6.732	6.757	+0.371	480	325	-32.3	2.465	2.4662	+0.048	665	795	+19.5	2.19	2.85	+30.1	6.96	19.24	+176.4		
	700	1.11	TSX ⊥	158-E10	1	-0.020 ±0.001	6.730	6.748	+0.267	505	245	-51.5	2.463	2.4650	+0.081	544	555	+2.0	0.92	1.34	+45.6	11.65	30.89	+165.2		
	700	1.11	TSGBF ⊥	125-3	1	-0.018 ±0.001	6.755	6.775	+0.296	410	248	-39.5	2.464	2.4637	-0.012	400	345	-13.8	0.93	1.31	+40.9	17.72	36.81	+107.7		
5	675	1.01	CSF	142-213	1	-0.068 ±0.001	6.735	6.762	+0.400	585	350	-40.2	2.463	2.4644	+0.056	885	787	-11.1	1.67	2.77	+65.9	7.70	21.02	+173.0		
	675	1.01	TSX	158-201	1	-0.078 ±0.001	6.728	6.771	+0.639	560	358	-36.1	2.464	2.4652	+0.048	890	620	-30.3	2.34	3.42	+46.2	6.05	17.87	+195.4		
	675	1.01	TSX ⊥	158-E4	1	-0.030 ±0.001	6.735	6.760	+0.371	610	395	-35.2	2.464	2.4607	-0.133	480	282	-41.3	1.00	1.51	+51.0	11.81	29.85	+152.8		
	675	1.01	TSGBF ⊥	125-1	1	-0.020 ±0.002	6.752	6.793	+0.607	451	262	-41.9	2.462	2.4636	+0.064	350	278	-20.6	0.89	1.21	+36.0	20.00	37.56	+87.8		
6	575	0.74	CSF ⊥	142-21	1	-0.048 ±0.001	6.735	6.771	+0.534	510	385	-24.5	2.464	2.4646	+0.024	690	353	-48.8	0.73	1.15	+57.5	14.51	35.73	+146.2		
	575	0.74	TSX ⊥	158-E2	1	-0.048 ±0.001	6.732	6.766	+0.505	610	415	-32.0	2.463	2.4648	+0.073	465	543	+16.8	1.06	1.44	+35.8	11.14	31.02	+178.4		
	575	0.74	TSX ⊥	158-M1	1	-0.050 ±0.001	6.730	6.765	+0.520	600	375	-37.5	2.464	2.4647	+0.028	555	747	+34.6	0.88	1.35	+53.4	10.88	33.19	+205.1		
	575	0.74	TSX ⊥	158-C4	1	-0.043 ±0.001	6.736	6.760	+0.356	483	310	-35.8	2.464	2.4647	+0.028	535	550	+2.8	1.15	1.45	+26.1	11.81	34.13	+189.0		

TABLE C21. H-5-1 Experimental Results

Capsule Position	Temp, °C	Fluence, $\times 10^{-21}$ nvt (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change $\Delta L/L_0$, %	Crystallite Parameters, Å										Young's Modulus		Electrical Resistivity		
							$\bar{C}$		L_C		$\Delta C/\bar{C}_0$, %		L_a		$\Delta a/a_0$, %	$\psi_i \times 10^{-6}$		$\Delta E/E_0$, %	$\rho_{ohm-cm} \times 10^4$		
							Initial	Final	Initial	Final	$\Delta C/L_{C0}$, %	Initial	Final	Initial		Final	Initial		Final		
1	425	0.52	CSF	142-214	1	-0.109 $\pm$ 0.001	6.734	6.774	+0.594	565	210	-62.8	2.465	2.4633	-0.068	1.56	2.45	+57.0	8.12	24.96	+207.4
	425	0.52	TSX	160-201	1	-0.144 $\pm$ 0.001	6.737	6.765	+0.415	485	220	-54.6	2.463	2.4633	+0.012	2.04	3.12	+52.9	7.03	22.87	+225.3
	425	0.52	TSX $\perp$	160-E1	1	-0.047 $\pm$ 0.001	6.728	6.770	+0.624	635	260	-59.1	2.462	2.4635	+0.060	0.85	1.41	+65.9	12.55	34.92	+178.2
	425	0.52	TSGBF $\perp$	125-5	1	-0.029 $\pm$ 0.001	6.755	6.801	+0.680	440	233	-47.0	2.463	2.4635	+0.020	0.91	1.25	+37.4	19.52	40.49	+107.4
2	575	0.84	CSF $\perp$	142-24	1	-0.066 $\pm$ 0.001	6.732	6.775	+0.638	600	245	-59.2	2.464	2.4651	+0.044	0.87	1.33	+52.9	12.83	34.17	+166.3
	575	0.84	TSX $\perp$	160-E2	1	-0.059 $\pm$ 0.001	6.735	6.762	+0.400	680	313	-54.0	2.463	2.4653	+0.093	0.81	1.23	+51.8	11.88	33.49	+181.9
	575	0.84	TSX $\perp$	160-M1	1	-0.063 $\pm$ 0.001	6.730	6.760	+0.445	645	290	-55.0	2.463	2.4646	+0.064	0.85	1.28	+50.6	12.12	32.53	+168.4
	575	0.84	TSX $\perp$	160-C1	1	-0.070 $\pm$ 0.001	6.730	6.767	+0.549	685	274	-60.0	2.462	2.4649	+0.117	0.91	1.30	+42.8	11.41	32.58	+185.5
3	700	1.13	CSF $\perp$	142-26	1	-0.026 $\pm$ 0.001	6.738	6.760	+0.326	471	296	-37.2	2.463	2.4654	+0.097	0.84	1.26	+50.0	12.69	33.51	+164.1
	700	1.13	TSX $\perp$	160-E3	1	-0.033 $\pm$ 0.001	6.728	6.771	+0.639	760	280	-63.2	2.463	2.4656	+0.105	0.90	1.36	+51.1	11.44	32.84	+187.1
	700	1.13	TSX $\perp$	160-M2	1	-0.034 $\pm$ 0.001	6.730	6.762	+0.475	640	299	-53.3	2.465	2.4651	+0.004	0.82	1.18	+43.9	12.22	33.21	+171.8
	700	1.13	TSX $\perp$	160-C2	1	-0.028 $\pm$ 0.001	6.722	6.761	+0.580	740	297	-59.9	2.464	2.4656	+0.064	0.81	1.24	+53.1	11.20	33.21	+196.5
4	750	1.33	CSF	142-215	1	-0.129 $\pm$ 0.001	6.735	6.759	+0.356	600	251	-58.2	2.465	2.4651	+0.004	1.61	2.48	+54.0	7.73	22.92	+196.5
	750	1.33	TSX	160-202	1	-0.133 $\pm$ 0.001	6.734	6.762	+0.415	545	254	-53.4	2.463	2.4653	+0.093	2.04	3.05	+49.5	6.81	20.81	+205.6
	750	1.33	TSX $\perp$	160-E4	1	-0.056 $\pm$ 0.001	6.730	6.746	+0.237	740	254	-65.7	2.463	2.4640	+0.040	0.90	1.40	+55.6	11.98	33.34	+178.3
	750	1.33	TSGBF $\perp$	125-6	1	-0.044 $\pm$ 0.001	6.756	6.795	+0.577	490	214	-56.3	2.463	2.4637	+0.028	0.95	1.27	+33.7	18.53	37.63	+103.1
5	725	1.29	CSF $\perp$	142-29	1	-0.058 $\pm$ 0.001	6.734	6.761	+0.400	554	283	-48.9	2.465	2.4649	-0.004	0.80	1.26	+57.5	13.17	34.92	+165.1
	725	1.29	TSX $\perp$	160-E5	1	-0.074 $\pm$ 0.001	6.728	6.771	+0.639	803	298	-62.9	2.463	2.4648	+0.073	1.00	1.49	+49.0	10.10	29.57	+192.8
	725	1.29	TSX $\perp$	160-M3	1	-0.048 $\pm$ 0.001	6.740	6.759	+0.281	599	370	-38.2	2.464	2.4656	+0.064	0.82	1.28	+56.1	12.42	35.78	+188.1
	725	1.29	TSX $\perp$	160-C4	1	-0.051 $\pm$ 0.001	6.728	6.765	+0.549	625	293	-53.1	2.462	2.4637	+0.069	0.81	1.34	+65.4	12.13	34.11	+181.2
6	600	0.96	CSF	142-216	1	-0.111 $\pm$ 0.001	6.726	6.767	+0.609	660	330	-50.0	2.465	2.4649	-0.004	1.56	2.53	+62.2	7.63	23.64	+209.8
	600	0.96	TSX	160-203	1	-0.114 $\pm$ 0.001	6.734	6.765	+0.460	740	410	-44.6	2.462	2.4646	+0.105	2.02	3.19	+57.9	6.49	19.95	+207.4
	600	0.96	TSX $\perp$	160-E6	1	-0.075 $\pm$ 0.001	6.731	6.755	+0.356	645	340	-47.3	2.462	2.4651	+0.125	0.94	1.58	+68.1	10.17	31.25	+207.3
	600	0.96	TSGBF $\perp$	125-8	1	-0.050 $\pm$ 0.001	6.755	6.784	+0.429	490	310	-36.7	2.463	2.4633	+0.012	0.92	1.29	+40.2	19.62	39.54	+101.5

TABLE C22. H-6-1 Experimental Results

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L _o , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity						
							C		L _C		ΔC/L _C , %		a		Δa/a _o , %		L _a		ΔL/L _a , %		psi × 10 ⁻⁶		ΔE/E _o , %		ohm-cm × 10 ⁻⁴		Δρ/ρ _o , %
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final			
1	425	0.51	CSF ⊥	142-27	1	-0.047 ±0.001	6.733	6.769	+0.534	480	255	-46.9	2.465	2.4626	-0.097	622	426	-31.5	1.11	1.43	+28.8	12.83	37.60	+193.1			
	425	0.51	TSX ⊥	160-E7	1	-0.053 ±0.001	6.735	6.770	+0.519	593	260	-56.2	2.465	2.4632	-0.073	645	345	-46.5	1.14	1.32	+15.8	10.25	33.05	+222.4			
	425	0.51	TSX ⊥	158-M6	1	-0.051 ±0.001	6.733	6.766	+0.490	680	242	-64.4	2.463	2.4626	-0.016	1650	772	-53.2	1.08	1.50	+38.9	11.12	35.50	+219.2			
	425	0.51	TSX ⊥	160-C5	1	-0.047 ±0.001	6.732	6.764	+0.475	684	280	-59.1	2.465	2.4635	-0.060	598	512	-14.4	1.05	1.45	+38.1	11.30	34.99	+209.6			
	575	0.81	CSF	142-223	1	-0.118 ±0.002	6.734	6.761	+0.400	540	279	-48.3	2.465	2.4654	+0.016	503	472	- 6.2	1.56	2.40	+53.8	7.77	25.02	+222.0			
2	575	0.81	TSX	160-204	1	-0.119 ±0.001	6.742	6.761	+0.281	527	310	-41.2	2.466	2.4630	-0.121	340	437	+28.5	2.31	3.40	+47.2	6.47	20.17	+211.8			
	575	0.81	TSX ⊥	160-E8	1	-0.077 ±0.001	6.730	6.756	+0.386	629	280	-55.5	2.465	2.4632	-0.073	454	298	-34.4	1.02	1.53	+50.0	10.17	30.62	+201.1			
	575	0.81	TSGBF ⊥	125-7	1	-0.024 ±0.002	6.751	6.770	+0.281	360	244	-32.2	2.462	2.4671	+0.207	314	238	-24.2	0.98	1.37	+39.8	19.52	41.07	+110.4			
	700	1.12	CSF	142-224	1	-0.096 ±0.002	6.733	6.761	+0.415	490	275	-43.9	2.464	2.4640	0	522	493	- 5.6	1.60	2.41	+50.6	7.44	22.78	+206.2			
	700	1.12	TSX	160-205	1	-0.104 ±0.001	6.725	6.759	+0.505	546	300	-45.1	2.465	2.4648	-0.008	413	523	+26.6	2.24	3.38	+50.9	6.34	19.76	+211.6			
3	700	1.12	TSX ⊥	160-E9	1	Oxidized	6.733	6.759	+0.386	645	315	-51.2	2.466	2.4651	-0.037	423	412	- 2.6	1.13	1.27	+12.4	12.11	33.78	+178.9			
	700	1.12	TSGBF ⊥	125-9	1	-0.004 ±0.001	6.757	6.773	0.236	440	230	-47.7	2.463	2.4628	-0.008	328	321	- 2.1	0.92	1.19	+29.3	20.47	42.29	+106.6			
	775	1.27	CSF ⊥	142-30	1	Oxidized	6.734	6.736	+0.029	450	313	-30.4	2.464	2.4615	-0.142	477	563	+18.0	0.97	1.21	+24.7	12.56	36.92	+193.9			
	775	1.27	TSX ⊥	160-E10	1	Oxidized	6.733	6.754	+0.311	607	325	-46.4	2.465	2.4616	-0.137	516	403	-21.9		1.22		12.22	35.89	+193.7			
	775	1.27	TSX ⊥	158-M7	1	Oxidized	6.726	6.746	+0.297	630	266	-57.8	2.462	2.4647	+0.109	1350	270	-80.0	0.96	1.37	+42.7	10.99	35.96	+227.2			
4	775	1.27	TSX ⊥	160-C6	1	Oxidized	6.734	6.753	+0.282	590	310	-47.4	2.465	2.4613	-0.150	437	420	- 3.9		1.26		11.38	35.80	+214.6			
	775	1.21	CSF	142-225	1	-0.070 ±0.001	6.734	6.757	+0.341	470	272	-42.1	2.464	2.4644	+0.016	444	373	-16.0		2.10		7.69	24.30	+216.1			
	775	1.21	TSX	160-206	1	-0.087 ±0.001	6.734	6.729	-0.074	635	241	-62.0	2.465	2.4644	-0.024	422	410	- 2.8	2.26	3.44	+52.2	6.26	19.63	+213.4			
	775	1.21	TSX ⊥	160-E11	1	Oxidized	6.741	6.729	-0.178	500	290	-42.0	2.465	2.4611	-0.158	373	428	+14.7	1.07	1.22	+14.0	12.10	35.21	+191.0			
	775	1.21	TSGBF ⊥	125-2	1	Oxidized	6.762	6.778	+0.236	380	211	-44.5	2.462	2.4632	+0.048	385	246	-36.1	0.94	1.25	+33.0	17.02	39.02	+129.2			
6	625	0.87	CSF ⊥	142-31	1	-0.047 ±0.001	6.734	6.761	+0.400	500	295	-41.0	2.465	2.4650	0	550	367	-33.3	0.78	1.26	+61.5	12.55	35.48	+182.7			
	625	0.87	TSX ⊥	160-E12	1	-0.038 ±0.001	6.719	6.765	+0.535	545	312	-42.8	2.465	2.4643	-0.028	399	437	+ 9.5		1.26		12.06	32.36	+168.3			
	625	0.87	TSX ⊥	158-E14	1	-0.037 ±0.001	6.738	6.756	+0.267	530	267	-49.6	2.463	2.4656	+0.105	937	292	-68.8	1.03	1.40	+35.9	11.79	32.50	+175.6			
	625	0.87	TSX ⊥	158-C16	1	-0.036 ±0.001	6.733	6.750	+0.252	620	304	-51.0	2.462	2.4657	+0.150	950	405	-57.4	1.04	1.34	+28.8	11.62	32.15	+176.7			

TABLE C23. H-4-2 Experimental Results

Capsule Position	Temp, °C	Fluence, ^a nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å						Young's Modulus		Electrical Resistivity	
							L _C			L _a			psi × 10 ⁻⁶		ohm-cm × 10 ⁴	
							Initial	Final	ΔC/C ₀ , %	Initial	Final	ΔL _C /L _{C0} , %	Initial	Final	Initial	Final
1	475	0.64	CSF	142-232	1	-0.118*±0.012	6.750	6.750	0.0	475	240	-49.5	2.4654	2.4611	-0.174	24.22
	475	0.64	TSX ⊥	158-E22	1	-0.118*±0.012	6.742	6.756	-0.088	640	278	-56.6	2.462	2.4612	-0.032	7.44
	450	1.16	TSX ⊥	158-E13	2	-0.188*±0.017	6.729	6.733	+0.059	581	262	-54.9	2.464	2.4615	-0.101	12.01
	450	1.16	TSX ⊥	158-C7	2	-0.156*±0.010	6.730	6.742	+0.178	590	289	-51.0	2.465	2.4607	-0.174	34.93
2	600	1.77	CSF	142-218	2	-0.361 ±0.001	6.724	6.725	+0.014	530	240	-54.7	2.466	2.4611	-0.198	11.25
	625	1.04	CSF	142-240	1	-0.170 ±0.001	6.737	6.734	-0.044	445	287	-35.5	2.4650	2.4631	-0.077	11.30
	625	1.04	TSX	158-216	1	-0.188 ±0.001	6.733	6.728	-0.074	530	270	-49.1	2.462	2.4607	-0.052	7.23
	600	1.77	TSGBF ⊥	125-4	2	-0.222 ±0.001	6.760	6.759	-0.014	450	202	-55.1	2.464	2.4603	-0.150	22.12
3	750	1.40	CSF ⊥	141-13	1	-0.080 ±0.001	6.754	6.723	-0.458	535	263	-50.8	2.4666	2.4623	-0.174	7.19
	750	1.40	TSX ⊥	158-E24	1	-0.068 ±0.001	6.734	6.717	-0.252	610	278	-54.4	2.462	2.4613	-0.028	21.12
	725	2.38	TSX ⊥	158-M2	2	-0.174 ±0.002	6.734	6.722	-0.178	555	258	-53.5	2.464	2.4604	-0.146	32.68
	725	2.38	TSX ⊥	158-C6	2	-0.183 ±0.001	6.725	6.711	-0.208	660	240	-63.6	2.465	2.4620	-0.121	11.45
4	775	2.65	CSF	142-217	2	-0.398 ±0.002	6.724	6.716	-0.118	515	238	-53.8	2.464	2.4607	-0.133	11.37
	775	2.65	TSX	158-209	2	-0.421 ±0.001	6.732	6.723	-0.133	480	248	-48.3	2.465	2.4573	-0.312	33.40
	825	1.54	TSX ⊥	160-M4	1	-0.094 ±0.001	6.750	6.717	-0.488	570	270	-52.6	2.4667	2.4613	-0.218	12.14
	825	1.54	TSGBF ⊥	125-10	1	-0.160 ±0.001	6.762	6.740	-0.325	405	198	-51.1	2.461	2.4605	-0.020	32.68
5	750	2.49	TSX ⊥	158-E4	2	-0.192 ±0.001	6.735	6.717	-0.267	610	240	-60.7	2.464	2.4605	-0.142	20.22
	800	1.48	TSX ⊥	160-E13	1	-0.113 ±0.001	6.748	6.722	-0.385	630	242	-61.6	2.4670	2.4614	-0.226	16.81
	800	1.48	TSX	160-208	1	-0.211 ±0.001	6.746	6.723	-0.340	650	273	-58.0	2.4677	2.4600	-0.312	11.96
	750	2.49	TSGBF ⊥	125-1	2	-0.323 ±0.002	6.752	6.736	-0.236	451	179	-60.3	2.462	2.4599	-0.085	34.35
6	625	1.84	CSF ⊥	142-21	2	-0.199 ±0.001	6.735	6.733	-0.029	510	230	-54.9	2.464	2.4609	-0.125	6.16
	625	1.84	TSX ⊥	158-E2	2	-0.201 ±0.001	6.732	6.742	+0.148	610	273	-55.2	2.463	2.4604	-0.105	20.00
	650	1.10	TSX ⊥	158-E19	1	-0.090 ±0.001	6.761	6.720	-0.606	532	290	-45.5	2.4648	2.4608	-0.162	14.51
	625	1.84	TSX ⊥	158-M1	2	-0.194 ±0.001	6.730	6.724	-0.089	600	250	-58.3	2.464	2.4605	-0.142	38.03

* Mean CTE, 25-425 °C

TABLE C24. H-5-2 Experimental Results

Capsule Position	Temp, °C	Fluence, nvt × 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus, psi × 10 ⁻⁶				Electrical Resistivity, ohm-cm × 10 ⁴					
							C		L _C		a		L _a		ΔL _a /L ₀ , %		ΔE/E ₀ , %		Initial		Final		Initial		Final	
							Initial	Final	ΔC/C ₀ , %	Initial	Final	ΔL _C /L _{C0} , %	Initial	Final	Δa/a ₀ , %	Initial	Final	ΔL _a /L _{a0} , %	Initial	Final	ΔE/E ₀ , %	Initial	Final	Δρ/ρ ₀ , %		
1	450	1.27	CSF	142-214	2	-0.430 ±0.001	6.734	6.745	+0.163	565	197	-65.1	2.465	2.4590	-0.243	525	295	+55.8	8.12	26.54	+226.8					
	475	0.75	TSX	158-208	1	-0.240 ±0.001	6.753	6.732	-0.310	445	218	-51.0	2.4654	2.4604	-0.202	845	328	+53.2	5.45	17.51	+221.3					
	475	0.75	TSX	158-E18	1	-0.159 ±0.001	6.751	6.735	-0.237	472	246	-47.9	2.4647	2.4601	-0.186	865	310	+60.2	11.59	29.36	+153.3					
	450	1.27	TSX ⊥	158-M4	2	-0.170 ±0.001	6.730	6.733	+0.044	593	231	-61.0	2.464	2.4599	-0.166	638	340	+52.8	11.47	36.57	+218.8					
2	600	1.14	CSF ⊥	142-46	1	-0.149 ±0.001	6.759	6.738	-0.310	470	242	-48.5	2.4661	2.4609	-0.210	1100	435	+56.2	12.24	35.71	+191.7					
	625	1.87	TSX ⊥	158-E12	2	-0.231 ±0.001	6.729	6.727	-0.029	695	248	-64.3	2.464	2.4591	-0.198	620	388	+27.7	12.18	34.12	+180.1					
	600	1.14	TSX ⊥	158-M8	1	-0.155 ±0.001	6.748	6.705	-0.637	457	212	-53.6	2.4647	2.4599	-0.194	946	535	+59.8	11.35	32.59	+187.1					
	600	1.98	TSX ⊥	160-C1	2	-0.312 ±0.001	6.730	6.728	-0.029	685	210	-69.3	2.462	2.4604	-0.064	998	420	+52.7	11.41	35.05	+207.2					
3	725	2.61	CSF ⊥	142-26	2	-0.258 ±0.001	6.738	6.719	-0.281	471	210	-55.4	2.463	2.4593	-0.150	587	322	+63.1	12.69	37.57	+196.0					
	725	2.61	TSX ⊥	160-E3	2	-0.294 ±0.001	6.728	6.723	-0.074	760	218	-71.3	2.463	2.4601	-0.117	744	400	+65.6	11.44	36.31	+217.4					
	725	1.48	CSF	142-238	1	-0.248 ±0.001	6.756	6.724	-0.473	458	238	-48.0	2.4660	2.4603	-0.231	694	470	+59.8	7.18	21.97	+206.0					
	725	1.48	TSX	158-220	1	-0.259 ±0.001	6.749	6.720	-0.429	565	231	-59.1	2.4670	2.4609	-0.649	990	785	+33.7	5.84	19.25	+229.6					
4	775	1.60	CSF ⊥	141-16	1	-0.128 ±0.001	6.751	6.729	-0.325	585	240	-59.0	2.4692	2.4599	-0.376	833	360	+62.8	11.80	34.33	+190.9					
	750	2.71	TSX ⊥	158-E10	2	-0.204 ±0.001	6.730	6.712	-0.267	505	228	-54.8	2.463	2.4599	-0.125	544	369	+59.8	11.65	35.51	+204.8					
	775	1.60	TSX ⊥	158-C2	1	-0.103 ±0.001	6.753	6.716	-0.547	505	245	-51.5	2.4656	2.4596	-0.243	720	400	+62.4	11.79	36.34	+208.2					
	775	2.93	TSGBF ⊥	125-6	2	-0.448 ±0.001	6.756	6.760	+0.059	490	148	-69.8	2.463	2.4576	-0.219	360	192	+33.7	18.53	39.60	+113.7					
5	750	1.51	CSF ⊥	141-14	1	-0.128 ±0.001	6.757	6.731	-0.384	462	273	-40.9	2.4671	2.4601	-0.283	467	392	+67.1	12.05	34.51	+186.4					
	750	1.51	TSX ⊥	158-M13	1	-0.124 ±0.001	6.759	6.699	-0.887	393	240	-38.9	2.4659	2.4585	-0.259	1275	432	+65.9	11.65	35.76	+207.0					
	750	2.80	TSX ⊥	160-C4	2	-0.320 ±0.001	6.728	6.722	-0.089	625	252	-59.7	2.462	2.4589	-0.125	1010	445	+81.5	12.13	36.56	+201.4					
	725	2.52	TSX	158-201	2	-0.390 ±0.001	6.728	6.733	+0.074	560	242	-56.8	2.464	2.4594	-0.186	890	410	+57.7	6.05	20.33	+236.0					
6	575	1.10	CSF	142-233	1	-0.201 ±0.001	6.759	6.721	-0.562	470	270	-42.6	2.4656	2.4597	-0.239	777	323	+34.6	7.13	22.24	+211.9					
	600	2.06	TSX	160-203	2	-0.406 ±0.001	6.734	6.734	+0.0	740	268	-63.8	2.462	2.4593	-0.109	907	372	+53.5	6.49	22.37	+244.7					
	600	2.06	TSX ⊥	160-E6	2	-0.289 ±0.001	6.731	6.731	+0.0	645	270	-58.1	2.462	2.4592	-0.113	925	330	+80.8	10.17	33.12	+225.7					
	575	1.10	TSGBF ⊥	125-11	1	-0.114 ±0.001	6.769	6.744	-0.369	411	285	-30.6	2.4640	2.4593	-0.190	668	288	+64.8	15.24	35.68	+134.1					

TABLE C25. H-6-2 Experimental Results

Capsule Position	Temp, °C	Fluence, ²¹ nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules, Used	Length Change ΔL/L ₀ , %	C		L _C		a		L _a		Young's Modulus, psi × 10 ⁻⁶		Electrical Resistivity, ohm-cm × 10 ⁴			
							Initial	Final	ΔC/C ₀ , %	Initial	Final	ΔL _C /L _{C0} , %	Initial	Final	Δa/a ₀ , %	Initial	Final	ΔE/E ₀ , %	Initial	Final
1	450	1.20	CSF ⊥	142-27	2	-0.236 ±0.001	6.733	6.748	+0.222	480	200	-58.3	2.465	2.4563	-0.352	622	332	12.83	40.55	+216.1
	450	1.21	TSX ⊥	160-E1	2	-0.246 ±0.001	6.728	6.736	+0.118	635	195	-69.3	2.462	2.4577	-0.174	1010	271	12.55	37.90	+202.0
	450	1.20	TSX ⊥	158-M6	2	-0.238 ±0.001	6.733	6.739	+0.089	680	212	-68.8	2.463	2.4571	-0.239	1650	380	11.12	38.46	+245.9
	450	1.20	TSX ⊥	160-C5	2	-0.224 ±0.001	6.732	6.731	-0.014	684	210	-69.3	2.465	2.4577	-0.296	598	211	11.30	37.65	+233.2
2	600	1.91	CSF	142-223	2	-0.471 ±0.001	6.734	6.717	-0.252	540	188	-65.2	2.465	2.4577	-0.296	503	270	7.77	28.10	+261.6
	600	1.83	TSX	158-210	2	-0.390 ±0.001	6.725	6.723	-0.029	580	240	-58.6	2.464	2.4581	-0.239	410	356	5.53	20.30	+267.1
	600	1.91	TSX ⊥	160-E8	2	-0.345 ±0.001	6.730	6.732	+0.029	629	220	-65.0	2.465	2.4580	-0.283	454	296	10.17	33.11	+225.6
	600	1.91	TSGBF ⊥	125-7	2	-0.273 ±0.001	6.751	6.753	+0.029	360	198	-45.0	2.462			314		19.52	41.87	+114.5
3	725	2.61	CSF	142-224	2	-0.493 ±0.002	6.733	6.728	-0.074	490	200	-59.2	2.464	2.4603	-0.150	522	505	7.44	26.23	+252.6
	725	2.61	TSX	160-205	2	-0.495 ±0.001	6.725	6.723	-0.029	546	202	-63.0	2.465	2.4584	-0.267	413	414	6.34	23.12	+264.7
	750	1.49	TSX ⊥	158-E21	1	-0.094 ±0.001	6.747	6.716	-0.459	446	235	-47.3	2.4665	2.4591	-0.300	1250	375	11.96	35.73	+198.7
	725	2.61	TSGBF ⊥	125-9	2	-0.390 ±0.002	6.757	6.754	-0.044	440	160	-63.6	2.463			328		20.47	43.47	+112.4
4	800	1.70	CSF ⊥	142-34	1	-0.132 ±0.001	6.753	6.723	-0.444	405	240	-40.7	2.4646	2.4581	-0.263	822	405	11.93	38.71	+224.5
	775	3.03	TSX ⊥	160-E4	2	-0.347 ±0.001	6.730	6.720	-0.148	740	200	-73.0	2.463	2.4585	-0.182	1150	307	11.98	40.22	+235.7
	800	1.70	TSX ⊥	167-C21	1	-0.108 ±0.002	6.754	6.713	-0.607	440	275	-37.5	2.4656	2.4587	-0.279	825	350	11.98	39.86	+232.7
	775	3.03	CSF	142-215	2	-0.606 ±0.001	6.735	6.720	-0.222	600	200	-66.7	2.465	2.4585	-0.263	466	323	7.73	27.49	+255.6
5	725	2.62	CSF	142-213	2	-0.413 ±0.001	6.735	6.726	-0.133	585	279	-52.3	2.463	2.4590	-0.162	885	430	7.70	26.94	+250.0
	750	2.72	TSX	160-206	2	-0.560 ±0.002	6.734	6.723	-0.163	635	230	-63.8	2.465	2.4588	-0.251	422	270	6.26	23.51	+275.6
	750	2.90	TSX ⊥	160-E5	2	-0.390 ±0.001	6.728	6.719	-0.133	803	230	-71.4	2.463	2.4584	-0.186	895	298	10.10	35.62	+252.7
	750	1.61	TSGBF ⊥	125-17	1	-0.185 ±0.001	6.771	6.734	-0.546	320	205	-35.9	2.4648	2.4579	-0.280	1110	1000	15.74	40.26	+155.8
6	625	2.04	CSF ⊥	142-31	2	-0.255 ±0.001	6.734	6.723	-0.163	500	238	-52.4	2.465	2.4583	-0.271	550	380	12.55	42.00	+234.7
	600	1.17	TSX ⊥	167-E26	1	-0.142 ±0.001	6.730	6.707	-0.341	600	280	-53.3	2.4668	2.4597	-0.287	792	362	11.26	36.21	+221.6
	600	1.91	TSX ⊥	158-C4	2	-0.217 ±0.001	6.736	6.729	-0.103	483	259	-46.4	2.464	2.4588	-0.211	535	293	11.81	40.36	+241.7
	600	1.17	TSX ⊥	167-C26	1	-0.120 ±0.001	6.740	6.723	-0.252	682	323	-52.6	2.4655	2.4585	-0.283	870	323	12.80	38.38	+199.8

TABLE C26. H-4-3 Experimental Results

Capsule Position	Temp, °C	Fluence nvt × 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L _o , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity							
							C		L _C		ΔC/L _C , %		a		Δa/Δa _o , %		L _a		ΔL/L _{ao} , %		ψi × 10 ⁻⁶		ΔE/E _o , %		ohm-cm × 10 ⁴		Δρ/ρ _o , %	
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	425	1.17	CSF ⊥	142-28	2	-0.137 ±0.001	6.730	6.734	+0.059	583	238	-59.2	2.462	2.4600	-0.081	480	330	-31.2	0.79	1.41	+78.5	12.12	38.52	+217.8				
	425	1.16	TSX ⊥	160-E7	2	-0.211 ±0.001	6.735	6.742	+0.104	593	206	-65.3	2.465	2.4580	-0.284	645	280	-56.6	1.14	1.73	+51.8	10.25	33.47	+226.5				
	425	1.17	TSX	160-201	2	-0.398 ±0.001	6.737	6.744	+0.104	485	195	-59.8	2.463	2.4551	-0.321	914	328	-64.1	2.04	3.42	+67.6	7.03	23.91	+240.1				
	425	1.17	TSGBF ⊥	125-5	2	-0.155 ±0.001	6.755	6.754	-0.015	440	195	-55.7	2.463	2.4562	-0.032	325	289	-11.1	0.91	1.32	+45.0	19.52	42.22	+116.3				
	600	2.14	CSF	142-240	2	-0.480 ±0.001	6.737	6.729	-0.119	445	245	-44.9	2.4650	2.4584	-0.268	569	342	-39.9	1.52	2.84	+86.8	7.19	23.51	+227.0				
2	600	2.14	TSX	158-216	2	-0.537 ±0.001	6.733	6.734	+0.015	530	198	-62.6	2.462	2.4573	-0.191	1152	440	-61.8	2.58	4.26	+65.1	5.40	20.00	+270.4				
	600	1.94	TSX ⊥	160-E2	2	-0.292 ±0.001	6.735	6.730	-0.074	680	248	-63.5	2.463	2.4579	-0.207	1250	365	-70.8	0.81	1.46	+80.2	11.88	36.58	+207.9				
	600	2.87	TSGBF ⊥	125-4	3	-0.492 ±0.001	6.760	6.762	+0.030	450	185	-58.9	2.464	2.4567	-0.296	420	342	-18.6	0.90	1.44	+60.0	22.18	38.10	+71.8				
	700	2.51	CSF ⊥	142-23	2	-0.234 ±0.001	6.730	6.723	-0.104	550	230	-58.2	2.464	2.4588	-0.211	500	645	+29.0	0.89	1.30	+46.1	12.43	37.18	+199.1				
	750	2.93	TSX ⊥	158-E24	2	-0.306 ±0.001	6.734	6.705	-0.431	610	200	-67.2	2.462	2.4588	-0.130	1150	420	-63.5	0.97	1.54	+58.8	12.14	35.78	+194.7				
3	725	3.91	TSX ⊥	158-M2	3	-0.409 ±0.001	6.734	6.730	-0.059	555	275	-50.4	2.464	2.4580	-0.244	505	520	+3.0	0.99	1.43	+44.4	11.45	36.72	+220.7				
	725	2.66	TSX ⊥	160-C2	2	-0.284 ±0.001	6.722	6.717	-0.074	740	205	-72.3	2.464	2.4587	-0.215	1290	372	-71.2	0.81	1.32	+63.0	11.20	37.87	+238.1				
	775	4.41	CSF	142-217	3	-1.028 ±0.001	6.724	6.728	+0.059	515	200	-61.2	2.464	2.4585	-0.223	697	388	-44.3	1.52	2.46	+61.8	7.05	24.59	+248.8				
	775	4.41	TSX	158-209	3	-1.023 ±0.002	6.732	6.705	-0.401	480	185	-61.4	2.465	2.4587	-0.256	665	850	+27.8	2.19	3.16	+44.3	6.96	23.18	+233.0				
	775	4.25	TSX ⊥	158-E4	3	-0.433 ±0.001	6.735	6.721	-0.208	610	240	-60.6	2.464	2.4584	-0.227	480	385	-19.8	1.00	1.69	+69.0	11.81	34.48	+191.9				
4	825	3.30	TSX ⊥	160-M4	2	-0.367 ±0.001	6.750	6.719	-0.459	570	202	-64.6	2.4667	2.4587	-0.324	605	700	+15.7	0.83	1.38	+66.3	11.97	38.18	+219.0				
	725	1.63	CSF ⊥	142-53	1	-0.089 ±0.001	6.727	6.717	-0.149	621	280	-54.9	2.4624	2.4588	-0.146	787	490	-37.7	0.77	1.19	+54.5	13.22	36.66	+177.3				
	725	1.63	TSX ⊥	167-E31	1	-0.101 ±0.001	6.725	6.717	-0.118	475	240	-49.5	2.4619	2.4592	-0.110	1135	538	-52.6	0.90	1.28	+42.2	14.27	34.95	+144.9				
	725	1.63	TSX	167-228	1	-0.222 ±0.001	6.728	6.717	-0.163	453	240	-47.0	2.4627	2.4590	-0.150	1160	615	-47.0	2.70	3.77	+39.6	5.36	17.97	+235.3				
	725	1.63	TSGBF ⊥	125-18	1	-0.145 ±0.001	6.740			198			2.4599			450			0.88	1.26	+43.2	15.74	37.15	+136.0				
5	600	2.08	CSF	142-216	2	-0.392 ±0.001	6.726	6.725	-0.015	660	247	-62.6	2.465	2.4586	-0.260	475	362	-23.8	1.56	2.50	+60.2	7.63	25.14	+229.5				
	625	2.22	TSX ⊥	158-E19	2	-0.314 ±0.001	6.761	6.733	-0.414	532	308	-42.1	2.4648	2.4587	-0.247	773	1105	+42.9	0.87	1.75	+101.1	11.78	30.24	+156.7				
	600	2.96	TSX ⊥	158-M1	3	-0.460 ±0.001	6.730	6.734	+0.059	600	210	-65.0	2.464	2.4587	-0.215	555	330	-40.5	0.88	1.48	+68.2	10.88	36.22	+232.9				
	600	2.08	TSGBF ⊥	125-8	2	-0.296 ±0.001	6.755	6.757	+0.030	490	310	-36.7	2.463	2.4563	-0.272	322	350	+8.7	0.92	1.28	+39.1	19.62	40.53	+106.6				

TABLE C27. H-5-3 Experimental Results

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity					
							C		L _C		ΔC/L _{C0} , %		ΔL _C /L _{C0} , %		Δa/a ₀ , %		L _a		ΔL _a /L _{a0} , %		Psi × 10 ⁻⁶		ΔE/E ₀ , %		ohm-cm × 10 ⁻⁴	
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	450	1.95	CSF	142-214	3	-0.677 ±0.001	6.734	6.751	+0.252	565	167	-70.4	2.465	2.4553	-0.393	525	220	1.56	2.62	+67.9	8.12	27.52	+238.9			
	450	1.43	TSX	158-208	2	-0.476 ±0.001	6.753	6.741	-0.177	445	210	-52.8	2.4654	2.4560	-0.381	845	310	2.69	4.43	+64.7	11.59	30.77	+257.2			
	450	1.43	TSX ⊥	158-E18	2	-0.304 ±0.001	6.751	6.738	-0.192	472	205	-56.6	2.4647	2.4576	-0.288	865	300	1.08	1.89	+75.0	11.59	30.77	+165.5			
	450	1.95	TSX ⊥	158-M4	3	-0.291 ±0.001	6.730	6.742	-0.178	593	215	-63.7	2.464	2.4576	-0.259	638	318	0.89	1.48	+66.3	11.47	37.35	+225.6			
2	600	2.91	CSF	142-218	3	-0.744 ±0.001	6.724	6.738	+0.208	530	205	-61.3	2.466	2.4580	-0.324	745	525	1.79	2.88	+60.9	7.23	24.15	+234.0			
	575	1.95	TSX	160-204	2	-0.459 ±0.001	6.742	6.723	-0.281	527	238	-54.8	2.466	2.4604	-0.227	340	475	2.31	3.39	+46.8	6.47	21.96	+239.4			
	600	3.01	TSX ⊥	158-E12	3	-0.475 ±0.001	6.729	6.720	-0.133	695	221	-68.2	2.464	2.4584	-0.227	620	560	1.12	1.57	+40.2	12.18	36.00	+195.6			
	600	3.12	TSX ⊥	160-C1	3	-0.611 ±0.001	6.730	6.732	+0.029	685	198	-71.1	2.462	2.4579	-0.166	998	345	0.91	1.50	+64.8	11.41	36.17	+217.0			
3	750	3.00	CSF ⊥	141-13	2	-0.324 ±0.001	6.754	6.719	-0.518	535	210	-60.7	2.4666	2.4588	-0.316	522	385	0.86	1.42	+65.1	11.91	37.79	+217.3			
	725	2.73	TSX ⊥	160-M2	2	-0.274 ±0.001	6.730	6.723	-0.104	640	220	-65.6	2.465	2.4592	-0.235	572	910	0.82	1.41	+72.0	12.22	36.80	+201.1			
	725	3.98	TSX ⊥	158-C6	3	-0.387 ±0.001	6.725	6.722	-0.044	660	240	-63.6	2.465	2.4610	-0.162	508	600	0.93	1.51	+62.4	11.37	36.14	+217.8			
	725	3.08	TSX	158-220	2	-0.766 ±0.002	6.749	6.726	-0.340	565	200	-64.6	2.4670	2.4591	-0.322	990	905	2.76	3.79	+37.3	5.84	20.60	+252.7			
4	800	3.54	CSF ⊥	141-16	2	-0.432 ±0.001	6.751	6.729	-0.325	585	200	-65.8	2.4692	2.4588	-0.421	833	460	0.86	1.45	+68.6	11.80	36.81	+211.9			
	775	4.65	TSX ⊥	158-E10	3	-0.452 ±0.001	6.730	6.719	-0.163	505	219	-56.6	2.463	2.4578	-0.211	544	328	0.92	1.49	+62.0	11.65	37.53	+222.1			
	775	3.27	TSX	160-202	2	-0.644 ±0.001	6.734	6.723	-0.163	545	195	-64.2	2.463	2.4596	-0.138	1025	470	2.04	3.05	+49.5	6.81	23.79	+249.3			
	775	4.87	TSCBF ⊥	125-6	3	-0.651 ±0.001	6.756	6.771	+0.222	490	150	-69.4	2.463	2.4579	-0.207	360	500	0.95	1.30	+36.8	18.53	40.18	+116.8			
5	700	2.99	CSF ⊥	142-46	3	-0.446 ±0.001	6.759	6.731	-0.414	470	200	-57.4	2.4661	2.4584	-0.312	1100	485	0.80	1.46	+82.5	12.24	38.83	+236.6			
	750	3.14	TSX ⊥	160-M3	2	-0.338 ±0.001	6.740	6.725	-0.222	599	240	-59.9	2.464	2.4582	-0.235	462	810	0.82	1.36	+65.8	12.42	38.85	+212.8			
	800	3.33	TSX	160-208	2	-0.770 ±0.001	6.746	6.723	-0.340	650	229	-64.8	2.4677	2.4573	-0.421	577	635	2.09	3.68	+76.1	6.16	21.38	+247.1			
	750	2.96	TSCBF ⊥	125-3	3	-0.419 ±0.001	6.755	6.754	0.014	410	195	-52.4	2.464	2.4559	-0.328	400	465	0.93	1.27	+36.6	17.72	40.15	+126.6			
6	625	3.08	CSF	142-21	3	-0.461 ±0.001	6.735	6.755	+0.296	510	229	-55.1	2.464	2.4598	-0.170	690	995	0.73	1.32	+80.8	14.51	40.00	+175.7			
	600	3.30	TSX ⊥	160-E6	3	-0.580 ±0.001	6.731	6.740	+0.133	645	242	-62.5	2.462	2.4583	-0.150	925	762	0.94	1.74	+85.1	10.17	33.80	+232.4			
	600	3.30	TSX	160-203	3	-0.808 ±0.001	6.734	6.733	-0.014	740	240	-67.6	2.462	2.4586	-0.138	907	250	2.02	3.07	+52.0	6.49	23.48	+261.8			
	600	2.34	TSCBF ⊥	125-11	2	-0.368 ±0.001	6.769	6.740	-0.428	411	212	-48.4	2.4640	2.4564	-0.308	668	550	0.88	1.47	+67.0	15.24	36.82	+141.6			

TABLE C28. H-6-3 Experimental Results

Capsule Position	Temp, °C	Fluence ^{2,21} nvt × 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules, Used	Length Change ΔL/L _o , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity					
							C		L _c		ΔL _c /L _c , %	a		Δa/a _o , %	L _a		ΔL _a /L _a , %	psi × 10 ⁻⁶		ΔE/E _o , %	ohm-cm × 10 ⁴		Δρ/ρ _o , %			
							Initial	Final	Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final				
1	450	1.80	CSF ⊥	142-27	3	-0.377 ±0.001	6.733	6.748	+0.222	480	195	-59.4	2.465	2.4566	-0.340	622	370	-40.5	1.11	1.54	+38.7	12.83	36.91	+187.7		
	450	1.81	TSX ⊥	160-E1	3	-0.408 ±0.001	6.728	6.745	+0.252	635	190	-70.1	2.462	2.4556	-0.259	1010	180	-82.2	0.85	1.66	+95.3	12.55	36.04	+187.2		
	450	1.80	TSX ⊥	158-M6	3	-0.377 ±0.001	6.733	6.752	+0.282	680	195	-71.3	2.463	2.4561	-0.320	1650	382	-76.8	1.08	1.66	+53.7	11.12	35.10	+215.6		
	450	1.80	TSX ⊥	160-C5	3	-0.378 ±0.001	6.732	6.746	+0.207	684	200	-70.8	2.465	2.4564	-0.348	598	280	-53.2	1.05	1.55	+47.6	11.30	34.88	+208.7		
2	575	2.94	CSF	142-223	3	-0.905 ±0.001	6.734	6.740	+0.089	540	230	-57.4	2.465	2.4593	-0.231	503	295	-41.4	1.56	2.33	+49.4	7.77	26.64	+242.8		
	575	2.86	TSX	158-210	3	-0.811 ±0.001	6.725	6.732	+0.104	580	210	-63.8	2.464	2.4581	-0.239	410	420	+ 2.4	2.64	3.75	+42.0	5.53	19.54	+253.3		
	575	2.94	TSX ⊥	160-E8	3	-0.661 ±0.001	6.730	6.762	+0.475	629	205	-67.4	2.465	2.4560	-0.365	454	465	+ 2.4	1.02	1.72	+68.6	10.17	31.98	+214.4		
	575	2.94	TSGBF ⊥	125-7	3	-0.573 ±0.001	6.751	6.746	-0.074	360	205	-43.1	2.462	2.4565	-0.223	314	362	+15.3	0.98	1.46	+49.0	19.52	37.05	+ 89.8		
3	725	4.10	CSF	142-224	3	-1.077 ±0.002	6.733	6.732	-0.014	490	200	-59.2	2.464	2.4570	-0.284	522	410	-21.5	1.60	2.62	+63.8	7.44	24.57	+230.2		
	725	4.10	TSX	160-205	3	-1.124 ±0.002	6.725	6.725	0.0	546	200	-63.4	2.465	2.4588	-0.251	413	585	+41.6	2.24	3.34	+49.1	6.34	22.57	+236.0		
	725	4.10	TSX ⊥	160-E3	3	-0.606 ±0.001	6.728	6.717	-0.163	760	218	-71.3	2.463	2.4592	-0.154	744	960	+29.0	0.90	1.54	+71.1	11.44	36.37	+217.9		
	725	4.10	TSGBF ⊥	125-9	3	-0.792 ±0.001	6.757	6.760	+0.044	440	149	-66.1	2.463	2.4563	-0.272	328	328	0.0	0.92	1.19	+29.3	20.47	42.88	+109.5		
4	800	4.92	CSF	142-215	3	-1.471 ±0.001	6.735	6.731	-0.059	600	163	-72.8	2.465	2.4587	-0.255	466	400	-14.2	1.61	2.38	+47.8	7.73	25.54	+230.4		
	800	4.92	TSX ⊥	160-E4	3	-0.646 ±0.001	6.730	6.728	-0.029	740	185	-75.0	2.463	2.4587	-0.174	1150	382	-66.8	0.90	1.54	+71.1	11.98	38.02	+217.4		
	800	3.49	TSX ⊥	158-C2	2	-0.315 ±0.001	6.753	6.727	-0.385	505	222	-56.0	2.4656	2.4590	-0.267	720	615	-14.6	0.85	1.50	+76.5	11.79	37.84	+220.9		
	825	3.43	TSGBF ⊥	125-10	2	-0.535 ±0.001	6.762	6.764	+0.029	405	150	-63.0	2.461	2.4587	-0.093	515	560	+ 8.7	0.92	1.22	+32.6	20.22	40.76	+101.6		
5	750	4.46	CSF	142-213	3	-1.077 ±0.001	6.735	6.726	-0.133	585	215	-63.2	2.463	2.4592	-0.154	885	355	-59.9	1.67	2.38	+42.5	7.70	25.49	+231.0		
	750	4.36	TSX	158-201	3	-0.985 ±0.001	6.728	6.716	-0.178	560	225	-59.8	2.464	2.4607	-0.133	890	325	-63.5	2.34	3.56	+52.1	6.05	20.89	+245.3		
	775	4.74	TSX ⊥	160-E5	3	-0.707 ±0.001	6.728	6.731	+0.044	803	205	-74.5	2.463	2.4589	-0.166	895	620	-30.7	1.00	1.70	+70.0	10.10	35.57	+232.4		
	750	4.64	TSX ⊥	160-C4	3	-0.568 ±0.001	6.728	6.709	-0.282	625	218	-65.1	2.462	2.4587	-0.134	1010	395	-60.9	0.81	1.42	+75.3	12.13	35.99	+196.7		
6	625	3.34	CSF ⊥	142-31	3	-0.547 ±0.001	6.734	6.731	-0.044	500	212	-57.6	2.465	2.4570	-0.334	550	630	+14.5	0.78	1.24	+59.0	12.55	38.67	+208.1		
	625	3.14	TSX ⊥	158-E2	3	-0.466 ±0.001	6.732	6.736	+0.059	610	240	-60.6	2.463	2.4579	-0.207	465	430	- 7.5	1.06	1.58	+49.0	11.14	35.59	+201.5		
	625	2.47	TSX ⊥	167-C26	2	-0.370 ±0.001	6.740	6.732	-0.118	682	275	-59.7	2.4655	2.4606	-0.198	870	630	-27.6	0.88	1.17	+33.0	12.80	38.76	+202.8		
	600	2.40	CSF	142-233	2	-0.562 ±0.002	6.759	6.734	-0.369	470	245	-47.9	2.4656	2.4592	-0.259	777	488	-37.2	1.76	2.86	+62.5	7.13	22.27	+212.3		

TABLE C29. H-4-4 Experimental Results

Capsule Position	Temp, °C	Fluence, ^a nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity							
							C		L _C		ΔC/C ₀ , %		ΔL _C /L _{C0} , %		Δa/a ₀ , %		L _a		ΔL _a /L _{a0} , %		psi × 10 ⁻⁶		ΔE/E ₀ , %		ohm-cm × 10 ⁻⁴		Δρ/ρ ₀ , %	
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	450	1.90	TSX	160-E7	3	-0.426 ±0.001	6.735	6.751	+0.238	593	195	-67.1	2.4650	2.4568	-0.333	645	280	-56.6	1.14	1.57	+37.7	10.25	32.19	+214.0				
	450	1.91	TSX	160-201	3	-0.730 ±0.001	6.737	6.752	+0.223	485	158	-61.0	2.4630	2.4573	-0.231	914	265	-71.0	2.04	3.24	+58.8	7.03	23.00	+227.2				
	450	1.91	TSGBF	125-5	3	-0.374 ±0.001	6.755	6.777	+0.326	440	163	-63.0	2.4630	2.4568	-0.252	325	335	+ 3.1	0.91	1.29	+41.8	19.52	39.88	+104.3				
	450	0.74	TSGBF	125-20	1	-0.080 ±0.001	6.738	6.760	+0.327	395	270	-31.6	2.4601	2.4600	-0.004	783	465	-40.6	0.90	1.29	+43.3	17.01	37.38	+119.8				
2	600	2.04	CSF	142-24	2	-0.295 ±0.005	6.732	6.738	+0.089	600	228	-62.0	2.4640	2.4595	-0.183	577	530	- 8.2	0.87	1.36	+56.3	12.83	36.28	+182.8				
	600	2.34	TSX	158-M8	2	-0.426 ±0.012	6.748	6.746	-0.030	457	218	-52.3	2.4647	2.4603	-0.179	946	520	-45.0	0.92	1.56	+71.7	11.35	33.96	+199.2				
	600	3.34	TSX	158-216	3	-0.960 ±0.001	6.733	6.722	-0.163	530	180	-66.0	2.4620	2.4587	-0.134	1152	475	-58.8	2.58	4.48	+73.6	5.40	18.90	+250.0				
	600	4.07	TSGBF	125-4	4	-0.777 ±0.001	6.760	6.771	+0.163	450	168	-62.7	2.4640	2.4590	-0.203	420	270	-35.7	0.90	1.36	+51.1	22.18	36.75	+ 65.7				
3	725	4.14	CSF	142-23	3	-0.485 ±0.001	6.730	6.739	+0.134	550	225	-59.1	2.4640	2.4602	-0.154	500	720	+44.0	0.89	1.32	+48.3	12.43	38.12	+206.7				
	725	5.54	TSX	158-M2	4	-0.585 ±0.001	6.734	6.729	-0.074	555	235	-57.7	2.4640	2.4588	-0.211	505	495	- 2.0	0.99	1.46	+47.5	11.45	37.17	+224.6				
	750	3.12	TSX	158-E21	2	-0.378 ±0.001	6.747	6.733	-0.207	446	205	-54.0	2.4665	2.4603	-0.251	1250	488	-61.0	0.92	1.56	+69.6	11.96	35.63	+197.9				
	725	1.63	TSGBF	125-202	1	-0.261 ±0.001	6.745	6.748	+0.044	375	225	-40.0	2.4604	2.4607	+0.012	1450	388	-73.2	1.48	2.08	+40.5	11.35	25.94	+128.5				
4	800	6.27	CSF	142-217	4	-1.988 ±0.001	6.724	6.736	+0.178	515	203	-60.6	2.4640	2.4596	-0.179	697	450	-21.1	1.52	2.65	+74.3	7.05	25.47	+261.3				
	800	6.27	TSX	158-209	4	-1.874 ±0.001	6.732	6.733	+0.015	480	205	-57.3	2.4650	2.4584	-0.268	665	635	- 4.5	2.19	3.36	+53.4	6.96	23.79	+241.8				
	800	3.49	TSX	167-228	2	-0.760 ±0.001	6.728	6.729	+0.015	453	218	-51.9	2.4627	2.4588	-0.158	1160	345	-70.3	2.70	4.03	+49.3	5.36	19.81	+269.6				
	825	5.16	TSX	160-M4	3	-0.601 ±0.001	6.750	6.733	-0.252	570	195	-65.8	2.4667	2.4598	-0.280	605	368	-39.2	0.83	1.44	+73.5	11.97	37.97	+217.2				
5	750	2.99	CSF	142-29	2	-0.311 ±0.001	6.734	6.728	-0.089	554	235	-39.5	2.4650	2.4591	-0.239	498	455	- 8.6	0.80	1.36	+70.0	13.17	37.37	+183.8				
	775	3.30	TSX	167-E31	2	-0.428 ±0.001	6.725	6.734	+0.134	475	248	-47.8	2.4619	2.4590	-0.118	1135	395	-65.2	0.90	1.51	+67.8	14.27	35.21	+146.7				
	775	2.91	CSF	142-225	2	-0.582 ±0.001	6.734	6.754	+0.297	470	175	-62.8	2.4640	2.4587	-0.215	444	665	+49.8		2.51		7.69	27.21	+253.8				
	750	3.31	TSGBF	125-17	2	-0.584 ±0.001	6.771	6.755	-0.236	320	195	-38.8	2.4648	2.4584	-0.260	1110	210	-81.1	0.87	1.38	+58.6	15.74	37.98	+141.3				
6	600	3.26	CSF	142-216	3	-0.739 ±0.001	6.726	6.748	+0.327	660	250	-62.1	2.4650	2.4587	-0.256	475	440	- 7.4	1.56	2.74	+75.6	7.63	25.45	+233.6				
	600	1.18	TSX	158-211	1	-0.195 ±0.001	6.717	6.739	+0.328	527	375	-28.8	2.4619	2.4600	-0.077	845	730	-13.6		3.56	+57.5	7.13	20.55	+188.2				
	600	4.14	TSX	158-M1	4	-0.682 ±0.001	6.730	6.746	+0.238	600	235	-60.8	2.4640	2.4588	-0.211	555	510	- 8.1	0.88	1.62	+84.1	10.88	36.89	+239.1				
	600	3.26	TSGBF	125-8	3	-0.568 ±0.001	6.755	6.769	+0.207	490	225	-54.1	2.4630	2.4580	-0.203	322	310	- 3.7	0.92	1.36	+47.8	19.62	40.26	+105.2				

