MECHANICAL PROPERTIES OF TWO TITANIUM FORGING ALLOYS, Ti 155A and C135AMo

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MATERIALS CENTRAL

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FOREWORD

This report was prepared by the Strength and Dynamics Branch, Metals and Ceramics Laboratory, under Project No. 7351, "Metallic Materials," Task No. 73521, "Behavior of Metals."

The work was administered under the direction of Materials Central, Directorate of Advanced Systems Technology, Wright Air Development Division, with Capt. Robert G. Henning acting as project engineer. The testing of all of the C135AMo alloy and part of the Ti 155A alloy was accomplished by Metcut Research Associates under Contract AF 33(616)-6225, "Non-Research and Development Mechanical Properties Testing." The Ti 155A and C135AMo alloys were purchased from Titanium Metals Corporation and Crucible Titanium respectively.

This report covers work conducted from January 1958 to November 1960.

ABSTRACT

Mechanical properties of two annealed titanium forging alloys, Ti 155A and C135AMo, were obtained. These properties included tensile, compressive, pin shear, bearing, and notched tensile at room, 200, 400, 600, 800, and 1000°F temperatures. Stressed and non-stressed exposure tests were conducted at 600, 800, and 1000°F. Torsion tests were conducted at room temperature only.

Properties vs. temperature graphs and tensile, compressive, and bearing stress-strain curves are presented. The ratio of the various properties to room temperature tensile results are plotted vs. temperature.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

W.J. TRAPP
Chief, Strength and Dynamics Branch
Metals and Ceramics Laboratory
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INTRODUCTION

The alloys tested in this program, Titanium Metals Corporation Alloy Ti 155A and Crucible Titanium Alloy C135AMo, are two forging alloys of relatively high strength. They are used primarily as jet engine compression discs, rings, and blades, and as other forgings requiring high strength, good impact and thermal shock resistance, and good tensile stability to 1000°F. Materials investigated were mill-annealed 1 1/4-inch diameter bar purchased from the manufacturers. Three heats of each alloy were tested.

SCOPE OF THE INVESTIGATION

Tensile notched tensile (K = 3.0), pin shear, bearing, compressive, tensile stability at temperature, and impact properties were determined at room and elevated temperatures. Impact results were also obtained at cryogenic temperatures. Torsion tests were run only at room temperature.

Chemical analyses of all heats were determined at Materials Central and are presented in Table 1. The following heat designations are used throughout this report:

Ti 155A		C135AMo	
Heat	Designation	Heat	Designation
4370	Heat No. 1	M5190	Heat No. 1
4702	Heat No. 2	M5192	Heat No. 2
7027	Heat No. 3	M5632	Heat No. 3

Mechanical Properties Determined

The various properties determined from each type of test performed are as follows:

1. Tensile tests
   a. Ultimate tensile strength
   b. Tensile yield strength (0.2% and 0.02%)
   c. Elongation in one-inch gage length
   d. Modulus of elasticity in tension
   e. Reduction in area
   f. Notched tensile strength
   g. Stressed and nonstressed 100 hour stability tests

2. Compression tests
   a. Compressive yield strength
   b. Modulus of elasticity in compression
   c. 0.70 and 0.85 Secant Modulus yield strengths

3. Bearing Tests (e/D = 2.0 and e/D = 1.5)
   a. Ultimate bearing strength
   b. Bearing yield stress (2.0% of hole diameters offset)

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4. Pin Shear tests
   a. Ultimate shear strength

5. Torsion tests
   a. Yield stress
   b. Modulus of rupture
   c. Modulus of rigidity
   d. Total twist to failure

6. Charpy V notch Impact tests
   a. Foot-pounds energy absorbed.

Test Conditions

The mechanical properties were obtained at 80, 200, 400, 600, 800, and 1000°F after 0.5 hour at test temperature. To determine the effects of prior exposure on strength, tensile specimens were exposed at 600, 800 and 1000°F for one hundred hours prior to tensile testing at both room temperature and the exposure temperature. Half of the specimens exposed for 100 hours were under a stress of one third the yield strength at the exposure temperature, and half were unstressed. Torsion tests were performed at room temperature only. Impact tests were performed at cryogenic temperatures as well as at some elevated temperatures.

SPECIMEN PREPARATION

All specimens were fabricated from 1 1/4-inch diameter mill annealed bar. Specimens were randomly marked within each heat as to heat designation and number of specimen.

The smooth tensile specimens were made to conform to Specification QQ-M-151, type 4, with 0.252 inch gage diameter and a one-inch gage length (Fig. 1). The notched tensile specimens had a specimen diameter of 0.300 inch and a notch diameter of 0.212 inch with a 60° notch of 0.012 inch root radius. This notched specimen gives a theoretical stress concentration factor of 3.0 and a reduction in specimen area of 50% (Fig. 2). Stressed and nonstressed stability specimens were identical with the smooth tensile specimens.

Compression specimens had a diameter of one-half inch and a length of two inches and were made in accordance with ASTM Standard E9-52T (fig. 3). Very close tolerances were adhered to in machining these specimens to insure that the ends were parallel to each other and perpendicular to the longitudinal axis.

Pin and clevis type bearing specimens were made by slitting two flat pieces from the center of the bar material and milling them to a thickness of 0.063 inch. The holes were then drilled and reamed. Two sets of specimens were made, one set with an edge distance to hole diameter ratio, e/D = 2.0 (fig. 4), and one set with e/D = 1.5 (fig. 5). The hole diameter was 0.250 inches.

Pin shear specimens of 0.250 inch diameter and 1 1/2-inch length (fig. 6) were made from the pieces remaining from the sides cut away from the bearing specimens.

Torsion specimens were fabricated as shown in figure 7. A smooth machine finish was obtained on all specimens.

Charpy V notch impact specimens were made as shown in figure 8.

TEST EQUIPMENT

Metcut Research Associates Equipment

All tests were performed on a Baldwin-Lima-Hamilton Corp. 60H hydraulic testing machine of 60,000 pounds capacity in three ranges, 0-60,000, 0-12,000 and 0-2,400 pounds. A Baldwin load-strain recorder equipped with a strain pacer and PSH-8MS extensometer was used with the above machine. A Marshall electric tensile testing furnace was used for all elevated temperature testing. A modified Waltz furnace was used for exposing and prestraining the stability tests. Loads were measured by strain gage load cells and maintained by large springs.

Wright Air Development Division Equipment

Room temperature tests were performed on a Baldwin FGT 50,000 pound capacity machine with ranges of 0-50,000, 0-10,000, 0-2,500 and 0-1,000 pounds. A Baldwin type SRA-7 recorder with a strain pacer and an SR-4 strain gage type extensometer was used.

Elevated temperature tests were performed on a Tinius Olsen 20,000 pound capacity screw type testing machine with ranges of 0-20,000, 0-10,000 and 0-2,000 pounds. A Baldwin microformer type extensometer and load strain recorder with a strain pacer were used with this machine. Temperatures were achieved with a Marshall electric furnace.

TEST PROCEDURES

All tests were conducted using a strain rate of 0.005 inch per inch to the yield strength after which a head travel rate of 0.05 inches per minute was used. Elevated temperature tests were held at test temperature one half hour before testing. All temperatures were maintained between the limits of ± 5°F. for the full gage length of the specimen.

Stressed stability tests were tensile stressed and were loaded in tension to one third of the 0.2 percent offset yield strength at the exposure temperature for 100 hours.

Standard tensile tests were then performed on the exposed specimens three tests being at room temperature and three at the exposure temperature.

Ten specimens per heat per alloy for the tensile, compressive, shear and bearing tests were tested at room temperature and three specimens per type of test, per heat per alloy, per temperature, per type of test were tested at elevated temperature. Five Charpy impact specimens were tested per temperature, per alloy, per heat.

TEST RESULTS

Chemical analysis is presented in table 1. Chemistry is typical of these alloys and is within the manufacturers limits.

Individual test data for each specimen are presented following this discussion and summarized in tables 2 to 16. Averages of property ratios vs. temperature are presented in tables 17 and 18. Average properties vs. temperature curves are presented in figures 9 thru 24. Similar curves for each heat also are shown.

Average property ratios vs. temperature curves are presented in figures 25 thru 36.

A typical stress-strain curve for each temperature for each heat and type of test is presented in the figures.

DISCUSSION

Ti 155A Alloys

Nearly all strength values for this alloy were within ±5% of the average value of the property. A few isolated cases fell outside the ±5% limit but were within ±7% of the average. Elastic modulus values in tension for 1/2 hour exposure were slightly below the manufacturer's specifications (16.5×10^6 psi) but are within reason considering the fact that all values were obtained autographically. Elastic modulus values obtained for the stability tests were higher than 16.5×10^6 psi some reaching 18×10^6 psi. In all property vs. temperature and property ratio vs. temperature graphs there is slight leveling of the property curve in the region between 400°F and 800°F as is typical in most titanium alloys.

C135AMo Alloy

All strength values for this alloy were within ±5% of the final average value and agreed well with the producers predictions. One exception was the elastic modulus (14.1×10^6 psi) which was low for this titanium alloy (16.2×10^6 predicted).

This alloy had a much greater level portion on the property vs. temperature and property ratio vs. temperature curves than the Ti 155A alloy. In some cases the strength showed a definite increase with increase in temperature in the range 400-800°F.

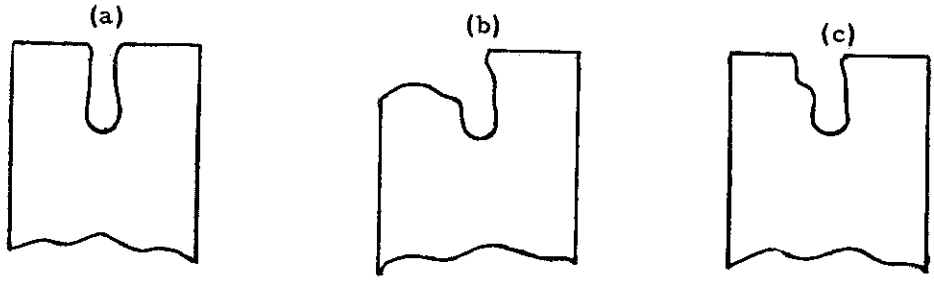
Charpy impact test results indicated a maximum value between 500°F and 1000°F.

CODE FOR SYMBOLS AND TERMS USED IN TABLES

Bearing Tests

Failure

Location - as shown in sketches the specimen failed in one of three ways:



Compression Tests

0.7 Secant

That stress which gives a secant modulus equal to 0.7 of the elastic modulus

0.85 Secant

That stress which gives a secant modulus equal to 0.85 of the elastic modulus

TABLE I
CHEMICAL ANALYSIS

Constituent	Ti 155A Alloy			C135AMo Alloy		
	Heat 1	Heat 2	Heat 3	Heat 1	Heat 2	Heat 3
% Carbon	0.02	0.02	0.02	0.013	0.018	0.012
% Nitrogen	0.014	0.017	0.015	0.007	0.005	0.008
% Oxygen	0.151	0.128	0.133	0.096	0.066	0.13
% Iron	1.50	1.34	1.33	—	—	—
% Chromium	1.39	1.33	1.28	—	—	—
% Molybdenum	1.22	1.18	1.19	3.44	3.47	3.42
% Aluminum	5.25	5.27	5.16	6.45	6.45	6.47
% Titanium	Balance	Balance	Balance	Balance	Balance	Balance
Hydrogen (parts per million)	44	45	63	68	71	75

TABLE 2
AVERAGE TENSILE PROPERTIES, Ti155A

Property	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
Yield Strength (KSI)	1	137	118	98	89	83	71
Yield Strength (KSI)	2	136	119	100	93	84	68
Yield Strength (KSI)	3	149	131	111	97	90	70
Average	—	141	123	103	93	86	70
Ultimate Tensile Strength (KSI)	1	151	137	123	113	102	86
Ultimate Tensile Strength (KSI)	2	152	139	122	114	104	79
Ultimate Tensile Strength (KSI)	3	153	139	121	112	102	82
Average	—	152	138	122	113	103	82
Elongation (%)	1	12.2	14.0	15.3	14.3	16.0	30.0
Elongation (%)	2	14.7	16.7	13.7	13.3	16.3	32.7
Elongation (%)	3	12.0	13.7	14.0	14.7	18.0	28.3
Average	—	13.0	14.8	14.3	14.1	16.8	30.3
Reduction in Area (%)	1	32.9	40.3	45.7	46.3	53.0	81.3
Reduction in Area (%)	2	41.0	47.8	47.3	44.5	50.7	77.2
Reduction in Area (%)	3	39.3	43.7	50.3	49.8	55.4	80.1
Average	—	37.7	43.9	47.8	46.9	53.0	79.5
Elastic Modulus ($X 10^6$ psi)	1	16.0	16.5	16.0	14.8	13.5	12.4
Elastic Modulus ($X 10^6$ psi)	2	15.2	14.2	14.5	14.3	13.4	9.7
Elastic Modulus ($X 10^6$ psi)	3	15.6	15.3	14.8	15.3	13.2	10.2
Average	—	15.6	15.3	15.1	14.8	13.4	10.8

TABLE 3
AVERAGE NOTCHED TENSILE PROPERTIES, Ti 155A

Property	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
Ultimate Strength (KSI)	1	224	215	192	177	164	142
	2	235	221	192	182	162	126
	3	234	223	196	180	165	129
Average	–	231	220	193	180	164	132
Reduction of Area (%)	1	5.7	6.5	9.3	10.8	13.8	26.8
	2	7.8	9.5	13.7	13.8	15.7	39.3
	3	6.6	11.0	11.7	14.8	15.7	38.5
Average	–	6.7	9.0	11.6	13.1	15.1	34.8
Elongation of Notch (%)	1	9.8	17.0	16.0	17.3	26.2	34.1
	2	12.9	16.7	19.2	21.3	25.0	62.1
	3	13.6	14.8	19.1	19.0	26.5	60.5
Average	–	12.1	16.2	18.1	19.2	25.9	52.2

TABLE 4
AVERAGE COMPRESSION PROPERTIES, Ti 155A

Property	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
2% Yield Strength (KSI)	1	142	128	113	98.9	88.7	67.5
	2	127	115	103	85.8	81.4	65.5
	3	127	121	92.3	83.4	77.2	58.9
Average	–	132	121	103	89.4	82.4	64.0
.7 Secant Strength (KSI)	1	148	135	115	101	93.4	71.8
	2	136	121	107	87.7	83.5	67.5
	3	137	132	98.7	85.3	80.5	59.6
Average	–	140	129	107	91.3	85.8	66.3
.85 Secant Strength (KSI)	1	139	123	111	93.4	82.6	62.7
	2	119	102	96.6	75.0	75.9	60.5
	3	118	117	77.6	73.7	71.0	50.4
Average	–	125	114	95.0	80.7	76.5	57.9
Modulus of Elasticity (10^6 psi)	1	17.9	17.1	17.0	16.9	13.6	11.9
	2	17.0	17.8	17.5	16.1	13.7	10.0
	3	15.8	15.0	15.9	15.4	12.5	10.1
Average	–	16.9	16.6	16.8	16.1	13.3	10.7

TABLE 5

AVERAGE BEARING PROPERTIES, Ti 155A

Property	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
1.5 Yield Strength (KSI)	1	216	192	181	170	165	130
	2	201	196	173	166	157	126
	3	204	202	183	174	157	126
Average	—	207	197	179	170	160	127
1.5 Ultimate Strength (KSI)	1	244	218	199	184	177	142
	2	238	221	198	187	172	136
	3	239	223	201	188	171	140
Average	—	240	221	199	186	173	139
2.0 Yield Strength (KSI)	1	251	242	214	204	186	156
	2	261	229	215	196	180	151
	3	260	243	223	202	190	146
Average	—	257	238	217	201	185	151
2.0 Ultimate Strength (KSI)	1	308	282	262	237	218	185
	2	307	280	254	233	209	180
	3	317	285	263	231	224	174
Average	—	311	282	260	234	217	180

TABLE 6

AVERAGE PIN SHEAR PROPERTIES, Ti 155A

Property	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
Ultimate Sheer Strength (KSI)	1	105	95	83	75	70	58
	2	100	93	81	74	67	55
	3	101	91	81	75	69	55
Average	—	102	93	82	75	69	56

AVERAGE CHARPY IMPACT PROPERTIES

Property	Heat	-423° F	-108° F	75° F	300° F	500° F	
Foot-Pounds Energy	1	8	11	15	22	33	
	2	10	15	15	28	43	
	3	8	13	16	26	37	
Average	—	9	13	15	25	38	

TABLE 7
AVERAGE NONSTRESSED STABILITY PROPERTIES, Ti 155A

Heat No.	Temperature (°F)		Ultimate Tensile Strength (kpsi)	0.02% Yield Strength (kpsi)	0.2% Yield Strength (kpsi)	Reduction of Area (%)	Elong. (%)	Modulus of Elasticity 10^6 psi
	Exposure	Test						
1	600	600	116	75.7	90.4	44.6	15	13.9
2	600	600	115	76.9	93.0	52.3	15	14.2
3	600	600	112	88.0	99.5	52.3	16	13.8
Ave.	–	–	114	80.2	94.3	49.7	15	14.0
1	600	RT	151	121	136	34.6	12	15.5
2	600	RT	150	121	132	44.0	15	15.1
3	600	RT	153	134	144	41.0	13	15.6
Ave.	–		151	130	137	39.9	13	15.4
1	800	800	107	75.4	88.1	49.2	16	12.5
2	800	800	105	75.4	82.8	53.3	18	11.4
3	800	800	103	74.2	83.2	55.4	17	13.0
Ave.	–	–	105	75.0	84.7	52.6	17	12.3
1	800	RT	153	139	142	29.8	11	17.3
2	800	RT	152	140	142	35.2	15	17.5
3	800	RT	154	138	145	35.2	13	18.0
Ave.	–		153	139	143	33.4	13	17.6
1	1000	1000	89.3	54.1	67.4	79.5	27	10.8
2	1000	1000	81.5	41.4	60.5	79.1	30	9.3
3	1000	1000	81.2	49.1	64.7	87.7	36	9.0
Ave.	–	–	84.0	48.2	64.2	82.1	31	9.7
1	1000	RT	157	135	143	31.8	12	18.2
2	1000	RT	156	133	141	35.2	14	17.6
3	1000	RT	156	137	147	38.0	13	18.3
Ave.	–		156	135	144	35.0	13	18.0

TABLE 8

AVERAGE STRESSED STABILITY PROPERTIES, Ti 155A

Heat	Temperature (°F)		Ultimate Tensile Strength (kpsi)	0.02 % Yield Strength (kpsi)	0.2 % Yield Strength (kpsi)	Reduction of Area (%)	Elong. (%)	Modulus of Elasticity 10^6 psi
	Exposure	Test						
1	600	600	114	78.3	91.3	13.1	15	14.9
2	600	600	115	81.5	92.6	44.6	15	13.7
3	600	600	113	87.8	101.	41.4	15	13.5
Ave. -	—	—	114	82.5	95.0	33.0	15	14.0
1	600	RT	151	130	143	38.8	12	18.0
2	600	RT	154	129	140	46.1	15	16.2
3	600	RT	157	136	150	37.9	13	17.7
Ave. -	—	—	154	132	144	40.9	13	17.3
1	800	800	107	73.0	87.3	49.6	15	13.4
2	800	800	109	77.5	83.9	48.4	19	13.1
3	800	800	105	79.6	87.7	54.9	17	12.8
Ave. -	-	-	107	76.7	86.3	51.0	17	13.1
1	800	RT	153	130	143	33.9	11	17.7
2	800	RT	157	140	144	31.9	14	17.2
3	800	RT	156	139	147	38.2	13	17.8
Ave -	-	-	155	138	145	34.7	13	17.6
1	1000	1000	91.5	58.4	70.2	78.8	28	11.3
2	1000	1000	83.0	42.2	64.3	77.4	29	11.5
3	1000	1000	83.9	46.5	61.6	84.4	31	10.5
Ave. -	—	—	86.1	49.0	65.4	80.2	29	11.1
1	1000	RT	155	142	146	13.5	6	17.8
2	1000	RT	156	138	143	26.3	11	18.1
3	1000	RT	158	144	151	20.7	8	18.3
Ave. -	—	—	156	141	147	20.2	8	18.1

TABLE 9

AVERAGE TORSIONAL PROPERTIES, Ti 155A

Property	Heat	80° F	200° F	400° F	600° F	800 °F	1000° F
0.2% Torsional Yield Strength (KSI)	1	102					
	2	92					
	3	99					
Average		98					
Torsional Modulus of Rupture (KSI)	1	131					
	2	128					
	3	131					
Average		130					
Torsional Shear Modulus (X 10^6 psi)	1	6.8					
	2	6.7					
	3	6.7					
Average		6.7					
Twist Per Inch (Degrees)	1	51					
	2	124					
	3	51					
Average		75					

TABLE 10

AVERAGE TENSILE PROPERTIES, C135AMo

Property	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
0.2% Yield Strength (KSI)	1	139	123	110	100	98	78
	2	135	127	108	107	98	83
	3	143	123	105	96	96	82
Average		139	124	108	101	97	81
Ultimate Tensile Strength (KSI)	1	170	159	146	141	145	129
	2	169	163	151	148	146	129
	3	173	158	144	139	141	128
Average		171	160	147	143	144	129
Elongation (%)	1	17	19	18	18	17	24
	2	16	15	16	15	16	23
	3	16	17	19	16	18	26
Average		16	17	18	16	17	24
Reduction in Area (%)	1	50	57	58	58	61	73
	2	46	49	47	50	62	70
	3	51	53	59	56	61	77
Average		49	53	55	55	61	73
Elastic Modulus ($\times 10^6$ psi)	1	13.6	12.7	12.9	13.5	12.1	12.5
	2	13.9	14.0	13.0	13.0	11.3	11.6
	3	14.7	12.6	12.7	13.4	12.9	9.0
Average		14.1	13.1	12.9	13.3	12.1	11.0
0.02 Yield Strength (KSI)	1	120	106	96	83	80	60
	2	118	108	92	87	82	69
	3	119	103	86	75	68	66
Average		119	106	91	82	77	65

TABLE II

AVERAGE NOTCHED TENSILE, PIN SHEAR, AND CHARPY IMPACT PROPERTIES, C135AMo

Property	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
Notched Tensile Ultimate Strength (KSI)	1	257	239	227	206	212	199
	2	247	238	219	202	203	199
	3	244	228	215	205	202	188
Average		249	235	220	204	206	195
Notched Tensile Reduction of Area (%)	1	10.6	10.4	12.6	16.9	14.2	28.9
	2	7.6	9.0	11.3	12.1	10.0	14.9
	3	6.3	9.3	11.4	12.7	14.1	20.1
Average		8.2	9.6	11.8	13.9	12.8	21.3
Pin Shear Ultimate Strength (KSI)	1	106	96	91	87	83	79
	2	104	95	91	89	83	79
	3	107	98	88	84	82	78
Average		106	96	90	87	83	79
Property	Heat	-423° F	-108° F	75° F	500° F	1000° F	
Charpy Impact Foot-Pounds Energy	1	8	13	16	27	25	
	2	8	12	16	24	20	
	3	8	12	14	26	21	
Average		8	12	15	26	22	

TABLE 12

AVERAGE COMPRESSION PROPERTIES, C135AMo

Property	Heat	80°	200° F	400° F	600° F	800° F	1000° F
0.2% Yield Strength (KSI)	1	148	126	117	105	98	88
	2	134	128	117	105	94	90
	3	149	134	118	99	98	86
Average		144	129	117	103	97	88
0.7 Secant Strength (KSI)	1	157	132	123	112	108	96
	2	144	135	126	114	101	100
	3	159	144	126	106	107	93
Average		153	137	125	111	105	96
0.85 Secant Strength (KSI)	1	145	123	111	101	93	84
	2	132	123	113	97	88	86
	3	147	130	115	96	93	82
Average		141	125	113	98	91	84
Modulus of Elasticity ($X 10^6$ psi)	1	15.5	14.9	15.6	14.9	13.3	10.8
	2	15.5	16.0	14.2	14.8	14.1	11.3
	3	16.0	15.9	14.8	13.8	13.4	10.8
Average		15.7	15.6	14.9	14.5	13.6	11.0

TABLE 13

AVERAGE BEARING PROPERTIES, C135AMo

Property	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
e/D = 1.5 Yield Strength (KSI)	1	250	226	218	202	203	173
	2	249	224	213	207	197	170
	3	239	232	208	195	199	165
Average		246	227	213	201	200	169
e/D = 1.5 Ultimate Strength (KSI)	1	263	236	225	210	209	194
	2	264	241	225	212	205	188
	3	264	248	226	209	207	187
Average		264	234	225	210	207	190
e/D = 2.0 Yield Strength (KSI)	1	285	271	247	240	230	198
	2	274	257	239	240	232	204
	3	271	258	242	233	232	192
Average		277	262	243	238	231	198
e/D = 2.0 Ultimate Strength (KSI)	1	314	283	269	254	251	231
	2	323	291	276	251	240	236
	3	324	290	265	246	238	234
Average		320	288	270	250	243	234

TABLE 14

AVERAGE NONSTRESSED STABILITY PROPERTIES, C135AMo

Property	Heat	Room Temperature Tests			Exposure Temperature Tests		
		600° F Exposure	800° F Exposure	1000° F Exposure	600° F Exposure	800° F Exposure	1000° F Exposure
Ultimate Tensile Strength (KSI)	1	189	207	186	149	155	116
	2	190	205	193	150	156	118
	3	192	205	190	145	150	116
Average		190	206	190	148	154	117
0.02 % Yield Strength (KSI)	1	140	155 (b)	172	86	79	63
	2	137	154	172	91	91	72
	3	142	156	167	86	91	59
Average		140	155	170	88	87	65
0.2% Yield Strength (KSI)	1	161	173 (b)	179	107	105	88
	2	157	168	178	108	108	87
	3	163	175	176	105	106	84
Average		160	172	178	107	106	86
Elongation (%)	1	12	8	6 (a)	15	14	27
	2	10	6	7	13	14	26
	3	10	9	10	16	15	27
Average		11	8	8	15	14	27
Reduction in Area (%)	1	43	23	15 (a)	53	59	79
	2	38	23	16	45	56	81
	3	44	29	34	53	59	81
Average		42	25	22	50	58	80
Modulus of Elasticity ($\times 10^6$ psi)	1	16.6	17.2	18.0	12.8	15.2	11.9
	2	16.3	17.2	17.7	12.4	12.3	10.0
	3	16.6	17.0	18.2	13.7	11.5	11.7
Average		16.5	17.1	18.0	13.0	13.0	11.2

(a) - One Test Only

(b) - Two Tests Only

TABLE 15

AVERAGE STRESSED STABILITY PROPERTIES, C135AMo

Property	Heat	Room Temperature Tests			Exposure Temperature Tests		
		600° F Exposure	800° F Exposure	1000° F Exposure	600° F Exposure	800° F Exposure	1000° F Exposure
Ultimate Tensile Strength (KSI)	1	189	205	189	149	155	113
	2	193	208	192	150	155	114
	3	194	208	197	145	149	113
Average		192	207	193	148	153	113
0.02% Yield Strength (KSI)	1	139	164	162	83	78	64
	2	135	147	163	83	80	67
	3	140	141	168	81	81	64
Average		138	151	164	82	80	65
0.2% Yield Strength (KSI)	1	160	194	175	104	102	81
	2	158	168	174	105	101	83
	3	161	169	181	102	100	84
Average		160	177	177	104	101	83
Elongation (%)	1	11	3	11	14	15	28
	2	10	7	9	14	14	28
	3	11	9	10	15	14	26
Average		11	6	10	14	14	27
Reduction in Area (%)	1	42	5	35	51	58	83
	2	35	21	29	50	52	82
	3	42	28	36	54	59	82
Average		40	18	33	52	56	82
Modulus of Elasticity (X 10^6 psi)	1	16.2	17.1	17.8	12.9	14.3	10.3
	2	16.3	16.9	17.0	13.2	11.9	9.9
	3	16.2	17.0	17.6	13.3	11.7	12.4
Average		16.2	17.0	17.5	13.1	12.6	10.9
Elongation during Prestraining (%)	1	0.3	2.0	1.7	1.3	0.3	1.7
	2	0.3	0.3	2.3	1.0	0.3	2.0
	3	0.0	0.0	2.3	0.0	0.0	1.7
Average		0.2	0.8	2.1	0.8	0.2	1.8

(a) Exposure Stress -- 600° F - 33,300 psi
800° F - 32,800 psi
1000° F - 24,600 psi

TABLE 16

AVERAGE TORSIONAL PROPERTIES, C135AMo

Property	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
0.2% Torsional Yield Strength (KSI)	1	99.6					
	2	90.5					
	3	98.5					
Average		96.2					
Torsional Modulus of Rupture (KSI)	1	144					
	2	140					
	3	145					
Average		143					
Torsional Shear Modulus ($X\ 10^6$ psi)	1	6.2					
	2	5.9					
	3	5.8					
Average		6.0					
Twist per Inch (°)	1	69					
	2	64					
	3	57					
Average		63					

TABLE 17

AVERAGE PROPERTY RATIOS, Ti155A

Property Ratio	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
Notched Tensile Ultimate/ Tensile Ultimate	1	1.48	1.42	1.27	1.17	1.09	0.94
	2	1.55	1.45	1.26	1.20	1.07	0.83
	3	1.53	1.46	1.28	1.18	1.08	0.84
Average		1.52	1.44	1.27	1.18	1.08	0.87
1.5 Bearing Yield/ Tensile Yield	1	1.58	1.40	1.32	1.24	1.20	0.95
	2	1.48	1.44	1.27	1.22	1.15	0.93
	3	1.37	1.35	1.23	1.17	1.05	0.84
Average		1.48	1.40	1.27	1.21	1.13	0.91
1.5 Bearing Ultimate/ Tensile Ultimate	1	1.62	1.44	1.32	1.22	1.17	0.94
	2	1.56	1.45	1.30	1.23	1.13	0.89
	3	1.56	1.46	1.31	1.23	1.12	0.91
Average		1.58	1.45	1.31	1.23	1.14	0.91
Pin Shear Ultimate/ Tensile Ultimate	1	0.69	0.63	0.55	0.50	0.46	0.38
	2	0.66	0.61	0.53	0.49	0.44	0.36
	3	0.66	0.61	0.54	0.49	0.45	0.37
Average		0.67	0.62	0.54	0.49	0.45	0.37
2.0 Bearing Yield / Tensile Yield	1	1.83	1.77	1.56	1.49	1.36	1.14
	2	1.92	1.68	1.58	1.44	1.32	1.11
	3	1.74	1.63	1.50	1.36	1.27	0.98
Average		1.83	1.69	1.55	1.43	1.32	1.08
2.0 Bearing Ultimate / Tensile Ultimate	1	2.04	1.87	1.73	1.57	1.44	1.22
	2	2.02	1.84	1.67	1.53	1.37	1.18
	3	2.07	1.86	1.72	1.51	1.46	1.14
Average		2.04	1.86	1.71	1.54	1.42	1.18
Modulus of Rupture/ Tensile Ultimate	1	0.88					
	2	0.84					
	3	0.86					
Average		0.86					
Torsional Yield / Tensile Yield	1	0.73					
	2	0.67					
	3	0.68					
Average		0.69					
Compression Yield / Tensile Yield	1	1.04	0.93	0.82	0.72	0.65	0.49
	2	0.93	0.84	0.76	0.63	0.60	0.48
	3	0.85	0.81	0.62	0.56	0.52	0.39
Average		0.94	0.86	0.73	0.64	0.59	0.45

TABLE 17 (CONTINUED)

Property Ratio	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
0.7 Secant Yield/ Tensile Yield	1	1.08	0.98	0.84	0.74	0.68	0.52
	2	1.00	0.89	0.79	0.64	0.61	0.50
	3	0.92	0.88	0.66	0.57	0.54	0.40
Average		1.00	0.92	0.76	0.65	0.61	0.47
0.85 Secant Yield / Tensile Yield	1	1.01	0.90	0.81	0.68	0.60	0.46
	2	0.87	0.75	0.71	0.55	0.56	0.44
	3	0.79	0.78	0.52	0.49	0.48	0.34
Average		0.89	0.81	0.68	0.57	0.55	0.41

Property Ratio	Heat	Room Temperature Tests			Exposure Temperature Tests		
		600° F Exposure	800° F Exposure	1000° F Exposure	600° F Exposure	800° F Exposure	1000° F Exposure
Non-Stressed Stability Tensile Ultimate / Tensile Ultimate	1	1.00	1.01	1.04	0.77	0.71	0.59
	2	0.99	1.00	1.03	0.76	0.69	0.54
	3	1.00	1.01	1.02	0.73	0.67	0.53
Average		1.00	1.01	1.03	0.75	0.69	0.55
Non-Stressed Stability Tensile 0.2 Yield / 0.2 Yield Strength	1	0.99	1.04	1.04	0.66	0.64	0.49
	2	0.97	1.04	1.04	0.68	0.61	0.44
	3	0.97	0.97	0.99	0.67	0.56	0.43
Average		0.98	1.02	1.02	0.67	0.60	0.45
Stressed Stability Tensile Ultimate / Tensile Ultimate	1	1.00	1.01	1.03	0.75	0.71	0.61
	2	1.01	1.03	1.03	0.76	0.72	0.55
	3	1.03	1.02	1.03	0.74	0.69	0.55
Average		1.01	1.02	1.03	0.75	0.71	0.57
Stressed Stability Tensile 0.2 Yield/ 0.2 Yield	1	1.04	1.04	1.06	0.67	0.64	0.51
	2	1.03	1.06	1.05	0.68	0.62	0.47
	3	1.01	0.99	1.01	0.67	0.59	0.41
Average		1.03	1.03	1.04	0.67	0.62	0.46

TABLE 18
AVERAGE PROPERTY RATIOS, C135AMo

Property Ratio	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
Notched Tensile Ultimate/ Tensile Ultimate	1	1.51	1.40	1.33	1.21	1.25	1.17
	2	1.46	1.41	1.29	1.19	1.20	1.18
	3	1.41	1.32	1.24	1.18	1.17	1.09
Average		1.46	1.38	1.29	1.19	1.21	1.15
Pin Shear Ultimate / Tensile Ultimate	1	0.62	0.56	0.53	0.51	0.49	0.46
	2	0.61	0.56	0.54	0.53	0.49	0.47
	3	0.62	0.57	0.51	0.48	0.47	0.45
Average		0.62	0.56	0.53	0.51	0.48	0.46
0.2 Torsional Yield / Tensile 0.2 Yield	1	0.72					
	2	0.67					
	3	0.69					
Average		0.69					
Modulus of Rupture / Tensile Ultimate	1	0.83					
	2	0.83					
	3	0.84					
Average		0.83					
Compression 0.2 Yield/ Tensile 0.2 Yield	1	1.06	0.91	0.84	0.75	0.70	0.63
	2	0.99	0.95	0.87	0.78	0.70	0.67
	3	1.04	0.94	0.82	0.69	0.68	0.60
Average		1.03	0.93	0.84	0.74	0.69	0.63
0.7 Secant Yield / Tensile 0.2 Yield	1	1.13	0.95	0.88	0.80	0.78	0.69
	2	1.06	1.00	0.93	0.84	0.75	0.74
	3	1.11	1.01	0.88	0.74	0.75	0.65
Average		1.10	0.99	0.90	0.79	0.76	0.69
0.85 Secant Yield / Tensile 0.2 Yield	1	1.04	0.88	0.80	0.73	0.67	0.60
	2	0.98	0.91	0.84	0.72	0.65	0.64
	3	1.03	0.91	0.80	0.67	0.65	0.57
Average		1.02	0.90	0.81	0.71	0.66	0.60
e/D = 1.5 Bearing Yield / Tensile 0.2 Yield	1	1.80	1.62	1.57	1.45	1.46	1.24
	2	1.84	1.66	1.58	1.53	1.46	1.26
	3	1.67	1.62	1.45	1.36	1.39	1.15
Average		1.77	1.63	1.53	1.45	1.44	1.22
e/D = 1.5 Bearing Ultimate / Tensile Ultimate	1	1.55	1.39	1.32	1.23	1.23	1.14
	2	1.56	1.42	1.33	1.25	1.21	1.11
	3	1.52	1.43	1.31	1.21	1.20	1.08
Average		1.54	1.41	1.32	1.23	1.21	1.11

TABLE 18 (CONTINUED)

Property Ratio	Heat	80° F	200° F	400° F	600° F	800° F	1000° F
e/D = 2.0 Bearing Yield / Tensile 0.2 Yield	1	2.05	1.95	1.78	1.73	1.65	1.42
	2	2.03	1.90	1.77	1.78	1.72	1.51
	3	1.89	1.80	1.69	1.63	1.62	1.34
Average		1.99	1.88	1.75	1.71	1.66	1.42
e/D = 2.0 Bearing Ultimate / Tensile Ultimate	1	1.85	1.66	1.58	1.49	1.48	1.36
	2	1.91	1.72	1.63	1.48	1.42	1.40
	3	1.87	1.68	1.53	1.42	1.37	1.35
Average		1.88	1.69	1.58	1.46	1.42	1.37

