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Astronuclear
Laboratory

SNPO-C
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TID/SNW--6

VOLUME 3

CATEGORY-C

**MATERIALS DATA
NUCLEAR SUBSYSTEM
E-105 APPENDIX**

MASTER

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FOREWORD

To aid in the handling of these Category C Materials Data, they are bound in six volumes: Volumes 1 through 6. Volume 6 contains the Confidential-Restricted Data. The complete listing of the DRMs contained in these six volumes are delineated in the Table of Contents according to DRM No. and the corresponding Materials covered in each volume. Each unclassified volume contains a complete Table of Contents for the five volumes.

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GROUP - 1

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INFORMATION CATEGORY

unclassified

R. A. Jones 12-12-70
Authorized Classifier Date
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VOLUME 3

DRM NO.

MATERIALS

PROPERTIES DATA

51233		H4LM Graphite
51234		Type 304 Stainless Steel Plate, Sheet & Tube Annealed
51234	.....	304 SS Tube, Annealed
51234 B.	.....	304 SS Tube, Annealed
51234 C.	.....	304 SS Tube, Annealed
51237	.....	302 SS Full Hard
51238	.....	A 286 Bars
51238 A.	.....	A 286 Bars
51238 B.	.....	A 236 Bars
51238 C.	.....	A 286 Bars
51238 D.	.....	A 286 Bars
51238 D.	.....	A-286 Bars
51238 E.	.....	A-286 Bars
51239	.....	301 Stainless Steel
51239 A.	.....	301 Stainless Steel
51239 B.	.....	301 Stainless Steel
51239 C.	.....	301 Stainless Steel
51239 D.	.....	301 Stainless Steel
51239 E.	.....	301 Stainless Steel
51239 F.	.....	301 Stainless Steel
51242	.....	Tungsten-2%Thoria
51243	.....	Nbc/Graphite Composite
51243 A.	.....	Nbc/Graphite
51244	.....	Pyrofoil, Laminated

VOLUME 4

DRM NO.

MATERIALS

PROPERTIES DATA

51244 A.....	Pyrofoil, Laminated
51244 B.....	Pyrofoil, Laminated
51244 C.....	Pyrofoil, Laminated
51244 D.....	Pyrofoil, Laminated
51248	6061-T6 Aluminum Pipe
51248 A.....	6061-T6 Aluminum Pipe
51248 B.....	6061-T6 Aluminum Pipe
51250.....	A-286 Sheet, Strip and Tube
51250 A.....	A-286 Sheet, Strip and Tube
51250 B.....	A-286 Sheet, Strip and Tube
51250 C.....	A-286 Sheet, Strip and Tube
51250 D.....	A-286 Sheet, Strip and Tube
51276.....	6061-T61 Aluminum Ring Forging
51276 A.....	6061-T61 Aluminum Ring Forging
51276 B.....	6061-T61 Aluminum Ring Forging
51284.....	Tungsten - 2% Thoria Bar
51284 A.....	Tungsten - 2% Thoria Bar
51288.....	ZRC, 60% Dense
51288 A.....	ZRC, 60% Dense
51289.....	ZRO ₂ / ZRC, 85% Dense
51294.....	6061-T6 Aluminum Ring Forging
51297.....	Lead
51298.....	A-286 Bar, CW and Aged
51298 A.....	A-286 Bar, CW and Aged
51298	A-286 Bar, CW and Aged

VOLUME 5

DRM NO.

MATERIALS PROPERTIES DATA

51299.....	T2M Foil
53160.....	316 S.S. Foil
53161.....	6061-T61 Al. Forged Plate
53162.....	Pyrofoil, Thermalized and Rerolled
53163.....	ZRC, 85% Dense
53166.....	Pyrofoil Laminates, Insulation, Coated and Layered with ZRC
53166.....	Pyrofoil Laminates, Insulation, Coated and Layered with ZRC
53166 B.....	Pyrofoil Laminates, Insulation, Coated and Layered with ZrC
53169.....	ZRC, 50% Dense
53169 A.....	ZRC, 50% Dense
53180.....	Pyrofoil, Corrugated
53182.....	Comparison of Materials/Specification/DRM's on Study Layout Drawings
53184.....	302 SS, 1/4 and 1/2 Hard
53184 A.....	302 SS, 1/4 and 1/2 Hard
53186.....	Armco Iron
53187.....	Hitron
53188.....	Silicon Steel
53190.....	SAE 9310
53191.....	440C Stainless Steel
53197.....	Plum Brook Reactor Ambient Irradiation of Copper - 24 v/o Boron ¹⁰ Material
53200.....	Durok

VOLUME 1

DRM NO.

MATERIALS PROPERTIES DATA

51201 A.....	6061 Aluminum
51201 B.....	6061 Aluminum
51201 C.....	6061-T651 Aluminum
51201 D.....	6061 Aluminum
51201 E.....	6061-T651 Aluminum
51201 F.....	6061-T651 Aluminum
51205 A.....	S-200 Beryllium
51205 B.....	S-200 Beryllium
51205 C.....	S-200 Beryllium
51205 D.....	S-200 Beryllium
51205 E.....	S-200 Beryllium
51205 F.....	S-200 Beryllium
51205 G.....	S-200 Beryllium
51205 H.....	S-200 Beryllium
51205 J.....	S-200 Beryllium
51205 K.....	S-200 Beryllium
51205 L.....	S-200 Beryllium
51205 M.....	S-200 Beryllium
51204 N.....	S-200 Beryllium
51205 P.....	S-200 Beryllium
51205 Q.....	S-200 Beryllium
51208 A.....	TZM Alloy
51208 B.....	TZM Alloy
51208 C.....	TZM Alloy
51208 D.....	TZM Molybdenum Alloy
51208 E.....	TZM Alloy
51208 F.....	TZM Alloy

VOLUME 1

DRM NO.

MATERIALS

PROPERTIES DATA

51209 A.....Tungsten
51214 A.....Cu-24 v/o B¹⁰
51214 B.....Copper-18 Boron (Bⁿ & B¹⁰)
51214 C.....Copper-18 v/o Boron (Bn & B¹⁰)
51214 D.....Copper-18 v/o Boron (Bn & B¹⁰)
51217 B.....Pyrofoil, Embossed
51218 A.....Pyrofoil, Flat
51218 B.....Pyrofoil, Flat
51218 C.....Pyrofoil, Flat
51218 E.....Pyrofoil, Flat

VOLUME 2

DRM NO.

MATERIALS
PROPERTIES DATA

51222 A..... Nbc/Graphite Composite
51222 B..... Nbc/Graphite Composite
51222 C..... Nbc/Graphite Composite
51222 D..... Nbc/Graphite Composite
51222 E..... Nbc/Graphite Composite
51222 F..... Nbc/Graphite Composite
51222 G..... Nbc/Graphite Composite
51222 H..... Nbc/Graphite Composite
51225 A..... Graphitite G
51225 B..... Graphitite G
51225 C..... Graphitite G
51225 D..... Graphitite G
51226 A..... P-03 Graphite
51226 B..... P-03 Graphite
51227 A..... ZTA Graphite
51227 B..... ZTA Graphite
51228 A..... Pyrolytic Graphite
51228 B..... Pyrolytic Graphite
51228 C..... Pyrolytic Graphite
51229 A..... Bath Shielding Material
51229 B..... Bath Shielding Material
51229 C..... Bath Shielding Material
51229 D..... Bath Shielding Material
51229 E..... Bath Shielding Material
51229 F..... Bath Shielding Material
51229 G..... Bath Shielding Material
51229 H..... Bath Shielding Material

51229 J.....Bath Shielding Material

51229 K.....Bath Shielding Material

51229 L.....Bath Shielding Material

51232 A.....Type 304 Stainless Steel Rod-Annealed

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 571233	REV (1)
SUBJECT (120) H4CM GRAPHITE - ESTIMATED MATERIALS PROPERTIES DATA						DRM TYPE (13) ESTIMATED DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 6/6/69	REACTOR
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1.							1. 2.
2.							3. 4.
3.							5. 6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1. PDS 30073-1		2.		3.		4.	
6.		7.		8.		9.	
10.							
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)							
1) PROVIDE PRELIMINARY ESTIMATES OF MATERIALS PROPERTIES FOR REACTOR ENGINEERING USE.							
2) ESTIMATES WERE BASED ON AEC 2270; TPL, PURDUE UNIVERSITY; SUPPLIER DATA; WANL TEST DATA; AND ON MATERIALS ENGINEER EXPERIENCE.							
3) NOT APPLICABLE							
APPROVALS A.L. SHOLLENBERGER 6/6/69 PREPARED BY DATE J. J. [Signature] 6/9/69 APPROVED BY DATE				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION [Signature] 6/6/69 AUTHORIZED CLASSIFIER DATE		SECURITY CLASS	

MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 2 DATE 6/4/68 MATERIAL HyLo Graphite

CONDITION 40" O x 72" L Extrusion DIRECTION W & N G

SPEC. NOS. *PDS 30073-2*

DATA BASIS	COMMENTS
Estimated	PRELIMINARY DATA

PROPERTY *Density*

TEMP., °F	$\bar{X}$, Lb/ft ³	S	N	COMPUTED VALUE,	COMMENTS
74-	0.063	0.004			

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MATERIALS DEPARTMENT DATA RELEASE

DRM. 1233 PAGE NO. 3 DATE 6/5/68 MATERIAL H4LM GRAPHITECONDITION 40" D x 72" L Extrusion DIRECTION W.G.SPEC. NOS. PDS 30073-2DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI ^{1/4}	S	N	COMPUTED VALUE	COMMENTS
75	1.40	0.14			
750	1.55	0.15			
1470	1.60	0.16			
2190	1.75	0.18			
2910	2.00	0.20			
3630	2.40	0.24			
4000	2.64	0.26			
4200	2.77	0.28			
4275	2.80	0.28			
4350	2.80	0.28			
4425	2.78	0.28			
4750	2.65	0.27			
5070	2.50	0.25			

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MATERIALS DEPARTMENT DATA RELEASE

 DRM 1233 PAGE NO. 4 DATE 6/5/69 MATERIAL H4LM GRAPHITE

 CONDITION 40" D x 72" L Extrusion DIRECTION W.G.

 SPEC. NOS. PDS 30073-2

 DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA
 IRRADIATED: 6×10^{14} N/CM² (E > 1 meV)

 PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
75	2.80	0.14			
250	2.75	0.14			
400	2.64	0.18			
500	2.50	0.15			
650	2.22	0.14			
750	1.97	0.15			
850	1.88	0.15			
1000	1.60	0.14			
2000	1.60	0.14			
2500	1.67	0.19			
3000	1.80	0.20			
3630	2.40	0.24			
4000	2.64	0.26			
4200	2.77	0.28			
4275	2.80	0.28			
4350	2.80	0.28			
4425	2.78	0.28			
4750	2.65	0.27			
5070	2.50	0.25			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 5 DATE 6/5/68 MATERIAL H4LM Graphite

CONDITION 40" D x 72" L EXTENSION DIRECTION A.G.

SPEC. NOS. POJ 30073-2

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
75	1.04	0.10			
750	1.05	0.11			
1470	1.06	0.11			
1750	1.10	0.11			
2190	1.25	0.13			
2600	1.30	0.13			
2910	1.40	0.14			
3150	1.45	0.15			
3400	1.54	0.15			
3630	1.65	0.17			
4000	1.90	0.19			
4200	2.06	0.21			
4250	2.09	0.21			
4350	2.12	0.22			
4750	2.10	0.21			
5070	2.05	0.21			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 6 DATE 6/5/69 MATERIAL H4LM GRAPBITE

CONDITION 40"Øx72" L EXTRUSION DIRECTION A. G.

SPEC. NOS. PDS 30073-L

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA
IRRADIATED: 6×10^{18} N/CM² (E > 1 MeV)

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE	COMMENTS
75	2.08	0.10			
250	2.00	0.10			
500	1.79	0.11			
750	1.48	0.11			
875	1.36	0.11			
1000	1.30	0.11			
1500	1.28	0.11			
2000	1.30	0.13			
2500	1.33	0.13			
3000	1.40	0.14			
3150	1.45	0.15			
3400	1.44	0.15			
3630	1.65	0.17			
4000	1.90	0.19			
4200	2.06	0.21			
4250	2.09	0.21			
4350	2.12	0.22			
4750	2.10	0.21			
5070	2.05	0.21			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 7 DATE 6/5/68 MATERIAL H4L on GRAPHITECONDITION 40" D x 72" L EXTRUSION DIRECTION W.G.SPEC. NOS. PDS 30073-2DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY FLEXURE STRENGTH

TEMP., °F	$\bar{X}$, KSI ^{1/2}	S	N	COMPUTED VALUE	COMMENTS
75	2.40	0.24			
750	2.40	0.24			
1470	2.50	0.25			
1800	2.53	0.25			
2190	2.60	0.26			
2600	2.70	0.27			
2990	2.80	0.28			
3250	2.98	0.30			
3630	3.24	0.32			
4000	3.55	0.36			
4350	4.70	0.47			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1133 PAGE NO. 8 DATE 6/6/69 MATERIAL H4LM GRAPHITE

CONDITION 40" D x 72" L EXTRUSION DIRECTION W. G.

SPEC. NOS. PDS 30073-2

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 6×10^{14} N/cm² ($E > 1$ MeV)

PROPERTY FLEXURE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE	COMMENTS
75	4.80	0.24			
300	4.53	0.24			
500	4.07	0.24			
700	3.37	0.24			
800	3.15	0.25			
900	3.01	0.25			
1000	2.95	0.25			
2000	2.80	0.26			
2500	2.78	0.27			
2750	2.80	0.28			
2850	2.82	0.28			
3000	2.85	0.28			
3250	2.98	0.30			
3630	3.24	0.32			
4000	3.55	0.36			
4350	4.70	0.47			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 9 DATE 6/6/68 MATERIAL H4Lm GraphiteCONDITION 40" O.D. x 72" L Extrusion DIRECTION A-FSPEC. NOS. PDV 30073-2DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY FLEXURE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
75	2.60	0.26			
750	2.60	0.26			
900	2.61	0.26			
1350	2.73	0.27			
1470	2.80	0.28			
1850	2.83	0.28			
2190	2.90	0.29			
2500	3.04	0.30			
2910	3.25	0.32			
3250	3.48	0.35			
3610	3.80	0.38			
4000	4.18	0.42			
4350	4.70	0.47			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1L33 PAGE NO. 10 DATE 6/6/68 MATERIAL H4LM Graphite

CONDITION 40" D x 72" L Extrusion DIRECTION A.G.

SPEC. NOS. PDS 30073-2

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRADIATED: 6×10^{18} N/CM² (E > 1 meV)

PROPERTY FLEXURE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
75	5.20	0.26			
150	5.00	0.26			
375	4.77	0.26			
500	4.43	0.26			
650	3.80	0.26			
750	3.50	0.26			
850	3.32	0.26			
900	3.26	0.26			
1000	3.20	0.26			
2000	3.15	0.29			
2250	3.16	0.29			
2500	3.17	0.30			
2750	3.21	0.32			
3000	3.30	0.33			
3620	3.80	0.38			
4000	4.18	0.42			
4350	4.70	0.47			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 11 DATE 6/6/69 MATERIAL H4LM GRAPHITECONDITION 40" DIA 72" L EXTRUSION DIRECTION WG & AGSPEC. NOS. POJ 30073-2DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY COMPRESSIVE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE	COMMENTS
75	5.10	0.5			
2000	5.10	↓			
2500	5.20				
3000	5.30				
3500	5.55				
4000	5.85				

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 12 DATE 6/5/69 MATERIAL H4LM: GRAPHITE

CONDITION 40" DIA L EXTENSION DIRECTION WG & AG

SPEC. NOS. PDS 30073-2

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 6×10^{18} N/CM² (E > 1 MeV)

PROPERTY COMPRESSIVE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
75	10.20	0.5			
500	8.55				
750	6.85				
850	6.45				
925	6.25				
1000	6.10				
2000	5.60				
2500	5.40				
2750	5.30				
3000	5.30				
3500	5.55				
4000	5.85				

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 13 DATE 6/6/69 MATERIAL H4LM. GRAPHITE

CONDITION 40" DIA 72" L EXTRUSION DIRECTION W.G.

SPEC. NOS. PDS 30073-2

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

PROPERTY Modulus of Elasticity

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
75	1.30	0.13			
500	1.32	0.13			
1000	1.38	0.14			
1500	1.44	0.14			
2000	1.50	0.15			
2500	1.56	0.15			
3000	1.62	0.16			
3500	1.70	0.17			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 14 DATE 6/6/59 MATERIAL H4LM GRAPHITE

CONDITION 4" DIA 12" L Extruded DIRECTION W. R.

SPEC. NOS. PDS 30073-2

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 5×10^{18} N/CM² (E > 1 mev)

PROPERTY MODULUS of ELASTICITY

TEMP., °F	$E, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE	COMMENTS
75	3.90	0.13			
250	3.28	0.13			
500	2.64	0.13			
700	2.34	0.14			
900	2.13	0.14			
1100	2.00	0.14			
1300	1.92	0.14			
1500	1.86	0.14			
1750	1.82	0.15			
2000	1.80	0.15			
2150	1.78	0.15			
2500	1.67	0.15			
2650	1.63	0.16			
2800	1.62	0.16			
2900	1.61	0.16			
3000	1.62	0.16			
3500	1.70	0.17			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 10 DATE 6/6/67 MATERIAL H4LM GRAPHITECONDITION 40" DIA 72" EXTRUSION DIRECTION A. G.SPEC. NOS. P0530073-LDATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY MODULUS OF ELASTICITY

TEMP., °F	$\bar{X}, 10^{10} \frac{lb}{in^2}$	S	N	COMPUTED VALUE,	COMMENTS
75	1.20	0.12			
500	1.22	0.12			
1000	1.24	0.12			
1500	1.34	0.13			
2000	1.40	0.14			
2500	1.46	0.15			
3000	1.52	0.15			
3500	1.62	0.16			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 16 DATE 6/6/68 MATERIAL 144 m GRAPHITECONDITION 4" OXIDIZED EXTRUSION DIRECTION A.G.SPEC. NOS. PDS 30073-2DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAIRRADIATED: 6×10^{14} N/cm² (E > 1 MeV)PROPERTY MODULUS OF ELASTICITY

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
75	3.60	0.12			
250	3.03	0.12			
500	2.45	0.12			
650	2.23	0.12			
800	2.07	0.12			
1000	1.91	0.12			
1250	1.78	0.13			
1500	1.72	0.13			
1750	1.69	0.14			
2000	1.68	0.14			
2250	1.67	0.14			
2500	1.60	0.15			
2700	1.53	0.15			
2800	1.52	0.15			
2900	1.52	0.15			
3000	1.55	0.15			
3500	1.62	0.16			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 17 DATE 6/6/68 MATERIAL H4LM GRAPHITE

CONDITION 40" DIA x 72" L EXTRUSION DIRECTION W.G.

SPEC. NOS. PDS 30073-2

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA
NO EFFECT DUE TO IRRADIATION

PROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	$10^{-6} \text{ in/in-}^\circ\text{F}$ $\bar{x}$	S	N	COMPUTED VALUE	COMMENTS
200	1.38	0.14			
400	1.45	0.15			
600	1.52	0.15			
800	1.58	0.16			
1000	1.64	0.16			
1500	1.80	0.18			
2000	1.93	0.19			
2500	2.09	0.20			
3000	2.25	0.23			
3500	2.43	0.24			
3650	2.52	0.25			
3800	2.66	0.27			
3900	2.81	0.28			
3950	2.92	0.29			
4000	3.14	0.31

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 18 DATE 6/6/69 MATERIAL H4LM
GRAPHITECONDITION 40" DIA 72" EXTRUSION DIRECTION A.G.SPECIMENS PDS 30073-2DATA BASIS ESTIMATED COMMENTS PRELIMINARY
DATANO EFFECT DUE TO IRRADIATIONPROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	$10^{-6} \text{ in/in-}^\circ\text{F}$ $\bar{X}_i$	S	N	COMPUTED VALUE,	COMMENTS
200	1.89	0.18			
400	1.95	0.19			
600	2.00	0.20			
800	2.05	0.21			
1000	2.12	0.21			
1500	2.28	0.23			
2000	2.43	0.24			
2500	2.58	0.26			
3000	2.72	0.27			
3500	2.86	0.28			
4000	3.00	0.30			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 19 DATE 6/6/69 MATERIAL H4Lm GraphiteCONDITION 40" DIA 72" L EXTRUSION DIRECTION W.G.SPEC. NOS. PDS 30073-1DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY THERMAL CONDUCTIVITY

TEMP., °F	BTU-Ft/Hr-Ft ² IN ² °F $\bar{X}_1$	S	N	COMPUTED VALUE	COMMENTS
0	116.4	12.0			
250	90.2	9.0			
500	74.6	7.3			
750	60.3	6.0			
1000	51.8	5.2			
1500	39.2	3.9			
2000	31.1	3.0			
2500	26.0	2.6			
3000	22.9	2.4			
3500	21.0	2.2			
4000	19.4	1.9			

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MATERIALS DEPARTMENT DATA RELEASE

 DRM 1233 PAGE NO. 20 DATE 6/6/69 MATERIAL H4LM Graphite

 CONDITION 4" D x 72" L Extrusion DIRECTION W. G.

 SPEC. NOS. PDS 30073-2

 DATA BASIS Estimated COMMENTS PRELIMINARY DATA

 IRRADIATED: $6 \times 10^{16} \text{ N/cm}^2$ ($E > 1 \text{ MeV}$)

 PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	$\frac{BTU \cdot ft}{hr \cdot ft^2 \cdot ^\circ F}$ $\bar{K}_x$	S	N	COMPUTED VALUE	COMMENTS
0	0	0			
150	16.8	1.68			
250	25.4	2.54			
375	32.1	3.21			
500	36.5	3.65			
750	41.0	4.10			
875	41.6	4.16			
1000	41.0	4.10			
1150	39.5	3.95			
1250	37.8	3.78			
1500	33.0	3.30			
2000	27.9	2.79			
2500	24.7	2.60			
3000	22.9	2.40			
3500	21.0	2.20			
4000	19.4	1.90			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 21 DATE 6/6/69 MATERIAL H4LM GRAPHITECONDITION 40" D x 72" L Extrusion DIRECTION A.G.SPEC. NOS. PDJ 30073-2DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY Thermal Conductivity

TEMP., °F	BTU-FT/HR- FT ² -°F; $\bar{K}_x$	S	N	COMPUTED VALUE,	COMMENTS
0	99.4	10.0			
250	78.0	7.8			
500	62.1	6.2			
750	51.0	5.1			
1000	43.2	4.3			
1250	37.3	3.7			
1500	32.4	3.2			
2000	26.0	2.6			
2500	22.0	2.2			
3000	19.5	2.0			
3500	18.0	1.8			
4000	17.3	1.7			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 22 DATE 6/6/69 MATERIAL HYLON. GRAPHITE

CONDITION 40" D x 72" L EXTRUSION DIRECTION A. G.

SPEC. NOS. PDS 30073-2

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 6×10^{18} N/CM² (E > 1 MeV)

PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	BTU-FT/60- SEC-°F ² $\bar{K}_1$	S	N	COMPUTED VALUE	COMMENTS
0	0	0			
125	10.0	1.0			
250	20.0	2.0			
375	26.2	2.6			
500	30.4	3.0			
700	34.0	3.4			
825	35.0	3.5			
900	34.9	3.5			
1000	34.2	3.4			
1500	28.1	2.8			
2000	23.8	2.4			
2500	20.7	2.1			
3000	19.5	2.0			
3500	18.0	1.8			
4000	17.3	1.7			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1233 PAGE NO. 23 DATE 6/6/68 MATERIAL H4LM GRAPHITECONDITION 40" O X 72" L EXTRUSION DIRECTION WG & AGSPEC. NOS. PDS 30071-2DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATANO EFFECT DUE TO IRRADIATIONPROPERTY SPECIFIC HEAT

TEMP., °F	$\bar{x}$, BTU/lb-°F	S	N	COMPUTED VALUE,	COMMENTS
75	0.195	0.002			
125	0.255	0.003			
500	0.320	0.003			
750	0.369	0.004			
1000	0.400	0.004			
1250	0.420	0.004			
2250	0.468	0.005			
3075	0.495	0.005			
4230	0.518	0.005			

DRW 1L33 PAGE NO. 24 DATE 6/6/68 MATERIAL H4LM GRAPHITE

SPEC. NOS. *PDS 30073-2*

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY Total Hemispherical Emittance

TEMP., °F	$\bar{X}$, °F	S	N	COMPUTED VALUE,	COMMENTS
75	0.70	0.10			
75.2	0.70	0.10			
111.2	0.83	0.10			
147.2	0.85	0.05			
219.2	0.85	0.05			
435.2	0.85	0.05			

Westinghouse Astronuclear Laboratory

CODE IDENT NO. 14383

SHEET L OF 23

71234

DRM TYPE (13)

ESTIMATED
DATA

DEPARTMENT (13)

MATERIALS

DATE (6)

4/7/69

REACTOR

SUBJECT (120)

Estimated Properties of Type 304
Stainless Steel Plate, Sheet, and Tube
As needed

PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM	
1.6100-219							1.	2.
2.							3.	4.
3.							5.	6.

DOCUMENT REFERENCES

(DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)

1. QQ-S-766	2.	3.	4.	5.
6. ATTA-A-269	7.	8.	9.	10.

1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)

1) PROVIDE PRELIMINARY ESTIMATED DATA FOR REACTOR ENRG.
USE.2) EXISTING DATA FROM AEC-2270, MIL-HDBK-5, ETC., WAS
USED WHEN AVAILABLE. WHERE DATA WERE NOT AVAILABLE,
ESTIMATES BASED ON COMPARISON WITH SIMILAR MATERIALS
OR ON MATERIALS ENGINEER'S EXPERIENCE, WERE USED.
STANDARD DEVIATIONS WERE ESTIMATED FROM EXIST-
ING TEST DATA OR ESTIMATED.

3) NOT APPLICABLE

APPROVALS

R. L. S. LLEWIS 4/7/69

PREPARED BY

E. C. LLOYD

APPROVED BY

DATE

4/7/69

DATE

INFORMATION CATEGORY

UNCLASSIFIED

CLASSIFICATION

R. L. S. LLEWIS 4/7/69

AUTHORIZED CLASSIFIER

DATE

SECURITY CLASS

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 2 DATE 4/3/58 MATERIAL 304 SS

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION _____

SPEC. NOS. PLATE & SHEET - 99-1-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY SEE BELOW

TEMP., °F	$\bar{X}$,	S	N	COMPUTED VALUE,	COMMENTS
75	<u>DENSITY</u>				
	0.287 LB/IN ³	0.003			
	<u>MELTING POINT</u>				
	2600	50			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1434 PAGE NO. 3 DATE 4/3/69 MATERIAL 304 SS.

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET - QQ-S-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE	COMMENTS
-423	200.0	5.0			
-320	180.0	4.5			
-100	130.0	3.0			
75	83.0	2.0			
100	79.0	2.0			
150	73.6	2.0			
200	70.6	2.0			
250	68.8	2.0			
300	68.0	1.5			
500	66.0	1.5			
700	63.0	1.5			
800	61.0	1.5			
900	58.5	1.5			
1000	54.5	1.5			
1100	49.0	1.0			
1200	41.5	1.0			
1500	20.0	0.4			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 4 DATE 4/2/69 MATERIAL 304 S.S.

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET - 89-5-766; TUBE ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED 1.3×10^{19} N/CM² ($E > 1$ MeV) + 5×10^{18} N/CM² ($E < .4$ MeV)

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-423	220.0	5.0			
-320	199.0	4.5			
-100	143.0	3.0			
75	87.3	2.0			
100	83.0	2.0			
150	77.5	2.0			
200	74.3	2.0			
300	70.0	2.0			
400	67.5	2.0			
500	66.0	2.0			
700	63.0	1.5			
800	61.0	1.5			
900	58.5	1.5			
1000	54.5	1.5			
1100	49.0	1.0			
1200	41.5	1.0			
1400	20.0	0.4			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 5 DATE 4/2/69 MATERIAL 304 S.S.CONDITION ANNEALED PLATE,
SHEET & TUBE DIRECTION LSPEC. NOS. PLATE & SHEET - QQ-S-766; TUBE - ASTM A-269DATA BASIS ESTIMATED COMMENTS PRELIMINARY
DATAPROPERTY TENSILE YIELD STRENGTH, 0.2%

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-425	55.0	5.0			
-400	46.2	5.0			
-375	40.8	5.0			
-350	38.8	4.0			
-320	36.0	4.0			
-275	33.8	4.0			
-250	33.0	3.0			
-225	32.5	3.0			
-200	32.0	3.0			
-100	32.0	3.0			
75	31.0	2.0			
200	27.8	2.0			
500	26.2	2.0			
800	22.5	2.0			
1000	19.0	2.0			
1200	15.0	1.0			
1500	11.0	1.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 6 DATE 4/3/69 MATERIAL 304 S.S.

CONDITION ANNEALED PLATE,
SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET - QQ-S-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{17} N/CM² ($E > 1$ MEV) + 3×10^{18} N/CM² ($E < .4$ EV)

PROPERTY TENSILE YIELD STRENGTH, 0.2 %

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-425	82.5	5.0			
-400	70.7	5.0			
-350	58.4	5.0			
-320	54.0	4.0			
-275	48.5	4.0			
-225	44.8	4.0			
-200	41.5	4.0			
-175	42.8	3.0			
-150	41.0	3.0			
-100	41.6	3.0			
-50	40.0	3.0			
0	37.0	3.0			
25	36.8	2.0			
75	36.0	2.0			
200	35.8	2.0			
250	35.0	2.0			
350	31.0	2.0			
425	28.4	2.0			
500	26.3	2.0			
600	22.5	2.0			
1000	17.0	2.0			
1200	15.0	1.0			
1500	11.0	1.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 7 DATE 4/3/69 MATERIAL 304 S.S.