TABLE C30. H-5-4 Experimental Results

Capsule Position	Temp, °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity			
							C		L _C		a		L _a		ψ ₀₁ × 10 ⁻⁶		ΔE/E ₀ , %		ohm-cm × 10 ⁴		Δρ/ρ ₀ , %			
							Initial	Final	ΔC/C ₀ , %	Initial	Final	ΔL _C /L _{C0} , %	Initial	Final	Δa/a ₀ , %	Initial	Final	ΔL _a /L _{a0} , %	Initial	Final	Δψ ₀₁ /ψ ₀₁₀ , %	Initial	Final	
1	450	1.98	CSF ⊥	142-28	3	-0.336 ±0.001	6.730	6.759	+0.431	583	182	-68.8	2.462	2.4581	-0.158	480	322	-32.9	0.79	1.39	+75.9	12.12	39.69	+227.5
	650	3.95	TSX ⊥	160-M3	3	-0.610 ±0.001	6.740	6.739	-0.015	599	210	-64.9	2.464	2.4572	-0.276	462	290	-37.2	0.82	1.51	+84.1	12.42	39.48	+217.9
	450	2.76	TSX ⊥	158-M4	4	-0.497 ±0.001	6.730	6.754	+0.419	593	180	-69.6	2.464	2.4565	-0.304	638	240	-62.4	0.89	1.54	+73.1	11.47	38.21	+233.1
	450	2.24	TSX	158-208	3	-0.810 ±0.001	6.753	6.758	+0.074	445	169	-62.0	2.4654	2.4566	-0.357	845	465	-45.0	2.69	4.55	+69.1	5.45	18.48	+239.1
2	625	3.44	CSF	142-240	3	-0.933 ±0.001	6.737	6.749	+0.178	445	191	-57.1	2.4650	2.4580	-0.284	569	325	-42.9	1.52	2.87	+88.8	7.19	23.80	+231.0
	600	3.25	TSX	160-204	3	-0.917 ±0.001	6.742	6.736	-0.089	527	188	-64.3	2.466	2.4587	-0.296	340	340	0	2.31	3.42	+48.1	6.47	23.04	+256.1
	600	4.31	TSX ⊥	158-E12	4	-0.688 ±0.001	6.729	6.743	+0.208	695	180	-74.1	2.464	2.4598	-0.170	620	367	-40.8	1.12	1.59	+42.0	12.18	36.01	+195.6
	600	4.42	TSX ⊥	160-C1	4	-0.788 ±0.001	6.730	6.746	+0.238	685	170	-75.2	2.462	2.4581	-0.158	998	330	-65.9	0.91	1.57	+72.5	11.41	35.44	+210.6
3	725	4.32	CSF ⊥	142-26	3	-0.564 ±0.001	6.738	6.738	0	471	188	-60.1	2.463	2.4593	-0.150	587	396	-32.5	0.84	1.40	+66.7	12.69	40.17	+216.5
	750	4.64	TSX ⊥	158-E24	3	-0.559 ±0.001	6.734	6.740	+0.089	610	197	-67.7	2.462	2.4599	-0.085	1150	340	-70.4	0.97	1.49	+53.6	12.14	37.51	+209.0
	725	4.44	TSX ⊥	160-M2	3	-0.577 ±0.001	6.730	6.734	+0.059	640	177	-72.3	2.465	2.4581	-0.320	572	278	-51.4	0.82	1.43	+74.4	12.22	38.16	+212.3
	750	4.79	TSX	158-220	3	-1.434 ±0.001	6.749	6.740	-0.133	565	168	-70.3	2.4670	2.4600	-0.283	990	400	-59.6	2.76	3.98	+44.2	5.84	21.79	+273.1
4	775	6.52	TSX ⊥	158-E10	4	-0.632 ±0.001	6.730	6.733	+0.045	505	164	-67.5	2.463	2.4577	-0.256	544	278	-48.9	0.92	1.54	+67.4	11.65	37.11	+218.5
	800	3.57	TSX ⊥	167-C21	2	-0.372 ±0.001	6.754	6.736	-0.267	440	180	-59.1	2.4656	2.4584	-0.292	825	340	-58.8	0.78	1.26	+61.5	11.98	39.61	+230.6
	800	5.14	TSX	160-202	3	-1.502 ±0.001	6.734	6.733	-0.015	545	154	-71.7	2.463	2.4584	-0.187	1025	410	-60.0	2.04	3.02	+48.0	6.81	24.31	+256.9
	800	6.74	TSGBF ⊥	125-6	4	-0.161 ±0.001	6.756	6.792	+0.533	490	106	-78.4	2.463	2.4572	-0.235	360	220	-38.9	0.95	1.37	+44.2	18.53	42.47	+129.2
5	725	4.72	CSF ⊥	142-46	3	-0.835 ±0.001	6.759	6.733	-0.385	470	167	-64.5	2.4661	2.4582	-0.320	1100	389	-64.6	0.80	1.42	+77.5	12.24	39.70	+224.3
	775	3.21	TSX ⊥	160-E13	2	-0.467 ±0.001	6.748	6.723	-0.370	630	187	-70.3	2.4670	2.4588	-0.332	845	360	-57.4	0.81	1.39	+71.6	11.96	37.76	+215.7
	775	5.06	TSX	160-208	3	-1.566 ±0.001	6.746	6.737	-0.133	650	192	-70.5	2.4677	2.4588	-0.361	577	370	-35.9	2.09	3.71	+77.5	6.16	21.66	+251.6
	750	4.22	TSGBF ⊥	125-1	3	-0.732 ±0.001	6.752	6.764	+0.178	451	149	-67.0	2.462	2.4573	-0.191	350	270	-22.9	0.89	1.24	+39.3	20.00	41.91	+109.6
6	600	4.58	TSX ⊥	160-E6	4	-0.861 ±0.001	6.731	6.753	+0.327	645	205	-68.2	2.462	2.4591	-0.118	925	460	-50.2	0.94	1.76	+87.2	10.17	34.22	+236.5
	625	3.50	TSX ⊥	158-E19	3	-0.560 ±0.001	6.761	6.751	-0.148	532	220	-58.6	2.4648	2.4577	-0.288	773	350	-54.7	0.87	1.81	+108.0	11.78	31.20	+164.8
	600	2.45	TSX ⊥	167-E26	2	-0.406 ±0.001	6.730	6.738	+0.119	600	240	-60.0	2.4668	2.4589	-0.320	792	308	-61.1	0.86	1.56	+81.4	11.26	33.96	+201.6
	600	4.58	TSX	160-203	4	-1.289 ±0.001	6.734	6.748	+0.208	740	202	-72.7	2.462	2.4576	-0.179	907	400	-55.9	2.02	3.32	+64.4	6.49	22.53	+247.1

TABLE C31. H-6-4 Experimental Results

Capsule Position	Temp. °C	Fluence, nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity			
							C		L _C		Δc/c ₀ , %		L _a		Δa/a ₀ , %		psi × 10 ⁻⁶		ohm-cm × 10 ⁴		Δρ/ρ ₀ , %			
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final				
1	450	2.44	CSF ⊥	142-27	4	-0.550 ± 0.001	6.733	6.749	+0.238	480	157	2.465	2.4597	-0.215	622	146	-76.5	+39.6	12.83	38.15	+197.3			
	450	2.45	TSX ⊥	160-E1	4	-0.594 ± 0.001	6.728	6.756	+0.416	635	152	2.462	2.4590	-0.122	1010	172	-83.0	+92.9	12.55	39.14	+211.9			
	450	2.44	TSX ⊥	158-M6	4	-0.554 ± 0.001	6.733	6.755	+0.327	680	183	2.463	2.4600	-0.122	1650	155	-90.6	+52.8	11.12	35.55	+220.0			
	450	2.59	CSF	142-214	4	-0.924 ± 0.001	6.734	6.749	+0.223	565	161	2.465	2.4590	-0.243	525	151	-71.2	+67.9	8.12	27.74	+241.6			
2	600	3.94	CSF	142-218	4	-1.121 ± 0.001	6.724	6.748	+0.357	530	180	2.466	2.4614	-0.187	745	200	-73.2	+67.0	7.23	25.00	+245.8			
	575	3.89	TSX	158-210	4	-1.184 ± 0.001	6.725	6.740	+0.223	580	197	2.464	2.4608	-0.130	410	198	-51.7	+50.8	5.53	19.88	+259.5			
	575	3.97	TSX ⊥	160-E8	4	-0.902 ± 0.001	6.730	6.743	+0.193	629	190	2.465	2.4608	-0.170	454	205	-54.8	+76.5	10.17	32.65	+221.0			
	575	3.97	TSGBF ⊥	125-7	4	-0.810 ± 0.001	6.751	6.766	+0.222	360	155	2.462	2.4612	-0.032	314	175	-44.3	+48.0	19.52	39.46	+102.2			
3	750	4.38	CSF ⊥	141-13	3	-0.575 ± 0.001	6.754	6.737	-0.252	535	175	2.466	2.4626	-0.162	522	220	-57.9	+72.1	11.91	37.36	+213.7			
	725	5.48	TSX ⊥	160-E3	4	-0.808 ± 0.001	6.728	6.737	+0.134	760	183	2.463	2.4615	-0.102	744	220	-70.4	+71.1	11.44	36.75	+221.2			
	725	5.48	TSX	160-205	4	-1.723 ± 0.001	6.725	6.734	+0.134	546	169	2.465	2.4615	-0.142	413	210	-49.2	+45.1	6.34	23.14	+265.0			
	725	5.48	TSGBF ⊥	125-9	4	-0.932 ± 0.001	6.757	6.779	+0.326	440	122	2.463	2.4571	-0.240	328	153	-50.3	+32.6	20.47	42.76	+108.9			
4	800	6.46	CSF	142-215	4	-2.286 ± 0.001	6.735	6.738	+0.045	600	166	2.465	2.4619	-0.126	466	181	-61.2	+54.0	7.73	27.72	+258.6			
	800	6.46	TSX ⊥	160-E4	4	-0.854 ± 0.001	6.730	6.742	+0.178	740	157	2.463	2.4620	-0.041	1150	198	-82.8	+72.2	11.98	39.23	+227.5			
	800	5.03	TSX ⊥	158-C2	3	-0.463 ± 0.001	6.753	6.731	-0.326	505	175	2.4656	2.4616	-0.162	720	235	-67.4	+69.4	11.79	39.90	+238.4			
	775	4.50	TSGBF ⊥	125-3	3	-0.661 ± 0.001	6.755	6.764	+0.133	410	145	2.464	2.4604	-0.146	400	148	-63.0	+37.6	17.72	40.99	+131.3			
5	775	3.06	CSF ⊥	142-53	2	-0.324 ± 0.001	6.727	6.731	+0.059	621	200	2.4624	2.4619	-0.020	787	231	-70.6	+68.8	13.22	39.24	+196.8			
	775	6.17	TSX ⊥	160-E5	4	-0.947 ± 0.001	6.728	6.731	+0.045	803	180	2.463	2.4600	-0.122	895	198	-66.7	+78.0	10.10	34.08	+237.4			
	750	5.79	TSX	158-201	4	-1.564 ± 0.001	6.728	6.728	0	560	187	2.464	2.4608	-0.130	890	192	-78.4	+56.4	6.05	21.95	+262.8			
	750	4.15	TSX	160-206	3	-1.096 ± 0.002	6.734	6.738	+0.059	635	195	2.465	2.4618	-0.130	422	172	-59.2	+29.2	6.26	22.70	+262.6			
6	600	4.07	CSF ⊥	142-21	4	-0.664 ± 0.001	6.735	6.749	+0.208	510	173	2.464	2.4611	-0.118	690	190	-72.5	+91.8	14.51	39.26	+170.6			
	600	4.13	TSX ⊥	158-E2	4	-0.673 ± 0.001	6.732	6.729	+0.045	610	187	2.463	2.4617	-0.053	465	204	-56.1	+62.3	11.14	34.41	+208.9			
	600	3.46	TSX ⊥	167-C26	3	-0.578 ± 0.001	6.740	6.739	-0.015	682	220	2.4655	2.4615	-0.162	870	225	-74.1	+38.6	12.80	41.57	+224.8			
	600	3.33	TSGBF ⊥	125-11	3	-0.588 ± 0.001	6.769	6.753	-0.236	411	200	2.4640	2.4600	-0.162	668	185	-72.3	+70.5	15.24	36.79	+141.4			

TABLE C32. H-4-5 Experimental Results

Capsule Position	Temp, °C	Fluence, nvt × 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity			
							c		l _c		a		l _a		ψi × 10 ⁻⁶		ΔE/E ₀ , %		ohm-cm × 10 ⁻⁴		Δρ/ρ ₀ , %			
							Initial	Final	Δc/L _c , %	Initial	Final	Δl _c /L _{c0} , %	Initial	Final	Δa/a ₀ , %	Initial	Final	Initial	Final	Initial	Final			
1	675	4.95	TSX ⊥	158-E4	4	-0.720 ±0.001	6.735			610		2.464		480		1.00	1.96	+96.0		11.81	34.00	+187.9		
	450	2.60	TSX ⊥	160-E7	4	-0.635 ±0.001	6.735			593		2.4650		645		1.14	1.68	+47.4		10.25	34.59	+237.5		
	450	2.61	TSX	160-201	4	-1.072 ±0.001	6.737			485		2.463		914		2.04	3.56	+74.5		7.03	23.86	+239.4		
	450	1.44	TSGBF ⊥	125-20	2	-0.206 ±0.001	6.738			395		2.4601		783		0.90	1.37	+52.2		17.01	38.45	+126.0		
2	600	4.14	CSF	142-223	4	-1.372 ±0.001	6.734			540		2.465		503		1.56	2.64	+69.2		7.77	26.31	+238.6		
	725	4.69	TSX	167-228	3	-1.422 ±0.001	6.728			453		2.4627		1160		2.70	4.07	+50.7		5.36	20.14	+275.7		
	675	2.71	TSX ⊥	158-M13	2	-0.430 ±0.001	6.759			393		2.4659		1275		0.88	1.58	+79.5		11.65	36.82	+216.1		
	675	2.83	TSGBF ⊥	125-18	2	-0.542 ±0.001										0.88	1.34	+52.3		15.74	38.42	+144.1		
3	725	5.80	CSF ⊥	142-23	4	-0.767 ±0.001	6.730			550		2.4640		500		0.89	1.38	+55.0		12.43	38.94	+213.3		
	725	7.20	TSX ⊥	158-M2	5	-0.750 ±0.001	6.734			555		2.4640		505		0.99	1.56	+57.6		11.45	36.91	+222.4		
	725	5.76	CSF	142-224	4	-1.805 ±0.002	6.733			490		2.464		522		1.60	2.56	+60.0		7.44	24.86	+234.1		
	725	3.29	TSGBF	125-202	2	-0.920 ±0.001	6.745			375		2.4604		1450		1.48	2.87	+93.9		11.35	27.52	+142.5		
4	800	5.39	CSF ⊥	141-16	3	-0.757 ±0.001	6.751			585		2.4692		833		0.86	1.47	+70.9		11.80	37.04	+213.9		
	800	7.01	TSX ⊥	160-M4	4	-0.721 ±0.001	6.750			570		2.4667		605		0.83	1.55	+86.7		11.97	38.33	+220.2		
	800	8.12	CSF	142-217	5	-3.125 ±0.001	6.724			515		2.4640		697		1.52	2.54	+67.1		7.05	25.42	+260.6		
	800	8.12	TSX	158-209	5	-2.981 ±0.001	6.732			480		2.4650		665		2.19	2.88	+31.5		6.96	23.98	+244.5		
5	650	4.04	TSX ⊥	158-M8	3	-0.582 ±0.001	6.748			457		2.4647		946		0.92	1.68	+82.6		11.35	34.56	+204.5		
	650	5.04	TSX	158-216	4	-1.508 ±0.001	6.733			530		2.4620		1152		2.58	4.40	+70.5		5.40	19.21	+255.7		
	625	5.77	TSGBF ⊥	125-4	5	-0.968 ±0.001	6.760			450		2.4640		420		0.90	1.34	+48.5		22.18	38.54	+73.8		
	650	4.96	TSGBF ⊥	125-8	4	-0.799 ±0.001	6.755			490		2.4630		322		0.92	1.27	+38.0		19.62	40.18	+104.8		
6	675	4.17	CSF ⊥	142-29	3	-0.671 ±0.001	6.734			554		2.4650		498		0.80	1.46	+82.5		13.17	37.46	+184.4		
	700	5.64	CSF	142-213	4	-1.694 ±0.001	6.735			585		2.463		885		1.67	2.60	+55.7		7.70	25.96	+237.1		
	600	5.32	TSX ⊥	158-M1	5	-0.864 ±0.001	6.730			600		2.4640		555		0.88	1.66	+88.6		10.88	35.50	+226.3		
	700	4.48	TSX ⊥	167-E31	3	-0.776 ±0.001	6.725			475		2.4619		1135		0.90	1.56	+73.3		14.27	35.26	+147.1		

TABLE C33. H-5-5 Experimental Results

Capsule Position	Temp, °C	Fluence, ²¹ nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity	
							C		L _C		ΔC/C ₀ , %		L _a		ΔL _a /L _{a0} , %		ΔE/E ₀ , %		ohm-cm × 10 ⁻⁴			
							Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final		
1	450	2.85	CSF ⊥	142-28	4	-0.582 ± 0.001	6.730		583		2.462		480		0.79	1.57	+98.7	12.12	39.11	+222.6		
	450	3.63	TSX ⊥	158-M4	5	-0.725 ± 0.001	6.730		593		2.464		638		0.89	1.79	+101.1	11.47	37.96	+231.0		
	450	3.11	TSX	158-208	4	-1.242 ± 0.001	6.753		445		2.4654		845		2.69	5.10	+89.6	5.45	18.92	+247.2		
	450	2.78	TSCBF ⊥	125-5	4	-0.603 ± 0.001	6.755		440		2.4630		325		0.91	1.48	+62.6	19.52	41.50	+112.6		
2	625	4.96	CSF	142-240	4	-1.600 ± 0.002	6.737		445		2.4650		569		1.52	3.46	+127.6	7.19	24.22	+236.9		
	600	4.77	TSX	160-204	4	-1.609 ± 0.001	6.742		527		2.466		340		2.31	3.71	+60.6	6.47	22.46	+247.1		
	600	5.94	TSX ⊥	160-C1	5	-0.954 ± 0.001	6.730		685		2.462		998		0.91	1.64	+80.2	11.41	37.13	+225.4		
	600	5.83	TSX ⊥	158-E12	5	-0.905 ± 0.001	6.729		695		2.464		620		1.12	1.69	+50.9	12.18	35.99	+195.5		
3	725	6.38	CSF ⊥	142-26	4	-0.917 ± 0.001	6.738		471		2.463		587		0.84	1.45	+72.6	12.69	39.25	+209.3		
	750	6.70	TSX ⊥	158-E24	4	-0.795 ± 0.001	6.734		610		2.462		1150		0.97	1.55	+59.8	12.14	36.36	+199.5		
	725	6.50	TSX ⊥	160-M2	4	-0.847 ± 0.001	6.730		640		2.465		572		0.82	1.51	+84.1	12.22	35.70	+192.1		
	725	6.85	TSX	158-220	4	-2.499 ± 0.001	6.749		565		2.4770		990		2.76	3.93	+42.2	5.84	21.28	+264.4		
4	775	8.80	TSX ⊥	158-E10	5	-0.637 ± 0.001	6.730		505		2.463		544		0.92	1.69	+83.7	11.65	38.16	+227.6		
	800	5.85	TSX ⊥	167-C21	3	-0.574 ± 0.001	6.754		440		2.4656		825		0.78	1.30	+66.7	11.98	39.88	+232.9		
	800	7.42	TSX	160-232	4	-2.864 ± 0.001	6.734		545		2.463		1025		2.04	2.91	+42.6	6.81	24.97	+266.7		
	800	9.02	TSCBF ⊥	125-6	5	+1.702 ± 0.001	6.756		490		2.463		360		0.95	1.80	+89.5	18.53	42.25	+128.0		
5	725	6.76	CSF ⊥	142-46	4	-1.216 ± 0.001	6.759		470		2.4661		1100		0.80	1.53	+91.3	12.24	40.01	+226.9		
	750	6.68	TSX ⊥	160-C4	4	-0.782 ± 0.001	6.728		625		2.462		1010		0.81	1.59	+96.3	12.13	38.04	+213.6		
	750	7.10	TSX	160-208	4	-2.733 ± 0.001	6.746		650		2.4677		577		2.09	3.67	+75.6	6.16	21.93	+256.0		
	750	6.26	TSCBF ⊥	125-1	4	-0.838 ± 0.001	6.752		451		2.462		350		0.89	1.42	+59.6	20.00	40.01	+100.0		
6	575	4.65	CSF	142-216	4	-1.262 ± 0.001	6.726		660		2.465		475		1.56	2.67	+71.2	7.63	25.65	+236.2		
	600	5.97	TSX	160-203	5	-1.883 ± 0.001	6.734		740		2.462		907		2.02	3.37	+66.8	6.49	25.11	+286.9		
	600	5.97	TSX ⊥	160-E6	5	-1.125 ± 0.001	6.731		645		2.462		925		0.94	1.87	+98.9	10.17	34.33	+237.6		
	600	4.89	TSX ⊥	158-E19	4	-0.856 ± 0.001	6.761		532		2.4648		773		0.87	1.88	+116.1	11.78	31.37	+166.3		

TABLE C34. H-6-5 Experimental Results

Capsule Position	Temp. °C	Fluence ^{6,21} nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L _o %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity			
							C		L _c				a		L _a				ψ × 10 ⁻⁶		ohm-cm × 10 ⁴		Δρ/ρ _o %	
							Initial	Final	ΔC/C _o %	Initial	Final	ΔL _c /L _c %	Initial	Final	Δa/Δ _o %	Initial	Final	ΔL _a /L _a %	Initial	Final	ΔE/E _o %	Initial	Final	
1	450	3.12	CSF	142-214	5	-1.170 ±0.001	6.734			565			2.465		525			1.56	2.70	+73.1	8.12	28.09	+245.9	
	450	2.98	TSX	160-E1	5	-0.751 ±0.001	6.728			635			2.462		1010			0.85	1.69	+98.8	12.55	36.30	+189.2	
	450	2.97	TSX	158-M6	5	-0.696 ±0.001	6.733			680			2.463		1650			1.08	1.77	+63.9	11.12	36.33	+226.7	
	450	2.33	TSX	160-C5	4	-0.540 ±0.001	6.732			684			2.465		598			1.05	1.56	+48.6	11.30	36.33	+221.5	
2	600	4.79	CSF	142-218	5	-1.448 ±0.001	6.724			530			2.466		745			1.79	3.06	+70.9	7.23	24.26	+235.5	
	600	4.74	TSX	158-210	5	-1.516 ±0.001	6.725			580			2.464		410			2.64	3.99	+51.1	14.89	20.09	+263.3	
	600	4.82	TSX	160-E8	5	-1.048 ±0.001	6.730			629			2.465		454			1.02	1.87	+83.3	10.17	32.40	+218.6	
	600	4.82	TSGBF	125-7	5	-0.989 ±0.001	6.751			360			2.462		314			0.98	1.50	+53.1	19.52	41.39	+112.0	
3	750	5.48	CSF	141-13	4	-0.769 ±0.002	6.754			535			2.466		522			0.86	1.48	+72.1	11.91	37.37	+213.8	
	725	6.58	TSX	160-E3	5	-0.957 ±0.001	6.728			760			2.463		744			0.90	1.62	+80.0	11.44	38.38	+235.5	
	725	6.58	TSX	160-205	5	-2.283 ±0.001	6.725			546			2.465		413			2.24	3.17	+41.5	6.34	23.30	+267.5	
	725	6.58	TSGBF	125-9	5	-0.861 ±0.001	6.757			440			2.463		328			0.92	1.26	+37.0	20.47	44.46	+117.2	
4	800	7.64	CSF	142-215	5	-2.986 ±0.001	6.735			600			2.465		466			1.61	2.52	+56.5	7.73	27.47	+255.4	
	800	7.64	TSX	160-E4	5	-0.955 ±0.001	6.730			740			2.463		1150			0.90	1.50	+66.7	11.98	39.33	+228.3	
	800	6.51	TSX	158-C2	4	-0.536 ±0.001	6.753			505			2.4656		720			0.85	1.66	+95.3	11.79	40.34	+242.2	
	800	4.39	TSX	160-E13	3	-0.647 ±0.001	6.748			630			2.4670		845			0.81	1.38	+70.4	11.96	37.70	+215.2	
5	750	7.21	TSX	160-E5	5	-1.106 ±0.001	6.728			803			2.463		895			1.00	1.83	+83.0	10.10	35.20	+248.5	
	675	4.99	TSX	160-M3	4	-0.732 ±0.001	6.740			599			2.464		462			0.82	1.47	+79.3	12.42	38.44	+209.5	
	750	6.83	TSX	158-201	5	-2.100 ±0.001	6.728			560			2.464		890			2.34	3.55	+51.7	6.05	22.48	+271.6	
	750	5.19	TSX	160-206	4	-1.565 ±0.001	6.734			635			2.465		422			2.26	3.23	+42.9	6.26	23.29	+272.0	
6	600	4.77	CSF	142-21	5	-0.807 ±0.001	6.735			510			2.464		690			0.73	1.48	+102.7	14.51	39.17	+169.9	
	600	4.83	TSX	158-E2	5	-0.804 ±0.001	6.732			610			2.463		465			1.06	1.70	+60.4	23.64	34.31	+208.0	
	600	4.16	TSX	167-C26	4	-0.708 ±0.001	6.740			682			2.4655		870			0.88	1.32	+50.0	12.80	42.23	+229.9	
	600	4.03	TSGBF	125-11	4	-0.754 ±0.001	6.769			411			2.4640		668			0.88	1.52	+72.7	15.24	37.07	+143.2	

C-50

Capsule Position	Temperature, °C	Fluence, nvt × 10 ²¹ (E > 0.18 MeV)	Sample Code	Sample Number	Length Change ΔL/L ₀ , %
1	675	0.31	CSF T	D1A	+0.052 ± 0.003
	675	0.31	CSF	D1B	+0.033 ± 0.005
2	700	0.76	CSF T	D2A	+0.054 ± 0.004
	700	0.76	CSF	D2B	-0.004 ± 0.002
3	725	1.22	CSF T	D3A	-0.028 ± 0.005
	725	1.22	CSF	D3B	-0.130 ± 0.007
4	625	0.95	CSF T	D4A	-0.068 ± 0.015
	625	0.95	CSF	D4B	-0.178 ± 0.013

TABLE C35. GEH-13-5 Experimental Results

TABLE C36. GEH-13-8 Experimental Results

Capsule Position	Temperature, °C	Fluence, ²¹ nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	Length Change ΔL/L ₀ , %
1	450	0.27	CSF ⊥	D14A	-0.009 ±0.005
	450	0.27	CSF	D14B	-0.020 ±0.003
	450	0.27	TSX ⊥	M3A	-0.013 ±0.003
	450	0.27	TSX	M3B	-0.024 ±0.002
1A	600	0.64	CSF ⊥	D15A	-0.048 ±0.006
	600	0.64	CSF	D15B	-0.092 ±0.004
	600	0.64	TSX ⊥	M5A	-0.045 ±0.005
	600	0.64	TSX	M5B	-0.098 ±0.005
	600	0.64	TSGBF ⊥	J5A	-0.025 ±0.004
	600	0.64	TSGBF	J5B	-0.049 ±0.003
2	700	0.91	CSF ⊥	D16A	-0.017 ±0.002
	700	0.91	CSF	D16B	-0.068 ±0.002
	700	0.91	TSX ⊥	M8A	+0.005 ±0.005
	700	0.91	TSX	M8B	-0.074 ±0.003
3	700	1.93	CSF ⊥	D2A	-0.134 ±0.013
	700	1.93	CSF	D2B	-0.242 ±0.002
	700	1.17	CSF ⊥	D17A	-0.038 ±0.002
	700	1.17	CSF	D17B	-0.111 ±0.005
	700	1.17	TSX ⊥	M9A	-0.025 ±0.002
	700	1.17	TSX	M9B	-0.119 ±0.005
3A	700	1.14	CSF ⊥	D19A	-0.036 ±0.004
	700	1.14	CSF	D19B	-0.126 ±0.004
	700	1.14	TSX ⊥	M13A	-0.009 ±0.005
	700	1.14	TSX	M13B	-0.134 ±0.002
	700	1.14	TSGBF ⊥	J8A	-0.015 ±0.005
	700	1.14	TSGBF	J8B	-0.084 ±0.004
4	700	0.98	CSF ⊥	D22A	-0.022 ±0.004
	700	0.98	CSF	D22B	-0.077 ±0.006
	700	0.98	TSX ⊥	M16A	+0.020 ±0.006
	700	0.98	TSX	M16B	-0.097 ±0.006
	700	0.98	TSGBF ⊥	J11A	-0.003 ±0.005
	700	0.98	TSGBF	J11B	-0.059 ±0.004

TABLE C37. GEH-13-10 Experimental Results

Capsule Position	Temp, °C	Fluence, ²¹ nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus, psi × 10 ⁻⁶				Electrical Resistivity, ohm-cm × 10 ⁴		Post 1 hr Anneal at 1700 °C			
						C		L _c		ΔL _c /L _{c0} , %		a		Δa/a ₀ , %		L _a		ΔL _a /L _{a0} , %		ΔE/E ₀ , %		Initial		Final	
						Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	800	1.72	CSF ⊥	142-71	-0.148 ±0.001	6.727	6.732	+0.074	520	220	-57.7	2.4628	2.4593	-0.014	1305	560	-57.1	0.81	1.20	+48.1	15.28	44.64	+192.1		
			CSF	142-249	-0.234 ±0.001	6.698	6.737	+0.582	370	223	-39.7	2.4608	2.4593	-0.006	668	470	-29.6	1.52	2.38	+56.6	7.40	22.31	+201.5		
			TSX ⊥	185-C1	-0.128 ±0.002	6.729	6.724	-0.074	505	380	-24.8	2.4616	2.4596	-0.008	1775	1105	-37.7	0.79	1.40	+77.2	11.96	35.15	+193.9		
			TSX	185-202	-0.254 ±0.001	6.724	6.739	+0.223	435	210	-51.7	2.4620	2.4584	-0.015	1115	600	-46.2	2.49	3.36	+34.9	5.86	18.82	+221.2		
			NC-8 ⊥	NC8-115	-0.164 ±0.001	6.726	6.733	+0.104	555	240	-56.8	2.4620	2.4583	-0.015	1465	380	-67.2	0.97	1.58	+62.9	10.08	31.12	+208.7		
			NC-8	NC8-250	-0.188 ±0.001	6.702	6.734	+0.418	495	230	-53.5	2.4614	2.4595	-0.008	1330	890	-33.1	1.32	2.05	+55.3	6.52	21.80	+234.4		
2	950	2.82	CSF ⊥	142-72	-0.448 ±0.002	6.711	6.737	+0.387	480	140	-70.8	2.4618	2.4583	-0.014	850	273	-67.9	0.83	1.05	+26.5	14.74	44.25	+200.2		
			TSX ⊥	185-C3	-0.342 ±0.003	6.716	6.731	+0.223	528	127	-75.9	2.4622	2.4595	-0.011	1780	390	-78.1	0.90	1.37	+52.2	12.10	39.16	+223.6		
			KC ⊥	187-1	-0.089 ±0.001	6.722	6.728	+0.089	535	165	-69.2	2.4622	2.4623	+0.001	1415	620	-56.2	0.85			12.61	46.27	+266.9		
			KC	187-201	-0.828 ±0.001	6.722	6.727	+0.074	610	159	-73.9	2.4619	2.4596	-0.009	1650	1560	-5.4	1.42			6.14	23.97	+290.4		
			63-16 ⊥	63-16-70	+0.363 ±0.002	6.746	6.769	+0.341	338	96	-71.0	2.4609	2.4555	-0.022	725	2399	+231.0	1.65	1.72	+4.2	16.15	33.07	+104.8		
			63-16	63-16-270	+0.108 ±0.002	6.750	6.771	+0.311	350	107	-69.4	2.4603	2.4571	-0.013	798	360	-54.9	1.29	1.15	-10.8	14.73	30.87	+109.6		
3	1100	3.81	CSF ⊥	142-73	-0.714 ±0.001	6.723	6.745	+0.327	428	128	-70.1	2.4619	2.4607	-0.005	760	405	-46.7	0.77	1.10	+42.9	13.61	43.06	+216.4		
			TSX ⊥	185-C4	-0.429 ±0.001	6.722	6.736	+0.208	520	128	-75.4	2.4623	2.4592	-0.013	1170	372	-68.2	0.88	1.41	+60.2	12.06	36.13	+199.6		
			KC ⊥	187-2	-0.278 ±0.010*	6.722	6.742	+0.298	450	136	-69.2	2.4630	2.4608	-0.009	1625	390	-76.0		1.30		12.23	43.94	+259.3		
			NC-8 ⊥	NC8-116	-0.903 ±0.002	6.719	6.739	+0.298	465	119	-74.4	2.4620	2.4598	-0.009	2000	690	-65.5	0.98	1.61	+64.3	10.05	31.96	+218.0		
			TSGBF ⊥	125-25	+3.284 ±0.002	6.773	6.809	+0.532	295	76	-74.2	2.4561	2.4554	-0.003	430	190	-55.8	0.88	1.03	+17.0	29.48	57.08	+93.6		
			TSX	185-206	-2.211 ±0.002	6.719	6.731	+0.179	490	128	-73.9	2.4638	2.4495	-0.058	730			2.41	3.40	+41.1	5.37	18.88	+251.6		
4	1200	4.51	CSF ⊥	142-76	-0.776 ±0.001	6.720	6.749	+0.432	445	98	-78.0	2.4614	2.4593	-0.009	935	590	-36.9	0.83	1.09	+31.3	14.94	43.99	+194.4		
			CSF	142-251	-4.502 ±0.005	6.712	6.754	+0.626	372	117	-68.5	2.4604	2.4573	-0.013	872	425	-51.3	1.66	2.33	+40.4	7.58	23.07	+204.4		
			TSX ⊥	185-C5	-0.352 ±0.001	6.716	6.729	+0.194	405	163	-59.8	2.4623	2.4622	-0.001	1430	1140	-20.3	0.86	1.44	+67.4	12.16	35.73	+193.8		
			TSX	185-204	-3.296 ±0.002	6.723	6.738	+0.223	468	120	-74.4	2.4616	2.4592	-0.010	1230	600	-51.2	2.36	3.32	+40.7	5.50	19.25	+250.0		
			NC-8 ⊥	NC8-119	-1.006 ±0.002	6.723	6.746	+0.342	570	126	-77.9	2.4610	2.4611	+0.001	875	342	-60.9	0.93	1.51	+62.4	10.49	35.21	+235.6		
				NC8-254	-3.445 ±0.001	6.723	6.749	+0.387	520	119	-77.1	2.4592	2.4573	-0.008	1085	420	-61.3	1.49	1.97	+32.2	4.68	23.24	+396.6		
5	1150	4.47	CSF	142-252	-4.788 ±0.002	6.728	6.739	+0.134	600	108	-82.0	2.4622	2.4599	-0.009	1600	520	-67.5	1.70	1.95	+14.7	7.95	39.74	+399.9		
			TSGBF ⊥	125-23	Broken	6.738	6.822	+1.247	290	71	-75.5	2.4582	2.4580	-0.001	315	285	-9.5				26.30			6.824	+1.276
			TSGBF	125-213	-4.321 ±0.001	6.756	6.817	+0.901	300	74	-75.3	2.4607	2.4564	-0.017	750	203	-59.6	1.52	1.74	+14.5	18.94	49.01	+158.8		
			63-16 ⊥	63-16-71	-0.194 ±0.002	6.748	6.769	+0.311	290	93	-67.9	2.4606	2.4557	-0.020	565	172	-69.6	1.68			15.30			6.807	+0.874
			63-17	63-17-250	-0.939 ±0.002	6.740	6.784	+0.653	320	85	-73.4	2.4603	2.4564	-0.016	445	275	-38.2	1.22	1.53	+25.4	13.60	30.13	+121.5		
			63-38 ⊥	63-38-60	+0.570 ±0.023	6.756	6.812	+0.829	350	73	-79.1	2.4610	2.4595	-0.006	570	180	-68.4	0.69	0.55	-20.3	36.96	78.19	+111.6	6.811	+0.814
6	1000	3.41	CSF ⊥	142-79	-0.793 ±0.008	6.722	6.752	+0.446	465	123	-73.5	2.4601	2.4600	-0.001	960	390	-59.4	0.77	1.11	+44.2	13.93	39.05	+180.3		
			CSF	142-253	-3.354 ±0.004	6.723	6.744	+0.312	560	93	-83.3	2.4611	2.4570	-0.017	920	435	-52.7	1.65	2.01	+21.8	7.65	40.48	+429.2		
			TSX	185-205	-2.348 ±0.005	6.723	6.742	+0.283	510	132	-74.1	2.4627	2.4578	-0.020	1115	325	-70.9	2.39	3.37	+41.0	5.48	18.73	+241.8		
			KC	187-202	-2.358 ±0.003	6.769	6.743	-0.386	465	122	-73.8	2.4635	2.4600	-0.014	2000	490	-75.5	1.36	1.97	+44.9	6.18	25.85	+318.3		
			NC-8	NC8-253	-1.970 ±0.013	6.722	6.738	+0.238	555	125	-77.5	2.4632	2.4596	-0.015	1450	590	-59.3	1.53	2.06	+34.6	6.29	24.47	+289.0		
			TSGBF	125-214	-3.933 ±0.002	6.760	6.804	+0.651	320	75	-76.6	2.4582	2.4596	+0.004	535	273	-49.0	1.69	1.61	-4.7	20.77	55.55	+167.4		

* Based on hole-to-hole measurements

TABLE C37a. GEH 13-10 Supplemental Results

Sample Code	Change, %	Coefficient of Thermal Expansion ^(a)							
		10 ⁻⁶ Per °C							
		100 °C ^(a)	200 °C	300 °C	400 °C	500 °C	600 °C	700 °C	Mean
CSF ⊥ (Unirradiated)		3.33	3.47	3.63	3.78	3.89	4.01	4.11	
CSF (Unirradiated)		1.14	1.24	1.38	1.52	1.68	1.81	1.93	
TSX ⊥ (Unirradiated)		2.92	3.35	3.75	3.97	4.14	4.25	4.33	
NC-8 ⊥ (Unirradiated)		2.53	2.66	2.73	2.94	3.12	3.79	3.95	
NC-8 (Unirradiated)		1.20	1.12	1.28	1.37	1.46	1.63	1.80	
NC-8 (NC8-253)		0.93	1.16	1.28	1.37	1.51	1.63	1.76	
	ΔCTE/CTE ₀	-22.5	+3.6	0	0	+3.4	0	-2.2	-2.5
KC ⊥ (Unirradiated)		3.85	4.12	4.26	4.50	4.61	4.77	4.92	
KC ⊥ (187-1)		4.00	4.23	4.46	4.67	4.79	4.92	5.13	
	ΔCTE/CTE ₀	+3.9	+2.7	+4.7	+3.8	+3.9	+3.1	+4.3	+3.8
KC ⊥ (187-2)		3.22	3.77	4.00	4.26	4.47	4.68	4.92	
	ΔCTE/CTE ₀	-16.4	-8.5	-6.1	-5.3	-3.0	-1.9	0	-5.9
TSGBF ⊥ (Unirradiated)		3.47	4.00	4.18	4.47	4.68	4.82	4.92	
TSGBF ⊥ (125-23)		4.62	5.14	5.43	5.71	5.90	6.01	6.09	
	ΔCTE/CTE ₀	+13.3	+28.5	+29.9	+27.7	+26.1	+24.7	+23.8	+24.9
TSGBF ⊥ (125-23) ^(b)		6.13	7.43	8.10	8.43	8.75	8.92	9.23	
	ΔCTE/CTE ₀	+76.6	+85.8	+93.8	+88.6	+87.0	+85.1	+87.6	+86.3
63-16 ⊥ (Unirradiated)		4.62	5.38	5.88	6.27	6.55	6.75	6.92	
63-16 ⊥ (63-16-71)		1.60	1.93	2.15	2.42	2.58	2.80	2.94	
	ΔCTE/CTE ₀	-65.4	-64.1	-63.4	-61.4	-60.6	-58.5	-57.5	-61.6
63-16 ⊥ (63-16-71) ^(b)		1.73	2.12	2.40	2.79	3.03	3.10	3.16	
	ΔCTE/CTE ₀	-62.6	-60.6	-59.2	-55.5	-53.8	-54.1	-54.3	-57.2
63-38 ⊥ (Unirradiated)		4.62	5.00	5.22	5.42	5.53	5.57	5.89	
63-38 ⊥ (63-38-60)		3.33	3.72	4.10	4.34	4.55	4.72	4.86	
	ΔCTE/CTE ₀	-27.9	-25.6	-21.5	-19.9	-17.7	-15.3	-17.5	-20.8
63-38 ⊥ (63-38-60) ^(b)		4.00	4.28	4.60	4.86	5.17	5.38	5.54	
	ΔCTE/CTE ₀	-13.4	-14.4	-11.9	-10.3	-6.5	-3.4	-6.0	-9.4

(a) 25 °C to the temperature tabulated

(b) Annealed for 1 hr at 1700 °C

TABLE C38. GEH-13-11 Experimental Results

Capsule Position	Temperature, °C	Fluence, ²¹ nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	Capsules, in.	Length Change $\Delta L/L_0$, %
1	800	4.93	CSF	141-9	2	-0.474 ± 0.005
	800	4.81	NC8	NC8-32	2	-0.418 ± 0.005
	800	2.77	CSF	142-249	2	-0.539 ± 0.005
	800	2.77	TSX	185-C1	2	-0.268 ± 0.005
To Be Used for Trends Only*						
2	950	5.34	CSF	142-72	2	-0.901 ± 0.010
	950	5.34	KC	187-201	2	-1.745 ± 0.010
	950	5.34	63-16	63-16-70	2	-0.204 ± 0.010
	950	5.34	63-16	63-16-270	2	-0.600 ± 0.010

* Samples Oxidized

TABLE C39. H-1 Experimental Results

Capsule Position	Temperature, °C	Fluence, ²¹ nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	No. of Capsules Used	Length Change ΔL/L ₀ , %	Crystallite Parameters, Å										Young's Modulus				Electrical Resistivity,									
							C		ΔC/C ₀ , %	L _C		ΔL _C /L _C , %	a		Δa/a ₀ , %	L _a		ΔL _a /L _a , %	psi × 10 ⁻⁶		ΔE/E ₀ , %	Ωm-cm × 10 ⁴		Δρ/ρ ₀ , %						
							Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final		Initial	Final				
1A	800	0.84	CSF ⊥	C33	1	-0.054	6.709	6.734	+0.373		760	415	-45.4																	
	800	0.84	GL10 ⊥	F23	1	-0.029	6.719	6.735	+0.238		700	305	-56.4																	
	800	0.84	GL11 ⊥	G29	1	-0.039	6.712	6.741	+0.432		560	301	-46.2																	
	800	0.84	VC ⊥	A10	1	-0.032	6.702	6.732	+0.448		740	395	-46.6																	
1B	850	1.04	RC ⊥	M14	1	-0.095	6.698	6.729	+0.463		550	375	-31.8																	
	850	1.04	RX-1 ⊥	N2	1	-0.045	6.720	6.746	+0.387		700	285	-59.3																	
	850	1.04	RX-2 ⊥	P3	1	-0.059	6.717	6.739	+0.328		710	340	-52.1																	
	850	1.04	RX-3 ⊥	Q2	1	-0.045	6.708	6.727	+0.283		770	370	-51.9																	
2A	950	1.30	CSF ⊥	C34	1	-0.061	6.705	6.727	+0.328		760	305	-59.9																	
	950	1.30	GL10 ⊥	F24	1	-0.018	6.709	6.727	+0.268		700	345	-50.7																	
	950	1.30	GL11 ⊥	G30	1	-0.055	6.727	6.732	+0.074		535	300	-43.9																	
	950	1.30	VC ⊥	A18	1	-0.029	6.702	6.732	+0.448		740	369	-50.1																	
2B	1000	1.56	RC ⊥	M5	1	-0.156	6.698	6.732	+0.508		550	298	-45.8																	
	1000	1.56	RX-1 ⊥	N16	1	-0.077	6.712	6.744	+0.477		590	275	-53.4																	
	1000	1.56	RX-2 ⊥	P4	1	-0.080	6.717	6.739	+0.328		790	243	-69.2																	
	1000	1.56	RX-3 ⊥	Q4	1	-0.071	6.695	6.727	+0.478		745	270	-63.8																	
3A	1075	1.82	CSF ⊥	C35	1	-0.135	6.709	6.725	+0.238		760	243	-68.0																	
	1075	1.82	GL10 ⊥	F25	1	-0.122	6.719	6.725	+0.089		700	270	-61.4																	
	1075	1.82	GL11 ⊥	G37	1	-0.141	6.712	6.739	+0.402		560	232	-58.6																	
	1075	1.82	VC ⊥	A13	1	-0.099	6.702	6.729	+0.403		740	243	-67.2																	
3B	1150	2.02	RC ⊥	M13	1	-0.307	6.698	6.755	+0.851		550	177	-67.8																	
	1150	2.02	RX-1 ⊥	N4	1	-0.257	6.705	6.714	+0.134		480	203	-57.7																	
	1150	2.02	RX-2 ⊥	P11	1	-0.340	6.717	6.712	-0.074		710	215	-69.7																	
	1150	2.02	RX-3 ⊥	Q5	1	-0.211	6.708	6.717	+0.134		770	195	-74.7																	
4A	1200	2.08	CSF ⊥	C38	1	-0.353	6.720	6.720	0		760	181	-76.2																	
	1200	2.08	GL10 ⊥	F21	1	-0.235	6.719	6.715	-0.060		700	183	-73.8																	
	1200	2.08	GL11 ⊥	G32	1	-0.294	6.712	6.727	+0.223		495	165	-66.7																	
	1200	2.08	VC ⊥	A14	1	-0.224	6.702	6.717	+0.224		740	178	-75.9																	
4B	1200	2.08	RC ⊥	M7	1	-0.451	6.698	6.729	+0.463		550	155	-71.8																	
	1200	2.08	RX-1 ⊥	N12	1	-0.374	6.712	6.732	+0.298		590	182	-69.2																	
	1200	2.08	RX-2 ⊥	P2	1	-0.374	6.717	6.705	-0.179		630	173	-72.5																	
	1200	2.08	RX-3 ⊥	Q6	1	-0.203	6.721	6.717	-0.060		800	175	-78.1																	
5A	1200	2.08	CSF ⊥	C40	1	-0.238	6.702	6.721	+0.283		760	162	-78.7																	
	1200	2.08	GL10 ⊥	F28	1	-0.218	6.729	6.719	-0.149		700	165	-76.4																	
	1200	2.08	GL11 ⊥	G34	1	-0.259	6.696	6.712	+0.239		640	341	-46.7																	
	1200	2.08	VC ⊥	A15	1	-0.050	6.702	6.707	+0.075		740	189	-74.4																	
5B	1200	1.95	RC ⊥	M10	1	-0.426	6.698	6.726	+0.418		550	168	-69.4																	
	1200	1.95	RX-1 ⊥	N13	1	-0.320	6.712	6.739	+0.402		590	181	-69.3																	
	1200	1.95	RX-2 ⊥	P13	1	-0.373	6.717	6.712	-0.074		710	195	-72.5																	
	1200	1.95	RX-3 ⊥	Q7	1	-0.273	6.708	6.721	+0.194		770	198	-74.3																	
6A	1075	1.76	CSF ⊥	C41	1	-0.134	6.709	6.732	+0.343		760	178	-76.6																	
	1075	1.76	GL10 ⊥	F30	1	-0.119	6.719	6.729	+0.149		700	215	-69.3																	
	1075	1.76	GL11 ⊥	G35	1	-0.131	6.712	6.725	+0.194		560	215	-61.6																	
	1075	1.76	VC ⊥	A17	1	-0.064	6.702	6.729	+0.403		740	183	-75.3																	
6B	1025	1.43	RC ⊥	M11	1	-0.152	6.698	6.721	+0.343		550	265	-51.8																	
	1025	1.43	RX-1 ⊥	N15	1	-0.115	6.712	6.727	+0.223		590	265	-55.1																	
	1025	1.43	RX-2 ⊥	P15	1	-0.159	6.717	6.714	-0.045		710	275	-61.3																	
	1025	1.43	RX-3 ⊥	Q10	1	-0.109	6.708	6.721	+0.194		770	330	-57.1																	

C-55

TABLE C40. Hot Test Hole Experimental Results

Temperature °C	Fluence nvt × 10 ⁻²¹ (E > 0.18 MeV)	Sample Code	Sample Number	Length Change ΔL/L ₀ , %	Mean Linear CTE (25-425 °C) in./in./°C/106
500-700	0.1	CSF ⊥		+0.02	
	0.5	CSF ⊥		-0.01	
	1.0	CSF ⊥		-0.08	
	1.5	CSF ⊥		-0.17	
	1.9	CSF ⊥		-0.25	
	0.1	CSF		0	
	0.5	CSF		-0.04	
	1.0	CSF		-0.15	
	1.5	CSF		-0.31	
	1.9	CSF		-0.45	
	0.2	TSX ⊥		+0.02	
	0.5	TSX ⊥		-0.02	
	1.0	TSX ⊥		-0.08	
	1.5	TSX ⊥		-0.16	
	1.9	TSX ⊥		-0.24	
	0.2	TSX		-0.01	
	0.5	TSX		-0.05	
	1.0	TSX		-0.15	
	1.5	TSX		-0.28	
	1.9	TSX		-0.40	
	0.1	TSGBF ⊥		+0.03	
	0.5	TSGBF ⊥		-0.02	
	1.0	TSGBF ⊥		-0.11	
	1.2	TSGBF ⊥		-0.15	
	0.1	TSGBF		+0.02	
	0.5	TSGBF		-0.06	
	1.0	TSGBF		-0.18	
	1.2	TSGBF		-0.23	
	0.2	KC ⊥		+0.03	
	0.5	KC ⊥		+0.01	
	1.0	KC ⊥		-0.03	
	1.5	KC ⊥		-0.08	
	1.9	KC ⊥		-0.12	
	0.1	KC		+0.01	
	0.5	KC		-0.08	
	1.0	KC		-0.21	
	1.5	KC		-0.33	
	1.9	KC		-0.42	
	0.83	RHM ⊥	GL9	+0.048 ±0.001	
	0.83	RHM ⊥	GL9	+0.072 ±0.001	

TABLE C40. (contd)

Temperature °C	Fluence nvt $\times 10^{-21}$ (E > 0.18 MeV)	Sample Code	Sample Number	Length Change $\Delta L/L_0, \%$	Mean Linear CTE (25-425 °C) in./in./°C/10 ⁶
500-700	0.21	61-73	⊥	+0.005 $\pm$ 0.002	
	0.50	61-73	⊥	+0.001 $\pm$ 0.004	3.14
	0.77	61-73	⊥	-0.014 $\pm$ 0.004	3.35
	0.21	61-73		-0.010 $\pm$ 0.008	
	0.50	61-73		-0.035 $\pm$ 0.011	1.04
	0.77	61-73		-0.740 $\pm$ 0.005	0.98
	0.19	63-16	⊥	+0.034 $\pm$ 0.001	
	0.19	63-16		+0.036 $\pm$ 0.001	
	0.19	63-17	⊥	+0.034 $\pm$ 0.001	
	0.19	63-17		+0.034 $\pm$ 0.002	
	0.19	63-19	⊥	+0.034 $\pm$ 0.001	
	0.19	63-19		+0.035 $\pm$ 0.002	
	0.19	63-38	⊥	+0.057 $\pm$ 0.001	
	0.19	63-38		+0.057 $\pm$ 0.001	
	0.19	H205	⊥	+0.013 $\pm$ 0.001	
	0.19	H205		+0.018 $\pm$ 0.001	
	0.33	H309	⊥	+0.024 $\pm$ 0.002	4.82
	0.33	H309		+0.014 $\pm$ 0.002	3.38
	0.33	H313	⊥	+0.026 $\pm$ 0.001	5.91
	0.33	H313		+0.020 $\pm$ 0.005	4.74
	0.31	PO3	⊥	-0.171 $\pm$ 0.005	
	0.31	PO3		-0.163 $\pm$ 0.005	
	0.51	65-5	⊥	-0.206 $\pm$ 0.001	
	0.51	65-5		-0.316 $\pm$ 0.001	
	0.51	65-8	⊥	-0.104 $\pm$ 0.003	
	0.51	65-8		-0.156 $\pm$ 0.003	
		61-56	⊥		2.82
		61-56			0.98
		61-67	⊥		3.47
		61-67			1.02
		61-69	⊥		3.51
		61-69			0.98
		61-70	⊥		3.42
		61-70			1.09
		61-73	⊥		3.27
		61-73			1.01
		64-13	⊥		4.90
		64-13			3.24
		64-17	⊥		5.78
		64-17			4.44

TABLE C40. (contd)

Temperature °C	Fluence nvt $\times 10^{-21}$ (E > 0.18 MeV)	Sample Code	Sample Number	Length Change $\Delta L/L_0$, %	Mean Linear CTE (25-425 °C) in./in./°C/10 ⁶
500-700	1.60	RHM	GL9	+0.024 $\pm$ 0.001	
	1.60	RHM	GL9	-0.014 $\pm$ 0.001	
	0.21	61-20 $\perp$		+0.006 $\pm$ 0.006	
	0.68	61-20 $\perp$		+0.036 $\pm$ 0.008	
	1.37	61-20 $\perp$		+0.055 $\pm$ 0.012	
	0.21	61-20		+0.005 $\pm$ 0.006	
	0.68	61-20		+0.019 $\pm$ 0.002	
	1.37	61-20		+0.003 $\pm$ 0.006	
	0.21	61-21 $\perp$		-0.009 $\pm$ 0.004	
	0.68	61-21 $\perp$		+0.029 $\pm$ 0.004	
	1.37	61-21 $\perp$		+0.062 $\pm$ 0.006	
	0.21	61-21		-0.006 $\pm$ 0.005	
	0.68	61-21		-0.001 $\pm$ 0.004	
	1.37	61-21		+0.004 $\pm$ 0.007	
	0.21	61-56 $\perp$		+0.004 $\pm$ 0.002	
	0.50	61-56 $\perp$		-0.003 $\pm$ 0.004	2.90
	0.77	61-56 $\perp$		-0.019 $\pm$ 0.003	2.98
	0.21	61-56		-0.005 $\pm$ 0.002	
	0.50	61-56		-0.028 $\pm$ 0.003	1.07
	0.77	61-56		-0.068 $\pm$ 0.003	0.92
	0.21	61-67 $\perp$		+0.004 $\pm$ 0.002	
	0.50	61-67 $\perp$		-0.003 $\pm$ 0.004	3.46
	0.77	61-67 $\perp$		-0.019 $\pm$ 0.003	3.37
	0.21	61-67		-0.005 $\pm$ 0.002	
	0.50	61-67		-0.028 $\pm$ 0.003	1.11
	0.77	61-67		-0.068 $\pm$ 0.003	1.08
	0.21	61-69 $\perp$		+0.002 $\pm$ 0.002	
	0.50	61-69 $\perp$		-0.001 $\pm$ 0.002	3.46
	0.77	61-69 $\perp$		-0.018 $\pm$ 0.004	3.63
	0.21	61-69		-0.002 $\pm$ 0.002	
	0.50	61-69		-0.033 $\pm$ 0.003	0.84
	0.77	61-69		-0.074 $\pm$ 0.003	0.99
	0.21	61-70 $\perp$		+0.013 $\pm$ 0.010	
	0.50	61-70 $\perp$		+0.012 $\pm$ 0.012	3.36
	0.77	61-70 $\perp$		-0.001 $\pm$ 0.008	3.58
	0.21	61-70		-0.001 $\pm$ 0.001	
	0.50	61-70		-0.026 $\pm$ 0.002	1.18
	0.77	61-70		-0.068 $\pm$ 0.004	1.14

TABLE C41. *General Atomics Experimental Results*

<u>Temperature °C</u>	<u>Fluence nvt $\times 10^{-21}$ (E > 0.18 MeV)</u>	<u>Sample Code</u>	<u>Length Change $\Delta L/L_0$, %</u>
400	2.1	H319 $\perp$	-0.48
400	2.1	H319 $\parallel$	-0.49
945	2.1	H319 $\perp$	-1.19
945	2.4	H319 $\perp$	-1.60
945	2.95	H319 $\perp$	-2.2
945	3.2	H319 $\perp$	-2.3
945	2.1	H319 $\parallel$	-1.42
945	2.4	H319 $\parallel$	-1.77
945	2.83	H319 $\parallel$	-1.89
945	2.95	H319 $\parallel$	-2.49
945	3.2	H319 $\parallel$	-2.61

TABLE C42. *Thermal Conductivity Experimental Results*

<u>Irradiation Temperature, °C</u>	<u>Fluence, nvt x 10⁻²¹ (E>0.18 MeV)</u>	<u>Sample Code</u>	<u>Sample Number</u>	<u>Temperature, °C</u>	<u>Thermal Conductivity, cal/cm/sec/°C</u>
---	0	CSF ⊥	D17	25	0.277
				45	0.275
				137	0.237
				240	0.205
				383	0.178
				532	0.155
700	1.17	CSF ⊥	D17	25	0.085
				86	0.090
				138	0.092
				197	0.094
				253	0.095
				311	0.089
				375	0.090
				440	0.089
				536	0.087
775	1.27	CSF ⊥	142-30	26	0.069
				61	0.071
				97	0.070
				140	0.073
				175	0.075
				209	0.074
				250	0.075
				309	0.074
				367	0.076
				400	0.076
				448	0.073
				497	0.072
475	0.92	CSF	141-206	25	0.096
				65	0.105
				98	0.108
				135	0.114
				151	0.113
				174	0.114
				225	0.112
				278	0.113
				308	0.113
				351	0.109
				425	0.114
				446	0.108
---	0	TSX ⊥	NPR-22	25	0.283
				104	0.262
				155	0.244
				207	0.232
				223	0.219
				295	0.204
				323	0.196
				380	0.188
				418	0.185
				450	0.179
				520	0.162

TABLE C42. (contd)