Property Ratio	Heat	Room Temperature Tests			Exposure Temperature Tests		
		600° F Exposure	800° F Exposure	1000° F Exposure	600° F Exposure	800° F Exposure	1000° F Exposure
Non-Stressed Stability Tensile Ultimate / Tensile Ultimate	1	1.09	1.22	1.11	0.88	0.91	0.68
	2	1.12	1.21	1.14	0.89	0.92	0.70
	3	1.11	1.18	1.10	0.84	0.87	0.67
Average		1.11	1.20	1.12	0.87	0.90	0.68
Non-Stressed Stability Tensile 0.02 Yield / 0.02 Yield Strength	1	1.43	1.29	1.17	0.72	0.66	0.52
	2	1.16	1.30	1.46	0.77	0.77	0.61
	3	1.19	1.31	1.40	0.72	0.76	0.49
Average		1.26	1.30	1.34	0.74	0.73	0.54
Non-Stressed Stability Tensile 0.2 Yield / 0.2 Yield Strength	1	1.29	1.24	1.16	0.77	0.75	0.63
	2	1.16	1.24	1.32	0.80	0.80	0.64
	3	1.14	1.22	1.23	0.73	0.74	0.59
Average		1.20	1.23	1.24	0.77	0.76	0.62
Stressed Stability Tensile Ultimate / Tensile Ultimate	1	1.11	1.20	1.11	0.88	0.91	0.66
	2	1.14	1.23	1.14	0.89	0.92	0.67
	3	1.12	1.20	1.14	0.84	0.86	0.65
Average		1.12	1.21	1.13	0.86	0.90	0.66
Stressed Stability 0.02 Yield Strength / 0.02 Yield Strength	1	1.16	1.37	1.35	0.69	0.65	0.53
	2	1.14	1.24	1.38	0.70	0.68	0.57
	3	1.18	1.18	1.41	0.68	0.68	0.54
Average		1.16	1.26	1.38	0.69	0.67	0.55
Stressed Stability 0.2 Yield Strength / 0.2 Yield Strength	1	1.15	1.39	1.26	0.75	0.73	0.58
	2	1.17	1.24	1.29	0.78	0.75	0.61
	3	1.12	1.18	1.26	0.71	0.71	0.59
Average		1.15	1.27	1.27	0.75	0.73	0.59

TABLE 19
TENSILE PROPERTIES OF Ti155A

Spec. No.	Temp. (°F)	Reduction of Area (%)	Yield Strength (psi)	Ultimate Strength (psi)	Modulus of Elasticity (psi)	Elongation (%)	Location of Fracture
1-1	RT	33.3	139,300	151,300	15.8×10^6	12.0	M.H.
1-2	RT	32.80	137,800	150,700	16.4×10^6	12.5	M H
1-3	RT	32.1	138,500	151,900	15.7×10^6	12.0	M H
1-4	RT	32.7	139,400	151,900	16.2×10^6	12.0	M H
1-5	RT	33.6	139,300	152,000	17.3×10^6	12.0	M H
1-6	RT	30.7	139,400	152,800	15.8×10^6	11.5	M H
1-7	RT	32.7	134,200	148,100	15.2×10^6	12.5	M H
1-8	RT	32.4	136,100	150,800	16.1×10^6	12.5	M H
1-9	RT	33.9	136,600	150,700	15.7×10^6	12.5	M H
1-10	RT	34.5	134,300	149,300	15.7×10^6	12.5	M H
Average		32.9	137,500	151,000	16.0×10^6	12.2	
1-11	200	40.5	117,000	137,800	16.6×10^6	14.0	M H
1-12	200	41.5	116,500	134,800	16.5×10^6	14.0	M H
1-13	200	39.0	120,000	139,400	16.3×10^6	14.0	M H
Average		40.3	118,000	137,300	16.5×10^6	14.0	
1-14	400	43.5	100,100	125,900	16.5×10^6	15.0	M H
1-15	400	46.5	97,800	123,500	16.4×10^6	15.0	M H
1-16	400	46.5	95,900	119,400	15.1×10^6	16.0	M H
Average		45.7	97,900	122,900	16.0×10^6	15.3	
1-17	600	45.5	91,400	115,300	14.3×10^6	14.0	M H
1-18	600	48.5	86,100	110,400	14.3×10^6	14.0	M H
1-19	600	44.5	89,100	113,900	15.7×10^6	15.0	M H
Average		46.3	88,900	113,200	14.8×10^6	14.33	
1-20	800	53.0	84,100	97,900	13.6×10^6	16.0	M H
1-21	800	52.0	80,500	102,000	13.3×10^6	16.0	M H
1-22	800	55.0	84,900	106,600	13.7×10^6	16.0	M H
Average		53.0	83,200	102,200	13.5×10^6	16.0	

TABLE 19 (CONTINUED)

Spec	Temp (°F)	Reduction of Area (%)	Yield Strength (psi)	Ultimate Strength (psi)	Modulus of Elasticity (psi)	Elongation (%)	Location of Fracture
1-23	1000	80.5	72,400	88,200	12.4×10^6	28.0	M H
1-24	1000	83.0	72,000	85,900	12.4×10^6	32.0	M H
1-25	1000	81.0	69,300	85,500	12.3×10^6	30.0	M H
Average		81.3	71,200	86,500	12.4×10^6	30.0	
2-1	RT	34.6	136,400	154,000	13.2×10^6	13.5	O Q
2-2	RT	43.0	134,900	151,400	14.9×10^6	17.0	O Q
2-3	RT	43.6	136,300	152,600	15.3×10^6	14.5	O Q
2-4	RT	39.4	133,700	151,900	14.4×10^6	15.0	M H
2-5	RT	42.0	137,000	150,900	15.2×10^6	14.5	M H
2-6	RT	40.6	136,400	151,700	15.6×10^6	16.0	M H
2-7	RT	45.2	139,500	152,300	15.3×10^6	14.0	M H
2-8	RT	36.8	136,600	153,600	15.2×10^6	14.0	M H
2-9	RT	41.8	136,900	152,500	15.3×10^6	13.0	O Q
2-10	RT	42.6	139,000	150,500	18.0×10^6	15.0	M H
Average		41.0	136,000	152,100	15.2×10^6	14.7	
2-11	200	53.5	123,300	142,200	14.3×10^6	14.0	O Q
2-12	200	42.0	116,900	139,900	13.9×10^6	18.0	M H
2-13	200	48.0	116,000	137,300	14.3×10^6	18.0	M H
Average		47.8	118,700	139,800	14.2×10^6	16.7	
2-14	400	39.0	93,900	121,800	13.8×10^6	13.0	O Q
2-17	400	50.0	102,600	125,500	14.6×10^6	14.0	M H
2-16	400	53.0	103,000	120,300	15.0×10^6	14.0	M H
Average		47.3	99,800	122,500	14.5×10^6	13.7	
2-15	600	42.0	94,700	111,900	16.1×10^6	12.0	M H
2-18	600	42.0	91,600	114,900	12.8×10^6	14.0	M H
2-19	600	49.5	91,800	114,400	13.9×10^6	14.0	M H
Average		44.5	92,700	113,700	14.3×10^6	13.3	

TABLE 19 (CONTINUED)

Spec No.	Temp. (°F)	Reduction of Area (%)	Yield Strength (psi)	Ultimate Strength (psi)	Modulus of Elasticity (psi)	Elongation (%)	Location of Fracture
2-20	800	56.0	85,400	103,800	15.0×10^6	15.0	MH
2-23	800	47.0	84,700	104,400	12.8×10^6	16.0	MH
2-25	800	49.0	82,600	103,700	12.3×10^6	18.0	MH
Average		50.7	84,200	104,000	13.4×10^6	16.3	
2-21	1000	78.5	67,200	79,800	10.7×10^6	34.0	MH
2-22	1000	79.0	69,500	78,800	9.4×10^6	34.0	MH
2-24	1000	74.0	66,000	77,500	8.9×10^6	30.0	MH
Average		77.2	67,600	78,700	9.7×10^6	32.7	
3-1	RT	42.0	146,000	151,100	16.5×10^6	12.5	MH
3-2	RT	37.5	150,100	153,400	16.0×10^6	11.5	OQ
3-3	RT	37.2	146,400	151,500.	15.1×10^6	12.0	MH
3-4	RT	40.25	146,300	153,000	15.7×10^6	12.0	MH
3-5	RT	37.1	154,600	159,400	15.7×10^6	11.5	OQ
3-6	RT	36.6	148,200	152,700	15.9×10^6	12.0	OQ
3-7	RT	41.2	148,600	154,300	15.0×10^6	12.0	OQ
3-8	RT	40.2	148,000	153,700	15.6×10^6	11.5	MH
3-9	RT	40.8	149,800	153 400	15.2×10^6	11.5	OQ
3-10	RT	39.8	148,300	152,800	15.0×10^6	13.5	OQ
Average		39.3	148,600	153,500	15.6×10^6	12.0	
3-11	200	45.5	130,500	137,300	14.5×10^6	13.0	MH
3-12	200	43.0	136,200	143,000	15.9×10^6	14.0	MH
3-13	200	42.5	127,400	136,800	15.5×10^6	14.0	MH
Average		43.7	131,400	139,000	15.3×10^6	13.7	
3-14	400	51.0	110,800	120,800	15.8×10^6	14.0	MH
3-15	400	47.5	113,900	120,900	13.2×10^6	14.0	MH
3-18	400	52.5	109,400	121,800	15.3×10^6	14.0	MH
Average		50.3	111,400	121,200	14.8×10^6	14.0	

TABLE 19 (CONTINUED)

Spec No.	Temp. (°F)	Reduction of Area (%)	Yield Strength (psi)	Ultimate Strength (psi)	Modulus of Elasticity psi	Elongation (%)	Location of Fracture
3-16	600	51.0	98,200	109,800	15.6×10^6	15.0	MH
3-17	600	49.5	93,100	114,700	15.2×10^6	15.0	MH
3-19	600	49.0	101,000	111,800	15.2×10^6	14.0	MH
Average		49.8	97,400	112,100	15.3×10^6	14.7	
3-20	800	55.0	90,000	101,300	12.5×10^6	20.0	MH
3-22	800	56.5	91,800	102,700	14.1×10^6	16.0	MH
3-23	800	54.7	89,600	103,400	13.1×10^6	*	*
Average		55.4	90,500	102,500	13.2×10^6	18.0	
3-21	1000	81.5	71,100	83,000	10.8×10^6	30.0	MH
3-24	1000	77.7	67,400	81,400	9.8×10^6	26.0	MH
3-25	1000	81.0	71,900	82,400	9.9×10^6	29.0	MH
Average		80.1	70,100	82,300	10.2×10^6	28.3	

*SPECIMEN LOST

TABLE 20

TENSILE PROPERTIES OF Ti 155A STRESSED STABILITY SPECIMENS
(PRESTRAINED 100 HOURS AT CONDITIONS SHOWN)

Spec. No.	Prestraining Conditions Temperature(°F)	Stress(psi)	% Elong. During Pre-stressing	Test Temp. (°F)	Ultimate Tensile Strength kpsi	Yield Points(kpsi) 0.02%	0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity 10^6 psi
1-1	600	29,620	0	600	115	79.0	92.3	10.5	15	13.5
1-2	600	29,620	0	600	115	79.0	92.5	12	14	15.7
1-3	600	29,620	0	600	111	76.8	89.0	16.8	16	15.5
Ave -	-	29,620	0	-	114	78.3	91.3	13.1	15	14.9
1-4	600	29,620	0	RT	148	131	142	45.4	12	17.8
1-5	600	29,620	0	RT	154	132	144	33	12	17.5
1-6	600	29,620	0	RT	150	127	140	38	13	18.7
Ave -	-	29,620	0		151	130	143	38.8	12	18.0
1-7	800	27,720	0	800	104	69.9	84.7	51.7	15	12.9
1-8	800	27,720	0	800	108	71.8	88.5	46.7	15	13.7
1-9	800	27,720	0	800	109	77.3	88.7	50.4	15	13.5
Ave -	-	27,720	0	-	107	73.0	87.3	49.6	15	13.4
1-10	800	27,720	0	RT	142	124	134	37.5	11	16.7
1-11	800	27,720	0	RT	156	133	145	31.7	11	17.3
1-12	800	27,720	0	RT	160	134	150	32.6	11	19.2
Ave -	-	27,720	0		153	130	143	33.9	11	17.7
1-13	1000	23,740	5	1000	91.4	57.1	69.8	79.5	29	10.9
1-14	1000	23,740	6	1000	92.6	59.8	71.3	77.5	27.4	11.4
1-15	1000	23,740	5	1000	90.5	58.3	69.6	79.4	27	11.7
Ave -	-	23,740	5	-	91.5	58.4	70.2	78.8	28	11.3

TABLE 20 (Cont'd)

Spec. No.	Prestraining Conditions Temperature(°F)	Stress(psi)	% Elong. During Pre-stressing	Test Temp. (°F)	Ultimate Tensile Strength kpsi	Yield Points(kpsi) 0.02%	0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity 10^6 psi
1-16	1000	23,740	5	RT	156	141	147	6.0	4	17.9
1-17	1000	23,740	5	RT	154	142	145	21.0	6	17.7
1-18	1000	23,740	4	RT	156	142	146	13.5	8	17.7
Ave -	-	23,740	5		155	142	146	13.5	6	17.8
2-1	600	30,900	0	600	114	85.0	94.2	38.5	16.5	13.1
2-2	600	30,900	.5	600	113	76.8	89.0	49.3	14.5	14.5
2-3	600	30,900	0	600	117	82.8	94.5	46.1	15	13.5
Ave -	-	30,900	.2	-	115	81.5	92.6	44.6	15.3	13.7
2-4	600	30,900	0	RT	153	127	139	41.2	15	15.9
2-5	600	30,900	0	RT	156	131	143	59.2	15	15.7
2-6	600	30,900	0	RT	154	128	139	38.0	14	17.1
Ave -	-	30,900	0		154	129	140	46.1	15	16.2
2-7	800	28,190	0	800	110	73.3	84.7	50.7	15	13.8
2-8	800	28,190	.5	800	110	80.9	85.0	47.4	19	13.7
2-9	800	28,190	1.0	800	107	78.3	82.0	47.2	22	11.8
Ave -	-	28,190	.5	-	109	77.5	83.9	48.4	19	13.1
2-10	800	28,190	.5	RT	157	138	143	34.3	17	16.6
2-11	800	28,190	0	RT	156	142	-	41.0	16	-
2-12	800	28,190	.5	RT	157	140	144	20.4	10	17.7
Ave -	-	28,190	.3		157	140	144	31.9	14	17.2

TABLE 20 (Cont'd)

Spec. No.	Prestraining Conditions Temperature(°F)	Stress(psi)	% Elong. During Pre-stressing	Test Temp. (° F)	Ultimate Tensile Strength kpsi	Yield Points(kpsi) 0.02%	0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity 10^6 psi
2-13	1000	22,520	14	1000	80.4	43.9	61.6	78.7	30	10.3
2-14	1000	22,520	6	1000	85.9	42.2	67.8	77.9	26	11.6
2-15	1000	22,520	6	1000	82.8	40.4	63.6	75.6	30	12.7
Ave -	-	22,520	8	-	83.0	42.2	64.3	77.4	29	11.5
2-16	1000	22,520	12	RT	157	134	138	31.0	14	17.8
2-17	1000	22,520	5	RT	155	139	144	10.5	7	17.7
2-18	1000	22,520	11	RT	156	142	146	37.5	13	18.7
Ave -	-	22,520	9		156	138	143	26.3	11	18.1
3-1	600	32,370	0	600	113	88.8	102	51.5	15	13.0
3-2	600	32,370	0	600	114	84.0	101	36.0	15	14.3
3-3	600	32,370	0	600	113	90.5	101	36.7	15	13.2
Ave -	-	32,370	0	-	113	87.8	101	41.4	15	13.5
3-4	600	32,370	0	RT	155	135	149	36.7	14	18.6
3-5	600	32,370	0	RT	158	140	151	36.5	13	16.9
3-6	600	32,370	0	RT	158	134	151	40.5	12	17.6
Ave -	-	32,370	0		157	136	150	37.9	13	17.7
3-7	800	30,170	0	800	108	79.7	88.7	54.8	18	13.2
3-8	800	30,170	0	800	103	80.0	87.8	53.3	17	12.2
3-9	800	30,170	0	800	104	79.2	86.7	56.6	17	13.0
Ave -	-	30,170	0	-	105	79.6	87.7	54.9	17	12.8

TABLE 20 (Cont'd)

Spec. No.	Prestraining Conditions Temperature(°F)	Stress(psi)	% Elong. During Pre-stressing	Test Temp. (°F)	Ultimate Tensile Strength kpsi	Yield Points(kpsi) 0.02%	0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity 10^6 psi
3-10	800	30,170	.5	RT	156	140	148	38	14	17.8
3-11	800	30,170	.5	RT	156	141	148	37.5	12	17.6
3-12	800	30,170	0	RT	155	137	146	39	14	17.9
Ave -	-	30,170	.3		156	139	147	38.2	13	17.8
3-13	1000	23,380	17	1000	81.0	47.8	59.4	86.6	32	9.7
3-14	1000	23,380	8	1000	87.0	47.6	64.7	83.5	30	10.2
3-15	1000	23,380	19	1000	83.6	44.2	60.6	83.0	30	11.5
Ave -	-	23,380	14.6	-	83.9	46.5	61.6	84.4	31	10.5
3-16	1000	23,380	16	RT	161	148	153	23.5	9	18.8
3-17	1000	23,380	19	RT	159	146	154	33.5	10	18.3
3-18	1000	23,380	9	RT	155	137	147	5	5	17.9
Ave -	-	23,380	14.6		158	144	151	20.7	8	18.3

TABLE 21

TENSILE PROPERTIES OF Ti 155A NONSTRESSED STABILITY SPECIMENS
(EXPOSED FOR 100 HOURS AT TEMPERATURES SHOWN)

Spec. No.	Temperature (°F) Exposure	Test	Ultimate Tensile Strength (kpsi)	Yield Points (kpsi) 0.02%	0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity 10^6 psi
1-1	600	600	119	76.3	92.4	43.8	14	14.5
1-2	600	600	112	75.2	89.1	44.5	18	13.5
1-3	600	600	116	75.6	89.7	45.5	14	13.6
Ave. -	-	-	116	75.7	90.4	44.6	15	13.9
1-4	600	RT	149	123	135	34.2	11	15.4
1-5	600	RT	155	122	140	32.5	12	15.6
1-6	600	RT	148	119	132	37.1	13	15.4
Ave. -	-		151	121	136	34.6	12	15.5
1-7	800	800	108	80.4	88.4	49	16	13.0
1-8	800	800	107	76.5	88.3	48.6	17	12.3
1-9	800	800	106	79.3	87.5	50	14	12.1
Ave. -	-	-	107	78.7	88.1	49.2	16	12.5
1-10	800	RT	152	138	141	33	11	16.3
1-11	800	RT	154	139	142	32.5	11	18.1
1-12	800	RT	154	139	144	24	11	17.5
Ave. -	-		153	139	142	29.8	11	17.3
1-13	1000	1000	88.6	44.9	66.0	80.7	26	10.7
1-14	1000	1000	87.2	63.4	72.6	81.2	25	10.7
1-15	1000	1000	83.2	54.0	63.7	78.6	30	10.9
Ave. -	-	-	86.3	54.1	67.4	80.2	27	10.8

TABLE 21 (Cont'd)

Spec. No.	Temperature (°F) Exposure	Test	Ultimate Tensile Strength (kpsi)	Yield Points (kpsi) 0.02%	0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity 10^6 psi
1-16	1000	RT	156	135	143	28.5	12	18.3
1-17	1000	RT	158	135	143	33.5	15	17.6
1-18	1000	RT	157	135	144	33.5	8	18.6
Ave. -	-		157	135	143	31.8	12	18.2
2-1	600	600	118	70.4	93.5	46.9	15	14.3
2-2	600	600	114	79.0	93.5	55.7	11	13.9
2-3	600	600	112	81.5	92.1	54.2	19	14.3
Ave. -	-	-	115	76.9	93.0	52.3	15	14.2
2-4	600	RT	150	124	135	42.7	15	15.0
2-5	600	RT	150	124	134	43.7	16	15.1
2-6	600	RT	149	116	128	45.5	15	15.3
Ave. -	-		150	121	132	44.0	15	15.1
2-7	800	800	104	75.0	84.2	49.5	19	11.7
2-8	800	800	105	74.8	81.3	53.8	17	10.9
2-9	800	800	105	76.5	83.0	56.5	19	11.6
Ave. -	-	-	105	75.4	82.8	53.3	18	11.4
2-10	800	RT	151	140	142	38.0	15	17.8
2-11	800	RT	152	140	142	42.0	15	18.3
2-12	800	RT	154	140	142	25.7	16	16.4
Ave. -	-		152	140	142	35.2	15	17.5

TABLE 21 (Cont'd)

Spec. No.	Temperature (°F) Exposure	Test	Ultimate Tensile Strength (kpsi)	Yield Points (kpsi) 0.02%	0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity 10^6 psi
2-13	1000	1000	87.3	33.1	57.7	78.7	28	9.5
2-14	1000	1000	80.1	42.8	59.4	74.2	30	9.5
2-15	1000	1000	77.0	48.3	64.5	84.3	31	9.0
Ave. -	-	-	81.5	41.4	60.5	79.1	30	9.3
2-16	1000	RT	156	131	142	41.5	17	17.3
2-17	1000	RT	158	136	143	34.5	14	16.9
2-18	1000	RT	153	132	139	29.5	12	18.5
Ave. -	-		156	133	141	35.2	14	17.6
3-1	600	600	113	87.5	100	53.7	18	14.3
3-2	600	600	112	90.0	100	52.7	13	13.3
3-3	600	600	111	86.5	98.5	50.6	16	13.8
Ave. -	-	-	112	88.0	99.5	52.3	16	13.8
3-4	600	RT	154	139	147	40.9	12	15.4
3-5	600	RT	150	130	140	41.5	14	15.2
3-6	600	RT	155	132	146	40.6	12	16.3
Ave. -	-		153	134	144	41.0	13	15.6
3-7	800	800	101	73.2	82.8	54.3	17	13.2
3-8	800	800	103	75.1	83.6	56.5	16	12.8
3-9	800	800	104	-	-	55.4	17	-
Ave. -	-	-	103	74.2	83.2	55.4	17	13.0

TABLE 21 (Cont'd)

Spec. No.	Temperature (°F) Exposure	Test	Ultimate Tensile Strength (kpsi)	Yield Points (kpsi) 0.02%	0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity 10^6 psi
3-10	800	RT	152	136	143	38	13	17.9
3-11	800	RT	155	140	146	33.8	13	17.9
3-12	800	RT	154	139	145	33.8	12	18.3
Ave. -	-		154	138	145	35.2	13	18.0
3-13	1000	1000	81.1	53.0	65.3	86.3	34	8.6
3-14	1000	1000	81.0	47.0	63.7	89.7	35	8.6
3-15	1000	1000	81.5	47.2	65.0	87.2	40	9.8
Ave. -	-	-	81.2	49.1	64.7	87.7	36	9.0
3-16	1000	RT	159	140	150	37.3	13	18.4
3-17	1000	RT	156	135	146	38.3	13	18.5
3-18	1000	RT	154	135	146	38.3	13	17.9
Ave. -	-		156	137	147	38.0	13	18.3

TABLE 22

NOTCHED TENSILE PROPERTIES OF Ti 155A

Specimen No	Temperature (°F)	Reduction of Area (%)	Ultimate Strength (kpsi)	Elongation in/in (%)
1 - 1	RT	4.2	225.8	9.1
1 - 2	RT	5.0	225.8	10.6
1 - 3	RT	7.1	221.5	9.3
1 - 4	RT	4.5	223.2	9.0
1 - 5	RT	4.8	227.7	9.9
1 - 6	RT	7.1	225.2	7.4
1 - 7	RT	6.8	220.3	8.4
1 - 8	RT	5.33	227.8	9.4
1 - 9	RT	7.4	230.0	13.2
1 - 10	RT	5.1	216.9	11.7
Average		5.7	224.4	9.8
1 - 11	200	7.0	217.6	15.5
1 - 12	200	7.0	215.0	21.5
1 - 13	200	5.5	212.5	14.0
Average		6.5	215.0	17.0
1 - 14	400	10.0	193.2	13.0
1 - 15	400	9.0	191.8	18.0
1 - 16	400	9.0	192.3	17.0
Average		9.3	192.4	16.0
1 - 17	600	9.5	174.2	21.0
1 - 18	600	12.0	181.0	13.0
1 - 19	600	11.0	174.5	18.0
Average		10.8	176.6	17.3
1 - 20	800	14.0	163.5	28.5
1 - 21	800	14.0	165.7	25.5
1 - 22	800	13.5	163.1	24.6
Average		13.8	164.1	26.2
1 - 23	1000	27.5	139.1	29.0
1 - 24	1000	27.0	142.8	33.5
1 - 25	1000	26.0	143.1	40.0
Average		26.8	141.7	34.1
2 - 1	RT	7.4	234.8	11.2
2 - 2	RT	6.5	233.1	13.8
2 - 3	RT	9.1	236.0	17.1
2 - 4	RT	9.1	226.1	8.9
2 - 5	RT	7.1	236.5	11.9
2 - 6	RT	7.6	237.9	13.3
2 - 7	RT	8.4	233.6	12.1
2 - 8	RT	7.9	235.7	13.3
2 - 9	RT	7.3	237.7	10.8
2 - 10	RT	7.5	236.6	16.5
Average		7.8	234.8	12.9
2 - 11	200	9.0	219.8	15.5
2 - 12	200	8.5	221.5	17.5
2 - 13	200	11.0	223.0	17.0
Average		9.5	221.4	16.7

TABLE 22 (CONTINUED)

Specimen No.	Temperature (°F)	Reduction of Area (%)	Ultimate Strength (kpsi)	Elongation in/in (%)
2 - 14	400	13.0	186.0	19.0
2 - 15	400	15.5	194.4	19.0
2 - 16	400	12.5	195.5	19.5
Average		13.7	192.2	19.2
2 - 17	600	14.0	177.9	23.0
2 - 18	600	14.5	190.8	20.0
2 - 19	600	13.0	178.1	21.0
Average		13.8	182.3	21.3
2 - 20	800	17.0	162.2	21.0
2 - 21	800	11.5	163.2	24.0
2 - 22	800	18.5	161.0	30.0
Average		15.7	162.1	25.0
2 - 23	1000	41.0	126.5	61.0
2 - 24	1000	40.0	126.8	64.5
2 - 25	1000	36.5	124.3	61.0
Average		39.3	125.9	62.1
3 - 1	RT	6.8	236.6	10.8
3 - 2	RT	7.3	236.2	18.05
3 - 3	RT	7.04	233.5	9.2
3 - 4	RT	8.1	236.5	21.2
3 - 5	RT	6.4	235.5	17.1
3 - 6	RT	5.9	226.1	14.3
3 - 7	RT	5.9	240.5	10.8
3 - 8	RT	6.2	238.2	14.6
3 - 9	RT	6.2	231.1	9.7
3 - 10	RT	6.2	230.1	9.8
Average		6.6	234.4	13.6
3 - 11	200	11.0	223.3	11.0
3 - 12	200	11.0	222.9	15.5
3 - 13	200	11.0	222.9	18.0
Average		11.0	223.0	14.8
3 - 14	400	10.5	194.6	17.5
3 - 15	400	12.0	197.2	22.9
3 - 16	400	12.5	195.5	17.0
Average		11.7	195.8	19.1
3 - 17	600	16.5	176.3	20.5
3 - 18	600	15.0	178.8	16.0
3 - 19	600	13.0	184.4	20.5
Average		14.8	179.9	19.0
3 - 20	800	17.0	163.5	25.5
3 - 21	800	12.0	162.8	28.0
3 - 22	800	18.0	168.6	26.0
Average		15.7	165.0	26.5
3 - 23	1000	39.0	130.9	69.0
3 - 24	1000	36.5	129.5	59.0
3 - 25	1000	40.0	126.4	53.5
Average		38.5	128.9	60.5

TABLE 23

ROUND COMPRESSION PROPERTIES OF Ti 155A

Spec. No.	Temp. (°F)	Modulus of Elasticity (10^6 psi)	.2% Yield (kpsi)	.7 Secant (kpsi)	.85 Secant (kpsi)
1-1	RT	18.9	151	154	150
1-2	RT	Not Tested Specimen Damaged	-	-	-
1-3	RT	17.6	141	148	138
1-4	RT	17.7	139	143	134
1-5	RT	18.4	139	146	136
1-6	RT	17.2	141	147	138
1-7	RT	17.7	144	150	140
1-8	RT	17.7	140	148	136
1-9	RT	17.6	144	152	141
1-10	RT	18.2	140	146	134
Ave. -		17.9	142	148	139
1-11	200	17.0	129	136	125
1-12	200	16.4	128	135	123
1-13	200	17.9	128	134	122
Ave. -	-	17.1	128	135	123
1-14	400	17.0	109	114	108
1-15	400	16.4	108	112	104
1-16	400	17.7	123	126	120
Ave. -	-	17.0	113	117	111
1-17	600	16.7	95.9	98.6	91.0
1-18	600	17.1	102	104	95.8
1-19	600	Defective Test	-	-	-
Ave. -	-	16.9	98.9	101	93.4

TABLE 23 (Cont'd)

Spec. No.	Temp. (°F)	Modulus of Elasticity (10^6 psi)	.2% Yield (kpsi)	.7 Secant (kpsi)	.85 Secant (kpsi)
1-20	800	13.2	90.3	94.2	84.7
1-21	800	14.2	88.1	92.4	80.7
1-22	800	13.3	87.7	93.6	82.3
Ave. -	-	13.6	88.7	93.4	82.6
1-23	1000	13.2	69.9	73.2	63.6
1-24	1000	11.4	67.3	72.2	64.3
1-25	1000	11.1	65.3	70.0	60.2
Ave. -	-	11.9	67.5	71.8	62.7
2-1	RT	16.7	133	138	128
2-2	RT	16.5	130	140	123
2-3	RT	16.5	126	135	119
2-4	RT	17.0	126	133	117
2-5	RT	17.7	123	133	114
2-6	RT	17.0	126	133	118
2-7	RT	14.7	134	145	128
2-8	RT	17.1	126	138	119
2-9	RT	17.8	123	132	112
2-10	RT	18.6	123	130	109
Ave. -		17.0	127	136	119
2-11	200	17.3	111	117	98
2-12	200	19.0	118	123	107
2-13	200	17.0	117	124	101
Ave. -	-	17.8	115	121	102

TABLE 23 (Cont'd)

Spec. No.	Temp. (°F)	Modulus of Elasticity (10^6 psi)	.2% Yield (kpsi)	.7 Secant (kpsi)	.85 Secant (kpsi)
2-14	400	18.2	112	115	106
2-15	400	18.5	106	110	100
2-16	400	15.8	90.7	96.7	83.7
Ave. -	-	17.5	103	107	96.6
2-17	600	16.5	89.4	91.5	78.8
2-18	600	15.9	-	-	-
2-19	600	15.9	82.3	84.0	73.8
Ave. -	-	16.1	85.8	87.7	75.0
2-20	800	13.3	82.7	86.0	77.2
2-21	800	13.7	83.3	85.8	79.2
2-22	800	14.1	78.3	80.7	71.2
Ave. -	-	13.7	81.4	83.5	75.9
2-23	1000	8.2	64.7	67.1	62.0
2-24	1000	9.5	69.9	73.3	63.6
2-25	1000	12.4	61.8	62.3	56.0
Ave. -	-	10.0	65.5	67.5	60.5
3-1	RT	15.3	126	136	118
3-2	RT	16.5	125	134	119
3-3	RT	15.3	126	137	118
3-4	RT	16.0	127	137	117
3-5	RT	15.9	127	136	111
3-6	RT	15.9	125	138	118
3-7	RT	14.8	127	136	121
3-8	RT	16.5	127	141	118

TABLE 23 (Cont'd)

Spec. No.	Temp. (°F)	Modulus of Elasticity (10^6 psi)	.2% Yield (kpsi)	.7 Secant (kpsi)	.85 Secant (kpsi)
3-9	RT	16.5	126	136	118
3-10	RT	15.7	131	140	122
Ave. -		15.8	127	137	118
3-11	200	15.5	129	141	124
3-12	200	14.2	121	131	117
3-13	200	15.3	113	123	109
Ave. -	-	15.0	121	132	117
3-16	400	17.8	92.4	94.2	75.3
3-26	400	17.3	90.1	88.8	71.1
3-27	400	12.7	94.5	103	86.5
Ave. -	-	15.9	92.3	98.7	77.6
3-17	600	14.7	83.7	86.0	76.8
3-18	600	16.0	81.3	83.2	71.8
3-19	600	15.5	85.3	86.6	72.5
Ave. -	-	15.4	83.4	85.3	73.7
3-20	800	11.4	76.3	80.7	71.2
3-21	800	13.9	75.0	77.4	68.6
3-22	800	12.3	80.2	83.3	73.2
Ave. -	-	12.5	77.2	80.5	71.0
3-23	1000	11.4	64.3	63.2	49.6
3-24	1000	9.5	59.0	60.2	53.4
3-25	1000	9.4	53.4	55.3	48.3
Ave. -	-	10.1	58.9	59.6	50.4

TABLE 24
PIN SHEAR PROPERTIES OF Ti 155A

Spec No	Temp (°F)	Ultimate Strength (KSI)
1- 1	RT	105.6
1- 2	RT	103.1
1- 3	RT	99.1
1- 4	RT	98.8
1- 5	RT	110.5
1- 6	RT	103.0
1- 7	RT	110.8
1- 8	RT	106.3
1- 9	RT	110.2
1- 10	RT	107.8
Average		105.5
1- 1	200	95.0
1- 2	200	94.8
1- 3	200	94.4
Average		94.7
1- 4	400	82.4
1- 5	400	83.9
1- 6	400	82.0
Average		82.8
1- 7	600	73.2
1- 8	600	74.8
1- 9	600	75.7
Average		74.6
1- 10	800	68.8
1- 11	800	71.6
1- 12	800	69.2
Average		69.9
1- 13	1000	58.2
1- 14	1000	57.3
1- 15	1000	59.3
Average		58.3

Spec No.	Temp. (°F)	Ultimate Strength (KSI)
2- 1	RT	102.3
2- 2	RT	101.0
2- 3	RT	99.0
2- 4	RT	101.7
2- 5	RT	101.0
2- 6	RT	97.7
2- 7	RT	105.0
2- 8	RT	100.0
2- 9	RT	97.3
2- 10	RT	97.6
Average		100.3
2- 1	200	95.6
2- 2	200	89.1
2- 15	200	93.6
Average		92.8
2- 3	400	82.0
2- 4	400	82.4
2- 5	400	79.0
Average		81.1
2- 6	600	72.7
2- 7	600	73.9
2- 8	600	75.3
Average		74.0
2- 9	800	69.1
2- 10	800	63.9
2- 11	800	68.3
Average		67.1
2- 12	1000	56.4
2- 13	1000	53.2
2- 14	1000	55.1
Average		54.9

Spec No.	Temp. (°F)	Ultimate Strength (KSI)
3- 1	RT	97.0
3- 2	RT	101.0
3- 3	RT	99.5
3- 4	RT	97.9
3- 5	RT	97.0
3- 6	RT	98.4
3- 7	RT	106.1
3- 8	RT	109.5
3- 9	RT	101.5
3- 10	RT	101.8
Average		101.0
3- 1	200	–
3- 2	200	91.7
3- 13	200	90.0
Average		91.
3- 3	400	80.4
3- 4	400	82.1
3- 14	400	82.0
Average		81.5
3- 5	600	73.1
3- 6	600	76.8
3- 15	600	74.8
Average		74.9
3- 7	800	69.5
3- 8	800	68.2
3- 9	800	70.3
Average		69.3
3- 10	1000	55.4
3- 11	1000	55.4
3- 12	1000	54.0
Average		54.9

TABLE 25

BEARING PROPERTIES OF Ti155A, $e/D = 1.5$

Specimen	Temperature (°F)	Location of Failure	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
1 - 1	80	a	248	224
1 - 2	80	a	250	217
1 - 3	80	b	236	215
1 - 4	80	b	245	–
1 - 5	80	a	248	218
1 - 6	80	b	247	217
1 - 7	80	b	247	223
1 - 8	80	b	238	204
1 - 9	80	b	244	214
1 - 10	80	b	235	214
Average	80		244	216
1 - 11	200	a	219	195
1 - 12	200	a	219	190
1 - 13	200	a	217	—
Average	200		218	192
1 - 20	400	a	193	182
1 - 21	400	a	200	180
1 - 22	400	a	205	182
Average	400		199	181
1 - 23	600	a	185	169
1 - 24	600	a	182	170
1 - 25	600	a	185	172
Average	600		184	170
1 - 32	800	a	174	164
1 - 33	800	a	181	167
1 - 34	800	a	177	—
Average	800		177	165
1 - 35	1000	a	138	123
1 - 36	1000	a	148	131
1 - 37	1000	a	141	137
Average	1000		142	130
2 - 1	80		241	204
2 - 2	80		234	–
2 - 3	80		244	211
2 - 4	80		245	209
2 - 5	80		241	197
2 - 6	80		236	201
2 - 7	80		236	196
2 - 8	80		237	197
2 - 9	80		236	199
2 - 10	80		237	197
Average	60		238	201
2 - 14	200	b	218	192
2 - 15	200	b	223	199
2 - 16	200	b	221	197
Average	200		221	196

TABLE 25 (CONTINUED)

Specimen	Temperature (°F)	Location of Failure	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
2 - 17	400	a	203	166
2 - 18	400	a	195	174
2 - 19	400	a	197	178
Average	400		198	173
2 - 26	600	a	183	161
2 - 27	600	a	187	168
2 - 28	600	a	190	170
Average	600		187	166
2 - 29	800	a	170	–
2 - 30	800	a	174	158
2 - 31	800	a	173	156
Average	800		172	157
2 - 38	1000	a	141	126
2 - 39	1000	a	135	123
2 - 40	1000	a	133	129
Average	1000		136	126
3 - 1	80		240	199
3 - 2	80		237	208
3 - 3	80		235	202
3 - 4	80		238	201
3 - 5	80		238	204
3 - 6	80		232	208
3 - 7	80		239	–
3 - 8	80		242	–
3 - 9	80		246	207
3 - 10	80		242	–
Average	80		239	204
3 - 14	200	a	219	197
3 - 15	200	a	231	212
3 - 16	200	b	219	196
Average	200		223	202
3 - 17	400	a	205	187
3 - 18	400	a	202	–
3 - 19	400	a	196	180
Average	400		201	183
3 - 26	600	a	186	173
3 - 27	600	a	189	174
3 - 28	600	b	190	175
Average	600		188	174
3 - 29	800	a	173	–
3 - 30	800	a	168	155
3 - 41	800	a	172	159
Average	800		171	157
3 - 38	1000	a	137	123
3 - 39	1000	a	146	131
3 - 40	1000	a	138	124
Average	1000		140	126

TABLE 26

BEARING PROPERTIES OF Ti155A $e/D = 2.0$

Specimen	Temperature (°F)	Location of Fracture	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
1- 1	80		305	253
1- 2	80		305	241
1- 3	80		308	266
1- 4	80		306	270
1- 5	80		364	261
1- 6	80		305	240
1- 7	80		311	254
1- 8	80		309	241
1- 9	80		308	241
1- 10	80		314	240
Average			308	251
1- 14	200	b	285	245
1- 15	200	b	278	237
1- 16	200	b	287	243
Average			282	242
1- 17	400	b	262	209
1- 18	400	a	262	224
1- 19	400	a	261	208
Average			262	214
1- 26	600	b	234	—
1- 27	600	b	237	203
1- 28	600	a	240	206
Average			237	204
1- 29	800	b	214	176
1- 30	800	b	221	187
1- 31	800	b	219	194
Average			218	186
1- 38	1000	a	183	156
1- 39	1000	a	181	156
1- 40	1000	a	191	—
Average			185	156
2- 1	80	a	304	262
2- 2	80	a	—	—
2- 3	80	b	308	266
2- 4	80	b	300	253
2- 5	80	b	308	262
2- 6	80	b	309	267
2- 7	80	b	307	263
2- 8	80	a	309	261
2- 9	80	b	313	253
2- 10	80	b	309	—
Average			307	261

TABLE 26 (CONTINUED)

Specimen	Temperature (°F)	Location of Fracture	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
2- 11	200	b	276	231
2- 12	200	a	290	237
2- 13	200	b	274	220
Average			280	229
2- 20	400	a	251	–
2- 21	400	a	253	209
2- 22	400	b	257	204
Average			254	215
2- 23	600	a	231	197
2- 24	600	a	233	198
2- 25	600	a	234	192
Average			233	196
2- 32	800	a	216	185
2- 33	800	a	209	174
2- 34	800	a	202	181
Average			209	180
2- 35	1000	a	173	153
2- 36	1000	a	181	149
2- 37	1000	a	186	152
Average			180	151
3- 1	80	b	316	260
3- 2	80	a	317	251
3- 3	80	a	351	271
3- 4	80	b	337	265
3- 5	80	a	307	260
3- 6	80	a	309	–
3- 7	80	b	315	261
3- 8	80	b	298	254
3- 9	80	b	318	263
3- 10	80	b	303	255
Average			317	260
3- 11	200	a	280	240
3- 12	200	b	289	247
3- 13	200	b	285	–
Average			285	243
3- 20	400	b	274	231
3- 21	400	a	256	224
3- 22	400	a	259	214
Average			263	223

TABLE 26 (CONTINUED)

Specimen	Temperature (°F)	Location of Fracture	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
3-23	600	a	235	205
3-24	600	a	227	201
3-25	600	a	232	199
Average			231	202
3-32	800	a	220	188
3-33	800	a	220	187
3-34	800	a	231	196
Average			224	190
3-35	1000	a	182	152
3-36	1000	a	170	145
3-37	1000	a	169	141
Average			174	146

TABLE 27

TORSION PROPERTIES OF Ti 155A

Specimen No.	Heat No.	0.2% Yield Strength (kpsi)	Modulus of Rupture (kpsi)	Shear Modulus (10^6 psi)	Twist per Inch (degrees)
14A	1	101.8	132.0	*	54.9
14B	1	101.0	131.5	*	42.8
14C	1	102.6	130.9	*	49.6
14D	1	101.0	131.5	6.8	57.6
Average		101.6	131.5	6.8	51.2
25A	2	90.5	129.3	*	137.3
25B	2	91.3	127.8	6.7	120.0
25C	2	92.5	128.0	6.7	115.0
25D	2	92.7	128.8	6.8	*
Average		91.8	128.5	6.7	124.1
33A	3	96.6	132.5	*	52.5
33B	3	103.0	133.8	6.4	47.1
33C	3	*	*	*	*
33D	3	97.0	126.5	6.9	54.6
Average		98.9	130.9	6.7	51.4

* Data obtained invalid.