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET - QQ-S-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY NOTCHED TENSILE STRENGTH, $K_T = 21.0$

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-423	160.0	13.0			
-375	175.2	13.0			
-365	177.0	12.5			
-350	178.9	12.5			
-320	180.0	12.0			
-300	180.3	14.0			
-270	180.0	11.5			
-230	179.0	11.5			
-200	178.0	11.0			
-150	175.0	11.0			
-100	170.0	11.0			
0	154.5	10.5			
75	133.0	10.0			
200	122.5	9.5			
300	108.0	8.0			
400	106.0	7.5			
500	106.0	7.5			
600	105.5	7.5			
700	101.8	7.0			
800	100.0	7.0			
1000	88.0	6.0			
1200	68.0	5.0			
1500	32.0	5.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 8 DATE 4/3/69 MATERIAL 304 SS.

CONDITION ANNEALED PLATE,
SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET - PP-5-756; TUBE ASTM A-259

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{19} \text{ N/cm}^2$ ($E > 1 \text{ Mev}$) & $3 \times 10^{19} \text{ N/cm}^2$ ($E < .4 \text{ Mev}$)

PROPERTY NOTED TENSILE STRENGTH, $\sigma_T = 21.0$

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-423	128.0	13.0			
-375	137.0	13.0			
-320	144.0	12.0			
-250	149.6	12.0			
-200	151.8	11.4			
-150	152.9	11.5			
-100	153.0	11.0			
-50	152.0	10.0			
0	147.4	10.4			
75	133.0	10.0			
200	122.5	9.5			
300	108.0	8.0			
400	106.0	7.5			
500	106.0	7.5			
600	105.5	7.5			
700	103.8	7.0			
800	100.0	7.0			
1000	88.0	6.0			
1200	68.0	5.0			
1500	32.0	5.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 9 DATE 4/5/69 MATERIAL 304 S.S.

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET - QQ-S-766; TUBE ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ELONGATION

TEMP., °F	$\bar{X}$, %	S	N	COMPUTED VALUE,	COMMENTS
-425	30.0	3.0			
-320	37.0	4.0			
-275	37.8	4.5			
-175	38.5	5.0			
-130	39.7	5.5			
-100	41.0	6.0			
-50	47.2	6.0			
-20	50.0	6.5			
0	51.0	7.0			
30	52.0	7.0			
75	53.0	7.0			
200	52.5	7.0			
400	50.0	6.5			
800	41.5	6.0			
1000	35.7	5.0			
1150	30.7	4.5			
1200	30.0	4.0			
1500	30.0	3.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 10 DATE 4/3/69 MATERIAL 304 S.S.

CONDITION ANNEALED PLATE
SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET - QQ-S-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{19} \text{ N/cm}^2$ ($E > 1 \text{ MeV}$) & $3 \times 10^{19} \text{ N/cm}^2$ ($E < .4 \text{ MeV}$)

PROPERTY ELONGATION

TEMP., °F	$\bar{X}$, %	S	N	COMPUTED VALUE,	COMMENTS
-423	21.0	3.0			
-320	21.9	4.0			
-200	28.2	5.0			
-150	29.5	5.5			
-100	32.8	6.0			
-75	33.0	6.0			
-50	35.7	6.5			
25	45.6	6.5			
50	47.3	7.0			
75	47.7	7.0			
100	47.2	7.0			
150	44.0	7.0			
175	45.0	7.0			
200	42.0	7.0			
400	39.4	6.5			
500	33.2	6.0			
900	31.0	5.5			
1000	28.2	5.0			
1100	23.5	4.5			
1175	22.0	4.5			
1150	21.0	4.0			
1200	21.0	4.0			
1500	18.0	3.0			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 11 DATE 4/2/69 MATERIAL 304 S.S.CONDITION ANNEALED PLATE,
SHEET & TUBE DIRECTION LSPEC. NOS. PLATE & SHEET-99-S-766; TUBE-ASTM A-269DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATANO EFFECT DUE TO IRRADIATIONPROPERTY MODULUS OF ELASTICITY IN TENSION

TEMP., °F	$\bar{X}$, 10^6 PSI	S	N	COMPUTED VALUE	COMMENTS
-423	28.0	1.0			
-100	28.0				
-75	27.5				
200	27.0				
500	24.7				
800	21.0				
1000	18.5				
1200	18.0				
1500	16.0				

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 12 DATE 4/4/68 MATERIAL 304 SS.

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET - 99-S-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY POISSON'S RATIO IN TENSION

TEMP., °F	$\bar{X}_i$	S	N	COMPUTED VALUE,	COMMENTS
-425	0.200	0.02 ↓			
-320	0.209				
-200	0.228				
-100	0.228				
0	0.240				
75	0.250				
200	0.270				
300	0.281				
400	0.289				
500	0.295				
600	0.298				
700	0.300				
800	0.300				
900	0.297				
1000	0.295				
1100	0.287				
1200	0.280				
1300	0.272				
1400	0.262				
1500	0.250				

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 13 DATE 4/4/69 MATERIAL 304 S.S.CONDITION ANNEALED PLATE,
SHEET & TUBE DIRECTION LSPEC. NOS. PLATE & SHEET-89-S-766; TUBE-ASTM A-269DATA BASIS ESTIMATED COMMENTS PRELIMINARY
DATAPROPERTY COMPRESSIVE YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-425	55.0	5.0			
-400	45.2	5.00			
-375	40.8	5.00			
-350	38.8	4.00			
-320	36.0	4.00			
-275	33.8	4.00			
-250	33.0	3.00			
-225	32.5	2.00			
-200	32.0	1.00			
-100	32.0	2.00			
75	31.0	2.00			
200	29.8	2.00			
500	26.3	2.00			
800	22.5	1.5			
1000	19.0	1.0			
1200	15.0	1.0			
1500	11.0	1.0			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 14 DATE 4/4/67 MATERIAL 304 SS

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET-QP-J-766; TUBE-ASTMA-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $5 \times 10^{17} \text{ n/cm}^2$ ($E > 1 \text{ MeV}$) & $3 \times 10^{17} \text{ n/cm}^2$ ($E < 400 \text{ eV}$)

PROPERTY COMPRESSIVE YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-425	52.1	5.0			
-400	70.7	5.0			
-350	57.4	4.0			
-320	54.0	4.0			
-275	48.5	4.0			
-225	44.8	3.0			
-200	42.5	3.0			
-175	42.8	3.0			
-150	42.0	3.0			
-100	41.6	3.0			
-50	40.0	3.0			
0	37.0	3.0			
25	36.8	2.0			
75	36.0	2.0			
100	35.8	2.0			
150	35.0	2.0			
200	31.0	2.0			
250	28.4	2.0			
300	26.3	2.0			
400	22.5	2.0			
600	17.0	2.0			
800	15.0	1.0			
1000	11.0	1.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 15 DATE 4/4/69 MATERIAL 304SS

CONDITION ANNEALED PLATE,
SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET-PP-S-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY
DATA

PROPERTY BEARING YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-425	127.5	5.0			
-320	108.0	4.0			
-100	81.0	4.0			
-50	72.2	4.0			
0	64.2	4.0			
50	59.0	4.0			
75	57.0	4.0			
150	53.4	3.0			
600	44.8	3.0			
1200	29.0	2.0			
1500	15.5	2.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 16 DATE 4/4/68 MATERIAL 304 SS

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET-QQ-S-766; TUBE-AJTM A-267

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{19} N/CM² ($E > 1$ MeV) & 3×10^{19} N/CM² ($E < .4$ MeV)

PROPERTY BEARING YIELD STRENGTH

TEMP., °	$\bar{X}$	S	N	COMPUTED VALUE,	COMMENTS
-423	151.3	5.0			
-320	126.5	4.0			
-100	92.3	4.0			
-50	77.0	4.0			
0	67.8	4.0			
50	63.0	4.0			
75	61.8	4.0			
150	59.0	4.0			
250	56.9	4.0			
325	55.8	3.5			
400	55.0	3.5			
600	55.0	2.0			
1000	49.0	2.0			
1200	41.5	2.0			
1350	33.0	2.0			
1425	26.0	2.0			
1500	15.5	2.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1L34 PAGE NO. 17 DATE 4/4/67 MATERIAL 304 SSCONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION LSPEC. NOS. PLATE & SHEET-QQ-S-756; TUBE-ASTM A-269DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY RUPTURE AT 10⁶ HOURS

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
75	75.0	3.0			
250	72.0	3.0			
400	69.1	3.0			
550	65.9	3.0			
700	62.0	3.0			
850	57.5	3.0			
1000	52.0	3.0			
1150	44.8	2.0			
1300	35.0	1.0			
1400	25.2	1.0			
1450	18.1	0.5			
1500	8.0	0.5			
			900 = 6.5		1.0
			1200 = 4.8		2.0
			1200 = 23.5		1.0
			1300 = 14.5		0.5
			1400 = 9.0		0.5
			1450 = 6.0		0.4
			1500 = 5.0		0.4

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 18 DATE 4/4/69 MATERIAL 304 SS

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET - QQ-S-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY FATIGUE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
<u>10⁷ CYCLES</u>					
-423	80.0	5.0			
-320	72.0	4.0			
-100	53.0	3.0			
-50	45.0	3.0			
0	39.4	2.5			
75	34.0	2.0			
150	31.1	2.0			
200	31.0	2.0			
300	30.9	2.0			
500	29.8	1.8			
600	28.4	1.8			
800	25.0	1.7			
1000	21.0	1.0			
1200	17.0	1.0			
1500	9.0	0.5			
<u>10⁸ CYCLES</u>					
-423	100.0	5.0			
-320	90.0	4.0			
-100	74.5	3.0			
-50	65.0	3.0			

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WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 19 DATE 4/4/67 MATERIAL 304 SS

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION L

SPEC. NOS. PLATE & SHEET-99-S-766; TUBE-ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{18} N/cm² (E > 1 Mev) & 3×10^{18} N/cm² (E < 4 Mev)

PROPERTY FATIGUE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
<u>10⁷ CYCLES</u>					
-423	88.0	5.0			
-320	79.3	4.0			
-100	57.4	3.0			
75	37.4	2.0			
120	24.0	2.0			
160	32.0	2.0			
200	31.0	2.0			
300	30.9	2.0			
500	29.8	1.8			
600	28.4	1.8			
800	25.0	1.7			
1000	21.0	1.0			
1200	17.0	1.0			
1500	9.0	0.5			
<u>10⁸ CYCLES</u>					
-423	110.0	5.0			
-320	79.0	4.0			
-100	71.5	3.0			
75	58.0	2.5			
120	46.0	2.0			
150	41.1	2.0			

~~continued~~

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 20 DATE 4/4/69 MATERIAL 304SS

CONDITION ANNEALED PLATE,
SHEET & TUBE DIRECTION _____

SPEC. NOS. PLATE & SHEET - QQ-S-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA
NO EFFECT DUE TO IRRADIATION

PROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	$10^{-6} \text{ in/in} \cdot ^\circ\text{F}$ $\bar{X}_i$	S	N	COMPUTED VALUE,	COMMENTS
-423	5.90	0.29			
-375	6.86	0.34			
-320	7.40	0.37			
-200	8.20	0.41			
-100	8.60	0.42			
75	9.00	0.45			
500	9.80	0.49			
1000	10.10	0.51			
1250	10.30	0.51			
1500	10.80	0.51			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 21 DATE 4/4/69 MATERIAL 304 SS

CONDITION ANNEALED PLATE,
SHEET & TUBE DIRECTION _____

SPEC. NOS. PLATE & SHEET-QQ-S-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	$\frac{BTU \cdot FT}{HR \cdot FT^2 \cdot ^\circ F}$ $\bar{K}$	S	N	COMPUTED VALUE,	COMMENTS
-423	1.20	0.12			
-380	2.90	0.29			
-320	4.25	0.43			
-100	7.20	0.72			
75	8.90	0.89			
300	10.00	1.00			
500	10.50	1.05			
700	11.18	1.12			
850	11.92	1.19			
1000	12.80	1.28			
1500	16.00	1.60			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 22 DATE 4/4/67 MATERIAL 304 SS

CONDITION ANNEALED PLATE,
SHEET & TUBE DIRECTION _____

SPEC. NOS. PLATE & SHEET-QQ-S-766; TUBE-ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{17} N/cm² (E > 1 mev) & 3×10^{18} N/cm² (E < 400 eV)

PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	DTU-55/4R- 550-5K X ₁	S	N	COMPUTED VALUE,	COMMENTS
-423	1.02	0.10			
-380	2.40	0.24			
-320	3.82	0.38			
-200	5.59	0.56			
-100	6.48	0.65			
-50	7.00	0.70			
0	8.00	0.80			
75	8.90	0.89			
300	10.00	1.00			
500	10.50	1.05			
700	11.18	1.12			
850	11.92	1.19			
1000	12.85	1.29			
1500	16.00	1.60			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 PAGE NO. 23 DATE 4/4/69 MATERIAL 304SS

CONDITION ANNEALED PLATE, SHEET & TUBE DIRECTION _____

SPEC. NOS. PLATE & SHEET - QQ-S-766; TUBE - ASTM A-269

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY SPECIFIC HEAT

TEMP., °F	$\bar{X}$, BTU/lb-°F	S	N	COMPUTED VALUE,	COMMENTS
-423	0	0			
-320	0.040	0.006			
-200	0.079	0.012			
-100	0.100	0.015			
0	0.113	0.017			
75	0.120	0.018			
150	0.124	0.019			
200	0.127	0.019			
300	0.130	0.020			
400	0.131	0.020			
500	0.132	0.020			
600	0.133	0.020			
1000	0.140	0.021			
1500	0.150	0.023			

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51134	REV (1) B
SUBJECT (120) 304 SS TUBE, ANNEALED - MATERIALS PROPERTIES DATA						DRM TYPE (13) TEST DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 7/25/70	REACTOR
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1. 3.1.2.1	561					610M-219	1. 2.
2.							3. 4.
3.							5. 6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1. ASTM A-269	2.	3.	4.	5.	6.	7.	10.
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY) 1) PROVIDE STATISTICAL PROPERTY DATA IN PARTIAL FULFILLMENT OF THE TEST SCOPE. 2) ONE LOT OF MATERIAL WAS TESTED IN THE LONGITUDINAL DIRECTION. BARTLETT'S TEST FOR HOMOGENEITY OF VARIANCES WAS SIGNIFICANT ONLY FOR TYS AND MODULUS OF ELASTICITY. ANALYSIS OF VARIANCE SHOWED SIGNIFICANT DIFFERENCES IN THE MEANS BETWEEN TEMPERATURES FOR ALL PROPERTIES EXCEPT POISSON'S RATIO. DATA FOR 1540°F WERE EXTRAPOLATED BY COMPARISON WITH THE LITERATURE EXCEPT FOR POISSON'S RATIO WHICH WAS A BEST FIT EXTENSION OF THE DATA. INTERPOLATED DATA WERE REPORTED TO BETTER DEFINE THE CURVE WITHIN THE 1% ACCURACY REQUIRED BY THE TEST SCOPE. MINIMUM DESIGN ALLOWABLES ARE PRESENTED. IF MAXIMUM VALUES ARE REQUIRED, USE: $D.A. max = \bar{X} + K_{\alpha/99} s$ 3) PAGES 2, 3, 5, 9, 11, AND 12 REPLACE PAGES 2, 3, 5, 9, 11, AND 12 OF THE PREVIOUS ISSUES PAGES 24, 25, AND 26 ARE NEW.							
APPROVALS R.L. SHILLINGER 7/1/70 PREPARED BY E. Clayton 7/2/70 APPROVED BY DATE				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION AUTHORIZED CLASSIFIER DATE		SECURITY CLASS	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234B PAGE NO. 2 DATE 7/24/70 MATERIAL 304 SS
 CONDITION ANNEALED TUBE DIRECTION L
 SPEC NOS. ASTM A-269 DATA BASIS SEE BELOW
 REFERENCES TP 219
 COMMENTS ONE LOT
 PROPERTY SEE BELOW

TEMP., °F	- X,	S	K	DESIGN ALLOWABLE	COMMENTS
80	0.287 LB/IN ²	DENSITY 0.0005	4.354	0.285	"A" QUALITY 97% CL, 99% P n=8
	2600°F	MELTING POINT 50°F			LITERATURE "C" QUALITY
STRAIN RATE EFFECTS					
NO SIGNIFICANT EFFECTS DUE TO VARYING STRAIN RATES EXCEPT AT VERY HIGH STRAIN RATES WHERE SOME INCREASE IN YIELD STRENGTH MAY OCCUR ("C" QUALITY)					
EFFECT OF HYDROGEN					
NO SIGNIFICANT EFFECT DUE TO EXPOSURE TO HYDROGEN OVER THE TEMPERATURE RANGE REPORTED ("C" QUALITY)					

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234B PAGE NO. 3 DATE 7/14/70 MATERIAL 304SS
 CONDITION ANNEALED TUBE DIRECTION L
 SPEC NOS. ASTM A-269 DATA BASIS "A" QUALITY 99% P / 95% CL
 REFERENCES TP 219
 COMMENTS ONE LOT
 PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	X, KSI	n	S	K	DESIGN ALLOWABLE	COMMENTS
-320	209.5	8.48	1.313	3.114	205.4	-
-100	-				127.5	INTERPOLATED
0	-				104.0	INTERPOLATED
80	94.5				90.5	-
200	-				82.1	INTERPOLATED
330	74.3				70.2	-
450	-				68.2	INTERPOLATED
580	71.9				67.8	-
750	-				66.2	INTERPOLATED
880	69.3				65.2	-
1000	-				61.0	INTERPOLATED
1180	53.0				48.9	-
1480	25.7				21.6	-
1540	-	↓	↓	↓	16.1	EXTRAPOLATED "C" QUALITY

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 B PAGE NO. 5 DATE 7/24/70 MATERIAL 304 S.S.
 CONDITION ANNEALED TUBE DIRECTION L
 SPEC NOS. ASTM A-269 DATA BASIS "A" QUALITY
99% P/94% CL
 REFERENCES TP 219
 COMMENTS ONE LOT
 PROPERTY TENSILE YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	n	S	K	DESIGN ALLOWABLE	COMMENTS
-320	72.3	8	1.993	4.354	63.6	INTERPOLATED
80	51.5		2.709		39.7	
250	-		-		30.6	
330	41.6		2.863		29.2	
580	38.8		1.908		30.5	
880	35.8		2.196		26.3	EXTRAPOLATED "C" QUALITY
1180	29.5		1.381		23.4	
1480	17.9		0.521		15.6	
1540	-		-		13.0	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 B PAGE NO. 9 DATE 7/24/70 MATERIAL 304 SS
 CONDITION ANNEALED TUBE DIRECTION L
 SPEC NOS. ASTM A-269 DATA BASIS "A" QUALITY
99% P/95% CL
 REFERENCES TP 219
 COMMENTS ONE LOT
 PROPERTY ELONGATION

TEMP., °F	$\bar{X}$, %	n	S	K	DESIGN ALLOWABLE	COMMENTS
-320	42.4	849	1.68	3.114	37.2	-
50	-				45.4	INTERPOLATED
80	51.2				46.0	-
110	-				45.0	INTERPOLATED
300	-				24.2	INTERPOLATED
330	27.8				22.5	-
380	-				22.1	INTERPOLATED
580	26.6				21.3	-
880	26.2				20.9	-
1000	-				19.8	INTERPOLATED
1180	21.0				15.7	-
1480	10.3				5.1	-
1540	-				3.0	EXTRAPOLATED "C" QUALITY

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 B PAGE NO. 11 DATE 7/25/70 MATERIAL 304 SS
 CONDITION ANNEALED TUBE DIRECTION L
 SPEC NOS. ASTM A-269 DATA BASIS "A" QUALITY 99% P / 95% CL
 REFERENCES TP 219
 COMMENTS ONE LOT
 PROPERTY Modulus of ELASTICITY

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	η	S	K	DESIGN ALLOWABLE	COMMENTS
-320	32.81	8	0.414	4.554	31.01	-
80	30.44		1.850		22.38	-
200	-		-		21.05	INTERPOLATED
330	28.61		1.850		20.56	-
450	-		-		18.40	INTERPOLATED
580	25.91		2.109		16.72	-
880	23.29		1.626		16.21	-
1000	-		-		15.25	INTERPOLATED
1180	21.88		2.347		11.46	-
1480	15.48	✓	3.042	✓	0.66	-

MATERIALS DEPARTMENT DATA RELEASE

TEMP., °F	$\bar{X}$,	n	S	K	DESIGN ALLOWABLE	COMMENTS
-320 TO 1540	0.295	24	0.034	3.181	0.186	EXTRAPOLATED BEYOND 1480°F

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1W4B PAGE NO. 24 DATE 7/14/70 MATERIAL 304SS
 CONDITION ANNEALED TUBE DIRECTION L
 SPEC NOS. ASTM A-269 DATA BASIS "D" QUALITY AVERAGE
 REFERENCES TP-219
 COMMENTS ONE LOT
 PROPERTY STRESS VS. STRAIN

TEMP., °F	STRAIN, IN/IN	STRESS KSI	K	DESIGN ALLOWABLE	COMMENTS
-320	0	0			
	0.0015	49.5			
	0.002	58.7			
	0.0025	64.1			
	0.003	67.5			
	0.0044	72.3			
	0.025	118.0			
	0.05	144.0			
	0.1	169.0			
	0.2	193.4			
	0.3	205.0			
	0.425	209.5			
80	0.475	207.0			
	0.535	197.0			
	0	0			
	0.0013	35.8			
	0.0015	41.0			
	0.002	46.4			
	0.0025	49.3			
	0.003	50.7			
	0.0037	51.5			
	0.05	64.0			
	0.15	79.5			
	0.25	88.0			
	0.35	92.0			
	0.515	94.5			
	0.575	89.5			

(CONTINUED)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 B PAGE NO. 25 DATE 7/15/70 MATERIAL 304SS

CONDITION _____ DIRECTION _____

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS _____

PROPERTY STRESS VS STRAIN (CONTINUED)

TEMP., °F	STRAIN, IN/IN	STRESS, KSI	K	DESIGN ALLOWABLE	COMMENTS
330	0	0			
	0.001	29.0			
	0.0015	35.5			
	0.0025	39.7			
	0.0035	41.6			
	0.05	55.5			
	0.1	64.0			
	0.2	72.4			
	0.28	74.3			
	0.3	72.0			
	0.32	66.0			
580	0	0			
	0.0008	26.5			
	0.0013	29.5			
	0.002	35.2			
	0.0025	37.0			
	0.0035	38.8			
	0.05	53.6			
	0.1	62.1			
	0.15	67.5			
	0.2	70.5			
	0.265	71.9			
	0.29	66.5			

(CONTINUED)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234B PAGE NO. 26 DATE 7/24/70 MATERIAL 304SS

CONDITION _____ DIRECTION _____

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS _____

PROPERTY STRESS VS STRAIN (CONTINUED)

TEMP., °F	STRAIN, IN/IN	STRESS, KSI	K	DESIGN ALLOWABLE	COMMENTS
880	0	0			
	0.0011	24.5			
	0.0015	30.4			
	0.002	33.5			
	0.0025	34.5			
	0.0035	35.8			
	0.025	45.5			
	0.05	57.8			
	0.1	60.0			
	0.15	65.1			
	0.2	68.0			
	0.26	69.3			
1180	0	0			
	0.0011	23.8			
	0.0015	26.8			
	0.002	28.3			
	0.0034	29.5			
	0.05	41.8			
	0.1	48.0			
	0.15	51.9			
	0.21	53.0			
1480	0	0			
	0.001	15.0			
	0.0015	16.5			
	0.002	17.5			
	0.0033	17.9			
	0.05	23.8			
	0.1	25.7			
	0.15	24.7			
	0.2	21.3			
	0.27	12.0			

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51234	REV (1) C
SUBJECT (120) 304SS TUBE, ANNEALED - MATERIALS PROPERTIES DATA						DRM TYPE (13) ESTIMATED DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 8/29/70	REACTOR
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1. 3.1.2.1	561					6/DA-219	1. 2.
2.							3. 4.
3.							5. 6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1. ASTM-A269	2.	3.	4.	5.			
6.	7.	8.	9.	10.			
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)							
1) PROVIDE ADDITIONAL ESTIMATES OF MATERIALS PROPERTIES DATA FOR REACTOR ENGINEER. USE 2) REFERENCES GIVEN ON EACH PAGE. IN GENERAL, WELDING EFFECTS ARE NOTED ONLY ON UTS, TYS, AND ELONGATION. NO EFFECT OF HYDROGEN NO EFFECT OF STRAIN RATE 3) PAGE 17 REPLACES PAGE 17 OF THE ORIGINAL ISSUE ALL OTHER PAGES ARE NEW.							
APPROVALS G. D. RAHRER L. ALBERTIN R. L. SHOLLINGER 8/29/70 PREPARED BY E. Clayton 8/31/70 APPROVED BY				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION AUTHORIZED CLASSIFIER		SECURITY CLASS	
DATE 8/31/70 DATE				DATE 8/29/70 DATE			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234 C PAGE NO. 17 DATE _____ MATERIAL 304 SS
CONDITION ANNEALED TUBE DIRECTION L
SPEC NOS. ASTM A-269 DATA BASIS "A" QUALITY
98% P, 95% C.L.
REFERENCES TP 219
COMMENTS NO EFFECT DUE TO IRRADIATION
PROPERTY RUPTURE STRENGTH, 100 HOUR

TEMP., °F	$\bar{X}$, KSI	n	S	K	DESIGN ALLOWABLE	COMMENTS
1000	43.3	17	2.199	3.414	35.8	-
1200	26.5	↓	↓	↓	19.0	-
1400	11.0	↓	↓	↓	3.5	EXTRAPOLATED "C" QUALITY
1465	7.5	↓	↓	↓	0	EXTRAPOLATED "C" QUALITY

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234C PAGE NO. 27 DATE _____ MATERIAL 304SSCONDITION ANNEALED Tube DIRECTION LSPEC NOS. ASTM A-269 DATA BASIS ESTIMATED

REFERENCES _____

COMMENTS IRRADIATED: $3 \times 10^{19} \text{ N/cm}^2$ ($E > 1 \text{ MeV}$) & $3 \times 10^{18} \text{ N/cm}^2$ ($E < .4 \text{ MeV}$)PROPERTY STRESS VS STRAIN

TEMP., °F	STRAIN, in/in	STRESS KSI	K	DESIGN ALLOWABLE	COMMENTS
-320	0	0			
	0.0005	47.5			
	0.0015	74.4			
	0.0035	95.0			
	0.0044	108.3			
	0.025	136.5			
	0.05	155.0			
	0.1	178.0			
	0.2	206.4			
	0.3	221.6			
	0.425	230.3			
	0.475	228.0			
80	0	0			
	0.0013	35.8			
	0.0015	41.5			
	0.002	48.3			
	0.003	56.5			
	0.0037	59.8			
	0.05	68.0			
	0.15	83.4			
	0.25	92.1			
	0.4	99.0			
	0.515	98.4			
	0.575	95.0			
(CONTINUED)					

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234C PAGE NO. 28 DATE _____ MATERIAL 304SSCONDITION ANNEALED TUBE DIRECTION L

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS IRRADIATEDPROPERTY STRESS VS STRAIN (CONTINUED)

TEMP., °F	STRAIN in/in	STRESS KSI	K	DESIGN ALLOWABLE	COMMENTS
330	0	0			
	0.001	29.0			
	0.0015	38.0			
	0.002	42.1			
	0.0025	44.0			
	0.0034	45.5			
	0.05	58.5			
	0.15	74.7			
	0.2	76.1			
	0.18	76.8			
	0.32	87.3			
OVER 330	NO EFFECT DUE TO IRRADIATION				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234C PAGE NO. 29 DATE _____ MATERIAL 304 SSCONDITION ANNEALED TUBE DIRECTION LSPEC NOS. ASTM A-269 DATA BASIS ESTIMATEDREFERENCES MATERIALS DATA HDBK & WANL TEST DATA

COMMENTS _____

PROPERTY GOODMAN DIAGRAMS - 10⁷ CYCLES

TEMP., °F	MEAN STRESS, KSI	MAX. STRESS KSI	MIN. STRESS KSI	DESIGN ALLOWABLE	COMMENTS
-320	62.7 0 40.0 80.0 120.0 160.0 205.4	62.7 91.0 117.3 147.6 175.9 205.4	-62.7 -10.0 40.5 94.0 146.5 205.4		UTS = 205.4
80	0 20.0 40.0 60.0 90.5	29.3 42.5 56.0 70.0 90.5	-29.3 -5.5 24.0 50.0 90.5		UTS = 90.5
1540	0 4.0 8.0 12.0 16.1	7.9 10.0 12.0 14.0 16.1	-7.9 -1.9 4.0 10.0 16.1		UTS = 16.1

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234C PAGE NO. 30 DATE _____ MATERIAL 304 S.S.CONDITION ANNEALED TUBE DIRECTION LSPEC NOS. ASTM A-269 DATA BASIS ESTIMATED

REFERENCES _____

COMMENTS IRRADIATED: 3×10^{19} N/cm² (EX 1 MEV) & 3×10^{18} N/cm² (EX 4800)PROPERTY GOODMAN DIAGRAMS - 10^7 CYCLES

TEMP., °F	MEAN STRESS KSI	MAX. STRESS KSI	MIN. STRESS KSI	DESIGN ALLOWABLE	COMMENTS
-320	0 40.0 80.0 120.0 160.0 200.0 230.3	78.7 104.0 131.3 157.6 183.7 210.0 230.3	-78.7 -24.0 29.0 82.0 135.5 190.0 230.3		UTS = 230.3
80	0 20.0 40.0 60.0 80.0 99.4	32.8 46.0 59.2 72.4 85.6 99.4	-32.8 -6.5 19.5 45.6 71.5 99.4		UTS = 99.4
1540	NO EFFECT DUE TO IRRADIATION				

MATERIALS DEPARTMENT DATA RELEASE

CONDITION ANNEALED ~~BAR~~ TUBE DIRECTION L

REFERENCES (1) ASTM SPECIAL TECHNICAL PUBLICATIONS NO. 124 AND DS 3-51 (2) AEROSPACE STRUCTURAL METALS HANDBOOK

PROPERTY 1% CREEP, 100 HOURS

TEMP., ° F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
900	45.0	2.5			ESTIMATE OF S- BEST ENGINEER- ING JUDGEMENT
1100	25.0	1.5			
1300	9.6	1.0			
1500	5.0	0.5			