<u>Irradiation Temperature, °C</u>	<u>Fluence, nvt x 10⁻²¹ (E>0.18 MeV)</u>	<u>Sample Code</u>	<u>Sample Number</u>	<u>Temperature, °C</u>	<u>Thermal Conductivity, cal/cm/sec/°C</u>
---	0	TSX ⊥	163-3	25	0.233
				117	0.229
				177	0.204
				230	0.202
				280	0.180
				332	0.175
				403	0.160
				467	0.163
				522	0.157
				572	0.151
---	-	TSX ⊥	M9	26	0.288
				115	0.258
				238	0.222
				362	0.185
				487	0.165
450	1.16	TSX ⊥	158-C7	26	0.057
				59	0.061
				80	0.061
				97	0.062
				143	0.065
				193	0.064
				271	0.064
				303	0.065
				326	0.067
				352	0.061
				405	0.064
				457	0.064
625	0.87	TSX ⊥	167-E12	26	0.071
				60	0.074
				109	0.078
				146	0.085
				167	0.089
				210	0.091
				215	0.087
				290	0.087
				293	0.088
				366	0.087
				369	0.087
				415	0.082
				421	0.080
				440	0.082
				497	0.077
650	1.2	TSX ⊥	163-3	28	0.070
				100	0.078
				136	0.079
				202	0.081
				270	0.085
				355	0.083
				425	0.082
				486	0.079
				558	0.062
				605	0.075

TABLE C42. (contd)

<u>Irradiation Temperature, °C</u>	<u>Fluence, nvt x 10⁻²¹ (E>0.18 Mev)</u>	<u>Sample Code</u>	<u>Sample Number</u>	<u>Temperature, °C</u>	<u>Thermal Conductivity, cal/cm/sec/°C</u>
650	7	TSX ⊥	NPR-20	25	0.049
				65	0.051
				92	0.053
				143	0.055
				180	0.056
				200	0.057
				228	0.058
				261	0.058
				298	0.060
				328	0.060
				386	0.057
				458	0.059
				477	0.058
				515	0.060
700	1.17	TSX ⊥	M9	25	0.080
				93	0.084
				190	0.092
				243	0.092
				308	0.090
				386	0.090
				466	0.087
				513	0.083
775	1.21	TSX ⊥	160-E11	28	0.065
				64	0.065
				95	0.069
				124	0.070
				165	0.066
				171	0.072
				181	0.072
				199	0.074
				266	0.072
				303	0.072
				357	0.074
				401	0.071
				448	0.069
				504	0.069
1000	7	TSX ⊥	NPR-19	25	0.065
				69	0.070
				108	0.073
				156	0.075
				188	0.076
				220	0.077
				260	0.080
				313	0.077
				362	0.079
				401	0.076
				440	0.076
				468	0.077
				508	0.076
				525	0.073

TABLE C42. (contd)

<u>Irradiation Temperature, °C</u>	<u>Fluence, nvt x 10⁻²¹ (E>0.18 MeV)</u>	<u>Sample Code</u>	<u>Sample Number</u>	<u>Temperature, °C</u>	<u>Thermal Conductivity, cal/cm/sec/°C</u>
---	0	TSX	163-206	27	0.407
				80	0.386
				122	0.354
				158	0.367
				192	0.342
				241	0.328
				378	0.288
				401	0.292
				493	0.244
				506	0.260
650	1.2	TSX	163-206	25	0.098
				101	0.103
				202	0.094
				295	0.106
				360	0.103
				416	0.108
				508	0.093
				608	0.098
---	-	NC8	1-1	25	0.501
				25	0.484
				67	0.474
				70	0.464
				73	0.478
				101	0.461
				103	0.455
				104	0.450
				152	0.442
				153	0.425
				157	0.445
				195	0.415
				248	0.367
				299	0.354
				360	0.322
				402	0.302
				453	0.290
				495	0.273
650	0.2	NC8	1-1	25	0.165
				62	0.166
				103	0.169
				151	0.180
				219	0.174
				244	0.174
				298	0.174
				338	0.176
				402	0.170
				442	0.169
				503	0.161

TABLE C42. (contd)

<u>Irradiation Temperature, °C</u>	<u>Fluence, nvt x 10⁻²¹ (E>0.18 MeV)</u>	<u>Sample Code</u>	<u>Sample Number</u>	<u>Temperature, °C</u>	<u>Thermal Conductivity, cal/cm/sec/°C</u>
1000	3.41	NC8	NC8-253	28	0.107
				62	0.112
				88	0.123
				111	0.120
				168	0.130
				225	0.130
				266	0.126
				313	0.120
				379	0.125
				421	0.124
				453	0.120
				479	0.119
				492	0.119
625	4.02	NC7 ⊥	NC7-34	28	0.046
				93	0.049
				116	0.049
				142	0.050
				175	0.050
				219	0.052
				251	0.053
				299	0.054
				300	0.052
				363	0.055
				365	0.054
				403	0.053
				450	0.050
				500	0.049
775	14.15	NC7	NC7-33	25	0.035
				64	0.038
				91	0.039
				122	0.040
				229	0.043
				289	0.045
				355	0.045
				385	0.046
				427	0.045
				465	0.045
				491	0.045
				503	0.045
				(rerun) 25	0.040
				67	0.046
				93	0.049
				127	0.053
				155	0.052
				219	0.055
				272	0.055
				350	0.058
				405	0.062
				455	0.061
				503	0.061

TABLE C42. (contd)

<u>Irradiation Temperature, °C</u>	<u>Fluence, nvt x 10⁻²¹ (E>0.18 MeV)</u>	<u>Sample Code</u>	<u>Sample Number</u>	<u>Temperature, °C</u>	<u>Thermal Conductivity, cal/cm/sec/°C</u>
950	2.82	KC ⊥	187-1	27	0.070
				62	0.077
				65	0.076
				98	0.077
				142	0.080
				160	0.080
				168	0.082
				183	0.080
				240	0.082
				270	0.079
				295	0.079
				433	0.078
				461	0.077
				500	0.075
1100	3.81	KC ⊥	187-2	28	0.070
				56	0.077
				83	0.077
				117	0.076
				149	0.080
				195	0.082
				235	0.085
				290	0.085
				383	0.080
				407	0.074
				452	0.075
				487	0.075
				512	0.073
---	0	TSGBF ⊥	J11	25	0.162
				137	0.170
				243	0.155
				355	0.140
				472	0.128
700	0.98	TSGBF ⊥	J11	25	0.063
				82	0.064
				131	0.068
				208	0.075
				223	0.075
				284	0.078
				362	0.074
				438	0.073
				518	0.071
				537	0.069
1150	4.47	TSGBF ⊥	125-23	27	0.035
				63	0.038
				102	0.040
				154	0.042
				204	0.045
				275	0.045
				321	0.045
				392	0.046
				445	0.046
				493	0.044
				505	0.044

TABLE C42. (contd)

<u>Irradiation Temperature, °C</u>	<u>Fluence, nvt x 10⁻²¹ (E>0.18 MeV)</u>	<u>Sample Code</u>	<u>Sample Number</u>	<u>Temperature, °C</u>	<u>Thermal Conductivity, cal/cm/sec/°C</u>
1150	4.47	63-17 ⊥	63-17-71	25	0.074
				67	0.082
				90	0.087
				121	0.090
				165	0.091
				218	0.092
				264	0.094
				320	0.091
				393	0.095
				438	0.092
				481	0.094
				504	0.091
1150	4.47	63-17	63-17-71	25	0.048
				60	0.051
				87	0.056
				120	0.055
				160	0.057
				206	0.059
				280	0.060
				338	0.061
				372	0.062
				410	0.063
				446	0.062
				508	0.063
1150	4.47	63-38 ⊥	63-38-60	25	0.032
				55	0.036
				83	0.038
				105	0.040
				158	0.042
				208	0.043
				247	0.044
				302	0.045
				380	0.045
				433	0.046
				498	0.044
				505	0.045
1150	4.47	63-38	63-38-60	25	0.065
				70	0.072
				97	0.076
				125	0.078
				163	0.081
				218	0.084
				273	0.084
				337	0.084
				391	0.089
				429	0.083
				480	0.084
				500	0.084

APPENDIX D
CURVE EQUATIONS

APPENDIX D

CURVE EQUATIONS

The equations of the best-fit third-order polynomial curve for the data shown graphically in the body of the report (BNWL-1056A) are given in Tables D1 through D8 in the following order:

<u>Table</u>	<u>Parameter</u>
D1	Length Change - CSF
D2	Length Change - NC8, NC7
D3	Length Change - TSX
D4	Length Change - TSGBF
D5	Length Change - 61-70 through 66-11
D6	Coefficient of Thermal Expansion - CSF, NC8
D7	Electrical Resistivity - CSF, NC8, TSX, TSGBF
D8	Young's Modulus - CSF, NC8, TSX, TSGBF

The equation coefficients are for an equation of the form $A + BX + CX^2 + DX^3$, with a coefficient of -3 being 10^{-3} , and +1 being 10^{+1} , etc. For the CTE, for electrical resistivity, and for Young's modulus the computed mean value is also listed. If the calculated curve were exactly correct, the "A" and the mean would be identical.

TABLE D1. *Curve Equations - Length Change - CSF*

Graphite Type	Orientation	Irradiation Temperature, °C	Equation Coefficients		
			B(X)	C(X ²)	D(X ³)
CSF	⌊	300-475	-2.40-1	+5.88-4	+7.27-4
CSF		575-625	-1.12-1	-1.41-2	+1.08-3
CSF		650-750	-1.78-1	-2.52-4	+6.80-4
CSF		775-825	-1.45-1	-8.57-3	+1.36-3
CSF		850-900	-2.86-1	+3.38-1	-1.25-1
CSF		925-975	-1.91-1	-6.63-2	+1.39-2
CSF		1000-1075	+3.64-1	-3.32-1	+4.62-2
CSF		1100-1175	-6.78-2	-3.60-1	+8.63-2
CSF		1200-1275	-8.08-1	+2.39-1	-2.17-2
CSF	⌋	300-475	-3.34-1	-1.10-2	+3.28-4
CSF		575-625	-1.79-1	-2.86-2	+9.35-4
CSF		650-750	-5.48-2	-4.65-2	+1.73-3
CSF		775-825	-1.35-1	-3.40-2	+1.09-3
CSF		850-900	-5.13-1	+7.35-1	-3.06-1
CSF		925-975	+2.52-1	-2.49-1	+1.58-2
CSF		1200-1275	+5.87-1	-1.04-2	+1.54-3

TABLE D2. *Curve Equations - Length Change - NC8, NC7*

Graphite Type	Orientation	Irradiation Temperature, °C	Equation Coefficients		
			B(X)	C(X ²)	D(X ³)
NC8	⌊	400-475	-2.94-1	+6.73-3	+7.58-4
NC8		575-625	-1.04-1	-2.23-2	+1.87-3
NC8		650-750	-9.66-2	-1.32-2	+1.26-3
NC8		775-825	-3.47-2	-5.31-3	-1.21-3
NC8		850-900	-7.34-2	-1.33-2	-1.16-3
NC8		925-975	-8.93-2	-9.72-2	+1.67-2
NC8		1000-1075	-3.29-1	+4.46-2	+8.99-3
NC8		1100-1175	-8.04-1	+3.38-1	-4.98-2
NC8		1200-1275	-1.24+0	+5.86-1	-8.01-2
NC8	⌋	300-375	-1.61-1	-1.16-1	+1.43-2
NC8		400-475	-3.14-1	-1.58-2	+6.21-4
NC8		575-625	-1.29-1	-2.63-2	+8.49-4
NC8		650-750	-1.57-1	-2.32-2	+6.41-4
NC8		775-825	+8.86-2	-5.25-2	+1.54-3
NC8		850-900	+1.90-1	-2.69-1	+2.97-2
NC8		925-975	-2.75-1	-6.24-2	+2.74-4
NC8		1000-1075	-1.07-1	-2.21-1	+1.72-2
NC8		1200-1275	-1.66+0	+6.66-1	-1.04-1
NC7	⌊	400-475	-2.23-2	-8.84-2	+1.37-2
NC7		575-625	+1.96-2	-5.48-2	+5.85-3
NC7		775-825	-1.51-1	-5.37-3	+1.96-3
NC7	⌋	400-475	-1.73-1	-4.43-2	-6.77-4
NC7		575-625	-8.02-2	-3.81-2	+2.51-3
NC7		775-825	-8.25-3	-6.43-2	+4.61-3

TABLE D3. Curve Equations - Length Change - TSX

Graphite Type	Orientation	Irradiation Temperature, °C	Equation Coefficients		
			B(X)	C(X ²)	D(X ³)
TSX	 ↓	400-475	-2.67-2	-1.55-1	+2.96-2
TSX		575-625	-8.78-2	-4.86-2	+5.93-3
TSX		650-750	-2.90-2	-3.52-2	+2.95-3
TSX		775-825	-3.83-2	-3.22-2	+3.09-3
TSX		850-900	-7.05-2	-4.49-2	+6.38-3
TSX		925-975	-8.09-2	-6.76-2	+1.89-2
TSX		1000-1075	-4.31-1	+9.92-2	+4.51-3
TSX		1100-1175	-8.77-1	+4.42-1	-6.33-2
TSX	 ↓	400-475	-2.30-1	-1.12-1	+1.79-2
TSX		575-625	-1.18-1	-7.60-2	+7.13-3
TSX		650-750	-2.21-1	+4.46-3	-3.71-3
TSX		775-825	-5.08-2	-5.44-2	+1.73-3
TSX		850-900	-8.07-2	-1.05-1	+4.28-3
TSX		925-975	+2.22-1	-2.40-1	+1.22-2

TABLE D4. Curve Equations - Length Change - TSGBF

Graphite Type	Orientation	Irradiation Temperature, °C	Equation Coefficients		
			B(X)	C(X ²)	D(X ³)
TSGBF	 ↓	400-475	+2.56-2	-1.71-1	+3.01-2
TSGBF		575-625	-8.15-2	-4.88-2	+4.65-3
TSGBF		650-750	+1.90-2	-1.01-1	+1.19-2
TSGBF		775-825	-5.42-2	-6.63-2	+1.03-2
TSGBF		850-900	-3.75-1	-7.03-3	+2.49-2
TSGBF		925-975	-8.58+0	+3.78+0	-3.42-1
TSGBF	 ↓	575-625	+6.53-2	-3.08-1	+4.65-2
TSGBF		650-750	+1.71-1	-2.67-1	+3.94-2
TSGBF		850-900	+1.69+0	-1.96+0	+3.10-1
TSGBF		925-975	-1.54+0	-1.78-2	+2.57-2
TSGBF		1000-1075	-1.35+0	-2.35-1	+6.77-2

TABLE D5. *Curve Equations - Length Change - 61-70 through 66-11*

Graphite Type	Orientation	Irradiation Temperature, °C	Equation Coefficients		
			B(X)	C(X ²)	D(X ³)
61-70	⊥	925-975	-8.52-2	-1.14-1	+2.21-2
61-70		925-975	+9.33-2	-2.21-1	+1.25-2
61-73	⊥	925-975	+7.45-2	-1.72-1	+2.17-2
61-73		925-975	+1.72-1	-2.41-1	+1.46-2
63-16	⊥	925-975	+5.12-1	-2.18-1	+2.05-2
63-16		850-900	+3.62-1	-8.03-2	-6.88-4
63-16		925-975	+6.63-1	-2.82-1	+2.42-2
63-17	⊥	575-625	+1.29-1	-1.58-1	+6.80-2
63-17		575-625	+1.39-1	-2.26-1	+9.20-2
63-38	⊥	850-900	+3.14-1	-1.28-1	+1.09-2
64-17	⊥	575-625	+7.98-2	-7.88-2	+7.29-3
64-17	⊥	850-900	+1.94-1	-1.50-1	+1.83-2
64-17		575-625	+4.55-2	-8.14-2	+1.69-2
64-17		850-900	-1.37-2	-4.12-2	-9.41-3
65-18	⊥	575-625	+1.87-1	-1.56-1	+2.96-2
65-18	⊥	650-750	+3.05-1	-2.24-1	+5.44-2
65-18	⊥	775-825	+1.09-1	+2.61-3	-8.37-4
65-18		575-625	+1.39-1	-1.66-1	+3.19-2
65-18		850-900	+2.28-1	-7.88-2	+2.72-5
65-18		925-975	+5.02-1	-2.50-1	+2.19-2
65-18		1000-1075	+3.35-1	-2.79-1	+2.68-2
65-21	⊥	650-750	-1.66-1	+3.94-2	-7.07-3
65-21	⊥	925-975	-1.33-1	-3.96-2	-9.89-3
65-21	⊥	1000-1075	+1.21+0	-6.89-1	+7.31-2
65-21		650-750	+2.34+0	-1.15+0	+1.21-1
65-21		925-975	+5.10-2	-1.53-1	+1.15-2
65-21		1000-1075	-4.73-1	-1.59-2	+2.72-3

TABLE D5. (contd)

Graphite Type	Orientation	Irradiation Temperature, °C	Equation Coefficients		
			B(X)	C(X ²)	D(X ³)
65-22	⊥	575-625	-5.76-2	+6.09-2	-3.32-2
65-22	⊥	850-900	+1.44-1	-5.31-2	+3.65-3
65-22	⊥	925-975	+7.25-3	-1.89-2	+3.20-3
65-22	⊥	1000-1075	+9.86-1	-5.61-1	+5.91-2
65-22		575-625	-1.96-1	+2.25-1	-9.24-2
65-22		925-975	+1.34-1	-1.35-1	+9.82-3
65-22		1000-1075	-1.06-1	-1.03-1	+9.57-3
65-29		1000-1075	-7.99-1	-1.03-2	+9.77-3
65-32	⊥	925-975	+1.79+0	-1.76+0	+3.03-1
65-32		925-975	-3.18+0	+2.18+0	-4.52-1
65-37	⊥	850-900	-1.59-2	-1.07-1	+1.31-2
65-37	⊥	925-975	+3.98-1	-4.24-1	+6.28-2
65-37	⊥	1000-1075	-4.89-1	+4.06-2	+1.12-2
65-37		850-900	+4.24-3	-1.71-1	+1.98-2
65-37		925-975	-2.69-1	-8.05-2	+3.97-4
65-37		1000-1075	-3.99-1	-2.60-1	+2.00-2
65-38		1000-1075	-2.85-1	-3.25-1	+2.30-2
65-42		1000-1075	-1.06+0	+3.20-1	-3.97-2
66-9	⊥	850-900	-4.29-2	-6.08-2	+8.28-3
66-11	⊥	575-625	+8.47-2	-1.35-1	+2.08-2
66-11		575-625	+7.53-2	-1.90-1	+3.43-2

TABLE D6. *Curve Equations - Coefficient
of Thermal Expansion - CSF, NC8*

Graphite Type	Orien- tation	Irradiation Temperature, °C	Mean (0 Exp.)	Equation Coefficients			
				A	B(X)	C(X ²)	D(X ³)
CSF	⊥	500-975	3.792+0	+4.031+0	-1.930-1	+1.622-2	+2.975-5
CSF		300-975	1.783+0	+1.784+0	+7.926-3	-9.378-3	+5.771-4
NC8	⊥	575-975	3.336+0	+3.360+0	-2.053-2	-3.760-2	+2.986-3
NC8		300-1075	1.662+0	+1.568+0	+3.481-2	-1.168-2	+6.618-4

TABLE D7. *Curve Equations - Electrical Resistivity -
CSF, NC8, TSX, TSGBF*

Graphite Type	Orien- tation	Irradiation Temperature °C	Mean (0 Exp.)	Equation Coefficients			
				A	B(X)	C(X ²)	D(X ³)
CSF	⊥	300-1275	1.333+1	+2.794+1	+4.190+0	-4.778-1	+1.736-2
CSF		300-1275	7.710+0	+1.846-1	+2.723+0	-3.202-1	+1.201-2
NC8	⊥	300-1275	1.101+1	+2.275+1	+4.825+0	-5.731-1	+2.112-2
NC8		300-1275	6.740+0	+1.624+1	+3.041+0	-3.575-1	+1.353-2
TSX	⊥	400-1275	1.257+1	+2.437+1	+8.676+0	-1.814+0	+1.172-1
TSX		400-1275	6.000+0	+9.940+0	+8.184+0	-1.790+0	+1.254-1
TSGBF	⊥	400-975	1.986+1	+3.261+1	+5.131+0	-1.034+0	+6.586-2
TSGBF		400-975	1.381+1	+1.877+1	+1.214+1	-4.667+0	+4.755+1

TABLE D8. *Curve Equations - Young's Modulus-CSF, NC8, TSX, TSGBF*

Graphite Type	Orien- tation	Irradiation Temperature, °C	Mean (0 Exp.)	Equation Coefficients			
				A	B(X)	C(X ²)	D(X ³)
CSF	⊥	300-550	7.004-1	+9.811-1	+2.688-1	-2.718-2	+8.281-4
CSF	⊥	575-825	7.004-1	+9.969-1	+1.533-1	-1.523-2	+4.406-4
CSF	⊥	925-1275	7.004-1	+7.380-1	+3.465-1	-1.114-1	+1.161-2
CSF		400-750	1.585+0	+1.838+0	+6.049-1	-9.988-2	+4.656-3
CSF		775-825	1.585+0	+2.028+0	+1.666-1	-1.543-2	+3.587-4
NC8	⊥	300-475	8.291-1	+1.024+0	+3.517-1	-4.848-2	+2.021-3
NC8	⊥	500-1275	8.291-1	+9.502-1	+2.647-1	-3.038-2	+9.885-4
NC8		400-825	1.497+0	+1.720+0	+3.521-1	-3.963-2	+1.179-3
TSX	⊥	400-550	8.889-1	+9.302-1	+9.692-1	-4.516-1	+6.917-2
TSX	⊥	575-625	8.889-1	+9.440-1	+4.649-1	-1.032-1	+8.031-3
TSX	⊥	650-1275	8.889-1	+9.838-1	+3.464-1	-7.109-2	+4.685-3
TSX		400-475	2.007+0	+2.020+0	+3.868+0	-2.544+0	+5.182-1
TSX		575-750	2.007+0	+2.114+0	+1.474+0	-3.952-1	+3.088-2
TSX		775-1275	2.007+0	+2.178+0	+9.524-1	-2.104-1	+1.292-2
TSGBF	⊥	400-625	8.656-1	+9.914-1	+4.081-1	-9.631-2	+6.827-3
TSGBF	⊥	650-825	8.656-1	+9.145-1	+2.783-1	-6.763-2	+5.301-3

APPENDIX E

SUPPLEMENTAL FIGURES

APPENDIX E

SUPPLEMENTAL FIGURESLENGTH CHANGE

Figures E1 through E6 present the dimensional behavior for graphites for which only a small amount of data are presently available.

EFFECT OF VARIATIONS IN IRRADIATION TEMPERATURE OF LENGTH CHANGE

Data for four graphites are presented in Figures E7 through E9.

VOLUME CHANGE

Supplemental data are shown in Figures E10 through E18.

CTE

Figures E19 through E34 present CTE data for the graphites exhibiting the same general behavior as those discussed in the main text (BNWL-1056A).

ELECTRICAL RESISTIVITY

Electrical resistivity data for a number of the graphites are shown in Figures E35 through E54.

YOUNG'S MODULUS OF ELASTICITY

Supplemental data are shown in Figures E55 through E62.

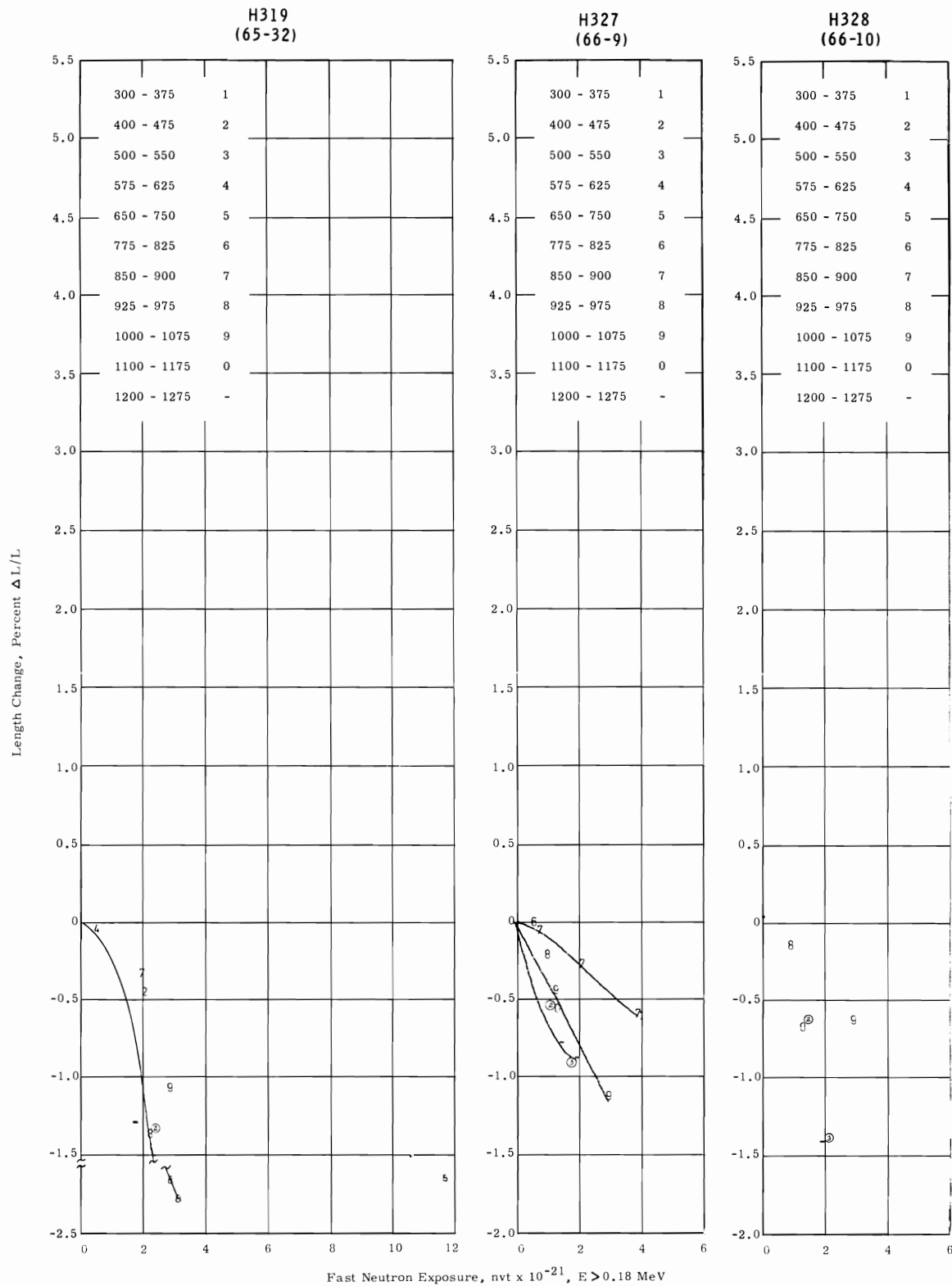


FIGURE E1. Length Change of Developmental Graphites
(Transverse)

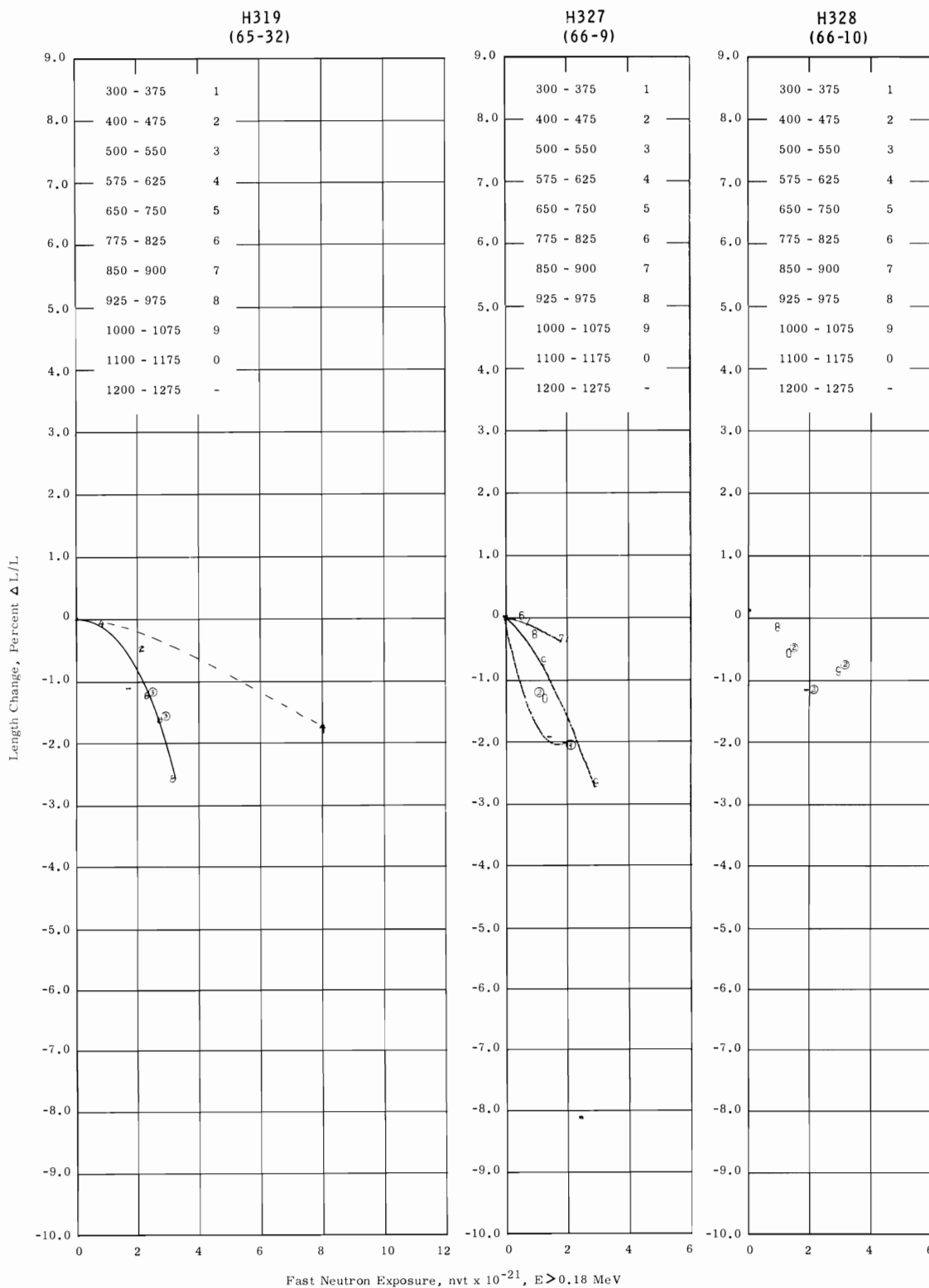


FIGURE E2. Length Change of Developmental Graphites (Parallel)

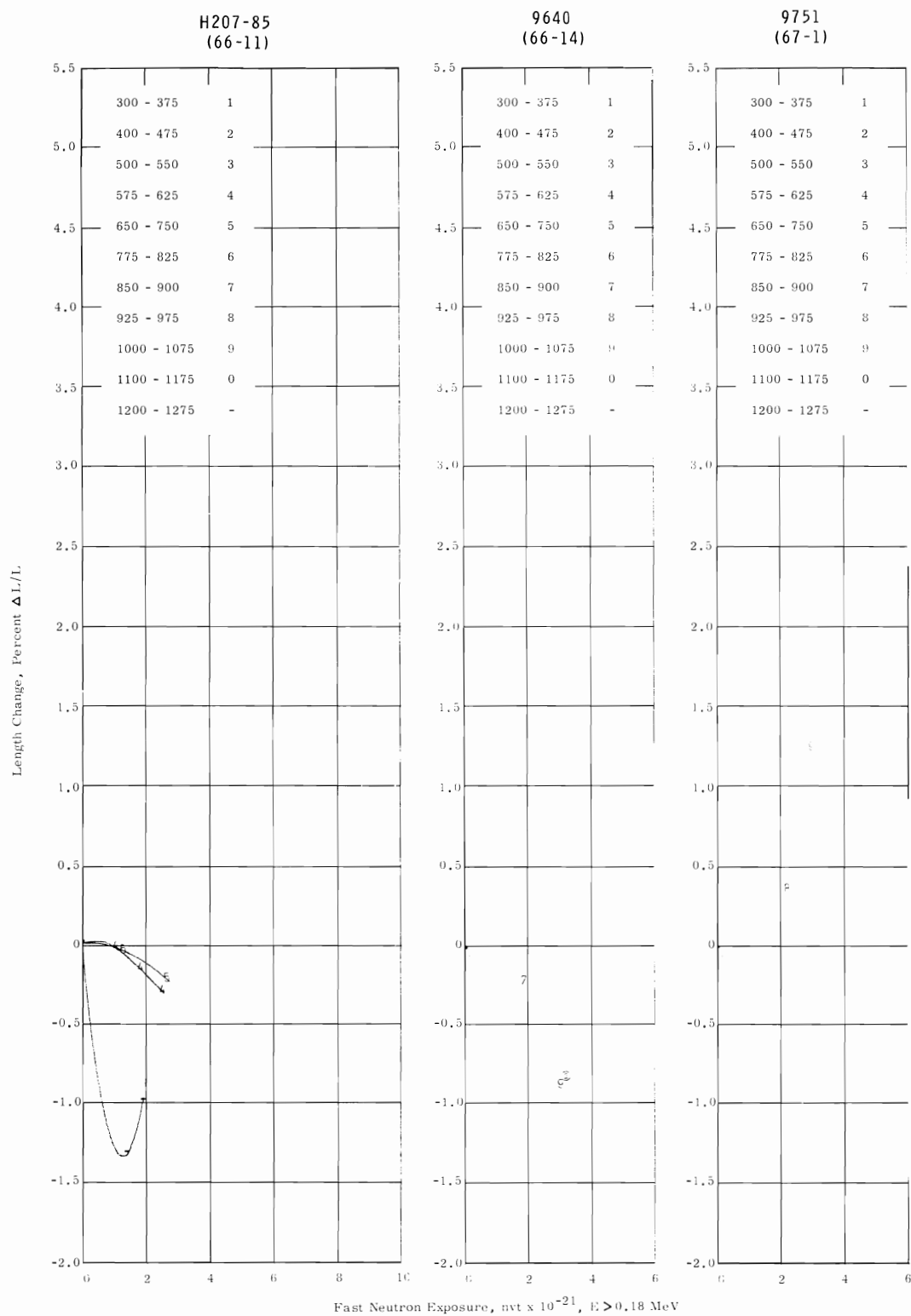


FIGURE E3. Length Change of Developmental Graphites
(Transverse)

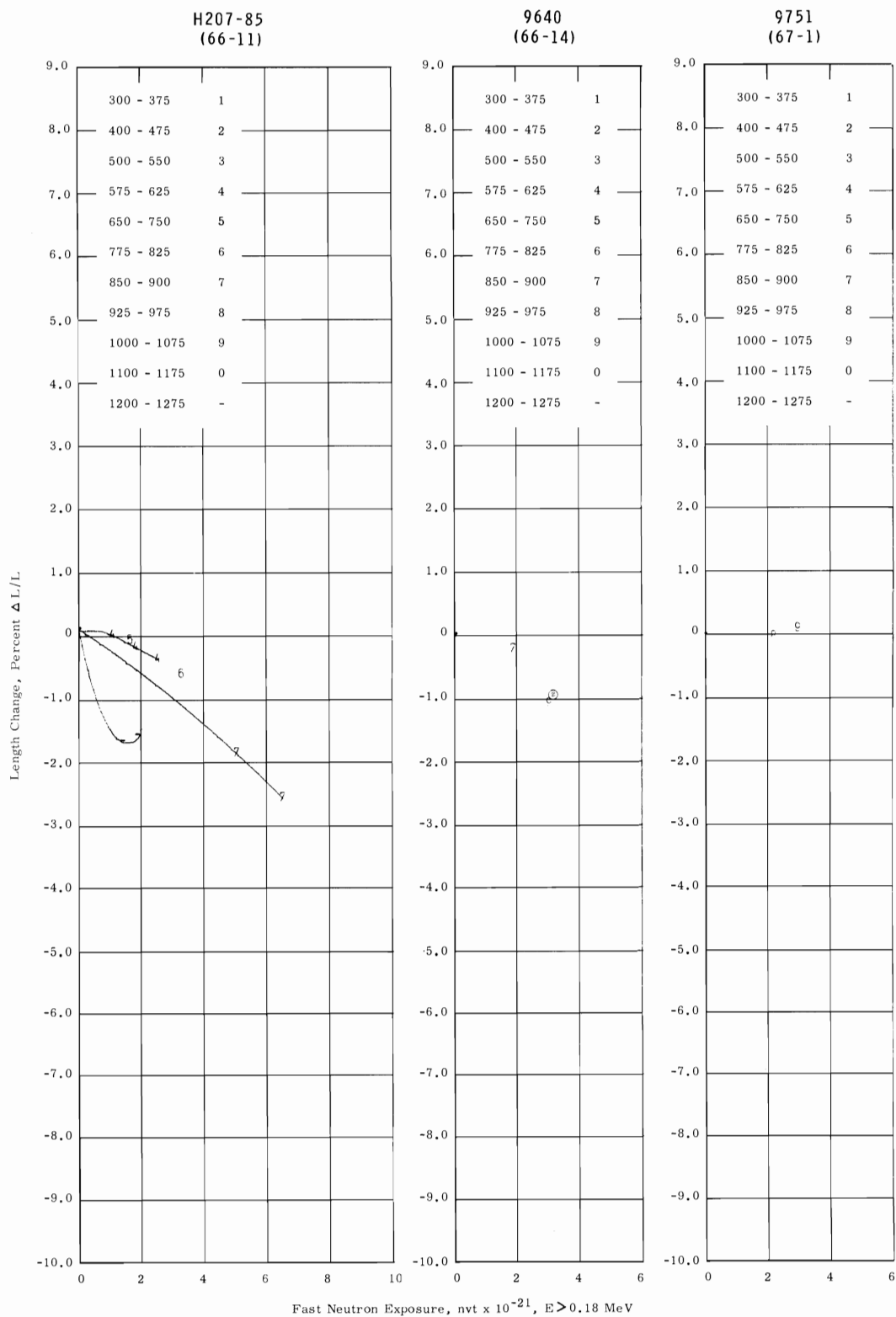


FIGURE E4. Length Change of Developmental Graphites (Parallel)

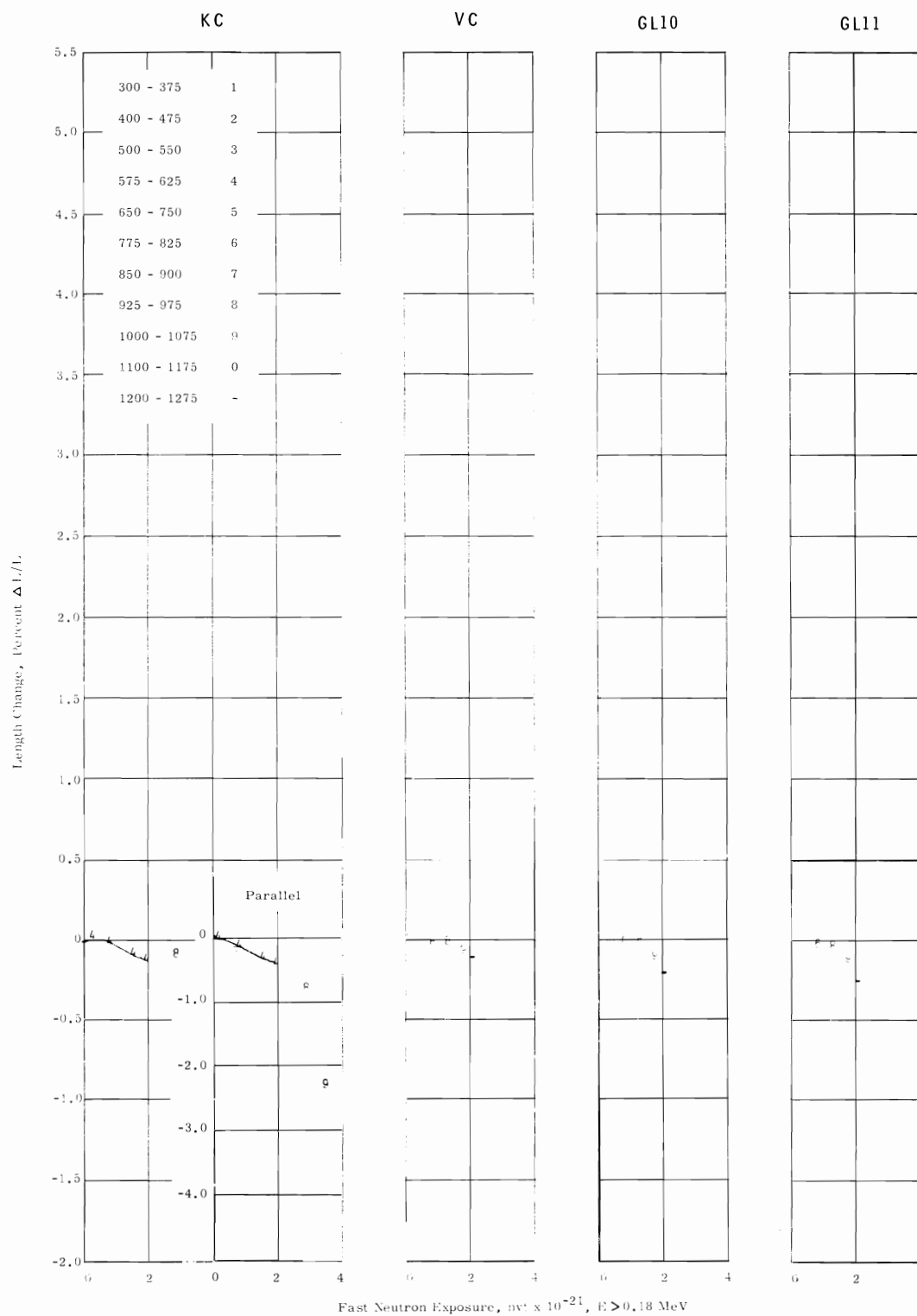


FIGURE E5. Length Change of Reactor Grade Graphites (Transverse)

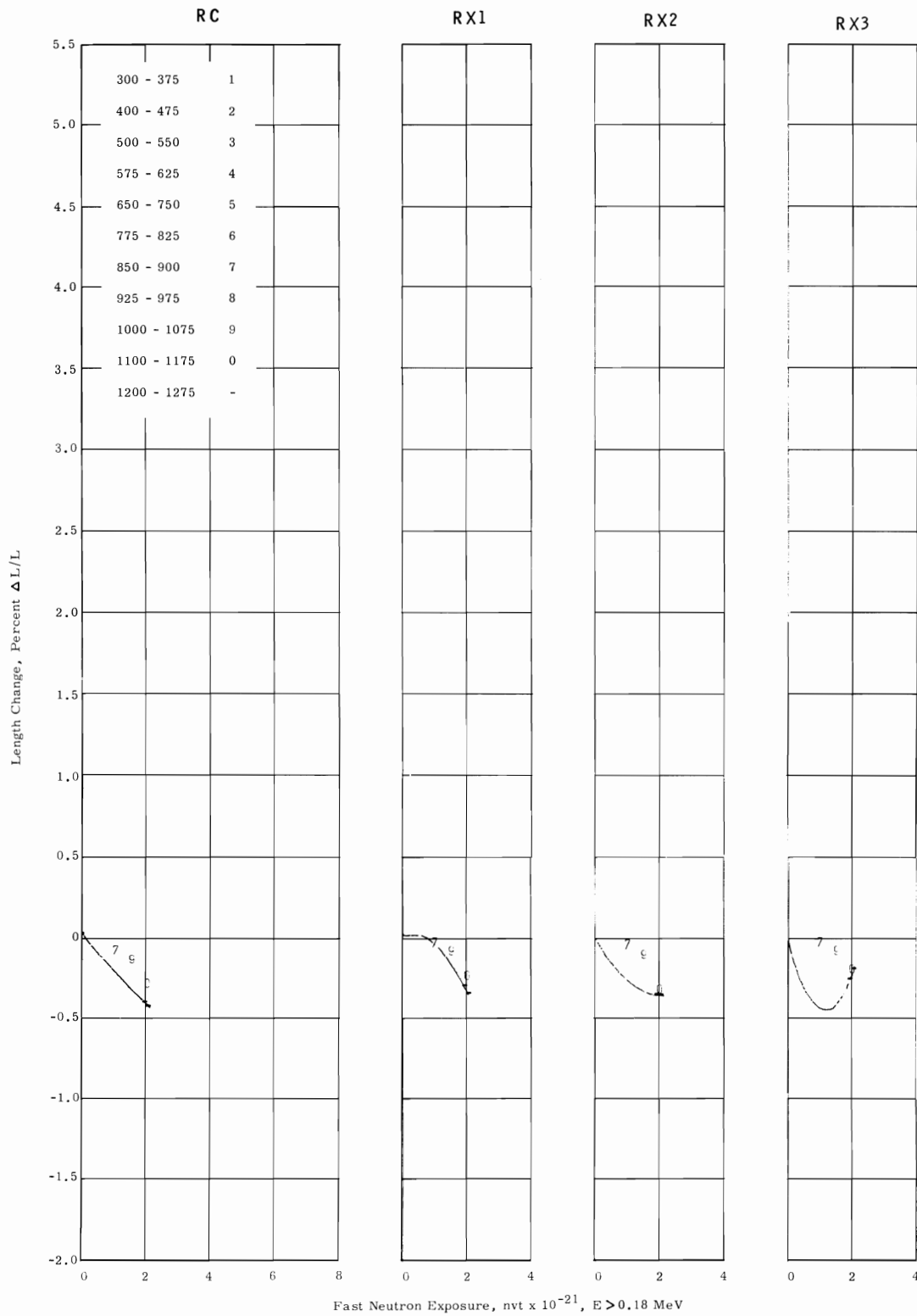


FIGURE E6. Length Change of Reactor Grade Graphites (Parallel)

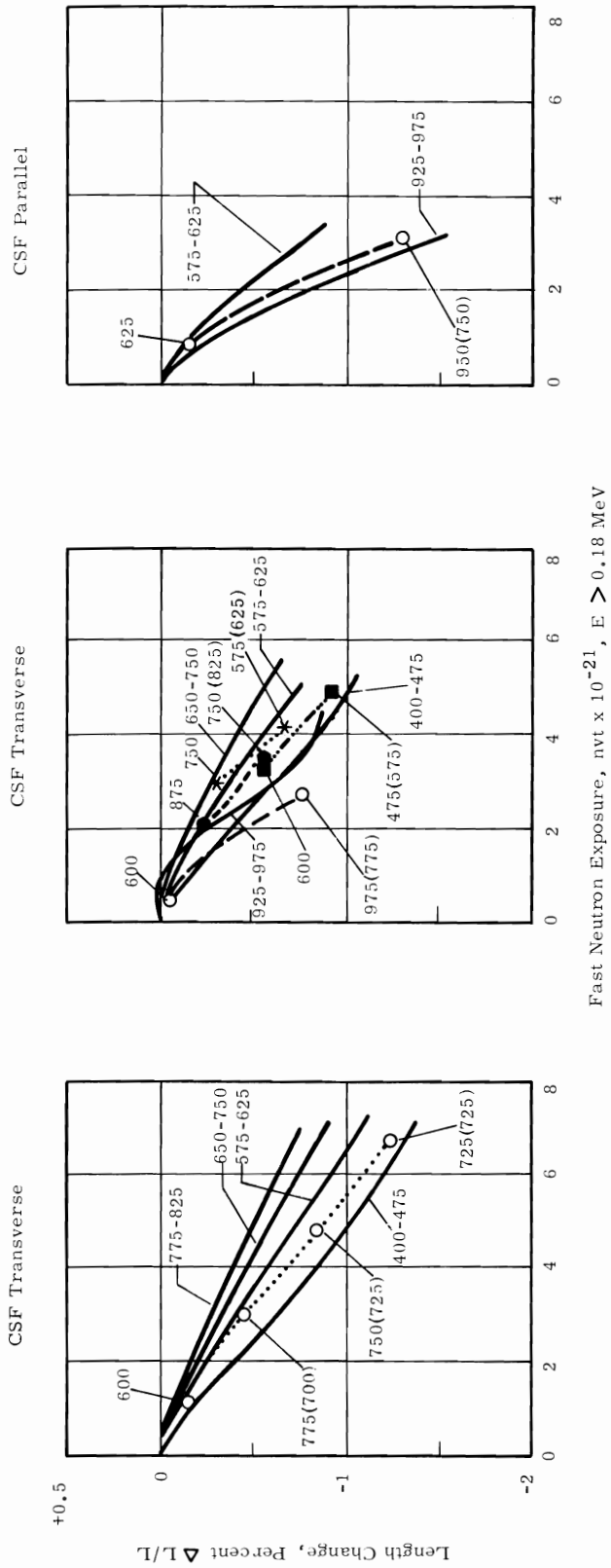
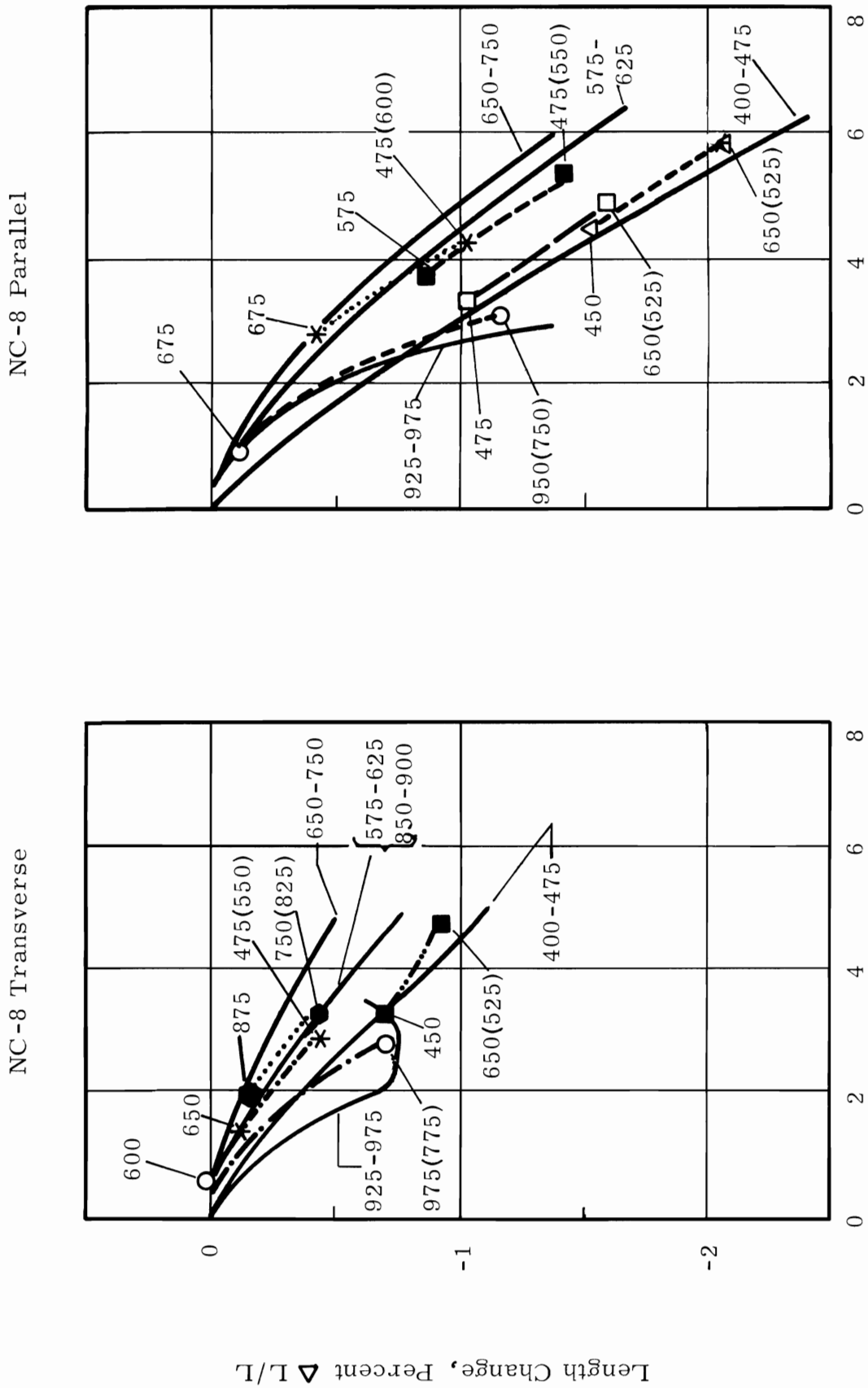


FIGURE E7. Length Change of CSF Graphite - Sample Irradiation Temperature Changed



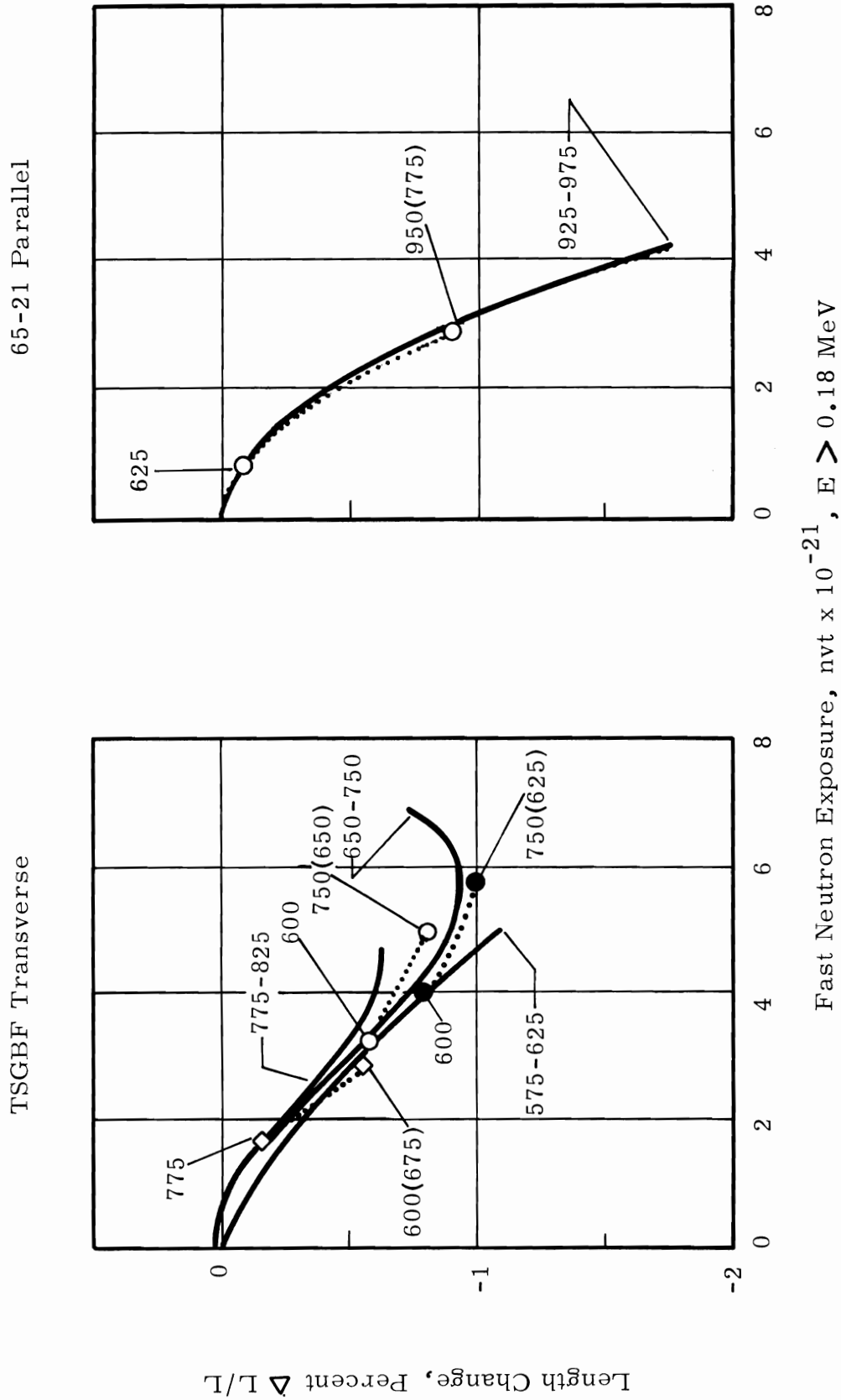


FIGURE E9. Length Change of TSGBF and Raw-Coke Graphites
- Sample Irradiation Temperature Changed