TABLE 28

CHARPY IMPACT PROPERTIES, OF Ti155A

HEAT NO. 1

Temp. (°F)	Spec No	Foot-Pounds
75	1	13
75	2	19
75	3	14
75	4	14
75	5	14
Average		15
-108	1	12
-108	2	11
-108	3	10
-108	4	12
Average		11
-423	1	9
-423	2	7
-423	3	8
-423	4	7
-423	5	7
Average		8
500	1	30
500	2	32
500	3	33
500	4	36
Average		33
300	1	22
300	2	22
300	3	22
300	4	22
Average		22

HEAT NO 2

Temp. (°F)	Spec No	Foot-Pounds
75	1	17
75	2	13
75	3	14
75	4	16
75	5	16
Average		15
-108	1	17
-108	2	17
-108	3	13
-108	4	15
-108	5	14
Average		15
-423	1	9
-423	2	11
-423	3	10
-423	4	9
-423	5	11
Average		10
500	1	42
500	2	42
500	3	44
500	4	43
Average		43
300	1	29
300	2	28
300	3	28
300	4	29
Average		28

HEAT NO 3

Temp (°F)	Spec. No.	Foot-Pounds
75	1	17
75	2	16
75	3	14
75	4	18
75	5	15
Average		16
-108	1	15
-108	2	11
-108	3	13
-108	4	14
Average		13
-423	1	9
-423	2	10
-423	3	9
-423	4	6
Average		8
500	1	36
500	2	36
500	3	36
500	4	42
Average		37
300	1	26
300	2	27
300	3	24
300	4	27
Average		26

TABLE 29

TENSILE PROPERTIES OF C135AMo

Specimen No.	Test Temperature (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	Yield Strength (kpsi) 0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity (10^6 psi)
1-1	RT	174	120	146	50.1	16	15.1
1-2	RT	172	(a)	-	51.7	17	-
1-3	RT	169	115	135	51.2	18	13.1
1-4	RT	167	117	134	50.7	18	13.5
1-5	RT	167	114	129	50.7	18	13.1
1-6	RT	173	123	145	49.0	17	13.3
1-7	RT	169	119	137	51.4	18	14.1
1-8	RT	167	(a)	-	52.7	17	12.9
1-9	RT	172	131	145	52.2	17	13.8
1-10	RT	169	122	141	37.8	17	13.8
Ave. - -		170	120	139	49.7	17	13.6
1-11	200	161	105	127	54.0	17	13.3
1-12	200	158	104	120	51.7	20	12.4
1-13	200	157	108	122	66.6	20	12.4
Ave. - -	-	159	106	123	57.4	19	12.7
1-14	400	145	97.6	112	59.8	21	12.7
1-15	400	144	92.8	105	56.6	17	12.0
1-16	400	149	97.0	114	56.5	15	14.1
Ave. - -	-	146	95.8	110	57.6	18	12.9
1-17	600	146	82.2	104	57.0	16	13.5
1-18	600	139	80.2	96.0	58.3	18	12.4
1-19	600	137	86.9	100	59.8	19	14.5
Ave. - -	-	141	83.1	100	58.4	18	13.5

(a) Yields not obtained because of recorder malfunction.

TABLE 29 (Cont'd)

Specimen No.	Test Temperature (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	Yield Strength (kpsi) 0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity (10^6 psi)
1-20	800	144	79.0	97.3	60.1	17	11.7
1-21	800	146	82.3	100	60.9	16	13.2
1-22	800	144	78.3	98.0	62.6	17	11.5
Ave. - -	-	145	79.9	98	61.2	17	12.1
1-23	1000	131	61.2	73.3	71.3	25	12.1
1-24	1000	125	67.3	87.7	72.9	26	10.6
1-25	1000	130	50.5	74.0	73.8	22	14.8
Ave. - -	-	129	60.0	78.3	72.7	24	12.5
2-1	RT	171	120	135	45.7	16	14.1
2-2	RT	170	120	137	48.2	16	14.4
2-3	RT	173	120	138	44.3	14	14.1
2-4	RT	168	115	131	45.2	15	13.7
2-5	RT	166	114	128	47.5	15	12.8
2-6	RT	172	120	139	44.3	16	14.8
2-7	RT	173	121	140	46.7	15	13.6
2-8	RT	169	119	136	49.3	19	14.0
2-9	RT	168	119	135	46.0	17	14.0
2-10	RT	165	110	127	47.8	16	13.3
Ave. - -		169	118	135	46.5	16	13.9
2-11	200	163	112	128	49.3	15	13.2
2-12	200	163	108	128	48.7	15	14.2
2-13	200	162	105	125	49.7	15	14.7
Ave. - -	-	163	108	127	49.2	15	14.0

TABLE 29 (Cont'd)

Specimen No.	Test Temperature (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	Yield Strength (kpsi) 0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity (10^6 psi)
2-14	400	150	86.8	108	50.2	16	14.0
2-15	400	150	95.0	108	43.0	17	12.6
2-16	400	153	94.8	110	48.1	16	12.4
Ave. - -	-	151	92.2	108	47.1	16	13.0
2-17	600	148	88.8	107	49.3	15	-
2-18	600	147	82.8	105	50.5	16	12.6
2-19	600	148	90.3	109	50.2	15	13.5
Ave. - -	-	148	87.3	107	50.0	15	13.0
2-20	800	149	83.3	-	59.2	14	12.2
2-21	800	145	80.8	97.0	61.4	16	10.1
2-22	800	144	80.7	99.2	66.9	17	11.6
Ave. - -	-	146	81.6	98.1	62.5	16	11.3
2-23	1000	127	73.2	81.8	72.9	23	13.9
2-24	1000	131	70.0	83.3	70.6	23	10.0
2-25	1000	129	63.8	85.3	67.5	23	10.8
Ave. - -	-	129	69.0	83.5	70.3	23	11.6
3-1	RT	170	119	140	52.0	18	14.2
3-2	RT	173	120	143	52.5	16	14.5
3-3	RT	176	112	145	49.0	14	15.9
3-4	RT	171	113	139	52.5	18	16.8
3-5	RT	167	116	135	51.0	18	13.2
3-6	RT	175	114	144	50.0	15	14.6
3-7	RT	176	126	148	52.5	15	14.6

TABLE 29 (Cont'd)

Specimen No.	Test Temperature (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	Yield Strength (kpsi) 0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity (10^6 psi)
3-8	RT	174	125	147	48.5	15	14.6
3-9	RT	175	122	147	53.0	15	13.1
3-10	RT	175	112	147	54.0	16	15.1
Ave. - -		173	119	143	51.5	16	14.7
3-11	200	156	105	121	53.0	17	11.9
3-12	200	163	105	129	54.0	17	13.7
3-13	200	156	100	120	52.0	17	12.1
Ave. - -	-	158	103	123	53.0	17	12.6
3-14	400	143	75.2	100	59.2	19	15.2
3-15	400	148	96.6	114	58.0	18	10.2
3-16	400	142	(a)	(a)	59.8	19	-
Ave. - -	-	144	85.9	105	59.0	19	12.7
3-17	600	141	68.1	93.0	55.0	16	14.2
3-18	600	139	75.4	97.4	56.0	16	13.7
3-19	600	137	83.1	97.6	56.5	17	12.2
Ave. - -	-	139	75.5	96.0	55.8	16	13.4
3-20	800	140	69.6	97.4	61.5	18	15.0
3-21	800	139	62.9	91.9	64.0	16	14.6
3-22	800	143	72.3	98.9	59.1	19	9.2
Ave. - -	-	141	68.2	96.1	61.5	18	12.9

(a) Yield not obtained because of recorder malfunction.

TABLE 29 (Cont'd)

Specimen No.	Test Temperature (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	Yield Strength (kpsi) 0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity (10^6 psi)
3-23	1000	127	61.9	79.8	74.5	25	19.3 (b)
3-24	1000	129	72.6	87.9	78.5	27	7.9
3-25	1000	115 (c)	62.5	77.6	77.5	16 (c)	10.2
Ave. - -	-	128	65.6	81.8	76.8	26	9.0

(b) Not used in average.
(c) Not used in average, failed at gage mark.

TABLE 30

TENSILE PROPERTIES OF C135AMo
Nonstressed Stability

Specimen No.	Pre-exposure Temperature (°F)	Test Temp. (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	Yield Strength (kpsi) 0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity (10^6 psi)
1-26	1000	RT	182 (a)	172	180	-	-	18.2
1-27	1000	RT	189	170	177	14.8	6	18.4
1-28	1000	RT	188 (a)	175	180	-	-	17.4
Ave. - -	-	-	186	172	179	14.8	6	18.0
1-29	1000	1000	115	63.2	89.3	81.5	25	13.5
1-30	1000	1000	116	62.7	91.3	77.6	28	10.9
1-31	1000	1000	116	62.3	84.0	77.7	28	11.5
Ave. - -	-	-	116	63	88	78.9	27	11.9
1-32	800	RT	208	154	172	23.2	8	17.5
1-33	800	RT	209	157	174	22.3	7	17.0
1-34	800	RT	203	-	-	23.4	7	-
Ave. - -	-	-	207	155	173	23.0	7.7	17.2
1-35	800	800	154	74.2	103	60.5	14	13.1
1-36	800	800	155	83.8	109	59.8	14	14.0
1-37	800	800	155	76.2	103	58.1	14	18.5
Ave. - -	-	-	155	79	105	59.5	14	15.2
1-38	600	RT	186	137	156	42.4	11	16.8
1-39	600	RT	191	138	162	44.7	13	16.6
1-40	600	RT	191	145	166	42.5	11	16.7
Ave. - -	-	-	189	140	161	43.2	11.7	16.6

(a) Specimen failed at threads.

TABLE 30 (Cont'd)

Specimen No.	Pre-exposure Temperature (°F)	Test Temp. (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	Yield Strength (kpsi) 0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity (10^6 psi)
1-41	600	600	145	87.0	105	54.8	15	14.3
1-42	600	600	150	88.0	109	52.4	15	11.9
1-43	600	600	151	83.7	107	52.0	14	12.3
Ave. - -	-	-	149	86	107	53.0	14.7	12.8
2-26	1000	RT	195	173	180	10.2	6	18.8
2-27	1000	RT	193	173	177	11.2	6	16.8
2-28	1000	RT	192	169	177	26.4	9	17.3
Ave. - -	-		193	172	178	15.9	7	17.7
2-29	1000	1000	119	70.0	86.3	79.7	26	10.5
2-30	1000	1000	119	75.5	88.7	79.2	25	10.0
2-31	1000	1000	117	69.3	86.0	83.5	26	9.7
Ave. - -	-	-	118.3	71.7	87.0	81.0	25.7	10
2-32	800	RT	207	152	166	18.7	6	18.1
2-33	800	RT	206	154	169	22.1	6	16.9
2-34	800	RT	202	155	168	27.8	7	16.6
Ave. - -	-		205	154	168	22.9	6.3	17.2
2-35	800	800	159	91.1	111	57.8	13	13.8
2-36	800	800	155	92.7	107	55.3	14	10.8
2-37	800	800	154	88.3	105	54.7	14	12.3
Ave. - -	-	-	156	90.7	108	55.9	13.7	12.3

TABLE 30 (Cont'd)

Specimen No.	Pre-exposure Temperature (°F)	Test Temp. (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	Yield Strength (kpsi) 0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity (10^6 psi)
2-38	600	RT	191	134	156	35.8	10	16.4
2-39	600	RT	190	139	157	39.5	9	15.9
2-40	600	RT	190	137	158	38.9	11	16.3
Ave. - -	-		190	137	157	38.1	10	16.3
2-41	600	600	149	89.4	108	43.6	14	11.7
2-42	600	600	151	94.7	110	44.5	12	12.5
2-43	600	600	151	90.0	107	46.3	12	12.5
Ave. - -	-	-	150	91.3	108	44.8	12.7	12.4
3-26	1000	RT	189	169	176	34.6	9	17.8
3-27	1000	RT	191	167	176	34.6	11	18.2
3-28	1000	RT	192	168	177	34.0	10	18.6
Ave. - -	-		190	167	176	34.4	10	18.2
3-29	1000	1000	114	57.3	82.7	81.6	28	11.5
3-30	1000	1000	116	60.6	84.7	81.7	28	11.2
3-31	1000	1000	119	(a)	-	81.7	24	12.4
Ave. - -	-	-	116	59	83.7	81.3	27	11.7
3-32	800	RT	205	153	171	24.0	9	17.3
3-33	800	RT	210	162	183	30.8	8	17.4
3-34	800	RT	202	155	172	31.3	10	16.3
Ave. - -	-		205	156	175	28.7	9	17.0

(a) Yield strength not obtained because of recorder malfunction.

TABLE 30 (Cont'd)

Specimen No.	Pre-exposure Temperature (°F)	Test Temp. (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	Yield Strength (kpsi) 0.2%	Reduction of Area (%)	Elongation (%)	Modulus of Elasticity (10^6 psi)
3-35	800	800	148	89.5	104	59.7	15	12.0
3-36	800	800	151	94.0	109	59.6	15	11.4
3-37	800	800	151	90.0	107	58.8	16	11.1
Ave. - -	-	-	150	91.2	106	59.3	15	11.5
3-38	600	RT	190	136	162	48.9	12	17.8
3-39	600	RT	192	147	164	41.6	10	16.0
3-40	600	RT	195	144	165	40.4	9	16.2
Ave. - -	-		192	142	163	43.6	10.3	16.6
3-41	600	600	142	87.3	104	54.9	16	13.4
3-42	600	600	148	85.0	106	47.6	17	13.8
3-43	600	600	145	85.6	105	56.0	14	14.0
Ave. - -	-	-	145	86.0	105	52.8	15.7	13.7

TABLE 31

TENSILE PROPERTIES OF C135AMo
Stressed Stability

Spec. No.	Prestressing Temp. (°F)	Prestressing Conditions Stress (psi)	% Elong. During Prestressing	Test Temp. (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	Yield Strength (kpsi) 0.2%	Reduction of Area (%)	Elong. (%)	Modulus of Elasticity (10^6 psi)
1-44	1000	24,600	1	RT	191	165	180	(*)	(*)	18.3
1-45	1000	24,600	2	RT	188	160	171	35.0	11	17.4
1-46	1000	24,600	2	RT	187	162	173	36.1	12	17.7
Ave. -	-	24,600	1.7		189	162	175	35.5	11.5	17.8
1-47	1000	24,600	0	1000	113	65.8	81.7	83.3	28	10.8
1-48	1000	24,600	3	1000	114	58.6	81.2	83.5	25	10.8
1-49	1000	24,600	2	1000	111	67.0	80.8	82.3	32	9.5
Ave. -	-	24,600	1.7	-	113	63.8	81.2	82.7	28	10.3
1-50	800	32,800	2	RT	208	169	194	1.8	2	18.6
1-51	800	32,800	2	RT	201	166	193	3.3	1	16.9
1-52	800	32,800	2	RT	207	158	195	10.1	5	16.5
Ave. -	-	32,800	2		205	164	194	5.0	2.7	17.1
1-53	800	32,800	1	800	152	81.6	102	59.1	16	13.5
1-54	800	32,800	0	800	157	70.9	101	57.7	14	15.1
1-55	800	32,800	0	800	155	83.2	104	56.5	14	14.5
Ave. -	-	32,800	.3	-	155	78.5	102	57.7	14.7	14.3
1-56	600	33,300	1	RT	193	138	161	41.9	9	15.8
1-57	600	33,300	0	RT	190	142	161	39.8	11	17.1
1-58	600	33,300	0	RT	185	137	158	45.0	13	15.9
Ave. -	-	33,300	.3		189	139	160	42.2	11	16.2

(*) Specimen failed in threads.

TABLE 31 (Cont'd)

Spec. No.	Prestressing Temp.(°F)	Conditions Stress (psi)	% Elong. During Prestressing	Test Temp. (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength(kpsi) 0.02%	0.2%	Reduction of Area (%)	Elong. (%)	Modulus of Elasticity (10^6 psi)
1-59	600	33,300	2	600	147	84.8	106	55.2	14	12.9
1-60	600	33,300	1	600	151	84.5	105	50.4	16	13.4
1-61	600	33,300	1	600	150	78.8	102	48.2	14	12.5
Ave. -	-	33,300	1.3	-	149	82.7	104	51.2	14.7	12.9
2-44	1000	27,800	3	RT	191	161	173	27.7	10	17.6
2-45	1000	27,800	2	RT	198	165	177	26.8	7	16.6
2-46	1000	27,800	2	RT	188	163	171	32.4	10	16.7
Ave. -	-	27,800	2.3		192	163	174	28.9	9	17.0
2-47	1000	27,800	1	1000	121	69.5	84.8	80.8	26	9.6
2-48	1000	27,800	2	1000	110	67.2	81.3	83.7	30	10.2
2-49	1000	27,800	3	1000	112	65.9	83.7	82.5	28	10.0
Ave. -	-	27,800	2	-	114	67.5	83	82.3	28	9.9
2-50	800	32,700	1	RT	208	144	168	19.7	7	17.6
2-51	800	32,700	0	RT	207	147	167	21.3	8	16.3
2-52	800	32,700	0	RT	208	150	169	21.3	6	16.9
Ave. -	-	32,700	.3		208	147	168	20.8	7	16.9
2-53	800	32,700	0	800	155	81.3	102	51.5	15	11.2
2-54	800	32,700	0	800	155	82.9	103	53.9	13	11.2
2-55	800	32,700	1	800	155	75.0	98.7	51.3	13	13.3
Ave. -	-	32,700	.3	800	155	79.7	101	52.2	14	11.9

TABLE 31 (Cont'd)

Spec. No.	Prestressing Conditions Temp.(°F)	Stress (psi)	% Elong. During Prestressing	Test Temp. (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength(kpsi) 0.02%	0.2%	Reduction of Area (%)	Elong. (%)	Modulus of Elasticity (10^6 psi)
2-56	600	35,700	0	RT	194	140	160	32.4	9	15.7
2-57	600	35,700	0	RT	193	132	157	37.3	10	16.8
2-58	600	35,700	1	RT	191	134	156	35.8	10	16.4
Ave. -	-	35,700	.3		193	135	158	35.1	10	16.3
2-59	600	35,700	1	600	150	83.8	106	49.3	14	12.3
2-60	600	35,700	1	600	152	83.4	105	46.8	13	13.4
2-61	600	35,700	1	600	147	82.8	105	53.7	15	14.0
Ave. -	-	35,700	1	-	150	83.3	105	49.9	14	13.2
3-44	1000	26,200	2	RT	190	161	174	37.3	10	18.2
3-45	1000	26,200	2	RT	202	174	185	35.3	10	17.2
3-46	1000	26,200	3	RT	199	170	183	34.1	11	17.4
Ave. -	-	26,200	2.3		197	168	181	35.6	10	17.6
3-47	1000	26,200	2	1000	111	72.8	87.8	83.3	20	10.9
3-48	1000	26,200	1	1000	115	62.2	84.1	82.8	31	13.3
3-49	1000	26,200	2	1000	113	58.0	81.2	80.6	28	12.9
Ave. -	-	26,200	1.7	-	113	64	84.3	82.2	26	12.4
3-50	800	32,000	0	RT	209	133	167	29.2	9	17.2
3-51	800	32,000	0	RT	206	135	168	28.2	9	17.2
3-52	800	32.000	0	RT	209	154	173	27.5	9	16.8
Ave. -	-	32,000	0		208	141	169	28.2	9	17.0

TABLE 31 (Cont'd)

Spec. No.	Prestressing Temp. (°F)	Conditions Stress (psi)	% Elong. During Prestressing	Test Temp. (°F)	Ultimate Tensile Strength (kpsi)	Yield Strength (kpsi) 0.02%	0.2%	Reduction of Area (%)	Elong. (%)	Modulus of Elasticity (10^6 psi)
3-53	800	32,000	0	800	148	81.3	98.0	58.6	14	11.8
3-54	800	32,000	0	800	151	81.4	103	60.1	14	11.7
3-55	800	32,000	0	800	148	82.0	100	58.1	14	11.5
Ave. -	-	32,000	0	-	149	81.5	100.3	58.9	14	11.7
3-56	600	32,000	0	RT	194	141	162	40.5	11	16.3
3-57	600	32,000	0	RT	194	141	162	40.4	11	16.2
3-58	600	32,000	0	RT	193	138	158	44.6	11	16.0
Ave. -	-	32,000	0		194	140	161	41.8	11	16.2
3-59	600	32,000	0	600	144	85.5	103	53.6	15	14.0
3-60	600	32,000	0	600	144	73.4	101	55.2	16	12.9
3-61	600	32,000	0	600	146	83.5	103	54.4	14	12.9
Ave. -	-	32,000	0	-	145	80.8	102	54.4	15	13.3

TABLE 32

NOTCHED TENSILE PROPERTIES OF C135AMo

	Specimen No.	Test Temperature (°F)	Ultimate Tensile Strength (kpsi)	Reduction of Area (%)
	1-62	RT	242	8.0
	1-63	RT	262	10.7
	1-64	RT	240	10.0
	1-65	RT	258	6.4
	1-66	RT	244	11.7
	1-67	RT	263	7.7
	1-68	RT	262	6.5
	1-69	RT	266	29.0
	1-70	RT	266	7.5
	1-71	RT	264	8.8
Ave.	-		257	10.6
	1-72	200	241	8.8
	1-73	200	240	10.8
	1-74	200	235	11.6
Ave.	-	-	239	10.4
	1-75	400	225	11.7
	1-76	400	229	15.2
	1-77	400	228	11.0
Ave.	-	-	227	12.6
	1-78	600	203	17.8
	1-79	600	204	18.2
	1-80	600	212	14.7
Ave.	-	-	206	16.9

TABLE 32 (Cont'd)

NOTCHED TENSILE PROPERTIES OF C135AMo

	Specimen No.	Test Temperature (°F)	Ultimate Tensile Strength (kpsi)	Reduction of Area (%)
	1-81	800	209	13.5
	1-82	800	217	14.3
	1-83	800	210	14.7
Ave.	-	-	212	14.2
	1-84	1000	201	23.5
	1-85	1000	196	34.8
	1-86	1000	200	28.5
Ave.	-	-	199	28.9
	2-62	RT	249	9.2
	2-63	RT	245	6.2
	2-64	RT	250	7.3
	2-65	RT	243	9.3
	2-66	RT	245	8.3
	2-67	RT	243	5.4
	2-68	RT	255	7.0
	2-69	RT	252	8.5
	2-70	RT	241	6.3
	2-71	RT	242	8.3
Ave.	-		247	7.6
	2-72	200	243	10.7
	2-73	200	234	8.3
	2-74	200	237	8.2
Ave.	-	-	238	9.0

TABLE 32 (Cont'd)

NOTCHED TENSILE PROPERTIES OF C135AMo

	Specimen No.	Test Temperature (°F)	Ultimate Tensile Strength (kpsi)	Reduction of Area (%)
	2-75	400	223	12.5
	2-76	400	222	9.2
	2-77	400	212	12.3
Ave.	-	-	219	11.3
	2-78	600	201	11.2
	2-79	600	200	12.7
	2-80	600	204	12.4
Ave.	-	-	202	12.1
	2-81	800	204	10.7
	2-82	800	198	11.0
	2-83	800	206	8.4
Ave.	-	-	203	10.0
	2-84	1000	199	15.8
	2-85	1000	195	18.2
	2-86	1000	204	10.9
Ave.	-	-	199	14.9
	3-62	RT	247	5.7
	3-63	RT	242	6.2
	3-64	RT	242	6.3
	3-65	RT	250	4.5
	3-66	RT	236	4.5
	3-67	RT	239	6.2

TABLE 32 (Cont'd)

NOTCHED TENSILE PROPERTIES OF C135AMo

	Specimen No.	Test Temperature (°F)	Ultimate Tensile Strength (kpsi)	Reduction of Area (%)
	3-68	RT	239	7.7
	3-69	RT	250	6.3
	3-70	RT	249	7.0
	3-71	RT	246	8.8
Ave.	-	-	244	6.3
	3-72	200	220	8.2
	3-73	200	235	10.0
	3-74	200	229	9.8
Ave.	-	-	228	9.3
	3-75	400	225	9.0
	3-76	400	212	12.7
	3-77	400	208	12.7
Ave.	-	-	215	11.4
	3-78	600	210	12.4
	3-79	600	202	12.4
	3-80	600	204	13.3
Ave.	-	-	205	12.7
	3-81	800	200	22.8
	3-82	800	206	9.5
	3-83	800	200	10.0
Ave.	-	-	202	14.1

TABLE 32 (Cont'd)

NOTCHED TENSILE PROPERTIES OF C135AMo

	Specimen No.	Test Temperature (°F)	Ultimate Tensile Strength (kpsi)	Reduction of Area (%)
	3-84	1000	185	26.7
	3-85	1000	187	21.6
	3-86	1000	191	12.2
Ave.	-	-	188	20.1

TABLE 33

COMPRESSION PROPERTIES OF C135AMo

	Specimen No.	Temperature (°F)	0.2% Yield (kpsi)	.7 Secant (kpsi)	.85 Secant (kpsi)	Modulus of Elasticity (10^6 psi)
	1-112	RT	153	160	151	15.0
	1-113	RT	147	157	143	16.5
	1-114	RT	153	163	151	15.0
	1-115	RT	149	159	147	15.5
	1-116	RT	140	148	137	14.2
	1-117	RT	141	149	139	15.0
	1-118	RT	148	157	144	16.5
	1-119	RT	144	152	141	15.0
	1-120	RT	154	165	151	16.2
	1-121	RT	151	160	149	15.9
Ave.	-		148	157	145	15.5
	1-122	200	122	129	119	14.7
	1-123	200	129	136	124	15.8
	1-124	200	127	133	125	14.3
Ave.	-	-	126	132	123	14.9
	1-125	400	116	124	111	15.5
	1-126	400	123	130	117	16.0
	1-127	400	111	116	106	15.3
Ave.	-	-	117	123	111	15.6
	1-128	600	106	110	101	16.1
	1-129	600	106	114	101	14.0
	1-130	600	104	111	102	14.7
Ave.	-	-	105	111.6	101.3	14.9

TABLE 33 (Cont'd)

COMPRESSION PROPERTIES OF C135AMo

	Specimen No.	Temperature (°F)	0.2% Yield (kpsi)	.7 Secant (kpsi)	.85 Secant (kpsi)	Modulus of Elasticity (10^6 psi)
	1-131	800	94.7	102	89.2	13.2
	1-132	800	98.2	108	92.8	14.0
	1-133	800	101	114	96.3	12.7
Ave.	-	-	97.9	108	92.7	13.3
	1-134	1000	87.8	96.2	85.8	12.1
	1-135	1000	88.2	96.2	83.9	10.0
	1-136	1000	87.8	95.4	82.7	10.4
Ave.	-	-	87.9	95.9	84.1	10.8
	2-112	RT	145	155	143	15.6
	2-113	RT	145	157	143	15.5
	2-114	RT	-	-	-	-
	2-115	RT	131	141	133	16.0
	2-116	RT	125	131	121	15.8
	2-117	RT	131	139	127	15.8
	2-118	RT	133	143	127	15.8
	2-119	RT	131	139	126	14.6
	2-120	RT	140	150	135	15.4
	2-121	RT	133	144	130	15.1
Ave.	-		134	144	132	15.5
	2-122	200	124	131	120	15.3
	2-123	200	126	133	119	15.9
	2-124	200	134	141	129	16.7
Ave.	-	-	128	135	123	16.0

TABLE 33 (Cont'd)

COMPRESSION PROPERTIES OF C135AMo

	Specimen No.	Temperature (°F)	0.2% Yield (kpsi)	.7 Secant (kpsi)	.85 Secant (kpsi)	Modulus of Elasticity (10^6 psi)
	2-125	400	123	133	119	14.5
	2-126	400	111	118	108	15.3
	2-127	400	116	127	113	12.7
Ave.	-	-	117	126	113	14.2
	2-128	600	98.8	107	92.2	15.3
	2-129	600	109	122	103	14.2
	2-130	600	106	112	94.2	14.9
Ave.	-	-	104.6	114	96.5	14.8
	2-131	800	94.3	101	89.3	14.0
	2-132	800	92.2	96.0	82.8	15.0
	2-133	800	95.5	107	90.3	13.3
Ave.	-	-	94	101	87.5	14.1
	2-134	1000	93.7	108	87.8	11.5
	2-135	1000	-	-	-	-
	2-136	1000	86.6	91.2	84.5	11.1
Ave.	-	-	90.2	99.6	86.2	11.3
	3-112	RT	146	156	148	14.0
	3-113	RT	151	160	150	15.3
	3-114	RT	142	151	140	15.8
	3-115	RT	149	157	146	16.5
	3-116	RT	141	149	139	15.8
	3-117	RT	148	157	142	16.0
	3-118	RT	156	173	156	17.8

TABLE 33 (Cont'd)

COMPRESSION PROPERTIES OF C135AMo

	Specimen No.	Temperature (°F)	0.2% Yield (kpsi)	.7 Secant (kpsi)	.85 Secant (kpsi)	Modulus of Elasticity (10^6 psi)
	3-119	RT	153	162	151	16.3
	3-120	RT	154	165	153	16.3
	3-121	RT	-	-	-	16.1
Ave.	-		149	159	147	16.0
	3-122	200	123	131	119	16.3
	3-123	200	144	153	142	15.8
	3-124	200	136	148	131	15.8
Ave.	-	-	134	144	130	15.9
	3-125	400	113	123	112	13.2
	3-126	400	120	128	116	15.3
	3-127	400	121	128	119	15.8
Ave.	-	-	118	126	115	14.8
	3-128	600	104	112	99.3	14.3
	3-129	600	98.2	107	95.7	13.9
	3-130	600	95.7	99.8	92.2	13.3
Ave.	-	-	99.3	106	95.7	13.8
	3-131	800	95.4	103	89.8	14.0
	3-132	800	98.3	108	93.7	13.5
	3-133	800	100	111	95.2	12.7
Ave.	-	-	97.9	107	92.9	13.4

TABLE 33 (Cont'd)

COMPRESSION PROPERTIES OF C135AMo

	Specimen No.	Temperature (°F)	0.2% Yield (kpsi)	.7 Secant (kpsi)	.85 Secant (kpsi)	Modulus of Elasticity (10^6 psi)
	3-134	1000	84.5	89.8	81.2	10.2
	3-135	1000	84.7	94.2	82.2	10.2
	3-136	1000	89.2	95.4	83.3	12.1
Ave.	-	-	86.1	93.1	82.2	10.8

TABLE 34

PIN SHEAR PROPERTIES OF C135AMo

	Specimen No.	Temperature (°F)	Ultimate Shear Strength (kpsi)
	1-87	RT	107
	1-88	RT	106
	1-89	RT	107
	1-90	RT	106
	1-91	RT	108
	1-92	RT	104
	1-93	RT	104
	1-94	RT	107
	1-95	RT	104
	1-96	RT	104
Ave.	-		106
	1-97	200	93.3
	1-98	200	98.8
	1-99	200	96.2
Ave.	-	-	96.1
	1-100	400	93.0
	1-101	400	93.7
	1-102	400	85.3
Ave.	-	-	90.6
	1-103	600	88.2
	1-104	600	85.0
	1-105	600	88.7
Ave.	-	-	87.3

TABLE 34 (Cont'd)

PIN SHEAR PROPERTIES OF C135AMo

	Specimen No.	Temperature (°F)	Ultimate Shear Strength (kpsi)
	1-106	800	80.5
	1-107	800	82.1
	1-108	800	85.8
Ave.	-	-	82.8
	1-109	1000	78.8
	1-110	1000	79.0
	1-111	1000	78.7
Ave.	-	-	78.8
	2-87	RT	99.8
	2-88	RT	103
	2-89	RT	107
	2-90	RT	111
	2-91	RT	101
	2-92	RT	102
	2-93	RT	105
	2-94	RT	105
	2-95	RT	100
	2-96	RT	106
Ave.	-		104
	2-97	200	99.8
	2-98	200	95.6
	2-99	200	88.6
Ave.	-	-	94.6

TABLE 34 (Cont'd)

PIN SHEAR PROPERTIES OF C135AMo

	Specimen No.	Temperature (°F)	Ultimate Shear Strength (kpsi)
	2-100	400	91.0
	2-101	400	90.2
	2-102	400	90.8
Ave.	-	-	90.6
	2-103	600	88.9
	2-104	600	88.7
	2-105	600	88.8
Ave.	-	-	88.8
	2-106	800	85.3
	2-107	800	80.6
	2-108	800	82.8
Ave.	-	-	82.9
	2-109	1000	80.2
	2-110	1000	77.2
	2-111	1000	81.2
Ave.	-	-	79.5
	3-87	RT	108
	3-88	RT	108
	3-89	RT	110
	3-90	RT	109
	3-91	RT	107
	3-92	RT	107
	3-93	RT	105

TABLE 34 (Cont'd)

PIN SHEAR PROPERTIES OF C135AMo

	Specimen No.	Temperature (°F)	Ultimate Shear Strength (kpsi)
	3-94	RT	103
	3-95	RT	109
	3-96	RT	105
Ave.	-		107
	3-97	200	95.3
	3-98	200	97.8
	3-99	200	100
Ave.	-	-	97.7
	3-100	400	87.7
	3-101	400	85.7
	3-102	400	90.3
Ave.	-	-	87.9
	3-103	600	81.6
	3-104	600	86.2
	3-105	600	85.3
Ave.	-	-	84.4
	3-106	800	81.7
	3-107	800	83.0
	3-108	800	82.7
Ave.	-	-	82.4

TABLE 34 (Cont'd)

PIN SHEAR PROPERTIES OF C135AMo

	Specimen No.	Temperature (°F)	Ultimate Shear Strength (kpsi)
	3-109	1000	77.4
	3-110	1000	77.7
	3-111	1000	77.8
Ave.	-	-	77.6