MATERIALS DEPARTMENT DATA RELEASE

PROPERTY FATIGUE STRENGTH, 10^3 CYCLES

TEMP., ° F	$\bar{x}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-320	145.0	14.5			ESTIMATE OFS- BEST ENGINEER- ING JUDGEMENT
80	65.0	6.5			
580	49.0	4.9			
880	47.0	4.7			
1180	36.0	3.6			
1480	17.0	1.7			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234C PAGE NO. 33 DATE 8/29/70 MATERIAL 304 STAINLESS STEELCONDITION ANNEALED TUBE DIRECTION LSPEC NOS. ASTM A-269 DATA BASIS ESTIMATED-C QUALITY

REFERENCES _____

COMMENTS IRRADIATED 1.4×10^{19} N/CM² (E < 0.4 EV) & 2.1×10^{19} N/CM² (E > MEV)PROPERTY FATIGUE STRENGTH, 10^3 CYCLES

TEMP., ° F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-320	138.0	14.0			ESTIMATE OF S- BEST ENGINEER- ING JUDGEMENT
80	58.0	6.0			
580	44.0	4.4			
880	42.0	4.2			
1180	32.0	3.2			
1480	15.0	1.5			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1284C PAGE NO. 34 DATE 8-28-70 MATERIAL 304 SS. Welded
CONDITION Annealed Tube - Welded DIRECTION L
SPEC NOS. ASTM A-169 DATA BASIS Estimated
REFERENCES DRM 1234 B & NASA TM X-52703, Oct. 30, 1969
COMMENTS _____
PROPERTY Ultimate Tensile Strength

TEMP., ° F	X, ksi	S	K	DESIGN ALLOWABLE	COMMENTS
-320	175	100 3.0			
-100	108	70 3.0			
0	87	2.5			
80	77	2.0			
200	70	1.8			
300	59	1.5			
400	57	1.5			
500	56	1.5			
800	54	1.5			
1000	50	1.5			
1200	40	1.5			
1400	21	1.5			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234C PAGE NO. 35 DATE 1-28-70 MATERIAL 304 SS. WeldedCONDITION Annealed Tube - Welded DIRECTION LSPEC NOS. ASTM A-269 DATA BASIS Estimated

REFERENCES _____

COMMENTS _____

PROPERTY Yield Strength, σ_y

TEMP., ° F	X, ksi	S	K	DESIGN ALLOWABLE	COMMENTS
-320	51	2.0			
-100	45	1.8			
0	42	1.7			
80	40	1.6			
200	28	1.2			
300	20	1.2			
400	19	1.1			
500	18	1.1			
800	16	1.0			
1000	13	0.8			
1200	12	0.8			
1400	9	0.8			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234C PAGE NO. 36 DATE 8-28-70 MATERIAL 304 SS - Welded
CONDITION Annealed Tube - Welded DIRECTION L
SPEC NOS. ASTM A-269 DATA BASIS Estimated
REFERENCES _____
COMMENTS _____
PROPERTY Elongation, 2^{1/2} Inches

TEMP., ° F	X, %	S	K	DESIGN ALLOWABLE	COMMENTS
-320	35				
-100	38				
0	39				
80	40				
200	30				
400	18				
600	17				
800	17				
1000	16				
1200	15				
1400	13				

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51237	REV (1)
SUBJECT (120) 302 S.S., FULL HARD - MATERIALS PROPERTIES DATA						DRM TYPE (13) ESTIMATED DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 10/29/70	REACTOR
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1.						DM-143.1	1. 2.
2.							3. 4.
3.							5. 6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1. AMS 5637		2. QP-S-766		3.		4. 5.	
6. MIL-S-5059		7. QP-W-423		8.		9. 10.	
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)							
1) PROVIDE PRELIMINARY ESTIMATES OF MATERIALS PROPERTIES DATA FOR REACTOR ENGINEERING USE.							
2) EXCEPT WHERE NOTED, THE FOLLOWING REFERENCES WERE USED:							
1- DRAM 51237 2- ANSC 2270 3- MIL-HDBK-5 4- AEROSPACE STRUCTURAL METALS HANDBOOK 5- WAWL-TME-1281 6- REIC #45							
3) N/A							
APPROVALS P.L. Schollenberger 11/4/70 PREPARED BY E. Clayton APPROVED BY DATE				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION AUTHORIZED CLASSIFIER DATE		SECURITY CLASS	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 2 DATE 12/22/70 MATERIAL 302 SSCONDITION FULL HARD DIRECTION L&TSPEC NOS. BAR: AM10657 WIRE: Q8-W-423
PLATE: SHEET: MIL-S-10574 Q8-1-766 DATA BASIS ESTIMATEDREFERENCES SEE PAGE 1

COMMENTS

PROPERTY SEE BELOW

TEMP., °F	X,	S	K	DESIGN ALLOWABLE	COMMENTS
		DENSITY			
70	0.14666/ G.U. IN	0.003			
		MELTING POINT			
	2600°F	25°F			
STRESS FOR 1% CREEP IN 100 HOURS & RUPTURE IN 100 HOURS WILL BE SUBSTANTIALLY HIGHER THAN THE YIELD STRENGTH UP TO THE MAXIMUM TEMPERATURE SPECIFIED, HENCE THEY WILL NOT BE DESIGN CRITERIA.					
MATERIAL IS BRITTLE WHEN AMOUNT OF COLD WORKING IS NO MORE THAN 40%. FULL HARD MATERIAL (~60% CW) IS BRITTLE ABOVE ~150°F					
NO SIGNIFICANT STRAIN RATE EFFECTS					
FLUENCE FOR IRRADIATED DATA IS 3.4×10^{18} N/CM ² (E > 1 MeV)					

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1227 PAGE NO. 3 DATE 10/24/70 MATERIAL 302 SS
CONDITION FULL HARD DIRECTION L & T
SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS _____
PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-423	352.0	1.4			
-110	246.7				
-50	226.2				
0	214.6				
80	204.0				
150	199.0				
240	194.4				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE.

DRM 1237 PAGE NO. 4 DATE 10/22/70 MATERIAL 302 SS
CONDITION FULL HARD DIRECTION L&T
SPEC NOS. SEE P. 2 DATA BASIS ESTIMATED
REFERENCES SEE P. 1
COMMENTS IRRADIATED
PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-423	314.0	5.37			
-100	244.2	↓			
0	231.0				
80	224.4				
240	210.0	↓			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 5 DATE 10/22/70 MATERIAL 302 SS
CONDITION FULL HARD DIRECTION LOT
SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS _____
PROPERTY TENSILE YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-423	217.0	5.37			
-200	169.0				
-150	164.3				
-120	163.0				
-75	164.0				
0	167.0				
80	168.0				
240	168.0				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 6 DATE 10/24/70 MATERIAL 30255
CONDITION FULL HARD DIRECTION L & T
SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS IRRADIATED
PROPERTY TENSILE YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-423	214.0	5.37			
-100	235.0	↓			
0	214.0				
80	200.0				
150	191.0				
240	186.0	↓			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 7 DATE 10/24/70 MATERIAL 302 S.S.
CONDITION FULL HARD DIRECTION L & T
SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS _____
PROPERTY ELONGATION

TEMP., °F	$\bar{X}$, %	S	K	DESIGN ALLOWABLE	COMMENTS
-423	35.4	3.46			
-320	33.4				
-120	28.0				
0	24.1				
80	20.5				
130	16.8				
180	11.0				
200	8.7				
225	6.8				
240	5.9				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 8 DATE 10/22/70 MATERIAL 302 SS
CONDITION FULL HARD DIRECTION LOT
SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS IRRADIATED
PROPERTY ELONGATION

TEMP., °F	$\bar{x}$, %	S	K	DESIGN ALLOWABLE	COMMENTS
-423	27.4	3.46			
-320	26.0	↓			
-200	23.3				
-100	20.2				
80	12.8				
240	5.2	↓			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 9 DATE 10/22/70 MATERIAL 302 S.S.
CONDITION FULL HARD DIRECTION LT
SPEC NOS. SEE PAGE 1 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS _____
PROPERTY NOTED TENSILE STRENGTH, $K_T = 6.3$

TEMP., °F	$\bar{x}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-423	200.0	4.39			
-375	241.5				
-350	249.0				
-320	252.0				
-275	250.0				
-200	243.0				
-150	239.3				
-100	237.0				
80	233.0				

MATERIALS DEPARTMENT DATA RELEASE

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-42.3	300.0	4.39			
80	261.5	4.39			
115	15				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1437 PAGE NO. 11 DATE 10/22/70 MATERIAL 302 SS
CONDITION FULL HARD SHEET, PLATE & WIRE DIRECTION L
780.6 TIK
SPEC NOS. MIL-S-5059, QQ-S-766, QQ-W-423 DATA BASIS ESTIMATED
METAL PROGRESS, MAY 1965, P. 103
REFERENCES NUCLEAR ENGRG. & DESIGN, VOL II, 1969, P. 366
COMMENTS _____
PROPERTY FRACTURE TOUGHNESS, K_{IC}

TEMP., °F	$\bar{X}$, KSI/IN.	S	K	DESIGN ALLOWABLE	COMMENTS
-423	164	8.2			
-300	206	10.3			
-200	205	10.3			
-100	200	10.0			
0	204	10.2			
100	210	10.5			
200	230	11.5			
300	220	11.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 12 DATE 10/24/70 MATERIAL 302 SS.CONDITION FULL HARD PLATE, SHEET & WIRE DIRECTION LSPEC NOS. SEE PAGE 11 DATA BASIS ESTIMATEDREFERENCES SEE PAGE 11COMMENTS IRRADIATED: 3.4×10^{18} N/GM² (E > 1 MeV)PROPERTY FRACTURE TOUGHNESS, K_{IC}

TEMP., °F	$\bar{X}$, KSI $\sqrt{IN}$	S	K	DESIGN ALLOWABLE	COMMENTS
-423	95	4.8			
-300	120	6.0			
-200	120	6.0			
-100	118	5.9			
0	120	6.0			
100	125	6.3			
200	140	7.0			
300	130	6.5			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 13 DATE 10/22/70 MATERIAL 302 SS
CONDITION FULL HARD PLATE SHEET & WIRE T. DIRECTION T
SPEC NOS. SEE PAGE 11 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 11
COMMENTS _____
PROPERTY FRACTURE TOUGHNESS, K_{IC}

TEMP., °F	$\bar{X}, KSI \sqrt{IN}$	S	K	DESIGN ALLOWABLE	COMMENTS
-423	111	5.6			
-300	109	5.5			
-200	120	6.0			
-100	130	6.5			
0	135	6.8			
100	142	7.1			
200	150	7.5			
300	160	8.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1L37 PAGE NO. 14 DATE 10/22/70 MATERIAL 302 S.S.
CONDITION FULL HARD PLATE, SHEET & WIRE TO DIRECTION T
SPEC NOS. SEE PAGE 11 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 11
COMMENTS IRRADIATED: 3.4×10^{18} N/CM² (E > 1 MeV)
PROPERTY FRACTURE TOUGHNESS, K_{IC}

TEMP., °F	X, KIPTIN.	S	K	DESIGN ALLOWABLE	COMMENTS
-423	65	3.3			
-300	60	3.0			
-200	70	3.5			
-100	75	3.8			
0	80	4.0			
100	85	4.3			
200	90	4.5			
300	95	4.8			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 15 DATE 10/22/70 MATERIAL 302 SS
CONDITION FULL HARD BAR TO 0.6" DIA DIRECTION L & T
SPEC NOS. AMS 5637 DATA BASIS Estimated
REFERENCES SEE PAGE 11
COMMENTS _____
PROPERTY FRACTURE TOUGHNESS, K_{IC}

TEMP., °F	$\bar{X}$, KSI $\sqrt{IN}$	S	K	DESIGN ALLOWABLE	COMMENTS
-423	150	7.5			
-300	155	7.8			
-200	168	8.4			
-100	164	8.2			
0	160	8.0			
100	170	8.5			
200	185	9.3			
300	175	8.8			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 16 DATE 10/22/70 MATERIAL 302 SS
CONDITION FULL HARD BAR TO 0.6" DIA. DIRECTION LT
SPEC NOS. AMS V637 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 11
COMMENTS IRRADIATED: 3.4×10^{18} N/CM² (E > 1 MeV)
PROPERTY FRACTURE TOUGHNESS, K_{IC}

TEMP., °F	$\bar{X}$, KSI $\sqrt{in}$	S	K	DESIGN ALLOWABLE	COMMENTS
-423	92	4.6			
-300	105	5.3			
-200	108	5.4			
-100	112	5.6			
0	115	5.8			
100	120	6.0			
200	124	6.2			
300	130	6.4			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 17 DATE 10/22/70 MATERIAL 302 SS
CONDITION FULL HARD DIRECTION L & T
SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS NO EFFECT DUE TO IRRADIATION
PROPERTY MODULUS OF ELASTICITY IN TENSION

TEMP., °F	$\bar{X}$, 10^6 PSI	S	K	DESIGN ALLOWABLE	COMMENTS
-422	35.0	0.528			
-320	34.8	↓			
-120	33.7				
80	32.3				
240	31.4	↓			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 18 DATE 10/22/70 MATERIAL 302 SS
CONDITION FULL HARD DIRECTION L & T
SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS NO EFFECT DUE TO IRRADIATION
PROPERTY POLYMER'S RATIO

TEMP., °F	$\bar{X}$,	S	K	DESIGN ALLOWABLE	COMMENTS
-423	0.250	0.002			
-120	0.280	↓			
80	0.295				
240	0.298				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1L37 PAGE NO. 19 DATE 1/24/70 MATERIAL 302 SSCONDITION FULL HARD DIRECTION L&TSPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATEDREFERENCES SEE PAGE 1

COMMENTS _____

PROPERTY COMPRESSIVE STRESS VS. STRAIN

TEMP., °F	STRAIN, in/in	STRESS KSI	K	DESIGN ALLOWABLE	COMMENTS
-423	0	0			
	0.004	142.0			
	0.008	289.0			
	0.010	352.0			
-320	0	0			
	0.004	132.5			
	0.008	260.5			
	0.010	319.0			
80	0	0			
	0.004	104.0			
	0.006	151.5			
	0.008	191.0			
240	0	0			
	0.004	101.5			
	0.006	146.0			
	0.008	184.0			
	0.010	212.0			

MATERIALS DEPARTMENT DATA RELEASE

TEMP., °F	X, ksi	S	K	DESIGN ALLOWABLE	COMMENTS
-42.3	270.0	2.75			
80	201.5	↓			
240	188.1				

MATERIALS DEPARTMENT DATA RELEASE

TEMP., °F	$\bar{X}$, PSI	S	K	DESIGN ALLOWABLE	COMMENTS
-423	300.5	2.75			
80	218.0	↓			
240	201.1	↓			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 23 DATE 11/4/70 MATERIAL 302 SSCONDITION FULL HARD DIRECTION L & TSPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATEDREFERENCES SEE PAGE 1COMMENTS VALUES ARE ESTIMATED 99% P/95% CLPROPERTY GOODMAN DIAGRAM, 10⁷ CYCLES

TEMP., °F	MEAN STRESS KSI	MAX. STRESS KSI	MIN STRESS KSI	DESIGN ALLOWABLE	COMMENTS
-423	0 50.0 100.0 150.0 200.0 250.0 300.0 344.1	187.2 210.0 232.8 255.6 278.4 301.2 324.0 344.1	-187.2 -110.0 -32.8 44.4 121.6 178.8 276.0 344.1		UTS: 344.1 KSI
80	0 50.0 100.0 150.0 196.1	105.8 129.0 152.2 175.4 196.1	-105.8 -29.0 47.8 124.6 196.1		UTS: 196.1 KSI
240	0 50.0 100.0 150.0 186.5	100.5 124.5 148.5 172.5 186.5	-100.5 -25.0 50.5 126.0 186.5		UTS: 186.5

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1L37 PAGE NO. 43A DATE 11/4/70 MATERIAL 302 SS
 CONDITION FULL HARD DIRECTION LOT
 SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
 REFERENCES SEE PAGE 1
 COMMENTS IRRADIATED
 PROPERTY Goodman S-N CURVE, 10⁷ CYCLES

TEMP., °F	MEAN STRESS KSI	MAX. STRESS KSI	MIN STRESS KSI	DESIGN ALLOWABLE	COMMENTS
-423	0 50.0 100.0 150.0 200.0 250.0 301.5	228.4 241.0 253.6 266.2 278.8 291.4 301.5	-228.4 -140.2 -52.0 36.2 124.4 212.6 301.5		UTS = 301.5 KSI
80	0 50.0 100.0 150.0 211.9	116.4 139.2 162.0 184.8 211.9	-116.4 -34.0 40.4 118.8 211.9		UTS = 211.9 KSI
240	0 50.0 100.0 150.0 197.5	102.0 125.7 149.4 173.1 197.5	-102.0 -25.5 57.0 127.5 197.5		UTS = 197.5 KSI

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1137 PAGE NO. 24 DATE 10/22/70 MATERIAL 302SS
CONDITION FULL HARD DIRECTION LOT
SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS NO EFFECT DUE TO IRRADIATION
PROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	10^{-6} IN/IN-°F $\bar{X}$	S	K	DESIGN ALLOWABLE	COMMENTS
-423	7.3	0.419			
-320	7.6	↓			
-100	8.1				
80	8.6				
240	9.0				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1637 PAGE NO. 25 DATE 10/22/70 MATERIAL 302 SS
CONDITION FULL HARD DIRECTION L & T
SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS NO EFFECT DUE TO IRRADIATION
PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	$\frac{0.70 \text{ FT}^2/\text{HR}}{\bar{X}, \text{ FT}^2/\text{IN}}$	S	K	DESIGN ALLOWABLE	COMMENTS
-423	4.5	0.45			
-320	5.0	0.50			
-100	6.0	0.60			
80	7.0	0.70			
150	7.4	0.74			
300	7.9	0.79			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 26 DATE 10/24/70 MATERIAL 302 SS
CONDITION FULL HARD DIRECTION LOT
SPEC NOS. SEE PAGE 2 DATA BASIS ESTIMATED
REFERENCES SEE PAGE 1
COMMENTS NO EFFECT DUE TO IRRADIATION
PROPERTY SPECIFIC HEAT

TEMP., °F	$\bar{x}$, BTU/LB-°F	S	K	DESIGN ALLOWABLE	COMMENTS
-423	0.080	0.012			
-320	0.085	0.013			
-100	0.097	0.014			
80	0.109	0.016			
200	0.117	0.017			
300	0.122	0.018			

SECURITY CLASS

DATA RELEASE MEMORANDUM

DRM NO

REV (1)

Westinghouse Astronuclear Laboratory

CODE IDENT NO. 14583

SHEET 1 OF 15

51238

DRM TYPE (13)

ESTIMATED
DATA

DEPARTMENT (13)

MATERIALS

DATE (6)

REACTOR

4/25/69

SUBJECT (120)

A-286 BARS - ESTIMATED MATERIAL
PROPERTIES DATA

PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM	
1. 570M-277							1.	2.
2.							3.	4.
3.							5.	6.

DOCUMENT REFERENCES

(DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)

1. AMS-5737	2.	3.	4.	5.
6.	7.	8.	9.	10.

1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)

1) PROVIDE PRELIMINARY ESTIMATED DATA FOR REACTOR ENGINEERING USE.

2) EXISTING X DATA FROM AEC-2275, MIL-HDBK-5, TESTS, ETC., WAS USED WHEN AVAILABLE. WHERE DATA WERE NOT AVAILABLE, ESTIMATES BASED ON COMPARISON WITH SIMILAR MATERIALS OR ON MATERIAL ENGINEER'S EXPERIENCE, WERE USED. STANDARD DEVIATIONS WERE ESTIMATED FROM EXISTING TEST DATA OR ESTIMATED.

3) NOT APPLICABLE

APPROVALS

INFORMATION CATEGORY

SECURITY CLASS

PREPARED BY

DATE

APPROVED BY

DATE

CLASSIFICATION

AUTHORIZED CLASSIFIER

DATE

R.L. SHOLLENBERGER 4/25/69

R.L. Shollenberger 4/25/69

UNCLASSIFIED

R.L. Shollenberger 4/25/69

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 2 DATE 4/24/69 MATERIAL A-246

CONDITION ~~ACTIVATION~~ A.T. & AGED BARS DIRECTION L

SPEC. NOS. AMS 5737

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY SEE BELOW

TEMP., °F	$\bar{X}$,	S	N	COMPUTED VALUE,	COMMENTS
75° FROM -320 TO 800	<u>DENSITY</u>				
	0.29 lb/in ³	0.003			
	<u>POISSON'S RATIO</u>				
	0.306	0.02			
	<u>MELTING POINT</u>				
	2550°F	25°F			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 3 DATE 4/24/69 MATERIAL A-286~~RECEIVED IN D.T. &~~CONDITION AGET BARS DIRECTION LSPEC. NOS. AMJ 5737DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	210.0	12.0			
-280	200.0	11.0			
-200	186.5	11.0			
-100	175.0	10.0			
0	165.0	9.5			
75	160.0	9.5			
200	152.5	9.0			
400	142.5	8.5			
600	135.0	8.0			
700	132.8	7.5			
800	132.0	7.5			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 4 DATE 9/24/69 MATERIAL A-286
~~PRECIPITATION~~ STG
CONDITION AsB BARS DIRECTION L

SPEC. NOS. AMS 5737

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA
IRRADIATED: 2×10^{18} N/cm² (E > 1 Mev) & 2×10^{18} N/cm² (E < .4 Mev)
PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	231.0	12.0			
-280	211.0	11.0			
-200	190.0	11.0			
-100	175.0	10.0			
0	165.0	9.5			
75	160.0	9.5			
200	152.5	9.0			
400	142.5	8.5			
600	135.0	8.0			
700	132.8	7.5			
800	132.0	7.5			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 5 DATE 4/24/69 MATERIAL A-286

~~PRELIMINARY~~ S.T. &
CONDITION AGED BARS DIRECTION L

SPEC. NOS. AMS 5737

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY TENSILE YIELD STRENGTH, 0.2%

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	150.0	8.0			
-100	129.0	7.0			
75	117.0	6.0			
150	113.3	6.0			
200	112.0	6.0			
400	111.0	6.0			
600	110.0	6.0			
800	109.0	6.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 6 DATE 4/21/69 MATERIAL A-2 & 6

~~PRECIPITATION B.T. +~~

CONDITION AGED BARS DIRECTION L

SPEC. NOS. AMS 5737

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $2 \times 10^{18} \text{ N/cm}^2 (E > 1 \text{ MeV}) + 2 \times 10^{18} \text{ N/cm}^2 (E < .4 \text{ MeV})$

PROPERTY TENSILE YIELD STRENGTH, 0.2%

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	165.0	8.0			
-200	141.0	7.5			
-100	129.0	7.0			
75	117.0	6.0			
150	113.3	6.0			
200	112.0	6.0			
400	111.0	6.0			
600	110.0	6.0			
800	109.0	6.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 7 DATE 4/2/68 MATERIAL A-186

~~ANALYTICAL~~ S.T.
CONDITION AGED BARS DIRECTION L

SPEC. NOS. AMS 5737

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ELONGATION

TEMP., °F	$\bar{x}$, %	S	N	COMPUTED VALUE,	COMMENTS
-320	34.0	3.0			
75	31.0	3.0			
300	29.3	2.0			
800	12.5	2.0			

DRM 1238 PAGE NO. 8 DATE 4/20/69 MATERIAL A-286

CONDITION BAES DIRECTION L

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ELONGATION

TEMP., °	$\bar{X}$,	S	N	COMPUTED VALUE,	COMMENTS
-320	30.6	3.0			
75	31.0	3.0			
300	29.3	2.0			
800	22.5	2.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 9 DATE 4/21/69 MATERIAL A-286

CONDITION STAGED BARS DIRECTION L

SPEC. NOS. AMS J-737

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY MODULUS OF ELASTICITY

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
-320	29.4	1.0			
-100	29.3				
0	29.2				
75	29.1				
200	28.0				
400	27.0				
600	26.0				
800	25.0				

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 10 DATE 9/25/69 MATERIAL A-286

CONDITION ST & AGED BARS DIRECTION L

SPEC. NOS. AMS 5737

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY MODULUS OF RIGIDITY

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
-320	10.5	0.3			
-100	10.5				
75	10.4				
200	10.2				
400	10.0				
600	9.5				
800	8.5				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 11 DATE 4/24/69 MATERIAL A-2FGCONDITION STAGED BARS DIRECTION LSPEC. NOS. AMS 5737DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY FATIGUE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
<u>10⁷ CYCLES</u>					
-320	102.0	5.0			
-100	85.0	3.5			
75	73.0	3.0			
150	71.0	3.0			
200	70.0	3.0			
300	69.5	3.0			
400	69.0	3.0			
600	67.2	2.5			
800	64.0	2.5			
<u>10⁶ CYCLES</u>					
-320	93.0	4.5			
-100	75.0	3.5			
0	68.0	3.5			
75	65.0	3.0			
400	62.0	3.0			
800	58.0	2.5			
(CONTINUED)					

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 11A DATE _____ MATERIAL A-286

CONDITION _____ DIRECTION _____

SPEC. NOS. _____

DATA BASIS _____ COMMENTS _____

PROPERTY FATIGUE STRENGTH (CONTINUED)

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
<u>10⁷ CYCLES</u>					
-320	90.0	4.5			
-100	72.0	3.5			
40	63.5	3.5			
75	62.0	3.0			
400	59.0	3.0			
800	55.0	2.5			
<u>10⁸ CYCLES</u>					
-320	89.0	4.5			
-100	71.0	3.5			
30	64.7	3.5			
75	61.0	3.0			
400	58.0	3.0			
800	54.0	2.5			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 12 DATE 4/20/69 MATERIAL A-246

CONDITION S.T. & AGED BARS DIRECTION L

SPEC. NOS. AMS 5737

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $2 \times 10^{18} \text{ N/cm}^2 (E > 1 \text{ MeV})$ & $2 \times 10^{18} \text{ N/cm}^2 (E < .4 \text{ eV})$

PROPERTY FATIGUE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
<u>10⁷ CYCLES</u>					
-320	113.3	5.0			
-100	93.5	3.5			
50	82.0	3.0			
75	80.4	3.0			
125	79.0	3.0			
200	77.5	3.0			
300	76.5	3.0			
400	76.0	3.0			
600	74.0	2.5			
800	70.5	2.0			
<u>10⁶ CYCLES</u>					
-320	102.3	4.0			
-100	82.5	3.0			
75	71.5	3.0			
150	69.8	3.0			
250	68.5	3.0			
300	68.3	3.0			
400	68.3	3.0			
500	67.8	3.0			
600	66.6	2.5			
800	63.9	2.0			

(CONTINUED)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 12A DATE 4/25/68 MATERIAL A-126

CONDITION _____ DIRECTION _____

SPEC. NOS. _____

DATA BASIS _____ COMMENTS _____

IRADIATED

PROPERTY FATIGUE STRENGTH (CONTINUED)

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
<i>10⁷ CYCLES</i>					
-320	99.0	4.5 ⁻			
-100	79.3	3.5 ⁻			
30	70.3	3.5 ⁻			
75	68.3	3.0			
125	66.7	3.0			
200	65.4	3.0			
400	65.0	3.0			
500	64.0	2.5 ⁻			
600	63.6	2.5 ⁻			
800	60.5 ⁻	2.0 ⁻			
<i>10⁸ CYCLES</i>					
-320	97.9	4.5 ⁻			
-100	78.2	3.5 ⁻			
30	69.2	3.5 ⁻			
75	67.2	3.0			
150	65.3	3.0			
250	64.5 ⁻	3.0			
400	63.9	3.0			
600	62.0	2.5 ⁻			
800	59.5 ⁻	2.5 ⁻			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1L38 PAGE NO. 13 DATE 11/15/69 MATERIAL A-286CONDITION STAGED BAK DIRECTION LSPEC. NOS. AMS 5737DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATANO EFFECT DUE TO IRRADIATIONPROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	$10^{-6} (in/in \cdot ^\circ F)$ $\bar{x}_i$	S	N	COMPUTED VALUE,	COMMENTS
-320	7.2	0.36			
-100	8.2	0.41			
75	8.8	0.45			
200	9.2	0.46			
400	9.5	0.48			
600	9.8	0.49			
800	9.7	0.49			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 14 DATE 4/25/69 MATERIAL A-246CONDITION STAGED BARS DIRECTION LSPEC. NOS. AMS 5737DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATANO EFFECT DUE TO IRRADIATION AT 2×10^{14} N/CM²PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	$\frac{BTU \cdot FT}{HR \cdot FT^2 \cdot ^\circ F}$ $\bar{X}_i$	S	N	COMPUTED VALUE,	COMMENTS
-320	4.0	0.40			
-100	5.8	0.58			
75	7.1	0.71			
200	7.9	0.79			
400	9.2	0.92			
600	10.4	1.04			
800	11.9	1.19			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 15 DATE 4/25/68 MATERIAL A-286CONDITION STAGED BARS DIRECTION LSPEC. NOS. AMS 5737DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATANO EFFECT DUE TO IRRADIATIONPROPERTY SPECIFIC HEAT

TEMP., °F	$\bar{X}$, BTU/LB-°F	S	N	COMPUTED VALUE,	COMMENTS
-320	0.040	0.006			
-280	0.058	0.008			
-240	0.068	0.010			
-200	0.076	0.012			
-100	0.091	0.014			
0	0.103	0.016			
75	0.110	0.017			
200	0.118	0.018			
400	0.126	0.019			
600	0.132	0.020			
800	0.136	0.020			

SECURITY CLASS

DATA RELEASE MEMORANDUM

DRM NO

51238
51238

REV (1)

A

Westinghouse Astronuclear Laboratory

CODE IDENT NO. 14683

SHEET L OF 4

DRM TYPE (13)

ESTIMATED

-DATA ANALYSIS

DEPARTMENT (13)

MATERIALS

DATE (6)

11/1/69

REACTOR

SUBJECT (120)

A-686 BARS - MATERIALS PROPERTIES
DATA

PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1.	559					570M-277	1. 2.
2.							3. 4.
3.							5. 6.