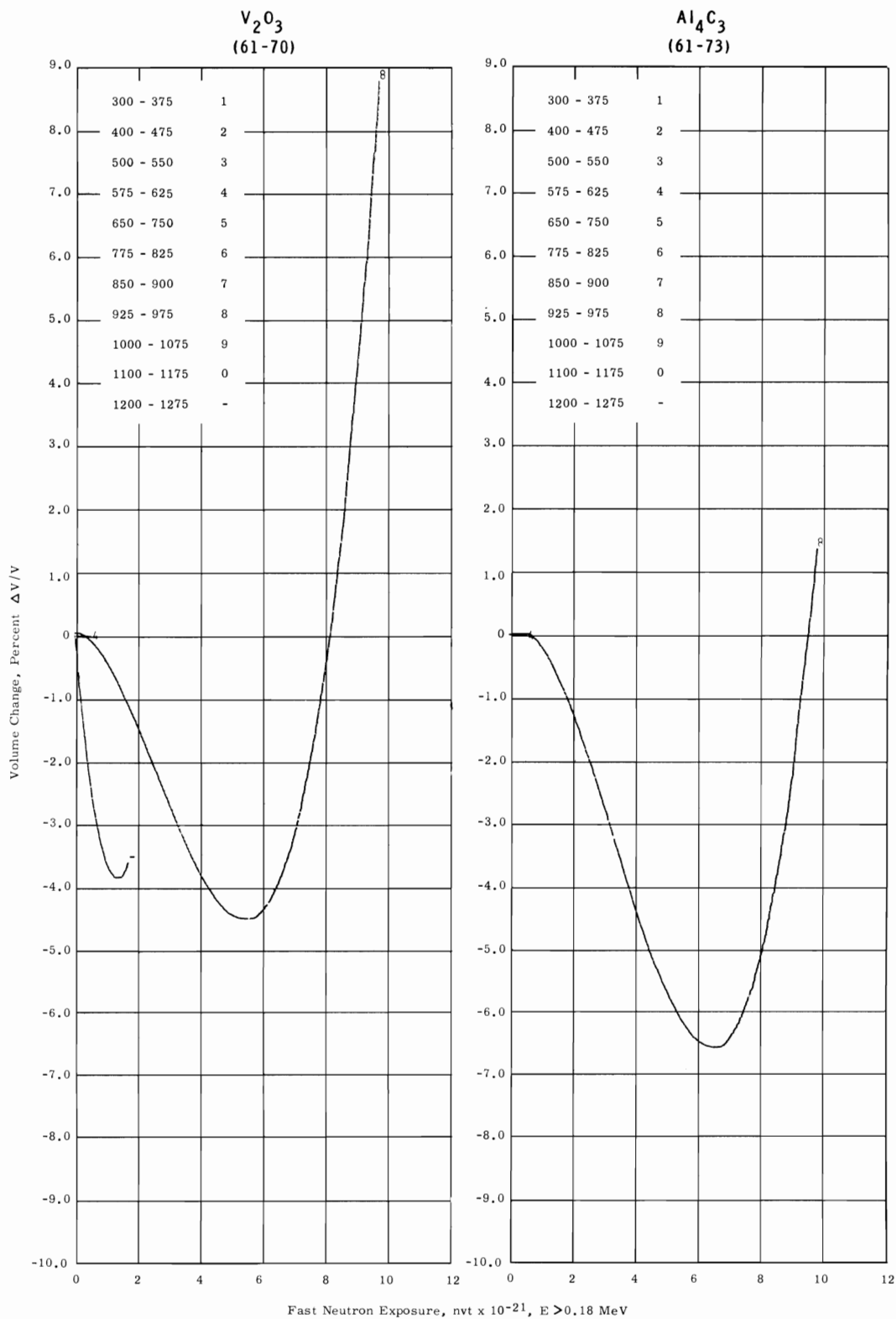


FIGURE E10. Volume Change of Additive Graphites

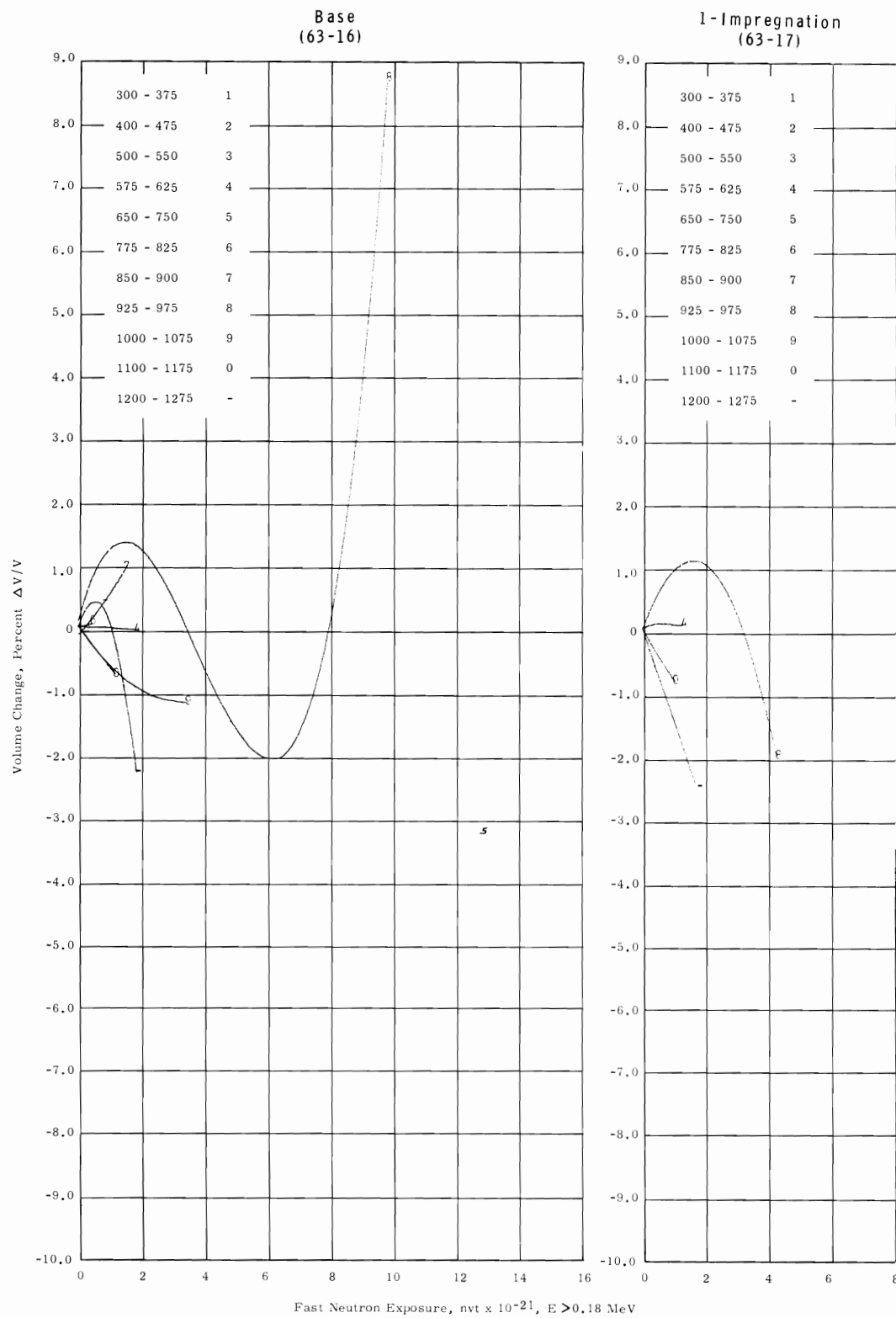


FIGURE E11. Volume Change of Raw-Coke Graphites

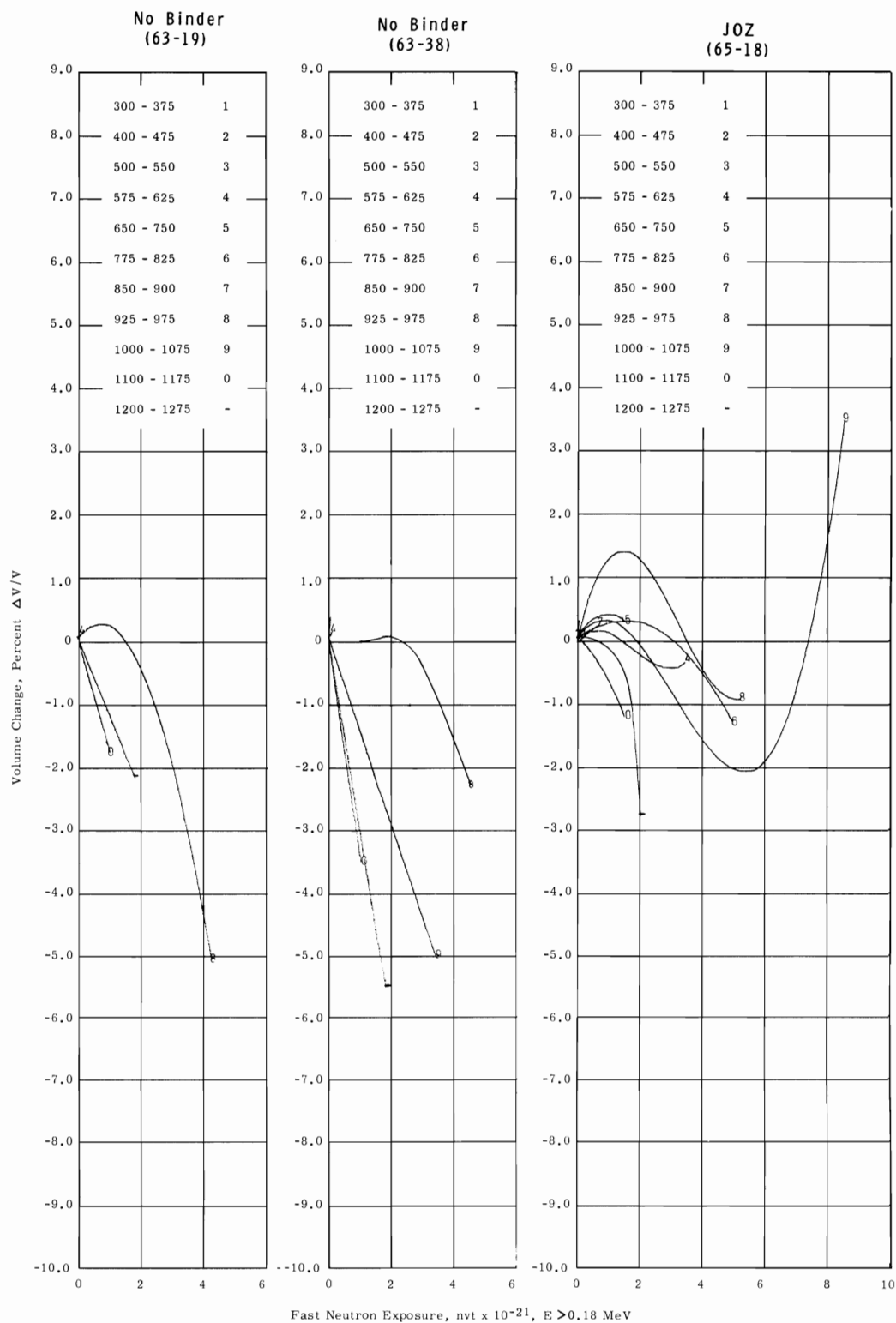


FIGURE E12. Volume Change of Raw-Coke Graphites

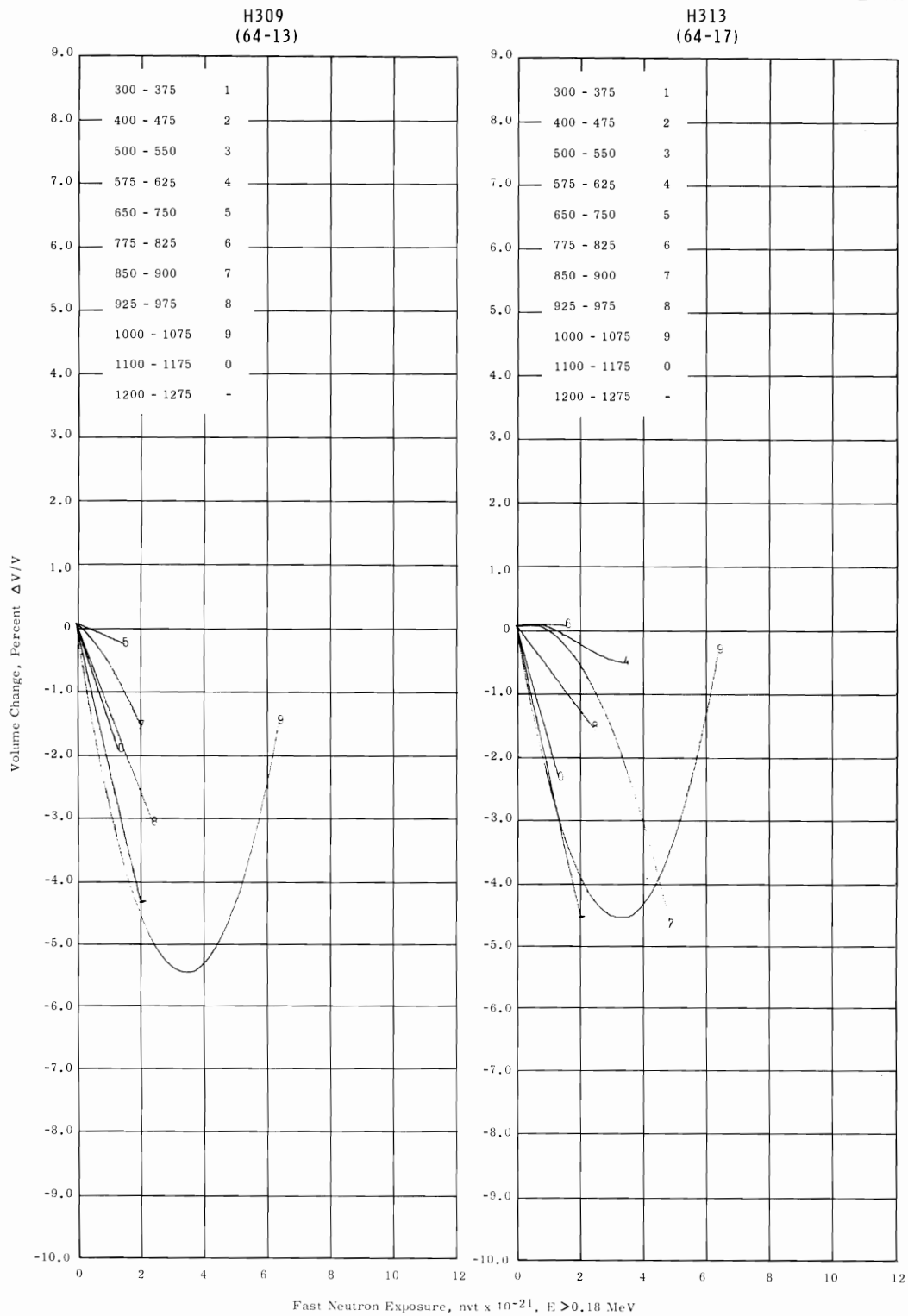


FIGURE E13. Volume Change of Coking Temperature Series Graphites

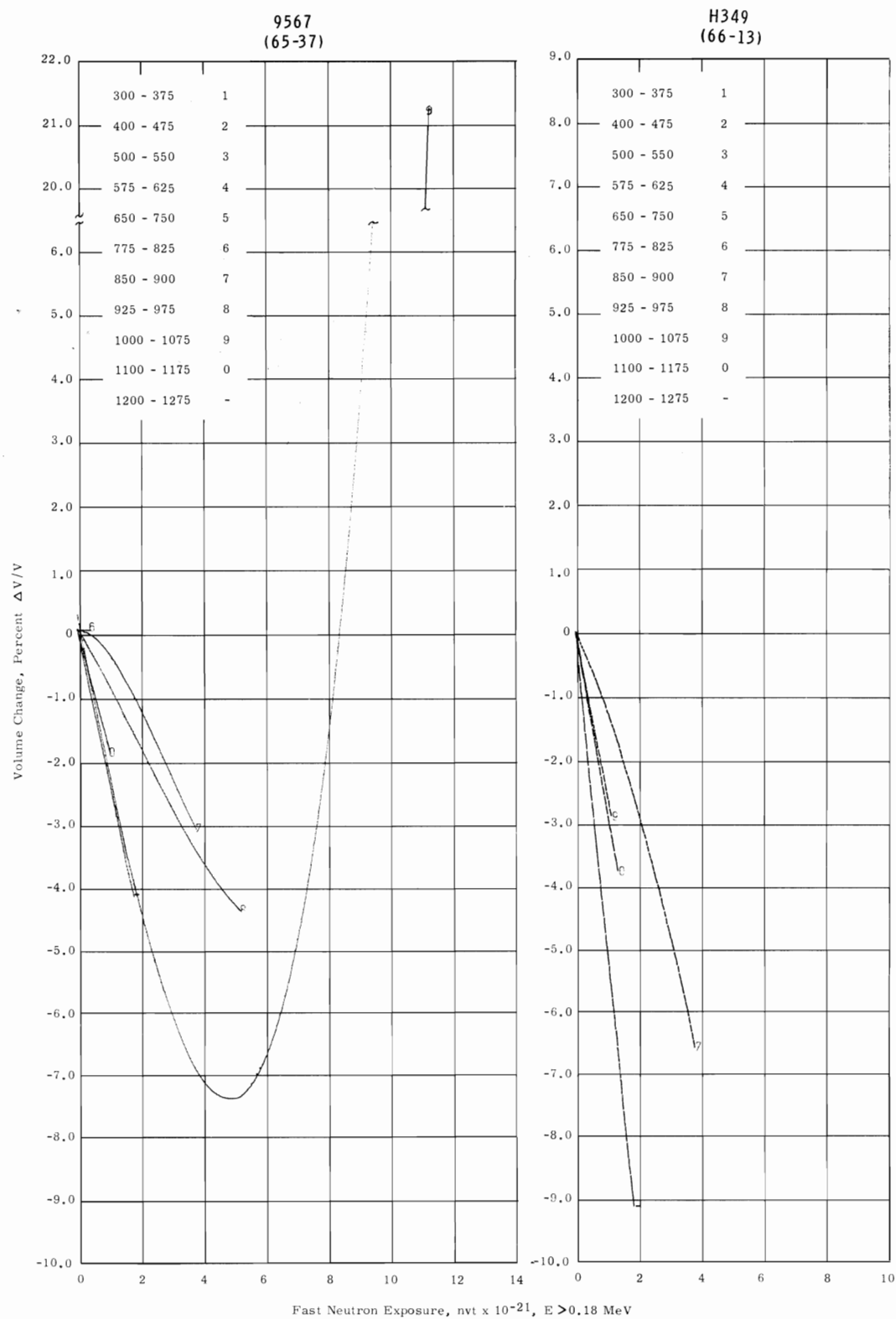


FIGURE E14. Volume Change of Experimental Graphites

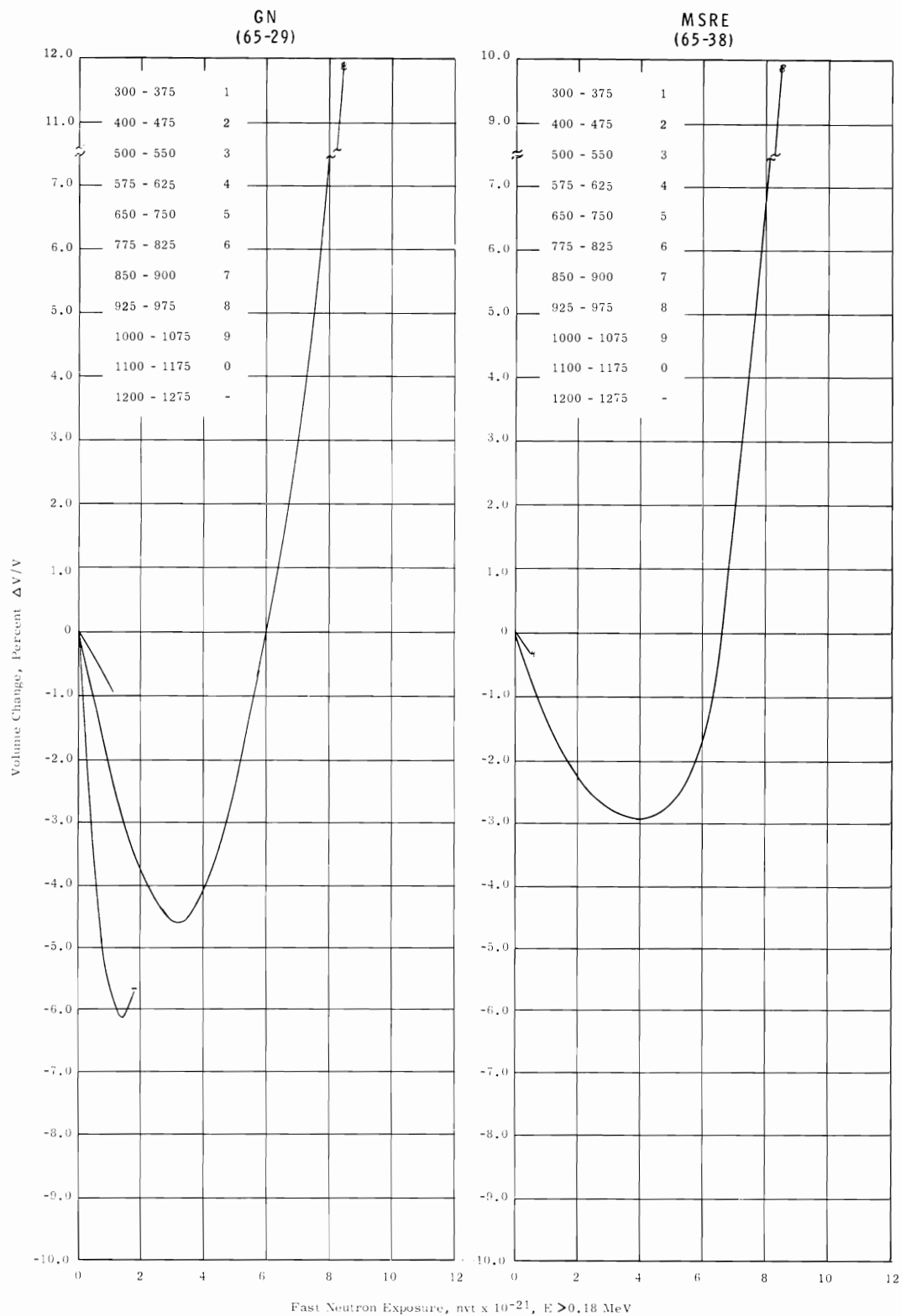


FIGURE E15. Volume Change of Nuclear-Grade Graphites

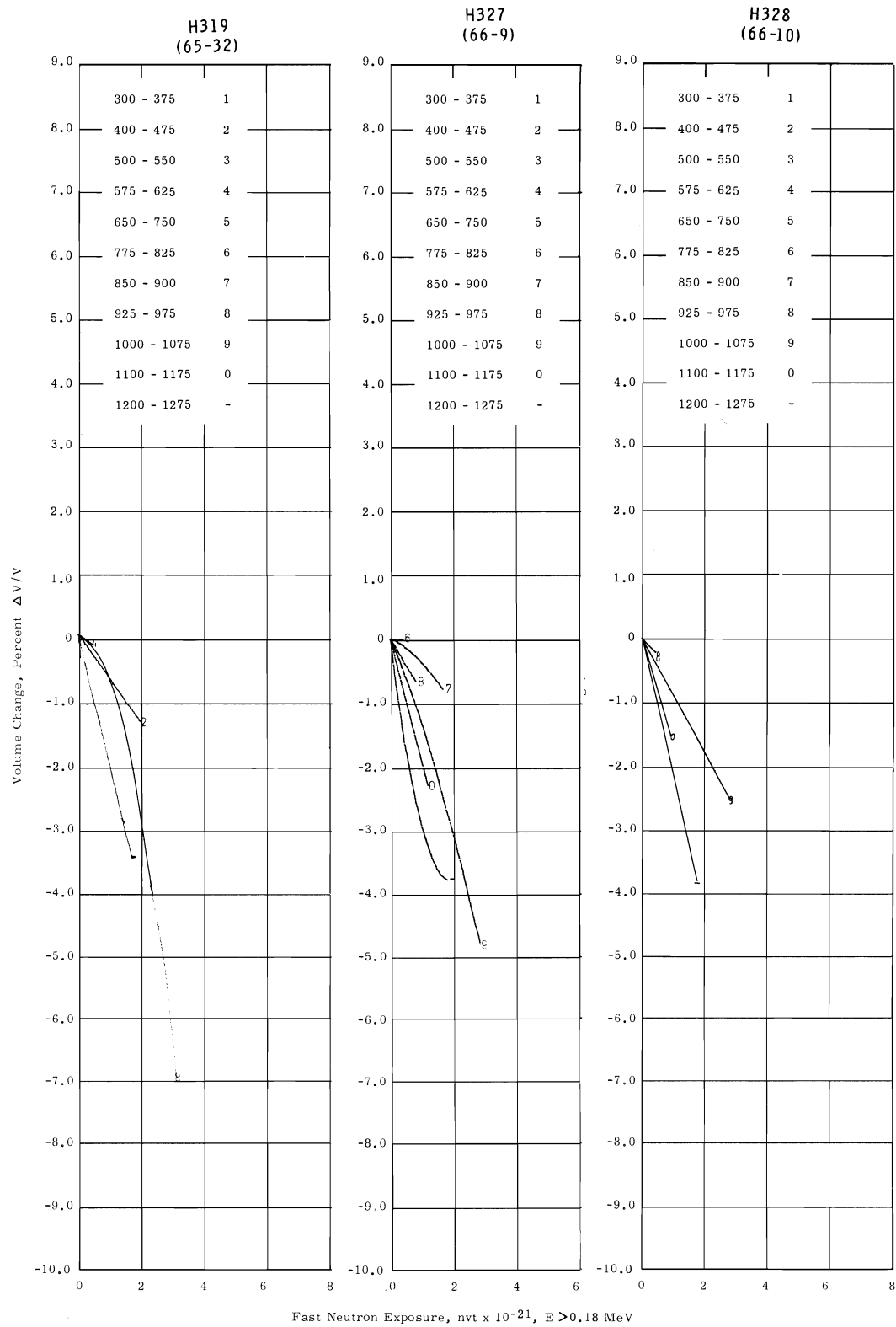


FIGURE E16. Volume Change of Developmental Graphites

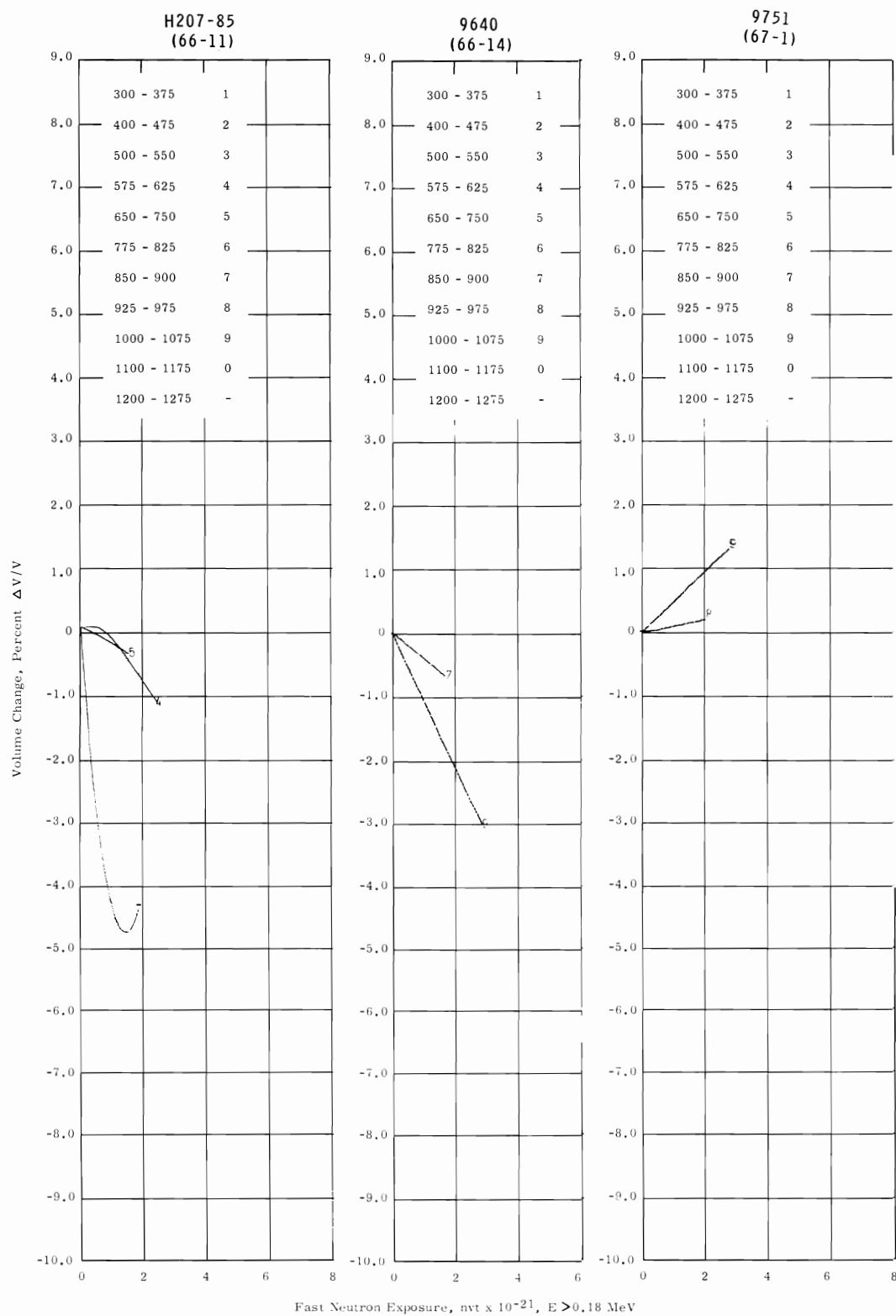


FIGURE E17. Volume Change of Developmental Graphites

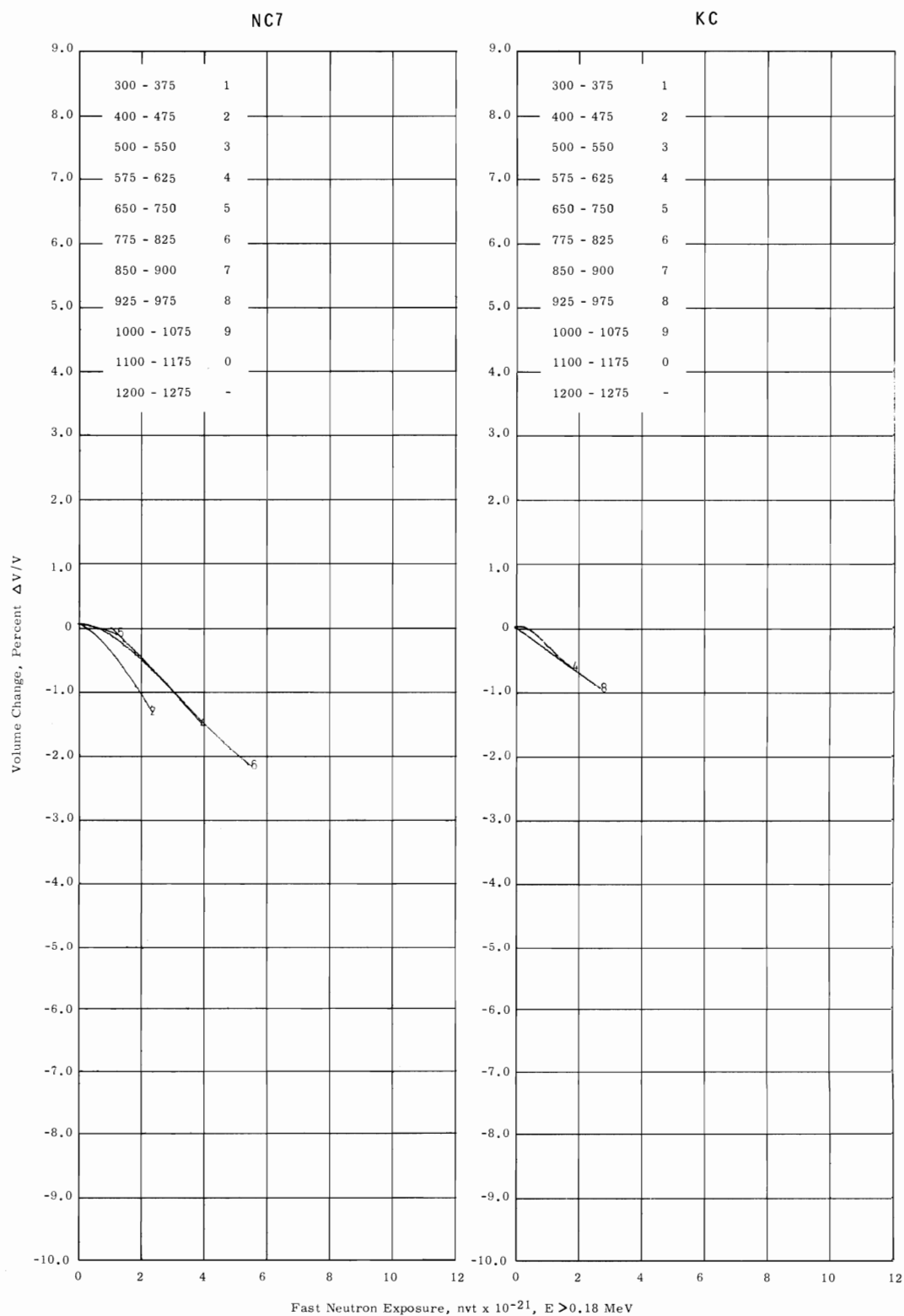


FIGURE E18. Volume Change of Reactor Grade Graphites

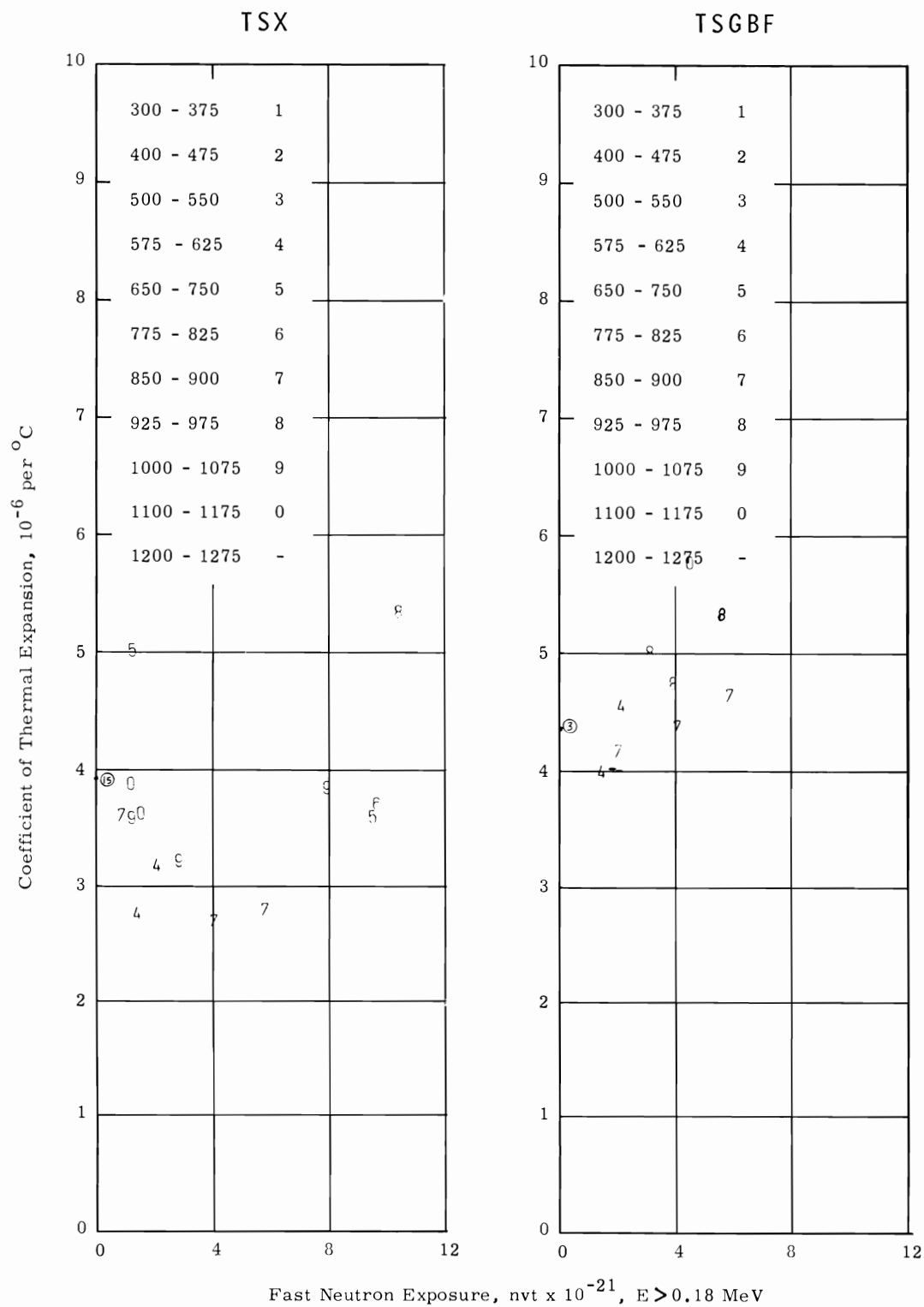


FIGURE E19. Coefficient of Thermal Expansion of TSX and TSGBF Graphites (Transverse)

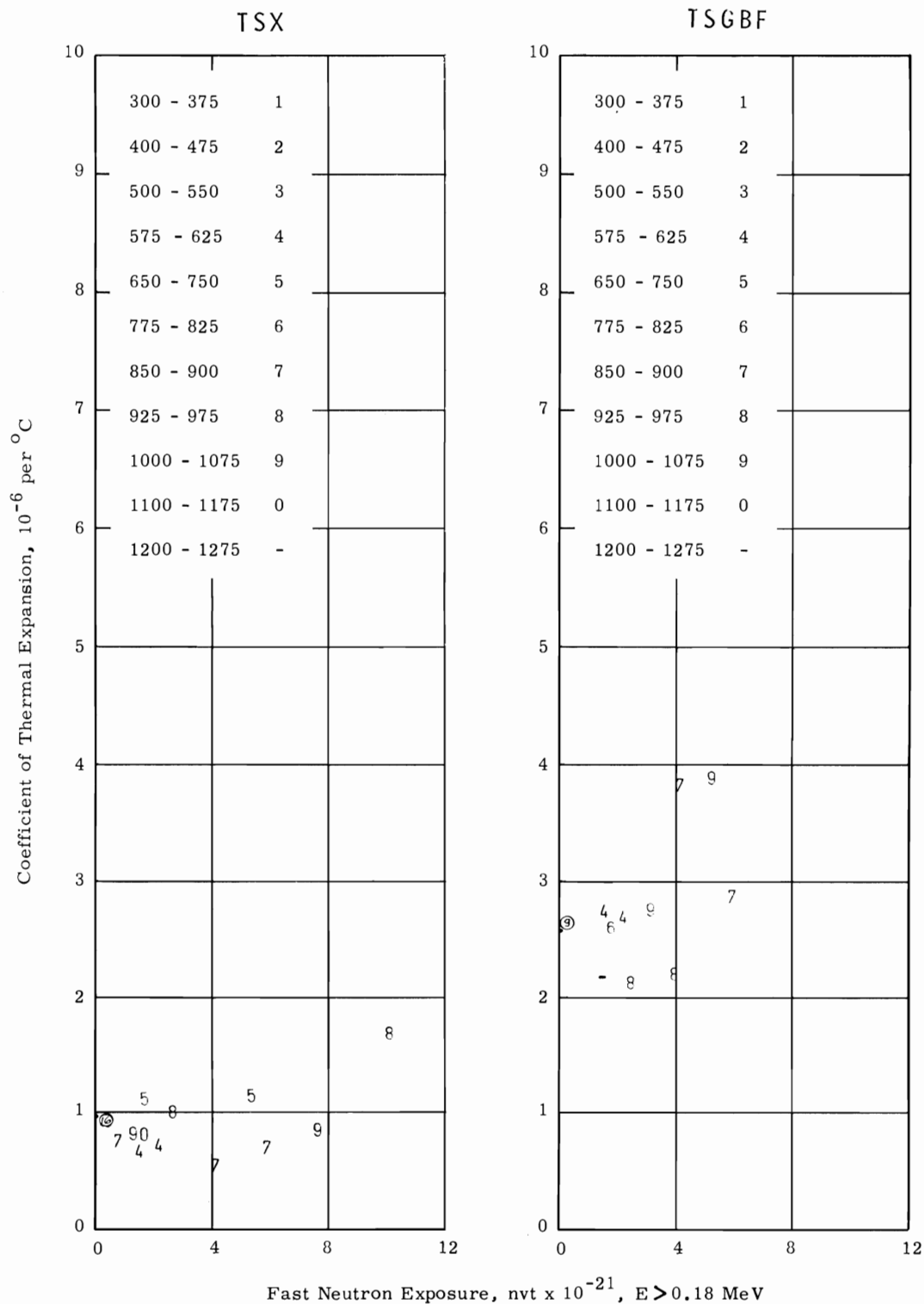


FIGURE E20. Coefficient of Thermal Expansion of TSX and TSGBF Graphites (Parallel)

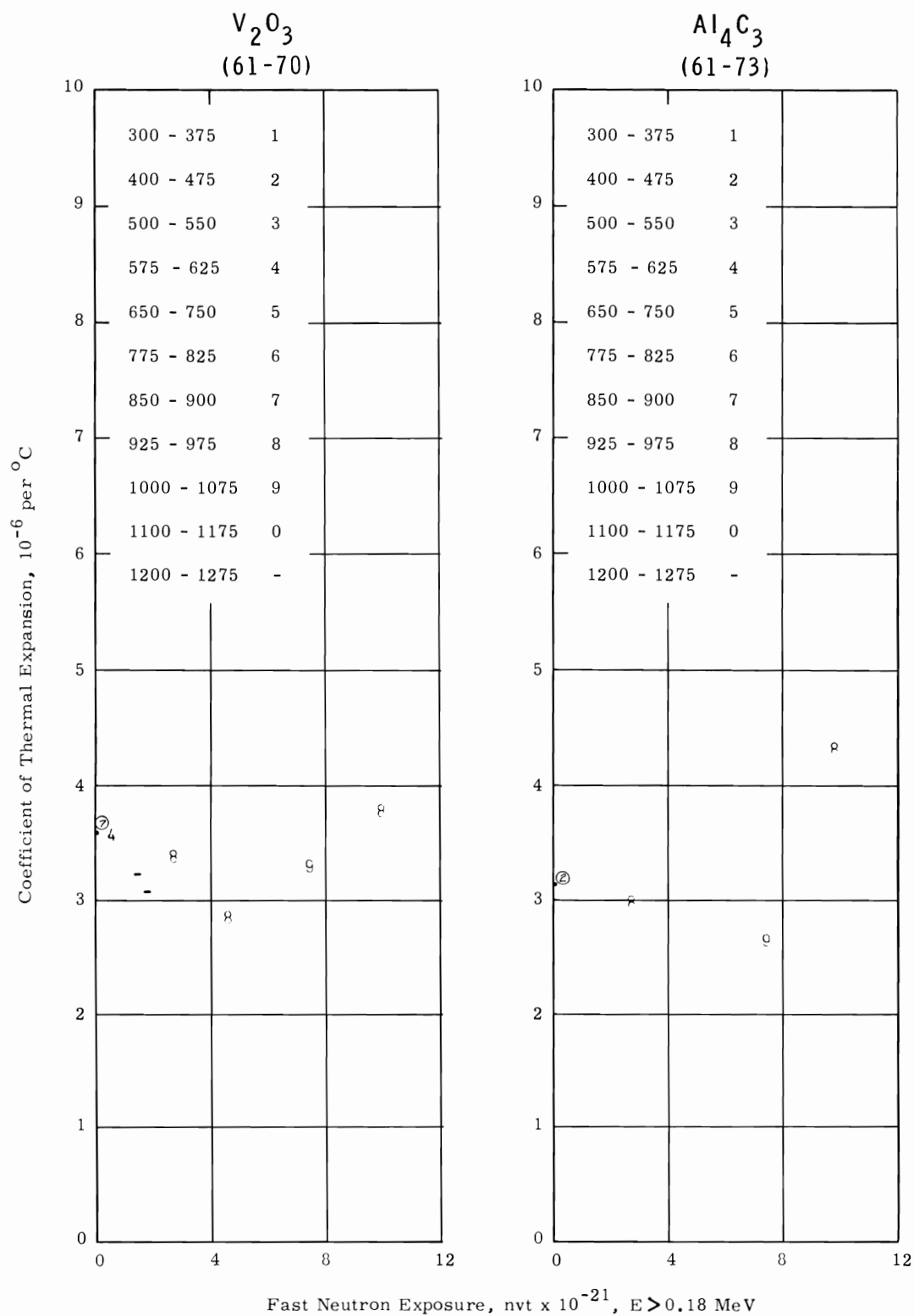


FIGURE E21. Coefficient of Thermal Expansion of Additive Graphites (Transverse)

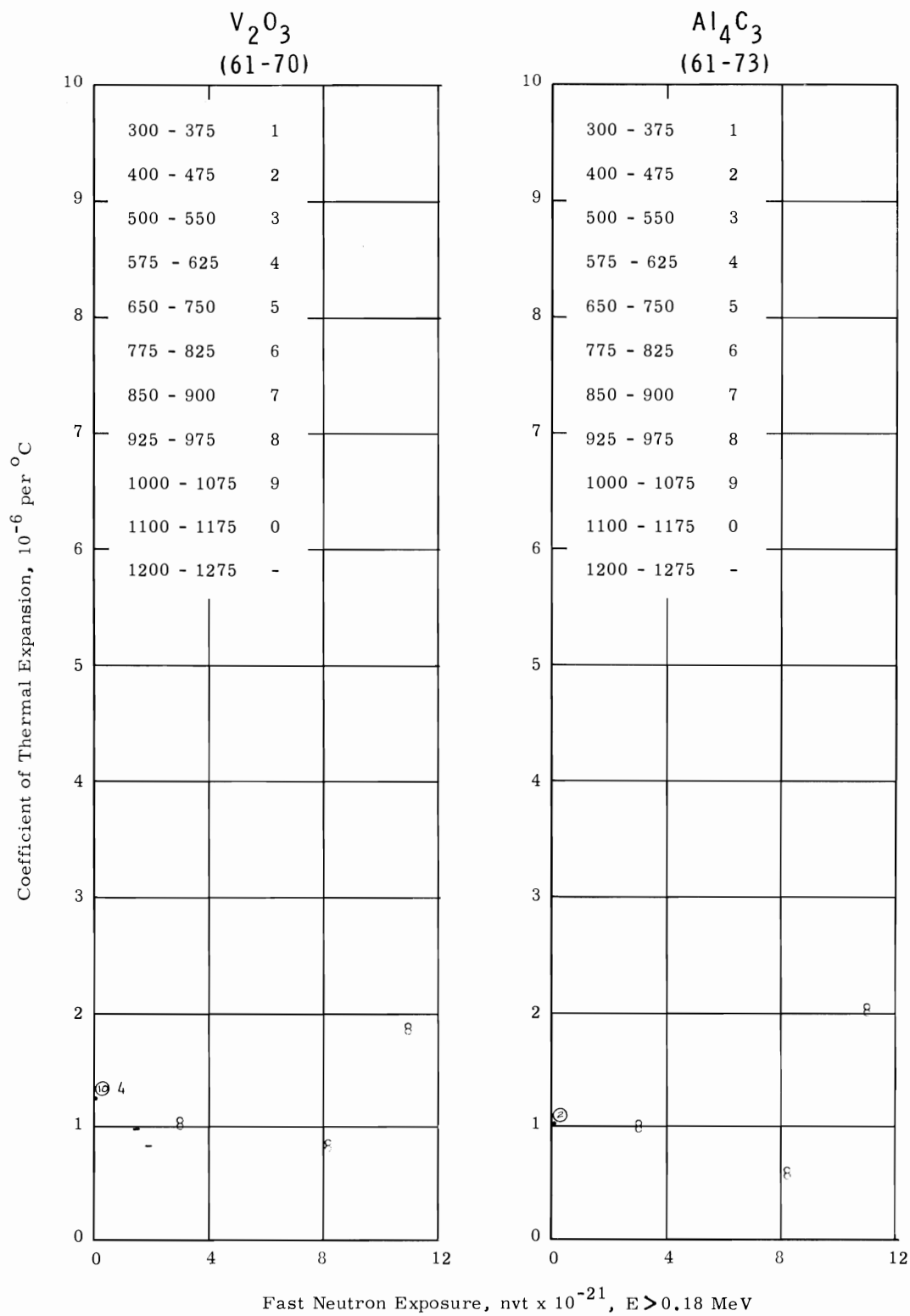


FIGURE E22. Coefficient of Thermal Expansion of Additive Graphites (Parallel)

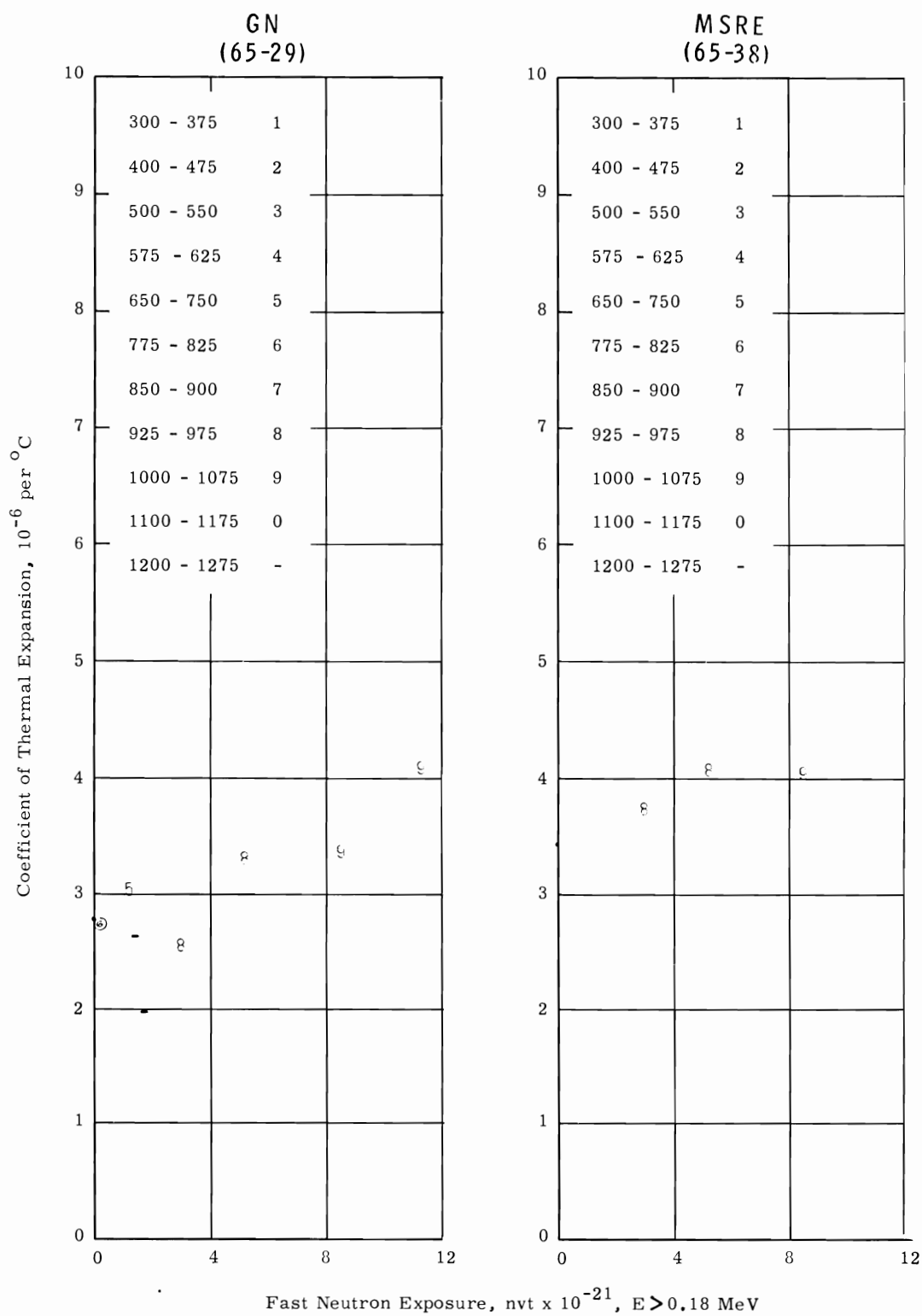


FIGURE E23. Coefficient of Thermal Expansion of Nuclear-Grade Graphites (Transverse)

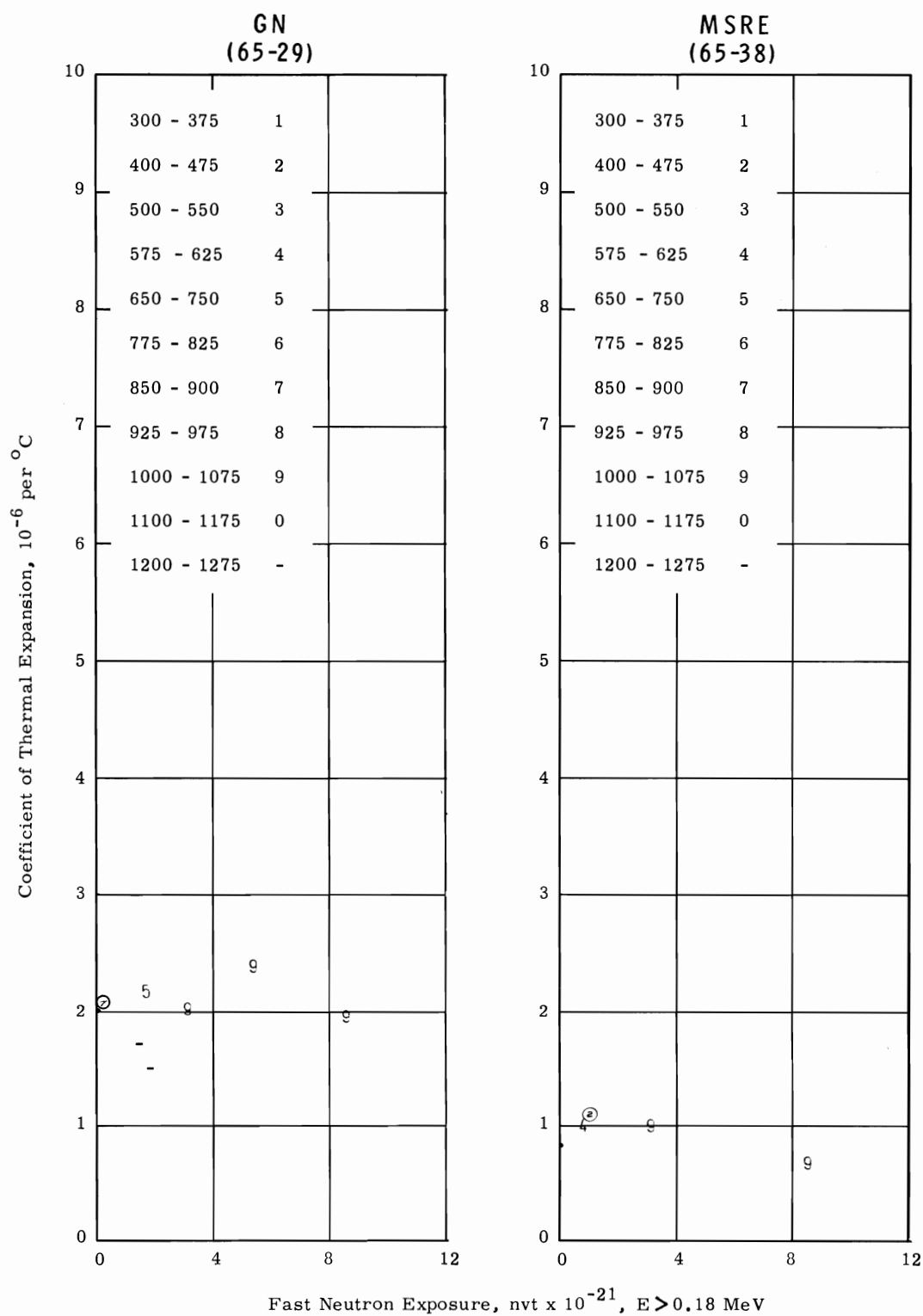


FIGURE E24. Coefficient of Thermal Expansion of Nuclear-Grade Graphites (Parallel)