TABLE 35

BEARING PROPERTIES OF C135AMo e/D = 1.5

	Specimen No.	Temperature (°F)	Failure Location	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
	1-137	RT	(a)	263	239
	1-138	RT	(a)	258	241
	1-139	RT	(a)	261	247
	1-140	RT	(a)	265	246
	1-141	RT	(a)	268	256
	1-142	RT	(a)	264	247
	1-143	RT	(b)	255	248
	1-144	RT	(a)	267	258
	1-145	RT	(a)	269	263
	1-146	RT	(a)	263	253
Ave.	-			263	250
	1-147	200	(a)	239	229
	1-148	200	(a)	234	224
	1-149	200	(a)	234	226
Ave.	-	-		236	226
	1-150	400	(b)	229	221
	1-151	400	(a)	214	213
	1-152	400	(a)	233	221
Ave.	-	-		225	218
	1-153	600	(a)	211	199
	1-154	600	(b)	210	203
	1-155	600	(a)	208	205
Ave.	-	-		210	202

TABLE 35 (Cont'd)

BEARING PROPERTIES OF C135AMo e/D = 1.5

	Specimen No.	Temperature (°F)	Failure Location	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
	1-156	800	(a)	201	195
	1-157	800	(a)	216	208
	1-158	800	(a)	211	206
Ave.	-	-		209	203
	1-159	1000	(b)	191	165
	1-160	1000	(a)	196	178
	1-161	1000	(a)	195	177
Ave.	-	-		194	173
	2-137	RT	(a)	264	250
	2-138	RT	(a)	269	256
	2-139	RT	(b)	270	263
	2-140	RT	(a)	267	255
	2-141	RT	(c)	257	242
	2-142	RT	(a)	266	249
	2-143	RT	(a)	263	246
	2-144	RT	(a)	250	234
	2-145	RT	(a)	260	241
	2-146	RT	(a)	269	254
Ave.	-			264	249
	2-147	200	(a)	245	219
	2-148	200	(a)	238	231
	2-149	200	(a)	239	223
Ave.	-	-		241	224

TABLE 35 (Cont'd)

BEARING PROPERTIES OF C135AMo e/D = 1.5

	Specimen No.	Temperature (°F)	Failure Location	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
	2-150	400	(a)	225	210
	2-151	400	(a)	225	213
	2-152	400	(a)	224	215
Ave.	-	-		225	213
	2-153	600	(a)	213	208
	2-154	600	(a)	207	206
	2-155	600	(a)	215	208
Ave.	-	-		212	207
	2-156	800	(a)	207	195
	2-157	800	(a)	204	198
	2-158	800	(a)	205	-
Ave.	-	-		205	197
	2-159	1000	(a)	196	169
	2-160	1000	(a)	182	167
	2-161	1000	(a)	187	173
Ave.	-	-		188	170
	3-137	RT	(a)	263	239
	3-138	RT	(a)	257	235
	3-139	RT	(a)	258	231
	3-140	RT	(a)	261	232
	3-141	RT	(b)	265	241
	3-142	RT	(a)	271	244
	3-143	RT	(b)	267	245

TABLE 35 (Cont'd)

BEARING PROPERTIES OF C135AMo e/D = 1.5

	Specimen No.	Temperature (°F)	Failure Location	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
	3-144	RT	(a)	266	241
	3-145	RT	(b)	261	236
	3-146	RT	(c)	269	247
Ave.	-			264	239
	3-147	200	(a)	250	229
	3-148	200	(a)	247	237
	3-149	200	(a)	247	230
Ave.	-	-		248	232
	3-150	400	(a)	227	209
	3-151	400	(a)	227	207
	3-152	400	(a)	225	-
Ave.	-	-		226	208
	3-153	600	(a)	213	190
	3-154	600	(a)	209	197
	3-155	600	(a)	205	197
Ave.	-	-		209	195
	3-156	800	(a)	213	205
	3-157	800	(a)	209	203
	3-158	800	(b)	198	191
Ave.	-	-		207	199

TABLE 35 (Cont'd)

BEARING PROPERTIES OF C135AMo e/D = 1.5

	Specimen No.	Temperature (°F)	Failure Location	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
	3-159	1000	(a)	184	164
	3-160	1000	(a)	194	-
	3-161	1000	(a)	184	167
Ave.	-	-		187	165

TABLE 36

BEARING PROPERTIES OF C135AMo e/D = 2.0

	Specimen No.	Temperature (°F)	Failure Location	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
	1-162	RT	(a)	313	289
	1-163	RT	(a)	295	258
	1-164	RT	(b)	294	275
	1-165	RT	(a)	317	277
	1-166	RT	(a)	310	281
	1-167	RT	(a)	325	300
	1-168	RT	(a)	320	305
	1-169	RT	(b)	314	291
	1-170	RT	(a)	327	273
	1-171	RT	(a)	321	299
Ave.	-			314	285
	1-172	200	(a)	280	271
	1-173	200	(a)	291	275
	1-174	200	(a)	279	268
Ave.	-	-		283	271
	1-175	400	(a)	263	255
	1-176	400	(a)	275	244
	1-177	400	(a)	269	247
Ave.	-	-		269	247
	1-178	600	(a)	251	245
	1-179	600	(b)	255	235
	1-180	600	(b)	255	239
Ave.	-	-		254	240

TABLE 36 (Cont'd)

BEARING PROPERTIES OF C135AMo e/D = 2.0

	Specimen No.	Temperature (°F)	Failure Location	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
	1-181	800	(a)	254	224
	1-182	800	(b)	247	242
	1-183	800	(a)	251	224
Ave.	-	-		251	230
	1-184	1000	(b)	235	198
	1-185	1000	(a)	233	201
	1-186	1000	(a)	225	196
Ave.	-	-		231	198
	2-162	RT	(b)	316	273
	2-163	RT	(c)	336	293
	2-164	RT	(a)	326	-
	2-165	RT	(b)	318	259
	2-166	RT	(b)	314	264
	2-167	RT	(b)	317	273
	2-168	RT	(b)	330	280
	2-169	RT	(c)	319	270
	2-170	RT	(b)	320	277
	2-171	RT	(a)	333	279
Ave.	-			323	274
	2-172	200	(a)	289	251
	2-173	200	(b)	291	254
	2-174	200	(a)	294	265
Ave.	-	-		291	257

TABLE 36 (Cont'd)

BEARING PROPERTIES OF C135AMo e/D = 2.0

	Specimen No.	Temperature (°F)	Failure Location	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
	2-175	400	(a)	281	241
	2-176	400	(a)	278	244
	2-177	400	(a)	270	233
Ave.	-	-		276	239
	2-178	600	(b)	250	239
	2-179	600	(a)	250	233
	2-180	600	(b)	252	248
Ave.	-	-		251	240
	2-181	800	(a)	235	219
	2-182	800	(a)	240	236
	2-183	800	(a)	245	242
Ave.	-	-		240	232
	2-184	1000	(a)	234	205
	2-185	1000	(b)	237	205
	2-186	1000	(b)	237	201
Ave.	-	-		236	204
	3-162	RT	(b)	327	268
	3-163	RT	(a)	328	274
	3-164	RT	(b)	326	265
	3-165	RT	(c)	313	267
	3-166	RT	(b)	325	264
	3-167	RT	(c)	326	275
	3-168	RT	(b)	326	274

TABLE 36 (Cont'd)

BEARING PROPERTIES OF C135AMo e/D = 2.0

	Specimen No.	Temperature (°F)	Failure Location	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
	3-169	RT	(b)	320	284
	3-170	RT	(a)	327	278
	3-171	RT	(b)	323	263
Ave.	-			324	271
	3-172	200	(a)	289	255
	3-173	200	(b)	297	257
	3-174	200	(a)	283	261
Ave.	-	-		290	258
	3-175	400	(b)	255	246
	3-176	400	(b)	266	243
	3-177	400	(a)	274	237
Ave.	-	-		265	242
	3-178	600	(b)	247	233
	3-179	600	(b)	246	236
	3-180	600	(a)	244	229
Ave.	-	-		246	233
	3-181	800	(b)	237	226
	3-182	800	(a)	240	237
	3-183	800	(b)	237	234
Ave.	-	-		238	232

TABLE 36 (Cont'd)

BEARING PROPERTIES OF C135AMo e/D = 2.0

	Specimen No.	Temperature (°F)	Failure Location	Bearing Ultimate Strength (kpsi)	Bearing Yield Strength (kpsi)
	3-184	1000	(a)	231	195
	3-185	1000	(a)	239	188
	3-186	1000	(b)	231	192
Ave.	-	-		234	192

TABLE 37

TORSION PROPERTIES OF C135AMo

Specimen No.	Heat No.	0.2% Yield Strength (kpsi)	Modulus of Rupture (kpsi)	Shear Modulus (10^6 psi)	Twist per Inch (degrees)
SA	1	98.6	143.7	6.2	70.1
SB	1	101.8	145.0	6.2	79.3
SC	1	98.5	143.8	6.4	57.4
SD	1	-	-	6.1	-
Average		99.6	144.2	6.2	68.9
TA	2	92.3	142.0	5.9	71.0
TB	2	89.2	138.0	5.8	57.5
TC	2	90.0	138.8	5.7	63.9
TD	2	-	-	6.0	-
Average		90.5	139.6	5.9	64.1
VA	3	101.8	148.0	5.7	66.9
VB	3	96.6	143.6	5.7	47.4
VC	3	97.0	145.0	5.9	55.6
VD	3	-	-	5.9	-
Average		98.5	145.5	5.8	56.7

TABLE 38

CHARPY IMPACT PROPERTIES OF C155AMo

Specimen	Temp (°F)	Foot-Pounds Energy
1- 1	75	16
1- 2	75	15
1- 3	75	
1- 4	75	16
1- 5	75	17
Average	75	16
1- 6	-108	13
1- 7	-108	13
Average	-108	13
1- 8	-423	9
1- 9	-423	8
Average	-423	8
1- 10	1000	27
1- 11	1000	22
1- 12	1000	26
Average	1000	25
1- 13	500	26
1- 14	500	28
1- 15	500	26
Average	500	27

Specimen	Temp. (°F)	Foot-Pounds Energy
2- 1	75	20
2- 2	75	13
2- 3	75	17
2- 4	75	15
2- 5	75	15
Average	75	16
2- 6	-108	12
2- 7	-108	12
Average	-108	12
2- 8	-423	8
2- 9	-423	8
Average	-423	8
2- 10	1000	23
2- 11	1000	18
2- 12	1000	20
	1000	20
2- 13	500	23
2- 14	500	26
2- 15	500	24
Average	500	24

Specimen	Temp (°F)	Foot-Pounds Energy
3- 1	75	13
3- 2	75	14
3- 3	75	15
3- 4	75	14
3- 5	75	13
Average	75	14
3- 6	-108	12
3- 7	-108	12
Average	-108	12
3- 8	-423	8
3- 9	-423	8
Average	-423	8
3- 10	1000	19
3- 11	1000	20
3- 12	1000	23
	1000	21
3- 13	500	26
3- 14	500	24
3- 15	500	28
Average	500	26

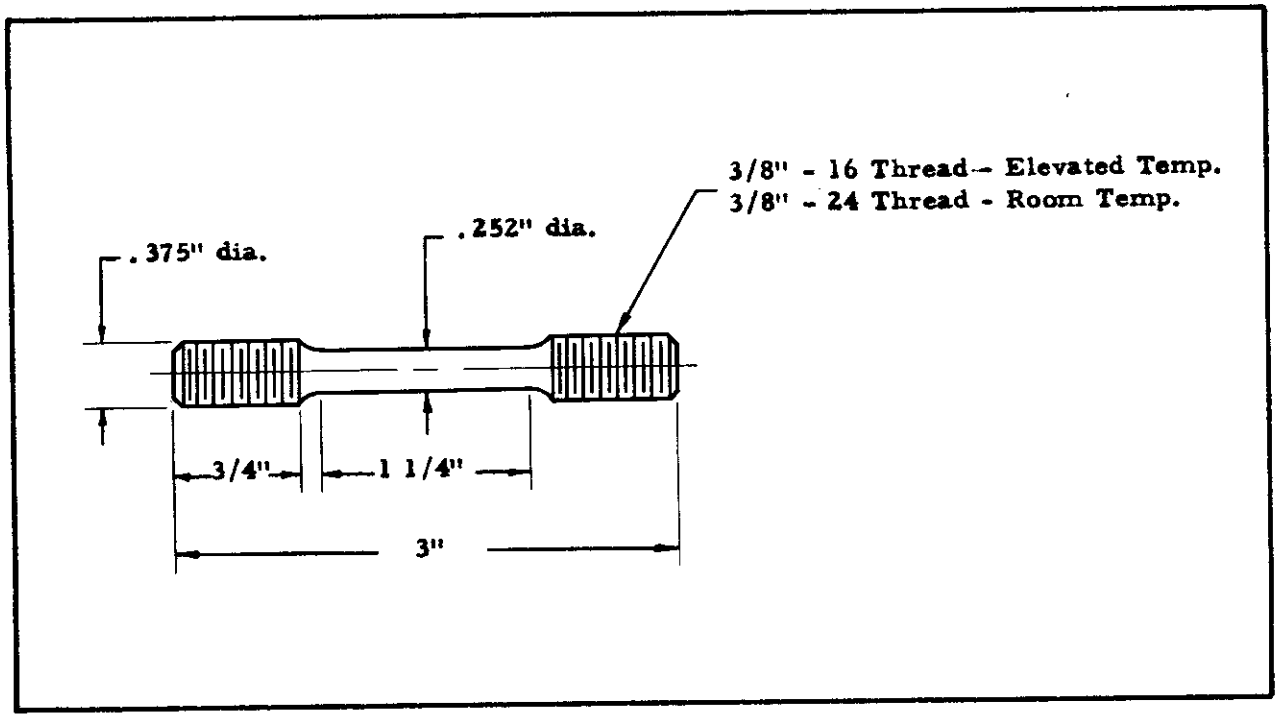


Figure 1. Smooth Tensile Specimen

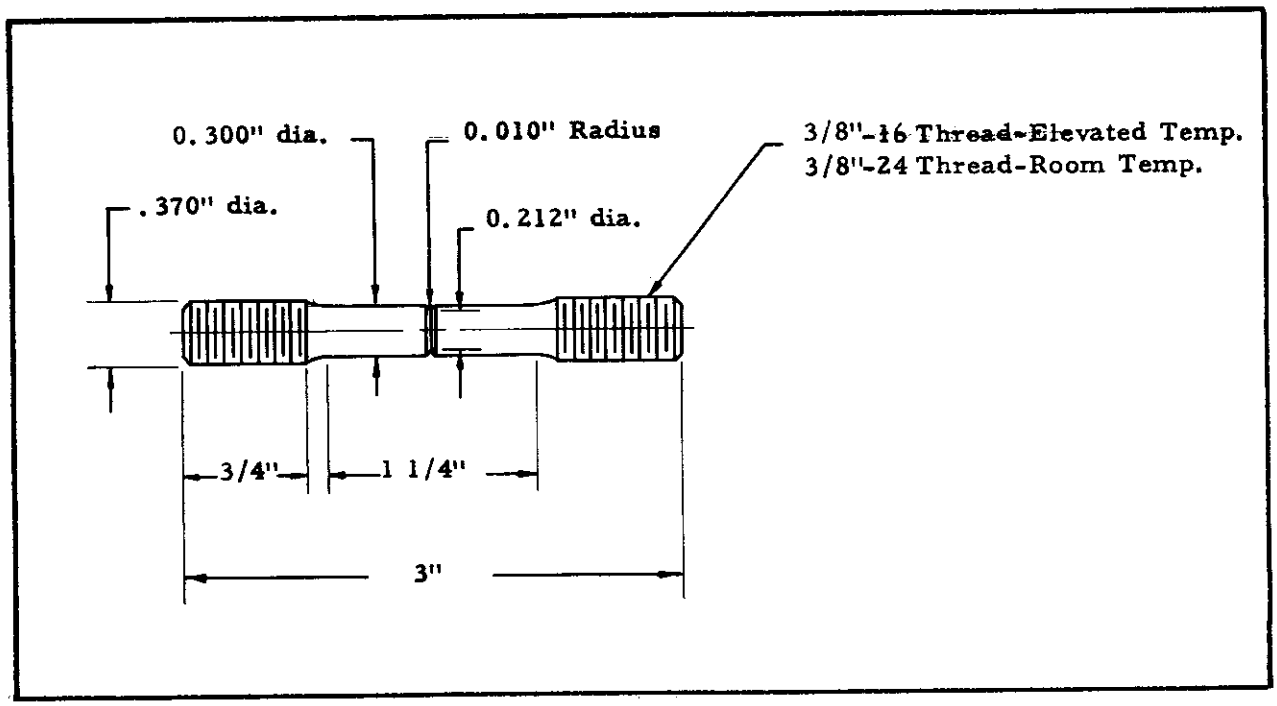


Figure 2. Notched Tensile Specimen

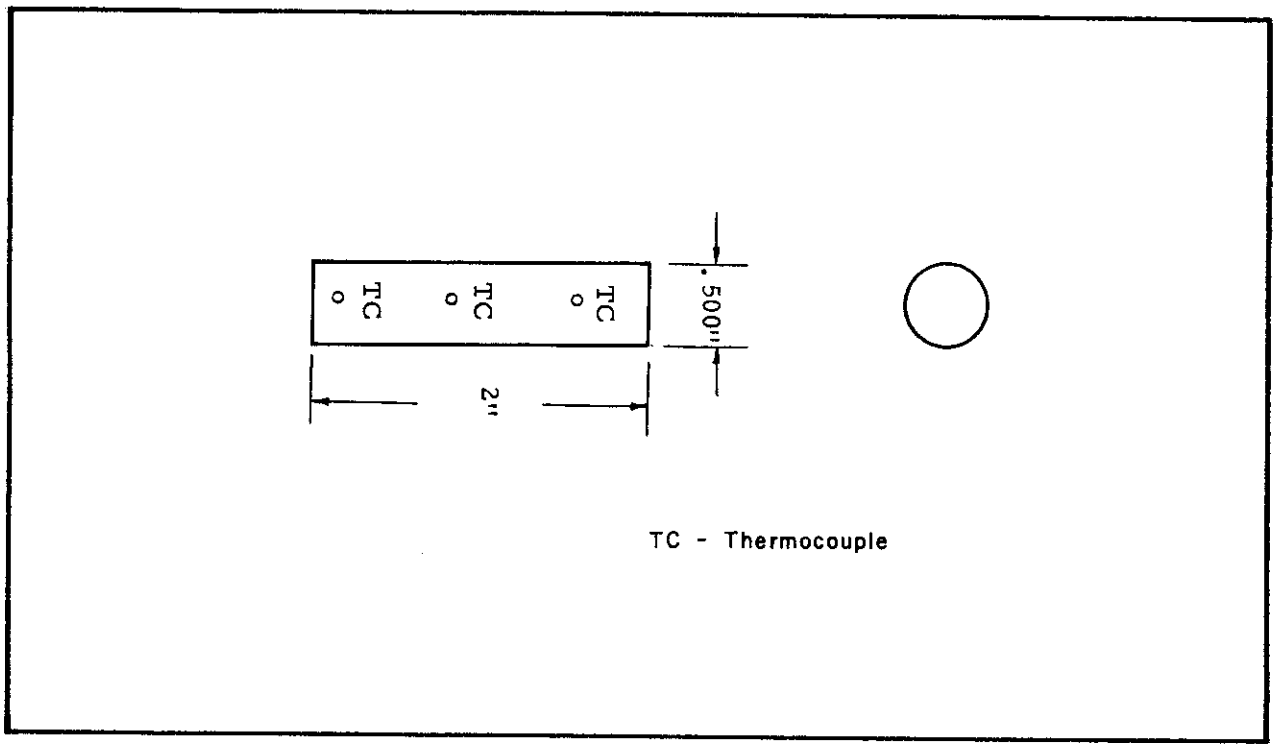


Figure 3. Round Compression Test Specimen

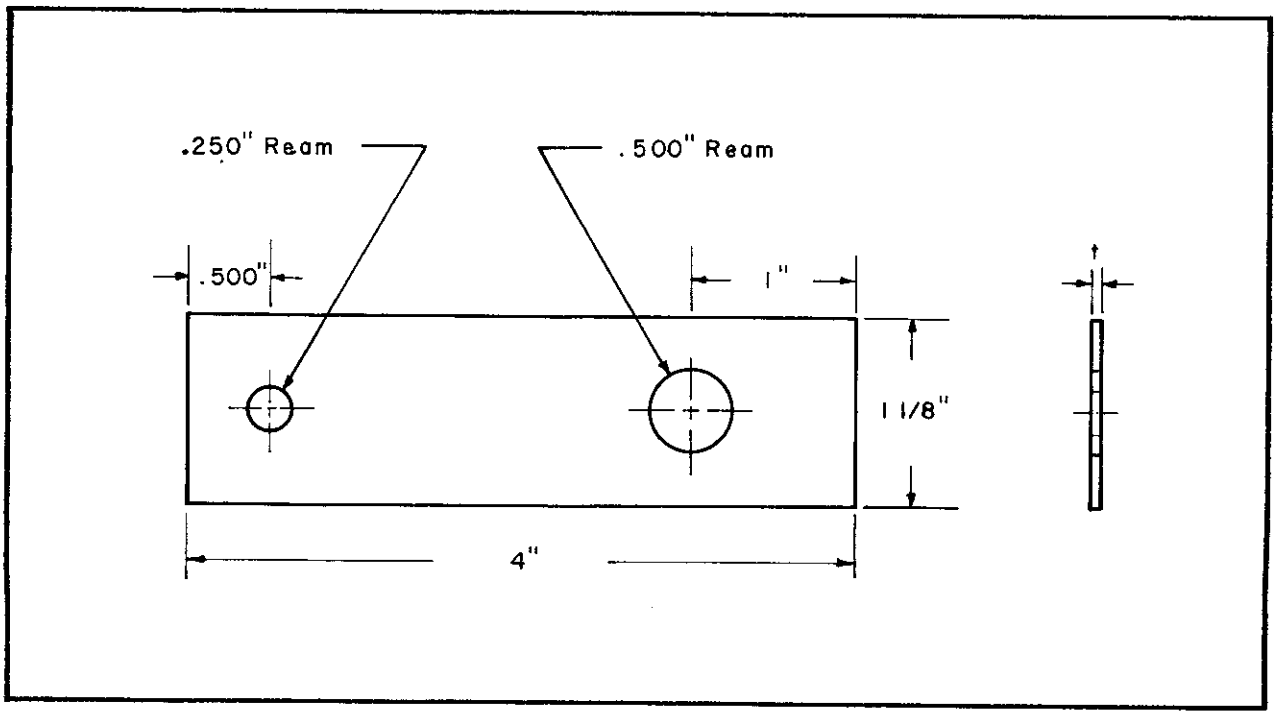


Figure 4. Sheet Bearing Test Specimen, Bearing Ratio e/D = 2.0

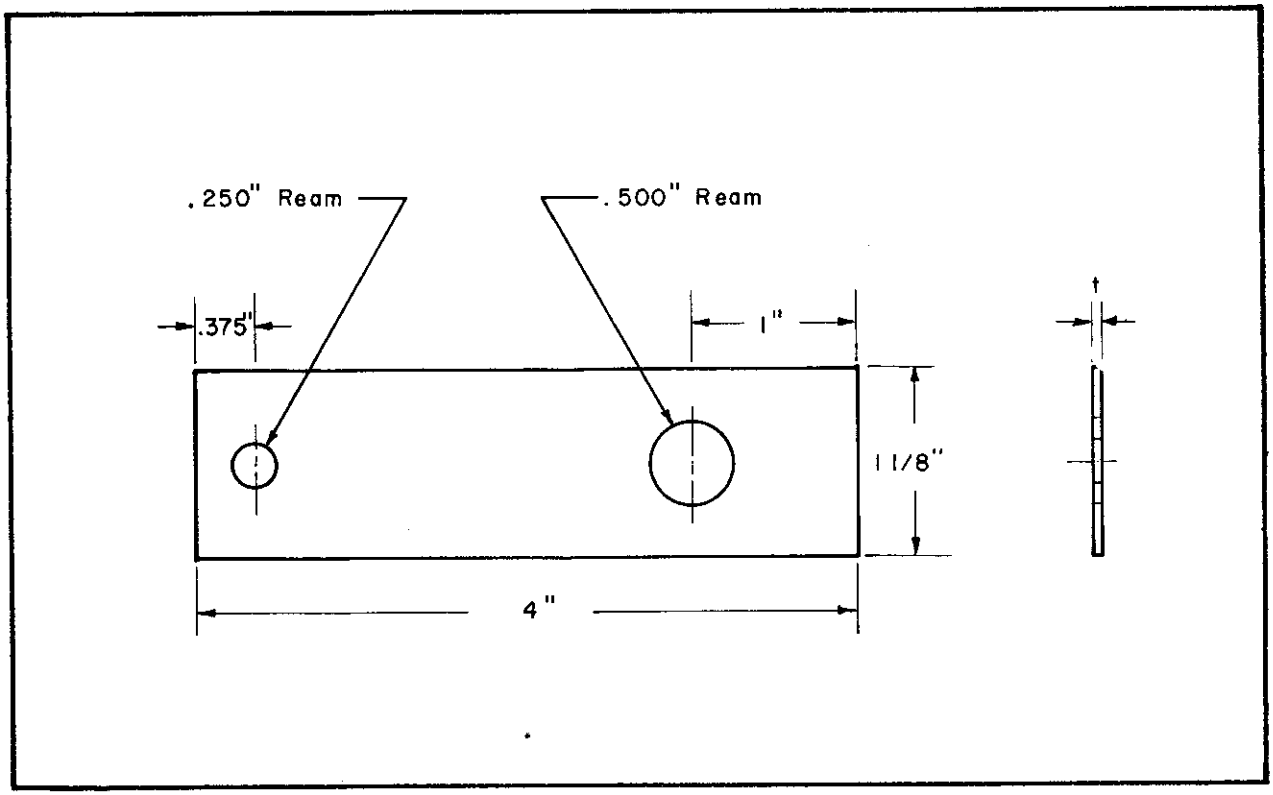


Figure 5. Sheet Bearing Test Specimen, Bearing Ratio e/D = 1.5

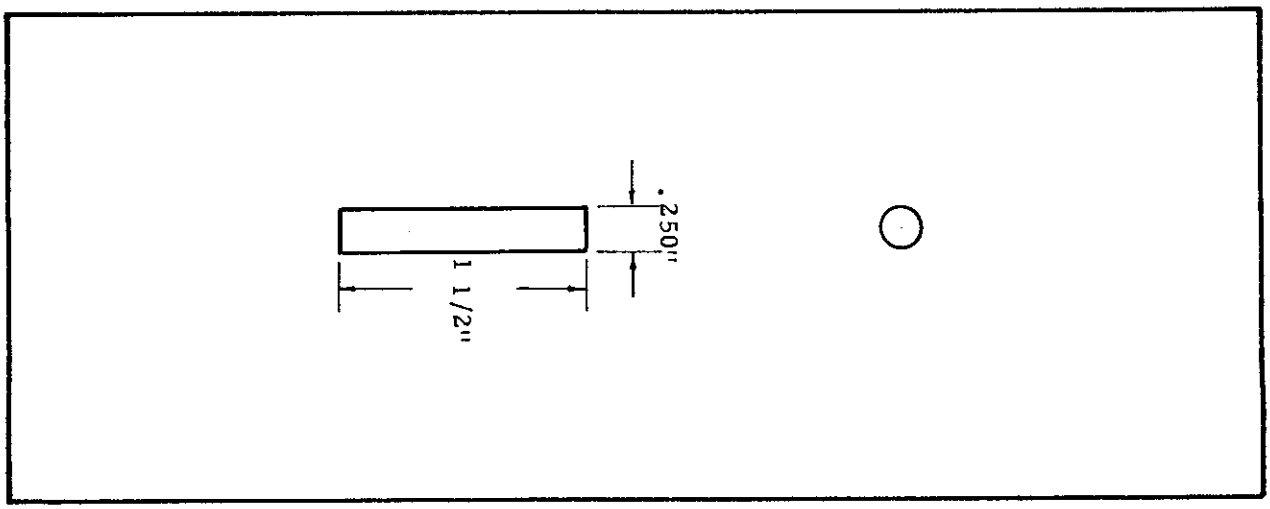


Figure 6. Pin Shear Test Specimen

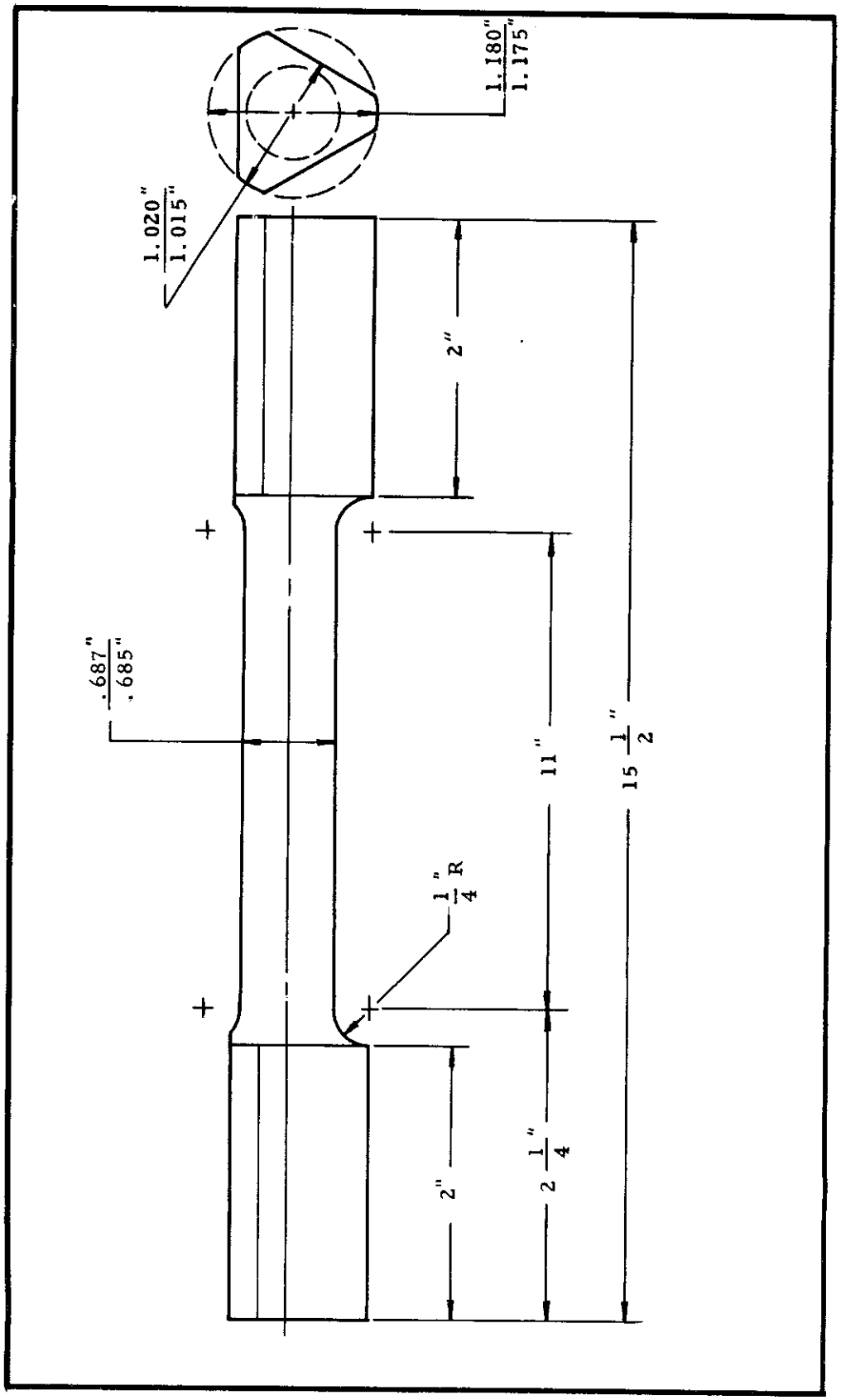


Figure 7. Torsion Test Specimen

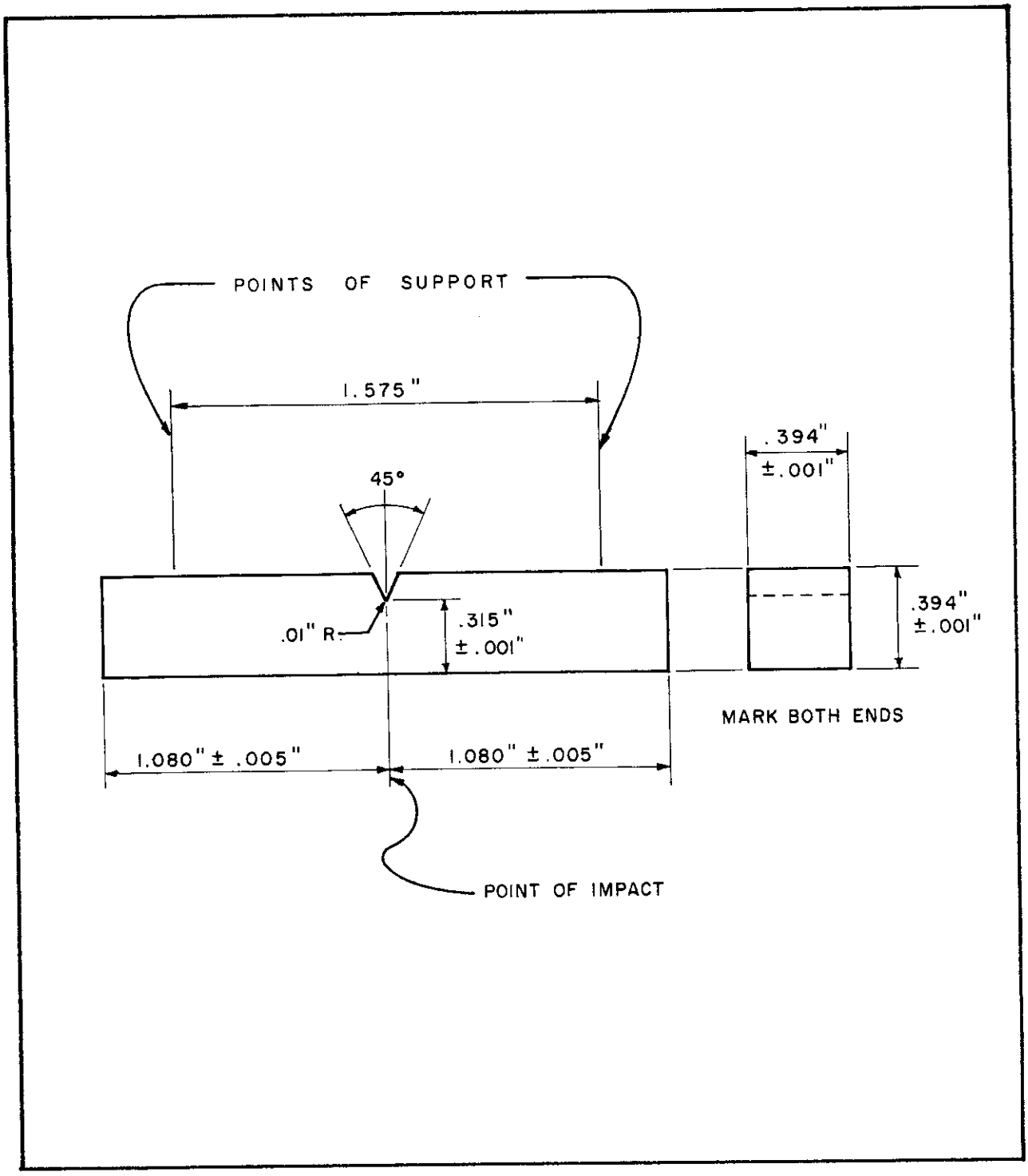


Figure 8. Charpy Impact Specimen With "V" Notch

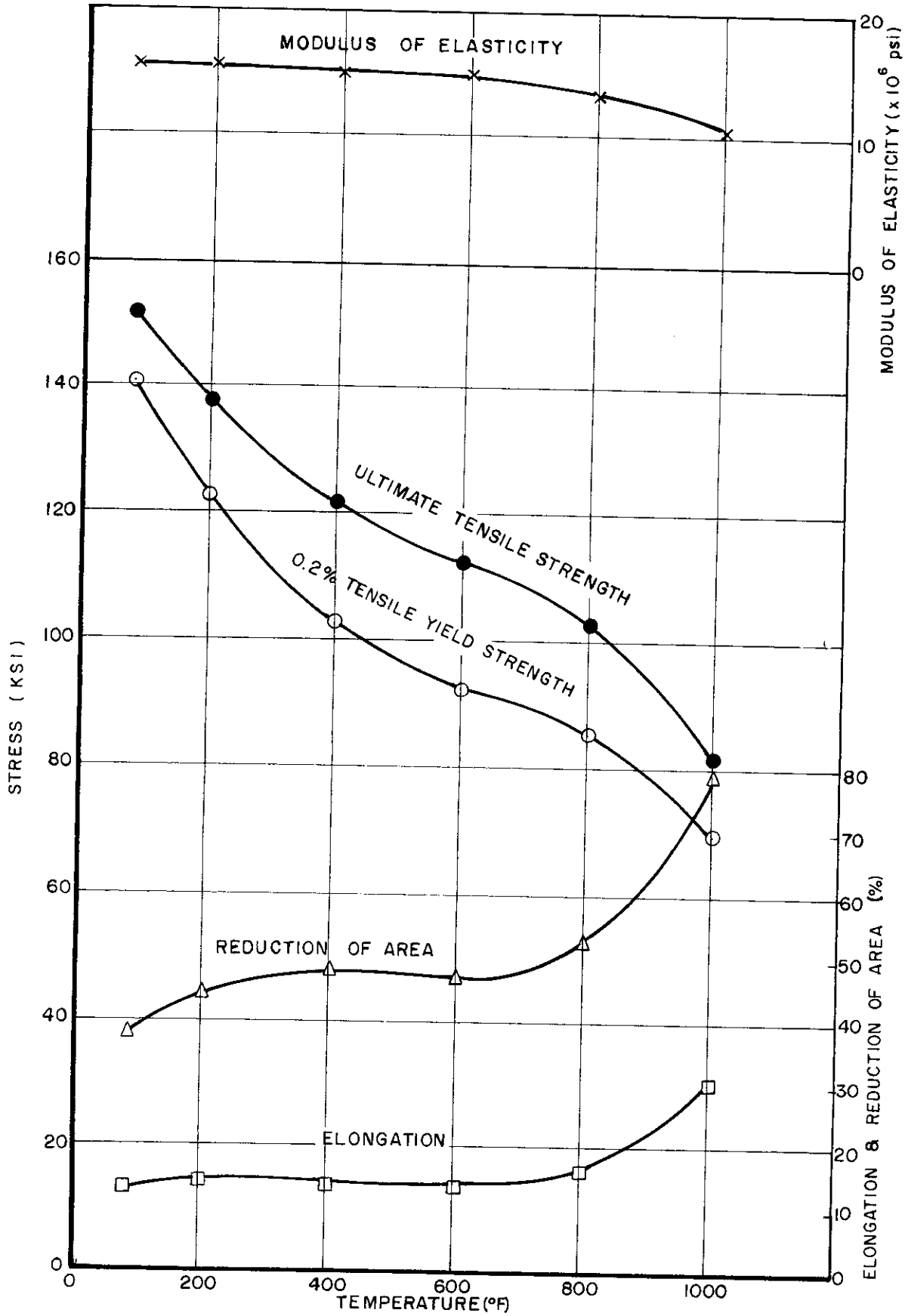


Figure 9. Average Tensile Properties vs. Temperature, Ti 155A, All Heats

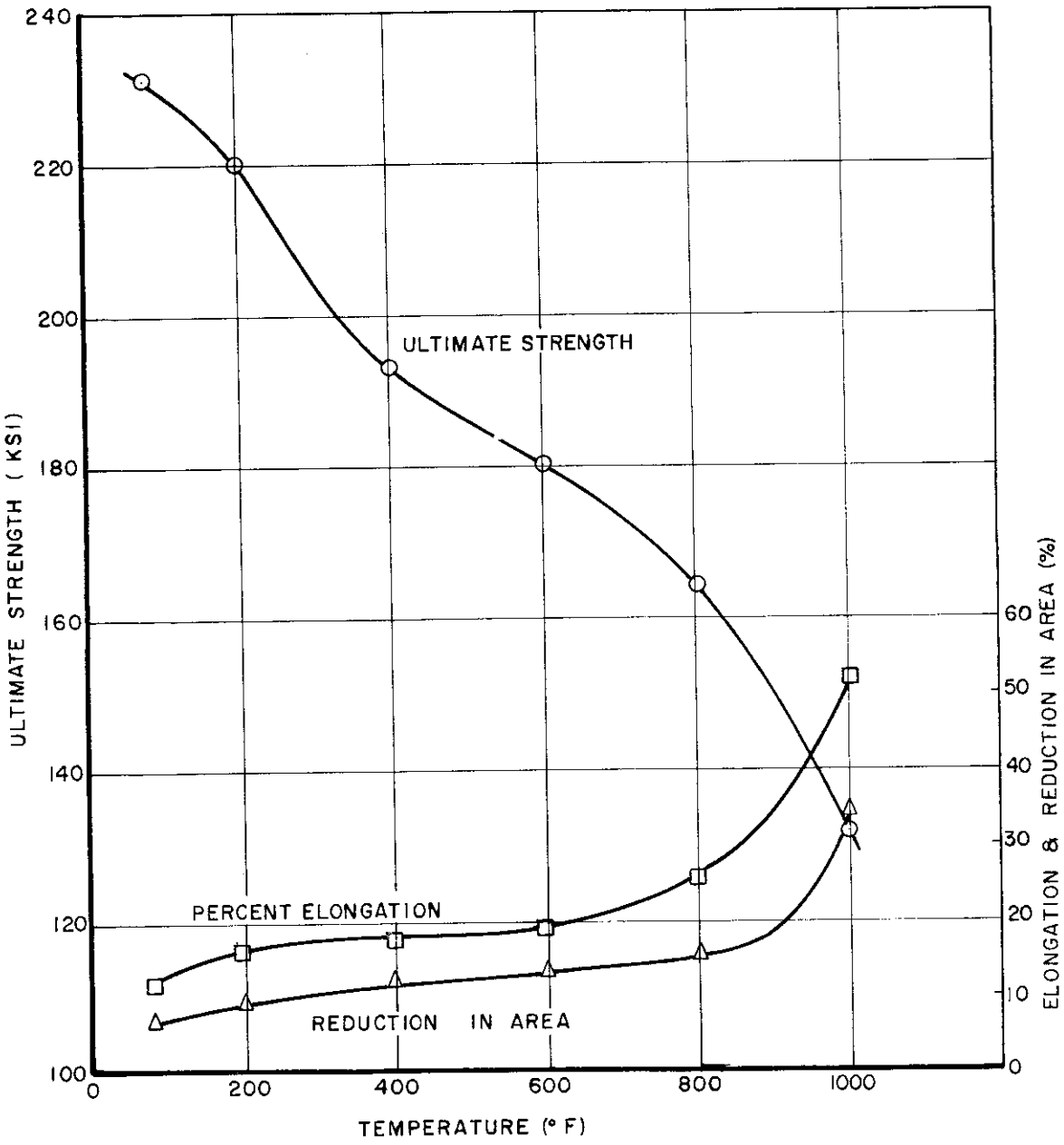


Figure 10. Average Notched (K_T = 3.0) Tensile Properties vs. Temperature, Ti 155A, All Heats