DOCUMENT REFERENCES

(DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)

1. AAS-737	2. JMS 5737	3.	4.	5.
6.	7.	8.	9.	10.

1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)

- 1) To provide additional estimated data not provided in the original issue of the DRM. *Signer*
- 2) Goodman Diagrams were constructed by computing a design allowable (99% N & 91% C.L.) for tensile, yield, & fatigue strength based on an infinite population. The diagrams were constructed from these design allowables and maximum and minimum stresses were extracted at specific mean stresses.
- 3) PAGES 16, 16A, & 17 ARE NEW, ADDITIONAL PAGES

APPROVALS

R.L. Shollenberger 11/1/69

PREPARED BY

E. L. Layland 11/6/69

APPROVED BY

INFORMATION CATEGORY

UNCLASSIFIED

CLASSIFICATION

R.L. Shollenberger 11/1/69

AUTHORIZED CLASSIFIER

DATE

SECURITY CLASS

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1138A PAGE NO. 16 DATE 11/5/69 MATERIAL P-286CONDITION S.T. & AGED BARS DIRECTION LSPEC NOS. AMS 5737 DATA BASIS ESTIMATEDREFERENCES AEROSPACE STRUCTURAL METALS HANDBOOK

COMMENTS _____

PROPERTY STRESS VS. STRAIN

TEMP., °F	STRAIN, E, IN/IN.	STRESS, KSI	K	DESIGN ALLOWABLE	COMMENTS
320	0	0			
	0.0095	131.0			
	0.01	133.0			
	0.02	148.0			
	0.03	158.0			
	0.06	172.5			
	0.10	185.0			
	0.20	199.0			
	0.32	208.5			
	0.33	207.5			
	0.34	204.0			
	0.36	190.0			
-110	0	0			
	0.008	110.0			
	0.009	119.5			
	0.01	121.5			
	0.02	134.0			
	0.03	138.0			
	0.06	149.0			
	0.12	160.5			
	0.24	172.5			
	0.26	171.0			
	0.28	167.0			
	0.30	140.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1438A PAGE NO. 15A DATE 11/5/67 MATERIAL A-286

CONDITION _____ DIRECTION _____

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS _____

PROPERTY STRESS VS. STRAIN (CONTINUED)

TEMP., °F	STRAIN, IN./IN.	STRESS, KSI	K	DESIGN ALLOWABLE	COMMENTS
75	0	0			
	0.0075	102.0			
	0.008	105.0			
	0.009	110.0			
	0.02	123.0			
	0.03	125.0			
	0.06	140.0			
	0.12	154.5			
	0.18	160.0			
	0.20	160.0			
	0.22	158.5			
500	0	0			
	0.003	55.0			
	0.004	71.0			
	0.006	90.0			
	0.05	109.0			
	0.10	124.0			
	0.15	129.0			
	0.25	141.0			
1200	0	0			
	0.006	44.0			
	0.008	77.0			
	0.01	88.0			
	0.05	91.0			
	0.10	91.0			
	0.25	88.0			

MATERIALS DEPARTMENT DATA RELEASE

PROPERTY GOODMAN DIAGRAMS, 10' CYCLES

[illegible]

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51238	REV (1) A
SUBJECT (120) A-286 BARS - MATERIALS PROPERTIES DATA						SHEET <u>1</u> OF <u>11</u>	
						DRM TYPE (13) MATERIALS DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 5/21/70	REACTOR

PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM	
1.						59PM-277	1.	2.
2.							3.	4.
3.							5.	6.

DOCUMENT REFERENCES
(DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)

1. AMS-5737	2.	3.	4.	5.
6.	7.	8.	9.	10.

1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)

1) TO PROVIDE STATISTICAL PROPERTIES DATA IN PARTIAL FULFILLMENT OF THE TEST SCOPE.

2) ONE LOT OF MATERIAL WAS TESTED IN THE LONGITUDINAL DIRECTION FROM -320 TO 680°F. ANALYSES WERE BY ANALYSIS OF VARIANCE, BARTLETT'S TEST FOR HOMOGENEITY AND SATTERTHWAITER'S APPROXIMATION FOR S.F. DESIGN ALLOWABLES ARE MINIMUM. IF MAXIMUM DESIGN ALLOWABLES ARE REQUIRED USE $D.A._{max} = \bar{X} + Ks$

3) SHEETS 4, 5, 7, AND 9 REPLACE SHEETS 4, 5, 7, AND 9 OF THE ORIGINAL ISSUE.

SHEETS 16 THROUGH 20 ARE NEW

APPROVALS P. L. S. HENBEGER 5/16/70 PREPARED BY E. L. CLAYTON 5/27/70 APPROVED BY DATE	INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION AUTHORIZED CLASSIFIER DATE	SECURITY CLASS
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WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238A PAGE NO. 2 DATE 5/21/70 MATERIAL A-286
 CONDITION S.T. & AGED BAR DIRECTION L
 SPEC NOS. AMS 5737 DATA BASIS SEE BELOW
 REFERENCES TP 277
 COMMENTS ONE LOT. NO EFFECT DUE TO IRRADIATION
 PROPERTY SEE BELOW

TEMP., °F	- X,	S	K	DESIGN ALLOWABLE	COMMENTS
80	0.29 LB/IN ²	<u>DENSITY</u> 0.003			ESTIMATED
-320 70 740	0.28	<u>POISSON'S RATIO</u> 0.0003	2.876	0.279	"A" QUALITY, 99% PL 95% CL n = 48
	2550°F	<u>MELTING POINT</u> 25°F			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238A PAGE NO. 3 DATE 5/21/70 MATERIAL A-286
 CONDITION S.T. & Annealed BAR DIRECTION L
 SPEC NOS. AMS 5737 DATA BASIS "A" QUALITY 99% P/95% CL
 REFERENCES TP 277
 COMMENTS ONE LOT
 PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	n	S	K	DESIGN ALLOWABLE	COMMENTS
-320	208.0	8	1.940	4.354	199.5	-
-120	177.4		2.160		167.9	-
0	-		-		156.0	INTERPOLATED
80	159.0		1.230		153.7	-
280	154.3		2.356		144.0	-
480	148.2		1.622		141.2	-
680	144.3		1.345		138.4	-
740	-	-	-	-	137.3	EXTRAPOLATED (C QUALITY)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238A PAGE NO. 5 DATE 5/21/70 MATERIAL A-286
CONDITION S.T. & AGED BAR DIRECTION L
SPEC NOS. AM-5 5737 DATA BASIS "A" QUALITY
99% P/95% CL
REFERENCES TP 277
COMMENTS ONE LOT
PROPERTY TENSILE YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	n	S	K	DESIGN ALLOWABLE	COMMENTS
-320	133.5	8	1.710	4.354	126.0	-
-120	121.7	↓	1.865	↓	113.5	-
80	116.3	↓	1.679	↓	109.0	-
280	113.6	↓	2.338	↓	103.4	-
480	110.7	↓	1.298	↓	105.0	-
680	109.2	↓	1.700	↓	101.8	-
740	-	-	-	-	99.9	EXTRAPOLATED (C QUALITY)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238A PAGE NO. 7 DATE 5/21/70 MATERIAL A-286CONDITION S.T. & AGED BAR DIRECTION LSPEC NOS. AMS 5737 DATA BASIS "A" QUALITY
99% P/95% CLREFERENCES TP 277COMMENTS ONE LOTPROPERTY ELONGATION

TEMP., °F	$\bar{X}$, %	n	S	K	DESIGN ALLOWABLE	COMMENTS
-320	32.8	8	0.463	4.354	30.7	-
-120	25.3	|	0.259	|	24.2	-
0	-	|	-	|	21.0	INTERPOLATED
80	20.9	|	0.232	|	19.9	-
280	18.6	|	0.342	|	17.1	-
480	17.1	|	0.232	|	16.1	-
680	16.1	|	0.642	|	13.3	-
740	-	-	-	-	12.1	EXTRAPOLATED (C QUALITY)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238A PAGE NO. 9 DATE 5/21/70 MATERIAL A-286
 CONDITION S.T. & AGED BAR DIRECTION L
 SPEC NOS. AMS 5737 DATA BASIS "A" QUALITY 99% P, 95% CL
 REFERENCES TP 277
 COMMENTS ONE LOT. NO EFFECT DUE TO IRRADIATION
 PROPERTY Modulus of Elasticity

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	n	S	K	DESIGN ALLOWABLE	COMMENTS
-320	32.41	8	0.688	4.354	29.41	-
-120	31.05		0.575		28.55	-
80	30.04		0.354		28.50	-
280	29.10		0.435		27.20	-
480	27.83		0.730		24.65	-
680	27.06		0.578	↓	24.54	-
740	-	-	-	-	24.10	EXTRAPOLATED (C QUALITY)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM CL38A PAGE NO. 16 DATE 5/21/70 MATERIAL A-286
 CONDITION ST & AGED BAR DIRECTION L
 SPEC NOS. AMS 5737 DATA BASIS "A" QUALITY 99% P / 95% CL
 REFERENCES TP 277
 COMMENTS ONE LOT
 PROPERTY REDUCTION OF AREA

TEMP., °F	$\bar{X}$, %	n	df	S_e	K	DESIGN ALLOWABLE	COMMENTS
-320	45.2	48	9	1.47	3.868	39.6	-
-120	45.5	↓	↓	↓	↓	39.8	-
80	45.0	↓	↓	↓	↓	39.4	-
280	44.0	↓	↓	↓	↓	38.4	-
480	43.2	↓	↓	↓	↓	37.5	-
680	43.2	↓	↓	↓	↓	37.5	-
740	-	-	-	-	-	37.1	EXTRAPOLATED (C QUALITY)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238A PAGE NO. 17 DATE 5/21/70 MATERIAL A-286
 CONDITION STAGED BAR DIRECTION L
 SPEC NOS. AMS 5737 DATA BASIS AVERAGE
 REFERENCES TP 277
 COMMENTS ONE LOT
 PROPERTY STRESS VS. STRAIN

TEMP., °F	STRAIN, in/in	STRESS, KSI	K	DESIGN ALLOWABLE	COMMENTS
-320	0	0			
	0.0037	122.0			
	0.0045	128.0			
	0.0061	133.5			
	0.0100	142.9			
	0.0150	151.0			
	0.0200	156.5			
	0.0400	170.0			
	0.0800	183.8			
	0.1200	191.9			
	0.1800	200.8			
	0.2400	206.3			
	0.2800	208.0			
-120	0	0			
	0.0036	111.6			
	0.0040	115.3			
	0.0050	119.1			
	0.0060	121.7			
	0.0100	130.0			
	0.0150	137.1			
	0.0200	143.0			
	0.0400	154.2			
	0.0800	164.4			
	0.1200	170.0			
	0.2100	177.0			
	0.2240	177.4			
	0.2400	173.6			
	0.2570	160.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1235A PAGE NO. 18 DATE 5/21/70 MATERIAL A-286

CONDITION _____ DIRECTION _____

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS _____

PROPERTY STRESS VS STRAIN (CONTINUED)

TEMP., °F	STRAIN, %, in/in	STRESS, KSI	K	DESIGN ALLOWABLE	COMMENTS
80	0	0			
	0.0035	105.5			
	0.0040	110.6			
	0.0050	114.5			
	0.0059	116.3			
	0.0100	124.0			
	0.0150	130.0			
	0.0200	134.0			
	0.0400	144.5			
	0.0600	150.3			
	0.0800	153.9			
	0.1200	157.2			
	0.1600	159.3			
	0.1700	159.0			
	0.1800	158.0			
	0.1900	154.5			
	0.2000	145.0			
	0.2080	132.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238A PAGE NO. 19 DATE 5/21/70 MATERIAL A-286

CONDITION _____ DIRECTION _____

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS _____

PROPERTY STRESS VS STRAIN (CONTINUED)

TEMP., °F	STRAIN %, IN/IN	STRESS, KSI	K	DESIGN ALLOWABLE	COMMENTS
280	0	0			
	0.0036	104.4			
	0.0040	107.8			
	0.0050	111.6			
	0.0059	113.6			
	0.0100	120.9			
	0.0150	126.9			
	0.0200	130.5			
	0.0400	141.0			
	0.0600	146.5			
	0.1000	151.8			
	0.1430	154.3			
	0.1500	153.7			
	0.1600	151.0			
	0.1700	145.5			
	0.1850	127.0			
480	0	0			
	0.0036	101.1			
	0.0040	105.4			
	0.0050	108.9			
	0.0060	110.7			
	0.0100	117.1			
	0.0150	122.8			
	0.0200	126.5			
	0.0400	136.4			
	0.0600	142.0			
	0.1000	147.4			
	0.1300	148.2			
	0.1400	147.1			
	0.1500	142.5			
	0.1650	124.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 123FA PAGE NO. 20 DATE 5/4/70 MATERIAL A-286

CONDITION _____ DIRECTION _____

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS _____

PROPERTY STRESS VS STRAIN (CONTINUED)

TEMP., °F	STRAIN, IN/IN	STRESS, KSI	K	DESIGN ALLOWABLE	COMMENTS
680	0	0			
	0.0034	91.5			
	0.0040	101.2			
	0.0045	105.1			
	0.0050	107.0			
	0.0060	109.2			
	0.0100	115.8			
	0.0150	120.0			
	0.0200	123.0			
	0.0400	133.0			
	0.0600	138.5			
	0.0800	141.8			
	0.1100	144.3			
	0.1200	143.0			
	0.1300	139.5			
	0.1600	119.0			

SECURITY CLASS	DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683	DRM NO 51238	REV (1) C
SHEET 1 OF 2		DRM TYPE (13) MATERIALS DATA	DEPARTMENT (13) MATERIALS

SUBJECT (120) A-LFG BARS - MATERIALS PROPERTIES DATA	DATE (6) 6/12/70	REACTOR
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PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1.	559					590M-277	1. 2.
2.							3. 4.
3.							5. 6.

DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)				
1. AMS 5737	2.	3.	4.	5.
6.	7.	8.	9.	10.

1. PURPOSE	2. ASSUMPTIONS/METHODS	3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)
1) TO CORRECT THE REVISION LETTER ON THE REVISION DATED 5/21/70 WHICH SHOULD HAVE BEEN "B" INSTEAD OF "A" AND TO UPDATE SOME OF THE STATISTICAL DATA IN THAT REVISION.		
2) REANALYSIS OF THE TEST DATA INDICATES BETTER CONCLUSIONS CAN BE DRAWN THAN WERE DRAWN TO DEVELOP THE DATA PREVIOUSLY ISSUED. THE MEANS FROM TEMPERATURE TO TEMPERATURE WERE SIGNIFICANTLY DIFFERENT FOR ALL PROPERTIES EXCEPT POISSON'S RATIO. SATTERTHWAITE'S APPROXIMATION WAS USED TO DETERMINE THE DEGREES OF FREEDOM ASSOCIATED WITH THIS ADDITIONAL RANDOM VARIABILITY AND THE K FACTOR USED WAS RELATED TO N AND df.		
3) PAGES 2, 3, 5, 7, 9, & 16 REPLACE PAGES 2, 3, 5, 7, 9, & 16 OF THE REVISION DATED 5/21/70		
THIS MATERIAL IS ESTIMATED TO BE DUCTILE		

APPROVALS	INFORMATION CATEGORY	SECURITY CLASS
P. L. Schellenberger 6/12/70	UNCLASSIFIED	
PREPARED BY E. L. Layton 6/12/70	CLASSIFICATION P. L. Schellenberger 6/12/70	
APPROVED BY	AUTHORIZED CLASSIFIER	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 2 DATE 6/17/70 MATERIAL A-186
 CONDITION ST & AGED BAR DIRECTION L
 SPEC NOS. AMS 5737 DATA BASIS SEE BELOW
 REFERENCES TP 277
 COMMENTS ONE LOT. NO EFFECT DUE TO IRRADIATION
 PROPERTY SEE BELOW

TEMP., °F	— X,	S	K	DESIGN ALLOWABLE	COMMENTS
80	0.29 LB/IN ³	DENSITY 0.003			ESTIMATED. "C" QUALITY
-320 TO 740	0.283	POISSON'S 0.0003	RATIO 2.876	0.282	"A" QUALITY. 99%P, 95% CL. N=48
	2550°F	MELTING 25°F	POINT		? Explanation

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 12380 PAGE NO. 3 DATE 6/17/70 MATERIAL A-286CONDITION ST & AGED BAR DIRECTION LSPEC NOS. AMS 5737 DATA BASIS "A" QUALITY
99% P, 95% CLREFERENCES TP 277COMMENTS ONE L.TPROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	n	st	S	K	DESIGN ALLOWABLE	COMMENTS
-320	208.0	45		1.82	6.13	196.8	-
-120	177.4					166.2	-
0	164.2					152.3	INTERPOLATED
80	159.0					147.9	-
180	156.1					144.3	INTERPOLATED
280	154.3					143.1	-
480	148.2					137.1	-
680	144.3					133.1	-
750	-					132.1	EXTRAPOLATED "C" QUALITY

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1234B PAGE NO. 5 DATE 6/17/70 MATERIAL A-286
CONDITION ST & AGED BAR DIRECTION L
SPEC NOS. AMS 5737 DATA BASIS "A" QUALITY 99% P, 95% CL
REFERENCES TP 277
COMMENTS ONE LOT
PROPERTY TENSILE YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	n	d	S	K	DESIGN ALLOWABLE	COMMENTS
-320	133.5	4	5	1.79	6.13	122.5	EXTRAPOLATED C QUALITY
-120	121.7					110.8	
80	116.3					105.3	
280	113.6					102.7	
480	110.7					99.7	
680	109.2					98.3	
750	-					98.2	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 12382 PAGE NO. 7 DATE 6/17/70 MATERIAL A-286CONDITION ST & AGED BAC DIRECTION LSPEC NOS. AMS 5737 DATA BASIS "A" QUALITY
99% P, 95% CLREFERENCES TP 277COMMENTS ONE LOTPROPERTY ELONGATION

TEMP., °F	$\bar{X}$, %	n	H	S	K	DESIGN ALLOWABLE	COMMENTS
-320	32.8	4	4	0.392	8.09	29.6	EXTRAPOLATED C QUALITY
-120	25.3					22.1	
80	20.9					17.7	
280	18.6					15.5	
480	17.1					14.0	
680	16.1					13.0	
750	-	↓	↓	↓	↓	12.2	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 PAGE NO. 7 DATE 6/17/70 MATERIAL A-286CONDITION ST & AGED BAR DIRECTION LSPEC NOS. AMS 5737 DATA BASIS "A" QUALITY
99% P, 95% CLREFERENCES TP 277COMMENTS ONE LOTPROPERTY Modulus of Elasticity

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	n	Δ	S	K	DESIGN ALLOWABLE	COMMENTS
-320	32.41	4.5		0.575	6.13	28.89	
-120	31.05					27.53	
80	30.03					26.51	
280	29.10					25.58	
480	27.83					24.31	
680	27.08					23.56	
750	-	↓	↓	↓	↓	23.30	EXTRAPOLATED C QUALITY

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238 B PAGE NO. 16 DATE 6/17/70 MATERIAL A-286CONDITION ST & AGED BAR DIRECTION LSPEC NOS. AMS 5737 DATA BASIS "A" QUALITY
99% P, 95% CLREFERENCES TP 277COMMENTS ONE LOTPROPERTY Reduction of AREA

TEMP., °F	$\bar{x}, \%$	n	df	s	K	DESIGN ALLOWABLE	COMMENTS
-120	45.2	48	9	0.695	3.74	42.6	EXTRAPOLATED C QUALITY
-120	45.5	↓	↓	↓	↓	42.9	
80	45.0	↓	↓	↓	↓	42.5	
280	44.1	↓	↓	↓	↓	41.5	
480	43.4	↓	↓	↓	↓	40.8	
680	43.2	↓	↓	↓	↓	40.7	
750	-	↓	↓	↓	↓	40.6	

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51235	REV (1) D
SUBJECT (120) A-286 BARS - MATERIALS PROPERTIES DATA						DRM TYPE (13) TEST DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 8/3/70	REACTOR
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1.	557					59DM-277	1. 2.
2.							3. 4.
3.							5. 6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1. AMS 5737	2.	3.	4.	5.			
6.	7.	8.	9.	10.			
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)							
1) PROVIDE STATISTICAL PROPERTIES DATA IN PARTIAL FULFILLMENT OF THE TEST SCOPE & TO PROVIDE ADDITIONAL DATA FROM THE LITERATURE.							
2) ANALYSIS OF DATA FROM DENSITY TESTS DISCLOSED NO SIGNIFICANCE IN THE DATA. POISSON'S RATIO HAD BEEN PREVIOUSLY REPORTED IN THE "C" REVISION. MELTING POINT WAS TAKEN FROM THE LITERATURE. EFFECT OF STRAIN RATE & EFFECT OF HYDROGEN ARE ESTIMATED FROM THE LITERATURE. DESIGN ALLOWABLES ARE REPORTED AS MINIMUM; IF MAXIMUM VALUES ARE REQUIRED USE $D.A._{max} = \bar{X} + Ks$							
3) PAGE 2 REPLACES PAGE 2 OF THE "C" REVISION							
APPROVALS R.L. SHOLLENBERGER 8/3/70 PREPARED BY DATE E. C. LAYTON 8/3/70 APPROVED BY DATE				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION AUTHORIZED CLASSIFIER DATE		SECURITY CLASS	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 12380 PAGE NO. 2 DATE 8/3/70 MATERIAL A-286
 CONDITION ST & AGED BAR DIRECTION -
 SPEC NOS. AMS 5737 DATA BASIS SEE BELOW
 REFERENCES TP 277
 COMMENTS ONE LOT
 PROPERTY SEE BELOW

TEMP., °F	- X,	S	K	DESIGN ALLOWABLE	COMMENTS
80	0.287 LB/CU.IN.	DENSITY 0.00026	4.354	0.286	"A" QUALITY 99% P, 95% CL H = 8
320 TO 740	0.283	POISSON'S RATIO 0.0003	2.876	0.282	"A" QUALITY 99% P, 95% CL H = 4F
MELT. POINT	2550°F	25°F			LITERATURE
NO EFFECT DUE TO STRAIN RATE					LITERATURE
NO EFFECT DUE TO HYDROGEN					LITERATURE & ESTIMATE

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 57238	REV (1) E	
SUBJECT (120) A-246 BARS - MATERIALS PROPERTIES DATA						DRM TYPE (13) ESTIMATED DATA		
						DEPARTMENT (13) MATERIALS		
						DATE (6) 8/29/70	REACTOR	
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM	
1. J.J.J	559					570M-177	1. 2.	
2. J.J.J	556					560M-332	3. 4.	
3. J.J.J	564						5. 6.	
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)								
1. AMS 5737		2.		3.		4.		
6.		7.		8.		9.		
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY) 1) PROVIDE ADDITIONAL ESTIMATES OF MATERIALS PROPERTIES DATA FOR REACTOR ENGRG. USE. 2) REFERENCES GIVEN ON EACH PAGE NO EFFECT DUE TO HYDROGEN NO EFFECT DUE TO STRAIN RATE 3) ALL PAGES ARE NEW								
APPROVALS <i>G.D. RAHNER</i> PREPARED BY <i>R.L. SHILLINGER</i> 8/29/70 DATE <i>8/31/70</i> APPROVED BY <i>Clayton</i> DATE				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION <i>W. Shillinger</i> 8/29/70 AUTHORIZED CLASSIFIER DATE				SECURITY CLASS

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1L3+E PAGE NO. 21 DATE 8/29/70 MATERIAL A-246
CONDITION ST + AGED BAR DIRECTION L
SPEC NOS. AMS 5737 DATA BASIS ESTIMATED
REFERENCES AGC 2L75 + WANL TESTS
COMMENTS _____
PROPERTY LOW CYCLE FATIGUE, 10^3 CYCLES

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-320	123.8	6.0			
-100	105.5	5.0			
80	89.5	3.5			
400	83.8	3.5			
800	76.0	3.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1238E PAGE NO. 22 DATE 8/28/70 MATERIAL A-286
CONDITION ST & AGED BAR DIRECTION L
SPEC NOS. AMS 5737 DATA BASIS ESTIMATED
REFERENCES EST. FROM AGC 2270 & WANL TESTS
COMMENTS IRRADIATED: $2 \times 10^{14} \text{ N/cm}^2$ ($E > 1 \text{ MeV}$) & $2 \times 10^{14} \text{ N/cm}^2$ ($E < .4 \text{ MeV}$)
PROPERTY LOW CYCLE FATIGUE; 10^2 CYCLES

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-320	134.0	6.7			
-100	114.5	5.0			
80	100.0	4.5			
400	91.0	3.5			
800	85.0	3.5			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1L38E PAGE NO. 23 DATE 8/28/70 MATERIAL A-286CONDITION ST & AGED BAR DIRECTION LSPEC NOS. AMJ 5737 DATA BASIS ESTIMATEDREFERENCES AGC 1475, MIL-HOOK-5, WALT TESTS

COMMENTS

PROPERTY GOODMAN DIAGRAMS, 10⁷ CYCLES

TEMP., °F	MEAN STRESS, KSI	MAX. STRESS KSI	MIN. STRESS KSI	DESIGN ALLOWABLE	COMMENTS
-320	0 40.0 80.0 120.0 160.0 196.8	90.0 111.5 133.0 154.5 176.0 196.8	-90.0 -32.0 26.2 84.3 142.4 196.8		UTS = 196.8
80	0 40.0 80.0 120.0 147.9	62.0 85.0 108.0 131.0 147.9	-62.0 -5.0 51.0 107.5 147.9		UTS = 147.9
800	0 40.0 80.0 132.0	55.0 78.0 101.0 132.0	-55.0 2.0 59.0 132.0		UTS = 132.0

MATERIALS DEPARTMENT DATA RELEASE

PROPERTY 1% CREEP - 100 HOURS

MATERIALS DEPARTMENT DATA RELEASE

REFERENCES

PROPERTY 1% CREEP - 100 HOURS

TEMP., ° F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
1000	84.0	8.4			ESTIMATE OF S- BEST ENGINEER- ING JUDGEMENT
1200	50.0	5.0			
1400	22.0	2.2			

MATERIALS DEPARTMENT DATA RELEASE

PROPERTY RUPTURE STRENGTH, 100 HOUR

MATERIALS DEPARTMENT DATA RELEASE

PROPERTY RUPTURE STRENGTH, 100 HOURS

SECURITY CLASS

DATA RELEASE MEMORANDUM

DRM NO

REV (1)

Westinghouse Astronuclear Laboratory

CODE IDENT NO. 14583

SHEET 1 OF 13

DRM TYPE (13)

ESTIMATED
DATA

DEPARTMENT (13)

MATERIALS

DATE (6)

REACTOR

4/28/68

SUBJECT (120)

301 STAINLESS STEEL - ESTIMATED MATERIALS
PROPERTIES DATA

PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1. 590M-L54							1. 2.
2.							3. 4.
3.							5. 6.

DOCUMENT REFERENCES

(DWGNO/PART NO/COMPUTER CODES/DRMS/MILS SPECS/CORRESPONDENCE)

1. PP-5-766	2.	3.	4.	5.
6.	7.	8.	9.	10.

1. PURPOSE

2. ASSUMPTIONS/METHODS

3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)

1) PROVIDE PRELIMINARY ESTIMATED DATA FOR REACTOR ENG'G.
USE.2) DATA FROM AGC-1275, MIL-HDBK-5, TESTS, ETC., WAS
USED WHERE AVAILABLE. WHEN DATA WERE NOT AVAIL-
ABLE, ESTIMATES BASED ON COMPARISON WITH SIMILAR
MATERIALS OR ON MATERIALS ENGINEER'S EXPERIENCE,
WERE USED.

3) NOT APPLICABLE

APPROVALS

P.L. SOLLERBERGER 4/28/68

PREPARED BY

DATE

E. L. Layton 4/29/68

APPROVED BY

DATE

INFORMATION CATEGORY

UNCLASSIFIED

CLASSIFICATION

P. L. Sollerberger 4/28/68

AUTHORIZED CLASSIFIER

DATE

SECURITY CLASS

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 2 DATE 4/29/68 MATERIAL 301 S.S.

CONDITION FULL HARD PLATE,
SHEET AND STRIP DIRECTION L & T

SPEC. NOS. QQ-S-766

DATA BASIS ESTIMATED COMMENTS PRELIMINARY
DATA

PROPERTY SEE BELOW

TEMP., °F	$\bar{X}$,	S	N	COMPUTED VALUE,	COMMENTS
75	<u>DENSITY</u>				
	0.286 lb/in ³	0.003			
	<u>POISSON'S RATIO</u>				
From -120 To 800	0.29	0.01			
	<u>MELTING POINT</u>				
	2725°F	25°F			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 PAGE NO. 3 DATE 4/29/62 MATERIAL 301 S.S.

CONDITION FULL HARD PLATE,
SHEET & STRIP DIRECTION L & T

SPEC. NOS. QQ-S-766

DATA BASIS ESTIMATED COMMENTS PRELIMINARY
DATA

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	298.0	14.0			
-100	215.0	12.0			
0	192.0	10.5			
75	182.0	9.0			
200	174.5	9.0			
350	170.5	9.0			
450	170.0	8.5			
500	169.2	8.5			
650	160.0	8.0			
725	151.0	7.5			
800	138.3	7.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 PAGE NO. 4 DATE 4/29/68 MATERIAL 301 SS

CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION LOT

SPEC. NOS. QQ-S-766

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 6X10¹⁸ N/cm² (E > 1 Mev) & 6X10¹⁸ N/cm² (E < .4 Mev)

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	179.0	14.0			
-300	191.0	14.0			
-270	206.0	14.5			
-240	211.0	14.5			
-200	218.0	14.0			
-170	220.0	13.5			
-140	218.0	13.0			
-100	215.0	12.0			
0	192.0	10.5			
75	182.0	9.0			
200	174.5	9.0			
350	170.5	9.0			
450	170.0	8.5			
500	168.2	8.5			
650	160.0	8.0			
725	151.0	7.5			
800	138.3	7.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 PAGE NO. 5 DATE 4/27/58 MATERIAL 301 S.S.

CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION L & T

SPEC. NOS. Q Q - S - 766

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY TENSILE YIELD STRENGTH, 0.2 %

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	220.0	9.0			
-100	203.5	9.0			
-250	190.0	8.5			
-200	180.0	8.5			
-100	167.0	8.0			
0	158.5	7.5			
75	154.9	7.0			
200	154.0	7.0			
350	152.5	7.0			
500	148.0	6.5			
650	137.5	6.0			
800	119.3	6.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 PAGE NO. 6 DATE 9/17/68 MATERIAL 301 S.S.CONDITION FULL HARD PLATE,
SHEET & STRIP DIRECTION L & TSPEC. NOS. Q Q - 5 - 766DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAIRRADIATED: $6 \times 10^{18} \text{ N/cm}^2$ (E2/mon) $6 \times 10^{18} \text{ N/cm}^2$ ($E < .4 \text{ MeV}$)PROPERTY TENSILE YIELD STRENGTH, 0.2%

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-520	176.0	9.0			
-100	170.3	8.0			
0	142.0	7.5			
75	137.4	7.0			
125	141.0	7.0			
170	146.0	7.0			
200	152.0	7.0			
230	160.0	7.0			
300	165.7	7.0			
350	168.0	7.0			
450	166.2	6.5			
500	164.0	6.5			
550	161.0	6.5			
650	147.1	6.0			
800	131.2	6.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 PAGE NO. 7 DATE 9/28/58 MATERIAL 301 S.S.CONDITION FULL HARD PLATE,
SHEET & STRIP DIRECTION LOTSPEC. NOS. QQ-S-766DATA BASIS ESTIMATED COMMENTS PRELIMINARY
DATAPROPERTY ELONGATION

TEMP., °F	$\bar{x}$, %	S	N	COMPUTED VALUE,	COMMENTS
-320	21.1	2.76			
-200	21.6	2.53			
-100	21.2	2.30			
0	19.8	2.10			
75	19.4	2.00			
175	16.9	2.00			
210	14.4	1.90			
250	7.7	1.70			
275	5.7	1.70			
350	2.9	1.50			
400	2.5	1.25			
650	3.0	1.00			
800	3.2	0.50			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1237 PAGE NO. 8 DATE 4/27/69 MATERIAL 301 SS.

CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION LOT

SPEC. NOS. QQ-S-766

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $6 \times 10^{14} \text{ N/cm}^2 (E > 1 \text{ MeV}) + 6 \times 10^{14} \text{ N/cm}^2 (E < .48 \text{ MeV})$

PROPERTY ELONGATION

TEMP., °F	$\bar{x}$, %	S	N	COMPUTED VALUE,	COMMENTS
-320	10.6	2.78			
-100	15.9	2.30			
0	18.3	2.20			
40	19.1	2.10			
75	19.4	2.00			
175	16.9	2.00			
350	10.9	1.50			
450	5.8	1.25			
500	4.4	1.25			
575	3.1	1.00			
650	2.4	1.00			
725	2.2	1.00			
800	2.4	0.50			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 PAGE NO. 9 DATE 4/28/69 MATERIAL 301 S.S.

CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION LOT

SPEC. NOS. QQ-S-766

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY MODULUS OF ELASTICITY

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
-320	32.5	1.0			
-100	30.0				
0	27.6				
75	26.4				
150	25.6				
200	25.0				
250	25.5				
350	26.2				
500	25.8				
650	24.4				
800	22.0				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 PAGE NO. 10 DATE 4/29/69 MATERIAL 301 S.S.CONDITION FULL HARD PLATE,
SHEET & STRIP DIRECTION LOTSPEC. NOS. QQ-S-766DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATANO EFFECT DUE TO IRRADIATIONPROPERTY MODULUS OF RIGIDITY

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
-120	11.50	0.3			
-100	11.20				
75	10.97				
350	10.60				
400	10.55				
500	10.51				
650	10.50				
700	10.48				
750	10.42				
800	10.20				

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 PAGE NO. 11 DATE 4/27/62 MATERIAL 301 SS

CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION L & T

SPEC. NOS. QQ-S-756

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	$10^{-6} \text{ in/in-}^\circ\text{F}$ $\bar{\alpha}_l$	S	N	COMPUTED VALUE,	COMMENTS
-320	6.00	0.30			
-200	6.20	0.31			
-100	6.40	0.33			
-50	6.80	0.35			
0	7.20	0.37			
75	7.70	0.39			
200	7.90	0.40			
400	8.10	0.41			
600	8.30	0.42			
800	8.60	0.43			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 PAGE NO. 12 DATE 4/29/68 MATERIAL 301 S.S.FULL HARD PLATE,
CONDITION SHEET & STRIP DIRECTION LOTSPEC. NOS. QQ-S-766DATA BASIS Estimated COMMENTS PRELIMINARY DATANo EFFECT DUE TO IRRADIATION AT $6 \times 10^{14} \text{ N/cm}^2$ PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	BTU-FT/HR- FT ² -°F $\bar{X}$	S	N	COMPUTED VALUE,	COMMENTS
-320	4.00	0.40			
-260	5.10	0.51			
-200	5.95	0.60			
-100	7.10	0.71			
0	7.70	0.77			
0	7.50	0.75			
75	7.70	0.77			
125	8.14	0.81			
200	9.10	0.91			
400	10.00	1.00			
600	11.00	1.10			
800	11.90	1.19			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 PAGE NO. 13 DATE 4/29/68 MATERIAL 301 SS

CONDITION FULL HARD PLATE,
SHEET & STRIP DIRECTION L & T

SPEC. NOS. Q0-S-766

DATA BASIS ESTIMATED COMMENTS PRELIMINARY
DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY SPECIFIC HEAT

TEMP., °F	$\bar{x}, BTU/LB-°F$	S	N	COMPUTED VALUE,	COMMENTS
-320	0.073	0.011			
-200	0.075	0.011			
-100	0.078	0.012			
-50	0.081	0.013			
-10	0.085	0.014			
20	0.104	0.016			
75	0.110	0.017			
200	0.119	0.018			
400	0.127	0.019			
600	0.133	0.020			
800	0.138	0.021			

SECURITY CLASS

DATA RELEASE MEMORANDUM

DRM NO

REV (1)

51237

A

Westinghouse Astronuclear Laboratory

CODE IDENT NO. 14683

SHEET 1 OF 10

DRM TYPE (13)

MATERIAL
DATA

DEPARTMENT (13)

MATERIAL

DATE (6)

REACTOR

5/27/70

SUBJECT (120)

301 STAINLESS STEEL - MATERIAL
PROPERTY DATA

PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1.	559					590M-254	1. 2.
2.							3. 4.
3.							5. 6.

DOCUMENT REFERENCES

(DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)

1. QQ-5-766	2.	3.	4.	5.
6.	7.	8.	9.	10.

1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)

1) PROVIDE STATISTICAL PROPERTIES DATA IN PARTIAL FULFILLMENT
OF THE TEST SCOPE

2) TWO LOTS OF TWO SIZES WERE TESTED IN THE LONGITUDINAL
AND TRANSVERSE DIRECTIONS FROM -320 TO 600°F. ANALY-
SIS OF VARIANCE AND BARTLETT'S TEST FOR HOMOGENEITY DIS-
CLOSED NO SIGNIFICANT DIFFERENCES IN THE DATA EXCEPT
FOR ELONGATION. FOR THIS PROPERTY, SATTERTHWAIT'S
APPROXIMATION WAS USED TO ESTABLISH DEGREES OF FREEDOM.
DESIGN ALLOWABLES ARE MINIMUM. IF MAXIMUM ALLOWABLES
ARE REQUIRED USE $D.A. max = \bar{X} + Ks$.

3) PAGES 2, 3, 5, 7, AND 9 REPLACE PAGES 2, 3, 5, 7, AND 9 OF
THE ORIGINAL ISSUE.

PAGES 14 THROUGH 17 ARE NEW

APPROVALS

A.L. Schollenberger 5/27/70

PREPARED BY

E. Clayton 5/28/70

APPROVED BY

DATE

INFORMATION CATEGORY

UNCLASSIFIED

CLASSIFICATION

N. Schollenberger 5/27/70

AUTHORIZED CLASSIFIER

DATE

SECURITY CLASS

MATERIALS DEPARTMENT DATA RELEASE

TEMP., ° F	$\bar{X}$,	S	K	DESIGN ALLOWABLE	COMMENTS
80	0.286 Lb/in ²	<u>DENSITY</u> 0.003			
	272.5 °F	<u>MELTING POINT</u> 25 °F			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239A PAGE NO. 3 DATE 5/26/70 MATERIAL 301 S.S.
 CONDITION 0.05% 0.042" THK. FULL HARD SHEET DIRECTION L & T
 SPEC NOS. QQ-S-766 DATA BASIS "A" QUALITY 99% P, 95% CL
 REFERENCES TP 254
 COMMENTS TWO LOTS
 PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	n	K	DESIGN ALLOWABLE	COMMENTS
-320	316.9	14.05	78	2.876	276.5	-
-120	246.5				206.1	-
-70	-				187.1	INTERPOLATED
0	-				172.0	INTERPOLATED
80	204.0				163.6	-
280	192.9				152.5	-
480	185.3				144.9	-
680	176.2	✓	✓	✓	135.8	-

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237A PAGE NO. 5 DATE 5/16/70 MATERIAL 301 SS
 CONDITION 0.015" & 0.042" T/K. FULL HARD SHEET DIRECTION L & T
 SPEC NOS. 99-5-766 DATA BASIS "A" QUALITY 99% P, 91% C L
 REFERENCES TP 254
 COMMENTS Two Lots
 PROPERTY TENSILE YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	n	K	DESIGN ALLOWABLE	COMMENTS
-320	171.7	5.37	48	2.876	176.3	-
-170	-				150.0	INTERPOLATED
-150	-				148.8	INTERPOLATED
-120	163.4				148.0	-
-50	-				149.7	INTERPOLATED
80	167.7				152.3	-
280	168.0				152.6	-
350	-				150.9	INTERPOLATED
480	157.8				142.4	-
680	140.0	↓	↓	↓	124.6	-

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239A PAGE NO. 7 DATE 5/26/70 MATERIAL 301 SS
 CONDITION 0.035" & 0.042" T/K. FULL HARD SHEET DIRECTION L & T
 SPEC NOS. QQ-S-766 DATA BASIS "A" QUALITY 99% P, 95% C L
 REFERENCES TP 254
 COMMENTS Two Lots
 PROPERTY ELONGATION

TEMP., °F	$\bar{X}$, %	η dH	S	K	DESIGN ALLOWABLE	COMMENTS
-320	33.4	98.5	3.46	4.60	17.5	-
-120	28.0	↓	↓	↓	12.1	-
80	20.4	↓	↓	↓	4.5	-
140	-	↓	↓	↓	0	INTERPOLATED
280	5.0	↓	↓	↓	↑	-
480	5.3	↓	↓	↓	ESSENTIALLY	-
680	4.5	↓	↓	↓	0	-

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239A PAGE NO. 7 DATE 9/26/70 MATERIAL 301 S.S.
 CONDITION 0.015" & 0.042" THK. FULL HARD SHEET DIRECTION L & T
 SPEC NOS. Q Q-S-766 DATA BASIS "A" QUALITY 99% P / 95% CL
 REFERENCES TP 254
 COMMENTS TWO LOTS - NO EFFECT DUE TO IRRADIATION
 PROPERTY MODULUS OF ELASTICITY

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	S	$\bar{1}$	K	DESIGN ALLOWABLE	COMMENTS
-320	34.95	0.828	98	2.876	32.57	
-120	33.71				31.33	
80	32.26				29.88	
280	31.21				28.83	
480	29.82				27.44	
680	28.39	↓	↓	↓	26.01	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237A PAGE NO. 14 DATE 5/16/70 MATERIAL 301 S.S.
 CONDITION 0.035" & 0.041" T/K. FULL HARD SHEET DIRECTION L & T
 SPEC NOS. QQ-S-766 DATA BASIS A QUALITY 99% P/95% CL
 REFERENCES TP 254
 COMMENTS Two L & Ts
 PROPERTY Reduction of Area

TEMP., °F	$\bar{X}$, %	S	n	K	DESIGN ALLOWABLE	COMMENTS
-320	26.5	2.64	48	2.876	18.9	-
-120	29.9				22.3	-
80	30.9				23.3	-
120	-				22.2	INTERPOLATED
200	-				15.5	INTERPOLATED
250	-				12.2	INTERPOLATED
280	19.0				11.5	-
320	-				11.0	INTERPOLATED
350	-				11.0	INTERPOLATED
400	-				10.3	INTERPOLATED
480	16.0				8.4	-
680	8.8	↓	↓	↓	1.2	-

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239A PAGE NO. 15 DATE 5/26/70 MATERIAL 301 SS
 CONDITION 0.035" & 0.042" THK FULL HARD SHEET DIRECTION L & T
 SPEC NOS. QQ-S-766 DATA BASIS "A" QUALITY 99% A / 95% C L
 REFERENCES TP 254
 COMMENTS TWO LOTS - NO EFFECT DUE TO IRRADIATION
 PROPERTY POISSON'S RATIO

TEMP., °F	$\bar{X}$	η	S	K	DESIGN ALLOWABLE	COMMENTS
-320	0.262	40	0.00224	2.941	0.255	-
-120	0.280				0.274	-
80	0.295				0.288	-
280	0.297				0.290	-
480	0.293				0.286	-
540	-	-	-	-	0.286	EXTRAPOLATED (C QUALITY)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239A PAGE NO. 16 DATE 5/26/70 MATERIAL 301 S.S.
 CONDITION 0.035" x 0.042" THK FULL HARD SHEET DIRECTION LAT
 SPEC NOS. QQ-1-766 DATA BASIS AVERAGE
 REFERENCES TP 254
 COMMENTS Two Lots
 PROPERTY STRESS vs STRAIN

TEMP., °F	STRAIN, IN/IN	STRESS KSI	K	DESIGN ALLOWABLE	COMMENTS
-320	0	0			
	0.0046	160.0			
	0.0054	175.0			
	0.006	184.0			
	0.0075	191.7			
	0.01	241.0			
	0.02	262.0			
	0.03	273.0			
	0.06	289.0			
	0.10	301.7			
	0.14	309.5			
	0.20	315.0			
	0.26	316.0			
	0.31	316.9			
	0.32	311.0			
	0.33	300.0			
-120	0	0			
	0.0042	142.5			
	0.0047	152.0			
	0.0055	158.3			
	0.0065	158.5			
	0.0068	163.4			
	0.01	190.0			
	0.04	212.5			
	0.08	229.0			
	0.12	238.3			
	0.16	245.0			
	0.252	246.5			
	0.17	230.0			
	0.284	202.5			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239A PAGE NO. 17 DATE 5/17/70 MATERIAL 301 S.S.CONDITION 0.025" & 0.041" THK FULL HARD SHEET DIRECTION LOT

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS _____

PROPERTY STRESS vs STRAIN (CONTINUED)

TEMP., °F	STRAIN, %, IN/IN	STRESS, KSI	K	DESIGN ALLOWABLE	COMMENTS
80	0	0			
	0.0043	142.0			
	0.005	153.0			
	0.0055	158.8			
	0.006	162.5			
	0.0065	165.0			
	0.0078	167.7			
	0.01	169.8			
	0.04	188.0			
	0.08	198.0			
	0.156	204.0			
280	0	0			
	0.0043	134.5			
	0.005	148.0			
	0.006	159.0			
	0.0074	168.0			
	0.01	191.0			
	0.017	192.9			
	0.02	192.5			
480	0	0			
	0.0042	126.0			
	0.0047	135.0			
	0.0052	137.5			
	0.006	149.5			
	0.0073	157.8			
	0.01	171.5			
	0.02	183.5			
	0.03	185.3			
	0.043	170.5			

SECURITY CLASS	DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683	DRM NO	REV (1)
		51239	B
		DRM TYPE (13) MATERIALS DATA	
		DEPARTMENT (13) MATERIALS	
SHEET 1 OF 2		DATE (6)	REACTOR
SUBJECT (120) 301 STAINLESS STEEL - MATERIALS PROPERTIES DATA		6/9/70	

PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1.	539					590M-L54	1. 2.
2.							3. 4.
3.							5. 6.

DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)				
1. PP-5-756	2.	3.	4.	5.
6.	7.	8.	9.	10.

1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)
- 1) PROVIDE STATISTICAL PROPERTIES DATA IN PARTIAL FULFILLMENT OF THE TEST SCOPE.
 - 2) ANALYSIS OF VARIANCES DISCLOSED SIGNIFICANT DIFFERENCES BETWEEN THE MEANS FOR THE VARIOUS TEMPERATURES; HOWEVER, BARTLETT'S TEST FOR HOMOGENEITY OF VARIANCES WITHIN TEMPERATURES WAS NOT SIGNIFICANT. THE WITHIN LOTS MEAN SQUARE WAS USED AS THE ESTIMATE OF RANDOM VARIANCE AND THE GROSS VARIABILITY CALCULATED AS $\sigma_G^2 = \sigma_G^2 = \sigma_w^2 + \sigma_A^2$. DEGREES OF FREEDOM WERE CALCULATED FROM SATTERTHWAITER'S APPROXIMATION AND A MINIMUM DESIGN ALLOWABLE COMPUTED. IF A MAXIMUM DESIGN ALLOWABLE IS REQUIRED, USE $D_{MAX} = \bar{X} + 1/2$.
 - 3) PAGE 11 REPLACES PAGE 11 OF THE "A" REVISION.

APPROVALS	INFORMATION CATEGORY	SECURITY CLASS
R.L. SHOLLENBERGER 6/9/70	UNCLASSIFIED	
PREPARED BY E. Clayton 4/16/70	CLASSIFICATION R.L. Shollenberger 6/9/70	
APPROVED BY	AUTHORIZED CLASSIFIER	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 51239B PAGE NO. 11 DATE 6/9/70 MATERIAL 301 STAINLESS STEELCONDITION 0.035-0.042" THK FULL HARD SHEET DIRECTION LSPEC NOS. QD-S-766 DATA BASIS "A" QUALITY 99% P, 94% C L.REFERENCES TP 254COMMENTS TW = LOTSPROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	10^{-6} IN/IN-°F $\bar{X}$,	n	s	K	DESIGN ALLOWABLE	COMMENTS
-400	7.16	72	8	0.419	4.012	5.48
-300	7.31					5.63
-200	7.46					5.77
-100	7.61					5.92
0	7.75					6.07
100	7.90					6.22
200	8.05					6.37
300	8.20					6.52
400	8.35					6.67

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51239	REV (1) C
SUBJECT (120) 301 STAINLESS STEEL - MATERIALS PROPERTIES DATA						DRM TYPE (13) TEST DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 6/29/70	REACTOR
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1.	559					570m-254	1.
2.							2.
3.							3.
							4.
							5.
							6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1. QQ-S-766	2.	3.	4.	5.			
6.	7.	8.	9.	10.			
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)							
1) TO CORRECT ERROR IN DATA ANALYSIS.							
2) DATA WAS INCORRECTLY INPUTED INTO THE COMPUTER PROGRAM FOR ANALYSIS OF VARIANCE. REANALYZED DATA WERE SIGNIFICANTLY DIFFERENT FROM TEMPERATURE TO TEMPERATURE. VARIANCES WERE NOT SIGNIFICANT.							
3) PAGE 2 REPLACES PAGE 3 OF THE "A" REVISION.							
APPROVALS P.L. SLOVENBERGER 6/30/70 PREPARED BY E. L. Layland 6/30/70 APPROVED BY				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION AUTHORIZED CLASSIFIER		SECURITY CLASS	
DATE 6/30/70 DATE				DATE 6/30/70 DATE			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239C PAGE NO. 3 DATE 6/29/70 MATERIAL 301 S.S.CONDITION 0.035 & 0.042" THK. FULL HARD SHEET DIRECTION L & TSPEC NOS. QD-S-766 DATA BASIS "A" QUALITY 99% P, 95% C.L.REFERENCES TP 254COMMENTS TWO LOTSPROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	n	df	S	K	DESIGN ALLOWABLE	COMMENTS
-320	316.9	8	36	3.4	4.03	303.2	INTERPOLATED
-120	246.5					232.8	
0	-					201.0	
80	204.0					190.3	
280	192.9					179.2	
480	185.3					171.6	
680	176.2					162.5	

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51239	REV (1) 0
SUBJECT (120) 301 STAINLESS STEEL-MATERIALS PROPERTIES DATA						DRM TYPE (13) TEST DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 7/30/70	REACTOR -
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1. 3.3.3	559					570M-254	1. 2.
2.							3. 4.
3.							5. 6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1. QQ-S-766	2.	3.	4.	5.			
6.	7.	8.	9.	10.			
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)							
1) PROVIDE STATISTICAL DESIGN DATA IN PARTIAL FULFILLMENT OF THE TEST SCOPE.							
2) ANALYSIS DISCLOSED NO SIGNIFICANCE IN THE DATA WITHIN THE TEMPERATURE TESTED. THE DESIGN ALLOWABLE IS REPORTED AS MINIMUM. IF MAXIMUM VALUES ARE REQUIRED USE $D.A. max = \bar{X} + Ks$							
3) PAGE 2 REPLACES PAGE 2 OF THE "A" REVISION							
APPROVALS P.L. SHOLLENBERGER 7/30/70 PREPARED BY DATE S. Clayton 7/3/70 APPROVED BY DATE				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION AUTHORIZED CLASSIFIER DATE		SECURITY CLASS	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1L39D PAGE NO. 2 DATE 7/30/70 MATERIAL 301 S.S.
CONDITION FULL HARD SHEET DIRECTION -
SPEC NOS. QQ-S-766 DATA BASIS SEE BELOW
REFERENCES TP 254
COMMENTS ONE LOT
PROPERTY SEE BELOW

TEMP., °F	$\bar{x}$,	S	K	DESIGN ALLOWABLE	COMMENTS
80	0.284 LB/CU.IN.	DENSITY 0.0007	4.354	0.281	99% P/95% CL "A" QUALITY n=8
	2725°F	MELTING POINT 25°F			LITERATURE

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51239	REV (1) E
SUBJECT (120) 301 STAINLESS STEEL - MATERIALS PROPERTIES DATA						DRM TYPE (13) TEST DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 8/14/70	REACTOR
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1. 3.3.3	559					590m-2v4	1. 2.
2.							3. 4.
3.							5. 6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1. QQ-S-766		2.		3.		4.	
6.		7.		8.		9.	
						10.	
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)							
1) PROVIDE STATISTICAL DESIGN DATA IN PARTIAL FULFILLMENT OF THE TEST SCOPE.							
2) A BEST-FIT CURVE WAS DETERMINED BY REGRESSION ANALYSIS TECHNIQUE FOR X DATA AT EACH TEMPERATURE AND THE X FOR 10 ⁵ CYCLES WAS TAKEN FROM THIS CURVE. BARTLETTS TEST FOR HOMOGENEITY SHOWED NO SIGNIFICANT DIFFERENCES IN THE VARIANCES SO A POOLED STANDARD DEVIATION, BASED ON THE TOTAL SAMPLE SIZE, WAS USED TO COMPUTE THE 95/99 ALLOWABLES.							
3) PAGE IS IN NEW							
APPROVALS R.L. SHOLLENBERGER 8/14/70 PREPARED BY DATE C. L. Poyton 8/25/70 APPROVED BY DATE				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION R. Shollenberger 8/14/70 AUTHORIZED CLASSIFIER DATE		SECURITY CLASS	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 E PAGE NO. 18 DATE 8/15/70 MATERIAL 301 S.S.
CONDITION 0.042" THK. FULL HARD SHEET DIRECTION L
SPEC NOS. QQ-S-766 DATA BASIS "A" QUALITY 99% P, 95% C.L.
REFERENCES TP 254
COMMENTS ONE LOT
PROPERTY FATIGUE STRENGTH, 10^7 CYCLES (TENSION-TENSION)

TEMP., °F	$\bar{X}$, KSI	n	S	K	DESIGN ALLOWABLE	COMMENTS
-320	270.3	20	2.94	3.295	260.6	BEST-FIT CURVE by REGRESSION ANALYSIS
80	201.5	↓	↓	↓	191.8	
480	175.2	↓	↓	↓	165.5	

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51239	REV (1) F
SUBJECT (120) 301 STAINLESS STEEL - MATERIAL PROPERTIES DATA						DRM TYPE (13) MATERIALS DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 8/27/70	REACTOR
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1. 3.3.3	559					570m-254	1. 2.
2.							3. 4.
3.							5. 6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1. 00-5-766	2.	3.	4.	5.			
6.	7.	8.	9.	10.			
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY) 1) TO PROVIDE ADDITIONAL DATA REQUESTED BY REACTOR ENGINEERING 2) EXISTING STATISTICAL OR ESTIMATED DATA WERE EXTENDED TO COVER ADDITIONAL TEMPERATURES. WHERE DATA DID NOT EXIST IT WAS ESTIMATED FROM THE LITERATURE OR BY EXTRAPOLATING FROM EXISTING DATA 3) PAGES 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 15 REPLACE PAGES 3 (REV. C), 4 (ORIG.), 5 (REV. A), 6 (ORIG.), 7 (REV. A), 8 (ORIG.), 9 (REV. A), 11 (REV. B), 12 (ORIG.), & 13 (ORIG.) PAGES 4A, 8A, 17A THROUGH F, 18A, 19, & 20 ARE NEW							
APPROVALS R.L. SHOLLENBERGER 8/27/70 PREPARED BY S. Playlora 8/27/70 APPROVED BY _____ DATE _____		INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION AUTHORIZED CLASSIFIER DATE			SECURITY CLASS		

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1229 F PAGE NO. 3 DATE 8/27/70 MATERIAL 301 SS.
 CONDITION 0.035" x 0.041" T/K FULL HARD SHEET DIRECTION L & T
 SPEC NOS. QQ-5-766 DATA BASIS "A" QUALITY 99% P, 95% CL
 REFERENCES TP 254
 COMMENTS Two L & T's
 PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	X, KSI	H	S	K	DESIGN ALLOWABLE	COMMENTS	
-423	352.0	8	36	3.4	4.03	338.3	EXTRAPOLATED
-320	316.9	↓	↓	↓	↓	303.2	"G" QUALITY
-120	246.5	↓	↓	↓	↓	231.8	-
0	214.7	↓	↓	↓	↓	201.0	INTERPOLATED
80	204.0	↓	↓	↓	↓	190.3	-
280	192.9	↓	↓	↓	↓	179.2	-
480	185.3	↓	↓	↓	↓	171.6	-
680	176.2	↓	↓	↓	↓	162.5	-

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 12395 PAGE NO. 4 DATE 8/27/70 MATERIAL 301 SS.CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION LTSPEC NOS. QP-S-766 DATA BASIS ESTIMATED

REFERENCES _____

COMMENTS IRRADIATED: 6×10^{18} N/CM² (E > 1 MCV) & 6×10^{18} N/CM² (E < .44 eV)PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-423	160.0	3.4	4.03		
-320	171.0				
-200	217.0				
-120	230.0				
0	241.8				
80	244.3				
150	243.8				
280	236.7				
480	215.0				
680	180.2				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237E PAGE NO. 4A DATE 8/27/70 MATERIAL 301 SS
CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION LOT
SPEC NOS. Q Q-5-766 DATA BASIS ESTIMATED

REFERENCES —

COMMENTS COMBINED EFFECTS - IRRADIATION & HYDROGENPROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-423	160.0	3.4	4.03		
-320	173.0				
-200	188.0				
-120	196.0				
0	204.6				
80	208.0				
150	208.0				
280	206.0				
480	196.0				
680	180.2				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239F PAGE NO. 5 DATE 8/27/70 MATERIAL 301 SS
 CONDITION 0.03540.042" THK. FULL HARD SHEET DIRECTION LOT
 SPEC NOS. Q9-S-766 DATA BASIS "A" QUALITY 99% P, 95% CL
 REFERENCES TP 254
 COMMENTS TWO LOTS - NO EFFECT DUE TO HYDROGEN
 PROPERTY TENSILE YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	n	K	DESIGN ALLOWABLE	COMMENTS
-423	217.0	5.37	48	2.876	201.6	EXTRAPOLATED "C" QUALITY
-320	191.7				176.3	
-170	165.4				150.0	INTERPOLATED
-150	164.2				148.8	INTERPOLATED
-120	163.4				148.0	-
-50	165.1				149.7	INTERPOLATED
80	167.7				152.3	-
280	168.0				152.6	-
350	166.3				150.9	INTERPOLATED
480	157.8				142.4	-
680	140.0	↓	↓	↓	124.6	-

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1237F PAGE NO. 6 DATE 8/27/70 MATERIAL 301 SSCONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION L & TSPEC NOS. PP-5-766 DATA BASIS ESTIMATED

REFERENCES _____

COMMENTS IRRADIATED: 6×10^{10} N/cm² (E > 1 Mev) & 6×10^{10} N/cm² (E < .48 Mev)PROPERTY TENSILE YIELD STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-423	130.0	5.37	2.876		
-320	153.0				
-120	185.0				
50					
0	176.5				
50	200.0				
80	201.5				
150	200.4				
200	199.8				
250	197.5				
280	195.8				
350	190.0				
480	175.5				
680	142.2				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239F PAGE NO. 7 DATE 8/27/70 MATERIAL 301 SS
 CONDITION 0.005 x 0.042" THK. FULL HARD SHEET DIRECTION L & T
 SPEC NOS. QQ-S-766 DATA BASIS "A" QUALITY 99% P, 90% CL
 REFERENCES TP 254
 COMMENTS TWO L&Ts
 PROPERTY ELONGATION

TEMP., °F	$\bar{X}$, %	n	H	S	K	DESIGN ALLOWABLE	COMMENTS
-423	35.4	48	5	3.46	4.6	17.5	EXTRAPOLATED
-320	33.4					17.0	"C" QUALITY
-120	28.0					12.1	-
80	20.4					4.5	-
140	15.9					ESSENTIALLY	INTERPOLATED
280	5.0					0	-
480	5.3					0	-
680	4.5					0	-

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239F PAGE NO. 8 DATE 8/27/70 MATERIAL 301 SSCONDITION FULL HARD SHEET, STRIP & PLATE DIRECTION LTSPEC NOS. QQ-S-766 DATA BASIS Estimated