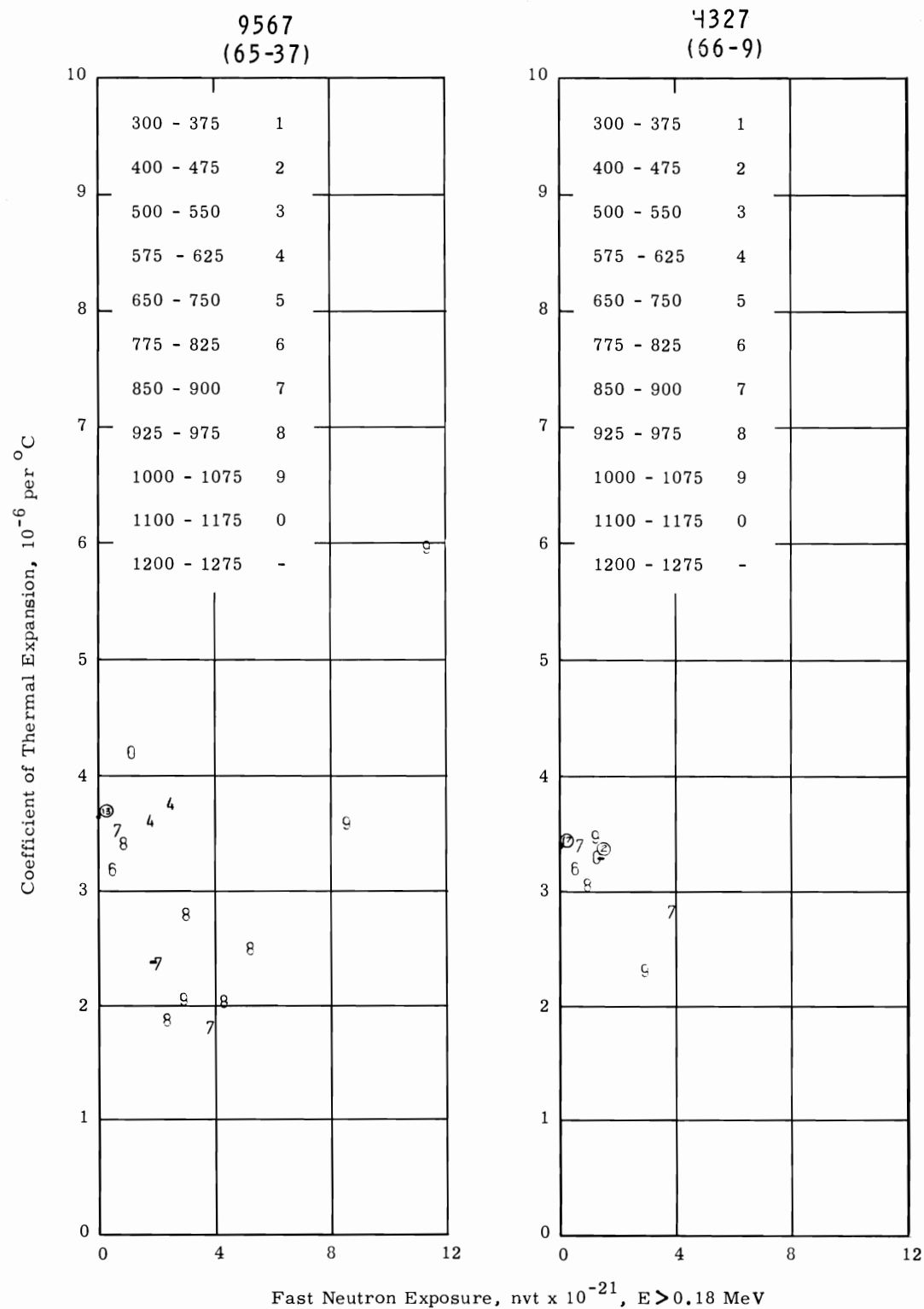


FIGURE E25. *Coefficient of Thermal Expansion of Experimental Graphites (Transverse)*

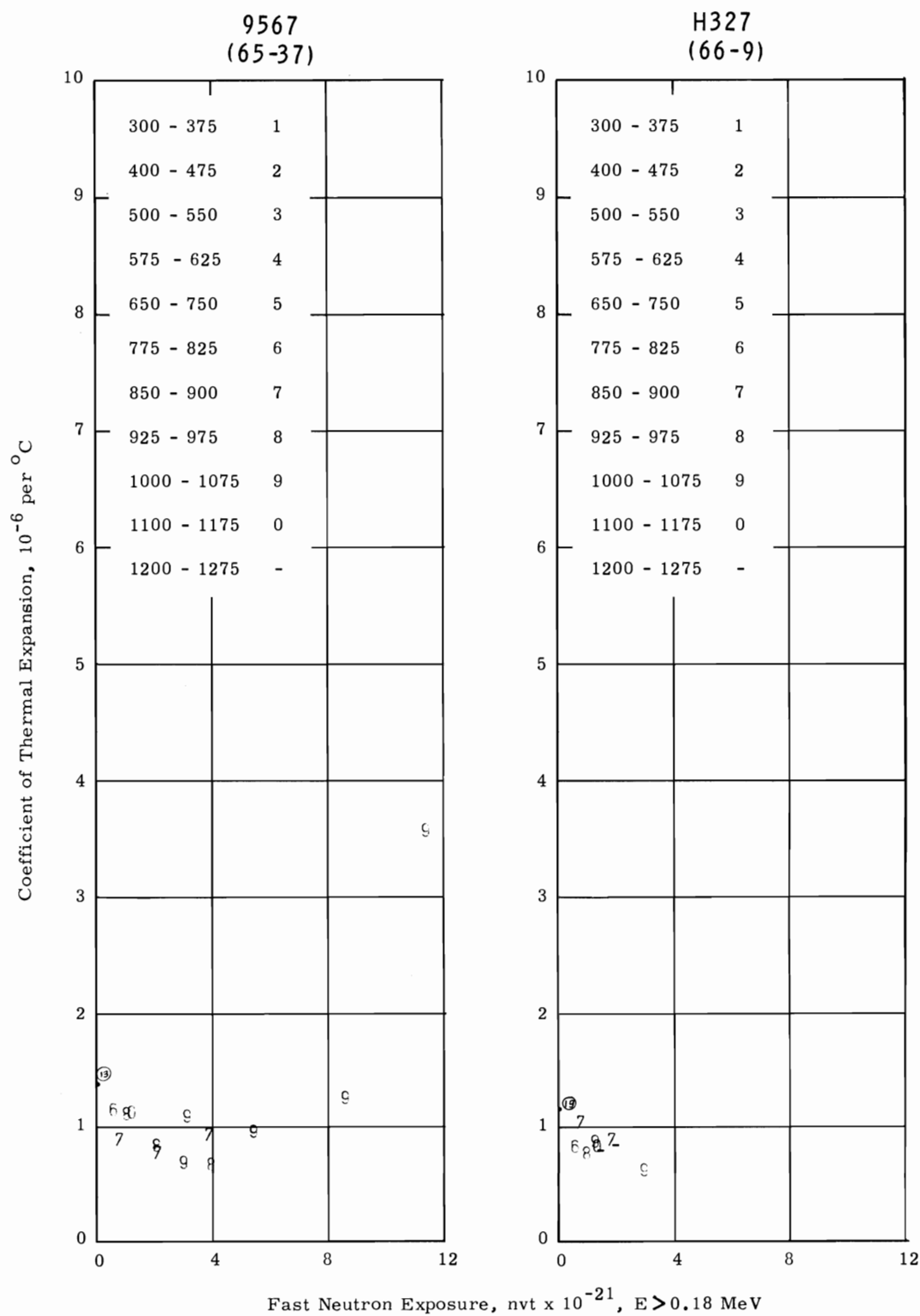


FIGURE E26. *Coefficient of Thermal Expansion of Experimental Graphites (Parallel)*

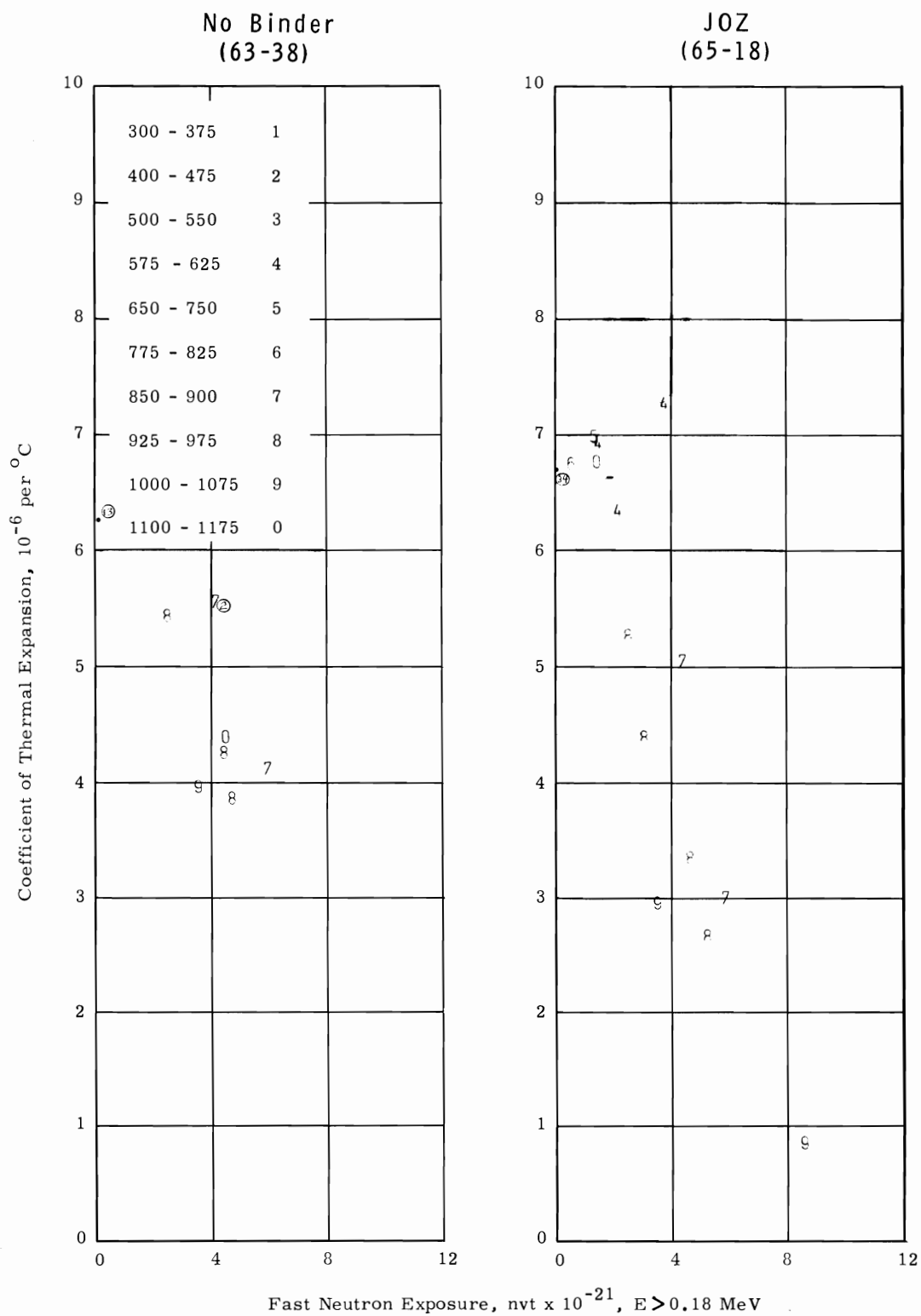


FIGURE E27. *Coefficient of Thermal Expansion of Raw-Coke Graphites (Transverse)*

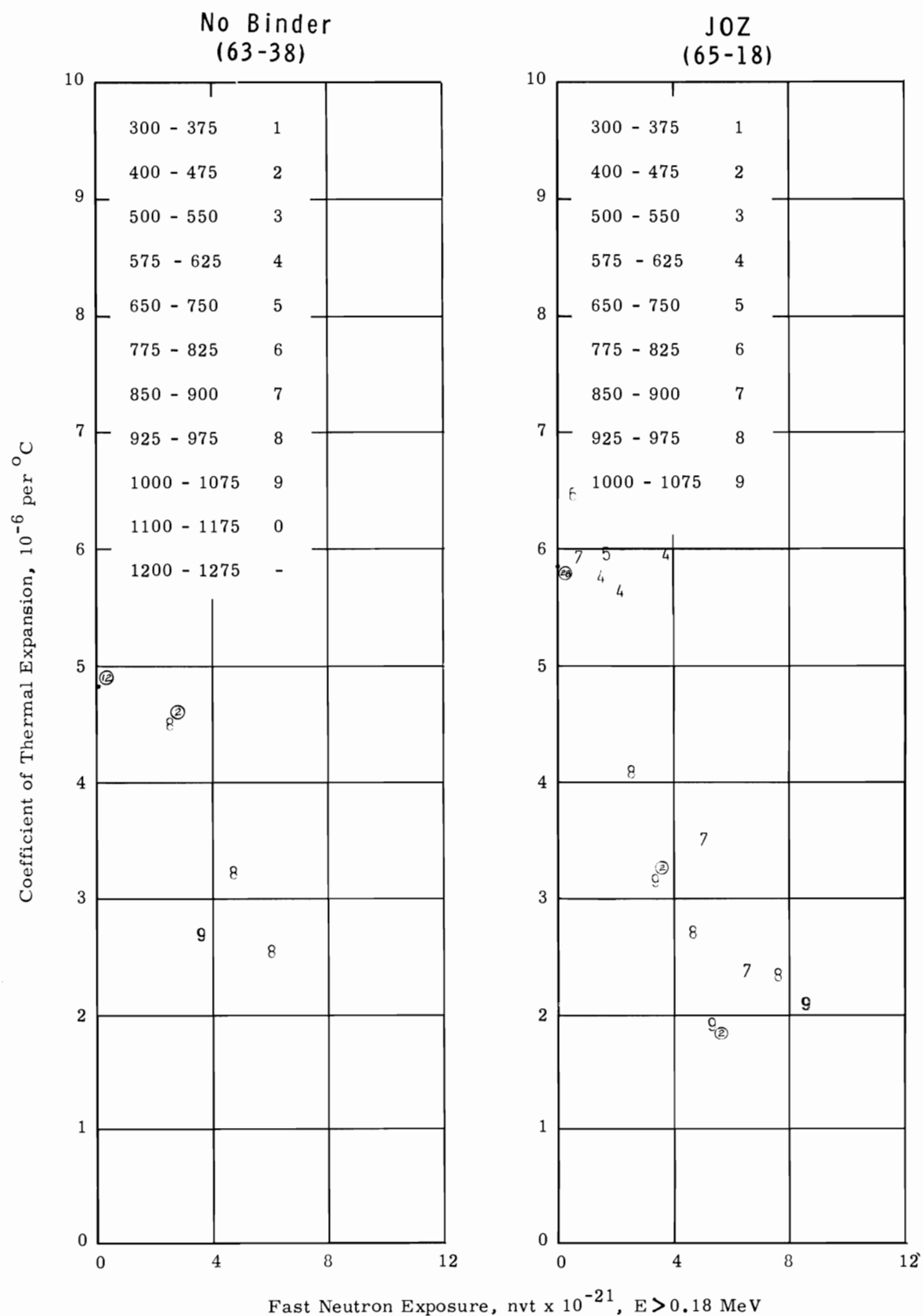


FIGURE E28. *Coefficient of Thermal Expansion of Raw-Coke Graphites (Parallel)*

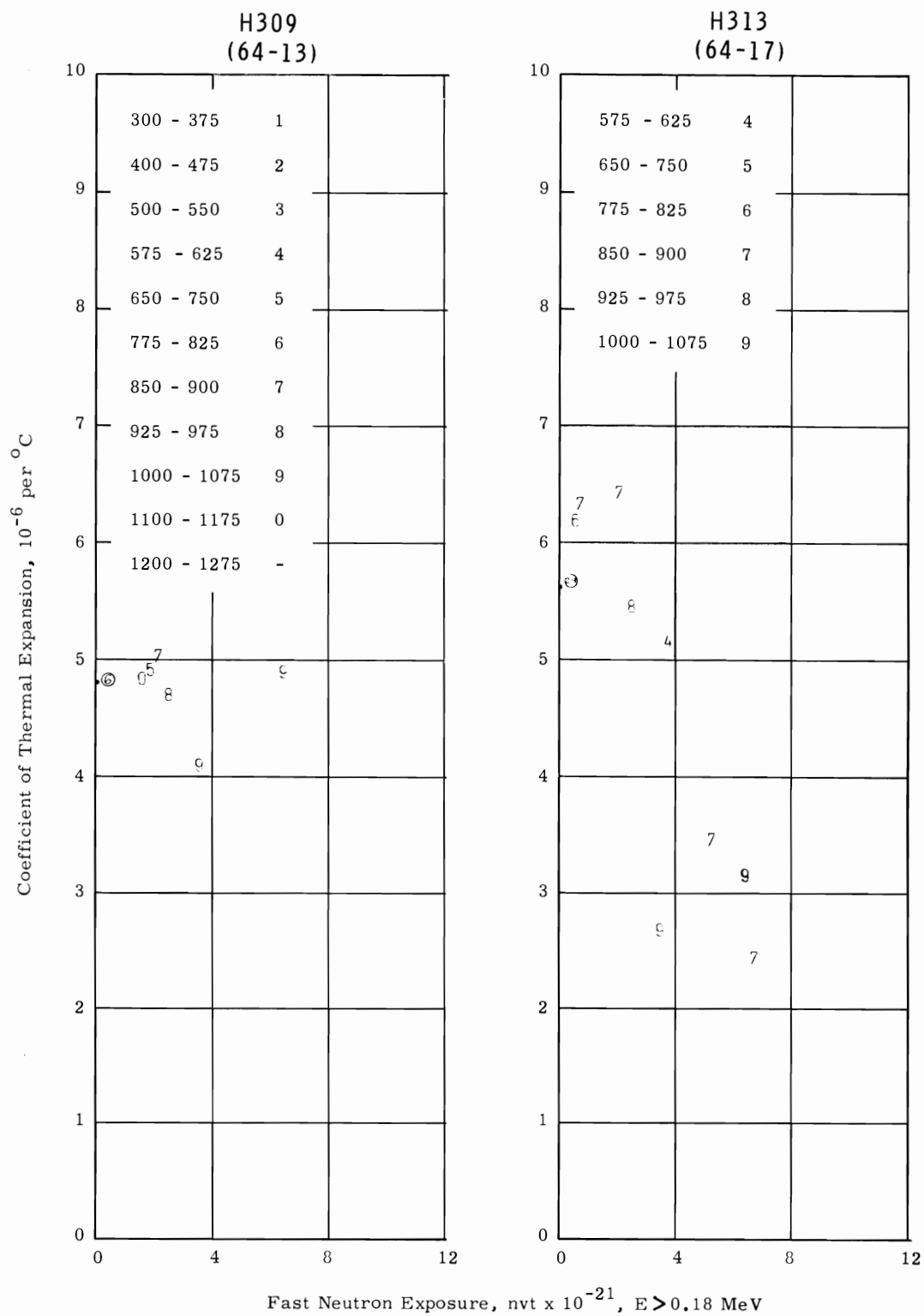


FIGURE E29. Coefficient of Thermal Expansion of Coking Temperature Series Graphites (Transverse)

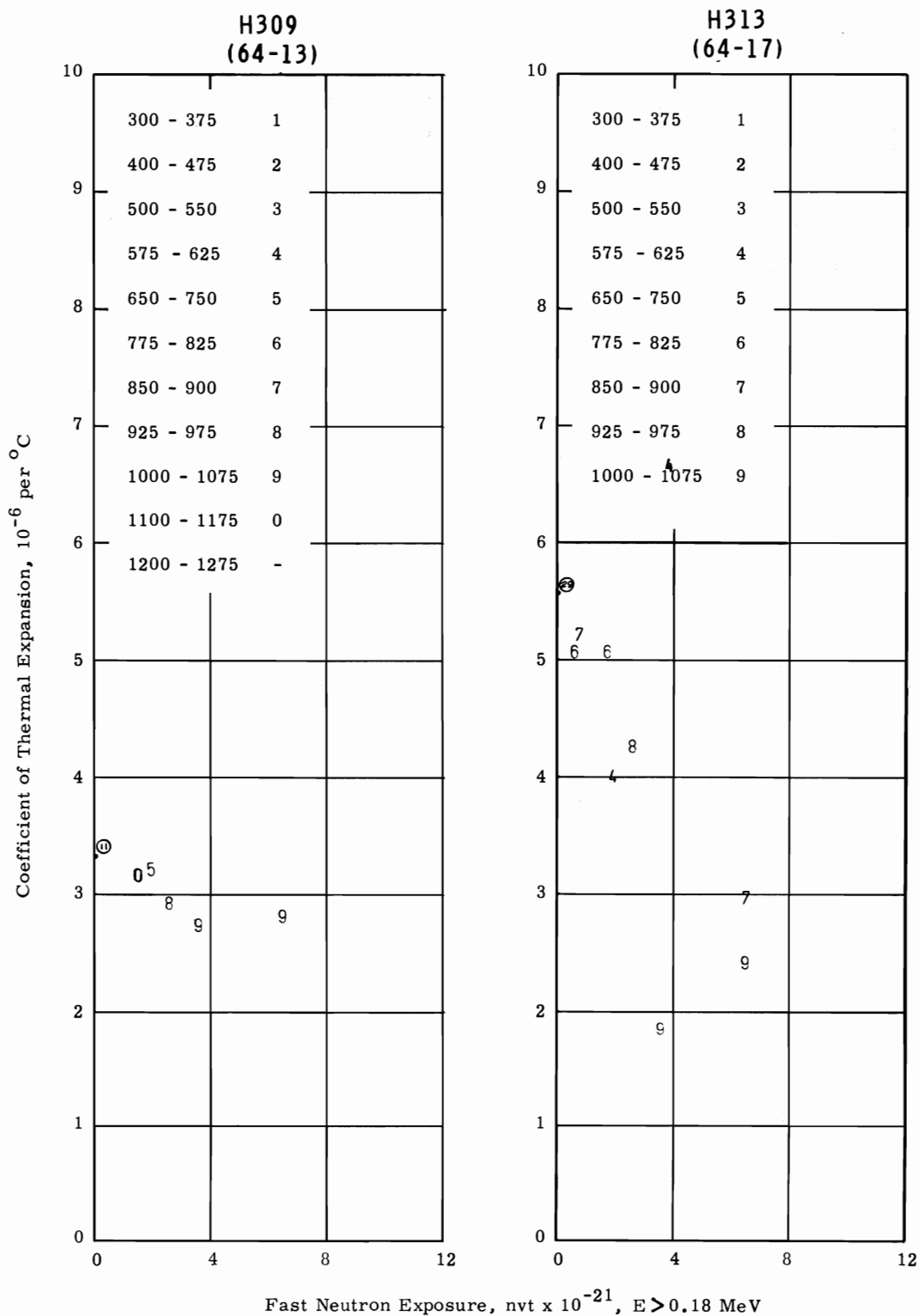


FIGURE E30. Coefficient of Thermal Expansion of Coking Temperature Series Graphites (Parallel)

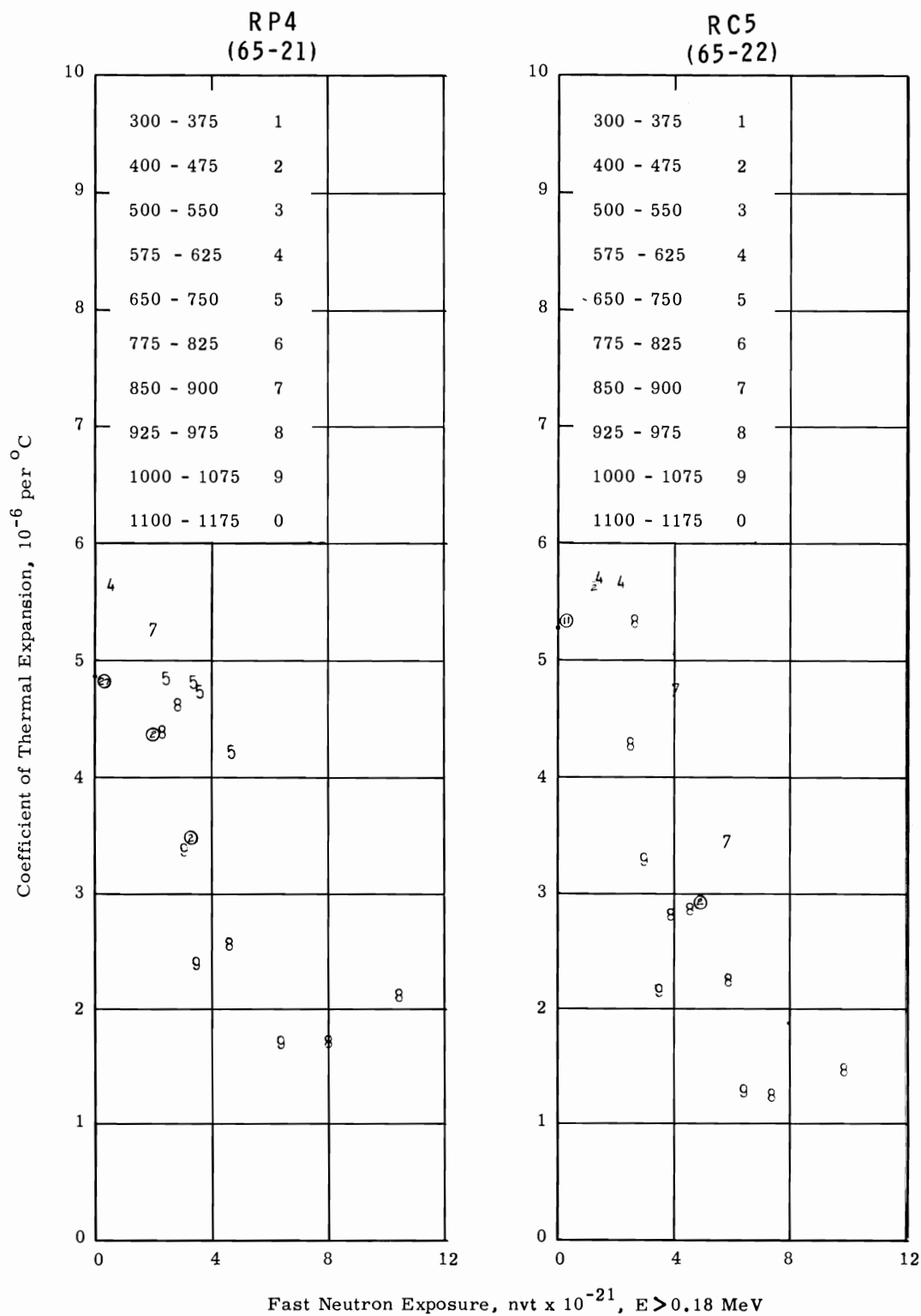


FIGURE E31. Coefficient of Thermal Expansion of Isotropic Graphites (Transverse)

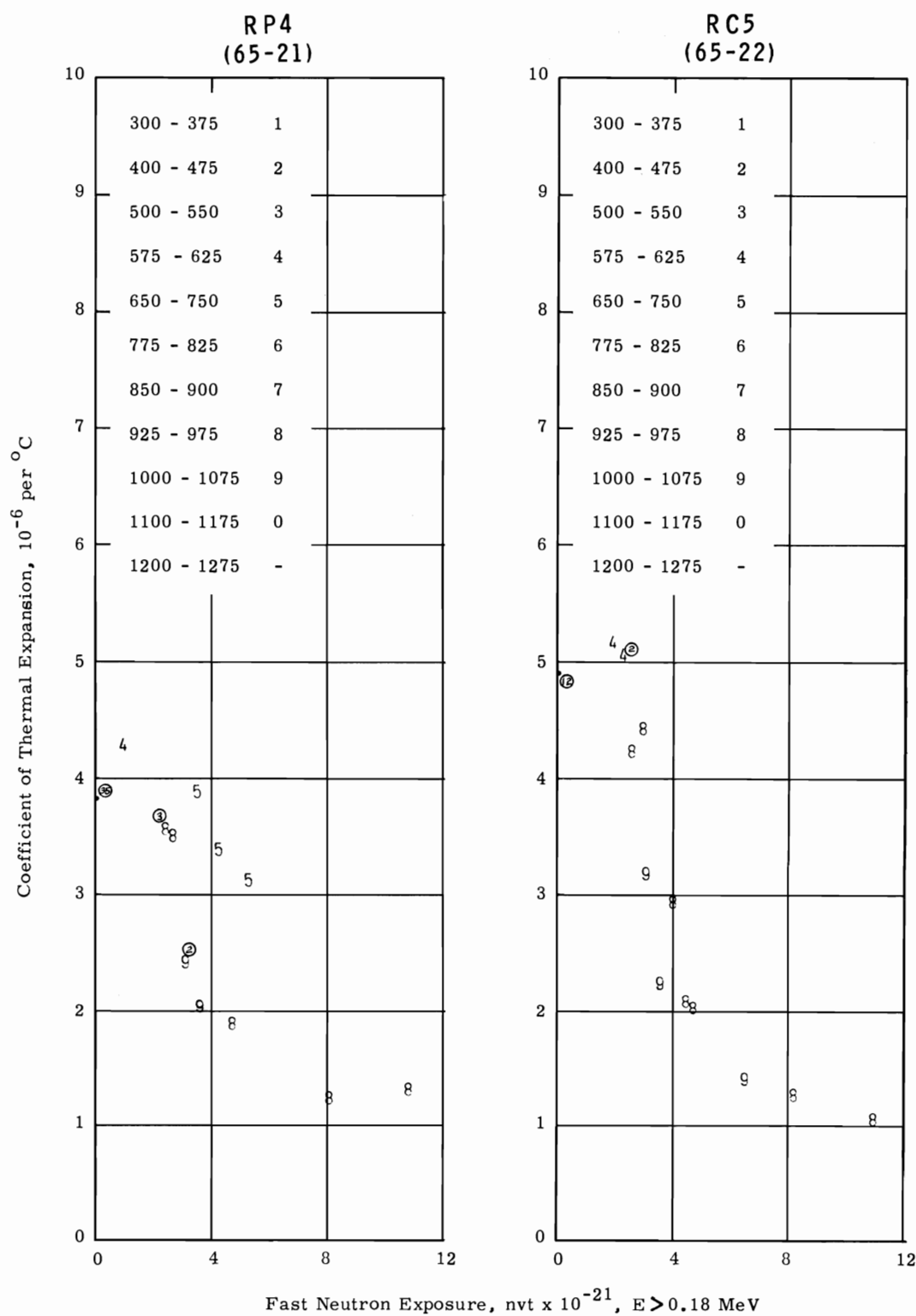


FIGURE E32. *Coefficient of Thermal Expansion of Isotropic Graphites (Parallel)*

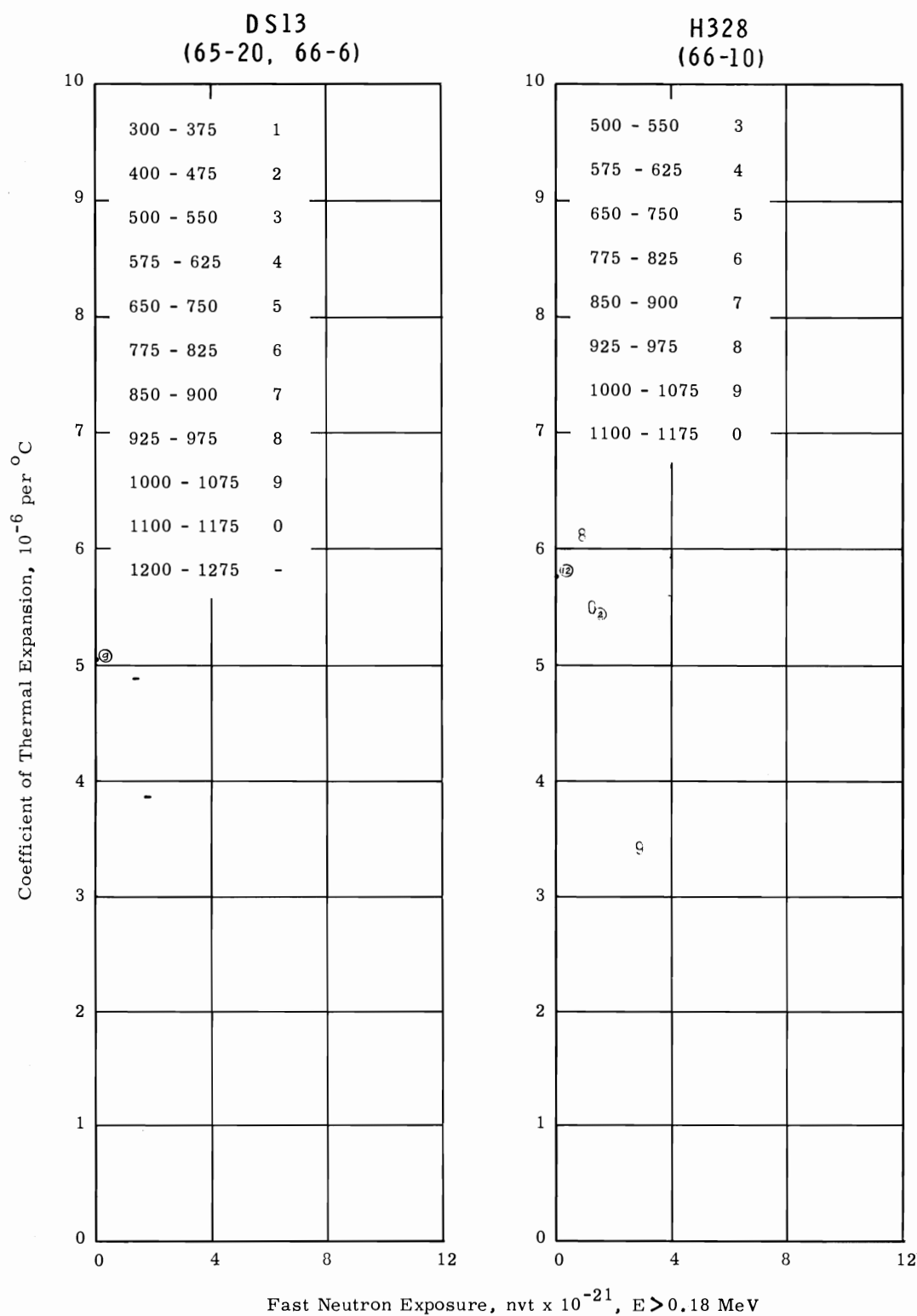


FIGURE E33. Co-efficient of Thermal Expansion of Specialty Graphites (Transverse)

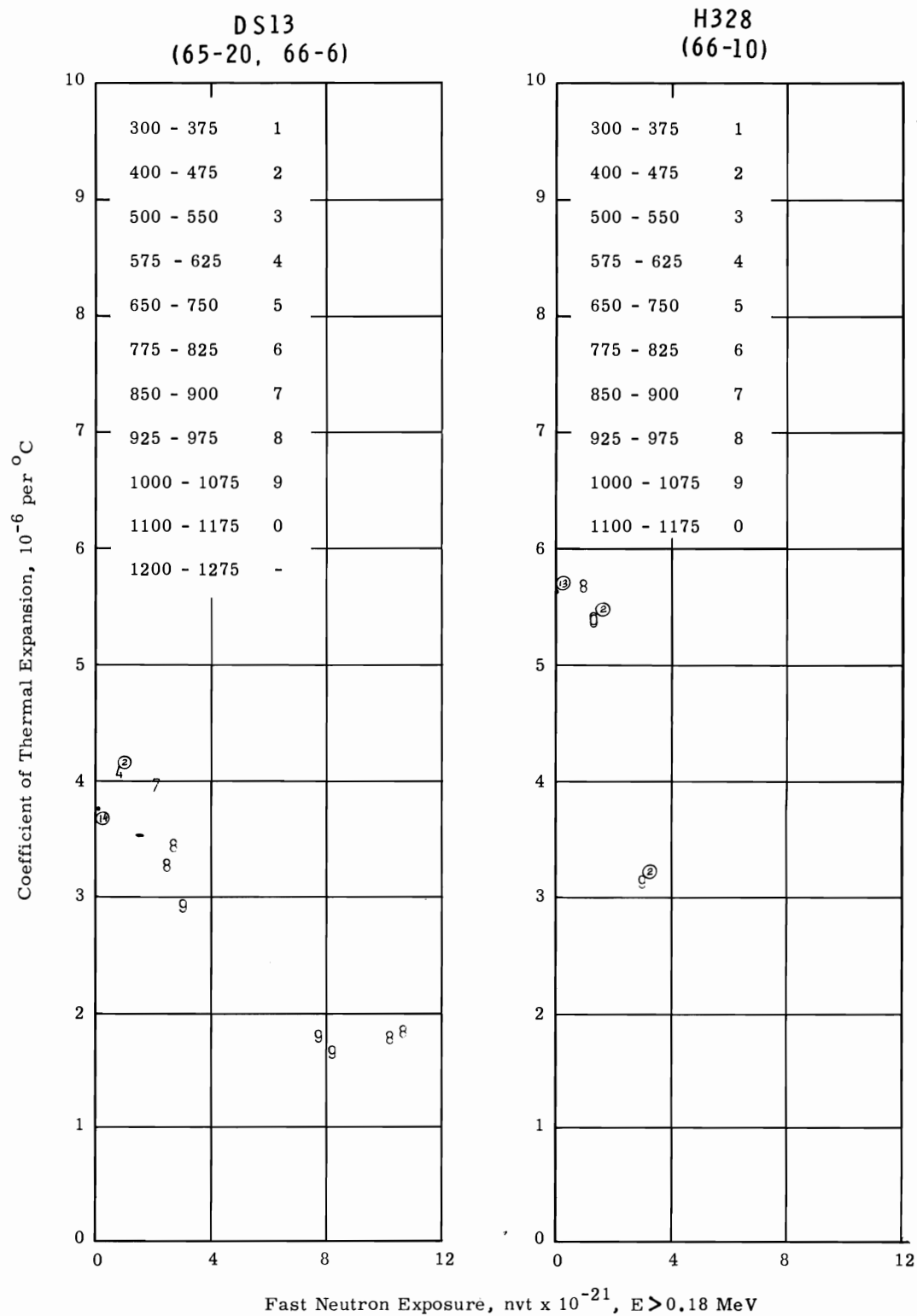


FIGURE E34. Coefficient of Thermal Expansion of Specialty Graphites (Parallel)