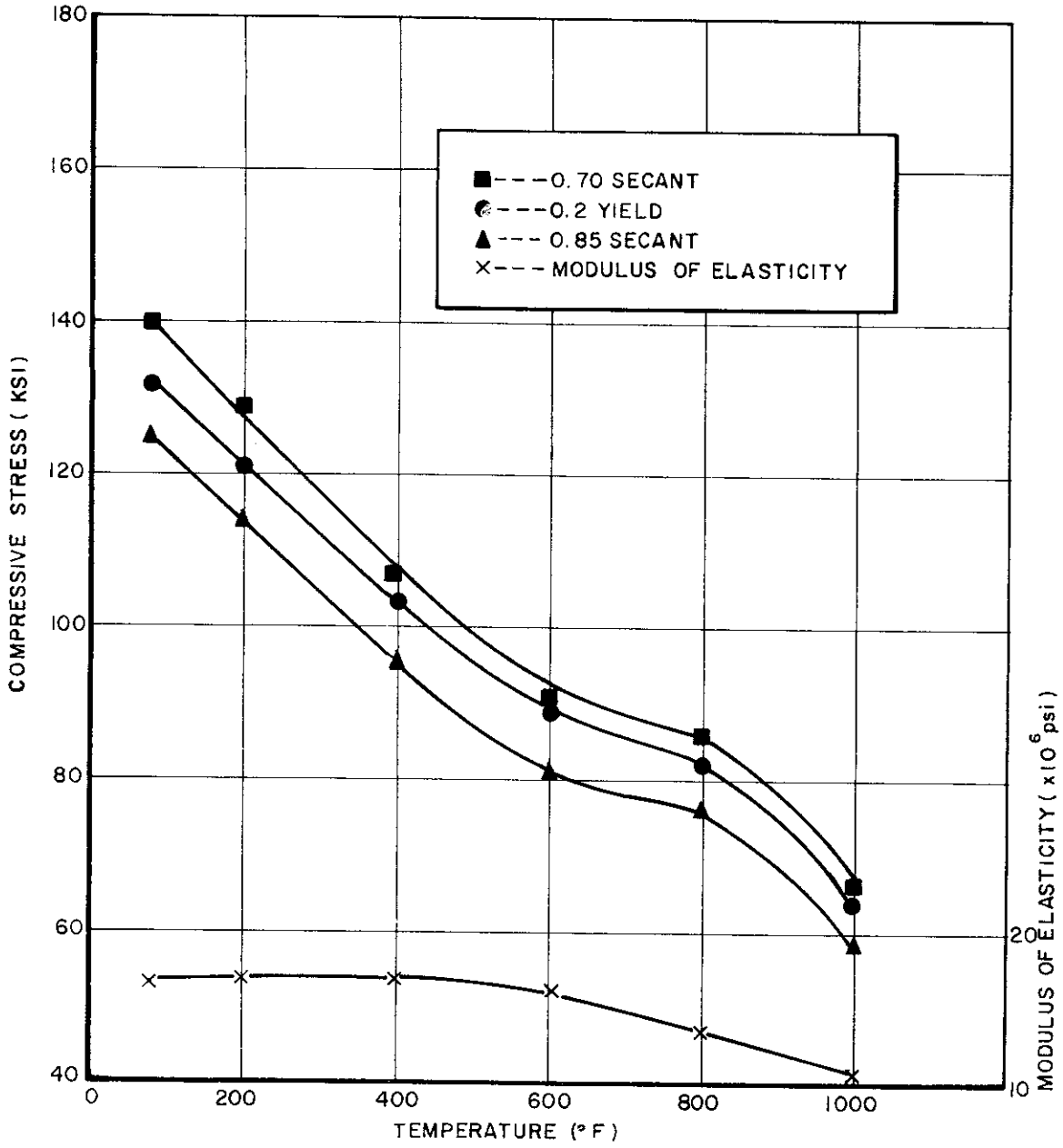


Figure 11. Average Compression Properties vs. Temperature, Ti 155A, All Heats

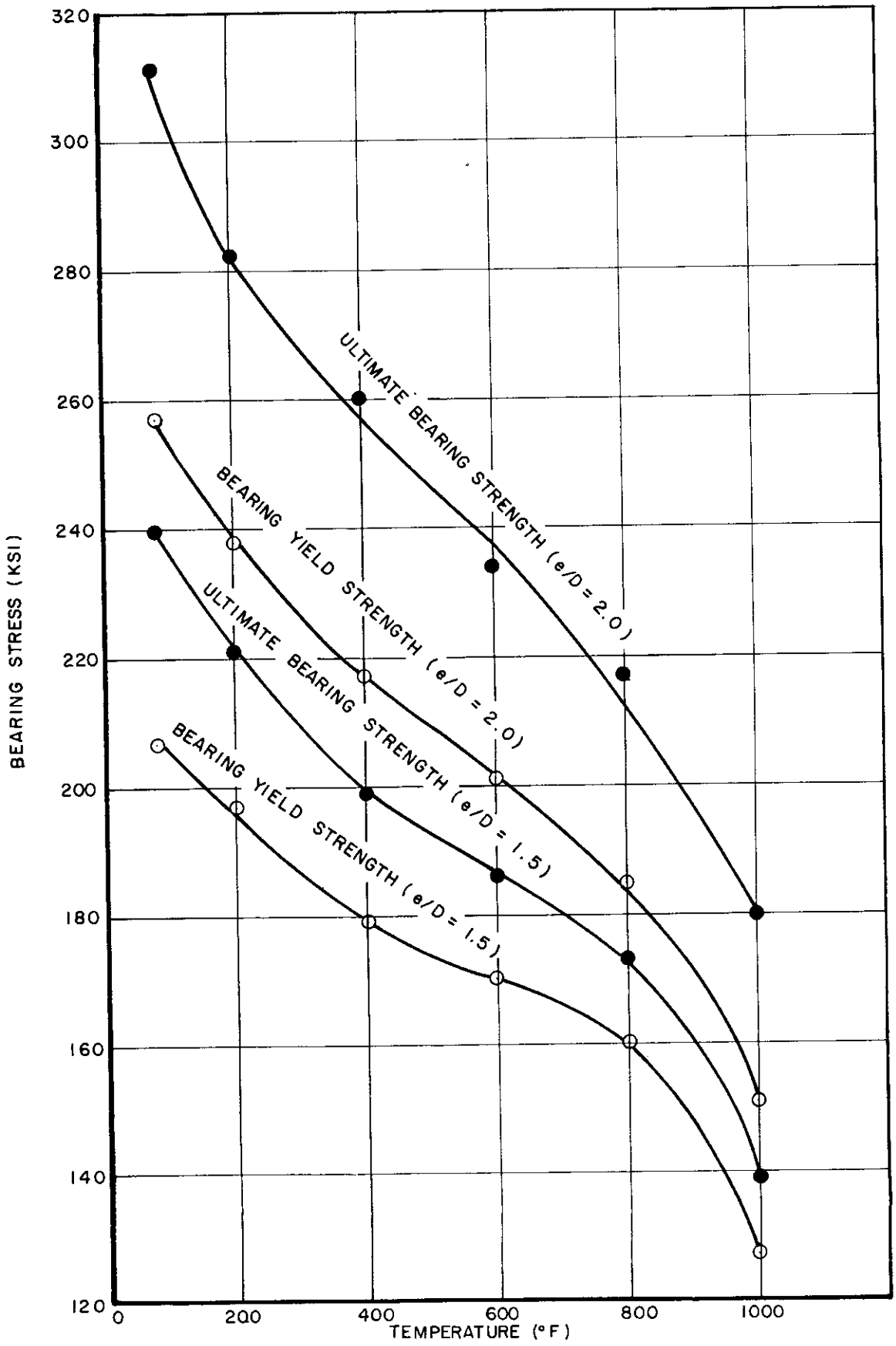


Figure 12. Average Bearing Properties vs. Temperature, Ti 155A, All Heats

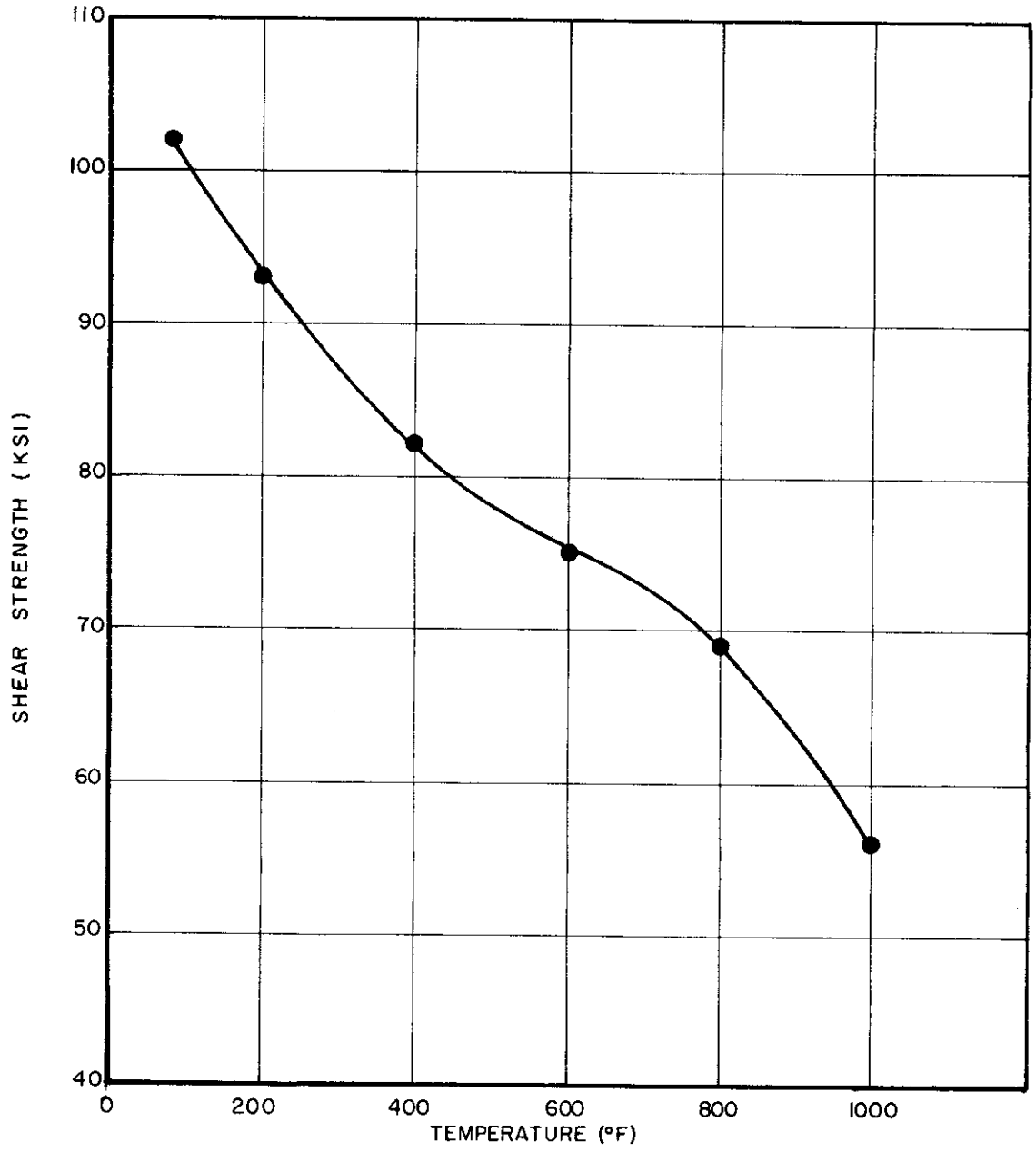


Figure 13. Average Pin Shear Properties vs. Temperature, Ti 155A, All Heats

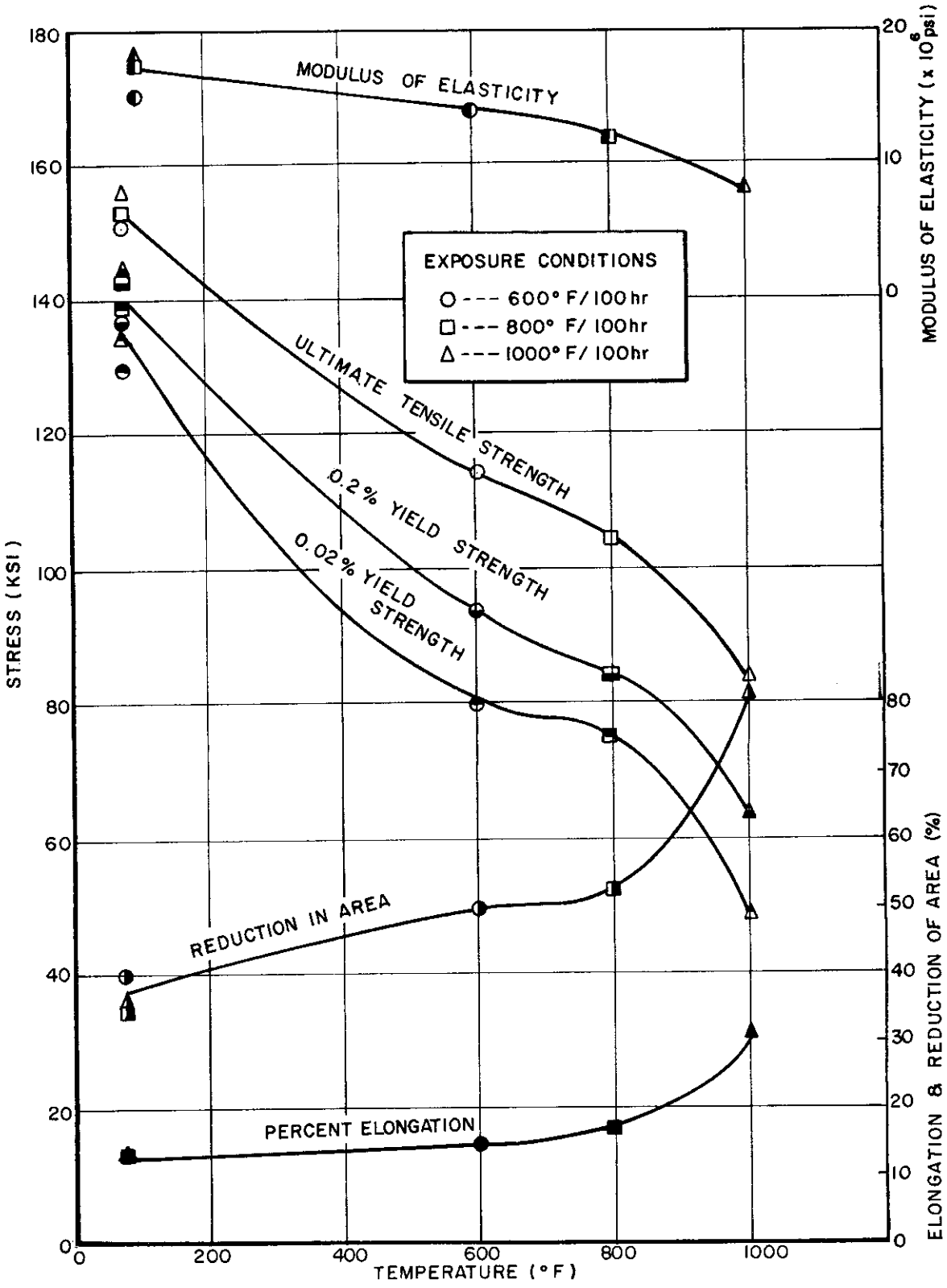


Figure 14. Average Nonstressed Stability Tensile Properties vs. Temperature, Ti 155A, All Heats

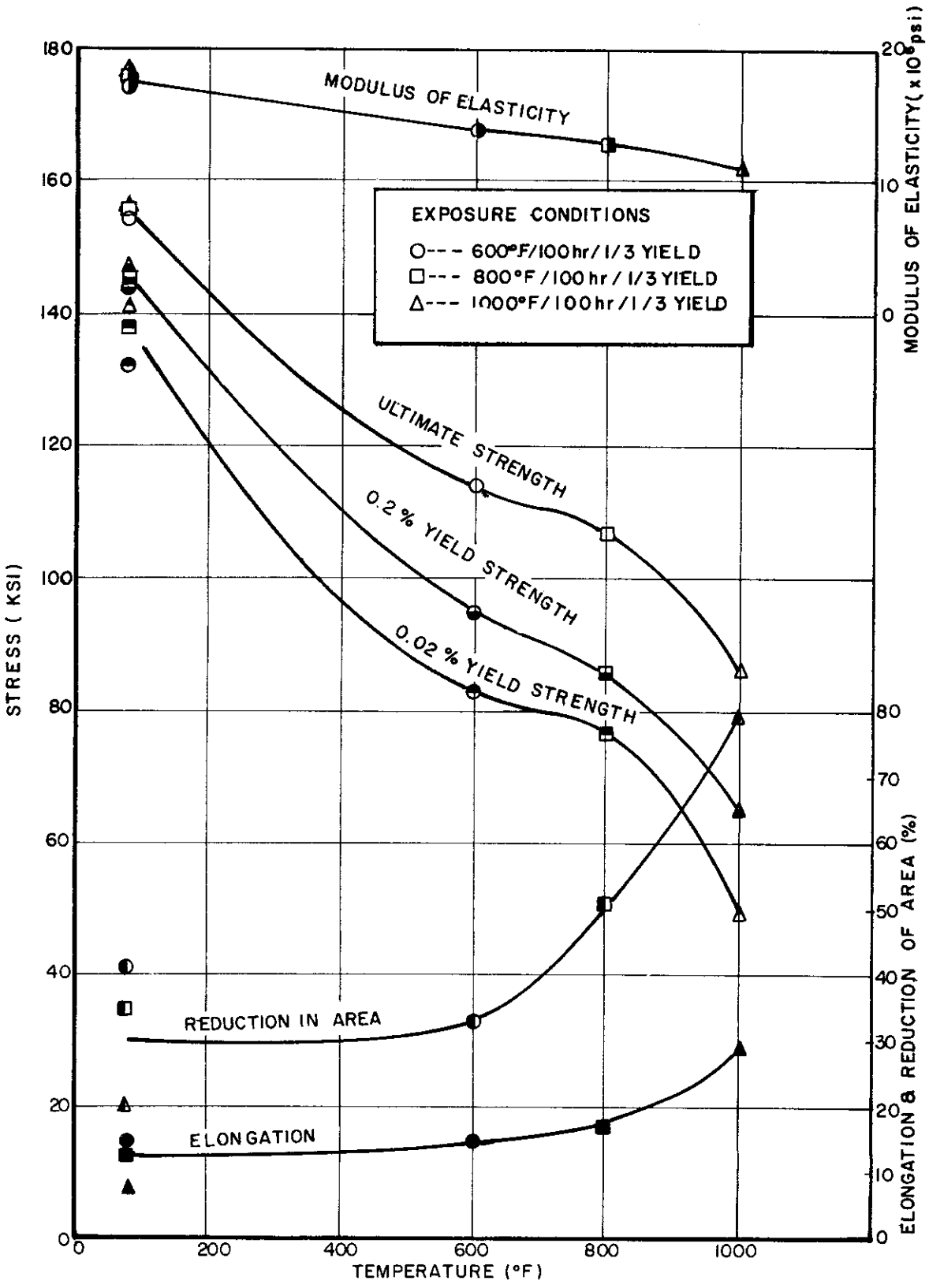


Figure 15. Average Stressed Stability Tensile Properties vs. Temperature, Ti 155A, All Heats

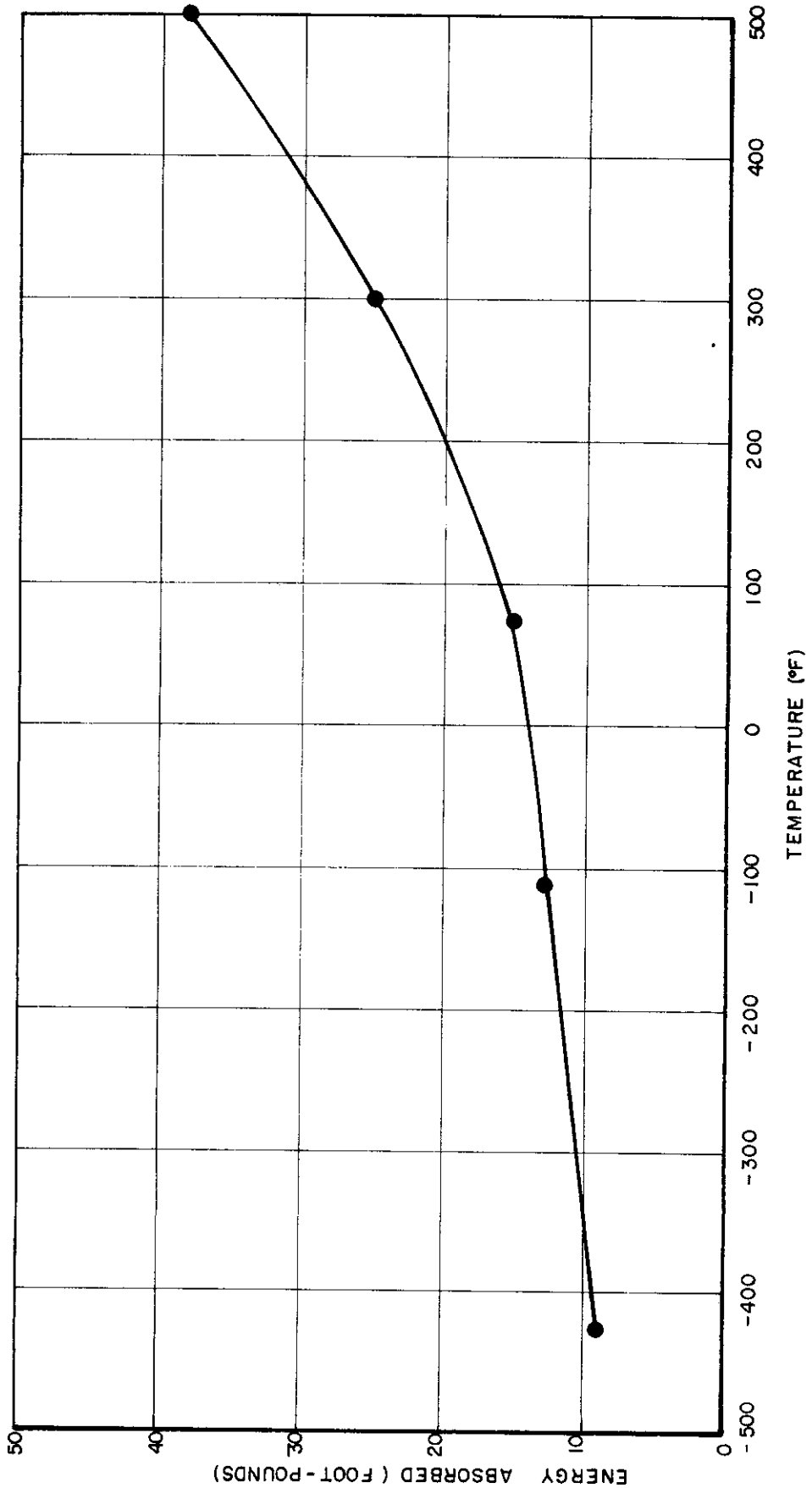


Figure 16. Average Charpy Impact Properties vs. Temperature, Ti 155A, All Heats

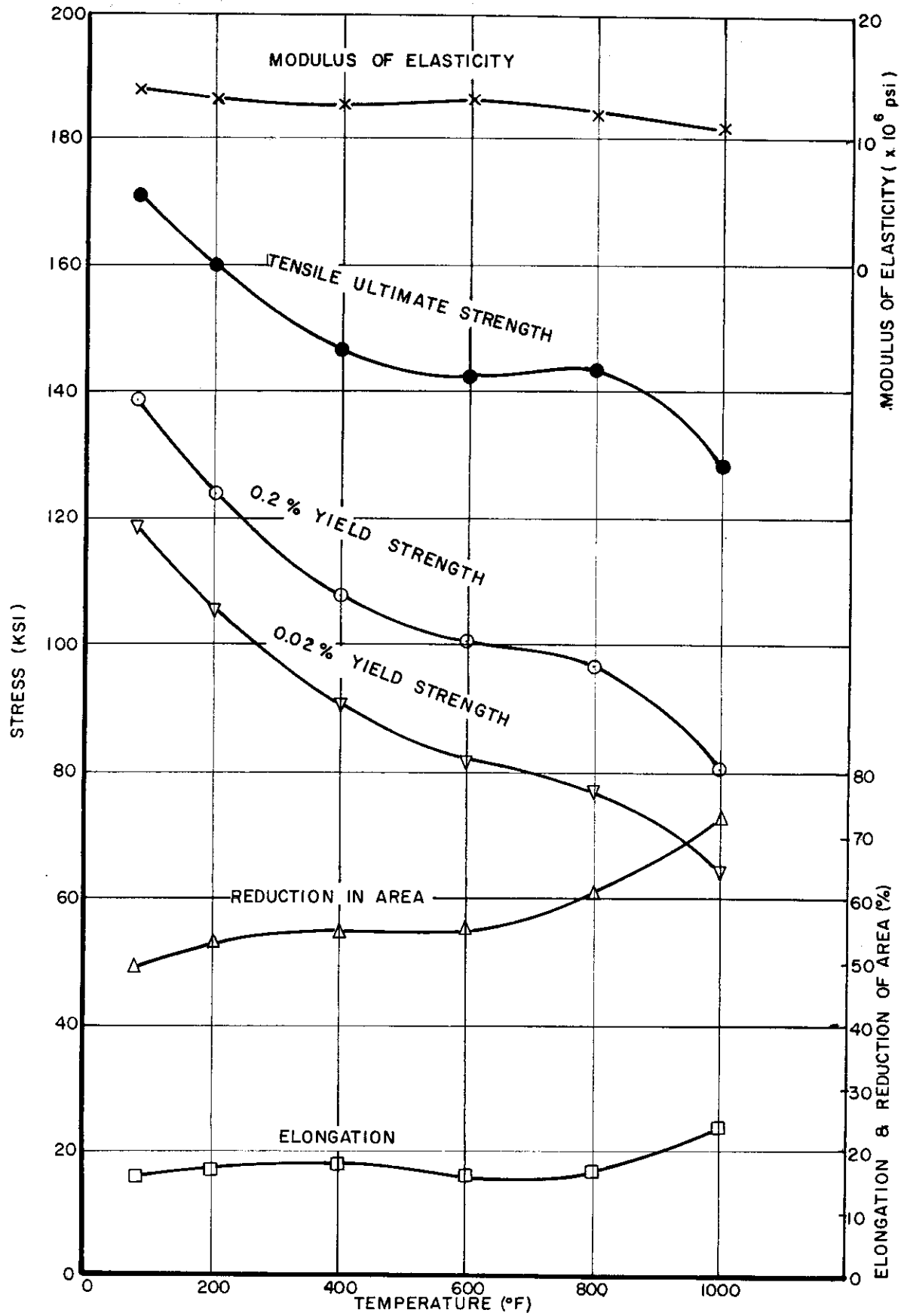


Figure 17. Average Tensile Properties vs. Temperature, C135AMo, All Heats

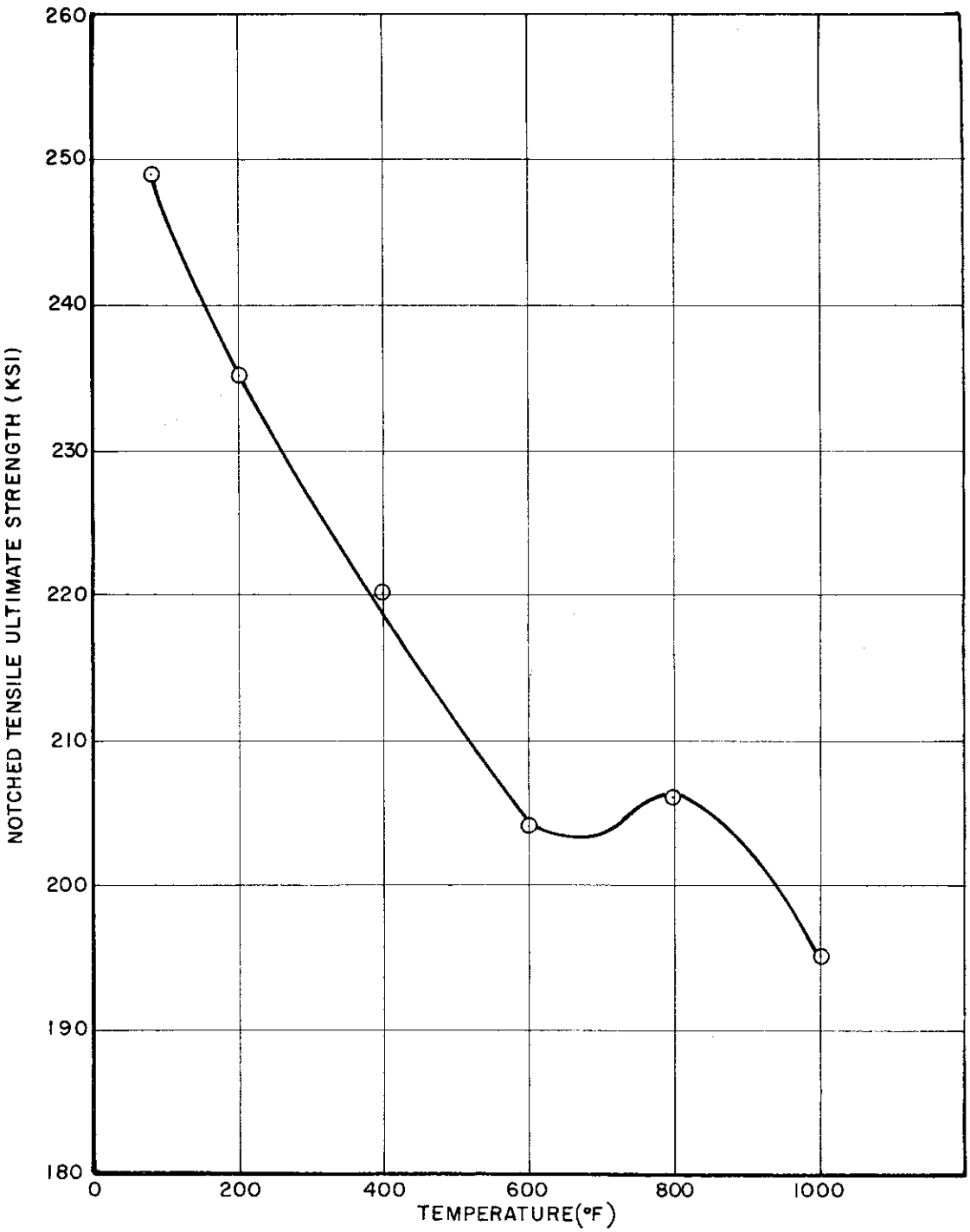


Figure 18. Average Notched Tensile Properties vs. Temperature, C135AMo, All Heats