REFERENCES _____

COMMENTS IRRADIATED: $6 \times 10^{14} \text{ N/cm}^2$ ($E > 1 \text{ MeV}$) & $6 \times 10^{14} \text{ N/cm}^2$ ($E < .4 \text{ MeV}$)PROPERTY ELONGATION

TEMP., °F	$\bar{x}$, %	S	K	DESIGN ALLOWABLE	COMMENTS
-423	17.0	3.46	4.6		
-320	16.7				
-120	16.0				
80	15.3				
100	15.0				
130	13.3				
170	8.3				
200	6.2				
240	5.0				
280	4.4				
300	4.1				
400	4.3				
480	4.6				
680	4.5				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1137F PAGE NO. 8A DATE 8/27/70 MATERIAL 301 SS
CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION L & T
SPEC NOS. QQ-5-766 DATA BASIS ESTIMATED

REFERENCES

COMMENTS COMBINED IRRADIATION & HYDROGEN EFFECTS

PROPERTY ELONGATION

TEMP., °F	$\bar{x}$, %	S	K	DESIGN ALLOWABLE	COMMENTS
-423	17.0	3.46	4.6		
-320	14.8				
-120	13.7				
80	11.5				
130	10.3				
170	8.3				
200	6.2				
240	5.0				
280	4.4				
300	4.1				
400	4.3				
480	4.6				
680	4.5				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239F PAGE NO. 9 DATE 8/17/70 MATERIAL 301 SS
 CONDITION 0.035x0.042" THK. FULL HARD SHEET DIRECTION LET
 SPEC NOS. QQ-S-766 DATA BASIS "A" QUALITY 99% P, 94% CL
 REFERENCES TP 254
 COMMENTS TWO LOTS - NO EFFECT DUE TO IRRADIATION & HYDROGEN
 PROPERTY MODULUS OF ELASTICITY

TEMP., °F	$\bar{X}$, 10 ⁶ PSI	S	H	K	DESIGN ALLOWABLE	COMMENTS
-423	35.00	0.818	48	2.876	32.62	EXTRAPOLATED
-320	34.95	↓	↓	↓	32.57	"C" QUALITY
-120	33.71	↓	↓	↓	31.33	-
80	32.26	↓	↓	↓	29.88	-
280	31.21	↓	↓	↓	28.83	-
480	29.82	↓	↓	↓	27.44	-
680	28.39	↓	↓	↓	26.01	-

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239 F PAGE NO. 11 DATE 8/27/70 MATERIAL 301 SS
 CONDITION 0.035 & 0.042" THK. FULL HARD SHEET DIRECTION L
 SPEC NOS. Q Q-S-766 DATA BASIS "A" QUALITY 99% P, 95% CL
 REFERENCES TP 254
 COMMENTS NO EFFECT DUE TO IRRADIATION OR HYDROGEN
 PROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	10^{-6} IN/IN- °F $\bar{X}$	n	df	S	K	DESIGN ALLOWABLE	COMMENTS
-400	7.16	72	8	0.419	4.012	5.48	EXTRAPOLATED "C" QUALITY
-200	7.46	↓	↓	↓	↓	5.77	
0	7.75	↓	↓	↓	↓	6.07	
200	8.05	↓	↓	↓	↓	6.37	
400	8.35	↓	↓	↓	↓	6.67	
540	8.56	↓	↓	↓	↓	6.88	

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239F PAGE NO. 12 DATE 8/27/70 MATERIAL 301 SS
 CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION L & T
 SPEC NOS. QQ-S-766 DATA BASIS ESTIMATED
 REFERENCES AGC-2275 & AEROSPACE
 COMMENTS No EFFECT DUE TO IRRADIATION & HYDROGEN
 PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	$\frac{BTU-FT/HR}{X, FT^2-°F}$	S	K	DESIGN ALLOWABLE	COMMENTS
-423	2.17	0.22			
-320	4.00	0.40			
-260	5.10	0.51			
-200	5.95	0.60			
-100	7.10	0.71			
0	7.50	0.75			
80	7.75	0.78			
125	8.14	0.81			
200	9.10	0.91			
400	10.00	1.00			
600	11.00	1.10			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1439F PAGE NO. 13 DATE 8/27/70 MATERIAL 301 SS
CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION LT
SPEC NOS. QQ-S-756 DATA BASIS ESTIMATED
REFERENCES AGC 2275
COMMENTS NO EFFECT DUE TO IRRADIATION & HYDROGEN
PROPERTY SPECIFIC HEAT

TEMP., °F	$\bar{X}$, BTU/LB-°F	S	K	DESIGN ALLOWABLE	COMMENTS
-423	0.070	0.010			
-320	0.073	0.011			
-200	0.075	0.011			
-100	0.078	0.012			
-50	0.081	0.013			
-10	0.085	0.014			
20	0.104	0.016			
80	0.111	0.017			
200	0.119	0.018			
400	0.127	0.019			
600	0.133	0.020			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1139F PAGE NO. 15 DATE 8/27/70 MATERIAL 301 SS
 CONDITION 0.035" & 0.042" T/K. FULL HARD SHEET DIRECTION L&T
 SPEC NOS. QQ-5-756 DATA BASIS "A" QUALITY 78% P, 95% CL
 REFERENCES TP 254
 COMMENTS TWO L&T'S - NO EFFECT DUE TO IRRADIATION ON HYDROGEN
 PROPERTY POISSON'S RATIO

TEMP., °F	$\bar{X}$	N	S	K	DESIGN ALLOWABLE	COMMENTS
-425	0.250	40	0.00224	2.941	0.243	EXTRAPOLATED "C" QUALITY
-320	0.262				0.255	-
-120	0.280				0.274	-
80	0.295				0.288	-
280	0.297				0.290	-
480	0.293				0.286	-
540	0.293				0.286	EXTRAPOLATED "C" QUALITY

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 11375 PAGE NO. 17A DATE 8/27/70 MATERIAL 301 SS
 CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION L & T
 SPEC NOS. QP-S-766 DATA BASIS Estimated
 REFERENCES _____
 COMMENTS IRRADIATED: 6×10^{14} N/cm² (E > 1 MeV) & 6×10^{18} N/cm² (E < .4 MeV)
 PROPERTY STRESS vs STRAIN

TEMP., °F	STRAIN, IN/IN	STRESS KSI	K	DESIGN ALLOWABLE	COMMENTS
-425	0	0			
	0.0045	120.0			
	0.0048	124.0			
	0.0052	127.0			
	0.0058	129.0			
	0.0063	129.9			
	0.0069	130.0			
	0.0075	131.2			
	0.008	132.6			
	0.01	139.0			
	0.015	145.1			
	0.02	148.6			
	0.025	150.8			
	0.03	151.5			
	0.05	154.5			
	0.08	157.0			
-220	0.12	159.0			
	0.17	160.0			
	0	0			
	0.0046	128.0			
	0.0050	130.4			
	0.0057	145.0			
	0.0065	150.0			
	0.0075	153.0			
	0.0085	155.5			
	0.01	159.6			
	0.015	165.8			
	0.03	173.5			
	0.05	180.3			
	0.08	186.5			
	0.11	189.5			
	0.14	190.5			
	0.167	191.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239F PAGE NO. 17B DATE 8/27/70 MATERIAL 301 SS

CONDITION _____ DIRECTION _____

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS IRRADIATEDPROPERTY STRESS VS STRAIN (CONTINUED)

TEMP., °F	STRAIN, IN/IN	STRESS KSI	K	DESIGN ALLOWABLE	COMMENTS
-120	0 0.00042 0.00055 0.0007 0.00083 0.0009 0.01 0.015 0.02 0.04 0.06 0.09 0.11 0.14 0.16	0 123.5 153.0 175.1 185.0 188.0 190.0 197.5 201.3 212.4 219.4 225.8 228.0 230.0 230.0			
80	0 0.00043 0.00047 0.0005 0.00055 0.0006 0.00071 0.01 0.02 0.04 0.07 0.11 0.153	0 170.0 170.5 185.9 192.2 196.4 201.5 207.5 217.0 226.1 234.5 240.6 244.3			

(CONTINUED)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239F PAGE NO. 17C DATE 8/21/70 MATERIAL 301 SS

CONDITION _____ DIRECTION _____

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS IRRADIATEDPROPERTY STRESS vs STRAIN (CONTINUED)

TEMP., °F	STRAIN, IN/IN	STRESS KSI	K	DESIGN ALLOWABLE	COMMENTS
280	0.0043	156.5			
	0.0047	167.6			
	0.005	173.4			
	0.0055	180.9			
	0.006	186.3			
	0.0066	190.8			
	0.0073	195.8			
	0.008	198.2			
	0.009	202.6			
	0.01	208.0			
	0.02	222.0			
	0.03	230.0			
480	0.044	236.7			
	0.0042	139.6			
	0.0047	150.7			
	0.0055	161.7			
	0.0065	170.6			
	0.0073	175.5			
	0.008	178.0			
	0.009	179.6			
	0.01	180.0			
	0.02	196.5			
	0.03	205.2			
	0.046	215.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239F PAGE NO. 170 DATE 8/27/70 MATERIAL 301 SS
 CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION L & T
 SPEC NOS. PP-S-766 DATA BASIS ESTIMATED
 REFERENCES _____
 COMMENTS COMBINED EFFECTS - IRRADIATION & HYDROGEN
 PROPERTY STRESS VS STRAIN

TEMP., °F	STRAIN, IN/IN	STRESS, KSI	K	DESIGN ALLOWABLE	COMMENTS
-423	0	0			
	0.0045	120.0			
	0.0048	124.0			
	0.0051	127.0			
	0.0054	129.0			
	0.0063	129.9			
	0.0069	130.0			
	0.0075	131.2			
	0.008	132.6			
	0.01	139.0			
	0.015	145.1			
	0.02	148.6			
	0.025	150.8			
	0.03	151.5			
	0.05	154.5			
	0.08	157.0			
	0.12	159.0			
	0.17	160.0			
-320	0	0			
	0.0046	128.0			
	0.005	136.4			
	0.0057	145.0			
	0.0065	150.0			
	0.0075	153.0			
	0.01	156.0			
	0.015	159.7			
	0.025	162.0			
	0.05	166.1			
	0.09	170.0			
	0.158	173.0			
(CONTINUED)					

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1239E PAGE NO. 17E DATE 8/27/70 MATERIAL 301 SS

CONDITION _____ DIRECTION _____

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS COMBINED EFFECTS - IRRADIATION & HYDROGENPROPERTY STRESS VS STRAIN (CONTINUED)

TEMP., °F	STRAIN, in/in	STRESS KSI	K	DESIGN ALLOWABLE	COMMENTS
-120	0	0			
	0.0042	123.5			
	0.0055	153.0			
	0.007	175.1			
	0.0083	185.0			
	0.009	187.0			
	0.01	187.3			
	0.0145	191.1			
	0.02	193.6			
	0.06	195.0			
	0.137	196.0			
80	0	0			
	0.0043	170.0			
	0.0047	180.5			
	0.005	185.9			
	0.0055	192.2			
	0.006	196.4			
	0.0071	201.5			
	0.008	203.1			
	0.01	204.0			
	0.015	204.8			
	0.07	207.0			
	0.115	208.0			

(CONTINUED)

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1139F PAGE NO. 17F DATE 8/17/70 MATERIAL 301 SS

CONDITION _____ DIRECTION _____

SPEC NOS. _____ DATA BASIS _____

REFERENCES _____

COMMENTS Combined Effects - Irradiation & HydrogenPROPERTY STRESS vs. STRAIN (CONTINUED)

TEMP., °F	STRAIN, in/in	STRESS KSI	K	DESIGN ALLOWABLE	COMMENTS
2 FC	0	0			
	0.0043	156.5			
	0.0047	167.6			
	0.005	173.4			
	0.0055	180.9			
	0.006	186.3			
	0.0066	190.8			
	0.0073	195.8			
	0.008	196.0			
	0.008	196.0			
	0.01	199.3			
	0.015	201.9			
4 FC	0.02	203.0			
	0.044	206.0			
	0	0			
	0.0042	139.6			
	0.0047	150.7			
	0.0055	161.7			
	0.0065	170.6			
	0.0073	175.5			
	0.008	178.0			
	0.009	179.6			
	0.01	179.8			
	0.015	185.5			
	0.02	189.0			
	0.03	193.5			
	0.04	195.3			
	0.046	196.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1LJ9F PAGE NO. 18A DATE 8/17/70 MATERIAL 301 SS
CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION L
SPEC NOS. 99-S-766 DATA BASIS Estimated

REFERENCES _____
COMMENTS IRRADIATED: $6 \times 10^{18} \text{ N/cm}^2$ ($E > 1 \text{ MeV}$) & $6 \times 10^{18} \text{ N/cm}^2$ ($E < 4 \text{ eV}$)
PROPERTY FATIGUE STRENGTH - 10^7 CYCLES (TENSION-TENSION)

TEMP., °F	$\bar{X}$, KSI	S	K	DESIGN ALLOWABLE	COMMENTS
-320	162.2	2.94	3.295		
80	201.5	↓	↓		
480	175.2	↓	↓		
COMBINED IRRADIATION & HYDROGEN EFFECTS					
-320	162.2	2.94	3.295		
80	141.1	↓	↓		
480	175.2	↓	↓		

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1L39F PAGE NO. 19 DATE 5/27/70 MATERIAL 301 SS
 CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION L
 SPEC NOS. PP-S-766 DATA BASIS ESTIMATED
 REFERENCES AEROSPACE STRUCTURAL METALS HOOK
 COMMENTS _____
 PROPERTY Fracture Toughness - K_{IC}

TEMP., °F	$\bar{X}$, KSI/2IN.	S	K	DESIGN ALLOWABLE	COMMENTS
-423	190.0	28.5			
-320	175.0	29.3			
-120	205.0	30.8			
80	205.0	30.8			
IRRADIATED: 6×10^{18} N/cm ² (E > 1 MeV) & 6×10^{18} N/cm ² (E < .4 MeV)					
-423	114.0	17.1			
-370	114.1	17.1			
-350	114.3	17.2			
-320	117.0	17.6			
-275	125.5	18.8			
80	246.0	36.9			
COMBINED IRRADIATION & HYDROGEN EFFECTS					
-423	114.0	17.1			
-370	114.1	17.1			
-350	114.3	17.2			
-320	117.0	17.6			
80	172.2	25.8			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 12395 PAGE NO. 20 DATE 8/27/70 MATERIAL 301 SS
 CONDITION FULL HARD PLATE, SHEET & STRIP DIRECTION T
 SPEC NOS. PP-V-766 DATA BASIS ESTIMATED
 REFERENCES AEROSPACE STRUCTURAL METAL HOOK
 COMMENTS _____
 PROPERTY FRACTURE TOUGHNESS - K_{IC}

TEMP., °F	$\bar{X}, KSI\sqrt{IN}$	S	K	DESIGN ALLOWABLE	COMMENTS
-423	95.0	14.25			
-370	100.7	16.11			
-320	110.0	16.50			
-275	125.0	18.75			
-225	134.9	20.24			
-175	141.0	21.15			
-120	145.0	21.80			
80	146.0	21.90			
IRRADIATED: $6 \times 10^{18} N/cm^2$ ($E > 1 MeV$) & $6 \times 10^{18} N/cm^2$ ($E < 40 eV$)					
-423	57.0	8.55			
-320	66.0	9.90			
80	160.0	24.20			
COMBINED IRRADIATION & HYDROGEN EFFECTS					
-423	57.0	8.55			
-320	66.0	9.90			
80	112.5	16.40			

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51241	REV (1)
SUBJECT (120) TUNGSTEN-2% THORIA - ESTIMATED MATERIALS PROPERTIES DATA						DRM TYPE (13) ESTIMATED DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 5/9/69	REACTOR
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1. 58DM-241							1. 2.
2.							3. 4.
3.							5. 6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1.	2.	3.	4.	5.			
6.	7.	8.	9.	10.			
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)							
<p>1) PROVIDE PRELIMINARY ESTIMATES OF MATERIALS PROPERTIES FOR REACTOR DESIGN USE.</p> <p>2) DATA WERE ESTIMATED FROM EXISTING TEST DATA, BY COMPARISON WITH SIMILAR MATERIALS, ETC., OR FROM MATERIALS ENGINEER'S EXPERIENCE.</p> <p>3) NOT APPLICABLE</p>							
APPROVALS R.L. SHOLLENBERGER <i>5/9/69</i> PREPARED BY DATE L.F. JAMES <i>5/12/69</i> APPROVED BY DATE				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION R.L. Shollenberger <i>5/9/69</i> AUTHORIZED CLASSIFIER DATE		SECURITY CLASS	

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 2 DATE 5/8/68 MATERIAL TUNGSTEN - 2% THORIA

CVD THIN SHEET &

CONDITION TUBE - ANNEALED DIRECTION A. G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
320	120.0	20.0			STRAIN RATE = 0.02 IN/IN/ MIN.
68	120.0	20.0			
200	120.0	20.0			
250	106.0	19.0			
400	87.0	18.0			
600	70.0	14.0			
750	61.0	12.0			
1000	51.0	10.0			
1500	40.0	8.0			
2000	31.0	6.0			
2500	24.2	5.0			
3000	18.0	4.0			
3500	13.0	3.0			
4000	9.4	2.0			
4500	7.0	1.4			
5000	5.0	1.0			
5500	3.0	0.6			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 3 DATE 5/8/69 MATERIAL TUNGSTEN - 2³10 THORIA

CONDITION CVD THIN SHEET + TUBE - ANNEALED DIRECTION A.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{14} N/CM² (E > 1 MEV) & 4×10^{17} N/CM² (E < 4 KEV)

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	132.0	20.0			STRAIN RATE = 0.02 in/in/min
200	132.0	20.0			
250	121.0	19.0			
400	96.0	18.0			
600	78.3	14.0			
750	68.1	12.0			
1000	55.3	10.0			
1250	46.0	9.0			
1400	42.0	8.0			
1500	40.0	8.0			
2000	31.0	6.0			
2500	24.2	5.0			
3000	18.0	4.0			
3500	13.0	3.0			
4000	9.4	2.0			
4500	7.0	1.4			
5000	5.0	1.0			
5500	3.0	0.6			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 4 DATE 5/8/68 MATERIAL TUNGSTEN - 2% THORIACONDITION CVD THINSHEET & TUBE - ANNEALED DIRECTION W.G.SPEC. NOS. —DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{x}$, KSI	S	N	COMPUTED VALUE	COMMENTS
320	156.0	20.0			STRAIN RATE = 0.02 IN/IN/MIN
200	156.0	10.0			
250	137.5	19.0			
400	116.0	18.0			
600	85.4	14.0			
750	79.2	12.0			
1000	63.3	10.0			
1500	51.0	8.0			
2000	40.0	6.0			
2500	32.0	5.0			
3000	25.0	4.0			
3500	17.8	3.0			
4000	12.0	2.0			
4500	9.0	1.4			
5000	6.5	1.0			
5500	3.9	0.6			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 5 DATE 5/8/67 MATERIAL TUNGSTEN - 2 1/2% THORIA

CVD THIN SHEET &

CONDITION TUBE - ANNEALED DIRECTION W. G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{14} N/cm² (E21 MOV) $\times 4 \times 10^{17}$ N/cm² (E < 4 keV)

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
~320	182.0	20.0			STRAIN RATE = 0.01 IN/IN/MIN.
200	172.0	20.0			
250	155.0	19.0			
400	126.0	18.0			
600	98.5	14.0			
750	84.4	12.0			
1000	69.6	10.0			
1500	52.0	8.0			
2000	40.0	6.0			
2500	32.0	5.0			
3000	25.0	4.0			
3500	17.8	3.0			
4000	12.0	2.0			
4500	9.0	1.4			
5000	6.5	1.0			
5500	3.9	0.6			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1L4L PAGE NO. 6 DATE 5/4/68 MATERIAL TUNGSTEN - 2 1/2% THORIACONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W.G.SPEC. NOS. —DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY ULTIMATE TENSILE STRENGTH - EFFECT OF STRAIN RATE

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	IN/IN/MIN. COMMENTS
2500	23.80	4.0			0.002
	32.50	5.0			0.02
	38.80	6.0			0.2
	41.60	6.0			2.0
	45.50	7.0			20.0
4000	5.25	0.8			0.002
	13.00	2.0			0.02
	17.00	3.0			0.2
	20.70	3.0			2.0
	23.30	4.0			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 7 DATE 5/4/68 MATERIAL TUNGSTEN - 2 1/2 THORIA

CVD THIN SHEET

CONDITION TUBE - ANNEALED DIRECTION A.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ULTIMATE TENSILE STRENGTH - EFFECT OF STRAIN RATE

TEMP., °F	$\bar{\sigma}$, KSI	S	N	COMPUTED VALUE,	in/in/min COMMENTS
2500	18.0	4.0			0.002
	25.0	5.0			0.02
	30.0	6.0			0.2
	32.0	6.0			2.0
	35.0	7.0			20.0
4000	4.0	0.2			0.002
	10.0	2.0			0.02
	13.0	3.0			0.2
	16.0	3.0			2.0
	18.0	4.0			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 8 DATE 1/8/69 MATERIAL TUNGSTEN - 2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION A.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY TENSILE YIELD STRENGTH, 0.2%

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	120.0	20.0			STRAIN RATE = 0.02 in/in/min
200	120.0	20.0			
250	103.5	18.5			
400	70.0	14.0			
600	50.0	10.0			
750	37.5	7.0			
1000	27.6	5.0			
1250	23.0	4.5			
1500	20.0	4.0			
2000	16.0	3.0			
2500	13.0	3.0			
3000	9.0	2.0			
3500	7.0	2.0			
4000	5.0	1.0			
4500	3.5	0.7			
5000	2.5	0.5			
5500	1.5	0.3			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 9 DATE 4/8/69 MATERIAL TUNGSTEN - 2% Thoria

CVD THIN SHEET

CONDITION TUBE - ANNEALED DIRECTION A. G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{14} N/cm² (E > 1 MeV) & 4×10^{17} N/cm² (E < .4 MeV)

PROPERTY TENSILE YIELD STRENGTH, 0.2%

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
320	132.0	20.0			STRAIN RATE = 0.02 in/in/min
200	132.0	20.0			
250	113.9	18.5			
400	77.0	14.0			
600	55.0	10.0			
750	41.3	7.0			
1000	30.4	5.0			
1250	25.0	4.5			
1500	21.2	4.0			
2000	16.0	3.0			
2500	13.0	3.0			
3000	9.0	2.0			
3500	7.0	2.0			
4000	5.0	1.0			
4500	3.5	0.7			
5000	2.5	0.5			
5500	1.5	0.3			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 10 DATE 5/4/68 MATERIAL TUNGSTEN - 2% THORIA

CVD THIN SHEET 4

CONDITION TUBE-ANNEALED DIRECTION W.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY TENSILE YIELD STRENGTH, 0.2 %

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
320	156.0	20.0			STRAIN RATE = 0.02 IN/IN/MIN
200	156.0	20.0			
250	125.0	18.4			
400	91.0	14.0			
600	64.0	10.0			
900	40.0	5.5			
1100	32.9	5.0			
1250	29.6	4.5			
1500	26.3	4.0			
2000	21.5	3.0			
2500	16.6	3.0			
3000	12.0	2.0			
3500	9.0	2.0			
4000	7.0	1.0			
4500	4.6	0.7			
5000	3.3	0.5			
5500	2.0	0.3			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 11 DATE 5/4/69 MATERIAL TUNGSTEN - 2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{18} \text{ N/cm}^2$ ($E > 1 \text{ MeV}$) + $4 \times 10^{17} \text{ N/cm}^2$ ($E < .4 \text{ MeV}$)

PROPERTY TENSILE YIELD STRENGTH, 0.2 %

TEMP., °F	$\bar{\sigma}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
320	171.6	20.0			STRAIN RATE = 0.02 in/in/min
400	171.6	20.0			
450	137.5	18.5			
500	100.1	14.0			
600	70.4	10.0			
700	44.0	5.5			
800	36.0	5.0			
900	31.0	4.5			
1000	27.5	4.0			
1100	21.5	3.0			
1200	16.6	3.0			
1300	12.0	2.0			
1400	9.0	2.0			
1500	7.0	1.0			
1600	4.6	0.7			
1700	3.3	0.5			
1800	2.0	0.3			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 12 DATE 5/8/69 MATERIAL TUNGSTEN - 2% THORIACONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W.G.SPEC. NOS. —DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY TENSILE YIELD STRENGTH, 0.2% - EFFECT OF STRAIN RATE

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	in/in/min. COMMENTS
2000	13.0	2.0			0.002
	16.8	3.0			0.02
	19.5	3.0			0.2
	22.1	3.0			2.0
	26.0	4.0			20.0
4000	3.9	0.6			0.002
	6.5	1.0			0.02
	7.8	1.2			0.2
	9.1	1.4			2.0
	10.4	1.6			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 13 DATE 5/8/69 MATERIAL TUNGSTEN - 2% THORIACONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION A.G.SPEC. NOS. —DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY TENSILE YIELD STRENGTH, 0.2% - EFFECT OF STRAIN RATE

TEMP., °F	$\bar{\epsilon}$, KSI	S	N	COMPUTED VALUE,	IN/IN/MIN. COMMENTS
2500	10.0	2.0			0.002
	13.0	3.0			0.02
	15.0	3.0			0.2
	17.0	3.0			1.0
	20.0	4.0			20.0
4000	3.0	0.6			0.002
	5.0	1.0			0.02
	6.0	1.2			0.2
	7.0	1.4			1.0
	8.0	1.6			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 14 DATE 5/8/69 MATERIAL TUNGSTEN - 2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ELONGATION

TEMP., °F	$\bar{x}$, %	s	N	COMPUTED VALUE,	COMMENTS
~310	0	0			STRAIN RATE = 0.02 in/in/min
300	0	0			
325	0.4	0.1			
350	0.8	0.2			
400	3.0	0.8			
600	13.0	3.0			
700	19.0	4.0			
800	23.0	5.0			
1000	28.0	6.0			
1050	29.0	6.0			
1100	29.4	6.0			
1200	30.0	6.0			
2000	30.0	6.0			
2150	29.0	5.5			
2250	29.7	5.5			
2500	28.9	5.0			
3000	26.0	5.0			
4000	20.0	4.0			
5000	15.0	3.0			
5500	10.0	2.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 10 DATE 5/8/69 MATERIAL TUNGSTEN-2% THORIA

CONDITION CVD THIN SHEET DIRECTION W.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{18} \text{ N/CM}^2$ ($E > 1 \text{ MeV}$) & $4 \times 10^{17} \text{ N/CM}^2$ ($E < .4 \text{ MeV}$)

PROPERTY ELONGATION

TEMP., °F	$\bar{X}$, %	S	N	COMPUTED VALUE,	COMMENTS
320	0	0			STRAINED RATE = 0.02 in/in/min
300	0	0			
325	0.4	0.1			
350	0.8	0.2			
400	3.0	0.8			
500	7.2	1.9			
600	11.7	3.0			
700	17.1	4.0			
800	20.7	5.0			
1000	25.2	6.0			
1050	26.1	6.0			
1100	26.5	6.0			
1200	27.0	6.0			
2000	27.0	6.0			
2250	27.0	6.0			
2500	26.8	5.0			
2750	26.5	5.0			
3000	26.0	5.0			
4000	20.0	4.0			
5000	15.0	3.0			
5500	10.0	2.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 16 DATE 5/4/69 MATERIAL TUNGSTEN-2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION A.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ELONGATION

TEMP., °F	$\bar{X}$, %	S	N	COMPUTED VALUE,	COMMENTS
-320	0	0			STRAIN RATE = 0.02 in/in/min
68	0	0			
250	0.25	0.07			
400	1.00	0.30			
500	2.50	0.60			
600	5.00	1.00			
800	10.75	2.50			
1000	18.00	4.00			
1050	18.95	4.00			
1100	19.33	4.00			
1200	19.90	4.00			
1250	20.00	4.00			
2000	20.00	4.00			
2100	19.80	3.50			
3000	16.82	3.00			
4000	13.80	3.00			
5000	11.00	2.00			
5500	9.00	2.00			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 17 DATE 5/4/69 MATERIAL TUNGSTEN - 2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION A. G.