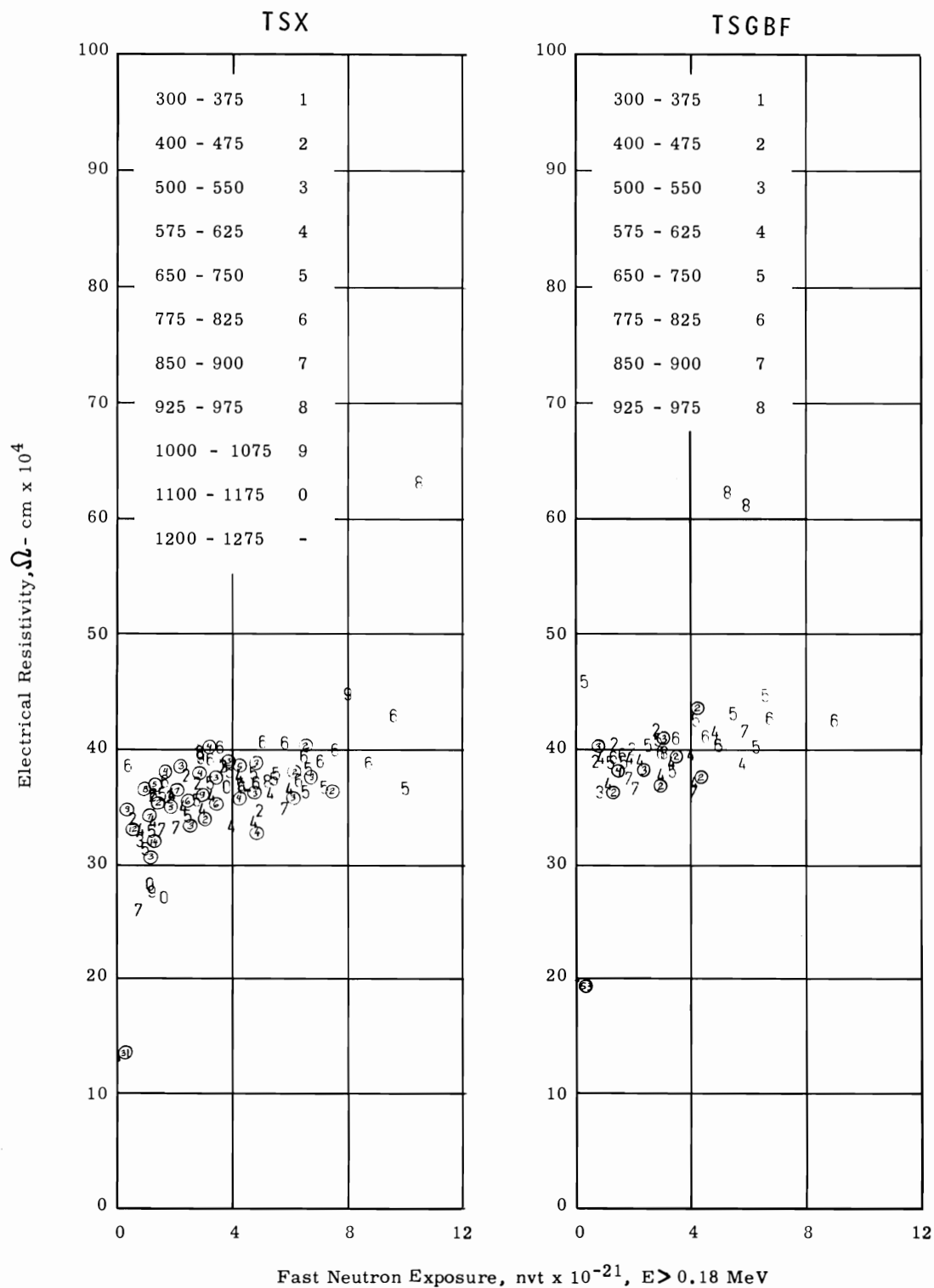


FIGURE E35. *Electrical Resistivity of TSX and TSGBF Graphites (Transverse)*

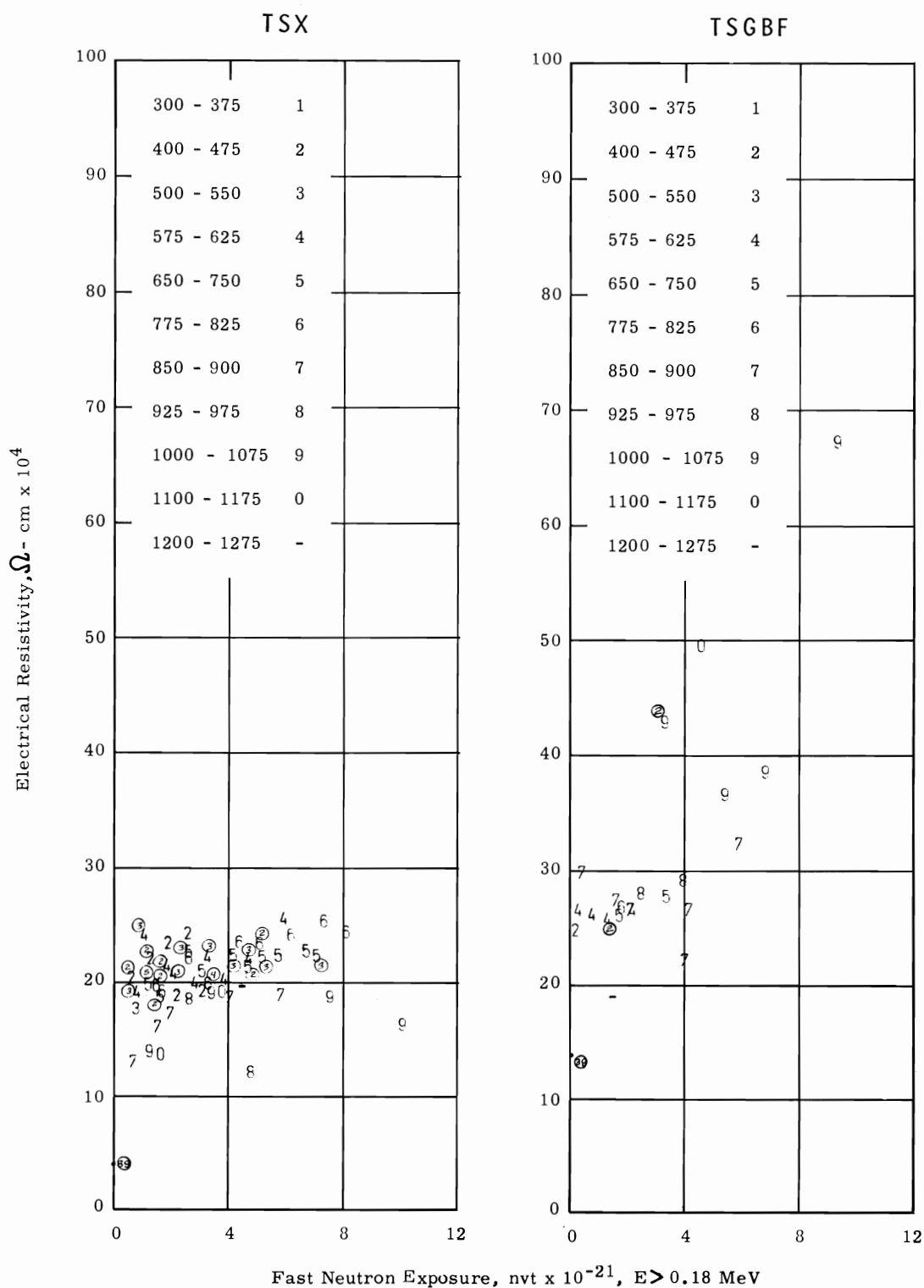


FIGURE E36. *Electrical Resistivity of TSX and TSGBF Graphites (Parallel)*

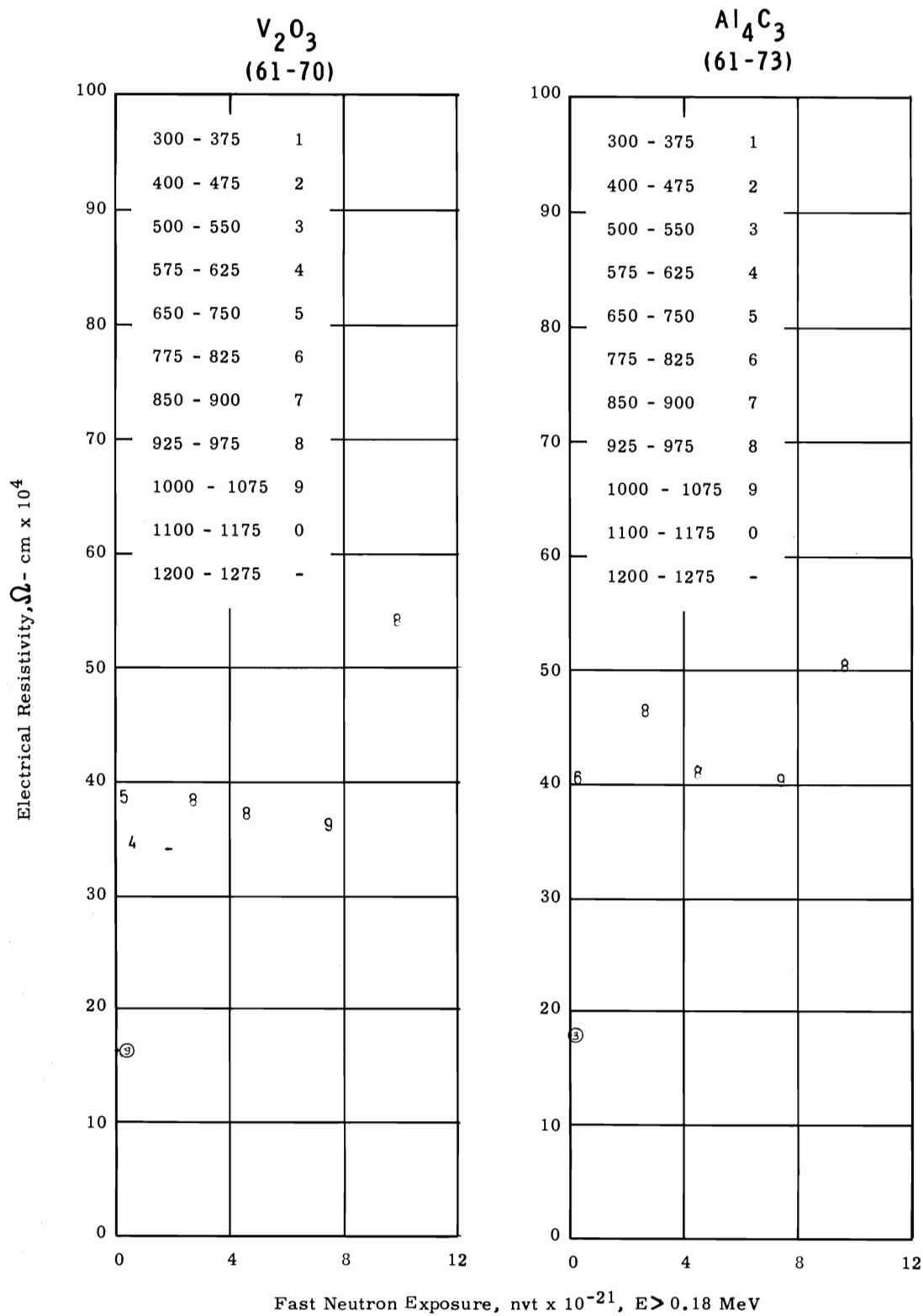


FIGURE E37. *Electrical Resistivity of Additive Graphites (Transverse)*

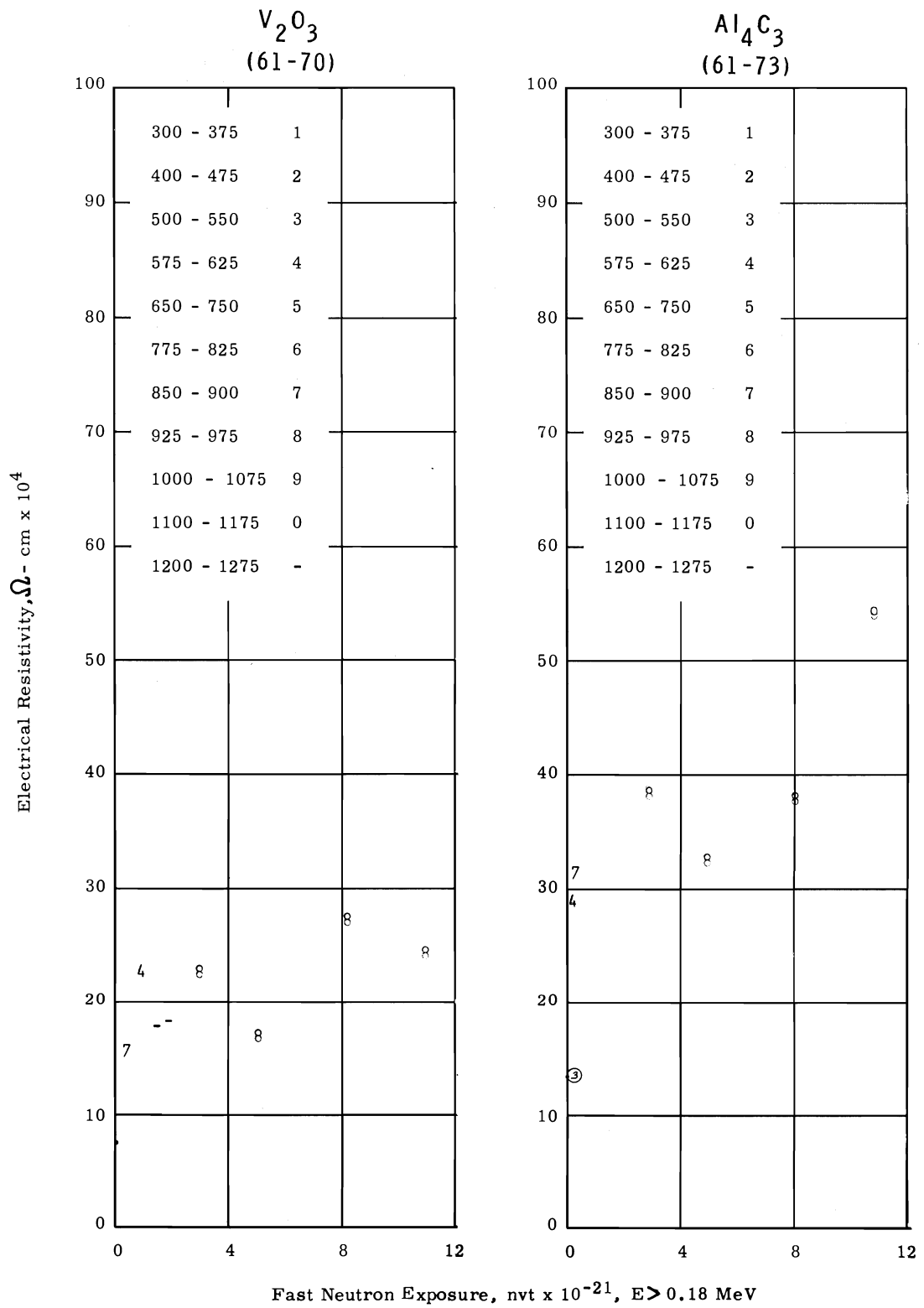


FIGURE E38. *Electrical Resistivity of Additive Graphites (Parallel)*

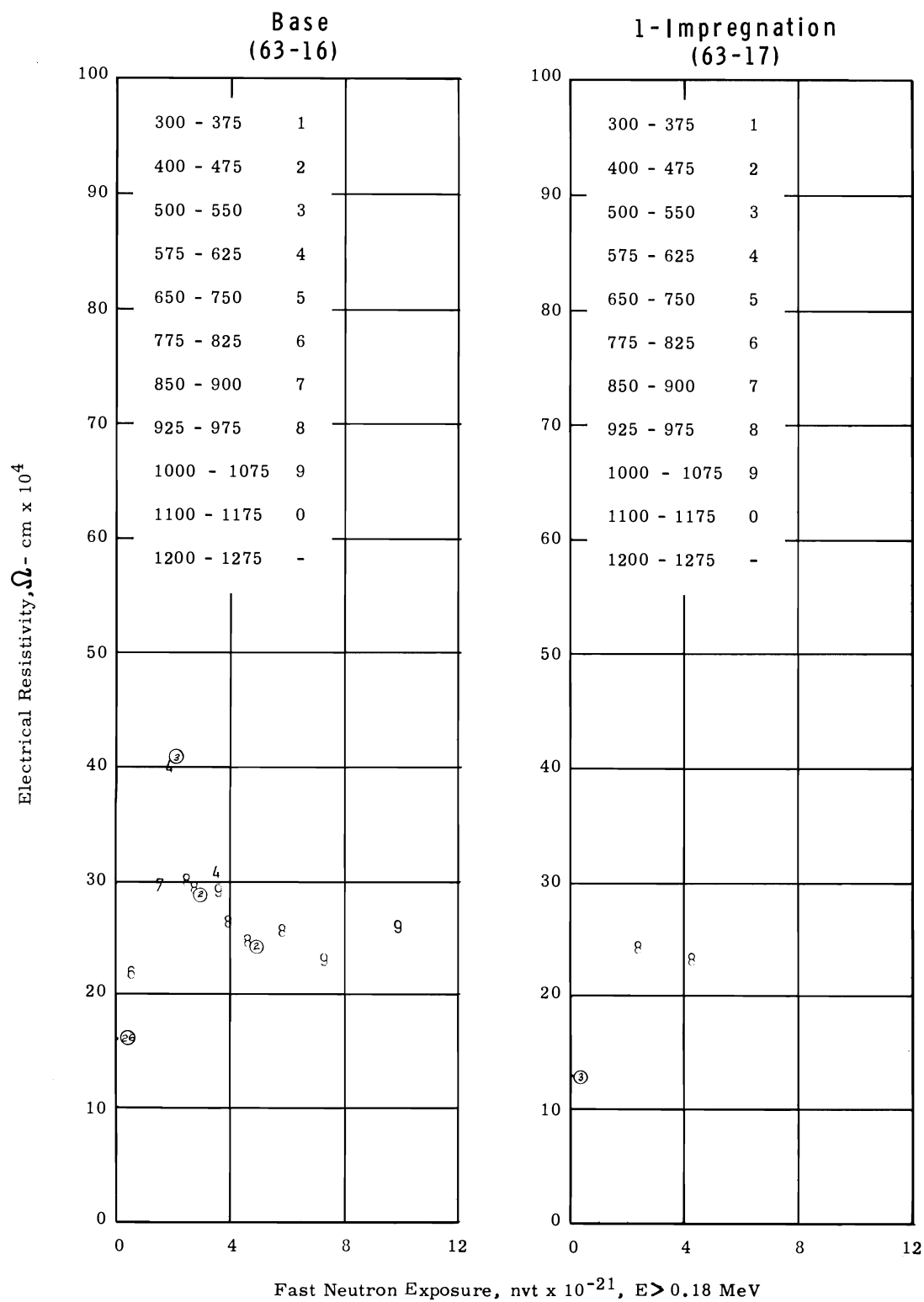


FIGURE E39. *Electrical Resistivity of Raw-Coke Graphites (Transverse)*

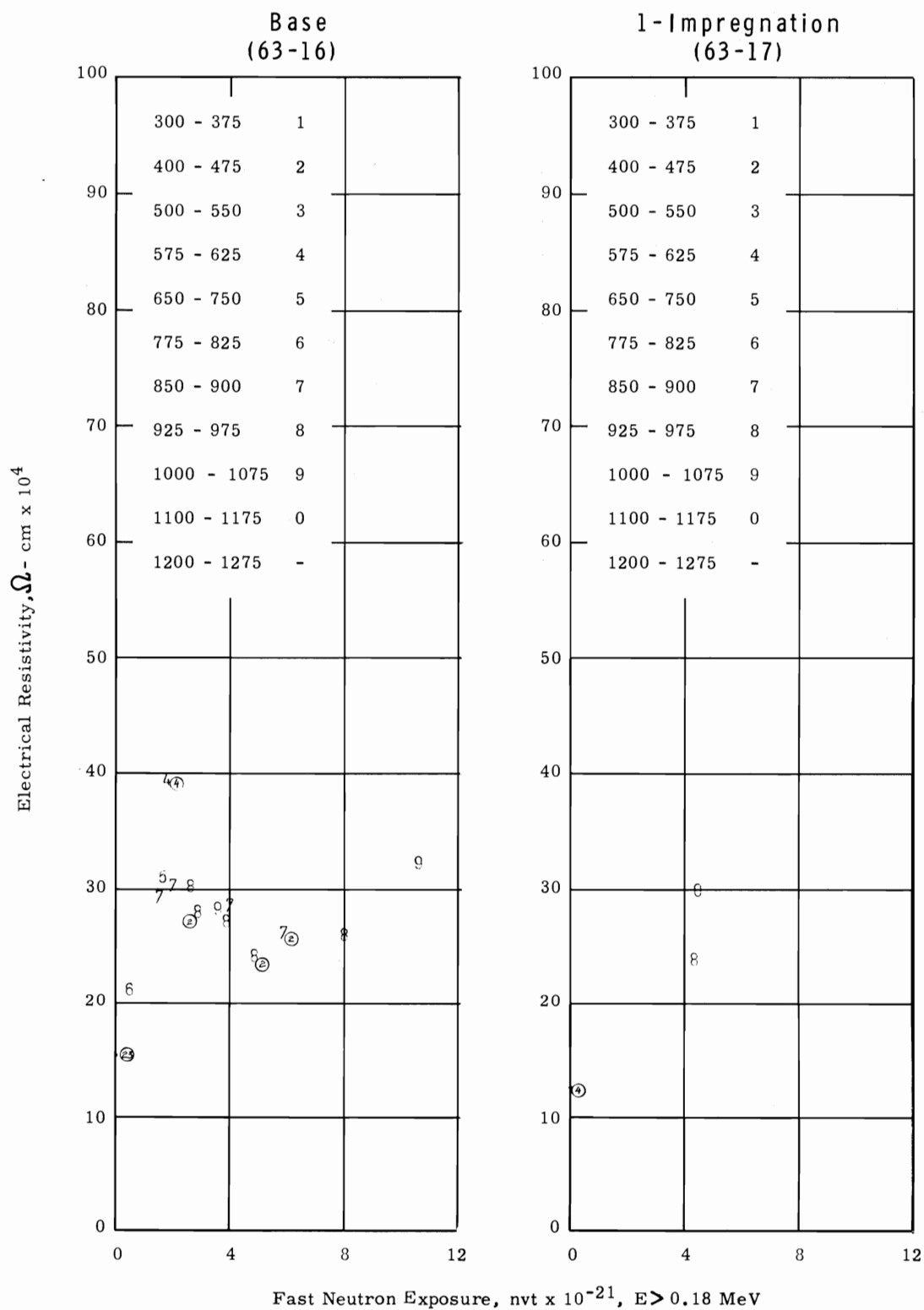


FIGURE E40. *Electrical Resistivity of Raw-Coke Graphites (Parallel)*

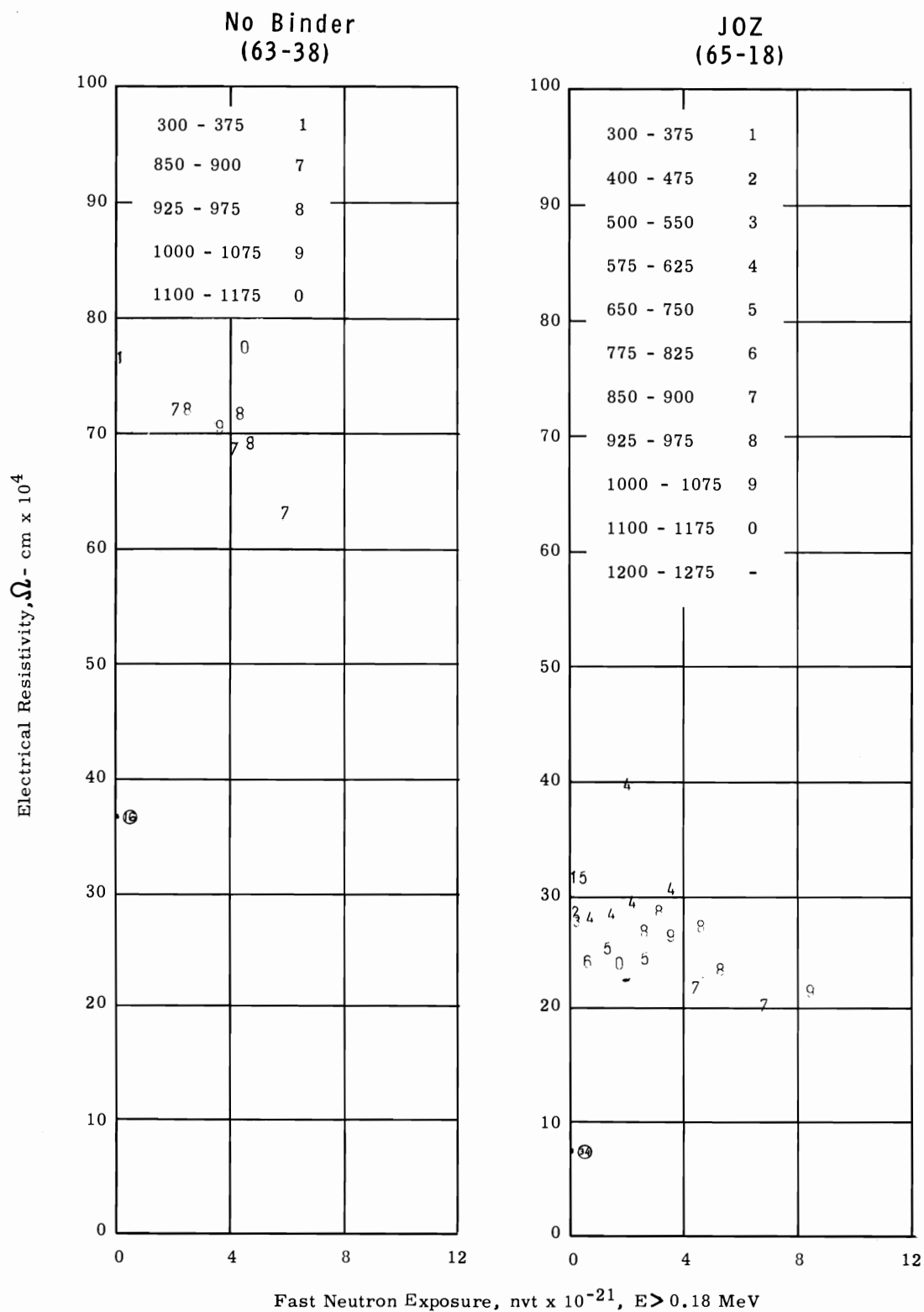


FIGURE E41. *Electrical Resistivity of Raw-Coke Graphites (Transverse)*

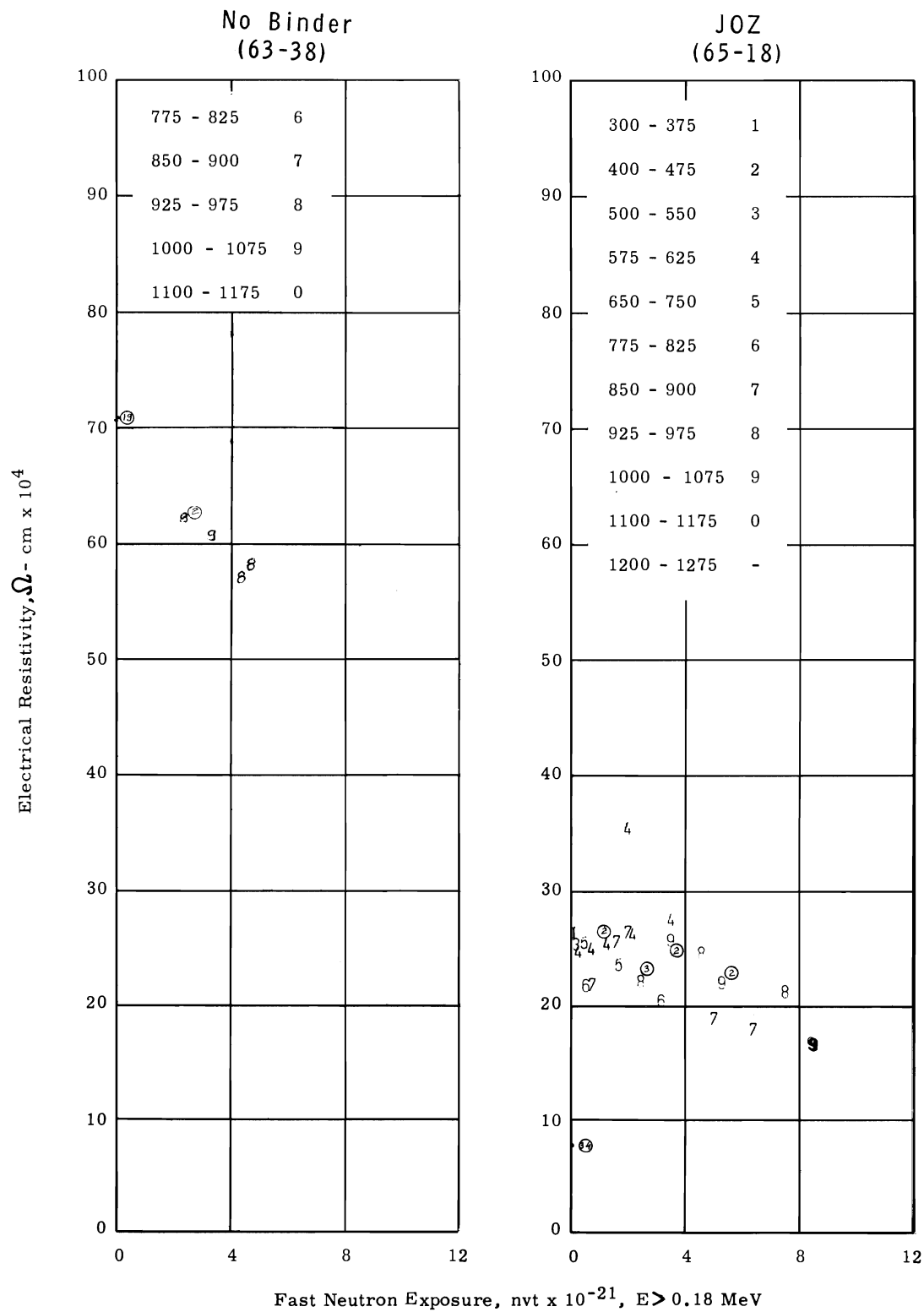


FIGURE E42. *Electrical Resistivity of Raw-Coke Graphites (Parallel)*

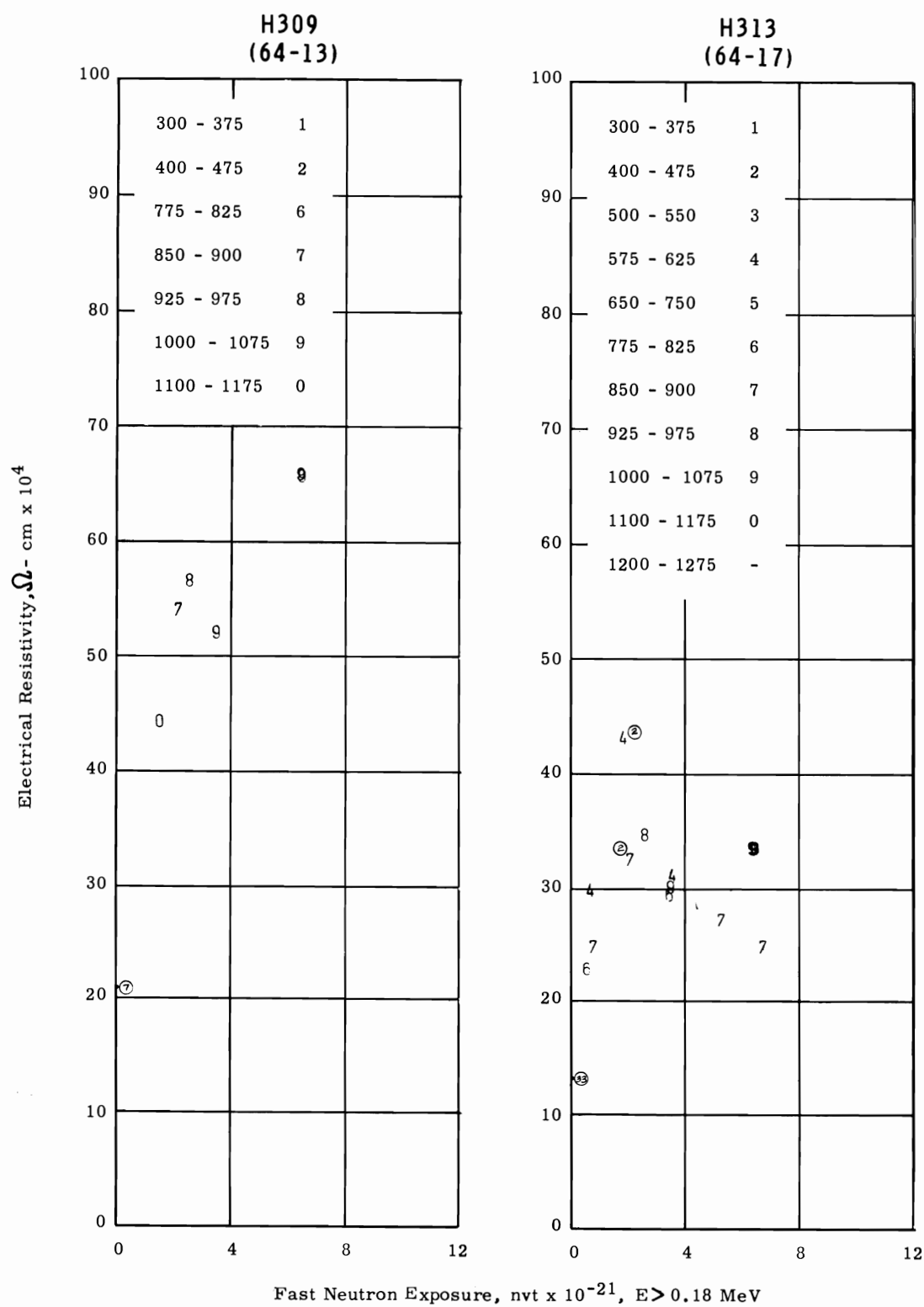


FIGURE E43. *Electrical Resistivity of Coking Temperature Series Graphites (Transverse)*

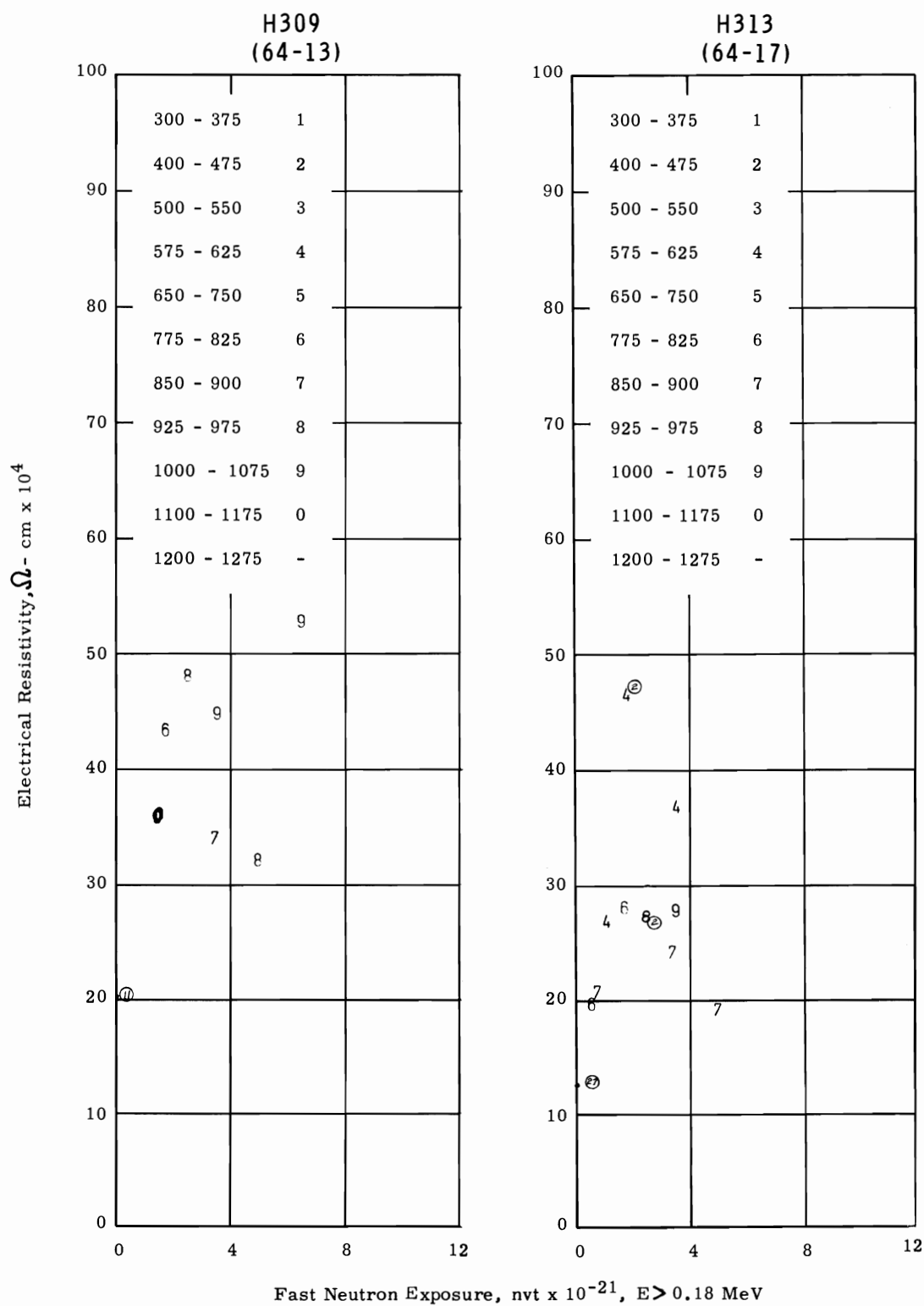


FIGURE E44. *Electrical Resistivity of Coking Temperature Series Graphites (Parallel)*

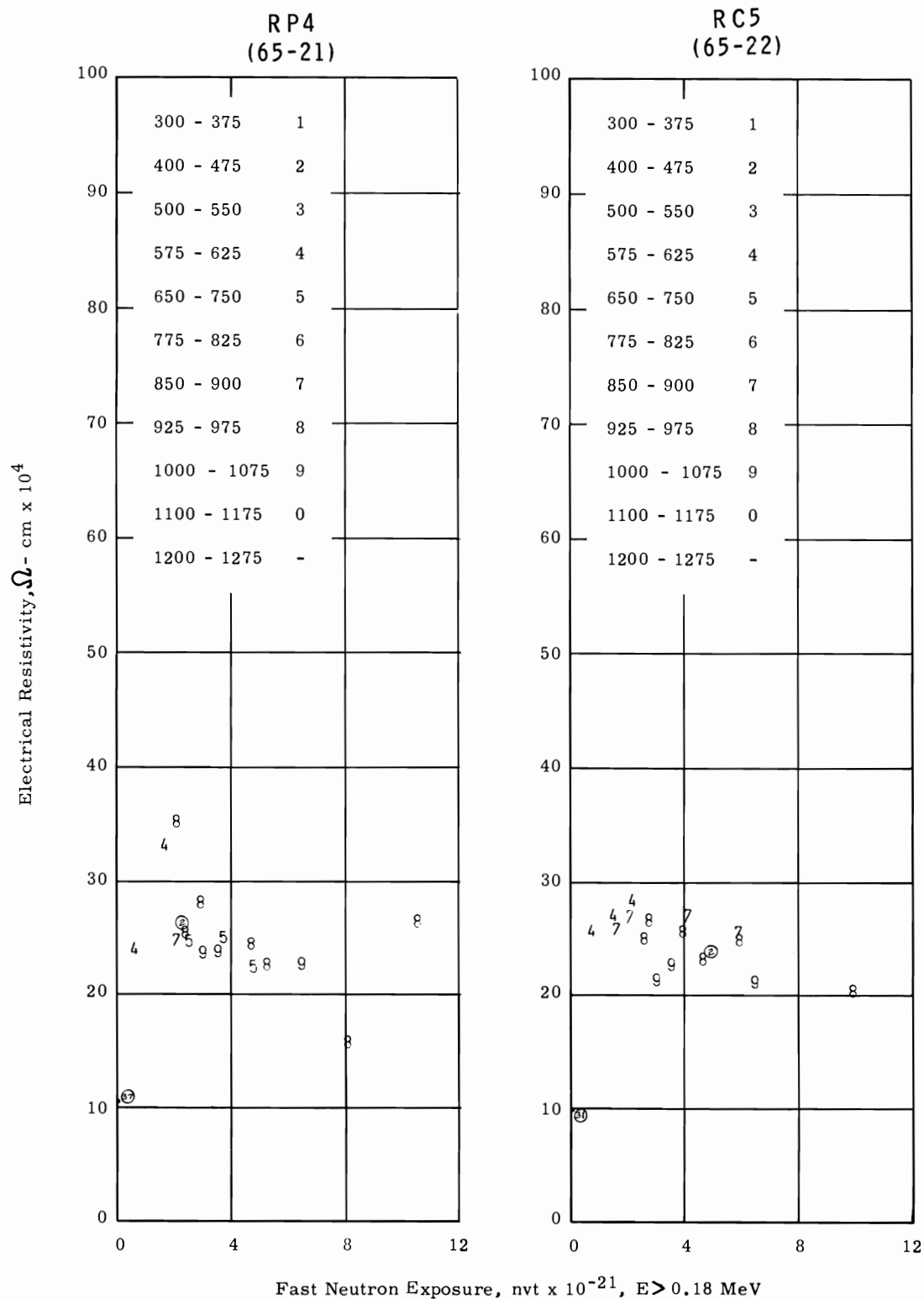


FIGURE E45. *Electrical Resistivity of Isotropic Graphites (Transverse)*

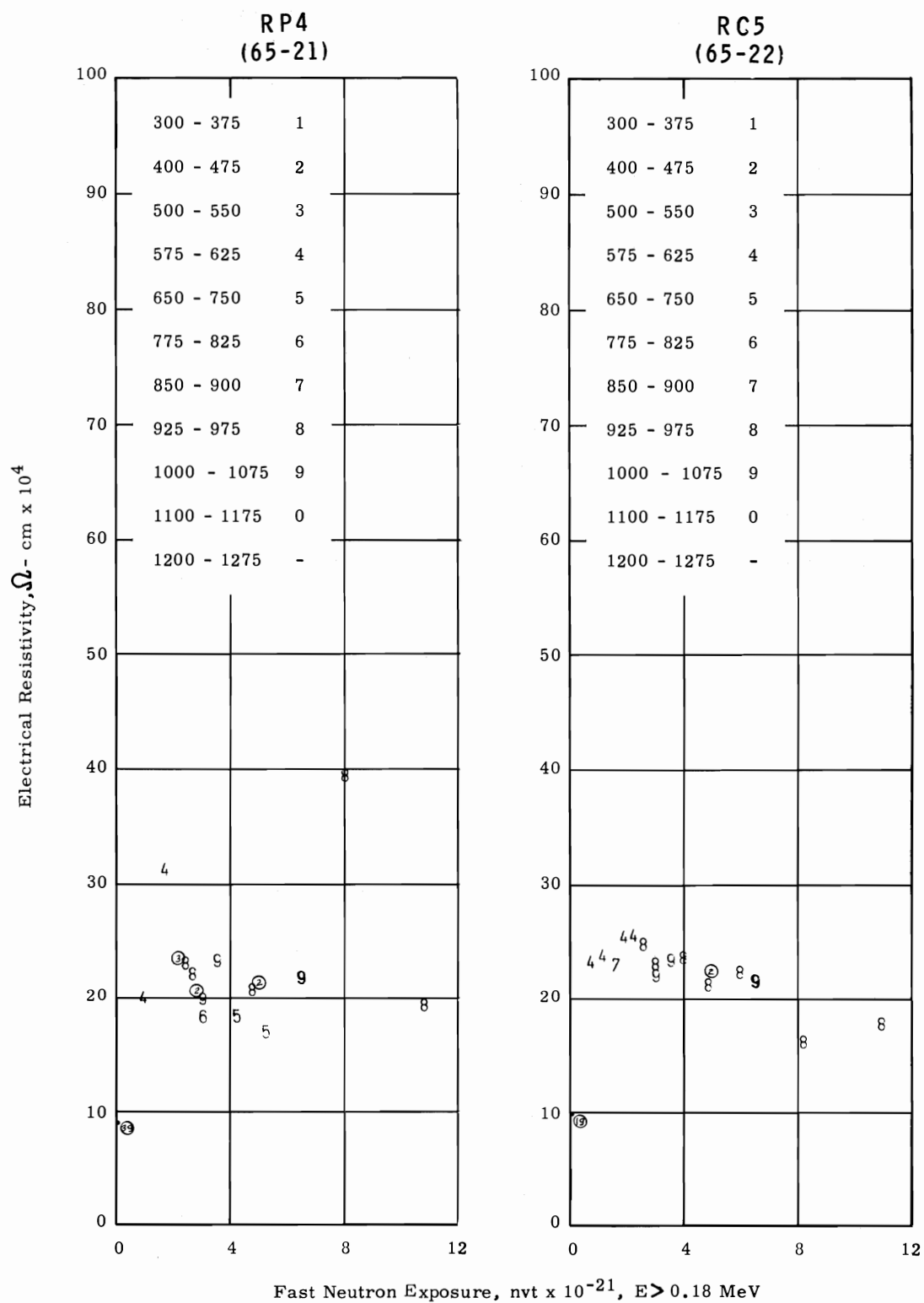


FIGURE E46. *Electrical Resistivity of Isotropic Graphites (Parallel)*

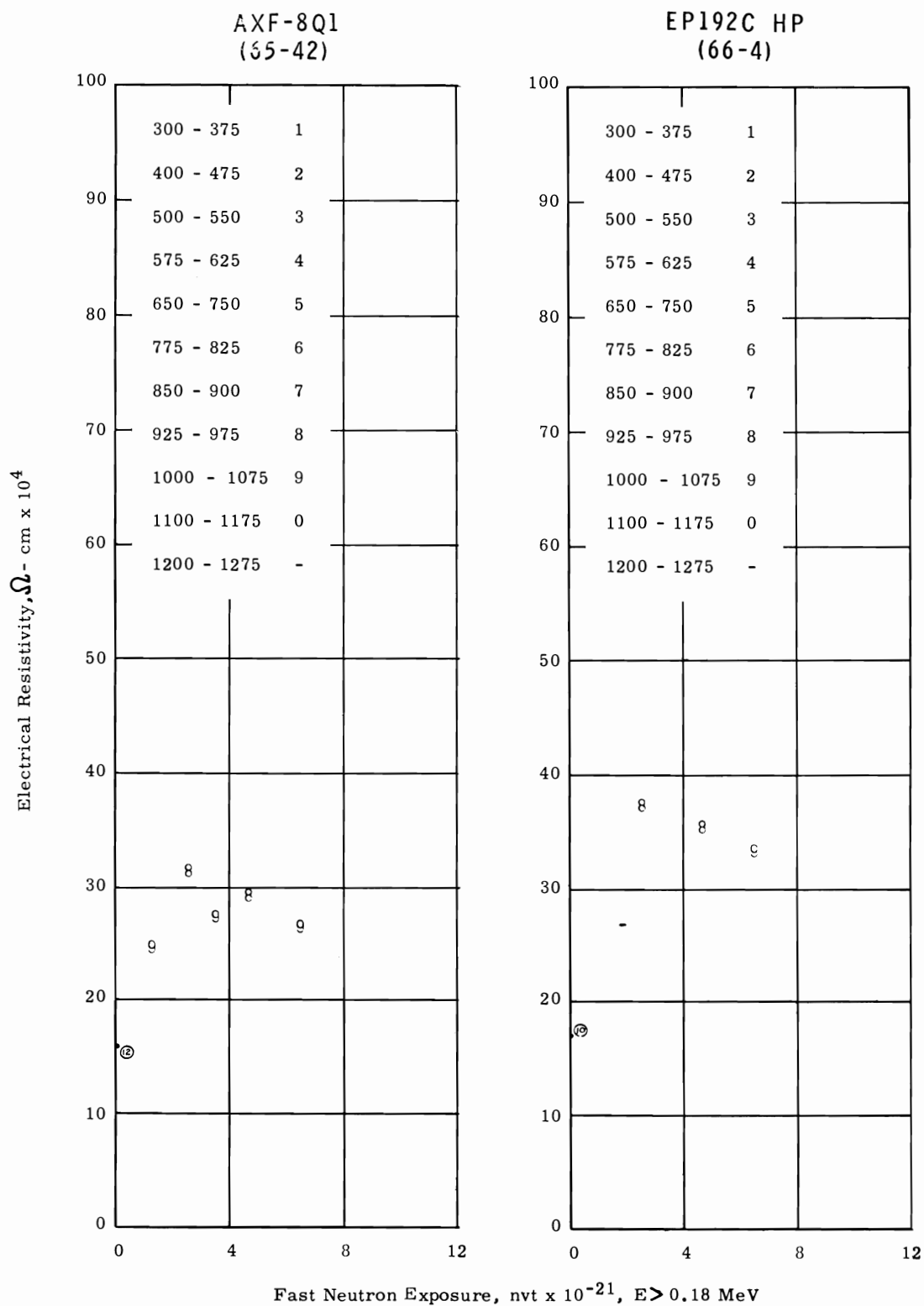


FIGURE E47. *Electrical Resistivity of Isotropic Graphites (Transverse)*

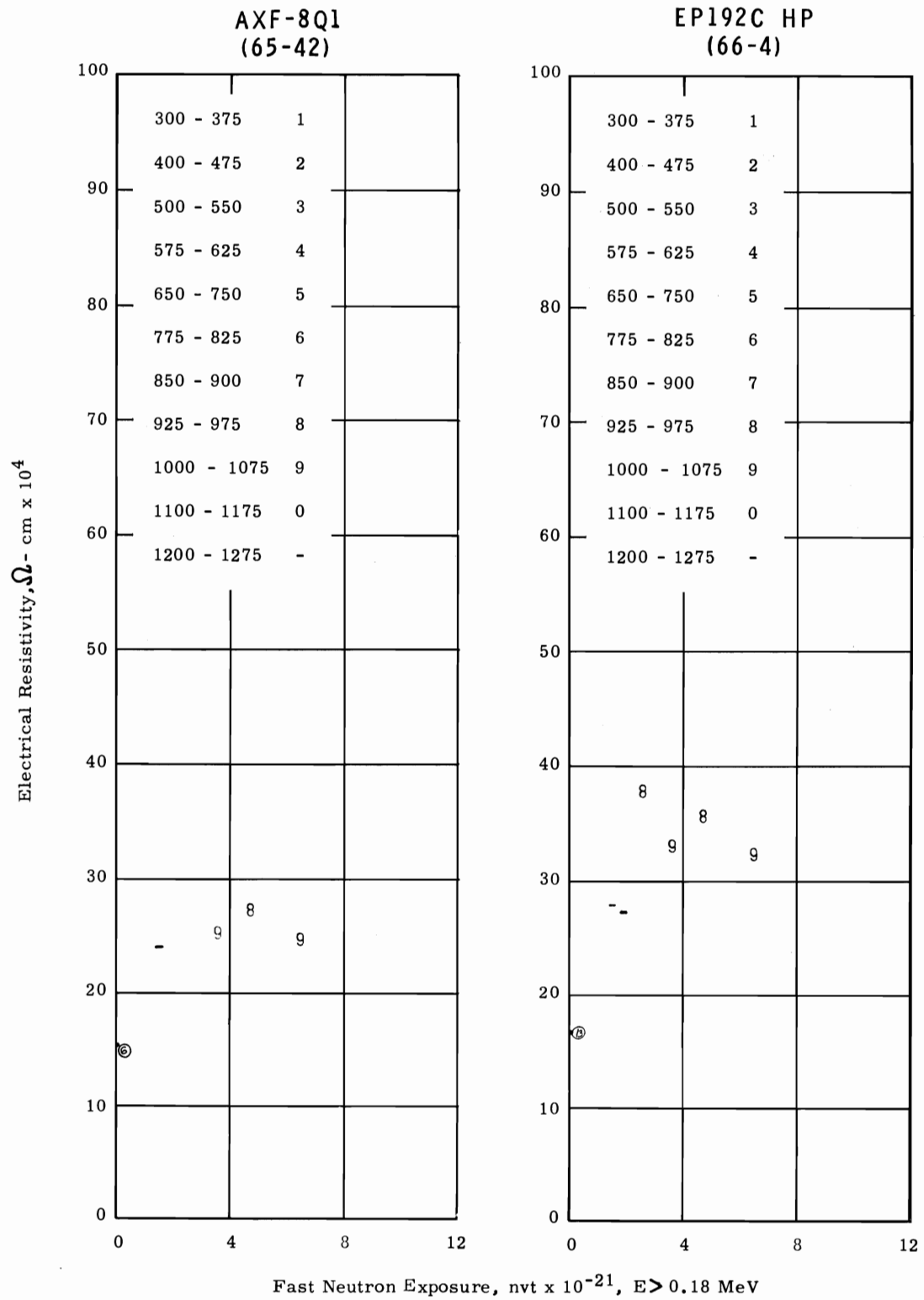


FIGURE E48. *Electrical Resistivity of Isotropic Graphites (Parallel)*

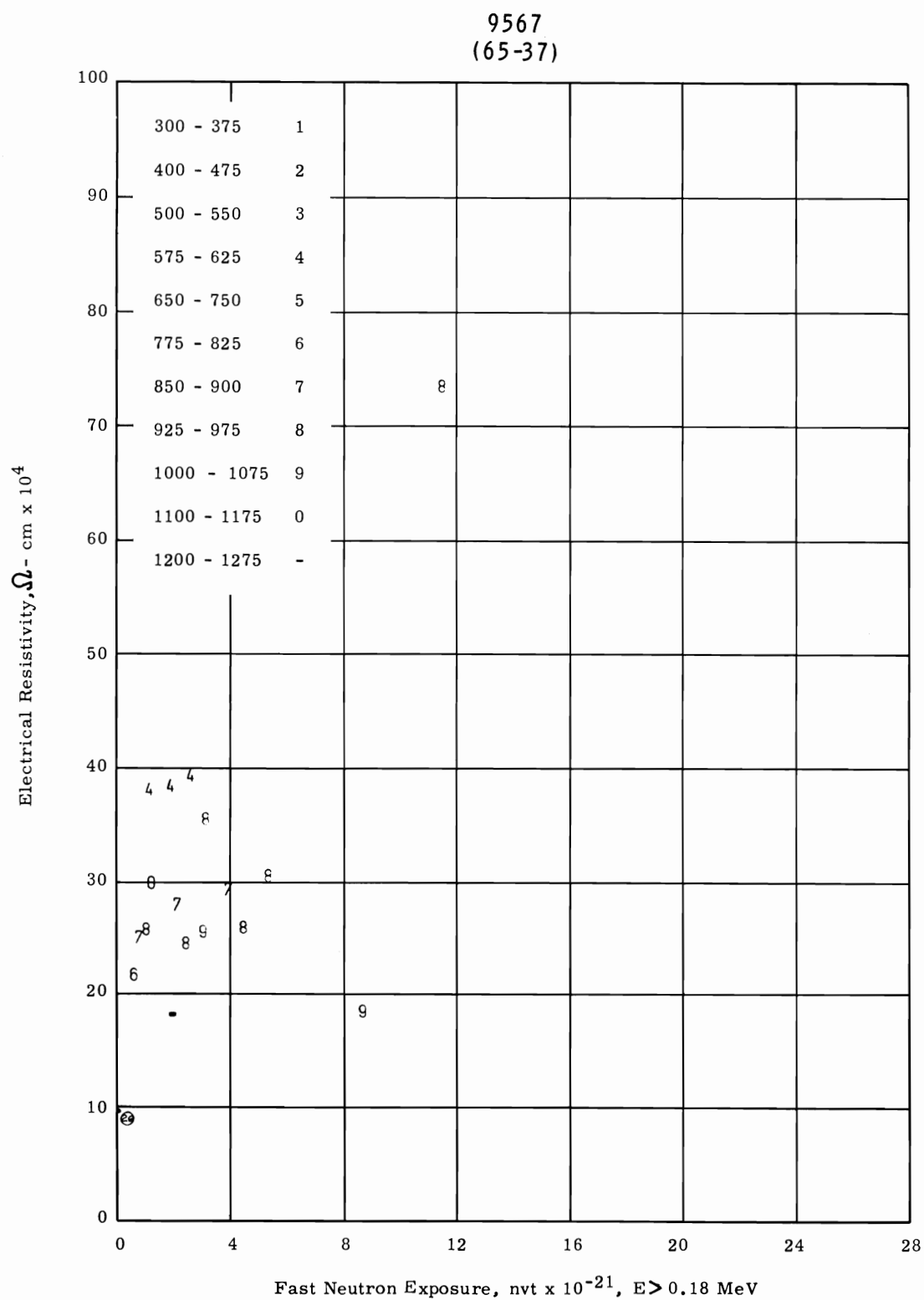


FIGURE E49. *Electrical Resistivity of Experimental Graphites (Transverse)*

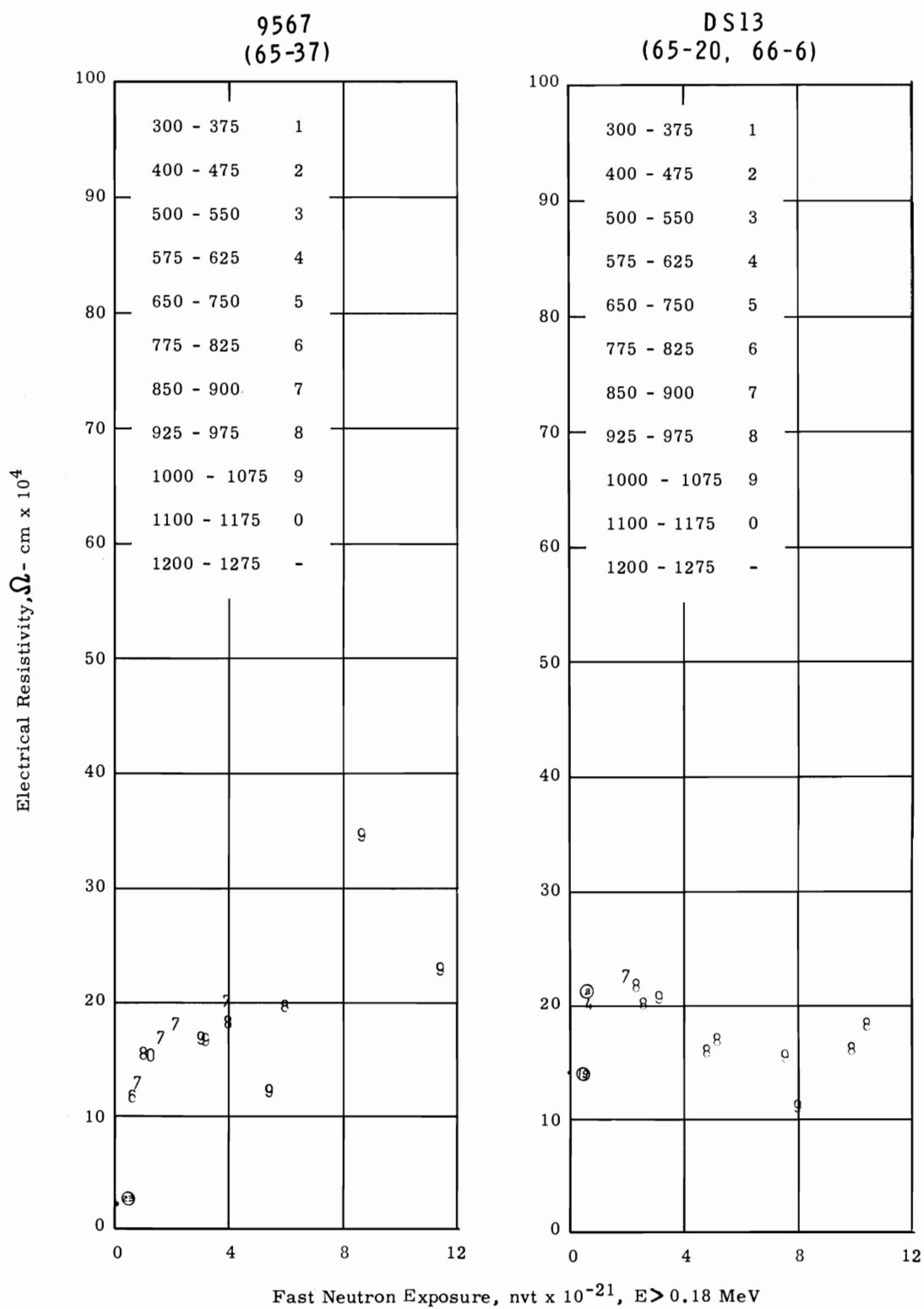


FIGURE E50. *Electrical Resistivity of Experimental Graphites (Parallel)*

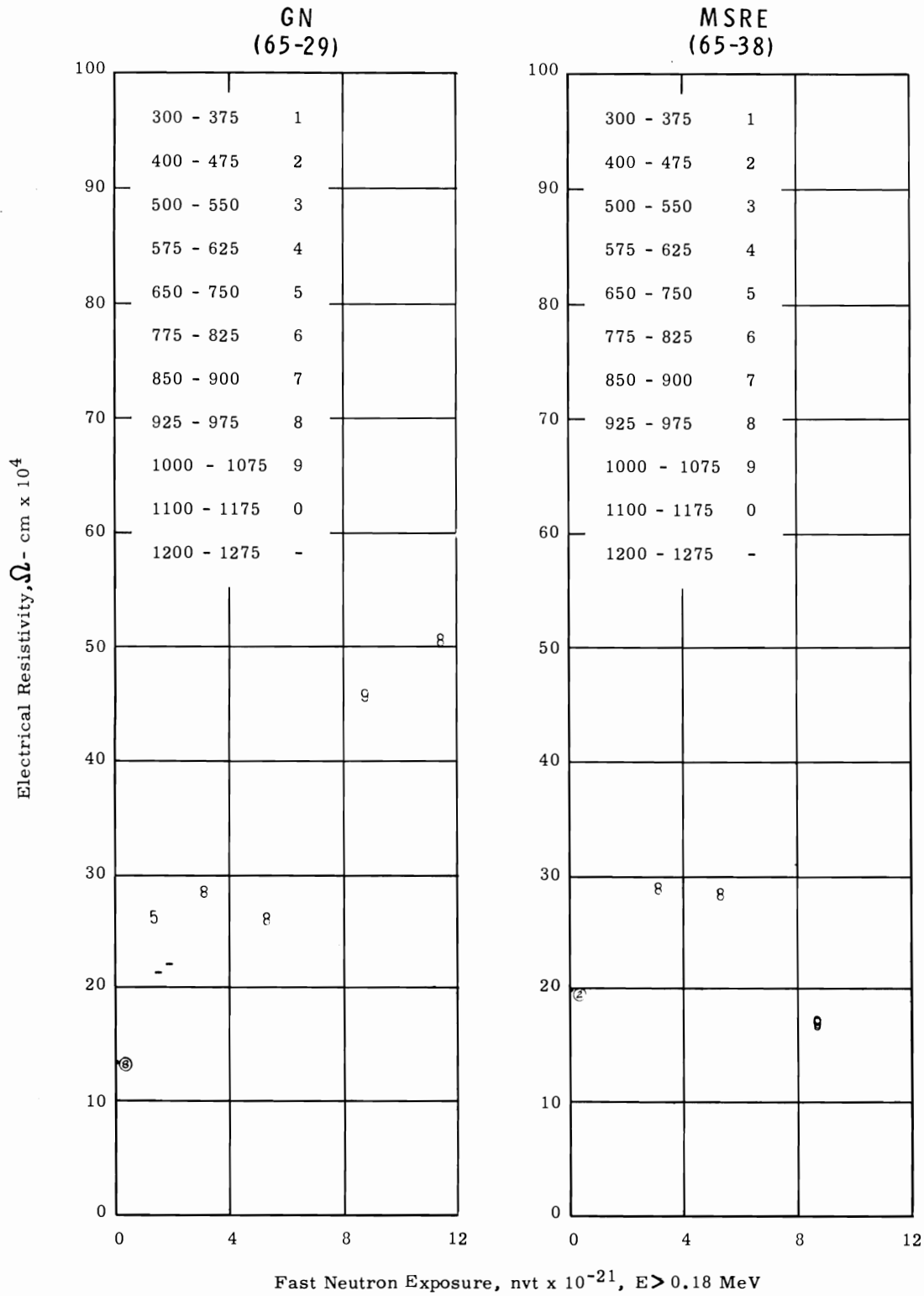


FIGURE E51. *Electrical Resistivity of Nuclear-Grade Graphites (Transverse)*

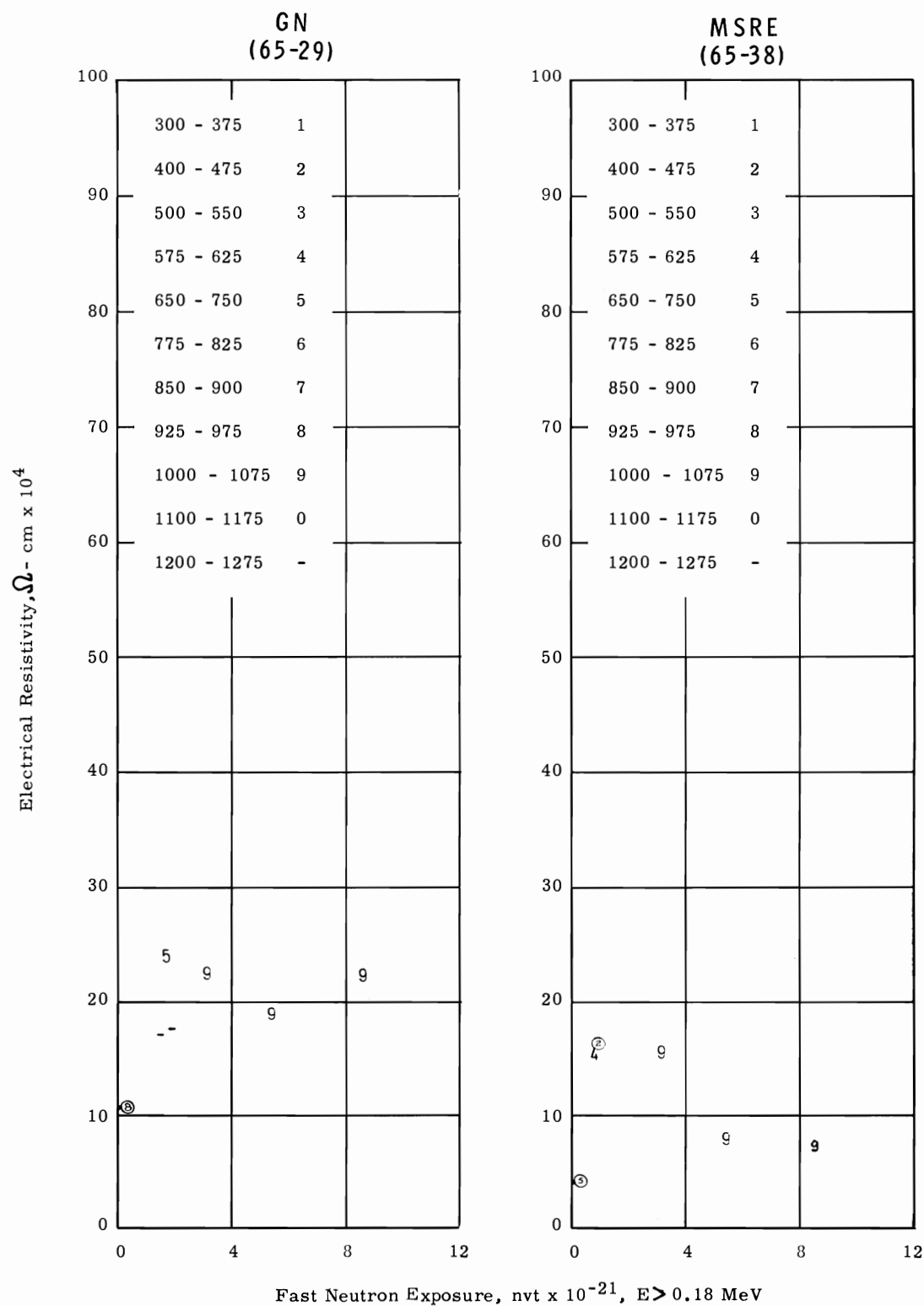


FIGURE E52. *Electrical Resistivity of Nuclear-Grade Graphites (Parallel)*

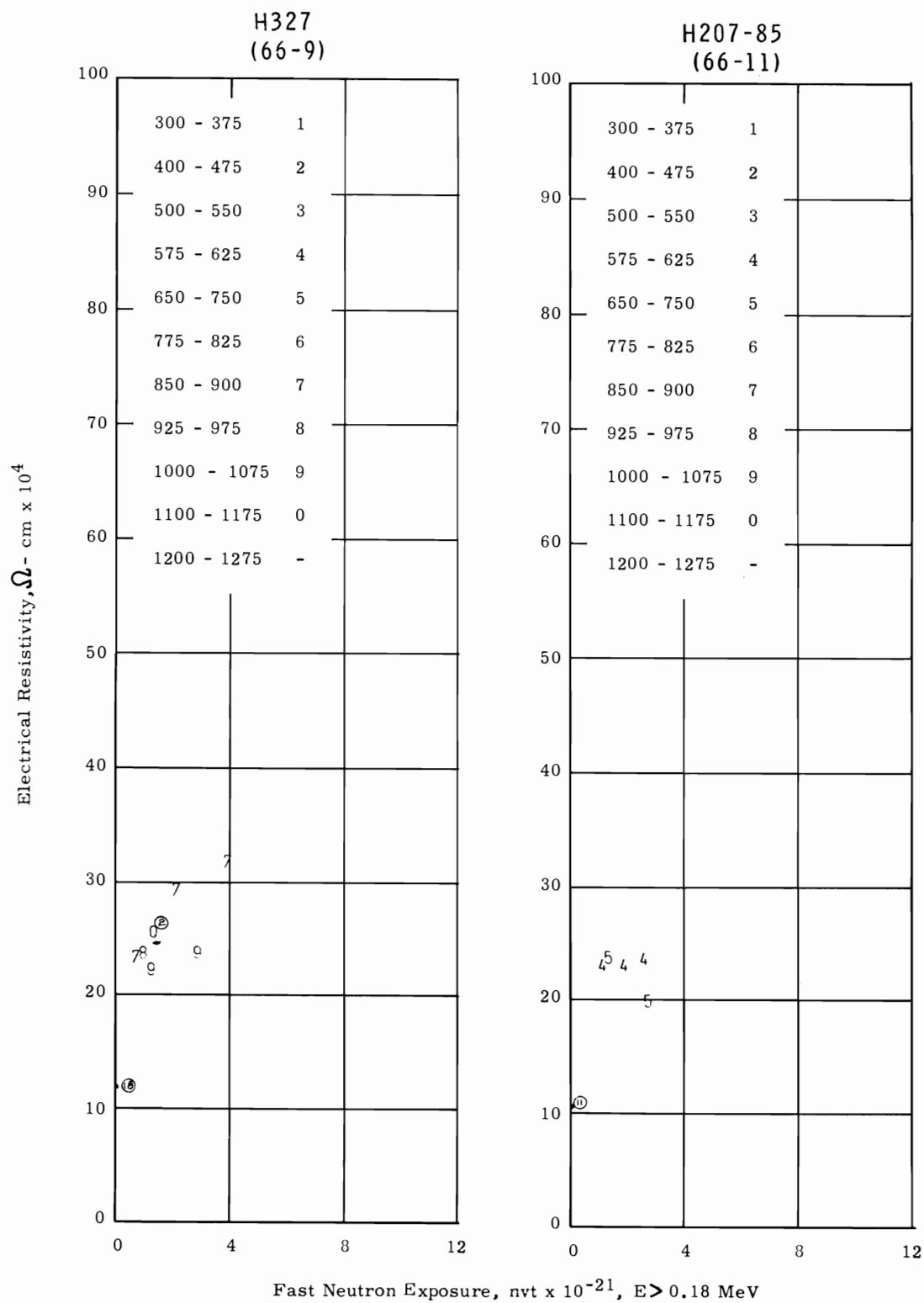


FIGURE E53. *Electrical Resistivity of Developmental Graphites (Transverse)*

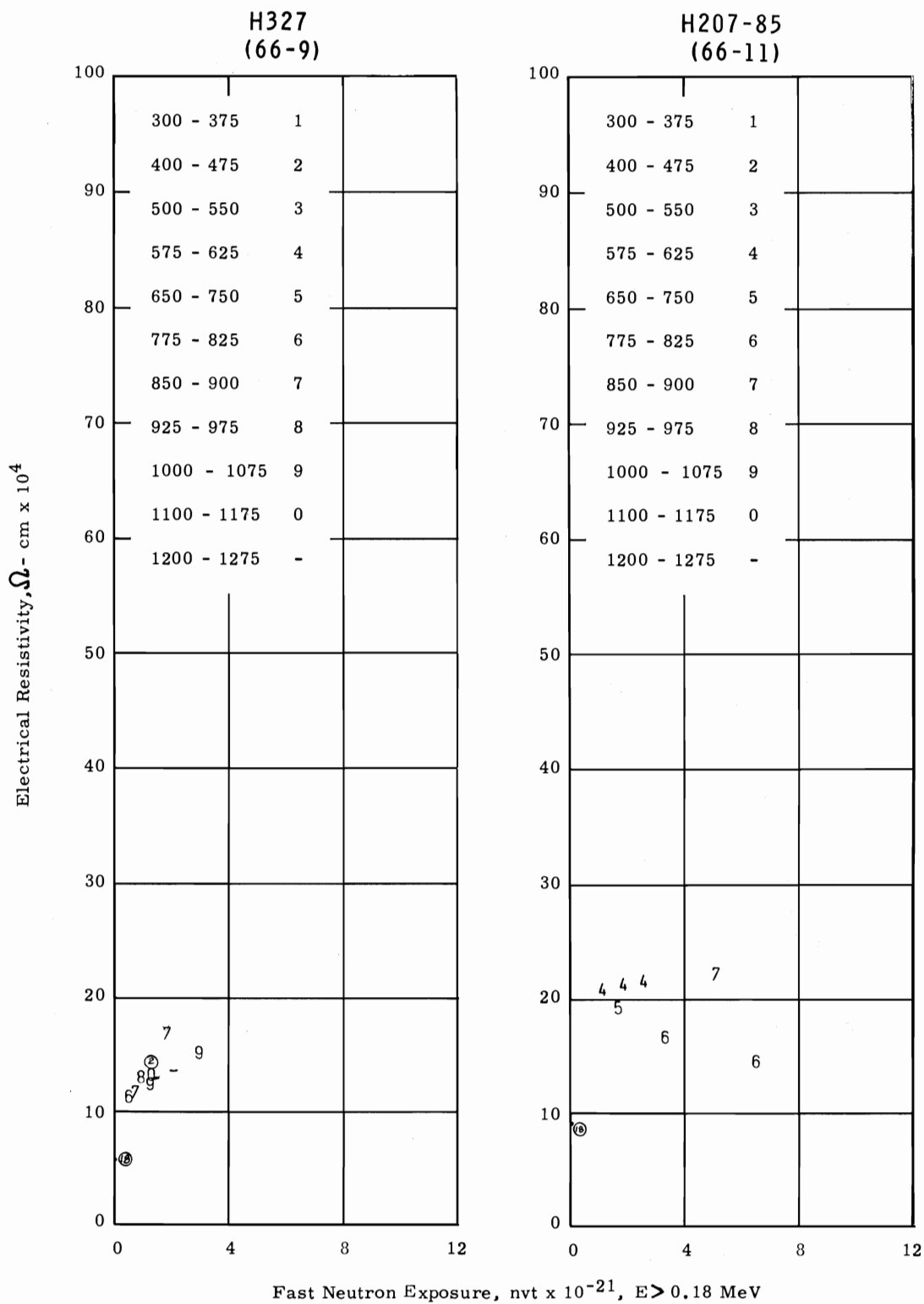


FIGURE E54. *Electrical Resistivity of Developmental Graphites (Parallel)*

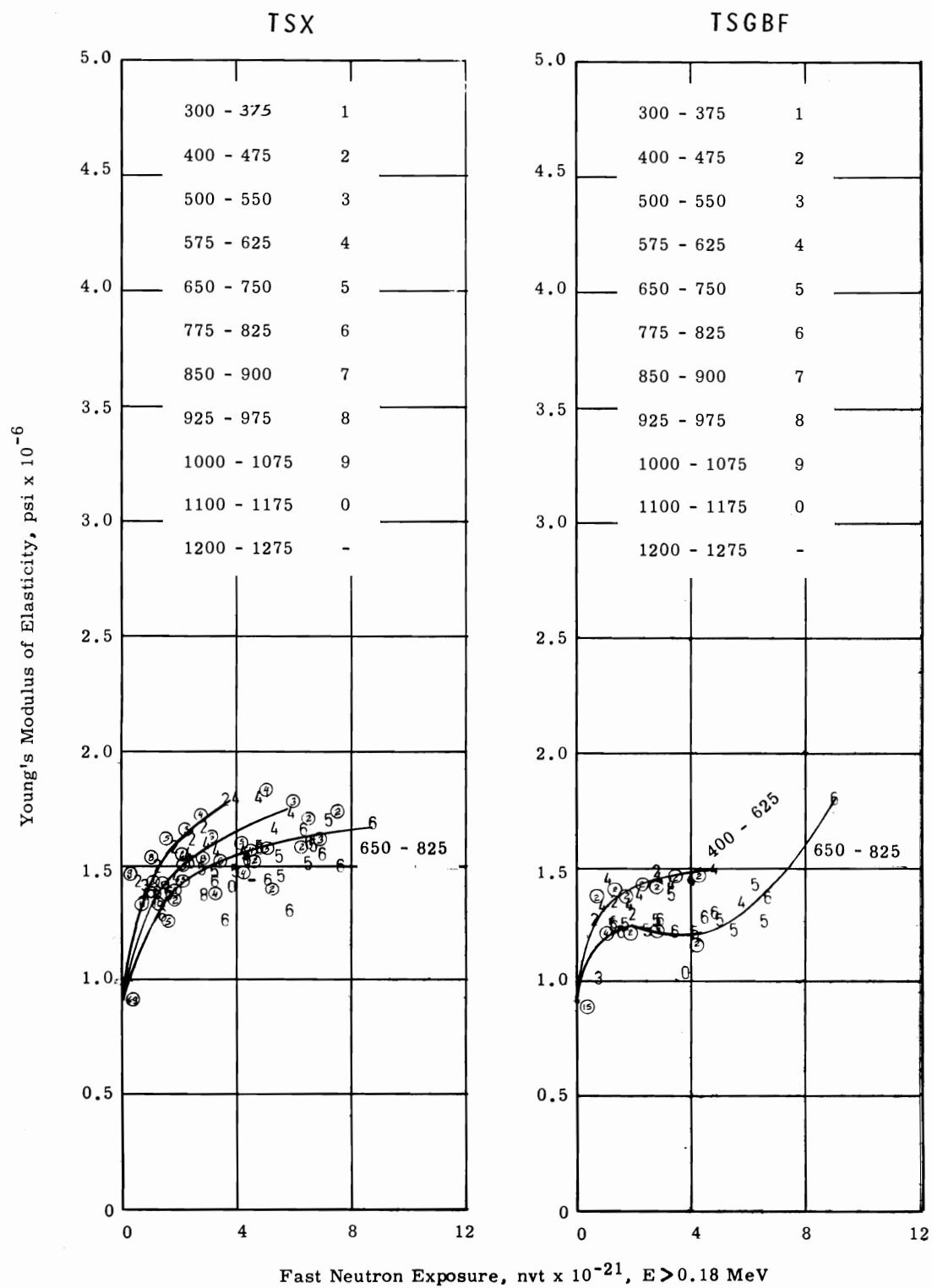


FIGURE E55. Young's Modulus of Elasticity of TSX and TSGBF Graphites (Transverse)