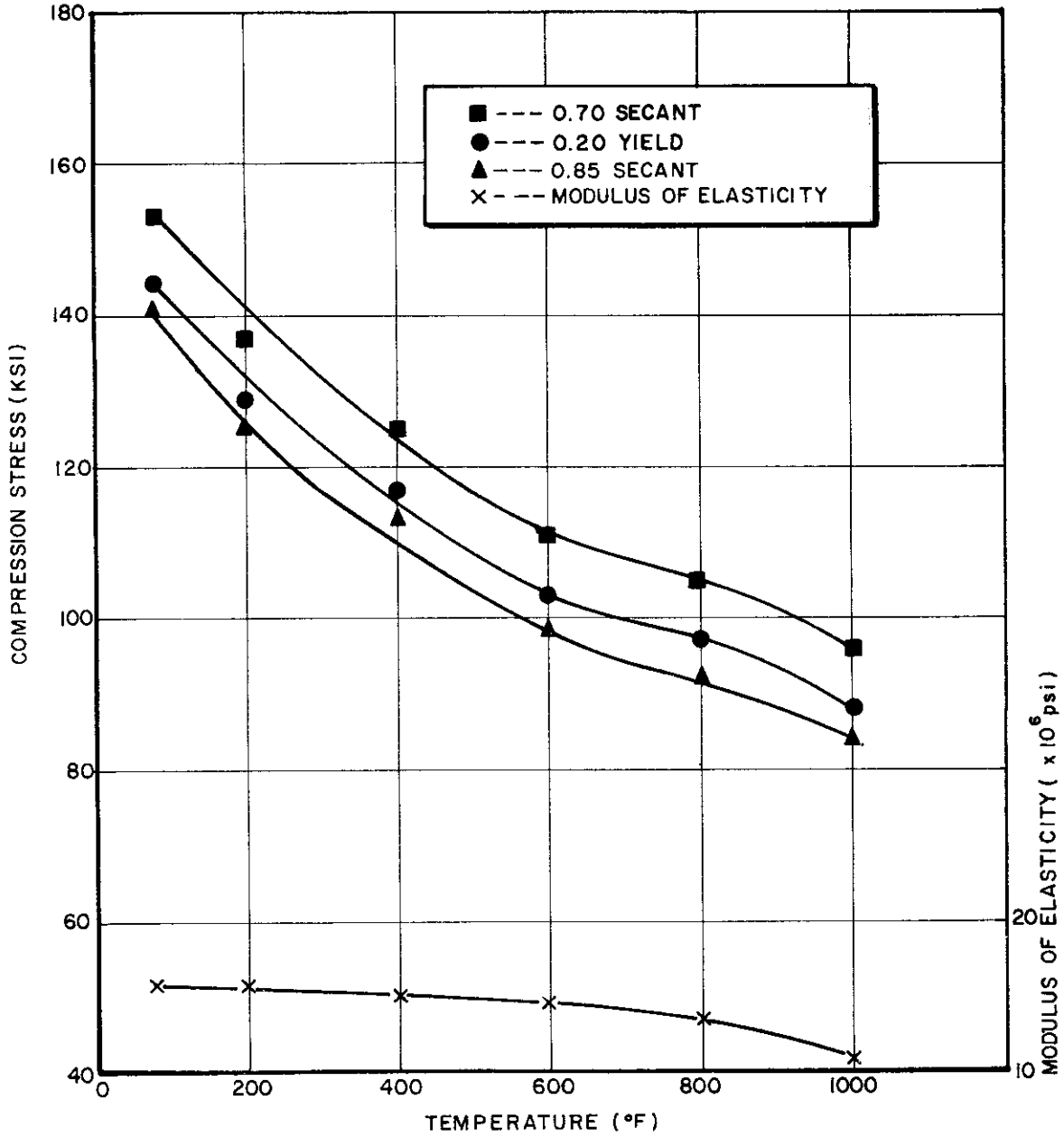


Figure 19. Average Compression Properties vs. Temperature, C135AMo, All Heats

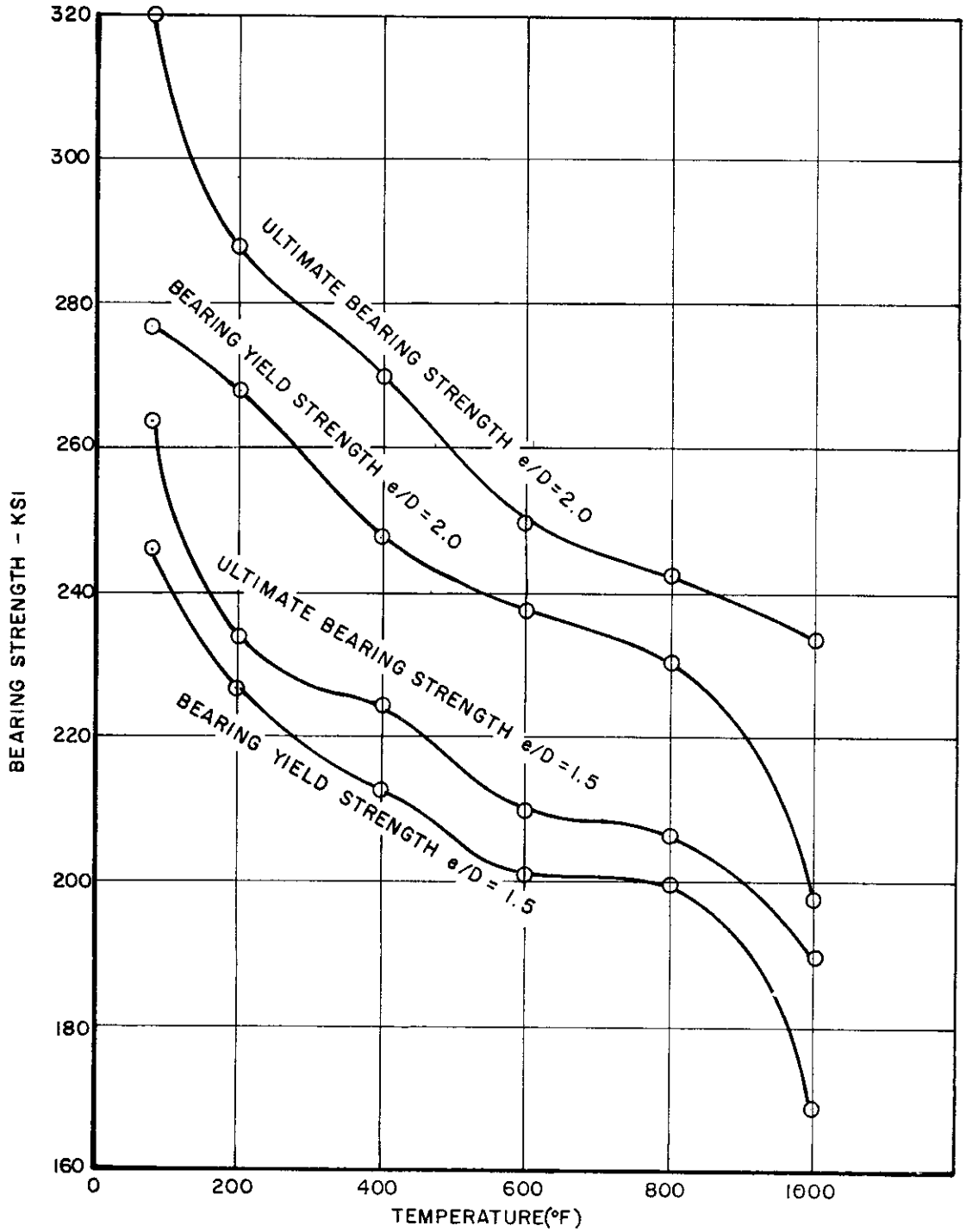


Figure 20. Average Bearing Properties vs. Temperature, C135AMo, All Heats

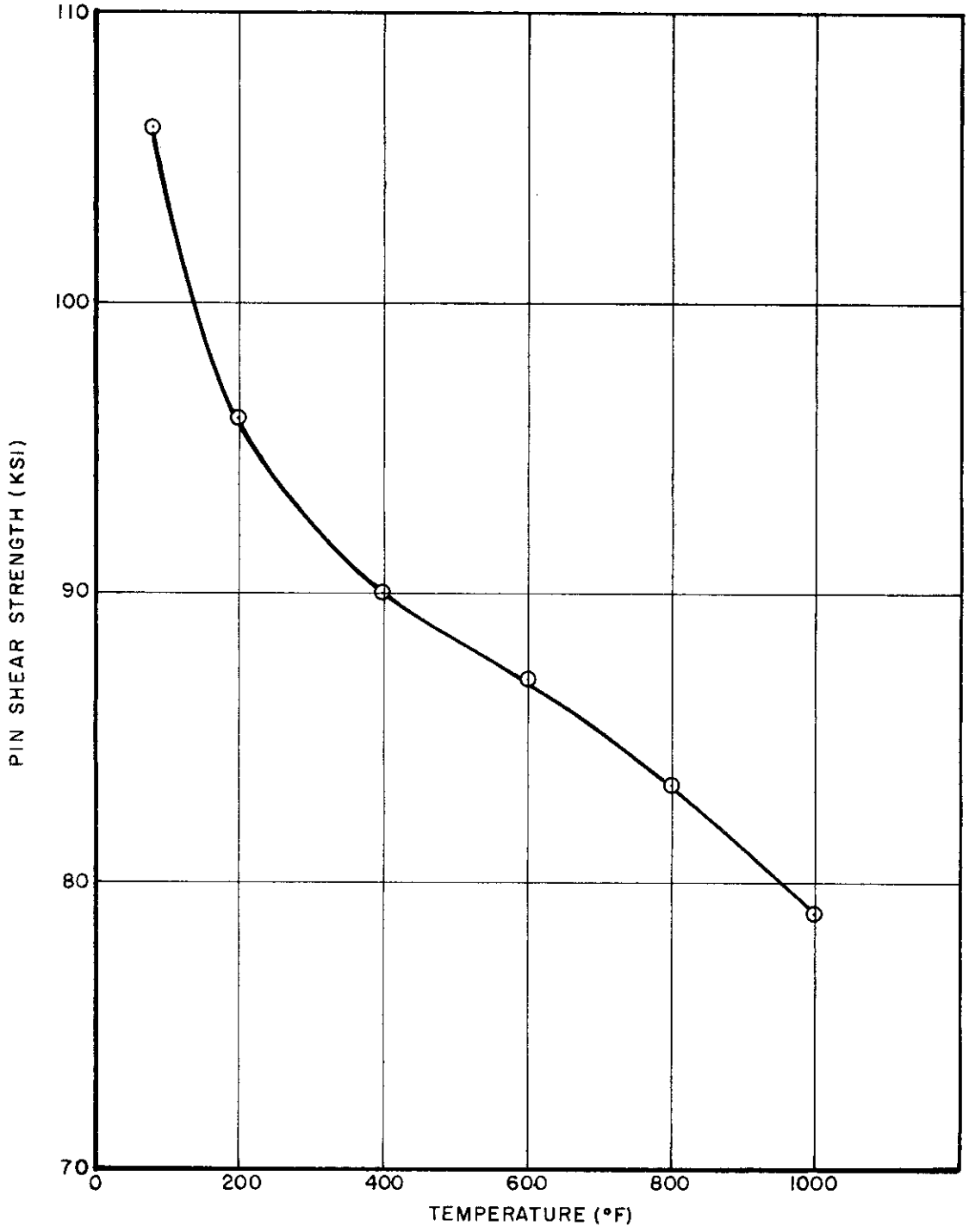


Figure 21. Average Pin Shear Properties vs. Temperature, C135AMo, All Heats

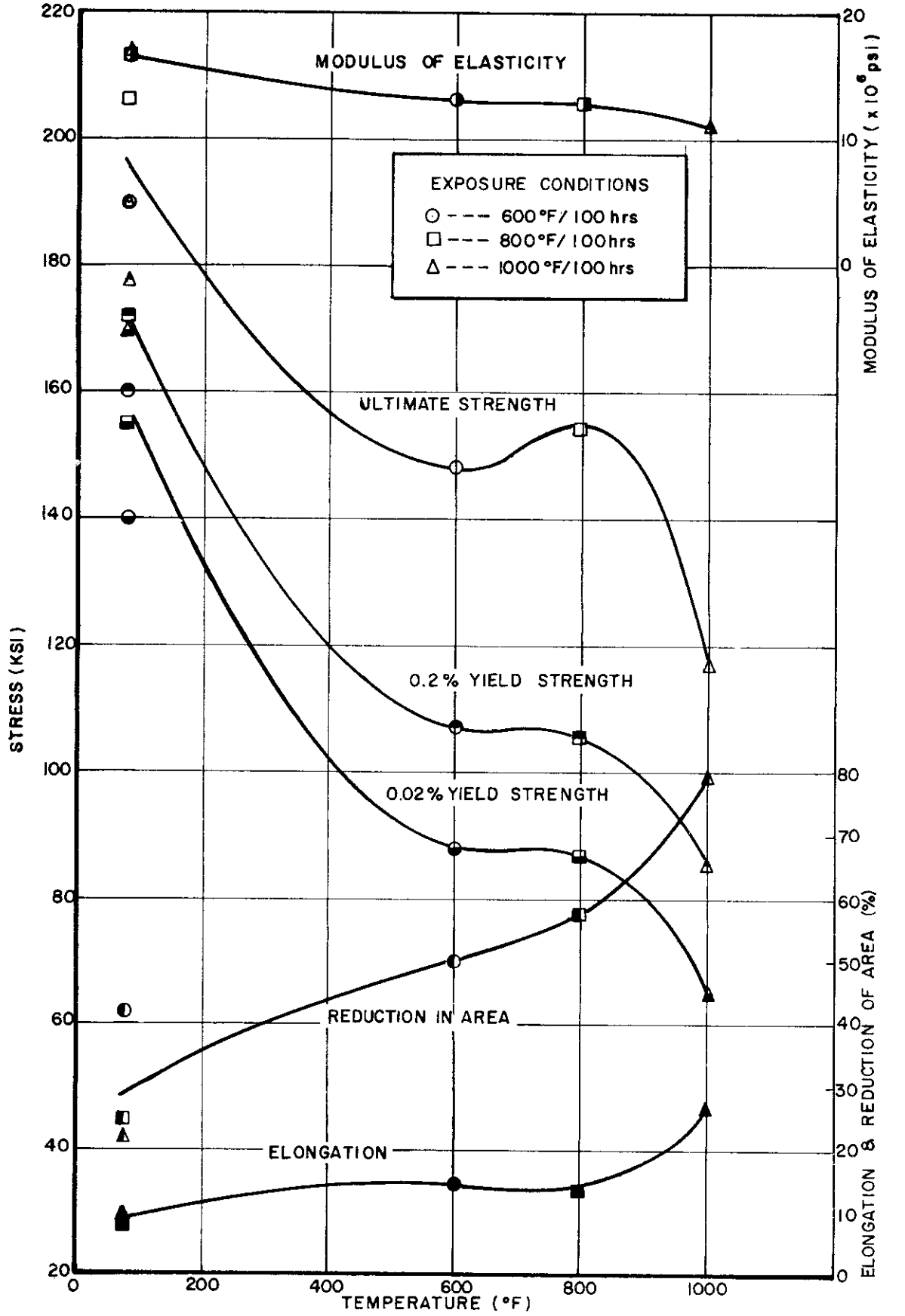


Figure 22. Average Nonstressed Stability Tensile Properties vs. Temperature, C135AMo, All Heats

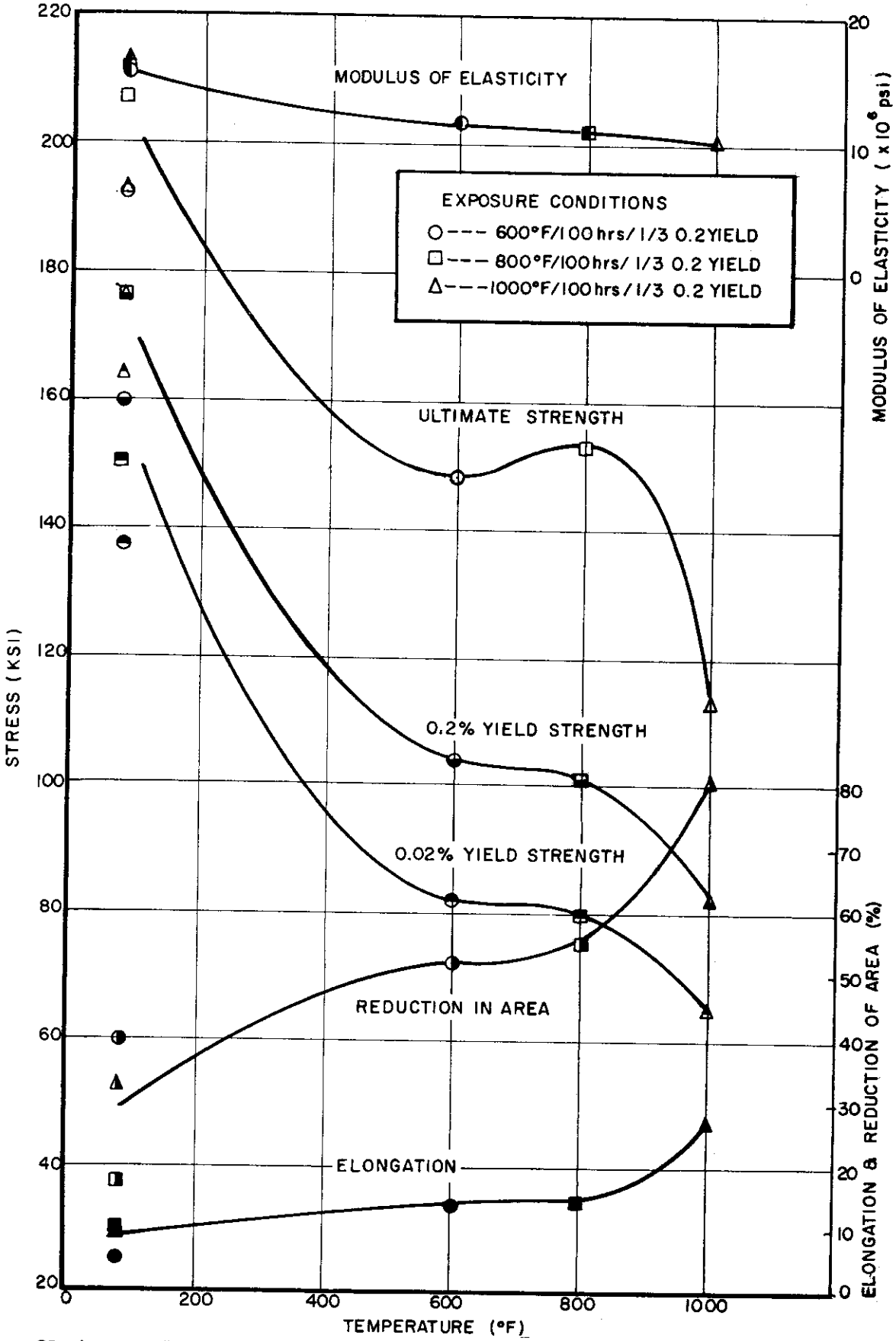


Figure 23. Average Stressed Stability Tensile Properties vs. Temperature, C135AMo, All Heats

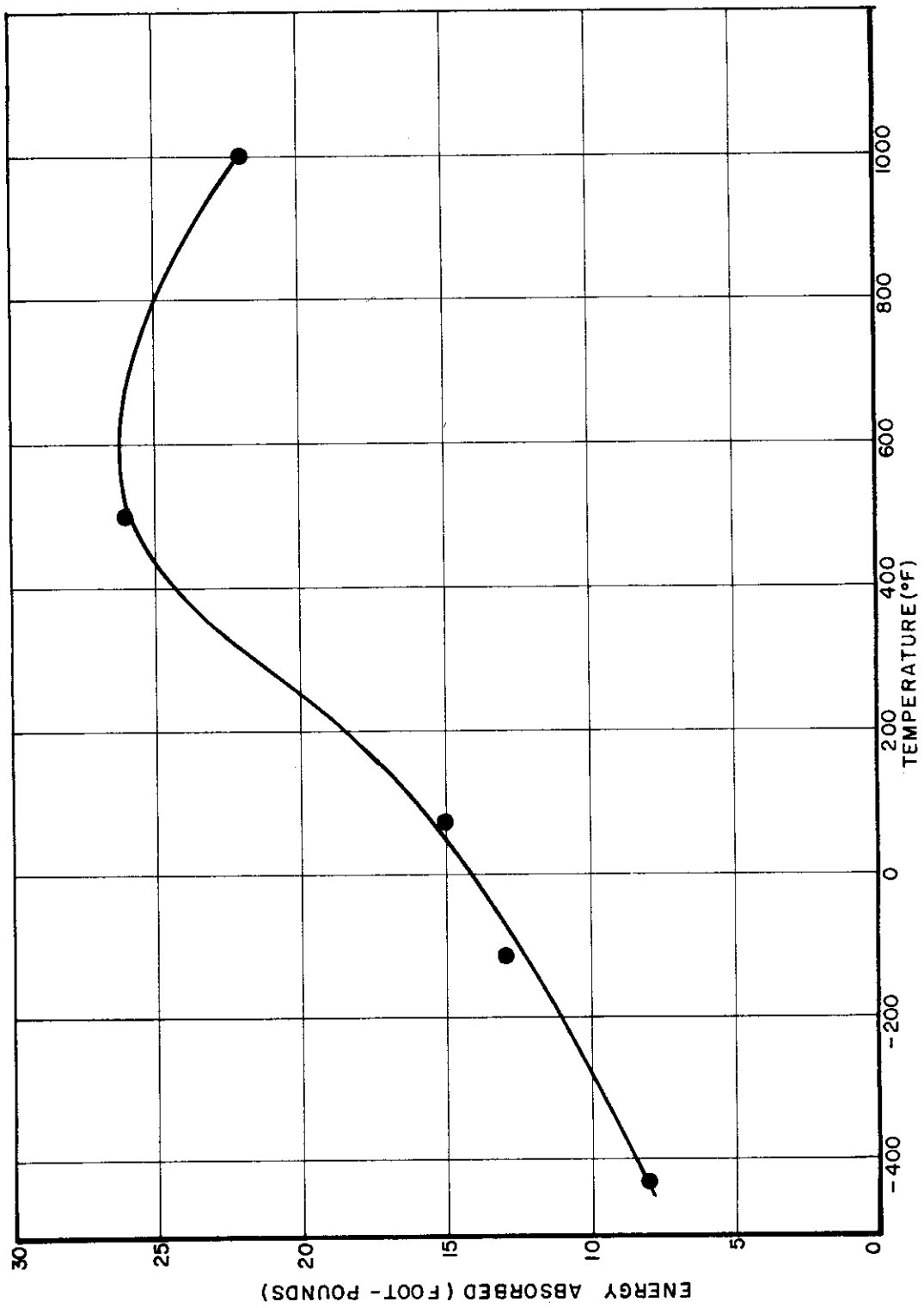


Figure 24. Average Charpy Impact Properties vs. Temperature, C135AMo, All Heats

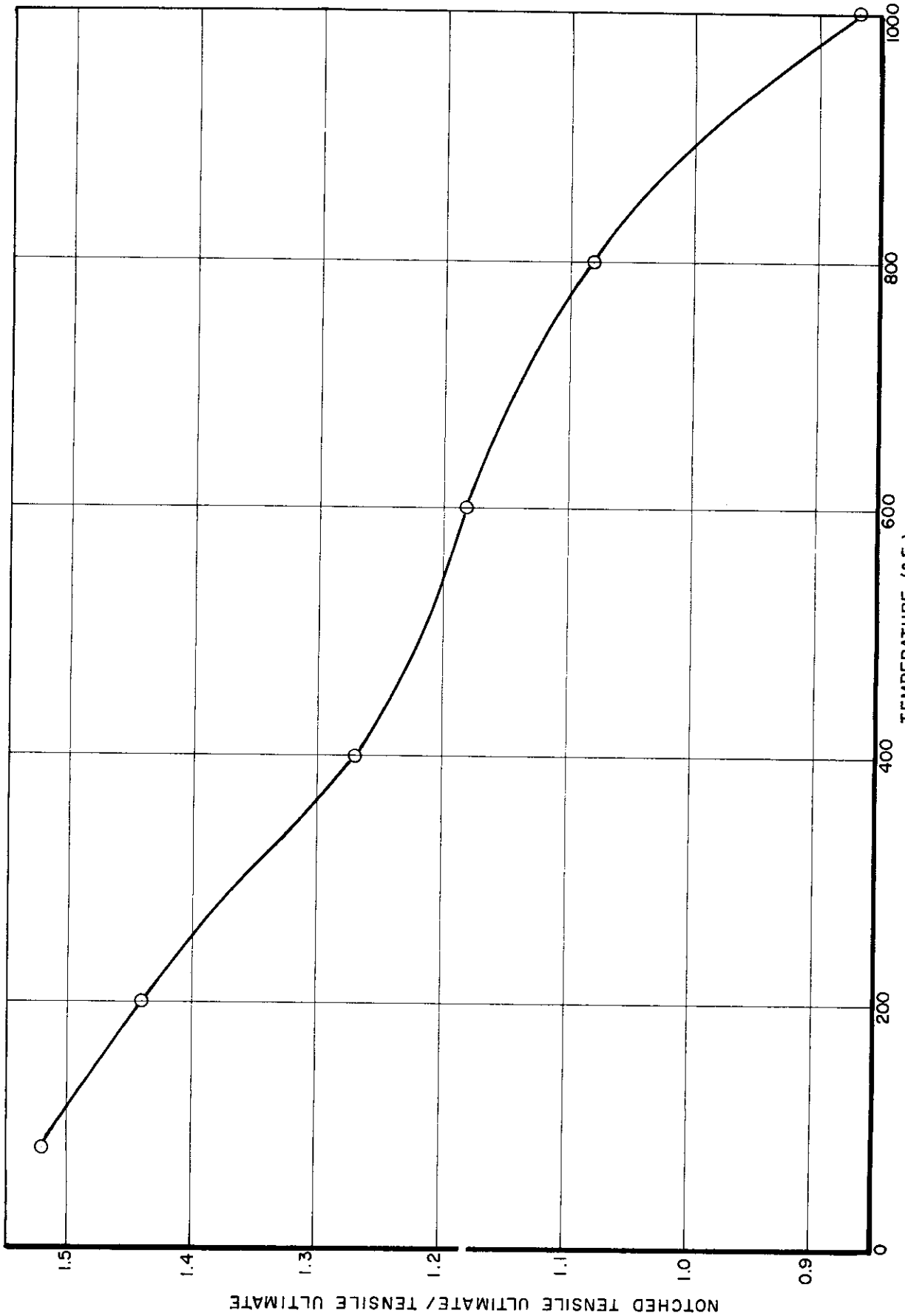


Figure 25. Average Notched Tensile Ultimate/Tensile Ultimate vs. Temperature, Ti 155A, All Heats

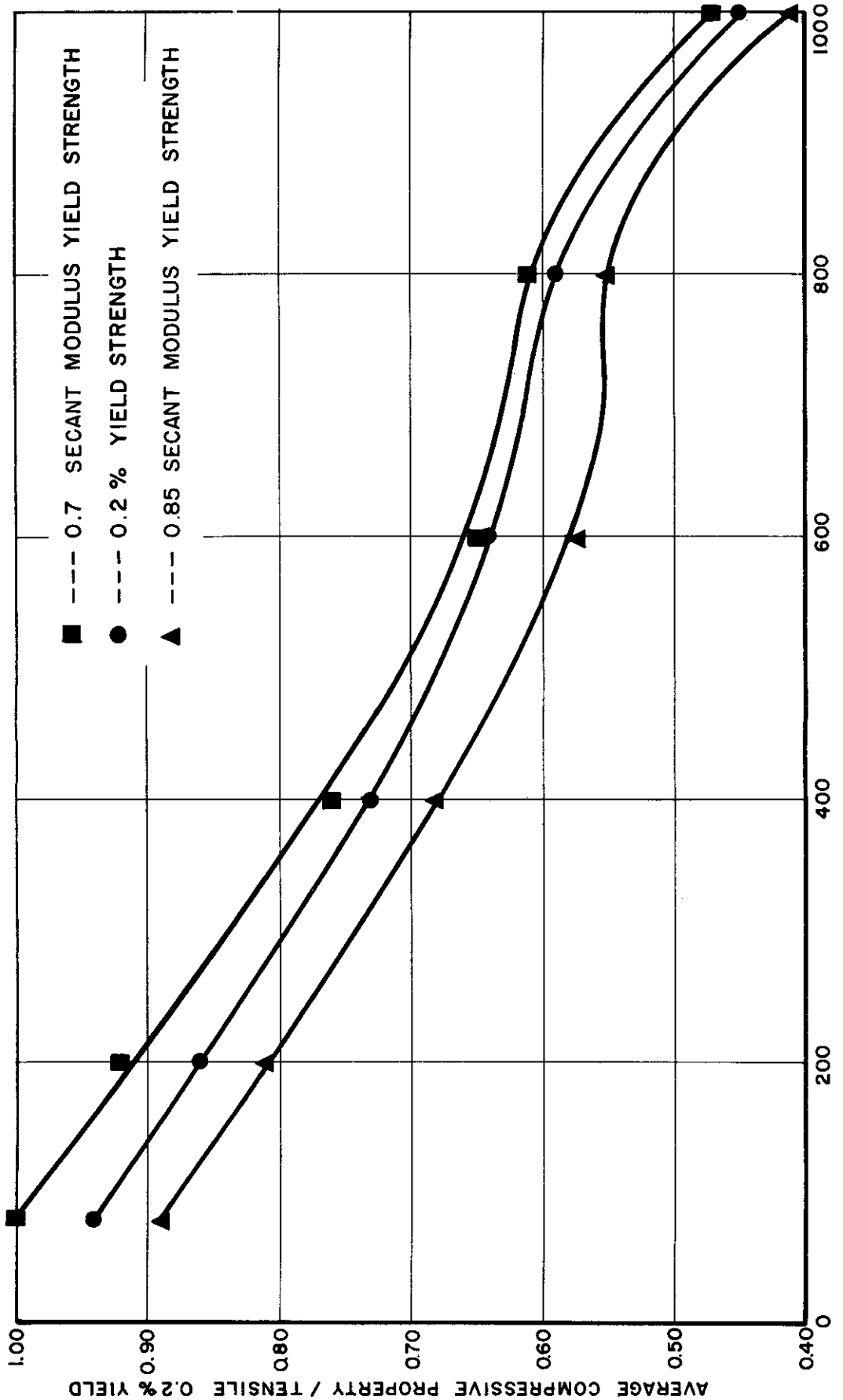


Figure 26. Average Compression Properties/Tensile 0.2% Yield vs. Temperature, Ti 155A, All Heats

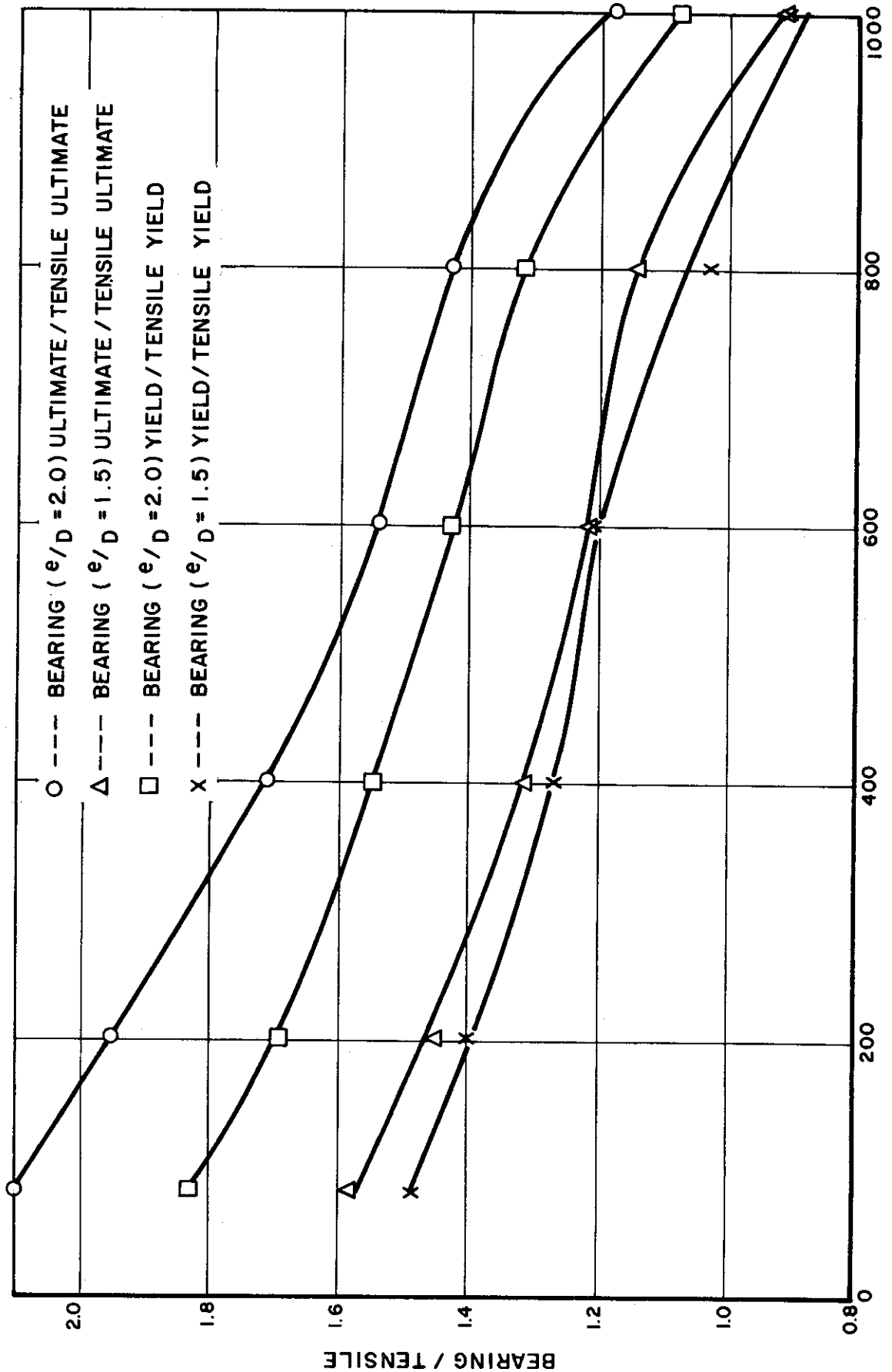


Figure 27. Average Bearing Properties/Tensile Properties vs. Temperature, Ti 155A, All Heats

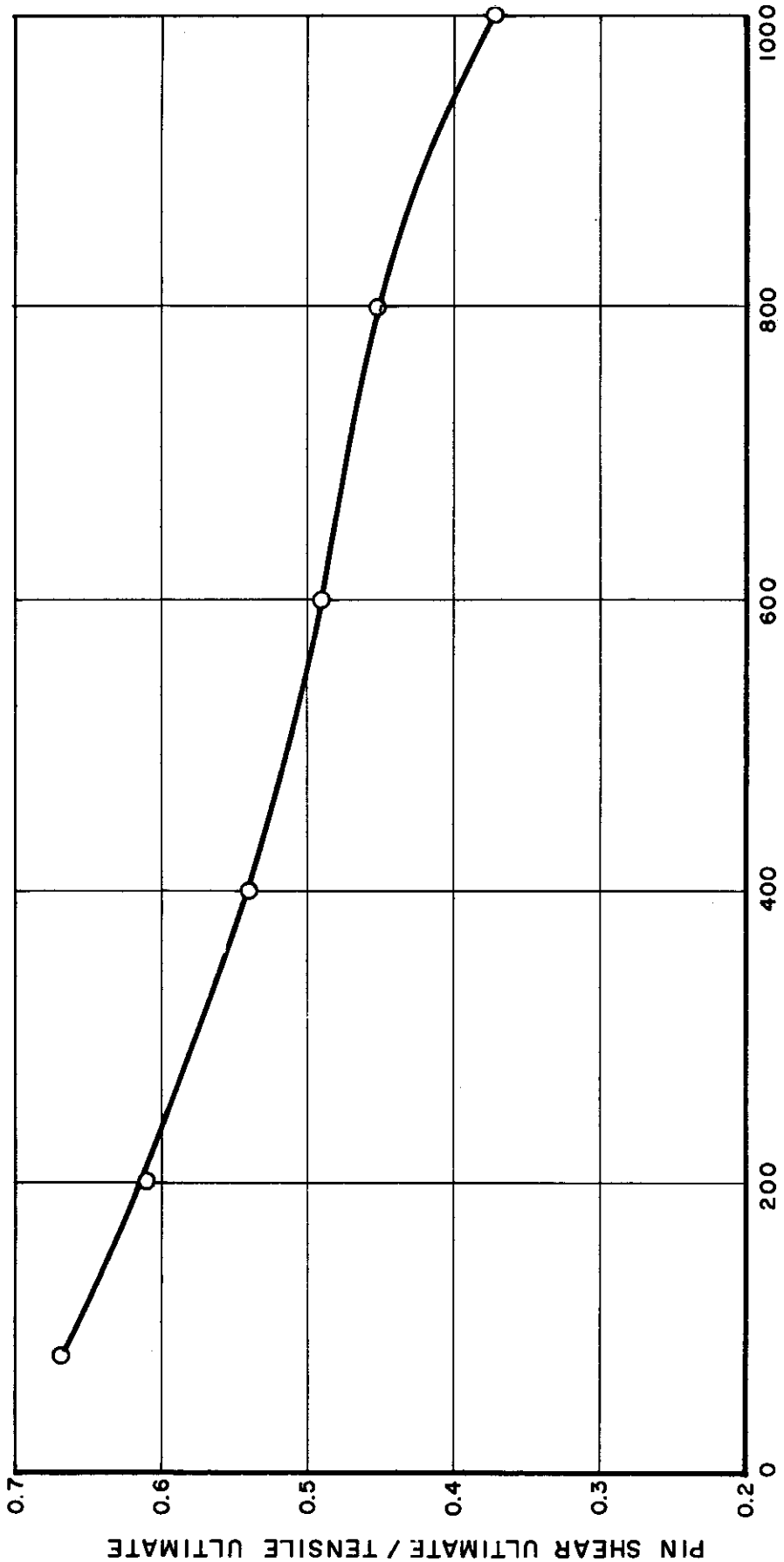


Figure 28. Average Pin Shear Ultimate/Tensile Ultimate vs. Temperature, Ti 155A, All Heats