SPEC. NOS. -

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{14} \text{ N/CM}^2 (E > 1 \text{ MEV}) + 4 \times 10^{17} \text{ N/CM}^2 (E < .4 \text{ eV})$

PROPERTY ELONGATION

TEMP., °F	$\bar{\epsilon}$, %	S	N	COMPUTED VALUE,	COMMENTS
-320	0	0			STRAIN RATE = 0.02 IN/IN/MIN
68	0	0			
250	0.25	0.07			
400	1.00	0.30			
500	2.25	0.60			
600	4.50	1.00			
1000	16.20	4.00			
1050	16.90	4.00			
1100	17.40	4.00			
1200	18.00	4.00			
2250	18.00	3.50			
2500	17.90	3.50			
3000	16.82	3.00			
4000	13.80	3.00			
5000	11.00	2.00			
5500	9.00	2.00			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 18 DATE 5/4/69 MATERIAL TUNGSTEN - 2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W. G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ELONGATION - EFFECT OF STRAIN RATE

TEMP., °F	$\bar{\epsilon}$, %	S	N	COMPUTED VALUE,	IN/IN/MIN COMMENTS
2500	27.0	5.0			0.002
	28.0	6.0			0.02
	31.0	6.0			0.2
	34.0	7.0			2.0
	38.0	8.0			20.0
4000	13.0	3.0			0.002
	20.0	4.0			0.02
	29.0	6.0			0.2
	50.0	10.0			2.0
	40.0	8.0			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 19 DATE 5/8/69 MATERIAL TUNGSTEN - 2% THORIA

CVD THIN SHEET &
CONDITION TUBE - ANNEALED DIRECTION A.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ELONGATION - EFFECT OF STRAIN RATE

TEMP., °F	$\bar{\epsilon}$, %	S	N	COMPUTED VALUE,	in/in/min COMMENTS
2500	18.0	4.0			0.002
	19.0	4.0			0.02
	20.0	4.0			0.2
	23.0	5.0			2.0
	25.0	5.0			20.0
4000	9.0	2.0			0.002
	14.0	3.0			0.02
	20.0	4.0			0.2
	35.0	7.0			2.0
	28.0	6.0			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 20 DATE 5/8/68 MATERIAL TUNGSTEN - 2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W.G. & A.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ULTIMATE COMPRESSIVE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
320	168.0	28.0			STRAIN RATE = 0.02 IN/IN/MIN
100	168.0	28.0			
250	164.0	27.0			
400	121.0	24.0			
600	100.0	20.0			
750	84.5	18.5			
850	78.0	17.00			
1000	71.0	14.00			
1500	56.0	11.0			
2000	43.0	8.0			
2500	33.0	7.0			
3000	25.0	5.0			
3500	20.0	4.0			
4000	14.0	3.0			
4500	10.0	2.0			
5000	7.0	1.4			
5500	4.0	0.8			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 21 DATE 5/8/69 MATERIAL TUNGSTEN - 2% THORIA

CVD THIN SHEET &
CONDITION TUBE-ANNEALED DIRECTION W.G. & A.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{16} N/CM² (E > 1 MEV) + 4×10^{17} N/CM² (E < .4 EV)

PROPERTY ULTIMATE COMPRESSIVE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	185.0	28.0			STRAIN RATE = 0.02 IN/IN/MIN
200	185.0	28.0			
250	183.0	27.0			
500	125.4	22.0			
650	100.0	20.0			
750	90.0	18.5			
850	82.5	17.0			
1000	74.5	14.0			
1500	58.7	11.0			
2000	43.0	8.0			
2500	33.0	7.0			
3000	25.0	5.0			
3500	20.0	4.0			
4000	14.0	3.0			
4500	10.0	2.0			
5000	7.0	1.4			
5500	4.0	0.8			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 22 DATE 5/4/69 MATERIAL TUNGSTEN-2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W.G. & A.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ULTIMATE COMPRESSIVE STRENGTH - EFFECT OF STRAIN RATE

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	IN/IN/MIN COMMENTS
2500	25.0	5.0			0.002
	35.0	7.0			0.02
	42.0	8.0			0.2
	45.0	9.0			2.0
	49.0	10.0			20.0
4000	6.0	1.2			0.002
	14.0	3.0			0.02
	18.0	4.0			0.2
	22.0	4.0			2.0
	25.0	5.0			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 23 DATE 5/8/69 MATERIAL TUNGSTEN - 2% THORIACONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W.G. & N.G.SPEC. NOS. —DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY COMPRESSIVE YIELD STRENGTH, 0.2%

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
320	168.0	28.0			STRAISS RATE = 0.02 in/in/min
200	168.0	28.0			
250	165.5	24.0			
400	113.0	20.0			
500	87.0	17.0			
650	61.4	14.0			
800	49.0	10.0			
1000	38.0	8.0			
1250	32.0	7.0			
1500	27.0	6.0			
2000	22.0	4.0			
2500	18.0	4.0			
3500	10.0	2.0			
4000	7.0	1.4			
4500	5.0	1.0			
5000	3.0	0.6			
5500	2.0	0.4			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 24 DATE 5/8/69 MATERIAL TUNGSTEN - 2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W.O. & D.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{14} N/CM² (E > 1 MeV) + 4×10^{17} N/CM² (E < .4 MeV)

PROPERTY COMPRESSIVE YIELD STRENGTH, 0.2 %

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
-320	201.6	28.0			STRAIN RATE = 0.02 IN/IN/IN
200	201.6	28.0			
250	200.0	24.0			
300	190.0	22.0			
500	104.4	17.0			
650	78.0	14.0			
750	64.0	12.0			
850	54.0	10.0			
1000	45.6	8.0			
1250	37.0	7.0			
1500	30.5	6.0			
2000	22.0	4.0			
2500	18.0	4.0			
3500	10.0	2.0			
4000	7.0	1.4			
4500	5.0	1.0			
5000	3.0	0.6			
5500	2.0	0.4			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 25 DATE 5/8/69 MATERIAL TUNGSTEN-2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W.G. & A.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY COMPRESSIVE YIELD STRENGTH, 0.2% - EFFECT OF STRAIN RATE

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	in/in/min in/in/min
2500	14.0	3.0			0.002
	18.0	4.0			0.02
	21.0	4.0			0.2
	24.0	5.0			2.0
	28.0	6.0			20.0
4000	4.0	0.8			0.002
	7.0	1.4			0.02
	8.0	1.6			0.2
	10.0	2.0			2.0
	11.0	2.0			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 26 DATE 5/8/69 MATERIAL TUNGSTEN - 2% THORIACONDITION CVD THIN SHEET & TUBE-ANNEALED DIRECTION WG & PGSPEC. NOS. —DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATANO EFFECT DUE TO IRRADIATIONPROPERTY MODULUS OF ELASTICITY, TENSION & COMPRESSION

TEMP., °F	$\bar{X}, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
68	50.0	5.0			
500	47.8	5.0			
1500	41.0	5.0			
2000	37.1	5.0			
2500	32.9	5.0			
3500	24.1	5.0			
4000	19.6	4.0			
4500	15.0	3.0			
5000	9.4	3.0			
5500	5.8	2.0			

DRM 1242 PAGE NO. 27 DATE 5/2/68 MATERIAL Tungsten - 2% Thorium

CVD Thin SHEET &
CONDITION Tube DIRECTION WG & AG

SPEC. NOS. _____

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY POISSON'S RATIO, TENSION & COMPRESSION

[illegible]

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 28 DATE 5/4/69 MATERIAL TUNGSTEN - 2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W. G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY TENSILE CREEP STRENGTH IN 75 MINUTES

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	% CREEP COMMENTS
4000	1.52	0.38			0.1
	2.08	0.52			0.4
	2.46	0.62			1.0
	2.86	0.72			2.0
	3.47	0.87			5.0
	4.00	1.00			10.0
	4.70	1.18			20.0
4260	1.10	0.28			0.1
	1.64	0.41			0.4
	2.00	0.50			1.0
	2.32	0.58			2.0
	2.83	0.71			5.0
	3.30	0.83			10.0
	3.87	0.97			20.0
4532	0.80	0.20			0.1
	1.30	0.33			0.4
	1.60	0.40			1.0
	1.86	0.47			2.0
	2.30	0.58			5.0
	2.70	0.68			10.0
	3.21	0.80			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1142 PAGE NO. 29 DATE 5/9/69 MATERIAL TUNGSTEN - 2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION A.G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY TENSILE CREEP STRENGTH IN 75 MINUTES

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE	% CREEP COMMENTS
4000	1.22	0.31			0.1
	1.66	0.42			0.4
	1.97	0.49			1.0
	2.29	0.57			2.0
	2.78	0.70			5.0
	3.20	0.80			10.0
	3.76	0.94			20.0
4260	0.88	0.22			0.1
	1.31	0.33			0.4
	1.60	0.40			1.0
	1.85	0.46			2.0
	2.26	0.57			5.0
	2.64	0.66			10.0
	3.10	0.78			20.0
4532	0.64	0.16			0.1
	1.04	0.26			0.4
	1.27	0.32			1.0
	1.48	0.37			2.0
	1.84	0.46			5.0
	2.16	0.54			10.0
	2.57	0.64			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 124L PAGE NO. 30 DATE 5/9/69 MATERIAL TUNGSTEN-2% THORIA

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION W. G.

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY COMPRESSIVE CREEP STRENGTH IN 75 MINUTES

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	% CREEP —————
4000	1.67	0.42			0.1
	2.29	0.57			0.4
	2.71	0.68			1.0
	3.15	0.79			2.0
	3.82	0.96			5.0
	4.40	1.10			10.0
4260	5.17	1.29			20.0
	1.21	0.30			0.1
	1.80	0.45			0.4
	2.20	0.55			1.0
	2.55	0.64			2.0
	3.11	0.78			5.0
4532	3.63	0.91			10.0
	4.25	1.06			20.0
	0.88	0.22			0.1
	1.43	0.26			0.4
	1.76	0.44			1.0
	2.05	0.57			2.0
	2.53	0.63			5.0
	2.97	0.74			10.0
	3.53	0.88			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

 DRM 1242 PAGE NO. 31 DATE 5/7/69 MATERIAL TUNGSTEN-2% THORIA

 CVD THIN SHEETS
 CONDITION TUBE-ANNEALED DIRECTION A.G.
SPEC. NOS. —
 DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

No EFFECT DUE TO IRRADIATION

PROPERTY COMPRESSIVE CREEP STRENGTH IN 75 MIN.

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	% CREEP
4000	1.82	0.46			0.1
	1.50	0.63			0.4
	3.07	0.77			1.6
	3.43	0.86			2.0
	4.16	1.04			5.0
	4.80	1.20			10.0
	5.63	1.41			20.0
4260	1.32	0.33			0.1
	1.97	0.49			0.4
	1.40	0.60			1.0
	1.78	0.70			2.0
	3.39	0.83			5.0
	3.96	0.99			10.0
	4.64	1.16			20.0
4532	0.96	0.24			0.1
	1.56	0.44			0.4
	1.92	0.48			1.0
	2.23	0.56			2.0
	2.76	0.69			5.0
	3.24	0.81			10.0
	3.85	0.96			20.0

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 32 DATE 5/9/68 MATERIAL TUNGSTEN-2% THORIACVD Thin Sheet
CONDITION TUBE-ANNEALED DIRECTION W & RSPEC. NOS. —DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

No EFFECT DUE TO IRRADIATION

PROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	$10^{-6} \text{ in/in/}^\circ\text{F}$ $\bar{X}_i$	S	N	COMPUTED VALUE,	COMMENTS
-320	2.32	0.10			
68	2.38	0.10			
1000	2.53	0.10			
2000	2.71	0.11			
3000	2.89	0.12			
4000	3.11	0.13			
5000	3.40	0.15			
5500	3.60	0.16			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 33 DATE 5/9/69 MATERIAL TUNGSTEN-2% THORIA

CONDITION CVD THIN SHEET & TUBE-ANNEALED DIRECTION WG & AG

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	$\frac{BTU \cdot FT}{HR \cdot FT^2 \cdot ^\circ F}$ $\bar{K}$	S	N	COMPUTED VALUE,	COMMENTS
-320	150.0	14.0			
-300	120.0	13.0			
-270	125.0	12.0			
-220	110.0	10.0			
-150	104.0	9.0			
-50	97.5	7.0			
68	92.0	5.0			
200	87.0	4.0			
500	78.9	3.0			
750	74.8	3.0			
1000	72.5	3.0			
1000	65.5	3.0			
1500	62.0	3.0			
3500	58.0	4.0			
4500	56.0	5.0			
5500	54.0	6.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 34 DATE 5/9/69 MATERIAL TUNGSTEN - 2% THORIA

CVD THIN SHEET &

CONDITION TUBE-ANNEALED DIRECTION WG & AG

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{18} \text{ N/cm}^2$ ($E > 1 \text{ MeV}$) - $4 \times 10^{17} \text{ N/cm}^2$ ($E < .4 \text{ MeV}$)

PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	RTU-57/102- FT-02 $\bar{X}_1$	S	N	COMPUTED VALUE,	COMMENTS
-320	135.0	15.0			
-300	121.5	13.0			
-270	112.5	12.0			
-220	99.0	10.0			
-150	93.6	9.0			
-50	87.3	7.0			
68	82.8	5.0			
200	79.3	4.0			
500	77.0	3.0			
750	72.1	3.0			
1000	69.9	3.0			
1500	65.5	3.0			
2000	65.5	3.0			
2500	62.0	3.0			
3500	58.0	4.0			
4500	56.0	5.0			
5500	54.0	6.0			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 30 DATE 5/9/69 MATERIAL TUNGSTEN - 2% Thoria

CONDITION CVD THIN SHEET & TUBE - ANNEALED DIRECTION WG & AG

SPEC. NO. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY SPECIFIC HEAT

TEMP., °F	$\bar{X}$, BTU/LB-°F	S	N	COMPUTED VALUE,	COMMENTS
-320	0.0290	0.0005			
0	0.0328	0.0005			
68	0.0333	0.0005			
250	0.0344	0.0005			
400	0.0348	0.0005			
1000	0.0361	0.0006			
2500	0.0394	0.0007			
3000	0.0408	0.0008			
4000	0.0432	0.0020			
5500	0.0488	0.0030			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1242 PAGE NO. 36 DATE 5/9/69 MATERIAL Tungsten-2% Thoria

CONDITION CVD Thin Sheet & Tube-Annealed DIRECTION WG & AG

SPEC. NOS. —

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY DENSITY

TEMP., °F.	$\bar{x}$, lb/in ³	S	N	COMPUTED VALUE,	COMMENTS
68	0.689	0.001			
1000	0.684	0.002			
2000	0.679	0.003			
3000	0.672	0.003			
4000	0.665	0.004			
5000	0.657	0.004			
5500	0.652	0.005			

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~~RESTRICTED DATA~~
ATOMIC ENERGY ACT
OF 1954

DATA RELEASE MEMORANDUM

Westinghouse Astronuclear Laboratory

CODE IDENT NO. 14683

SHEET 1 OF 43

DRM NO
51243

REV (1)

DRM TYPE (13)
ESTIMATED DATA

DEPARTMENT (13)
MATERIALS

DATE (6)
5/20/69

REACTOR

SUBJECT (120)

NBC/GRAPHITE Composite - Estimated MATERIALS PROPERTIES DATA

PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1. <u>CCOM-221</u>							1. 2.
2.							3. 4.
3.							5. 6.

DOCUMENT REFERENCES

(DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)

1. <u>POS 30106-3</u>	2.	3.	4.	5.
6.	7.	8.	9.	10.

1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)

- 1) PROVIDE PRELIMINARY ESTIMATES OF MATERIALS PROPERTIES DATA FOR REACTOR ENGINEERING USE.
- 2) ESTIMATES BASED ON EXISTING TEST DATA, COMPARISON WITH SIMILAR MATERIALS, OR ON MATERIALS ENGINEER'S EXPERIENCE
- 3) NOT APPLICABLE

~~GROUP 1~~

EXCLUDED FROM AUTOMATIC DOWNGRADING
AND DECLASSIFICATION

APPROVALS

R.L. SHOLLENBERGER 5/20/69
PREPARED BY DATE
F.F. Jones 5/21/69
APPROVED BY DATE

INFORMATION CATEGORY

UNCL 5/26/70
CRD
CLASSIFICATION
R. Shollenberger 5/20/69
AUTHORIZED CLASSIFIER DATE

SECURITY CLASS

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ATOMIC ENERGY ACT
OF 1954

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~~RESTRICTED DATA~~
ATOMIC ENERGY ACT
OF 1954

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 2 DATE 5/14/68 MATERIAL Composite NBC/Graphite

CONDITION Post-Pressed Billet DIRECTION W.G.

SPEC. NOS. PDS 30106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{x}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
68	9.10	0.9			
3550	9.10	1.4			
3750	8.90	1.1			
3900	8.60	1.0			
4100	7.93	0.9			
4350	6.70	0.7			
4532	6.10	0.6			

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OF 1954

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~~RESTRICTED DATA~~
ATOMIC ENERGY ACT

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 3 DATE 5/18/68 MATERIAL NbC/graphite composite

CONDITION Post-pressed Billet DIRECTION W.G.

SPEC. NOS. PDS 30106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{14} N/CM² ($E > 1.0$ MeV) + 4×10^{17} N/CM² ($E < .40$ eV)

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}, KSI$	S	N	COMPUTED VALUE,	COMMENTS
68	10.00	0.9			
1000	10.00	1.0			
1075	9.90	1.0			
1200	9.22	1.1			
1250	9.10	1.1			
3550	9.10	1.2			
3750	8.90	1.1			
3900	8.60	1.0			
4100	7.93	0.9			
4350	6.70	0.7			
4532	6.10	0.6			

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~~RESTRICTED DATA~~
ATOMIC ENERGY ACT

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~~RESTRICTED DATA~~

~~ATOMIC ENERGY ACT~~
~~OF 1954~~

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1L43 PAGE NO. 4 DATE 5/14/69 MATERIAL NbC/graphite composite

CONDITION Post-pressed Billet DIRECTION A. G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{x}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
6 F	3.80	0.8			
3550	3.80	0.8			
4250	3.75	0.7			
4350	3.70	0.7			
4512	3.30	0.7			

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~~ATOMIC ENERGY ACT~~
~~OF 1954~~

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~~RESTRICTED DATA~~

~~ATOMIC ENERGY ACT~~
~~OF 1954~~

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 5 DATE 5/14/69 MATERIAL NbC/GRAPHITE Composite

CONDITION Post-pressed Billet DIRECTION A.G.

SPEC. NOS. PDS 30106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{18} \text{ n/cm}^2$ ($E > 1 \text{ MeV}$) $\times 4 \times 10^{17} \text{ n/cm}^2$ ($E < 1 \text{ MeV}$)

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
68	4.20	0.8			
1000	4.20	0.8			
1100	4.00	0.8			
1150	3.90	0.8			
1250	3.80	0.8			
3550	3.80	0.8			
4250	3.75	0.7			
4350	3.70	0.7			
4552	3.30	0.7			

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WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 6 DATE 5/14/67 MATERIAL NbC/GRAPHITE Composite

CONDITION Hot-pressed Billet DIRECTION W.G.

SPEC. NOS. PDS 30106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

PROPERTY FLEXURE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
68	15.00	1.5			
1750	15.86	1.6			
2000	15.80	1.6			
2100	15.70	1.6			
2200	15.60	1.6			
2500	15.00	1.6			
2600	14.85	1.6			
2700	14.80	1.6			
2850	14.90	1.6			
3000	15.15	1.7			
3125	15.45	1.7			
3250	15.80	1.7			
3350	16.50	1.7			
3450	17.15	1.7			
3500	17.30	1.7			
3550	17.25	1.7			
3600	17.10	1.7			
3650	16.90	1.7			
4532	9.70	1.2			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 7 DATE 5/14/69 MATERIAL NBC/GRAPHITE Composite

CONDITION POST-PRESSED BILLET DIRECTION W. G.

SPEC. NOS. POS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{18} \text{ N/GM}^2$ ($E > 1 \text{ MeV}$) + $4 \times 10^{18} \text{ N/GM}^2$ ($E < .4 \text{ MeV}$)

PROPERTY FLEXURE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
68	16.00	1.5			
1000	17.00	1.5			
1050	16.94	1.5			
1100	16.70	1.5			
1125	16.50	1.5			
1150	15.95	1.5			
1175	15.74	1.5			
1200	15.63	1.5			
1250	15.60	1.5			
1750	15.76	1.6			
2000	15.80	1.6			
2100	15.70	1.6			
2200	15.60	1.6			
2500	15.00	1.6			
2600	14.85	1.6			
2700	14.80	1.6			
2850	14.90	1.6			
3000	15.15	1.7			
3125	15.45	1.7			
3250	15.80	1.7			
3350	16.50	1.7			
3450	17.15	1.7			
3500	17.50	1.7			
3550	17.25	1.7			
3600	17.10	1.7			
3650	16.90	1.7			
4052	9.70	1.2			

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DRM 1143 PAGE NO. 8 DATE 5/19/67 MATERIAL NbC/GRAPHITE Composite

CONDITION Hot-Pressed Billet DIRECTION A.G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY FLEXURE STRENGTH

TEMP., °F	$\bar{x}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
68	8.00	0.8			
2000	7.70	0.8			
2250	7.41	0.8			
2500	7.20	0.8			
2700	7.20	0.8			
2800	7.32	0.9			
3000	7.75	1.0			
3100	8.06	1.0			
3300	9.10	1.1			
3500	10.20	1.2			
3600	10.05	1.2			
4552	6.60	1.0			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 9 DATE 5/14/67 MATERIAL NbC/GRAPHITE COMPOSITE

CONDITION POST-PRESSED BILLET DIRECTION A.G.

SPEC. NOS. PDS-30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{14} N/CM² (E > 1 MEV) & 4×10^{17} N/CM² (E < .4 KEV)

PROPERTY FLEXURE STRENGTH

TEMP., °F	$\bar{R}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
68	8.80	0.8			
1000	8.65	0.8			
1050	8.55	0.8			
1100	8.43	0.8			
1200	7.96	0.8			
1250	7.81	0.8			
2000	7.70	0.8			
2250	7.41	0.8			
2500	7.20	0.8			
2700	7.20	0.8			
2800	7.32	0.9			
3000	7.75	1.0			
3100	8.06	1.0			
3300	9.10	1.1			
3500	10.20	1.2			
3600	10.05	1.4			
4532	6.60	1.0			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 11 DATE 5/14/69 MATERIAL NBC/GRAPHITE
Composite

CONDITION POST-PRESSED BILLET DIRECTION W.G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{18} N/cm² (E > 1 MeV) & 4×10^{17} N/cm² (E < .4 MeV)

PROPERTY ULTIMATE COMPRESSIVE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
68	24.50	2.0			
1000	24.50	2.0			
1100	24.10	2.0			
1200	22.80	2.0			
1250	22.40	2.0			
3050	22.40	2.0			
3750	21.90	1.4			
4000	21.70	1.6			
4250	20.03	1.5			
4375	19.00	1.5			
4532	16.50	1.5			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 12 DATE 5/14/69 MATERIAL ABC/GRAPHITE Composite

CONDITION POST-PRESSED BILLET DIRECTION A.G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ULTIMATE COMPRESSIVE TENSILE STRENGTH

TEMP., °F	$\bar{\sigma}$, KSI	S	N	COMPUTED VALUE	COMMENTS
68	28.0	2.0			
3550	28.0	2.0			
3750	27.8	1.8			
4000	28.0	1.6			
4250	25.5	1.5			
4375	24.0	1.5			
4532	20.6	1.5			

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DRM 1243 PAGE NO. 13 DATE 5/15/69 MATERIAL NBC/GRAPHITE Composite

CONDITION POST-PRESSED BULLET DIRECTION A.C.

SPEC. NOS. POS 30105-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{16} \text{ N/cm}^2$ (E < 1 MeV) $\times 4 \times 10^{17} \text{ N/cm}^2$ (E < 4 MeV)

PROPERTY ULTIMATE COMPRESSIVE STRENGTH

TEMP., °F	$\bar{\sigma}$, KSI	S	N	COMPUTED VALUE	COMMENTS
68	30.75	2.0			
1000	30.75	2.0			
1100	30.35	2.0			
1200	29.10	2.0			
1250	28.40	2.0			
1300	28.00	2.0			
3550	28.00	2.0			
3750	27.80	1.8			
4000	28.00	1.6			
4250	25.50	1.5			
4375	24.00	1.5			
4532	20.60	1.5			

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DRM 1243 PAGE NO. 14 DATE 5/14/69 MATERIAL NBC/GRAPHITE Composite

CONDITION POST-PRESSED BILLET DIRECTION W.G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY ULTIMATE SHEAR STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
68	10.10	2.2			
1600	10.10	2.2			
2550	9.90	2.2			
2750	9.25	2.0			
3100	7.00	1.5			
3250	6.11	1.4			
3550	5.00	1.1			
3850	4.20	1.0			
4350	3.50	0.8			

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DRM 1243 PAGE NO. 15 DATE 5/14/69 MATERIAL NBC/GRAPHITE Composite

CONDITION Post-Pressed Billet DIRECTION A.G.

SPEC. NOS. PPJ 30106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

No Effect Due to Irradiation

PROPERTY ULTIMATE SHEAR STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE	COMMENTS
68	12.30	2.8			
1600	12.30	2.8			
1750	12.40	2.8			
2750	10.19	2.6			
3100	9.90	2.2			
3250	9.20	2.1			
3400	9.00	2.0			
3550	8.90	2.0			
3900	8.50	1.8			
4550	7.50	1.7			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1L43 PAGE NO. 16 DATE 5/16/68 MATERIAL nbcr/graphite composite

CONDITION POST-PRESSED BILLET DIRECTION W.G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ELONGATION

TEMP., °F	ϵ , %	S	N	COMPUTED VALUE,	COMMENTS
68	0.15	0.03			
1500	0.17	0.04			
2000	0.18	0.05			
2525	0.20	0.05			
2750	0.23	0.06			
3100	0.30	0.06			
3300	0.37	0.08			
3550	0.50	0.10			
4000	0.80	0.16			
4550	1.15	0.23			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 17 DATE 5/16/68 MATERIAL NBC/Graphite Composite

CONDITION Post-Prepared Billet DIRECTION W. G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

Irradiated: 3×10^{16} N/cm² ($E > 1$ MeV) & 4×10^{17} N/cm² ($E < .4$ eV)

PROPERTY ELONGATION

TEMP., °F	ϵ , %	S	N	COMPUTED VALUE,	COMMENTS
68	0.080	0.01			
1000	0.120	0.03			
1100	0.140	0.03			
1200	0.160	0.04			
1250	0.167	0.04			
1500	0.170	0.04			
2000	0.180	0.05			
2525	0.200	0.05			
2750	0.230	0.06			
3100	0.300	0.06			
3300	0.370	0.08			
3550	0.500	0.10			
4000	0.800	0.16			
4350	1.150	0.23			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 17 DATE 5/15/69 MATERIAL NbC/Graphite Composite

CONDITION POST-PRESSED BILLET DIRECTION A.G.

SPEC. NOS. POS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{14} \text{ N/GM}^2 (E > 1 \text{ MeV}) + 4 \times 10^{17} \text{ N/GM}^2 (E < 4 \text{ FeV})$

PROPERTY ELONGATION

TEMP., °F	$\bar{\epsilon}$, %	S	N	COMPUTED VALUE,	COMMENTS
68	0.080	0.01			
1000	0.120	0.03			
1100	0.140	0.03			
1200	0.150	0.04			
1250	0.167	0.04			
1500	0.170	0.04			
2000	0.180	0.05			
2520	0.200	0.05			
2700	0.210	0.05			
3100	0.250	0.05			
3320	0.290	0.06			
3550	0.300	0.07			
4000	0.514	0.10			
4350	0.700	0.14			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 18 DATE 5/18/69 MATERIAL NBC/GRAPHITE COMPOSITE

CONDITION POST-PRESSED PILLLET DIRECTION A. G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ELONGATION

TEMP., °F	$\bar{\epsilon}$, %	S	N	COMPUTED VALUE,	COMMENTS
68	0.150	0.03			
1500	0.170	0.04			
2000	0.180	0.05			
2525	0.200	0.05			
2750	0.210	0.06			
3100	0.250	0.05			
3325	0.290	0.06			
3550	0.350	0.07			
4000	0.515	0.10			
4350	0.700	0.14			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 18 DATE 5/16/69 MATERIAL NbC/graphite composite

CONDITION POST-PRESSED BILLET DIRECTION W.G.

SPEC. NOS. PDS-30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY Modulus of Elasticity in Tension

TEMP., °F	$\bar{E}$, 10 ⁶ PSI	S	N	COMPUTED VALUE,	COMMENTS
68	11.10	1.3			
3500	11.10	1.3			
3600	10.96	1.2			
3700	10.58	1.1			
3775	9.80	1.0			
3850	7.00	0.9			
3900	6.00	0.8			
4000	4.69	0.7			
4100	3.93	0.6			
4200	3.50	0.5			
4300	3.07	0.4			
4532	2.70	0.4			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 19 DATE 5/15/59 MATERIAL NBC/Graphite Composite

CONDITION Post-Pressed Billet DIRECTION W. G.

SPEC. NOS. PDS 30106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{18} \text{ n/cm}^2$ ($E > 1 \text{ MeV}$) + $4 \times 10^{17} \text{ n/cm}^2$ ($E < .4 \text{ MeV}$)

PROPERTY Modulus of Elasticity in Tension

TEMP., °F	$\bar{\epsilon}, 10^6 \text{ psi}$	S	N	COMPUTED VALUE,	COMMENTS
68	16.65	1.3			
500	16.65	1.3			
600	16.10	1.3			
1000	13.88	1.3			
1250	11.88	1.3			
1350	11.45	1.3			
1425	11.30	1.3			
1500	11.20	1.3			
1600	11.10	1.3			
3500	11.10	1.3			
3600	10.96	1.2			
3700	10.58	1.1			
3775	9.40	1.0			
3850	7.00	0.9			
3900	6.00	0.8			
4000	4.67	0.7			
4100	3.93	0.6			
4200	3.50	0.5			
4350	3.07	0.4			
4532	2.70	0.4			

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DRM 1243 PAGE NO. 20 DATE 5/16/69 MATERIAL NBC/GRAPHITE Composite

CONDITION POST-PRESSED RIBLET DIRECTION A. G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY Modulus of ELASTICITY in TENSION
Compression

TEMP., °F	$\times 10^6$ PSI	S	N	COMPUTED VALUE,	COMMENTS
68	2.9	0.5			
3500	2.9	0.5			
3750	2.7	0.5			
4350	1.6	0.4			
4532	1.4	0.4			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 21 DATE 5/16/68 MATERIAL NbC/Graphite Composite

CONDITION Post-pressed Billet DIRECTION A.G.

SPEC. NOS. PDS 30106-3

DATA BASIS Estimated COMMENTS Preliminary Data

IRRADIATED: 3×10^{14} N/cm² ($E > 1$ MeV) & 4×10^{17} N/cm² ($E < 40$ eV)

PROPERTY Modulus of Elasticity in Tension

TEMP., °F	$\bar{\epsilon}, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
68	4.35	0.5			
750	3.95	0.5			
800	3.90	0.5			
1250	3.15	0.5			
1350	3.00	0.5			
1400	2.95	0.5			
1500	2.90	0.5			
3500	2.90	0.5			
3750	2.70	0.5			
4350	1.60	0.4			
4532	1.40	0.4			

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DRM 1243 PAGE NO. 22 DATE 5/16/69 MATERIAL NBC/GRAPHITE Composite

SPEC. NOS. PJ550106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY Modulus of Elasticity in Compression

TEMP., °F	$\bar{x}, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
68	13.0	1.8			
3100	7.2	1.2			
3500	6.5	1.1			
4350	4.6	1.0			
4532	4.3	0.9			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 23 DATE 5/16/69 MATERIAL NbC/Graphite Composite

CONDITION Post-Pressed Billet DIRECTION W.G.