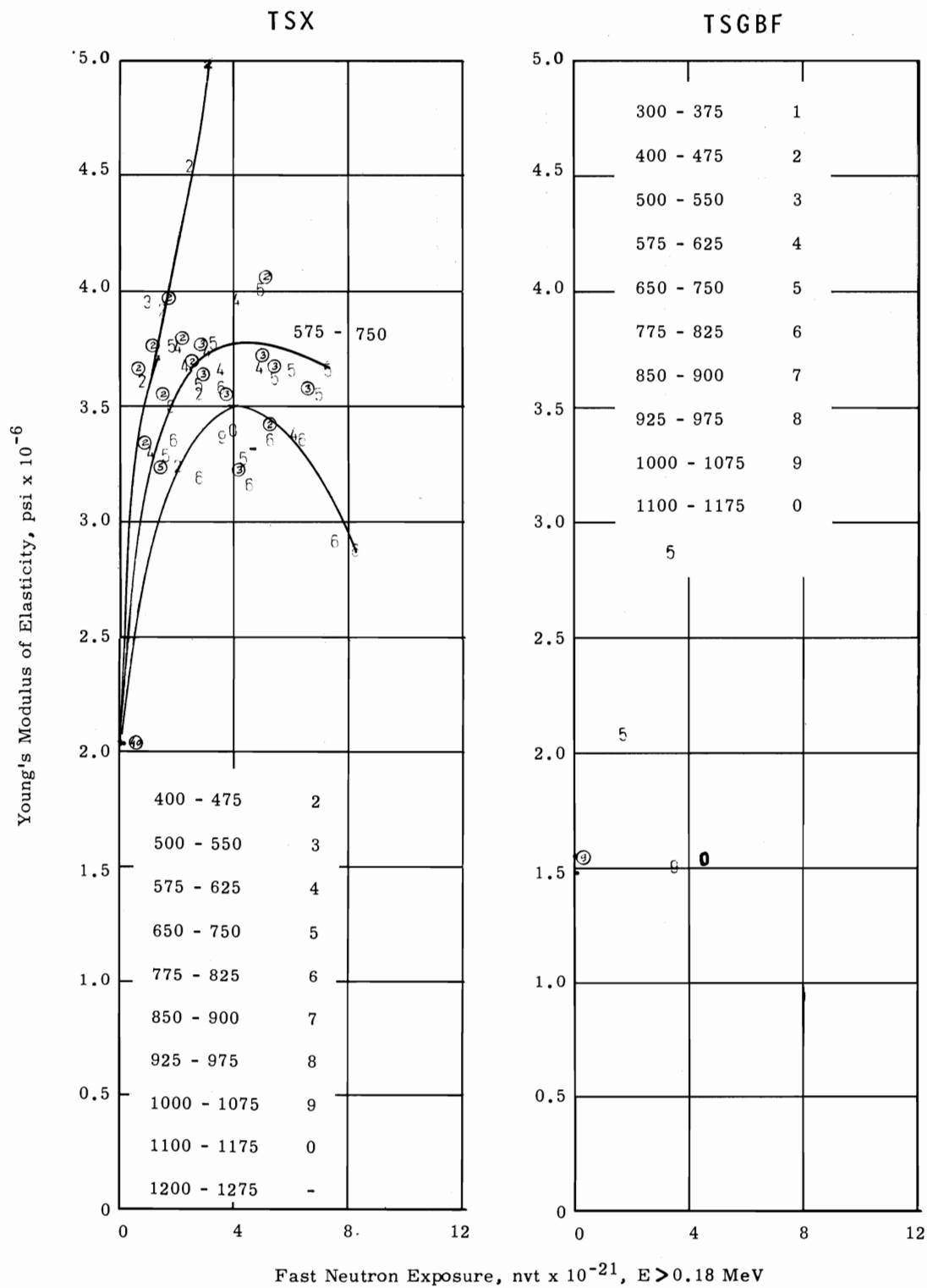


FIGURE E56. *Young's Modulus of Elasticity of TSX and TSGBF Graphites (Parallel)*

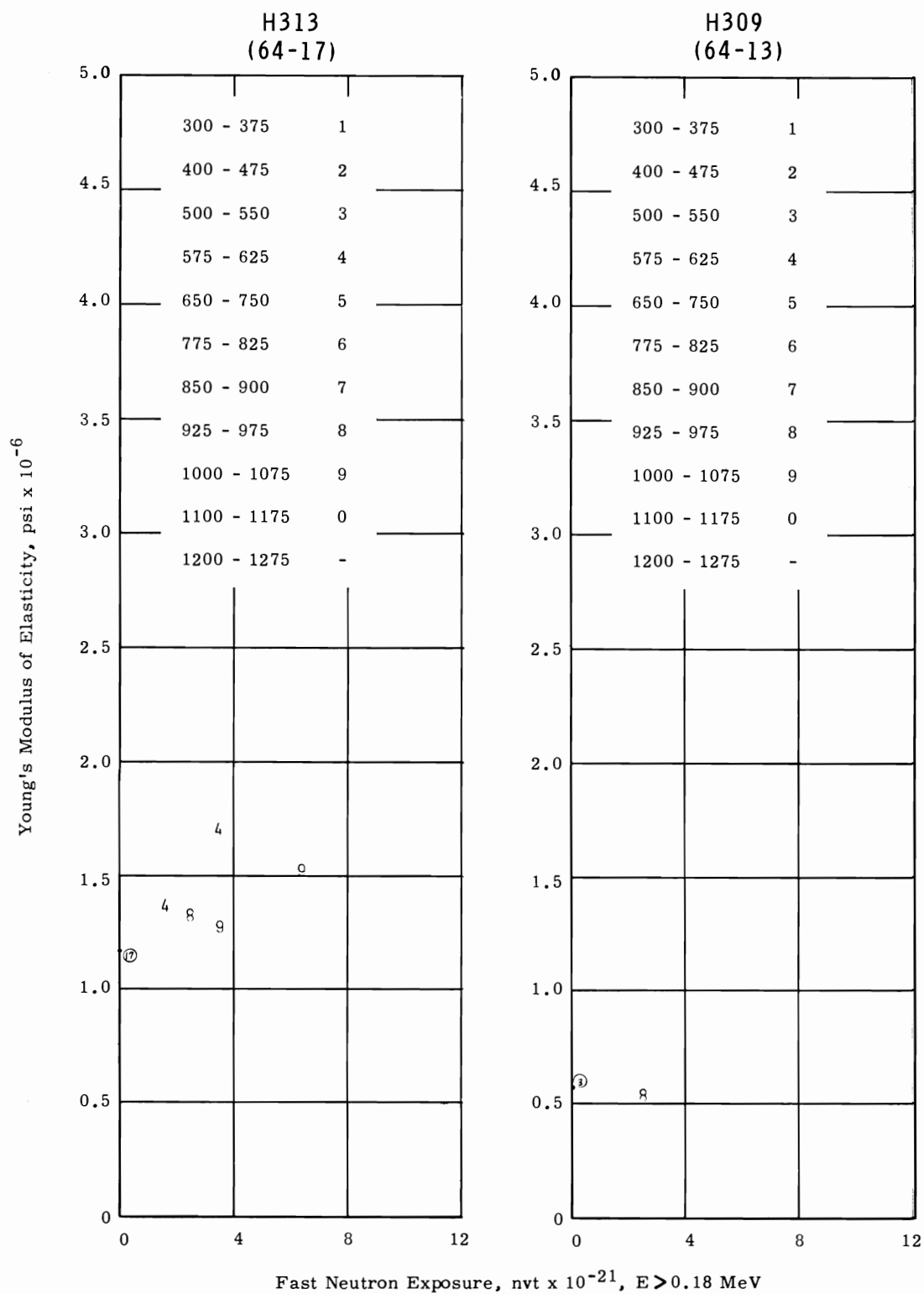


FIGURE E57. *Young's Modulus of Elasticity of Coking Temperature Series Graphites (Transverse)*

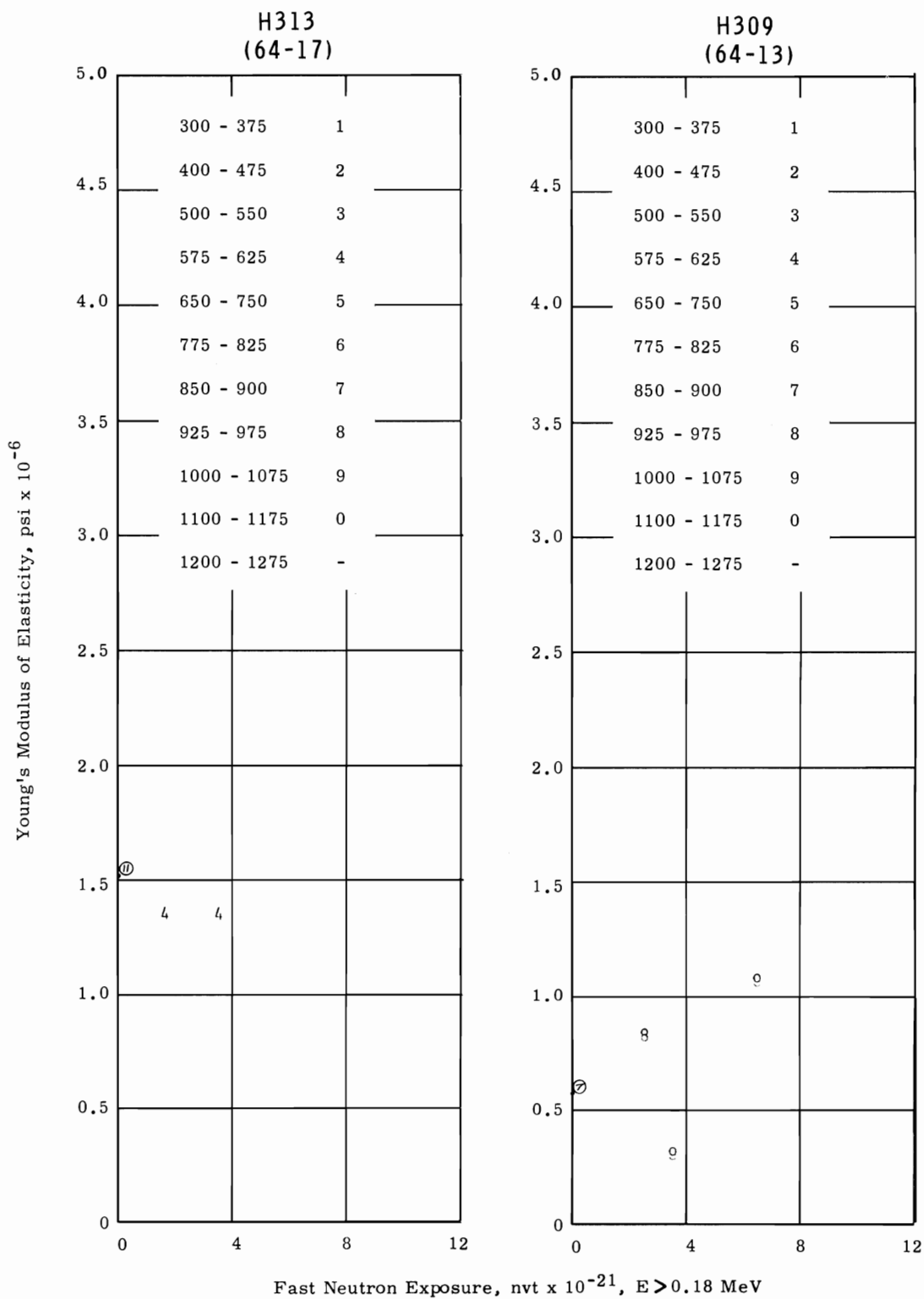


FIGURE E58. *Young's Modulus of Elasticity of Coking Temperature Series Graphites (Parallel)*

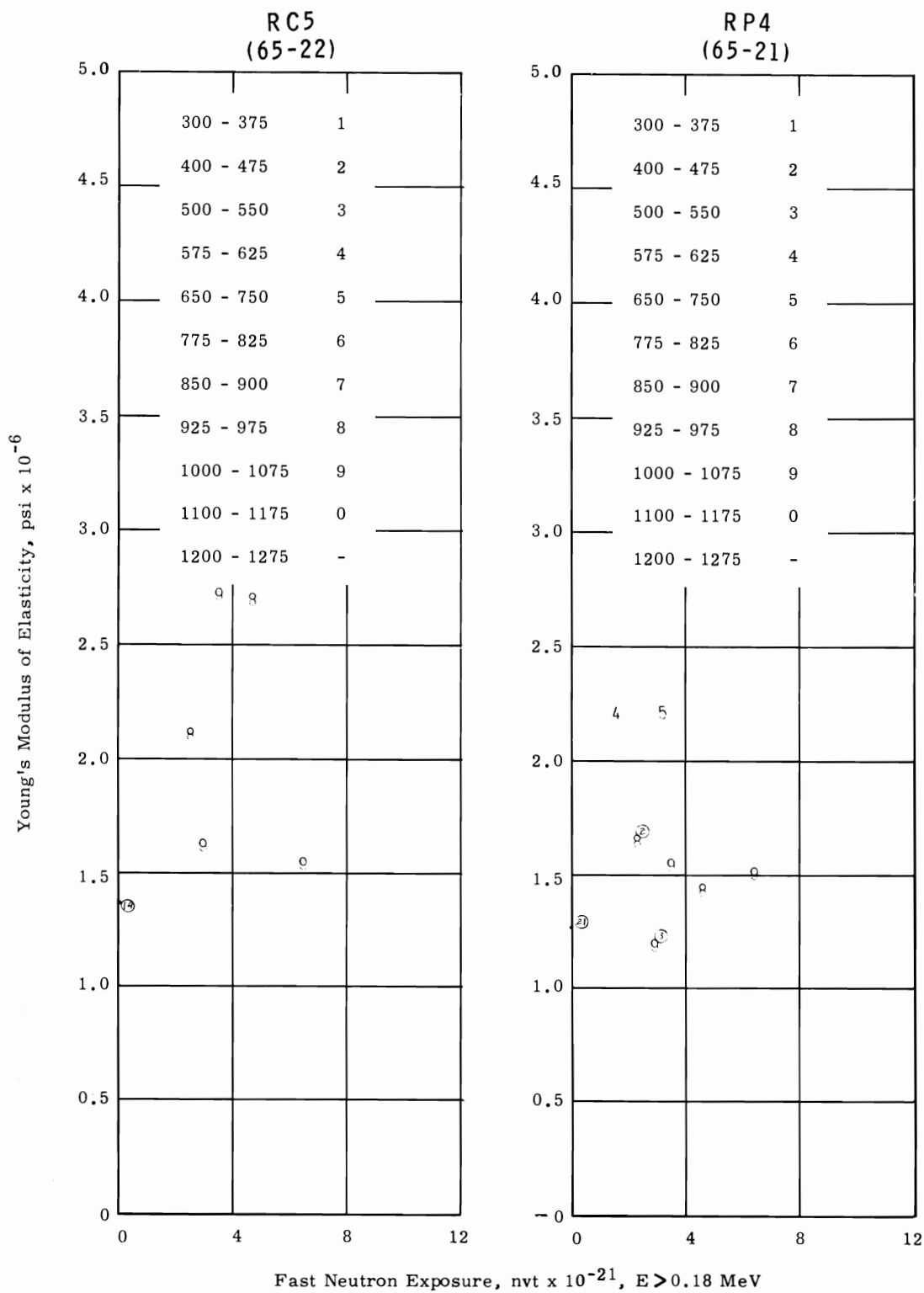


FIGURE E59. *Young's Modulus of Elasticity of Isotropic Graphites (Transverse)*

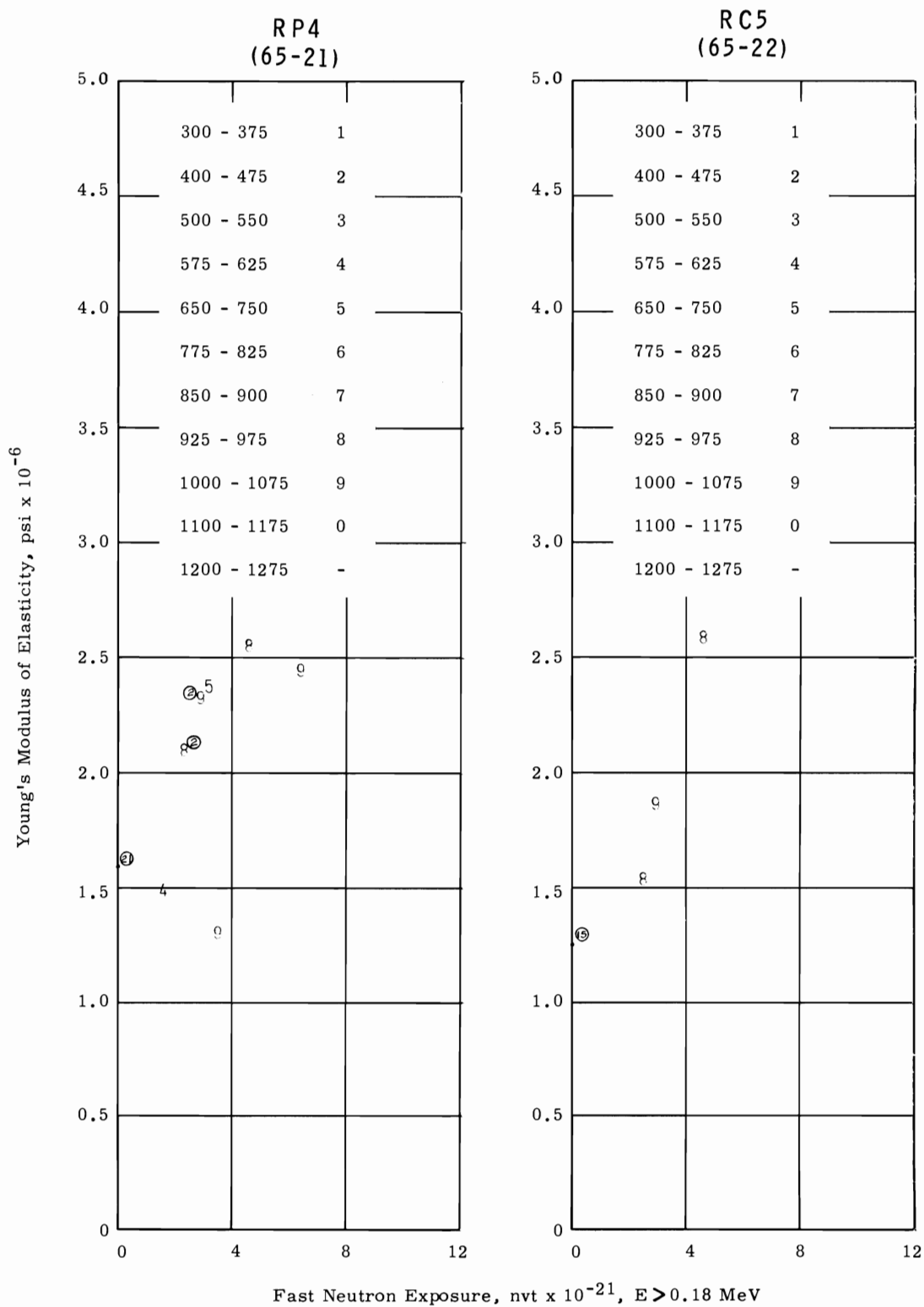


FIGURE E60. *Young's Modulus of Elasticity of Isotropic Graphites (Parallel)*

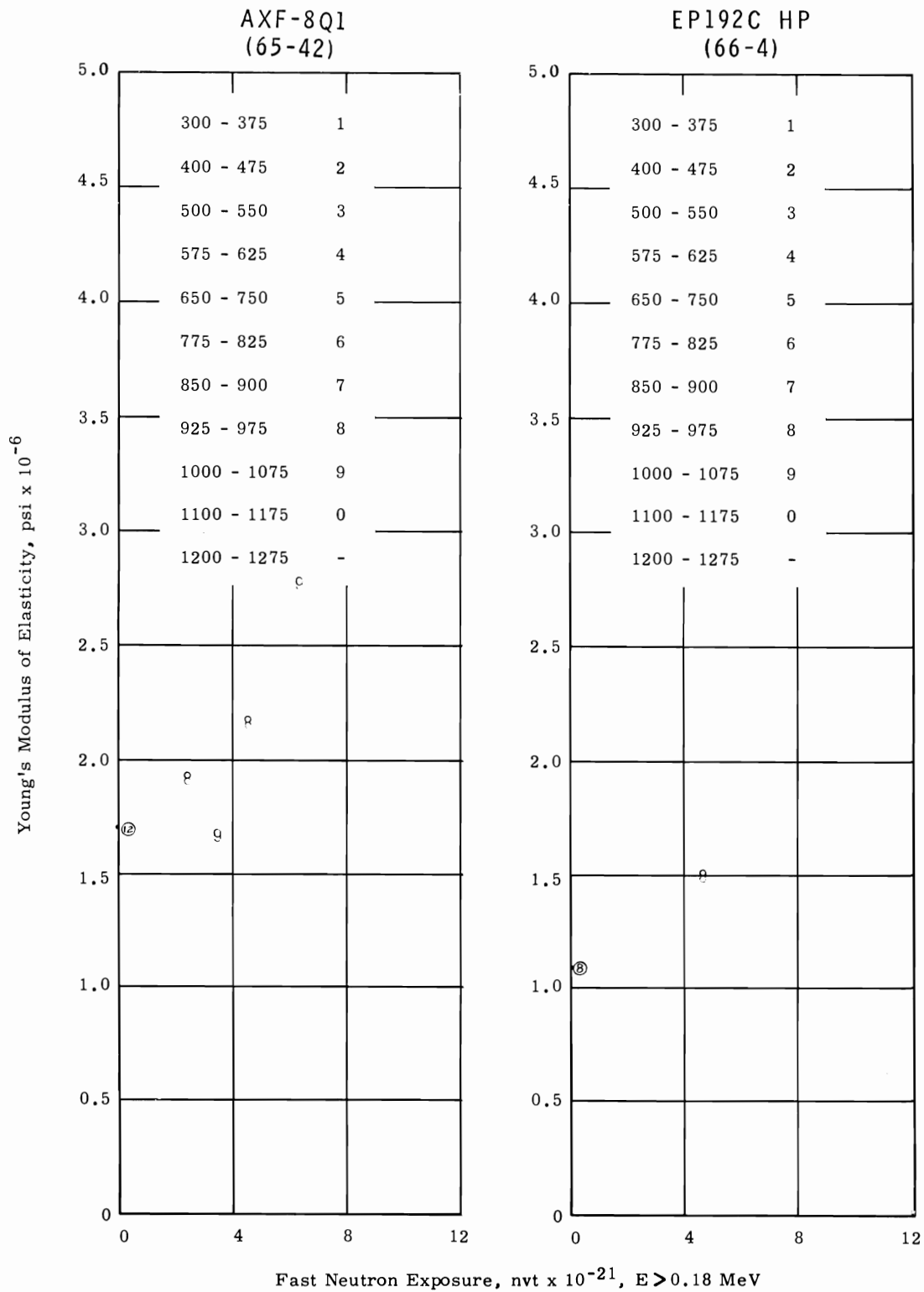


FIGURE E61. *Young's Modulus of Elasticity of Isotropic Graphites (Transverse)*

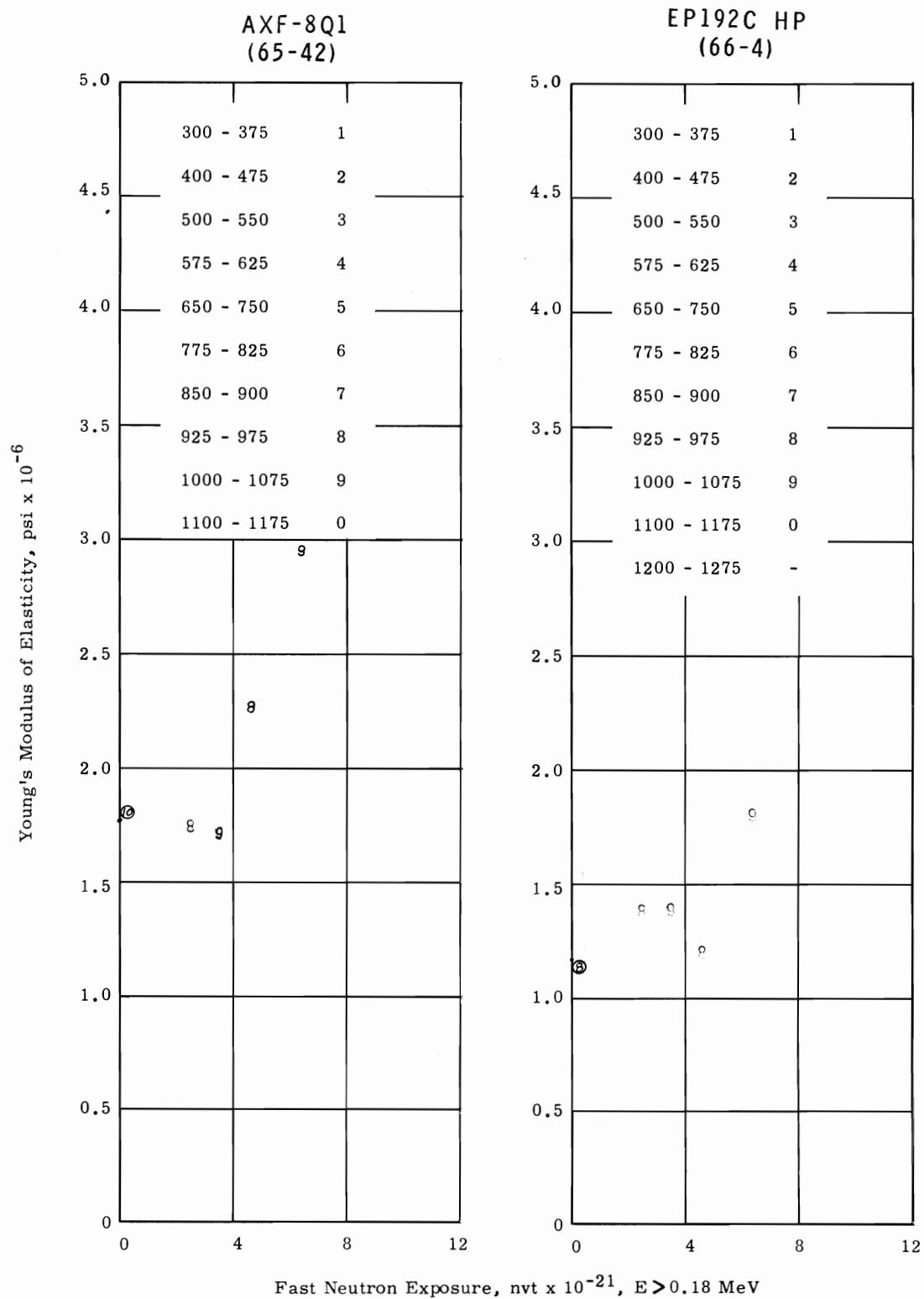


FIGURE E62. *Young's Modulus of Elasticity of Isotropic Graphites (Parallel)*

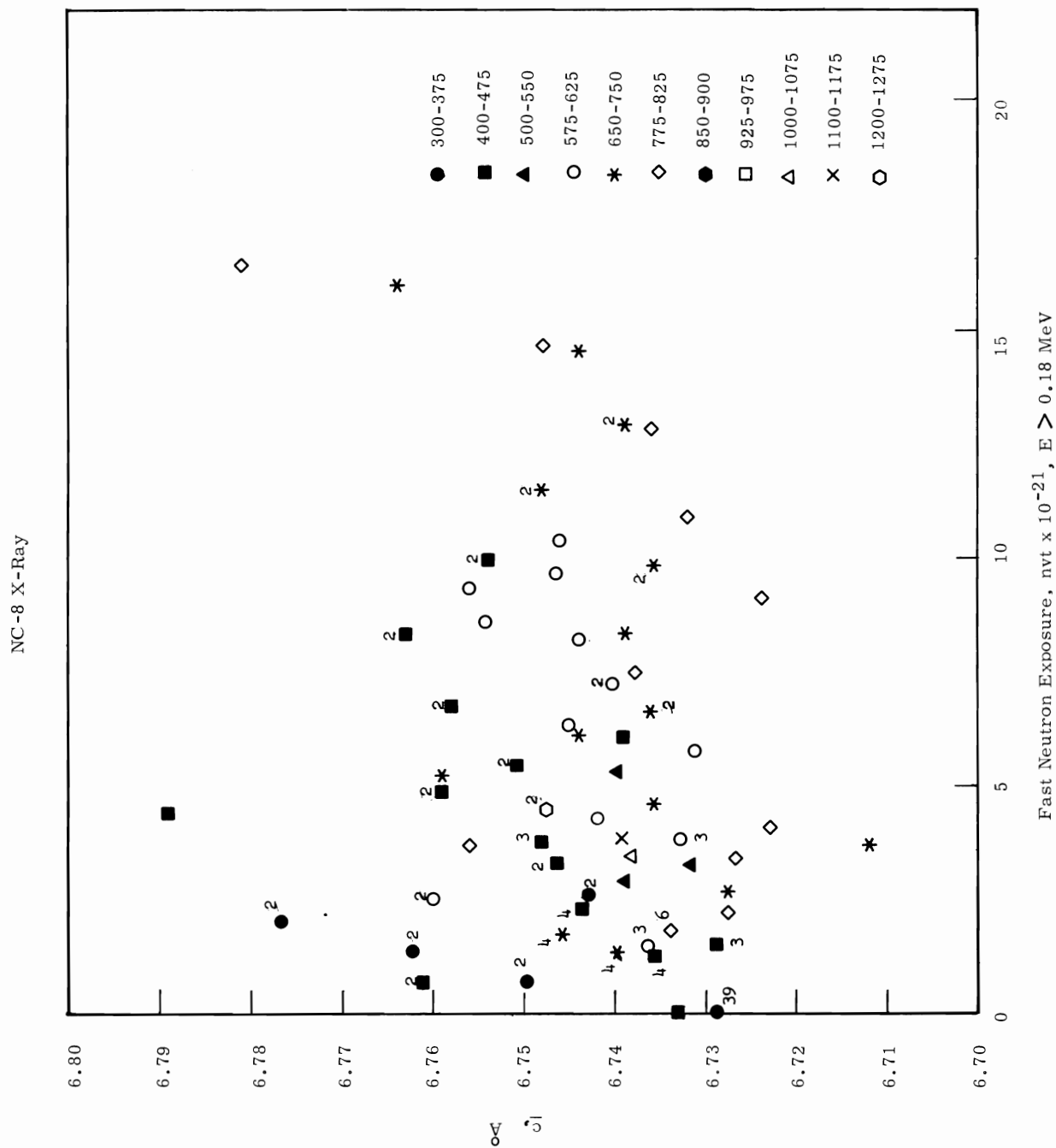
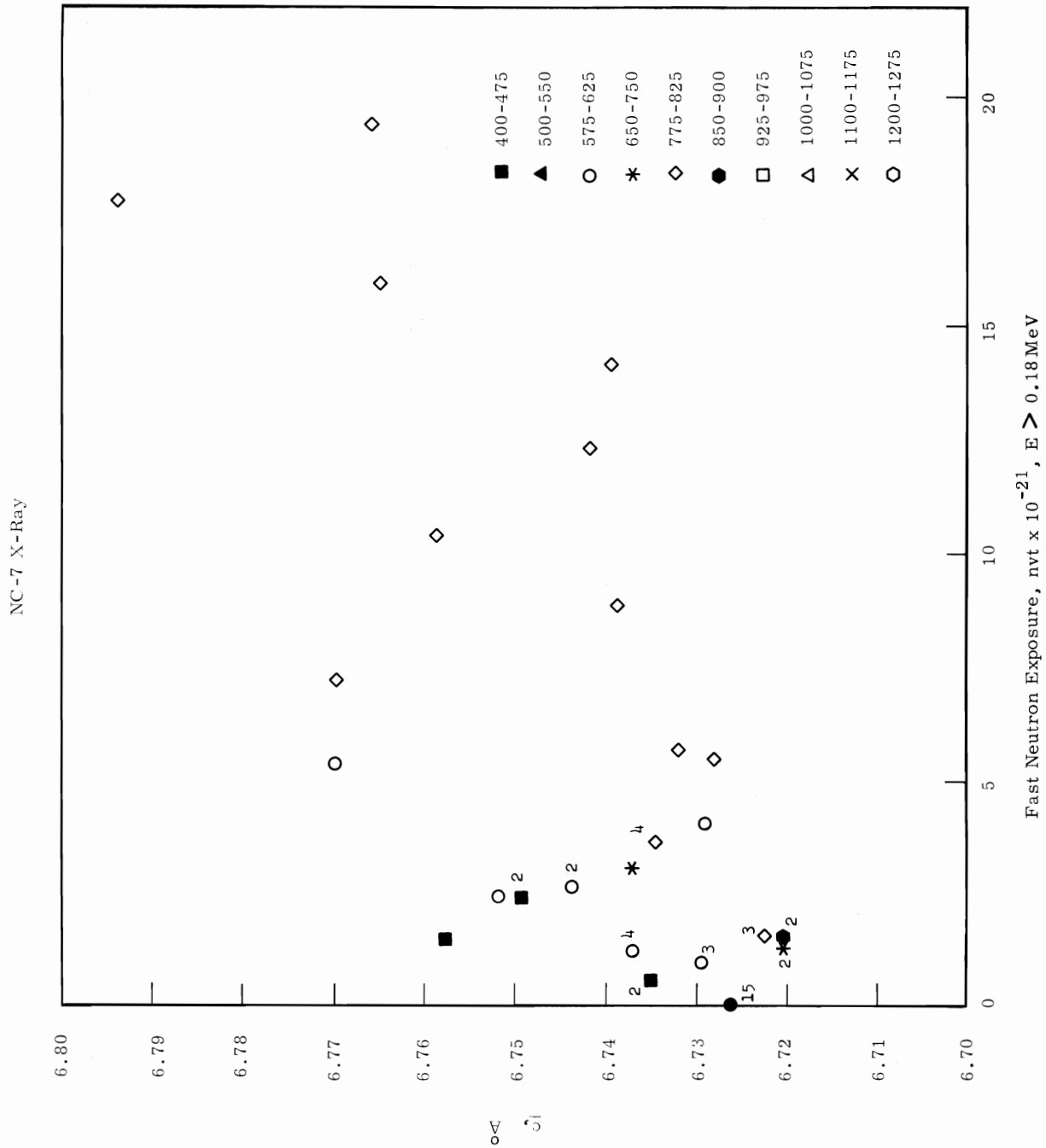


FIGURE E63. Crystallite Layer Spacing (d) of NC8 Graphite



X-Ray

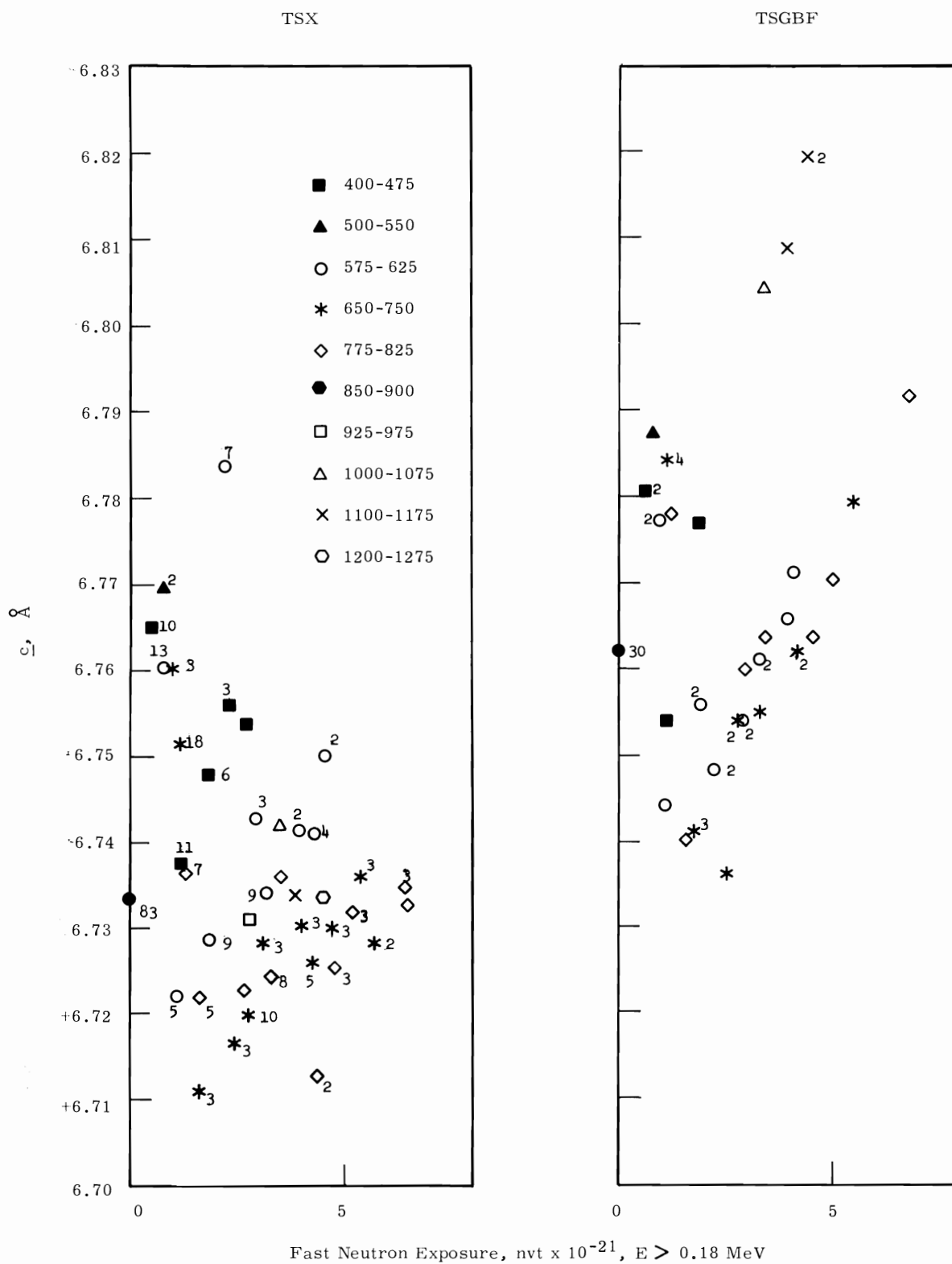


FIGURE E65. Crystallite Layer Spacing ($\bar{c}$) of TSX and TSGBF Graphites

NC-8 X-Ray

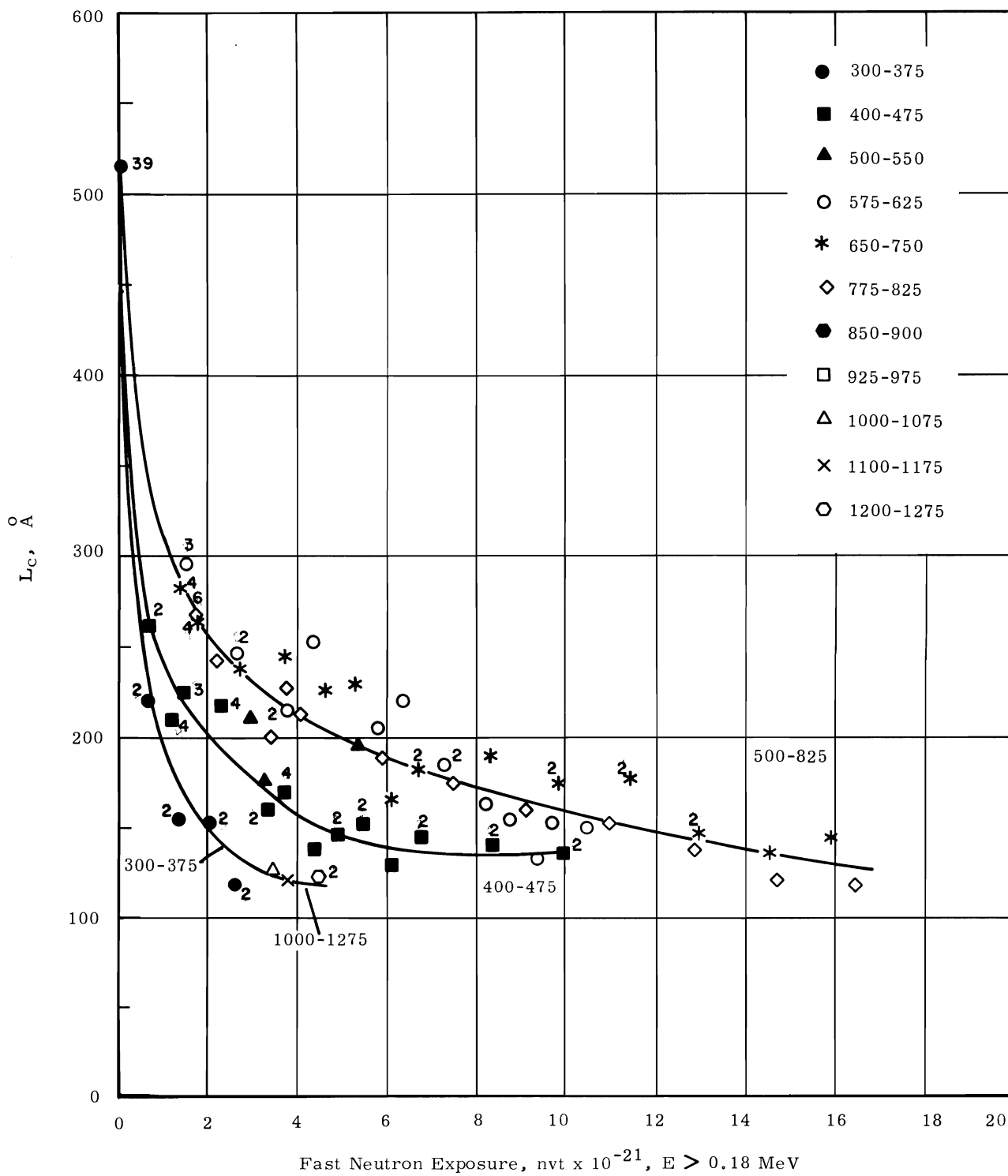


FIGURE E66. Apparent Crystallite Size (L_c) of NC8 Graphite

NC-7 X-Ray

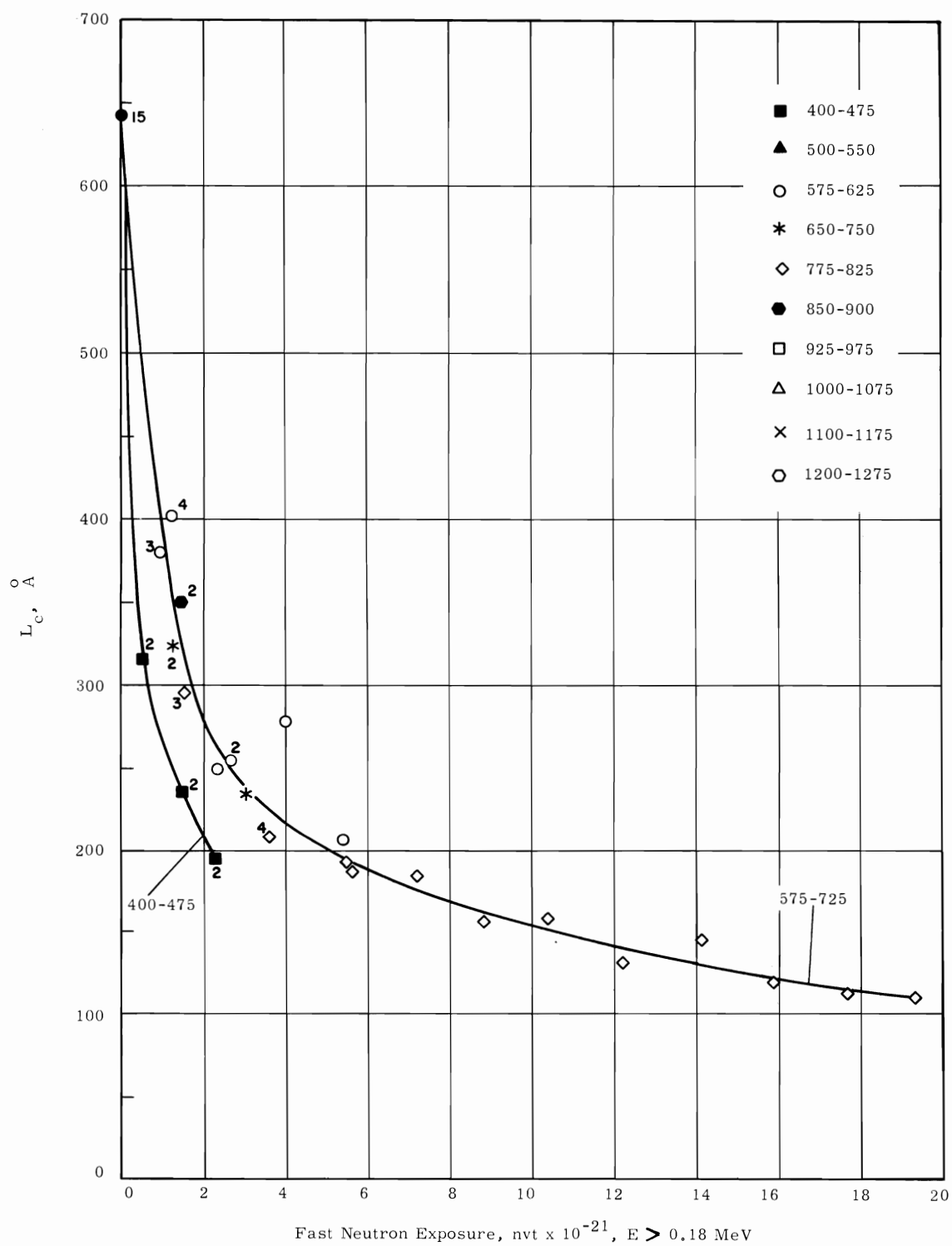


FIGURE E67. Apparent Crystallite Size (L_c) NC7 Graphite

X-Ray

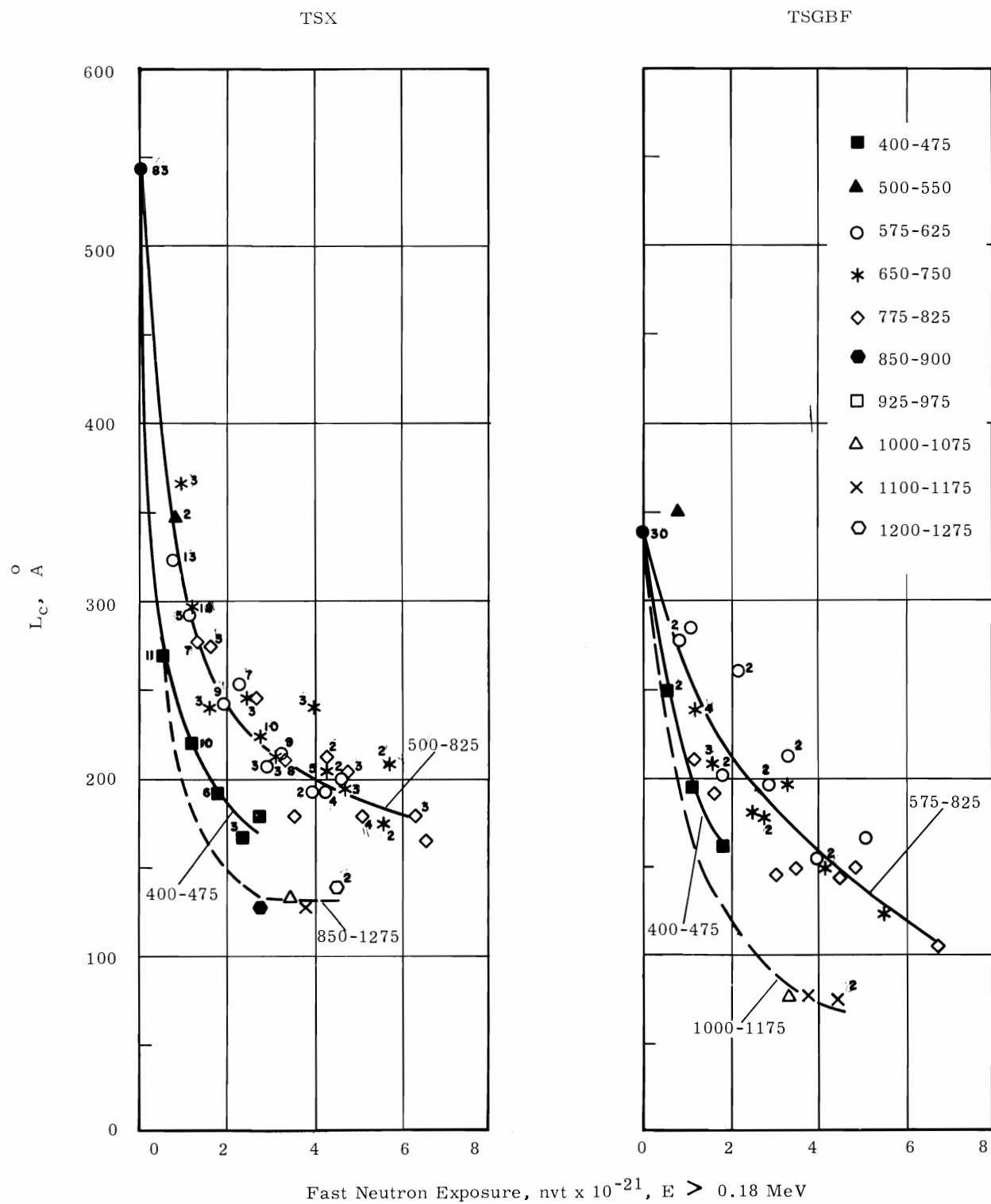
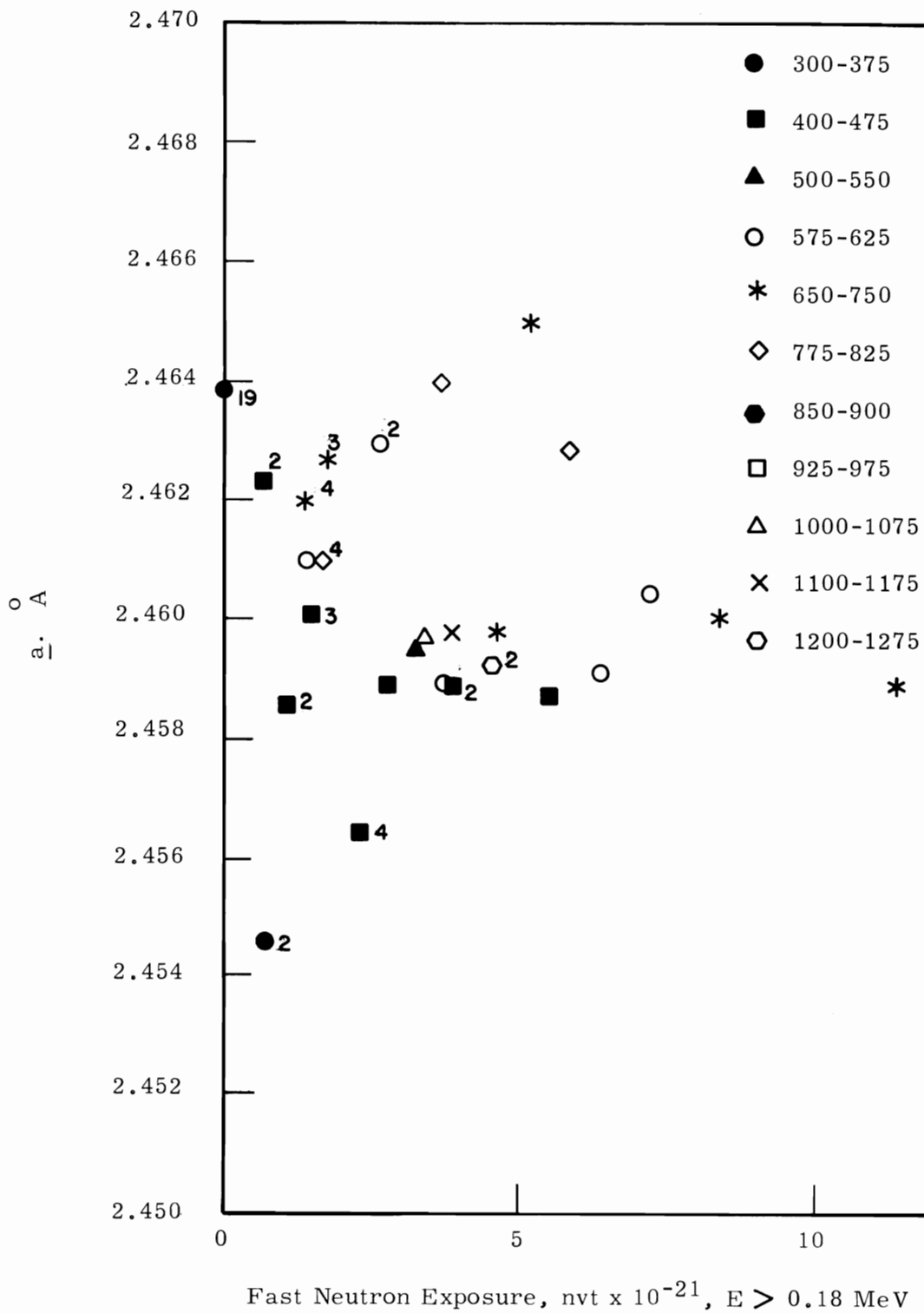