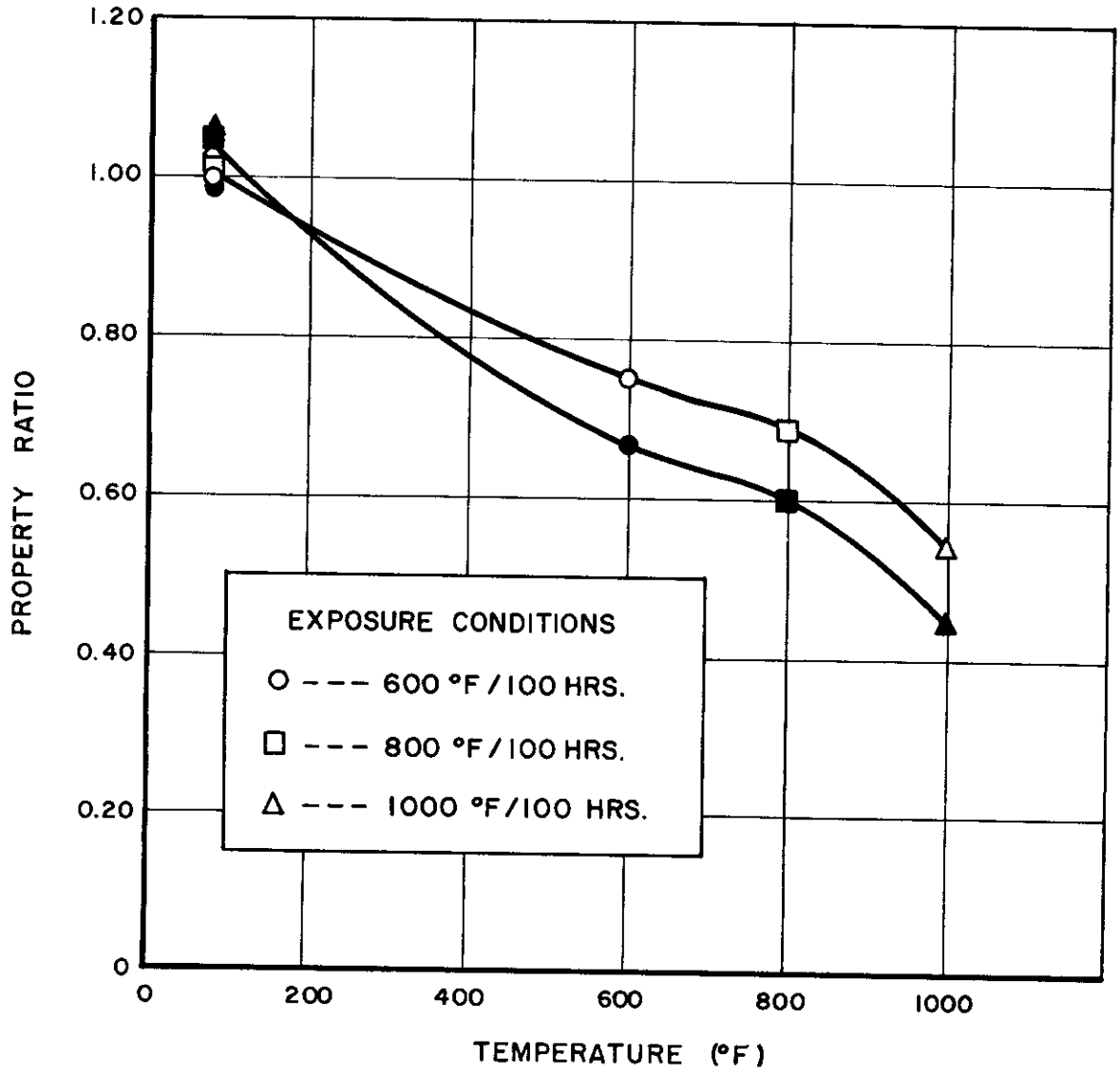


Figure 29. Average Nonstressed Stability Tensile/Tensile Properties vs. Temperature, Ti 155A, All Heats

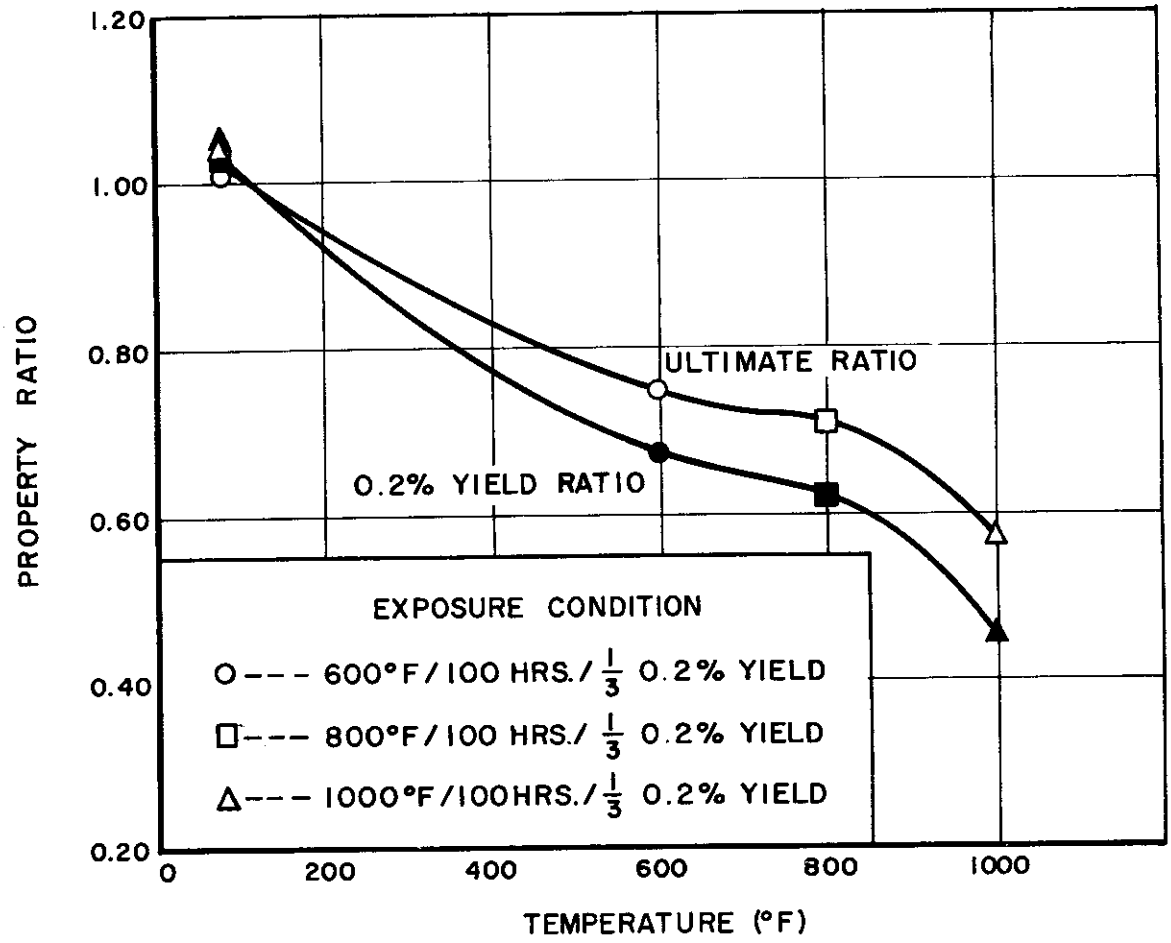


Figure 30. Average Stressed Stability Tensile/Tensile Properties, vs. Temperature, Ti 155A, All Heats

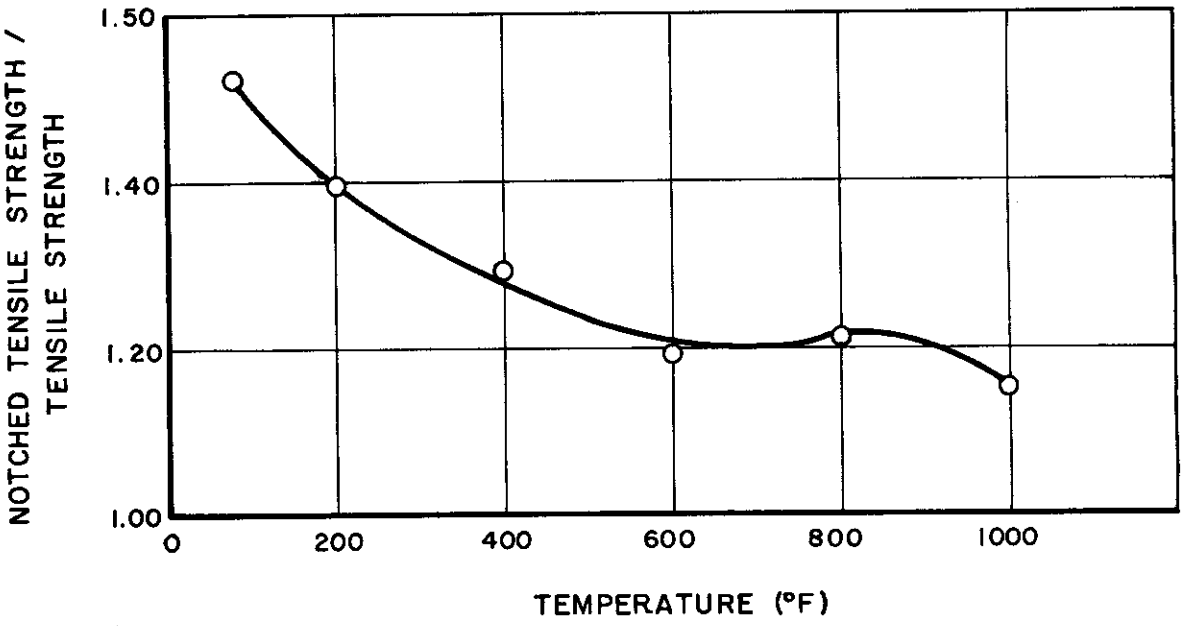


Figure 31. Average Notched Tensile Ultimate/Tensile Ultimate, vs. Temperature, C135AMo, All Heats

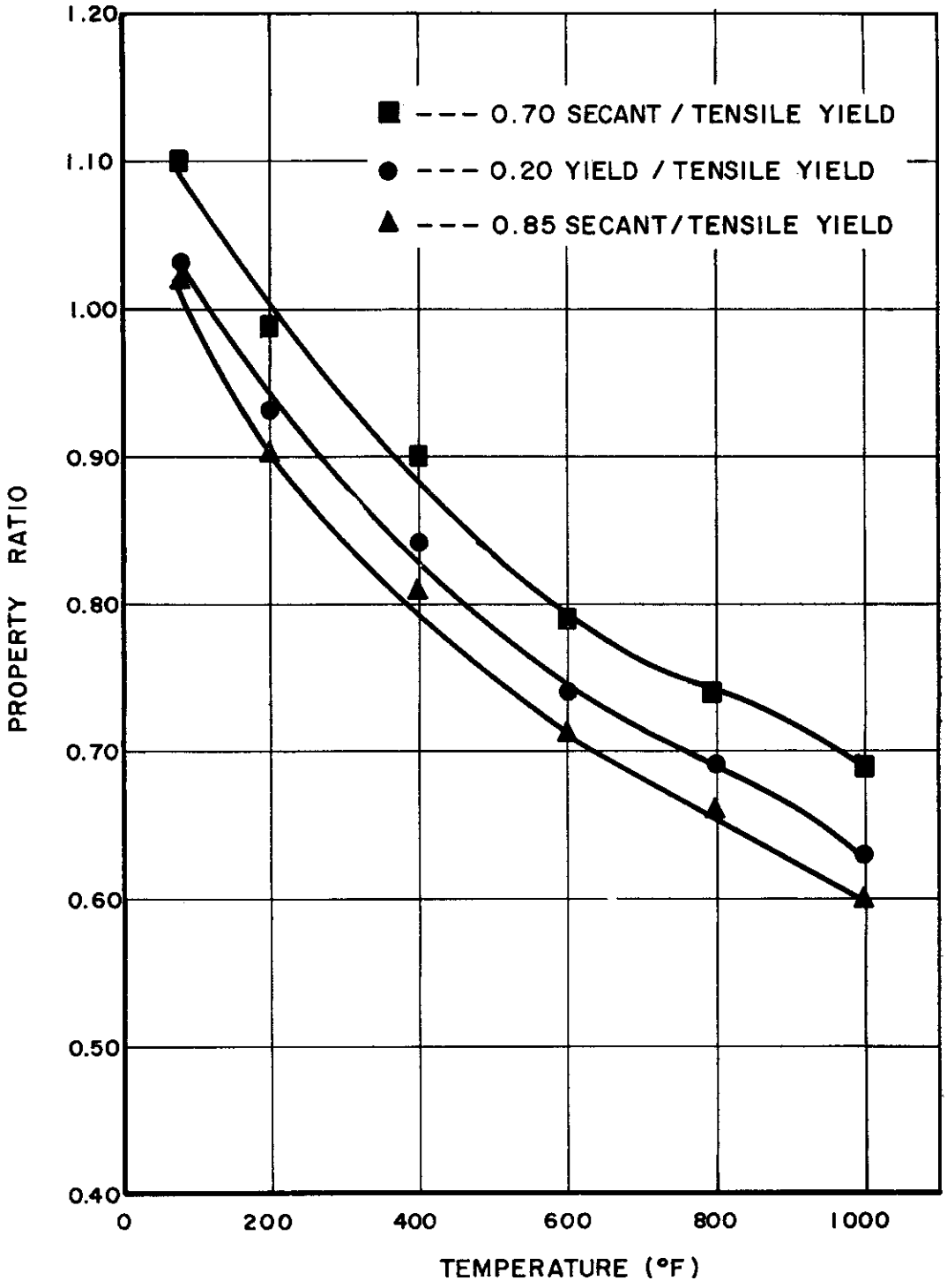


Figure 32. Average Compression Properties/Tensile Properties, vs. Temperature, C135AMo, All Heats

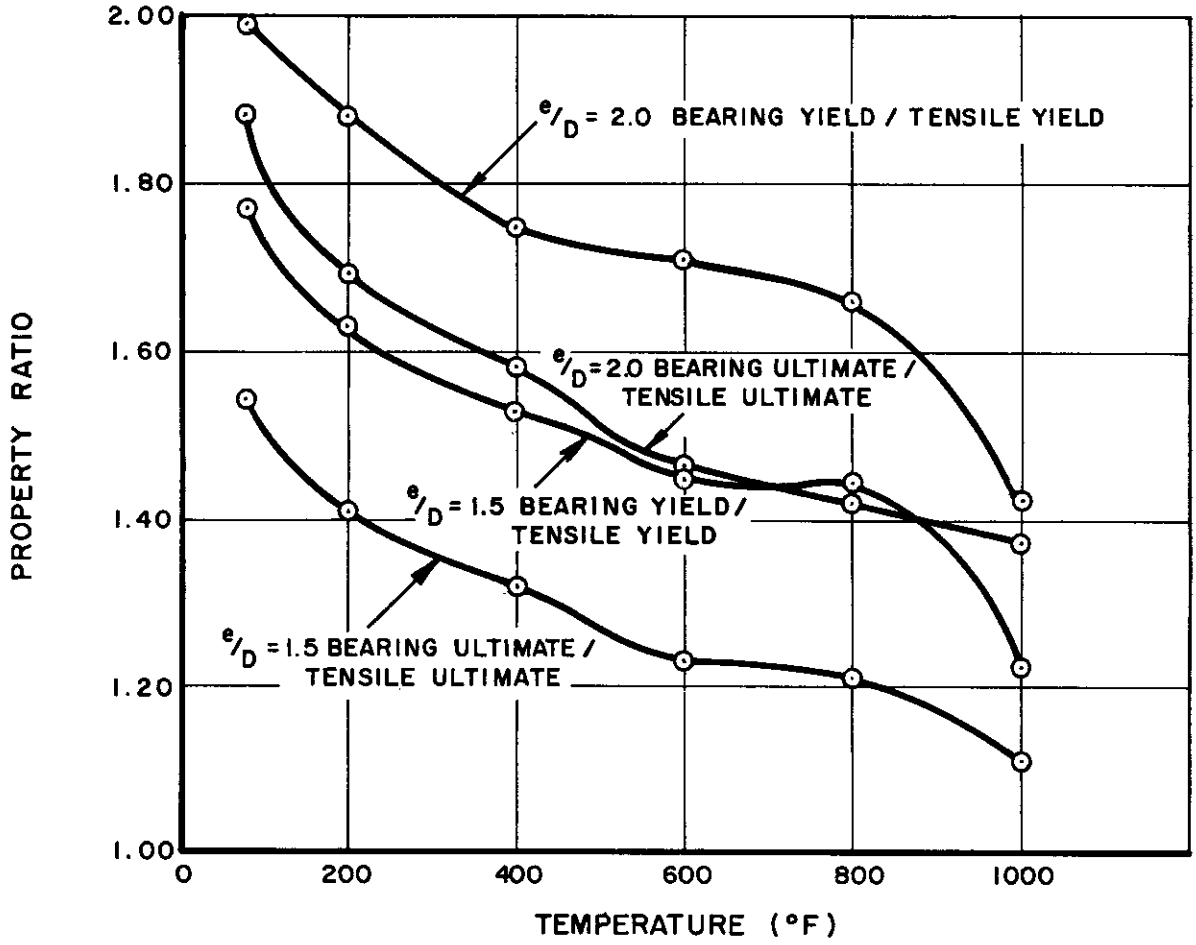


Figure 33. Average Bearing Properties/Tensile Properties vs. Temperature, C135AMo, All Heats

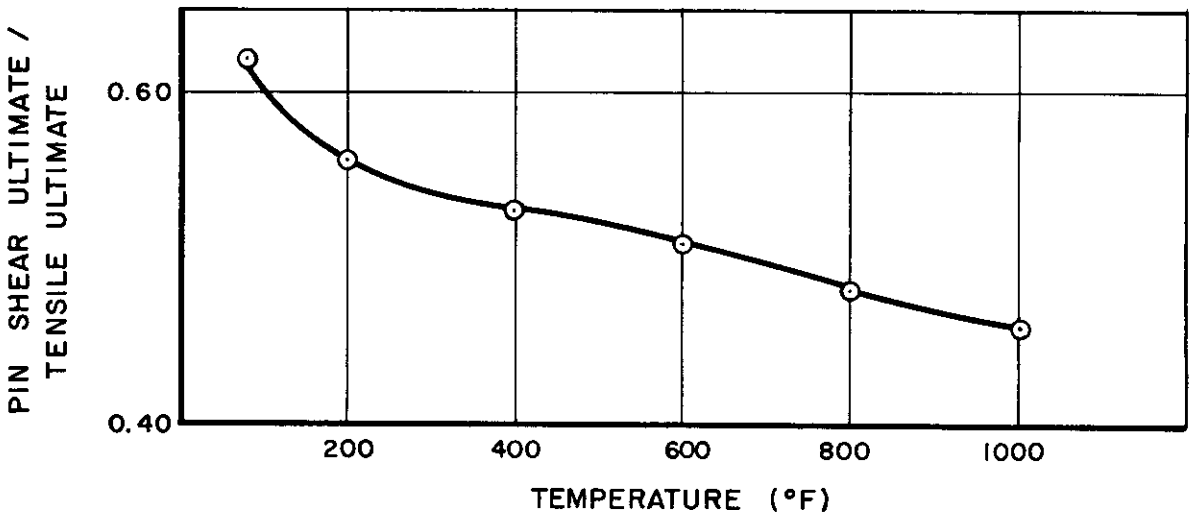


Figure 34. Average Pin Shear Ultimate/Tensile Ultimate vs. Temperature, C135AMo, All Heats

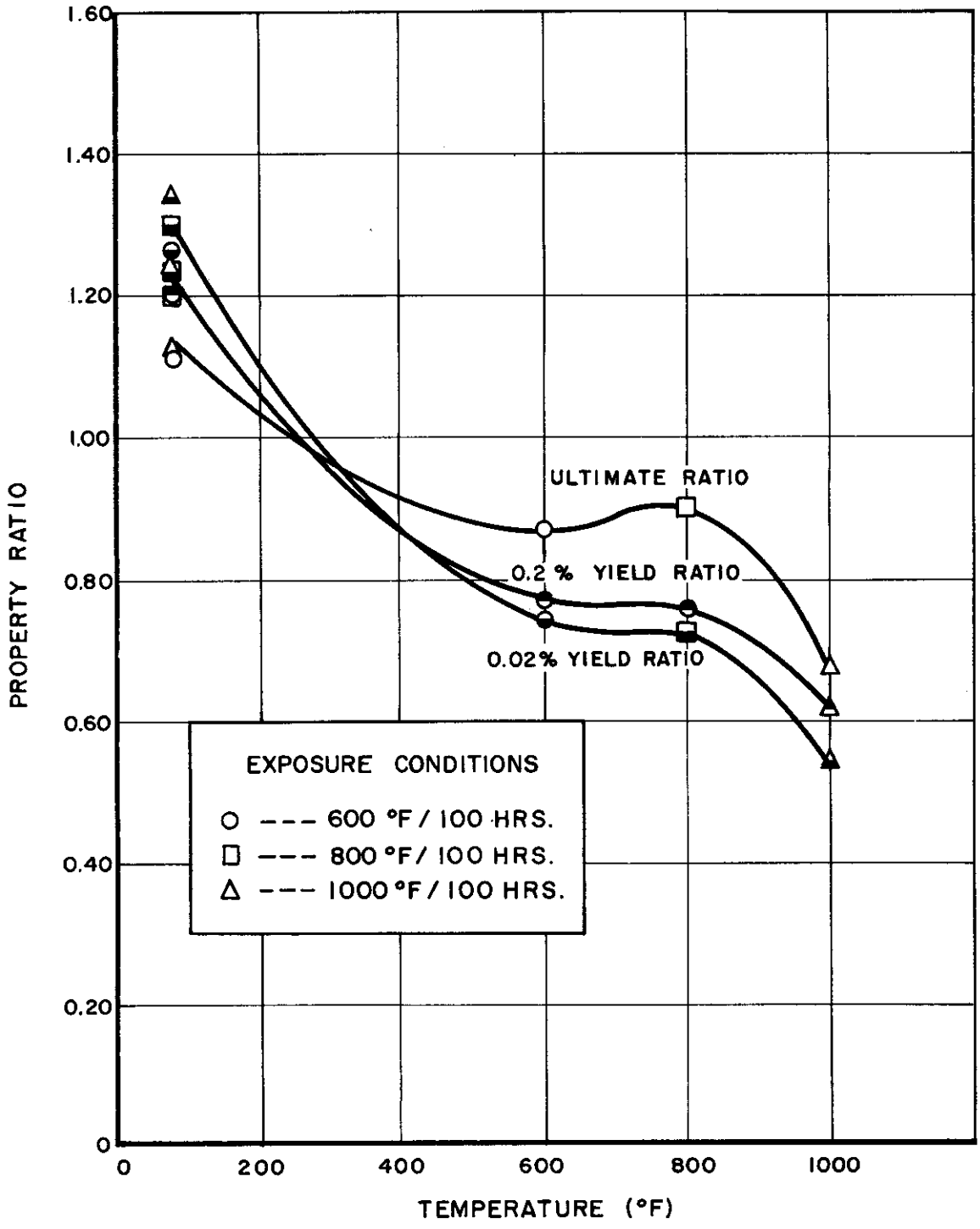


Figure 35. Average Nonstressed Stability Tensile/Tensile Properties vs. Temperature, C135AMo, All Heats

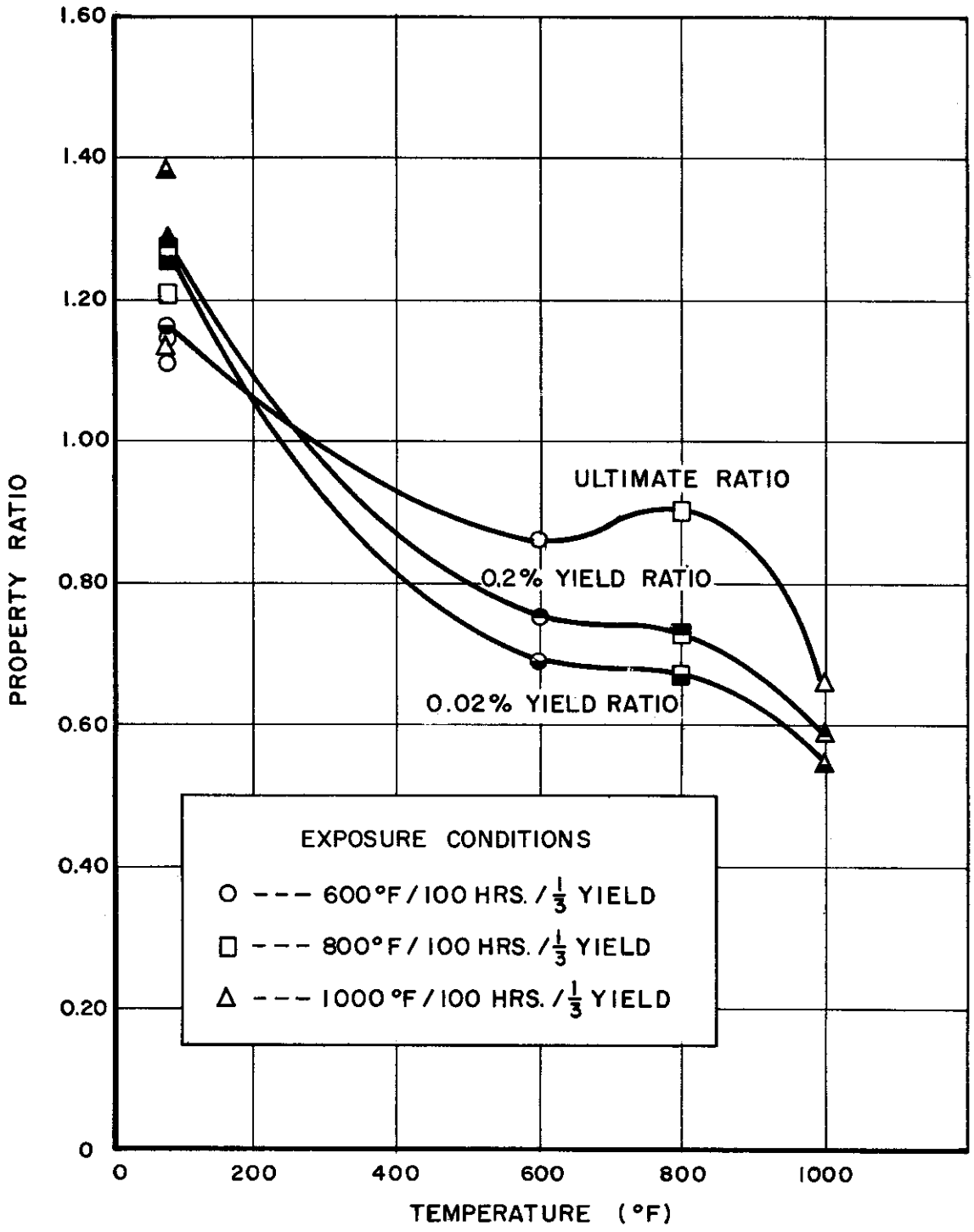


Figure 36. Average Stressed Stability Tensile/Tensile Properties vs. Temperature, C135AMo, All Heats

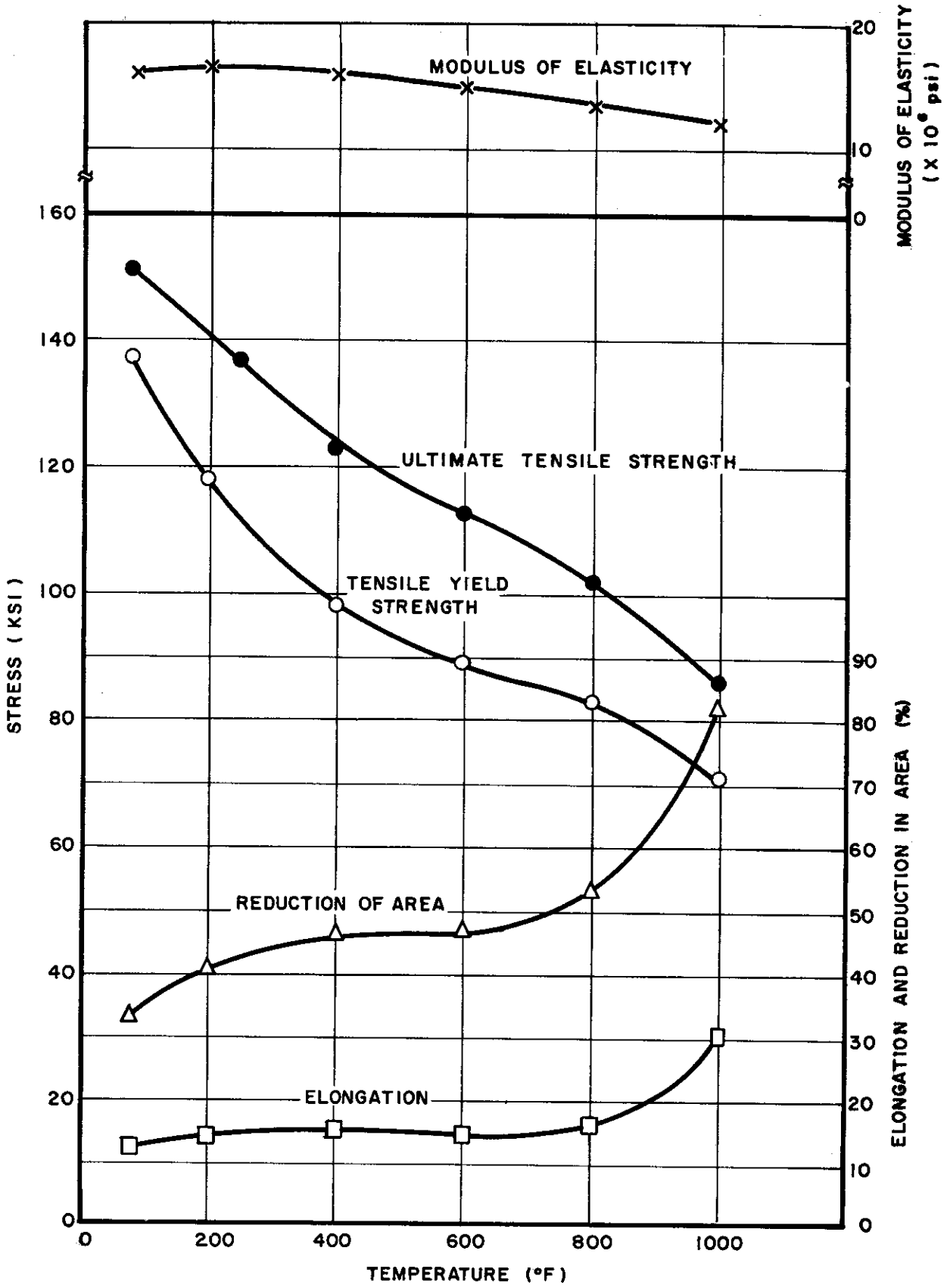


Figure 37. Tensile Properties vs. Temperature, Ti 155A, Heat 1

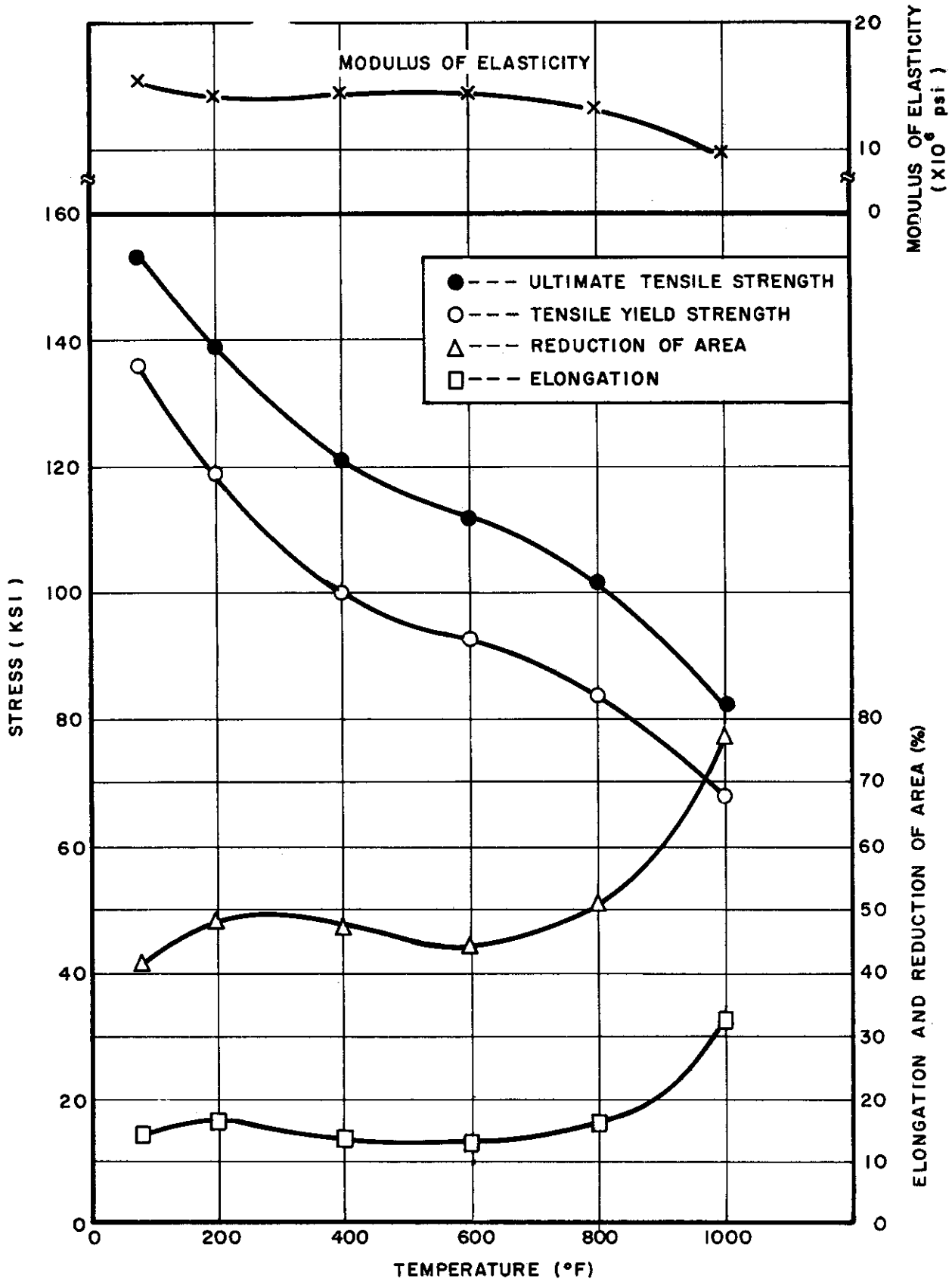


Figure 38. Tensile Properties vs. Temperature, Ti 155A, Heat 2

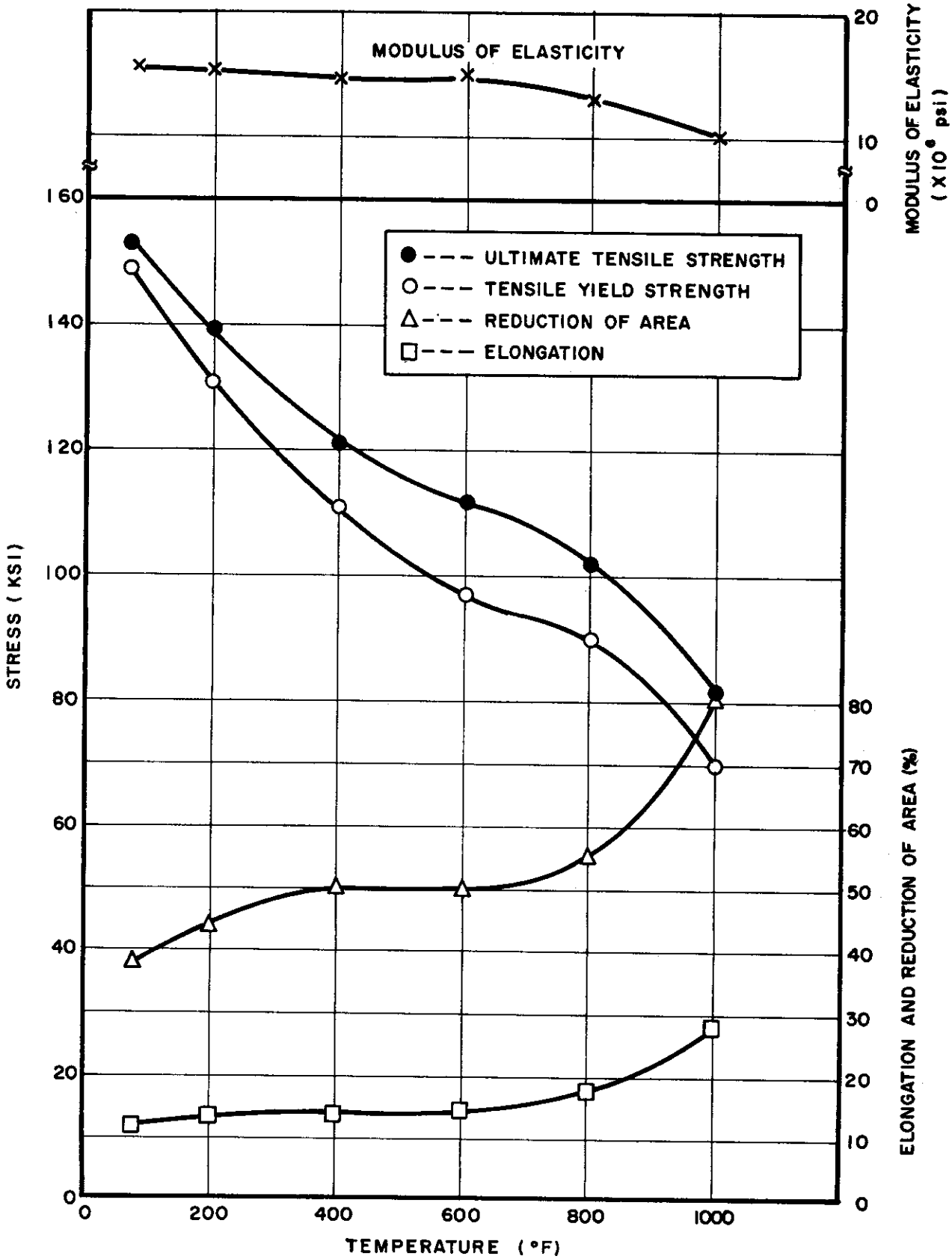


Figure 39. Tensile Properties vs. Temperature, Ti 155A, Heat 3

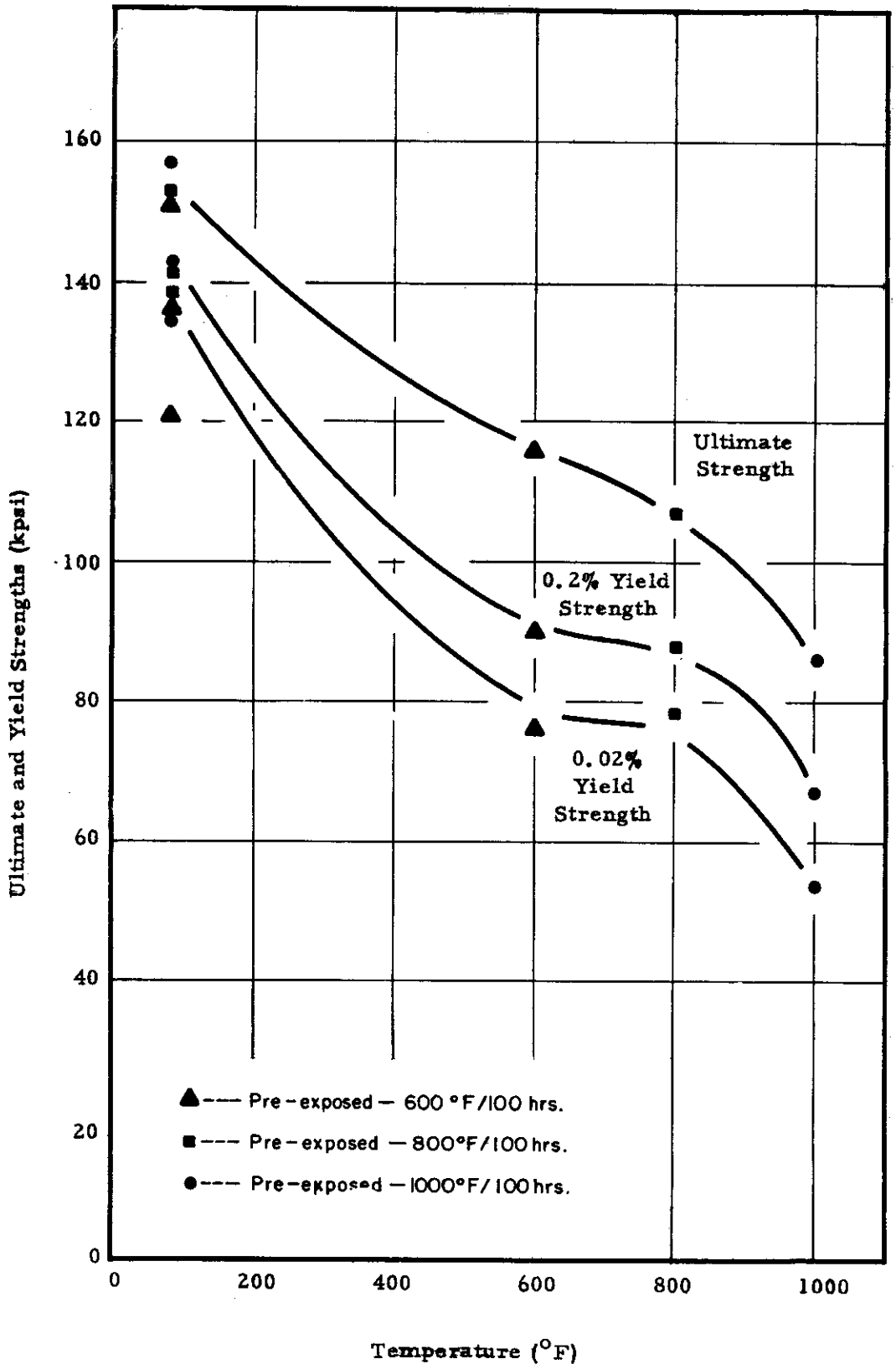


Figure 40. Tensile Properties vs. Temperature, Nonstressed Stability, Ti 155A, Heat 1