SPEC. NOS. PDS 20106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

Irradiated: 3×10^{18} N/cm² ($E > 1 \text{ MeV}$) 4×10^{17} N/cm² ($E < 1 \text{ MeV}$)

PROPERTY Modulus of Elasticity in Compression

TEMP., °F	$\times 10^6$ PSI	S	N	COMPUTED VALUE,	COMMENTS
68	19.5	1.8			
500	18.2	1.7			
1000	13.8	1.6			
1100	12.3	1.6			
1200	11.3	1.5			
1300	10.8	1.5			
1400	10.4	1.4			
1500	10.2	1.3			
3100	7.2	1.2			
3500	6.5	1.1			
4350	4.6	1.0			
4532	4.3	0.9			

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PROPERTY Modulus of Elasticity in Compression

TEMP., °F	$\bar{x}, 10^6 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
68	6.0	0.6			
3100	3.3	0.4			
3000	3.0	0.4			
4350	2.1	0.3			
4532	2.0	0.3			

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DRM 1243 PAGE NO. 25 DATE 10/16/69 MATERIAL NBC/GRAPHITE Composite

CONDITION POST-PRESSED BILLET DIRECTION A.G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{14} \text{ N/CM}^2 (E > 1.0 \text{ MeV})$ & $4 \times 10^{17} \text{ N/CM}^2 (E < .4 \text{ MeV})$

PROPERTY Modulus of Elasticity in Compression

TEMP., °F	$\times 10^5 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
68	9.00	0.6			
250	8.90	0.6			
500	8.55	0.6			
750	7.93	0.6			
850	7.55	0.5			
1000	6.64	0.5			
1100	6.00	0.5			
1200	5.58	0.5			
1300	5.27	0.5			
1500	4.86	0.5			
3100	3.30	0.4			
3500	3.00	0.4			
4350	2.10	0.3			
4532	1.00	0.3			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 27 DATE 1/20/67 MATERIAL NiC/graphite composite

CONDITION Post-Irradiated Billet DIRECTION WG. & A.G.

SPEC. NOS. P0530106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

IRRADIATED: $3 \times 10^{18} \text{ n/cm}^2 (E > 1 \text{ MeV}) \leftarrow 4 \times 10^{17} \text{ n/cm}^2 (E < 4 \text{ eV})$

PROPERTY POISSON'S RATIO

TEMP., °F	$\bar{\epsilon}_t$	S	N	COMPUTED VALUE,	COMMENTS
68	0.300	0.02			
250	0.298				
500	0.282				
1000	0.223				
1250	0.191				
1500	0.175				
3100	0.150				
4350	0.130				

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WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 ~~1143~~ ~~A~~ PAGE NO. 28 DATE 4/10/69 MATERIAL NBC/GRAPHITE Composite

CONDITION POST-PRESSED BILLET DIRECTION W. G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY COMPRESSIVE CREEP STRENGTH IN 75 MINUTES

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
<u>10^{-2} IN/IN STRAIN</u>					
4030	1.90	0.05			
4260	1.90	0.20			
4350	1.83	0.28			
4450	1.70	0.40			
4532	1.55	0.55			
<u>5×10^{-4} IN/IN STRAIN</u>					
4030	6.05	0.05			
4260	5.10	0.36			
4532	3.72	0.67			

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-CP 1954

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MATERIALS DEPARTMENT DATA RELEASE

1243
DRM ~~11111~~ PAGE NO. 29 DATE 9/20/69 MATERIAL NBC/GRAPHITE Composite

CONDITION Post-pressed Billet DIRECTION A.G.

SPEC. NOS. PPS 30105-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

No Effect Due To Irradiation

PROPERTY Compressive Creep Strength for 75 minutes

TEMP., °F	$\bar{\epsilon}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
<u>10⁻⁴ IN/IN STRAIN</u>					
4030	6.05	0.05			
4260	6.00	0.20			
4532	5.20	0.70			
<u>10⁻² IN/IN STRAIN</u>					
4030	1.92	0.05			
4260	1.90	0.05			
4532	1.90	0.09			

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MATERIALS DEPARTMENT DATA RELEASE

1243
DRM ~~1243~~ PAGE NO. 30 DATE 9/10/69 MATERIAL ~~Composite~~ ^{WBC/graphite}

CONDITION POST-HEATED BILLET DIRECTION W.G. & A.G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY TENSILE CREEP STRENGTH IN 75 MINUTES

TEMP., °F	$\bar{\epsilon}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
STRA					
<u>10⁻² IN/IN STRAIN</u>					
4030	1.32	0.20			
4200	0.95	0.10			
4352	0.73	0.08			
4425	0.58	0.03			
4532	0.50	0.05			
<u>5x10⁻⁴ IN/IN STRAIN</u>					
4030	3.55	0.50			
4200	2.74	0.43			
4352	2.10	0.33			
4425	1.87	0.29			
4532	1.61	0.26			
<u>10⁻³ IN/IN STRAIN</u>					
4030	4.90	0.65			
4352	3.16	0.50			
4425	2.76	0.36			
4532	2.52	0.42			

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WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 31 DATE 5/2/69 MATERIAL ABC/GRAPHITE
Composite

CONDITION POST-HEATED BILLET DIRECTION W.O.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY FATIGUE STRENGTH, 30 CYCLES

TEMP., °	$\bar{X}$	S	N	COMPUTED VALUE,	COMMENTS
68	8.20	0.9			STRESS APPLIED FOR 10 SEC. PER CYCLE
1600	7.33	1.1			
2500	6.97	1.2			
3100	6.80	1.3			
3550	6.80	1.2			
3650	6.70	1.0			
4150	5.00	0.7			
4532	4.60	0.6			

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WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 32 DATE 5/10/68 MATERIAL ABC/GRAPHITE COMPOSITE

CONDITION POST-PRESSED BILLET DIRECTION W. O.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{14} N/cm² (E > 1 MeV) & 4×10^{17} N/cm² (E < .4 MeV)

PROPERTY FATIGUE STRENGTH, 10 CYCLES

TEMP., °	$\bar{x}$	S	N	COMPUTED VALUE,	COMMENTS
68	9.24	0.9			STRESS APPLIED FOR 10 SECS. PER CYCLE
1000	8.40	1.0			
1050	8.32	1.0			
1100	8.12	1.0			
1175	7.70	1.0			
1250	7.50	1.1			
1600	7.33	1.1			
2500	6.97	1.2			
3100	6.80	1.3			
3550	6.80	1.4			
3650	6.70	1.0			
4350	5.00	0.7			
4532	4.60	0.6			

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WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1L43 PAGE NO. 33 DATE 5/20/68 MATERIAL nick/graphite composite

CONDITION Hot-Pressed Billet DIRECTION A.G.

SPEC. NOS. PDJ 30106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

PROPERTY FATIGUE STRENGTH, 30 CYCLES

TEMP., °	$\bar{X}$	S	N	COMPUTED VALUE,	COMMENTS
68	3.4	0.5			STRESS APPLIED FOR 10 SEC PER CYCLE
3100	2.7	0.5			
3550	2.9	0.5			
4350	2.8	0.5			
4425	2.7	0.4			
4522	2.5	0.4			

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WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 34 DATE 5/20/68 MATERIAL NBC/GRAPHITE composite

CONDITION POST-PRESSED BILLET DIRECTION A. G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{14} N/GM² (E > 1 MEV) & 4×10^{17} N/GM² (E < .4 MEV)

PROPERTY FATIGUE STRENGTH, 30 CYCLES

TEMP., °	$\bar{X}$	S	N	COMPUTED VALUE	COMMENTS
68	3.74	0.5			STRESS APPLIED FOR 10 SEC PER CYCLE
1000	3.52	0.5			
1100	3.33	0.5			
1150	3.20	0.5			
1200	3.14	0.5			
3100	2.90	0.5			
3550	2.90	0.5			
4350	2.80	0.5			
4425	2.70	0.4			
4532	2.50	0.4			

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WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 50 DATE 5/20/68 MATERIAL NbC/Graphite Composite

CONDITION Post-pressed Billet DIRECTION W. G.

SPEC. NOS. PDS 30106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

No Effect due to Irradiation

PROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	$10^{-6} \Delta L / L \Delta T$ $\bar{x}$	S	N	COMPUTED VALUE,	COMMENTS
68	2.80	0.3			
400	3.17	0.3			
1000	3.57	0.3			
1500	3.78	0.3			
2250	3.94	0.2			
3000	3.98	0.2			
3500	4.02	0.2			
4000	4.06	0.2			
4300	4.10	0.2			
4400	4.09	0.2			
4532	4.04	0.2			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 36 DATE 5/20/69 MATERIAL ABC/GRAPHITE
COMPOSITE

CONDITION POST-PRESSED BILLET DIRECTION A.G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	10^{-6} IN/IN-°F $\bar{\alpha}$	S	N	COMPUTED VALUE,	COMMENTS
68	3.00	0.21			
750	3.58	0.24			
1500	3.91	0.27			
2250	4.10	0.28			
3000	4.18	0.29			
3500	4.30	0.30			
4000	4.46	0.31			
4300	4.66	0.33			
4532	5.00	0.35			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 37 DATE 5/20/67 MATERIAL NbC/GRAPHITE
Composite

CONDITION Part-Pressed Billet DIRECTION W. G.

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	B70-44/62- FT ² -°F X _i	S	N	COMPUTED VALUE,	COMMENTS
68	70.0	4.9			
300	63.0	4.4			
500	58.3	4.1			
1000	48.6	3.5			
1500	42.0	2.9			
2000	38.0	2.6			
2500	35.0	2.4			
3000	32.7	2.4			
3500	31.5	2.2			
4000	30.5	2.1			
4500	29.8	2.1			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 38 DATE 5/20/69 MATERIAL NBC/graphite Composite

CONDITION Post-pressed Billet DIRECTION W. G.

SPEC. NOS. PDS 30106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA
IRRADIATED: 3×10^{14} N/cm² ($E > 1$ MeV) + 4×10^{13} N/cm² ($E < .4$ MeV)

PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	BTU-FT/HR- IN ² -°F K	S	N	COMPUTED VALUE,	COMMENTS
68	44.0	4.9			
250	45.4	4.4			
500	47.0	4.1			
600	47.0	4.0			
750	46.5	3.9			
1000	45.0	3.5			
1350	43.1	3.2			
1500	42.0	2.9			
2000	38.0	2.6			
2500	35.0	2.4			
3000	32.7	2.4			
3500	31.5	2.2			
4000	30.5	2.1			
4500	29.8	2.1			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 39 DATE 5/20/69 MATERIAL NbC/GRAPHITE Composite

CONDITION POST-PRESSED BILLET DIRECTION A.G.

SPEC. NOS. PDJ 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	DTU-VT/12- PTV-08 X ₁	S	N	COMPUTED VALUE,	COMMENTS
68	32.0	4.8			
150	27.5	4.2			
300	24.4	3.6			
500	21.4	3.4			
750	18.9	3.0			
1000	17.2	2.6			
1250	16.1	2.5			
1500	15.5	2.4			
2000	15.0	2.1			
3000	13.9	2.0			
4000	13.2	1.9			
4500	13.0	1.9			

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WESTINGHOUSE ASTRONUCLEAR LABORATORY
 MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 40 DATE 5/20/69 MATERIAL NbC/graphite composite

CONDITION Hot-pressed Billet DIRECTION A. G.

SPEC. NOS. PDJ 30106-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

IRRADIATED: 3×10^{14} N/GM² (E > 1 Mev) & 4×10^{17} N/GM² (E < 40 eV)

PROPERTY Thermal Conductivity

TEMP., °F	RTU-4T/4R- ATL-02 X _i	S	N	COMPUTED VALUE,	COMMENTS
68	19.3	4.8			
500	17.1	3.4			
1000	15.7	2.6			
1500	14.5	2.4			
2000	15.0	2.1			
3000	13.9	2.0			
4000	13.2	1.9			
4500	13.0	1.9			

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WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 41 DATE 5/20/68 MATERIAL nb C/graphite Composite

CONDITION Part-Treated Billet DIRECTION WG & AG

SPEC. NOS. PD 530105-3

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

No Effect due to irradiation

PROPERTY Specific HEAT

TEMP., °F	$\bar{x}, BTU/LB \cdot ^\circ F$	S	N	COMPUTED VALUE,	COMMENTS
68	0.105	0.0006			
150	0.122	0.0008			
300	0.140	0.0010			
500	0.157	0.0012			
750	0.172	0.0014			
1000	0.183	0.0016			
1500	0.196	0.0018			
2000	0.206	0.0019			
3000	0.222	0.0020			
4000	0.232	0.0022			
4532	0.234	0.0023			

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WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 PAGE NO. 42 DATE 5/20/67 MATERIAL NBC/GRAPHITE Composite

CONDITION POST-PRESSED BILLET DIRECTION WF & AG

SPEC. NOS. PDJ 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY DENSITY

TEMP., °F	$\frac{g}{cm^3}$	S	N	COMPUTED VALUE,	COMMENTS
68	0.1693	0.0012			
1500	0.1661	0.0014			
3000	0.1632	0.0018			
3500	0.1621	0.0019			
4000	0.1608	0.0020			
4532	0.1595	0.0021			

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DATA RELEASE MEMORANDUM

Westinghouse Astronuclear Laboratory

CODE IDENT NO. 14683

SHEET 1 OF 2

DRM NO
51243

REV (1)
A

DRM TYPE (13)
ESTIMATED DATA

DEPARTMENT (13)
MATERIAL

DATE (6)
6/25/69

REACTOR

SUBJECT (120)

NBC/GRAPHITE - ESTIMATED MATERIAL
PROPERTIES DATA

PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1. <u>80</u>						<u>RODA-LL1</u>	1. 2.
2.							3. 4.
3.							5. 6.

DOCUMENT REFERENCES

(DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)

1. <u>PDS-30106-3</u>	2.	3.	4.	5.
6.	7.	8.	9.	10.

1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)

- 1) PROVIDE PRELIMINARY ESTIMATES OF FRACTURE TOUGHNESS FOR REACTOR ENGINEERING USE.
- 2) ESTIMATES OF K_{Ic} WERE BASED ON PRELIMINARY WANA DATA, WOL SPECIMEN, AND G_{Ic} WAS CALCULATED FROM K_{Ic}
- 3) THESE DATA ARE IN ADDITION TO DATA SUBMITTED IN THE ORIGINAL DRM DATED 5/20/69

~~GROUP 1~~

~~EXCLUDED FROM AUTOMATIC DOWNGRADING AND DECLASSIFICATION~~

APPROVALS

N. Shalla Buge 6/25/69
PREPARED BY DATE
R.H. Singleton 7/1/69
APPROVED BY DATE

INFORMATION CATEGORY

UNCL.
C-RD NR 6/25/69
CLASSIFICATION
N. Shalla Buge 6/25/69
AUTHORIZED CLASSIFIER DATE

SECURITY CLASS

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WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1243 A PAGE NO. 44 DATE 6/25/68 MATERIAL Nbc/Graphite Composite

CONDITION Part-Pressed Billet DIRECTION SEE BELOW

SPEC. NOS. PDS 30106-3

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY FRACTURE TOUGHNESS

TEMP., °F	$\bar{X}$	S	N	COMPUTED VALUE,	COMMENTS
<u>W.G.</u>					
68	5.0 KSI $\sqrt{IN}$	0.75			K _{IC}
68	2.1 LB/IN.	0.33			G _{IC}
<u>A.G.</u>					
68	2.7 KSI $\sqrt{IN}$	0.40			K _{IC}
68	2.4 LB/IN	0.36			G _{IC}

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ATOMIC ENERGY ACT

OF 1954

SECURITY CLASS		DATA RELEASE MEMORANDUM Westinghouse Astronuclear Laboratory CODE IDENT NO. 14683				DRM NO 51244	REV (1)
SUBJECT (120) PYROFOIL, LAMINATED - ESTIMATED MATERIALS PROPERTIES DATA						DRM TYPE (13) ESTIMATED DATA	
						DEPARTMENT (13) MATERIALS	
						DATE (6) 5/22/69	REACTOR
PARA NO	CEI	PARA NO	CEI	PARA NO	CEI	TEST SCOPE NO	DATA ITEM
1. M640M-124							1. 2.
2. E30M-259							3. 4.
3.							5. 6.
DOCUMENT REFERENCES (DWGNO/PART NO/COMPUTER CODES/DRMS/MTLS SPECS/CORRESPONDENCE)							
1. PDS 30097-1	2.	3.	4.	5.			
6. PDS 30181-1	7.	8.	9.	10.			
1. PURPOSE 2. ASSUMPTIONS/METHODS 3. CONCLUSIONS (USE CONTINUATION SHEET IF NECESSARY)							
1) PROVIDE PRELIMINARY ESTIMATES OF MATERIALS PROPERTIES DATA FOR REACTOR ENGINEERING USE.							
2) ESTIMATES ARE BASED ON EXISTING TEST DATA, COMPARISON WITH SIMILAR MATERIALS, OR ON MATERIALS ENGINEER'S EXPERIENCE.							
3) NOT APPLICABLE							
APPROVALS R.L. SHOLLENBERGER 5/22/69 PREPARED BY DATE L.J. JENSEN 5/26/69 APPROVED BY DATE				INFORMATION CATEGORY UNCLASSIFIED CLASSIFICATION AUTHORIZED CLASSIFIER 5/24/69 DATE		SECURITY CLASS	

DRM 1244 PAGE NO. 2 DATE 5/20/68 MATERIAL Pyro Tech

SPEC. NOS. PDS 30097-1 Mfgd from PDS 30102-2 TAPE,
0.0005" THK.

DATA BASIS	COMMENTS
ESTIMATED	PRELIMINARY DATA

PROPERTY DENSITY

TEMP., °F	$\bar{x}$, LB/IN ²	S	N	COMPUTED VALUE,	COMMENTS
75	0.042	0.002			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 3 DATE 5/20/69 MATERIAL PYRITIC

CONDITION Laminated DIRECTION a-b

SPEC. NOS. PDS 30097-1 Mfg'd from PDS 30142-2 TAPE, 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
70	1.065	0.090			
1000	1.080	0.110			
2000	1.110	0.112			
3000	1.140	0.116			
3500	1.150	0.134			
4000	1.190	0.151			
4150	1.250	0.166			
4300	1.353	0.181			
4400	1.530	0.196			
4450	1.565	0.211			
4500	1.880	0.226			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 4 DATE 5/20/68 MATERIAL P.Y. foil

CONDITION LAMINATED DIRECTION a-b

PDS 30097-1 MFG'd from PDS 30182-2 TAPE,
SPEC. NOS. 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRADIATED: 6×10^{18} N/GM² ($E > 1$ MeV)

PROPERTY ULTIMATE TENSILE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
70	1.700	0.090			
500	1.600	0.100			
1000	1.450	0.110			
2000	1.220	0.112			
2250	1.180	0.113			
2500	1.160	0.114			
3000	1.140	0.116			
3500	1.150	0.134			
4000	1.190	0.151			
4150	1.250	0.166			
4300	1.353	0.181			
4400	1.530	0.196			
4450	1.565	0.211			
4500	1.840	0.226			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 5 DATE 5/20/69 MATERIAL Pyrofoil

CONDITION LAMINATED DIRECTION a-b

PDS 30097-1 MOD from PDS 30182-2 TAPE,
SPEC. NOS. 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY FLEXURE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS.
70	1.350	0. N			
3000	1.350				
3750	1.375				
4000	1.400				
4100	1.430				
4250	1.502				
4350	1.513				
4425	1.752				
4500	2.000				

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 6 DATE 5/20/69 MATERIAL Pyrofoil

CONDITION Laminated DIRECTION a-b

PDS 30097-1 MOD 500M PDS 30182-2 TAPE,
SPEC. NOS. 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

(IRRADIATED: 6×10^{14} N/CM² ($E > 1$ MEV))

PROPERTY FLEXURE STRENGTH

TEMP., °F	$\bar{X}$, KSI	S	N	COMPUTED VALUE,	COMMENTS
70	2.160	0.15			
300	2.075				
500	1.885				
650	1.675				
800	1.506				
900	1.502				
1000	1.485				
2000	1.485				
2250	1.475				
2500	1.450				
2750	1.385				
3000	1.350				
3750	1.375				
4000	1.400				
4100	1.430				
4250	1.502				
4350	1.513				
4425	1.752				
4500	2.000				

WESTINGHOUSE ASTRONUCLEAR LABORATORY

MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 7 DATE 5/22/69 MATERIAL Pyral fuelCONDITION LAMINATED DIRECTION a-bSPEC. NOS. PDS 30097-1 Mfg'd from PDS 30182-2 TAPE,
0.004" THKDATA BASIS ESTIMATED COMMENTS PRELIMINARY DATAPROPERTY ELONGATION

TEMP., °F	$\bar{\epsilon}$, %	S	N	COMPUTED VALUE,	COMMENTS
70	0.300	0.03			
3000	0.300				
3175	0.310				
3300	0.324				
3500	0.366				
3650	0.433				
3800	0.520				
4000	0.750				
4100	0.832				
4250	0.910				
4500	1.000				

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 5 DATE 5/22/69 MATERIAL PYR-FIL

CONDITION LAMINATED DIRECTION a-b

PDS 30097-1 MFGD FROM PDS 3018 L-2 TAPE,
SPEC. NOS. 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 6x10¹⁸ N/CM² (E > 1 MeV)

PROPERTY ~~ELONGATION~~ ELONGATION

TEMP., °F	$\bar{\epsilon}$, %	S	N	COMPUTED VALUE,	COMMENTS
70	0.015	0.003			
1000	0.015	0.003			
1150	0.029	0.003			
1300	0.050	0.003			
1400	0.080	0.003			
1500	0.130	0.030			
1650	0.240	0.030			
1750	0.270	0.030			
1850	0.290	0.030			
2000	0.300	0.030			
3000	0.300	0.030			
3175	0.310	0.030			
3300	0.324	0.030			
3500	0.366	0.030			
3650	0.433	0.030			
3800	0.520	0.030			
4000	0.750	0.030			
4100	0.832	0.030			
4250	0.910	0.030			
4500	1.000	0.030			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 9 DATE 5/22/68 MATERIAL PYR-12

CONDITION Laminated DIRECTION a-b

PDS 30097-1 mfgd from PDS 30182-2 TAPE,
SPEC. NOS. 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY Modulus of Elasticity in Tension

TEMP., °F	$\bar{E}, 10^5 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS
70	0.51	0.14			
1000	0.52				
2000	0.53				
2150	0.54				
2400	0.57				
2500	0.58				
2750	0.59				
3000	0.60				
3250	0.60				
3500	0.59				
3750	0.57				
4000	0.55				
4500	0.49				

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 10 DATE 5/22/69 MATERIAL Pyrrolite

CONDITION Laminated DIRECTION α - R

PDS 30097-1 MFG'd from PDS 3018L-2 TAPE,

SPEC. NOS. 0.005" THK.

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 6×10^{14} N/CM² (E > 1 MeV)

PROPERTY MODULUS OF ELASTICITY IN TENSION

TEMP., °F	$\bar{E}, 10^5 \text{ PSI}$	S	N	COMPUTED VALUE,	COMMENTS.
70	0.815	0.14			
200	0.810				
300	0.790				
500	0.725				
750	0.630				
900	0.585				
1000	0.570				
1250	0.565				
2500	0.590				
3000	0.600				
3250	0.600				
3500	0.590				
3750	0.570				
4000	0.550				
4500	0.490				

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 11 DATE 5/22/69 MATERIAL Pyrofoil

CONDITION LAMINATED DIRECTION a-b

PDS 30097-1 MFGD FROM PDS 3018 L-2 TAPE,
SPEC. NOS. 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY COMPRESSIVE MODULUS OF ELASTICITY

TEMP., °F	$\bar{x}$, 10 ⁶ PSI	S	N	COMPUTED VALUE,	COMMENTS
70	0.010	0.03	}		
1000	0.010	0.03			
2000	0.040	0.07			
3000	0.054	0.07			
4000	0.050	0.07			
4500	0.042	0.07			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 12 DATE 5/22/69 MATERIAL Pycrofoil

CONDITION LAMINATED DIRECTION a-b

PDS 30097-1 MYGOL from PDS 301FL-L TAPE,
SPEC. NOS. 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

IRRADIATED: 6×10^{14} N/CM² (E > 1 MeV)

PROPERTY COMPRESSIVE MODULUS & ELASTICITY

TEMP., °F	$\bar{\epsilon}, 10^6$ PSI	S	N	COMPUTED VALUE,	COMMENTS
70	0.016	0.03			
500	0.014	0.03			
1000	0.011	0.03			
2000	0.044	0.07			
3000	0.054	0.07			
4000	0.050	0.07			
4500	0.042	0.07			

DRM 1244 PAGE NO. 13 DATE 5/24/68 MATERIAL Pypo foil

PDS 30097-1 mfgd. from PDS 30162-2 TAPE,
SPEC. NOS. 0.005" T/K

No Effect due to Irradiation

PROPERTY COMPRESSIVE CREEP AT 3600°F & 60 PSI

TEMP., TIME, MINUTES	10^3 in/in $\bar{x}_i$	S	N	COMPUTED VALUE,	COMMENTS
5	8	2			
10	16	6			
15	26	8			
20	34	10			
30	50	14			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 14 DATE 5/22/68 MATERIAL Cyrolite

CONDITION Laminated DIRECTION a-b

PDS 30097-1 mfgd from PDS 30182-2 TAPE,
SPEC. NOS. 0.005" THK.

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	$10^{-6} \text{ in/in } ^\circ\text{F}$ $\bar{x}_i$	S	N	COMPUTED VALUE,	COMMENTS
70	-0.77	0.05			
500	-0.35				
1000	-0.09				
2000	0.35				
3000	0.42				
4500	0.42				

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 10 DATE 5/24/69 MATERIAL PyroSeal

CONDITION Laminated DIRECTION C

PDS 30097-1 MPOD. from PDS 30181-2 TAPE,

SPEC. NOS. 0.005" THK

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

No EFFECT DUE TO IRRADIATION

PROPERTY MEAN COEFFICIENT OF LINEAR THERMAL EXPANSION

TEMP., °F	$10^{-6}/10^{-5} F$ $\bar{\alpha}_L$	S	N	COMPUTED VALUE,	COMMENTS
70	10.70	1.1			
1000	13.80	↓			
1500	14.90				
1750	15.25				
2000	15.50				
4500	15.50	↓			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 16 DATE 5/22/68 MATERIAL Pyrofoil

CONDITION Laminated DIRECTION C

SPEC. NOS. PDS30097-1 mfgd from PDS301A2-2 TAPE,
0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY Thermal Conductivity

TEMP., °F	BTU-IN/HR- FT ² -°F $\bar{K}$	S	N	COMPUTED VALUE,	COMMENTS
70	2.40	0.16			
250	2.15	0.24			
500	1.94	0.23			
750	1.80	0.21			
1000	1.70	0.20			
1500	1.57	0.20			
2000	1.50	0.20			
2350	1.48	0.20			
2500	1.49	0.20			
3000	1.60	0.20			
3500	1.83	0.22			
4000	2.20	0.24			
4500	2.70	0.28			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 17 DATE 5/22/67 MATERIAL Pyrofoil

CONDITION Laminated DIRECTION C

PDS 30097-1 Mfg'd from PDS 30152-2 TAPE,
SPEC. NOS. 0.005" THK

DATA BASIS Estimated COMMENTS PRELIMINARY DATA

IRRADIATED: 6×10^{14} N/cm² (E > 1 MeV)

PROPERTY THERMAL CONDUCTIVITY

TEMP., °F	BTU-FT/HR- FT ² -°F $\bar{K}$	S	N	COMPUTED VALUE,	COMMENTS
70	0.120	0.01			
700	1.352	0.14			
800	1.480	0.15			
900	1.520	0.15			
1000	1.530	0.15			
1150	1.520	0.15			
1900	1.350	0.14			
2000	1.340	0.13			
2100	1.340	0.13			
2250	1.350	0.14			
2600	1.450	0.15			
3000	1.600	0.20			
3500	1.830	0.22			
4000	2.200	0.24			
4500	2.700	0.28			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 18 DATE 5/22/68 MATERIAL Pylon for 2

CONDITION LAMINATED DIRECTION —

PDS 30097-1 Mtd from PDS 3018L-2 TAPE,
SPEC. NOS. 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

NO EFFECT DUE TO IRRADIATION

PROPERTY SPECIFIC HEAT

TEMP., °F	$\bar{x}, BTU/LB \cdot ^\circ F$	S	N	COMPUTED VALUE,	COMMENTS
70	0.24	0.02			
1000	0.38	0.04			
1500	0.46	0.5			
1750	0.48	0.5			
2000	0.50	0.5			
4000	0.50	0.5			

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MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 17 DATE 5/22/68 MATERIAL Cyano foil

CONDITION LAMINATED DIRECTION —

PDS 30097-1 Mfgd from PDS 3018 L-2 TAPE,
SPEC. NOS. 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY CORROSION RATE

TEMP., °F	0.001" RE- G. REACTION PER MIN. X ₁	S	N	COMPUTED VALUE,	COMMENTS
2000	0.0015	0.0003			
3000	0.0140	0.0028			
3150	0.0250	0.0045			
3300	0.0500	0.0100			
3500	0.1100	0.0220			
3650	0.1800	0.0360			
3800	0.2900	0.0580			
4000	0.5400	0.1080			
4500	1.6000	0.3200			

WESTINGHOUSE ASTRONUCLEAR LABORATORY
MATERIALS DEPARTMENT DATA RELEASE

DRM 1244 PAGE NO. 20 DATE 5/22/62 MATERIAL Pys Soil

CONDITION LAMINATED DIRECTION —

PDS 30097-1 MTRD FROM PDS 30182-2 TAPE.

SPEC. NOS. 0.005" THK

DATA BASIS ESTIMATED COMMENTS PRELIMINARY DATA

PROPERTY TOTAL HEMISPHERICAL EMISSIVITY

TEMP., °F	$\bar{x}$	S	N	COMPUTED VALUE,	COMMENTS
70	0.700	0.10			
400	0.710	0.10			
600	0.725	0.10			
752	0.750	0.10			
900	0.796	0.10			
1112	0.830	0.10			
1472	0.850	0.05			
4352	0.850	0.05			