FIGURE E68. Apparent Crystallite Size (L_c) of TSX and TSGBF Graphites

NC-8 X-Ray



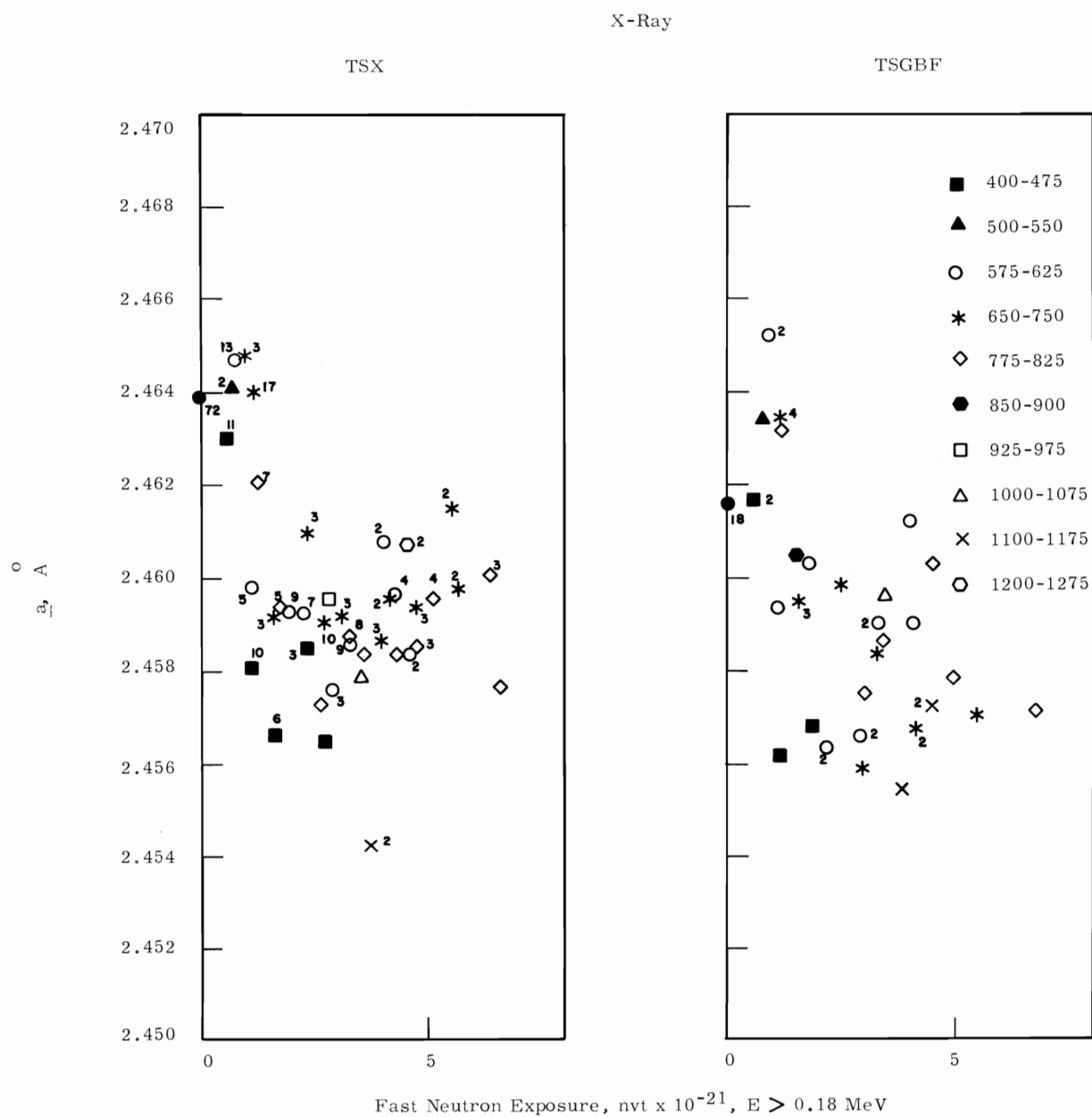


FIGURE E70. Unit Cell Spacing (a) of TSX and TSGBF Graphites

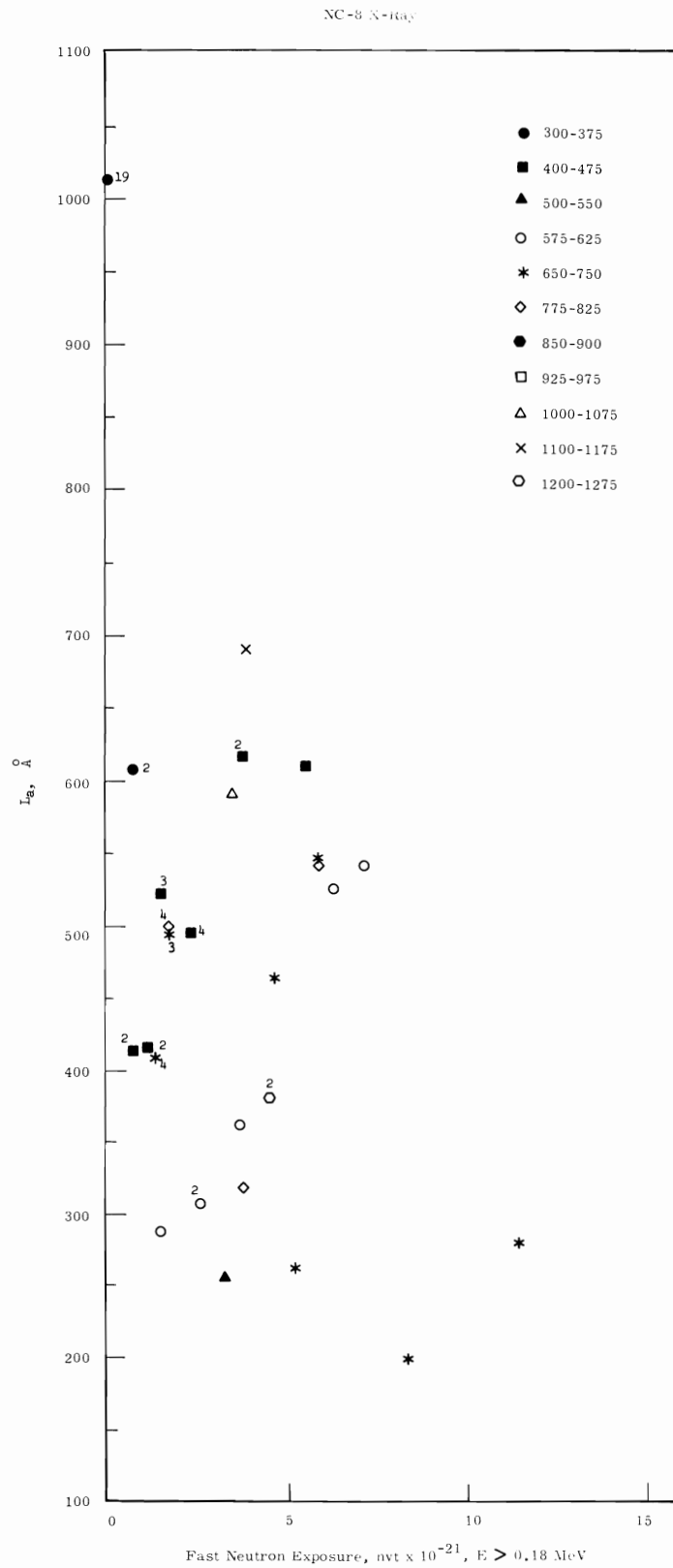


FIGURE E71. Apparent Crystallite Size (L_a) of NC8 Graphite

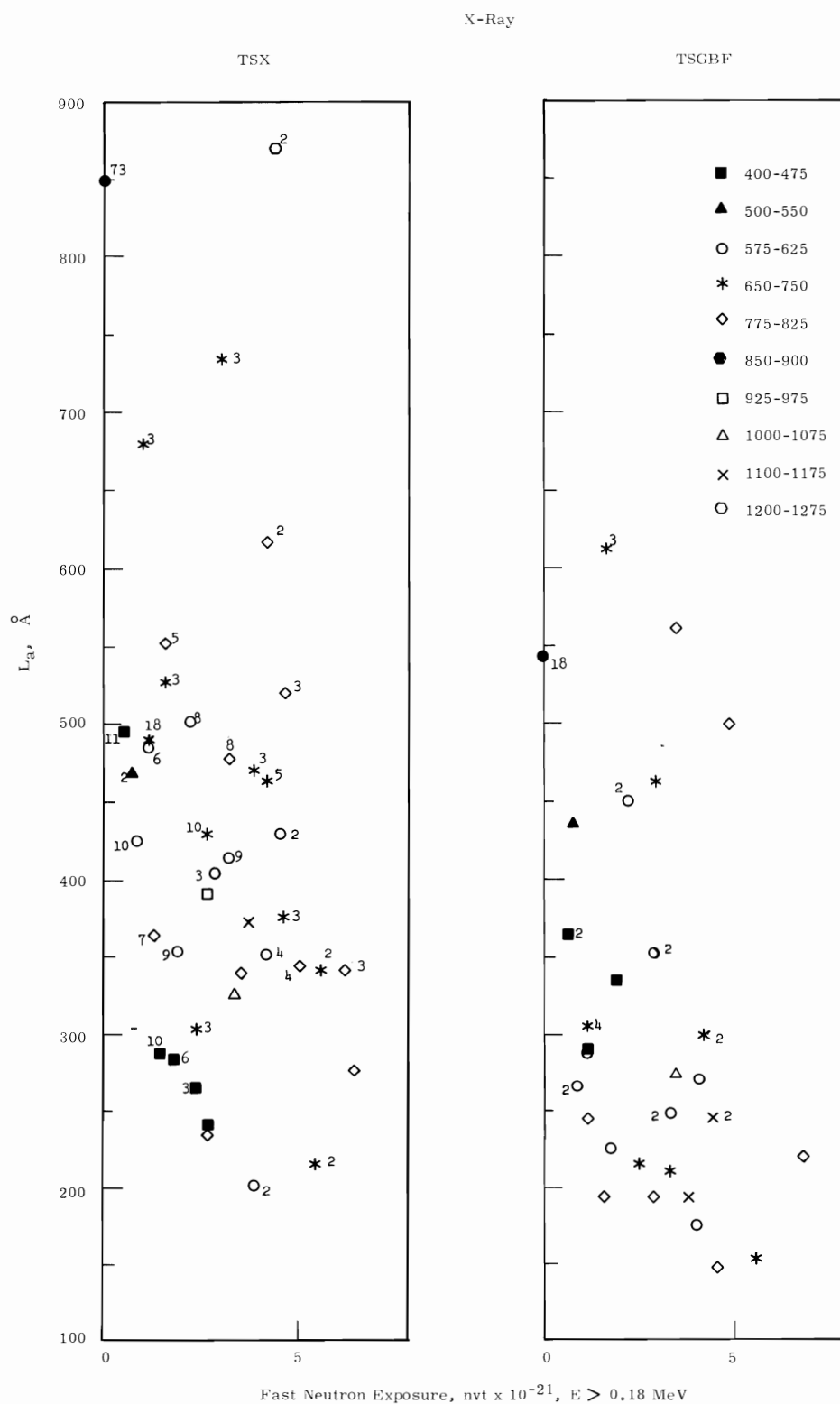


FIGURE E72. Apparent Crystallite Size (L_a) of TSX and TSGBF Graphites

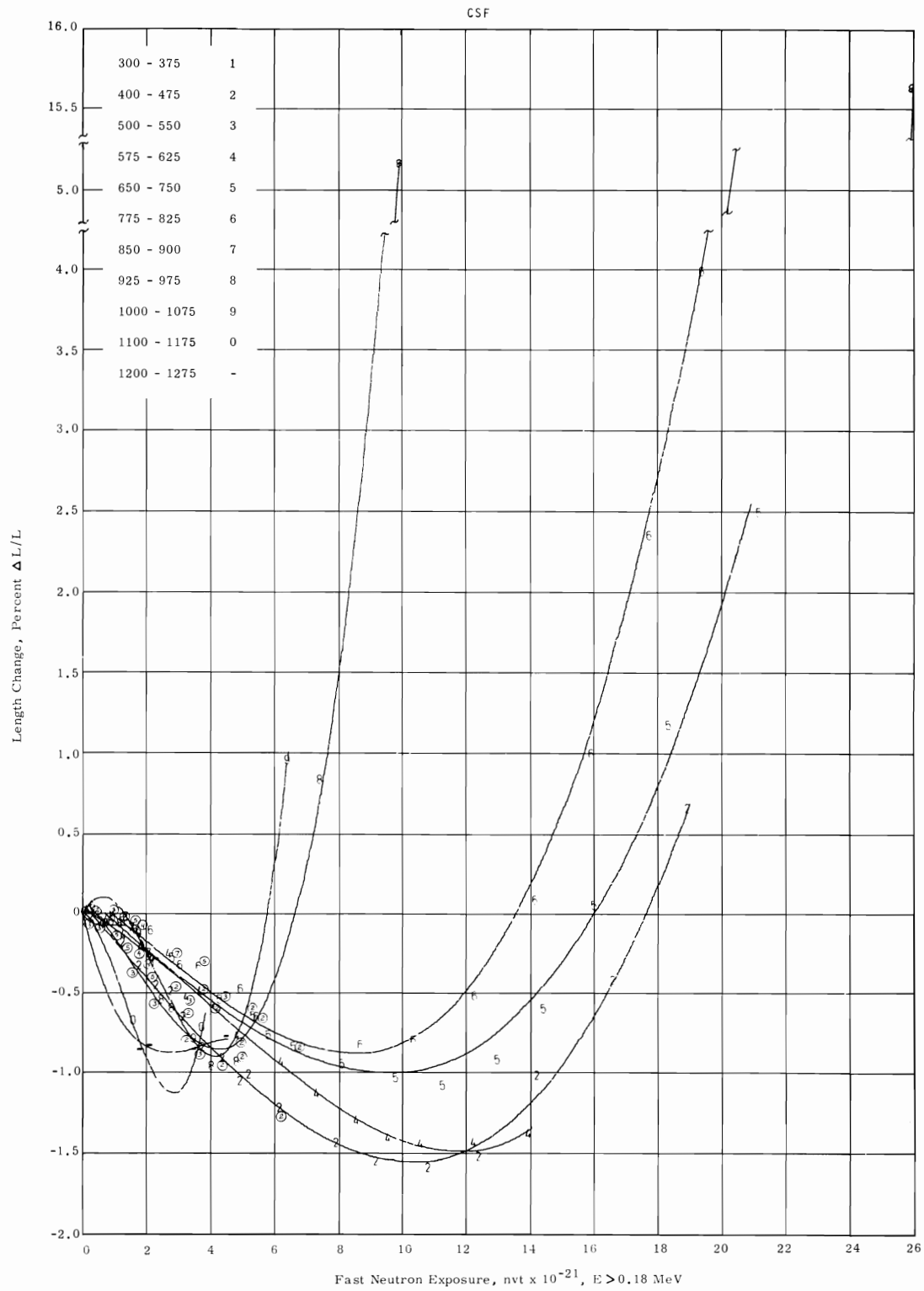
APPENDIX F

OVERLAY GRAPHS

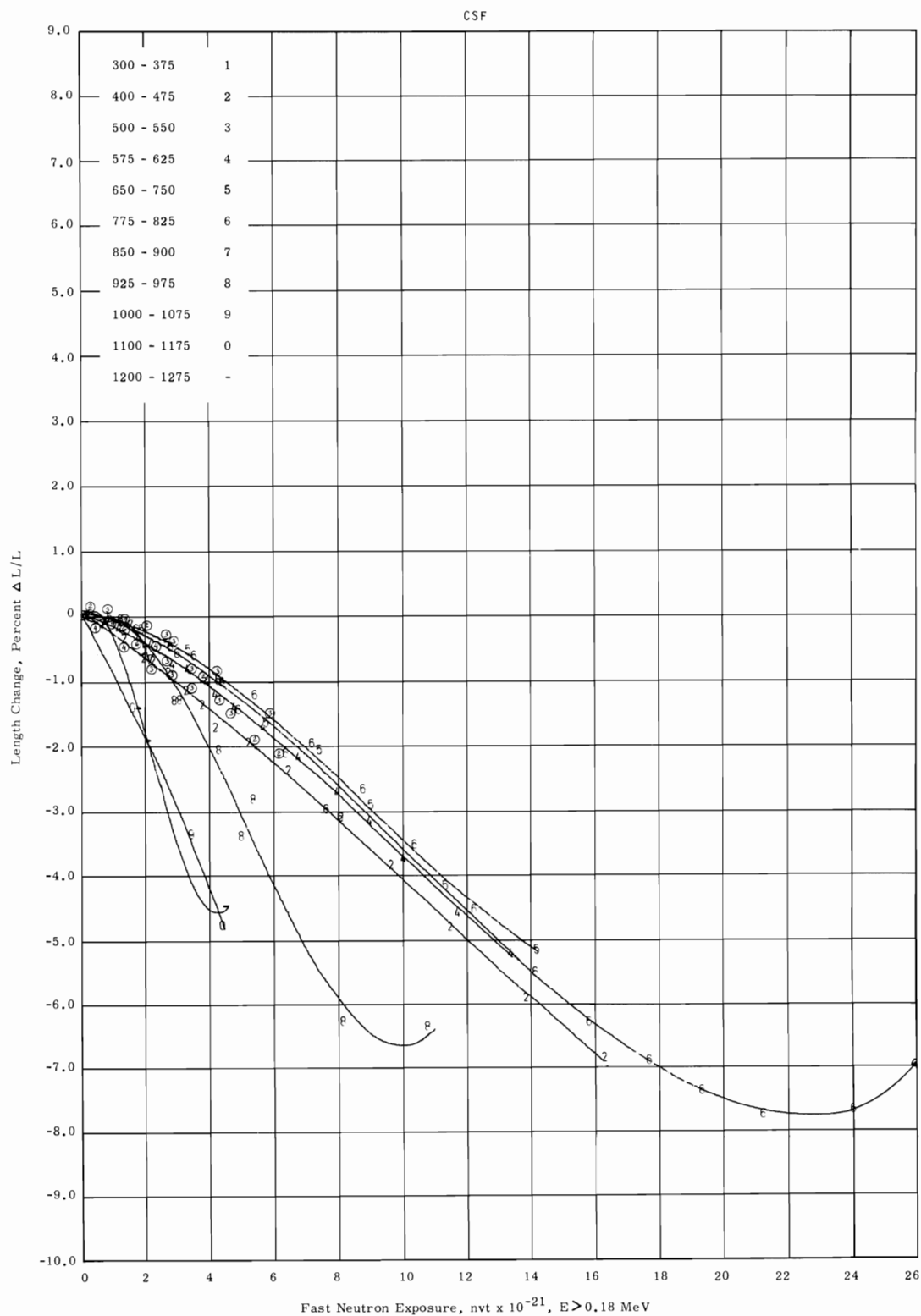
APPENDIX F

OVERLAY GRAPHS

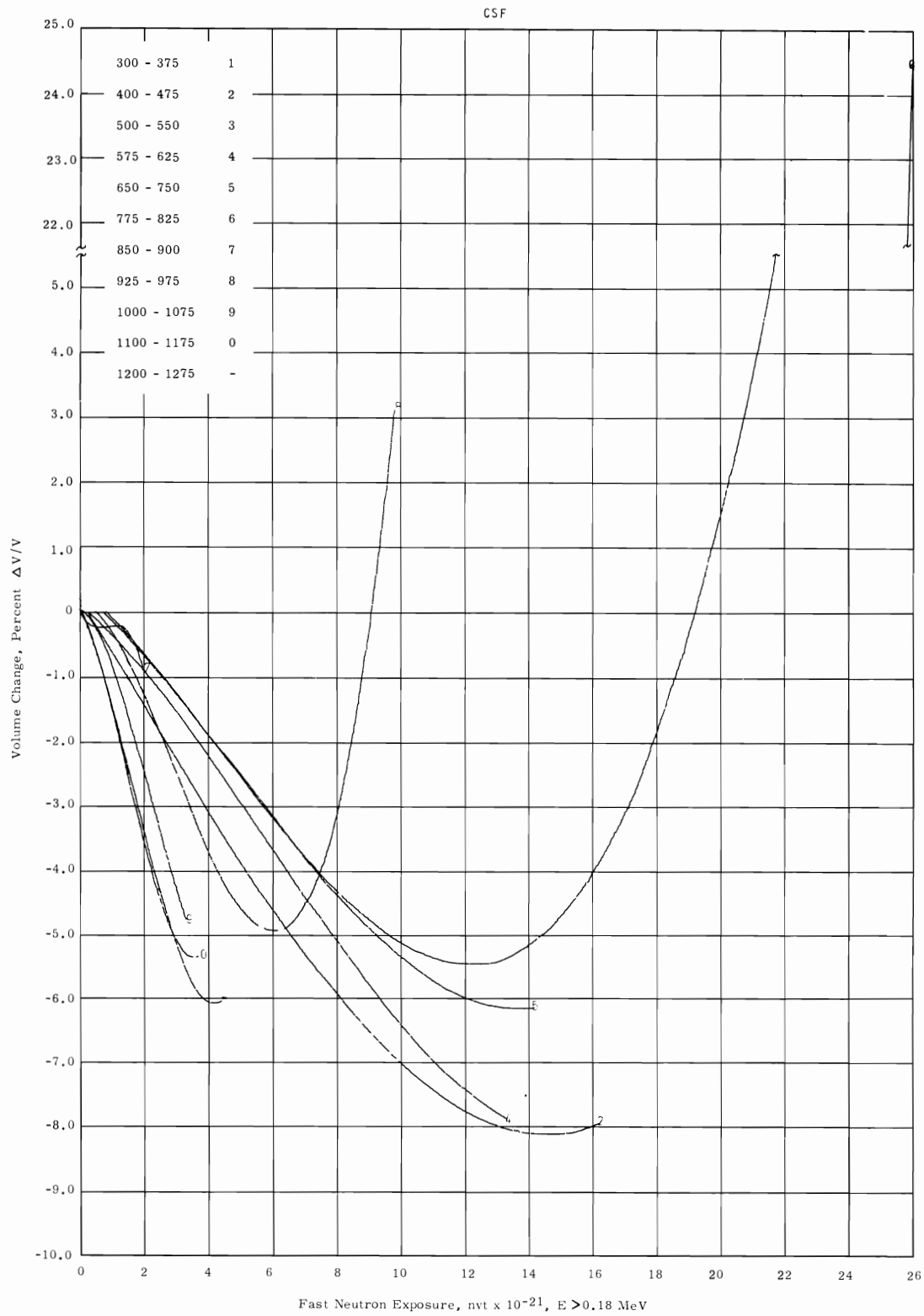
An easily removable duplicate set of 11 graphs for the CSF graphite is provided in this appendix for use as overlay graphs to allow ready comparisons of the behavior of different materials.



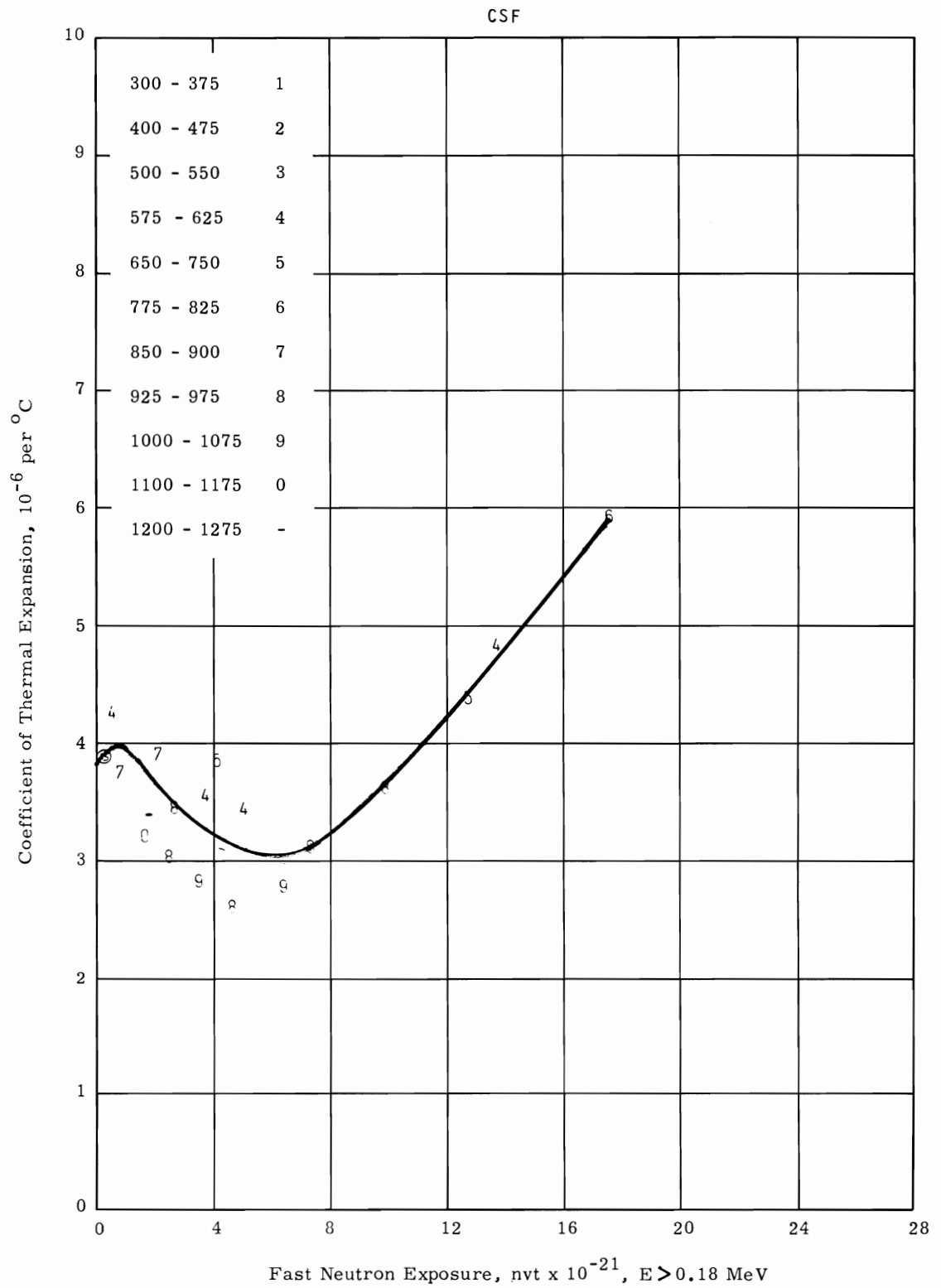
Length Change of CSF Graphite (Transverse)



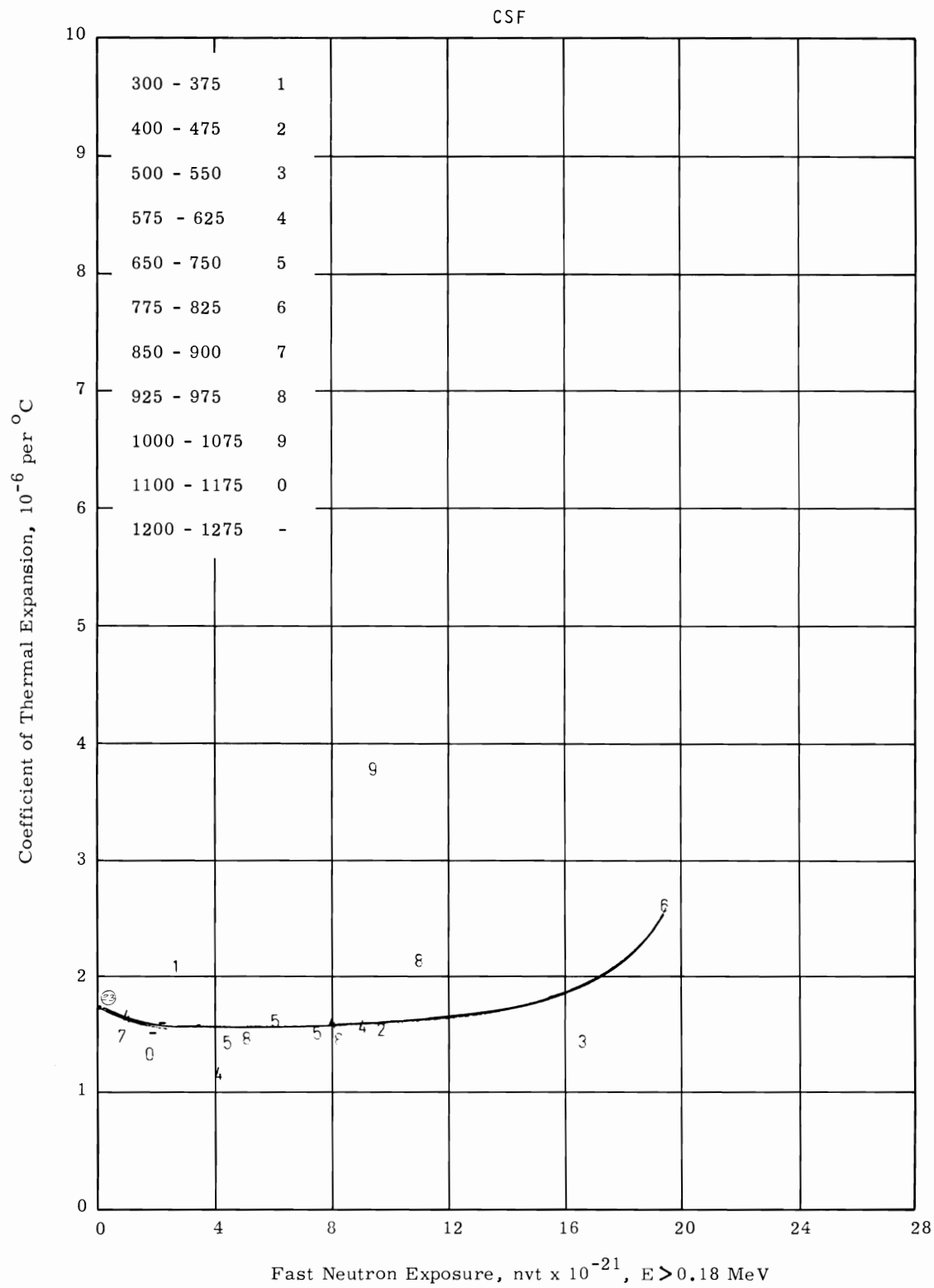
Length Change of CSF Graphite (Parallel)



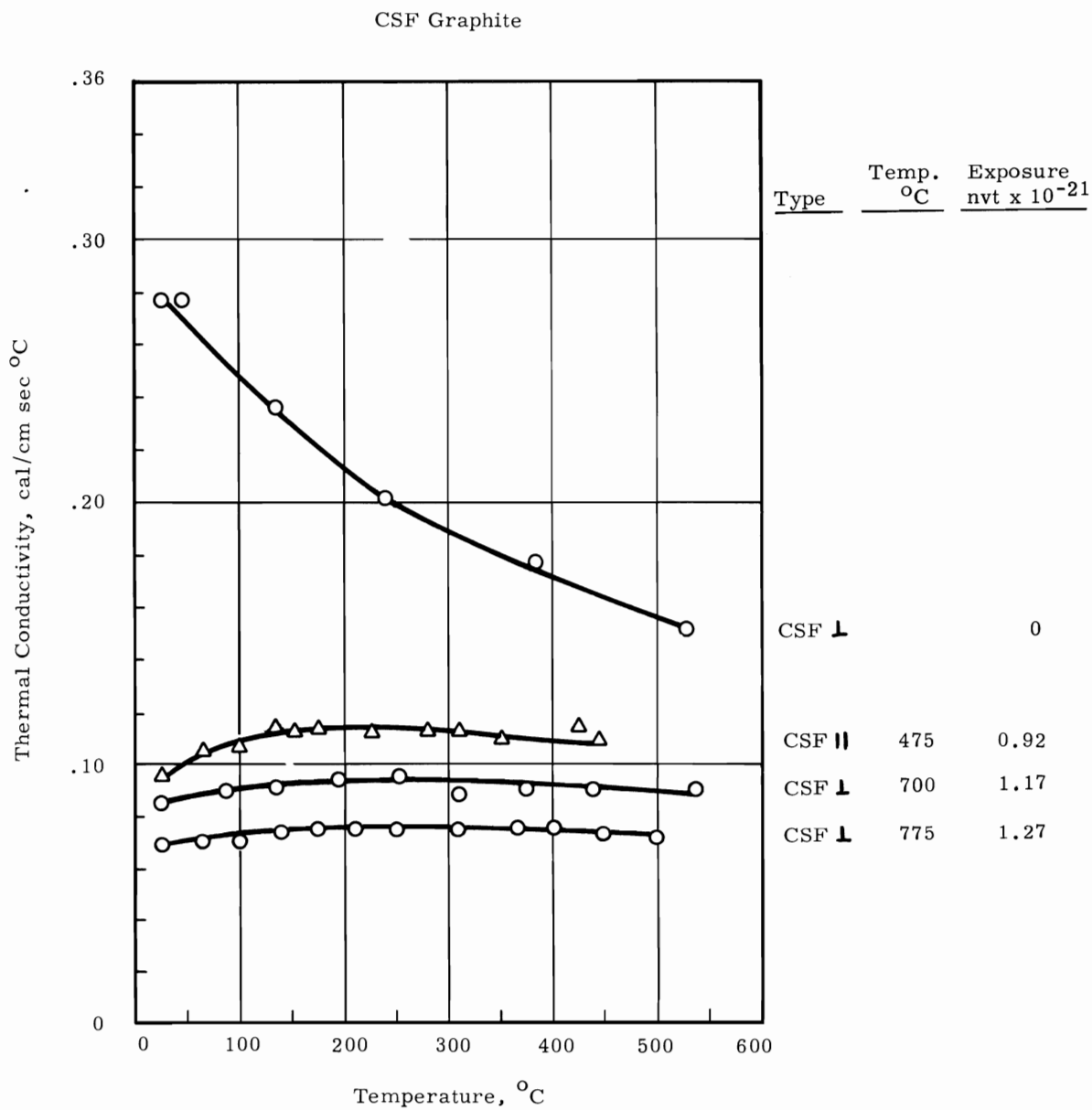
Volume Change of CSF Graphite



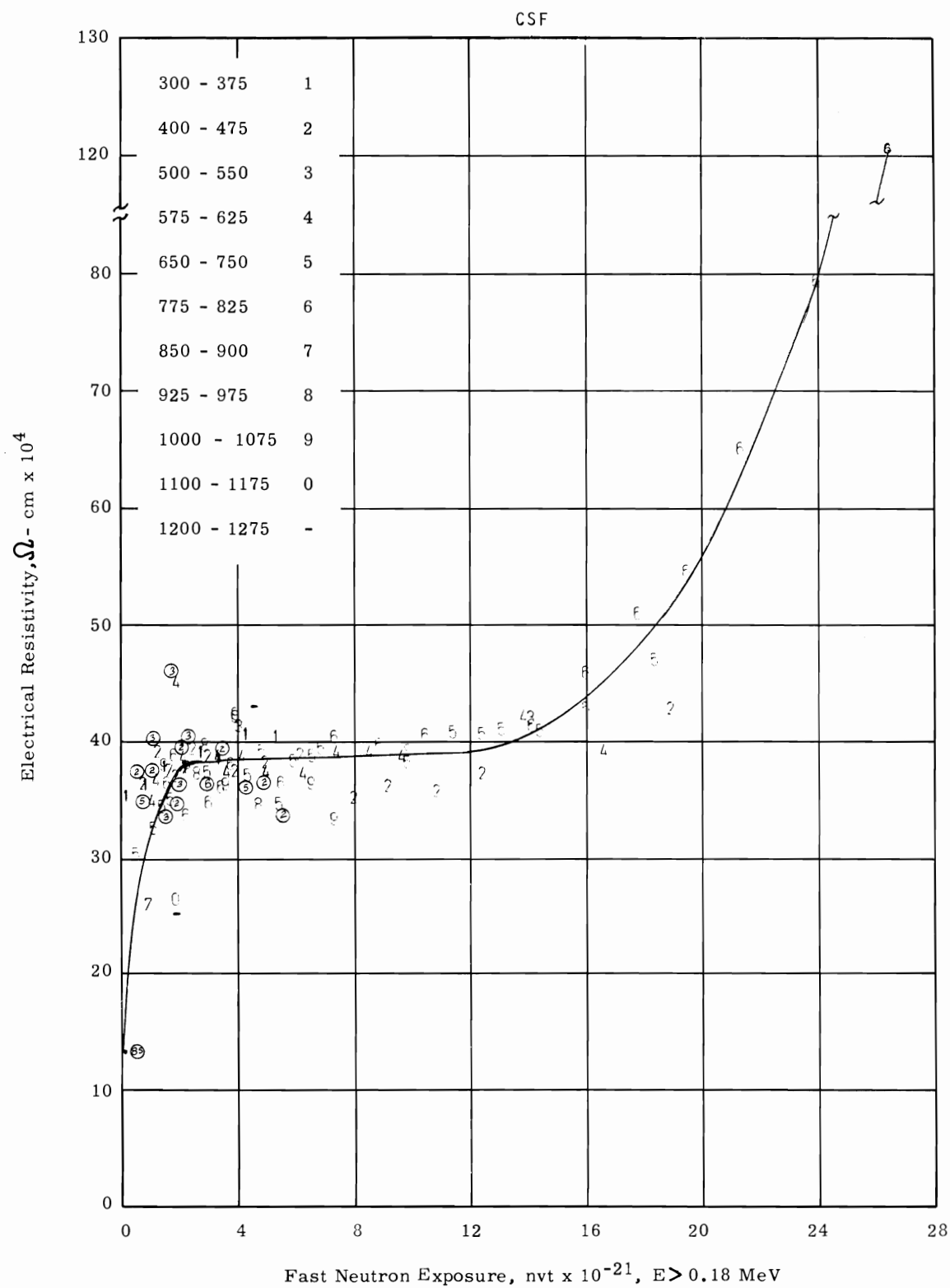
Coefficient of Thermal Expansion of CSF Graphite (Transverse)



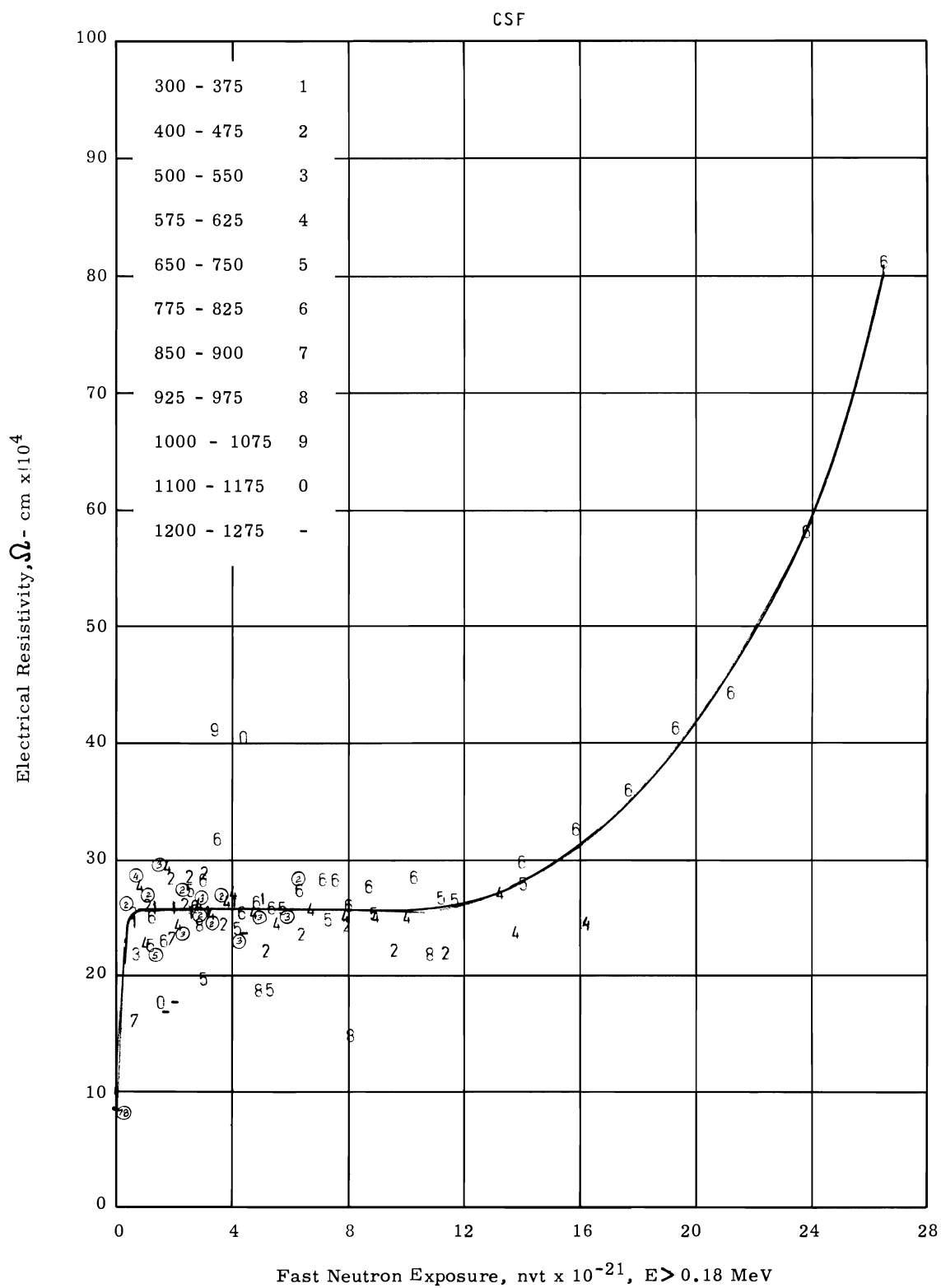
Coefficient of Thermal Expansion of CSF Graphite (Parallel)



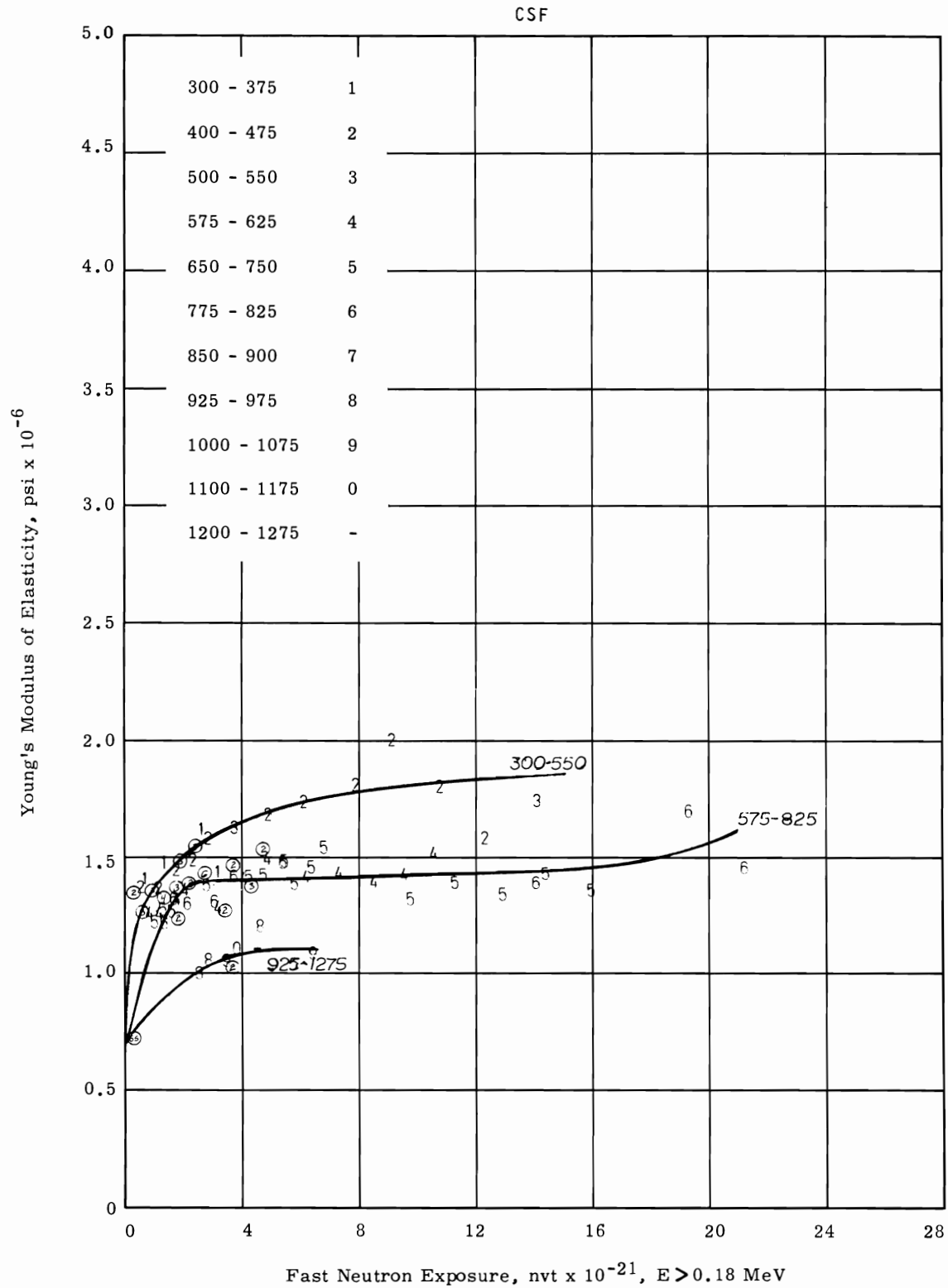
Thermal Conductivity of CSF Graphite



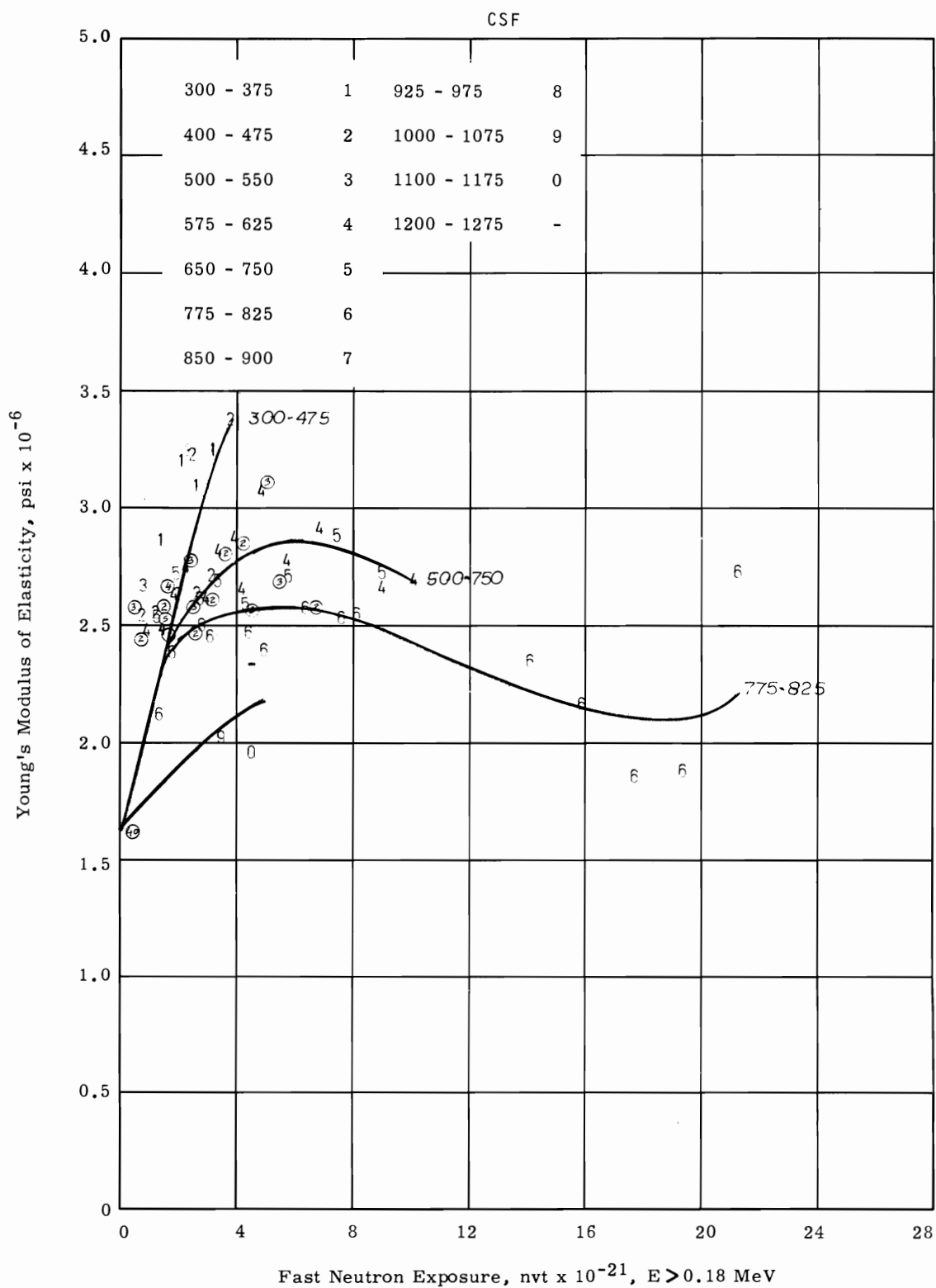
Electrical Resistivity of CSF Graphite (Transverse)



Electrical Resistivity of CSF Graphite (Parallel)

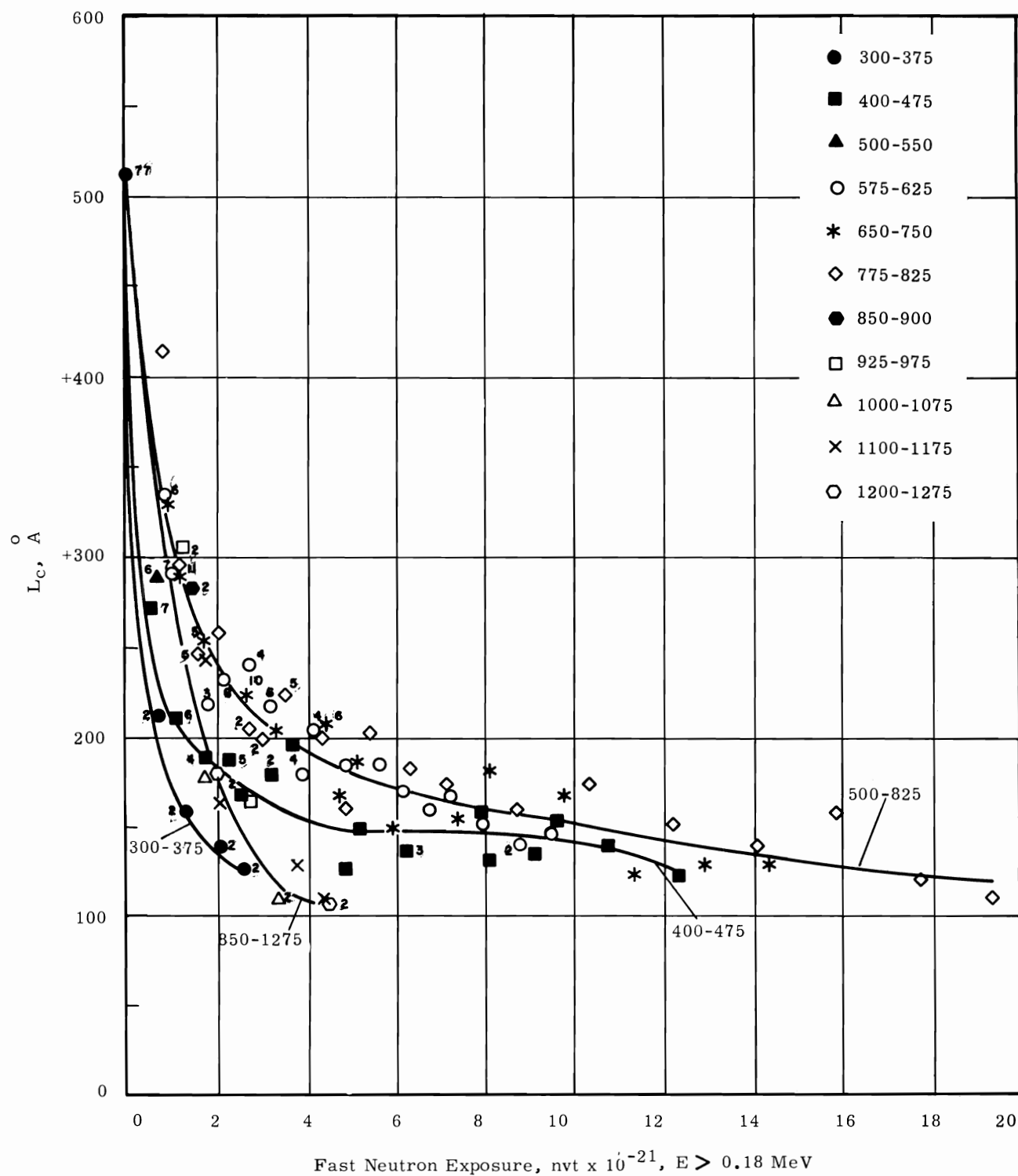


Young's Modulus of Elasticity of CSF Graphite (Transverse)



Young's Modulus of Elasticity of CSF Graphite (Parallel)

CSF



Apparent Crystallite Size (L_c) of CSF Graphite

DISTRIBUTIONNo. of
CopiesOFFSITE

1	<u>AEC Chicago Patent Group</u> G. H. Lee
4	<u>AEC Division of Reactor Development and Technology</u> J. E. Fox (2) R. E. Pahler J. M. Simmons
219	<u>AEC Division of Technical Information Extension</u>
1	<u>Argonne National Laboratory</u> R. M. Adams
3	<u>Atomic Energy Research Establishment</u> <u>Metallurgy Division</u> Harwell Didcot, Berkshire, ENGLAND W. N. Reynolds J. H. W. Simmons (2)
2	<u>Atomics International</u> K. W. Foster
1	<u>Atomic Power Development Associates</u> <u>1911 First Street, Detroit, Michigan</u> W. E. McHugh
2	<u>Basic Carbon Corporation</u> <u>Sanborn, New York</u> H. M. Killmar
1	<u>Berkeley Nuclear Lab.</u> <u>Berkeley, Glos., ENGLAND</u> P. P. Jennings
1	<u>Brookhaven National Laboratory</u> D. H. Gurinsky

No. of
Copies

- 3 Centre d' Etudes Nucleaires de Saclay
 Boite Postale No. 2
 Gif-sur-Vvette (Seine-et-Oise), FRANCE
 P. Leveque
 J. Rappeneau (2)
- 3 Culcheth Laboratories
 Reactor Materials Laboratory
 UKAEA
 Wigshaw Lane
 Warrington, Lancashire, ENGLAND
 B. T. Kelly (2)
 P. T. Nettley
- 3 Dragon Project Office
 Atomic Energy Establishment
 Winfirth
 Dorchester, Dorset, ENGLAND
 R. A. U. Huddle
 L. W. Graham (2)
- 1 Euratom C.C.R.
 Petten, Netherlands
 V. Lungagnani
- 1 General Electric Company
 Pleasanton, California
 G. E. Robinson
- 1 General Electric Company, Ltd.
 Hirst Research Centre
 Wembley, Middlesex, ENGLAND
 Dr. H. H. W. Losty
- 1 Gmelin Institute Atomic Energy
 Documentation Center
 Postschliebfach 9088
 Frankfurt, WEST GERMANY
 Dr. Irmgard Wensel

No. of
Copies

4	<u>Great Lakes Carbon Corporation</u> Research and Development Department P. O. Box 637, Niagara Falls, New York B. L. Bailey L. H. Juel (3)
3	<u>Gulf General Atomic Incorporated (AEC)</u> G. B. Engle (2) R. Turner
1	<u>Idaho Nuclear Corporation</u> E. Fast
1	<u>Los Alamos Scientific Laboratory</u> W. S. Clouser
1	<u>Marquardt Corporation</u> D. W. Bareis
1	<u>Nukem Nuclear</u> 645 Hanan Postfach 869 West Germany G. Spener
3	<u>Oak Ridge Operations Office</u> W. J. Larkin D. F. Cope (2)
2	<u>POCO Graphite, Inc.</u> Garland, Texas R. K. Carlson
2	<u>Pure Carbon Company</u> St. Marys, Pennsylvania R. R. Paxton
1	<u>Reactor Centrum Nederland</u> Petten, Netherlands R. Blackstone
1	<u>Rice University</u> Houston, Texas J. L. Margrave

No. of
Copies

- 1 SIGRI ELEKTROGRAPHIT GmbH
 8901 Meitingen Dei
 Augsburg, WEST GERMANY
 O. J. Vohler
- 2 Speer Carbon Products
 Research & Development Laboratories
 Packard Road & 47th Street
 Niagara Falls, New York
 W. E. Parker
- 2 Speer Carbon Products
 Development Department
 St. Marys, Pennsylvania
 W. A. Bauer
 M. B. Redmount
- 2 THTR Projektleitung
 517 Julich
 bei Aachen, WEST GERMANY
 L. Valette
- 1 Union Carbide Corporation
 Cleveland, Ohio
 J. T. Meers
- 1 Union Carbide Corporation
 270 Park Avenue, New York, N.Y.
 P. J. Hastings
- 1 Union Carbide Corporation
 Lawrenceburg, Tennessee
 L. D. Stoughton
- 4 Union Carbide Corporation (ORNL Y-12)
 W. P. Eatherly
 B. L. Greenstreet
 F. J. Witt (2)
- 2 Union Carbide Corporation (ORNL X-10)
 R. Kennedy (2)

No. of
Copies

1 Wright Air Development Division
Wright-Patterson AFB, Ohio
 R. H. Wilson (Major)

ONSITE-HANFORD

1 AEC Chicago Patent Group
R. K. Sharp (Richland)

2 AEC RDT Site Representative
P. G. Holsted

2 AEC Richland Operations Office
R. L. Plum
C. L. Robinson

3 Battelle Memorial Institute

4 Douglas United Nuclear, Inc.
P. C. Carlson
R. Cooperstein
D. H. Curtiss
A. Russell

25 Battelle-Northwest
D. E. Baker
J. H. Cox
G. M. Dalen
W. J. Gray
J. W. Helm (3)
R. G. Henderson
F. D. Hobbs
R. S. Hope
A. J. Jervis
J. C. Knoll
R. E. Nightingale
A. L. Pitner
J. C. Tobin
C. E. Vogel
E. M. Woodruff
H. H. Yoshikawa
 Technical Information Files (5)
 Technical Publications (2)