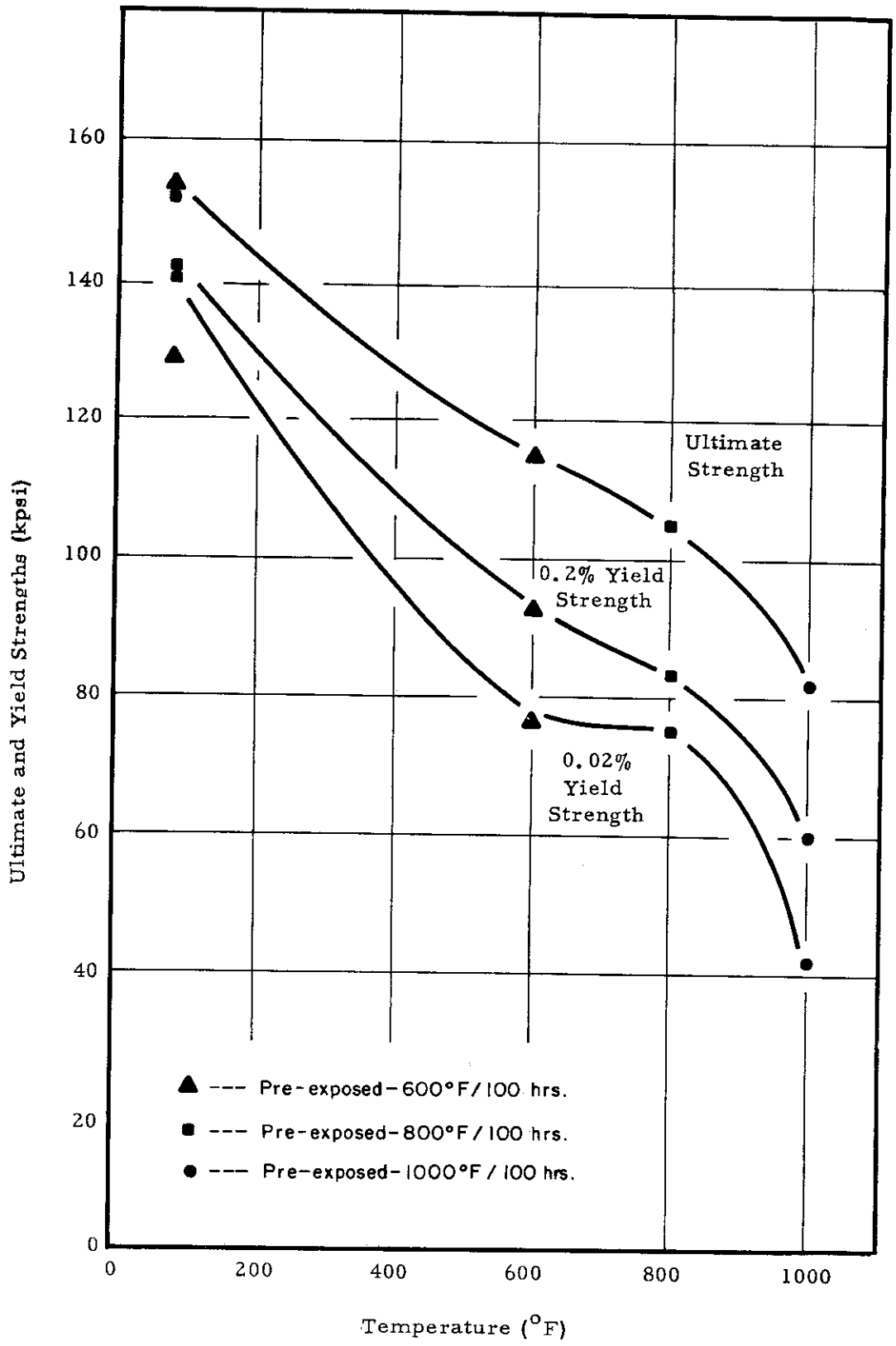


Figure 41. Tensile Properties vs. Temperature, Nonstressed Stability, Ti 155A, Heat 2

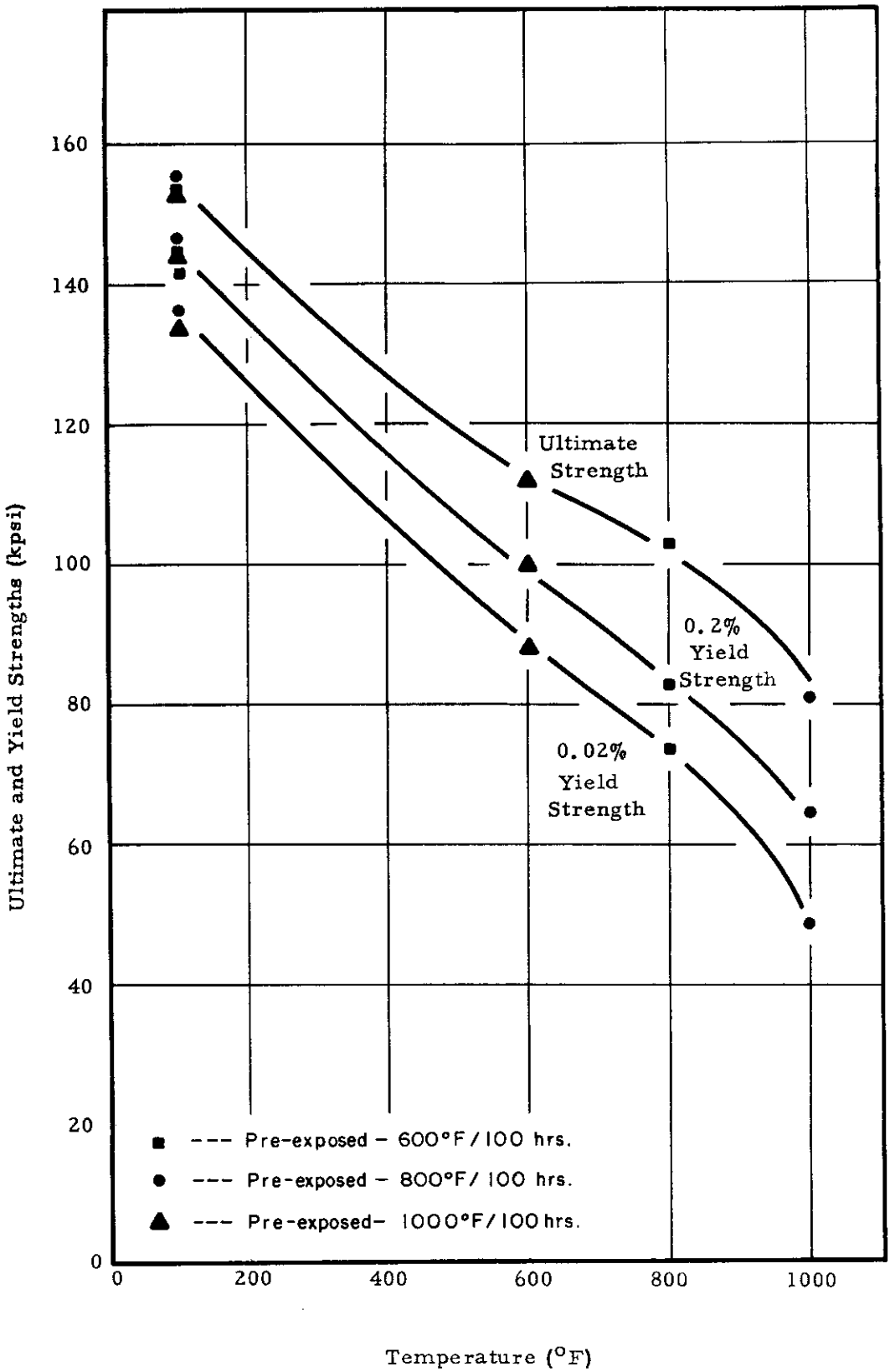


Figure 42. Tensile Properties vs. Temperature, Nonstressed Stability, Ti 155A, Heat 3

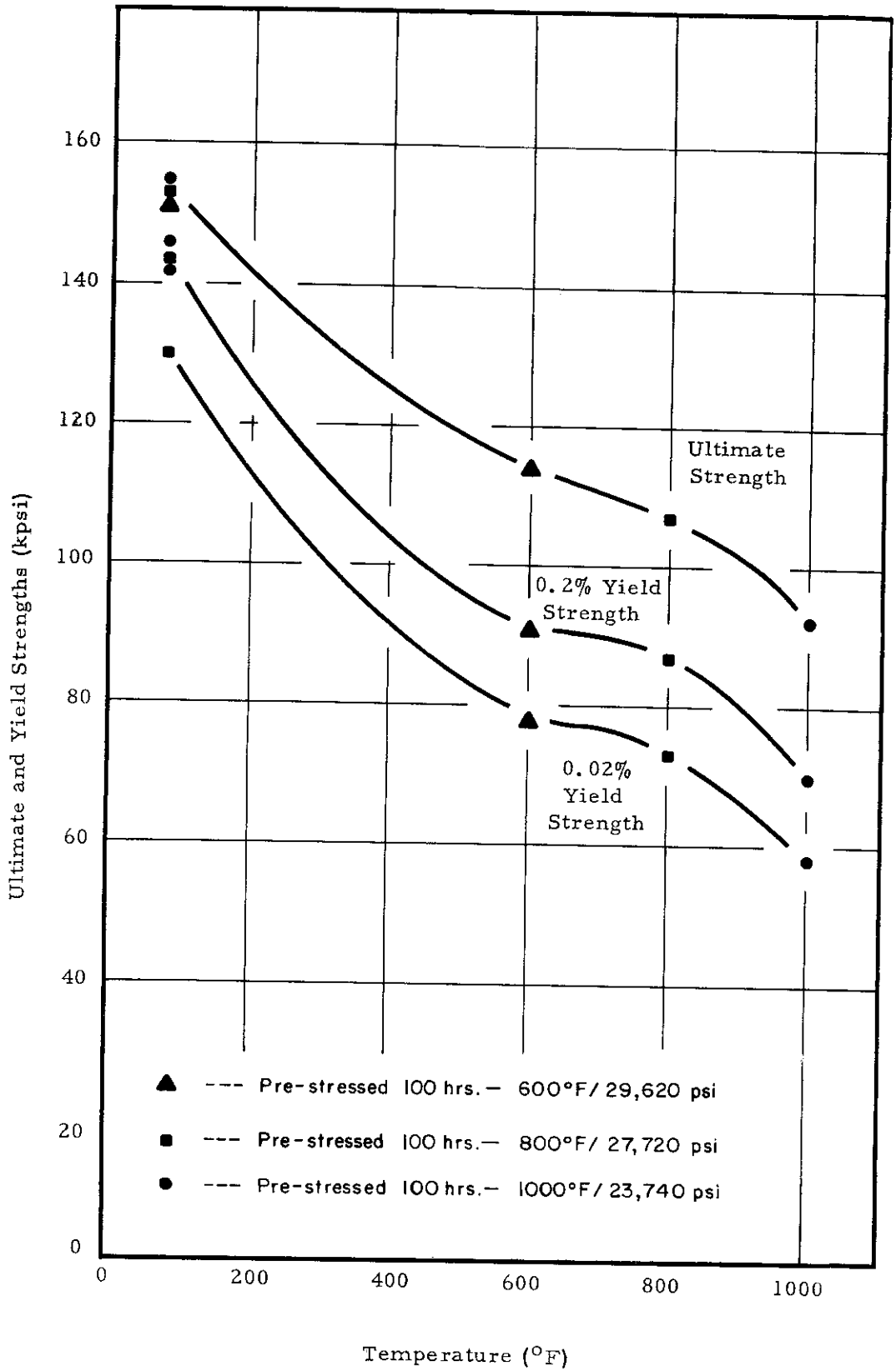


Figure 43. Tensile Properties vs. Temperature, Stressed Stability, Ti 155A, Heat 1

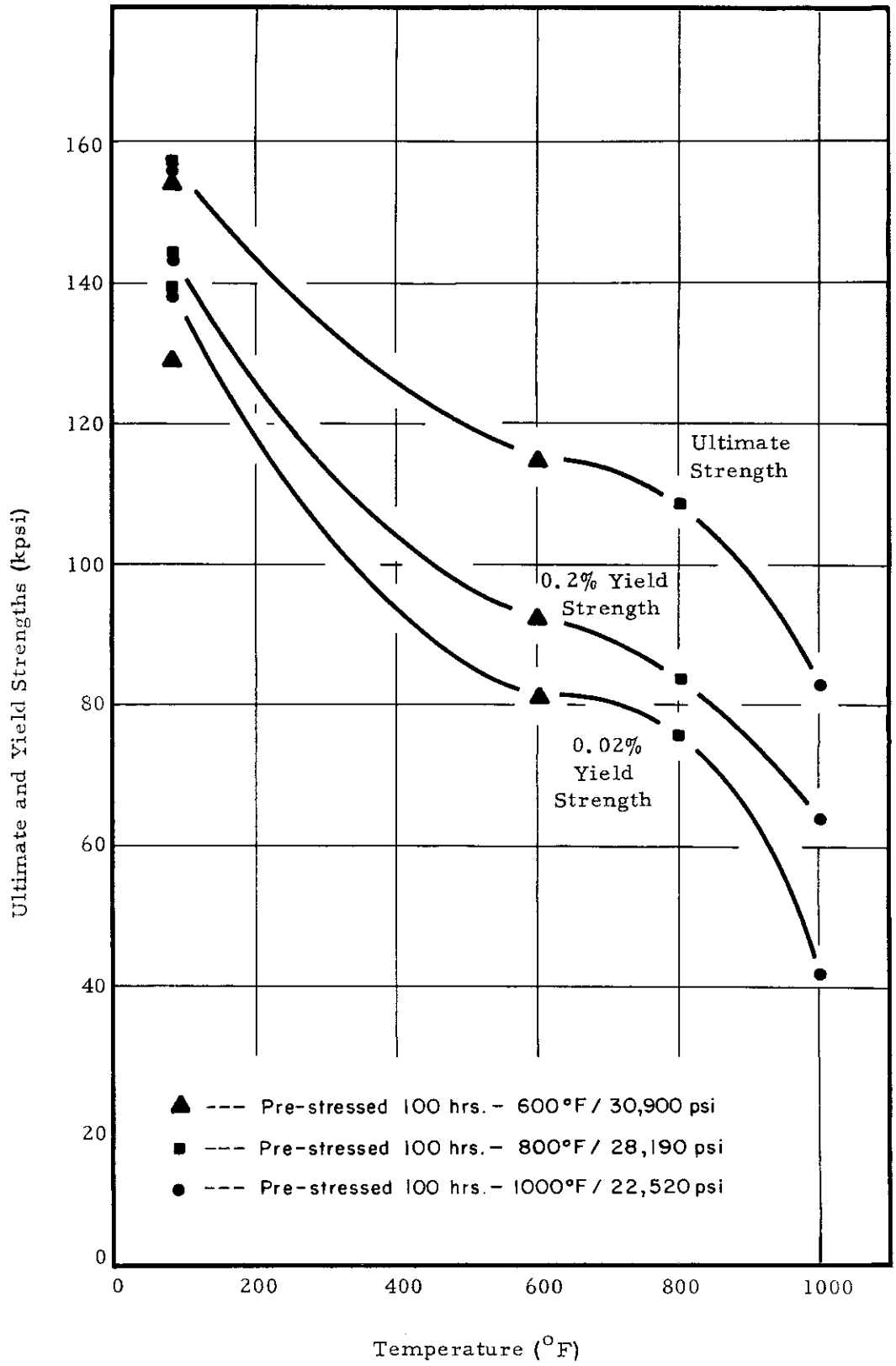


Figure 44. Tensile Properties vs. Temperature, Stressed Stability, Ti 155A, Heat 2

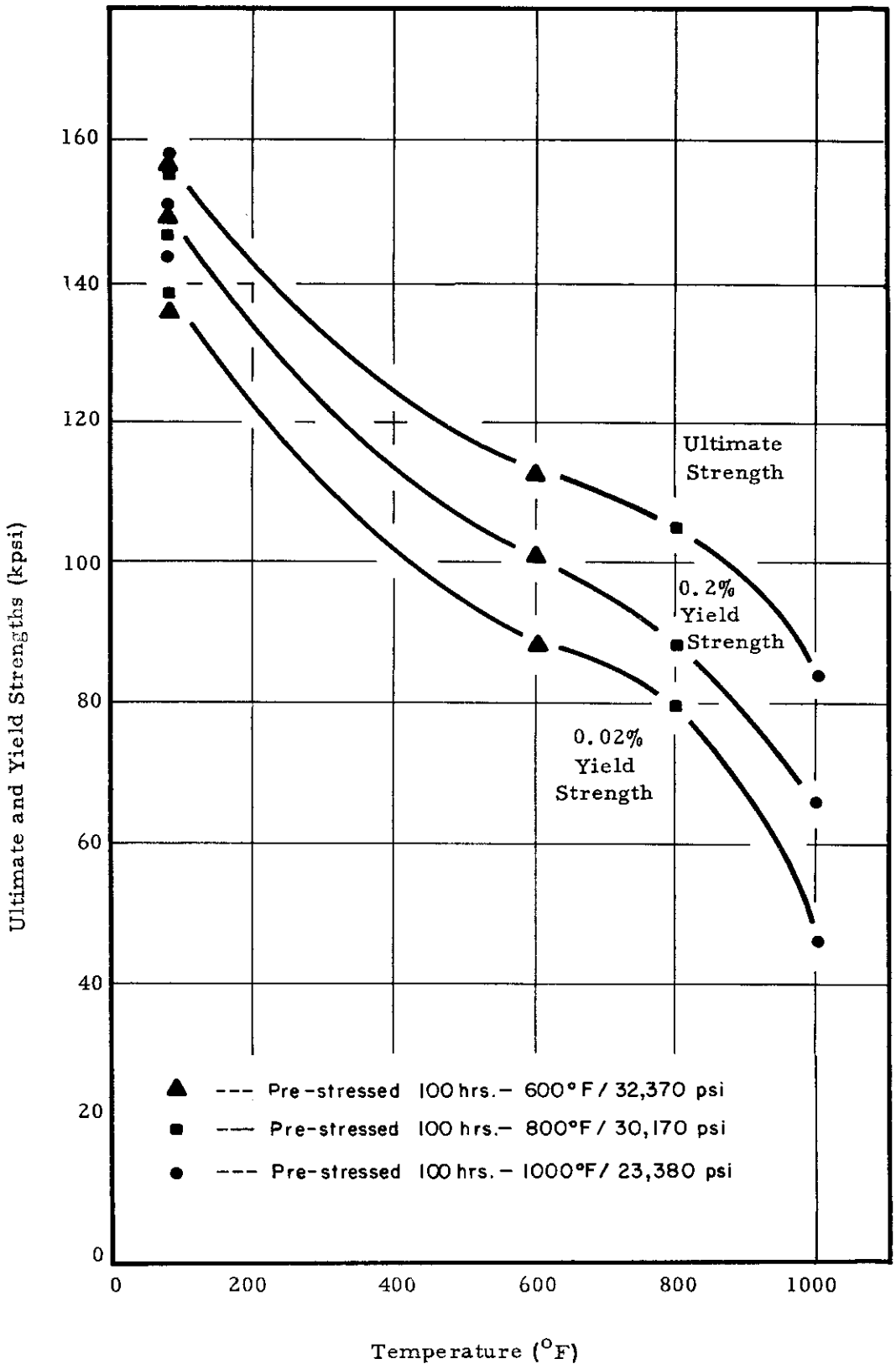


Figure 45. Tensile Properties vs. Temperature, Stressed Stability, Ti 155A, Heat 3

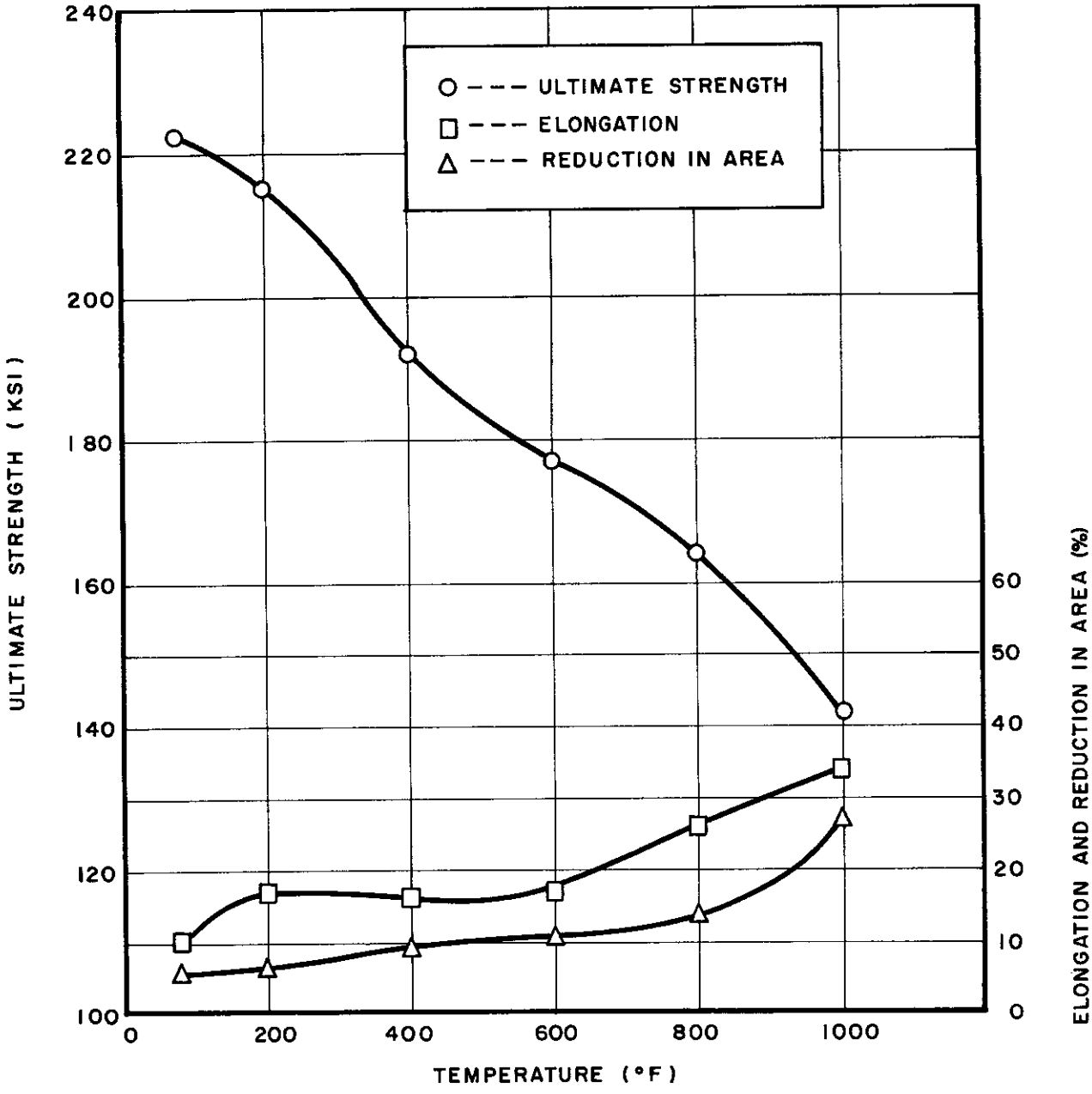


Figure 46. Notched ($K_T = 3.0$) Tensile Properties vs. Temperature, Ti 155A, Heat 1

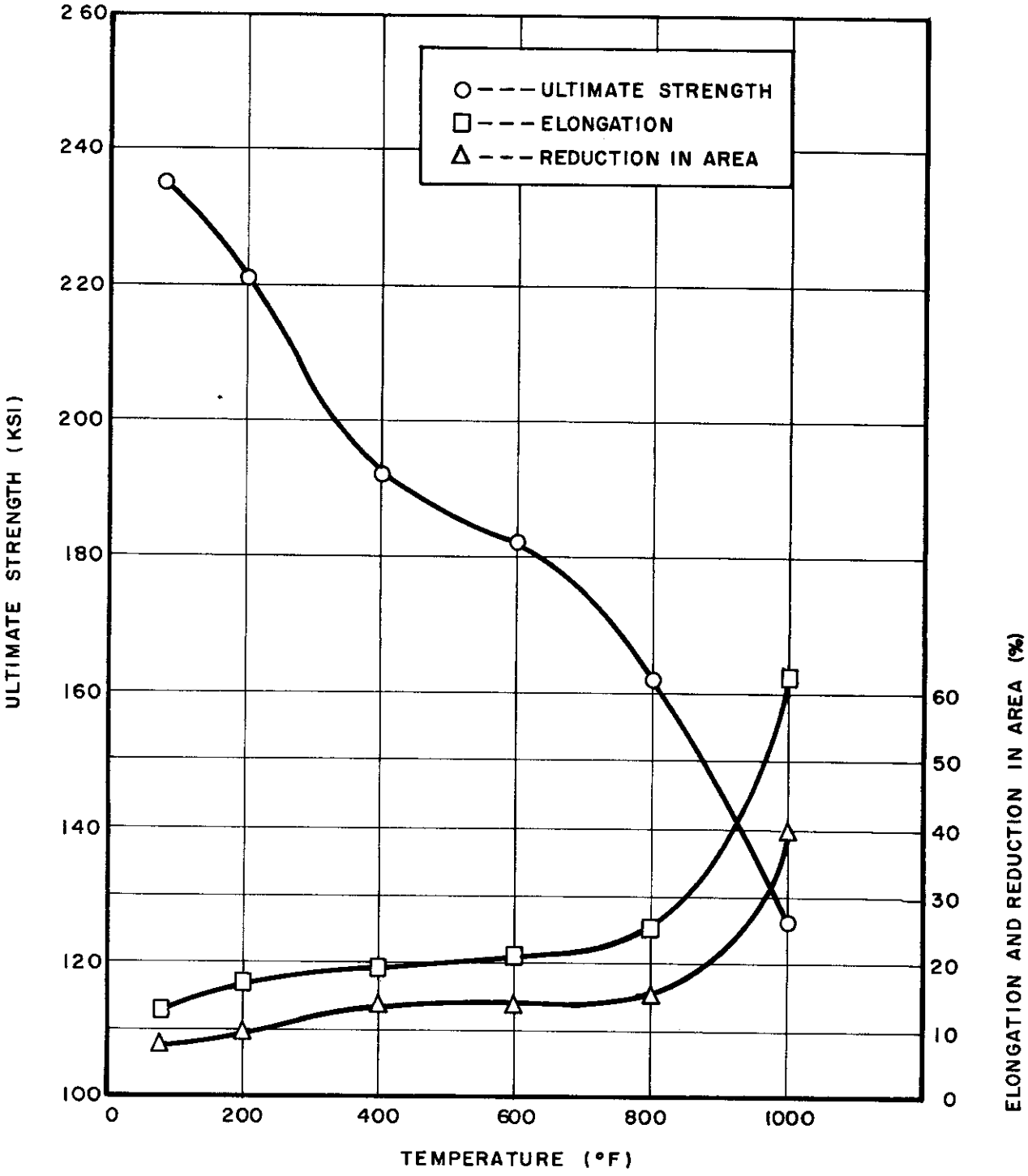


Figure 47. Notched ($K_T = 3.0$) Tensile Properties vs. Temperature, Ti 155A, Heat 2

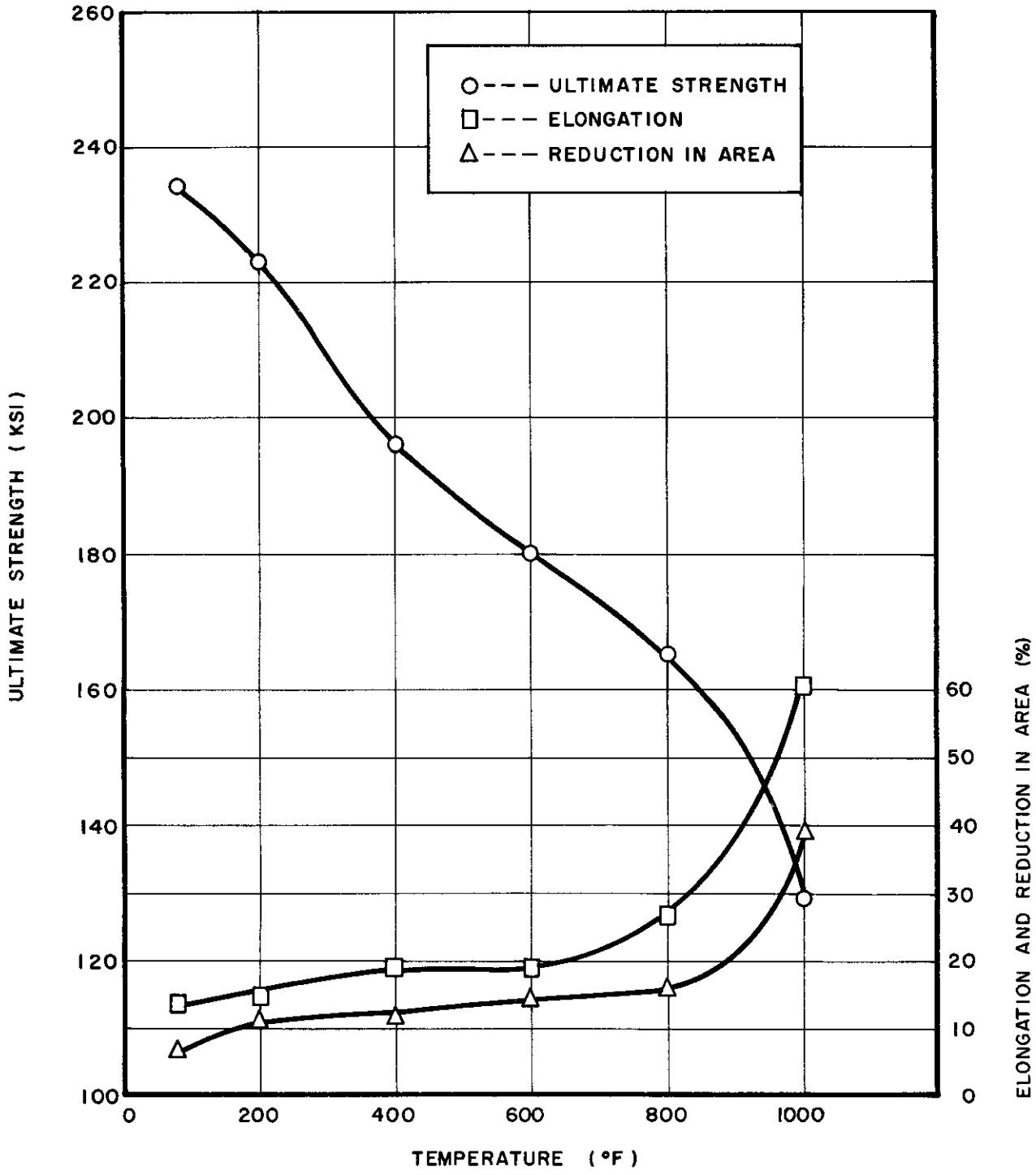


Figure 48. Notched (K_T = 3.0) Tensile Properties vs. Temperature, Ti 155A, Heat 3

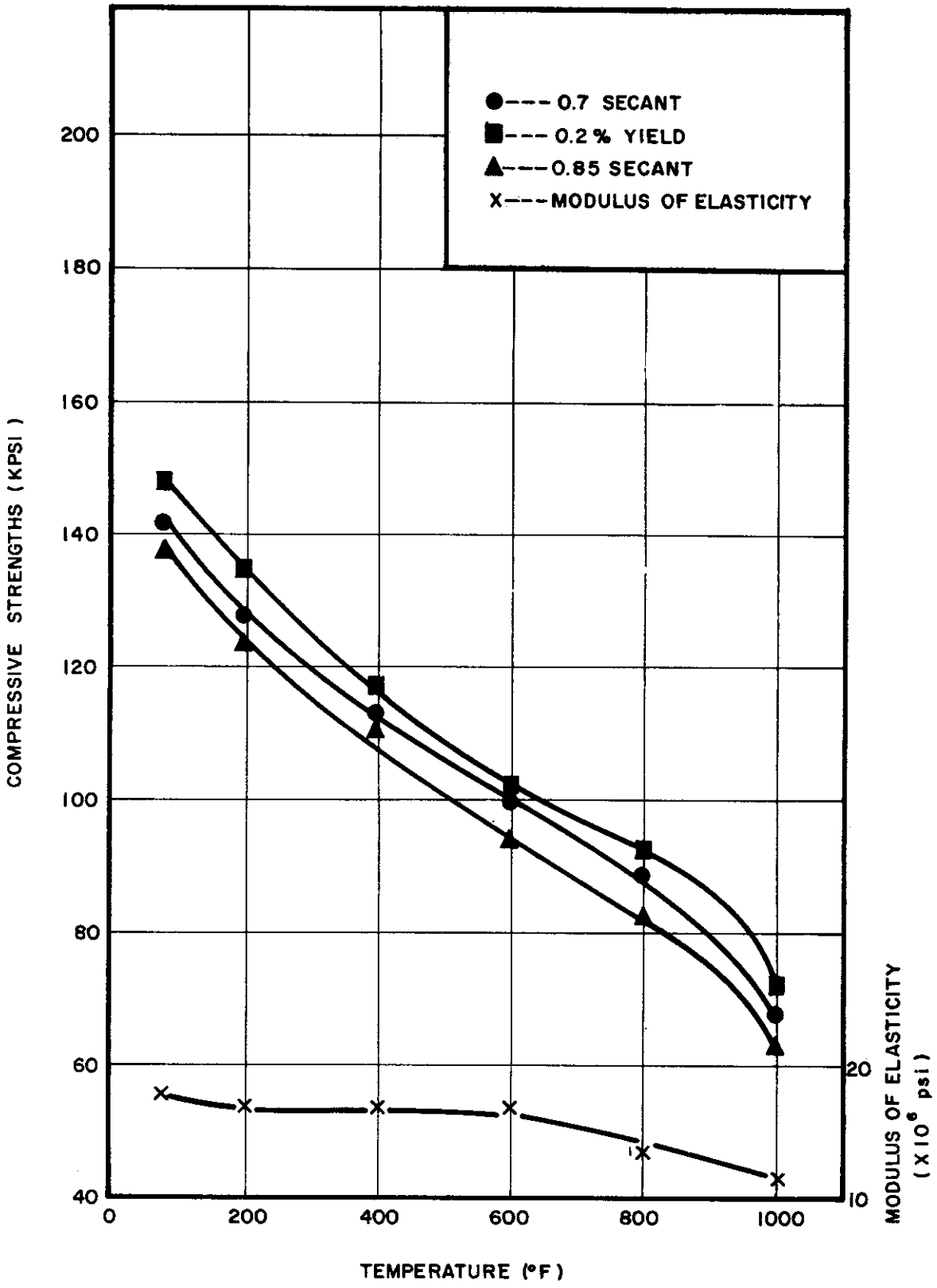


Figure 49. Compressive Properties vs. Temperature, Ti 155A, Heat 1

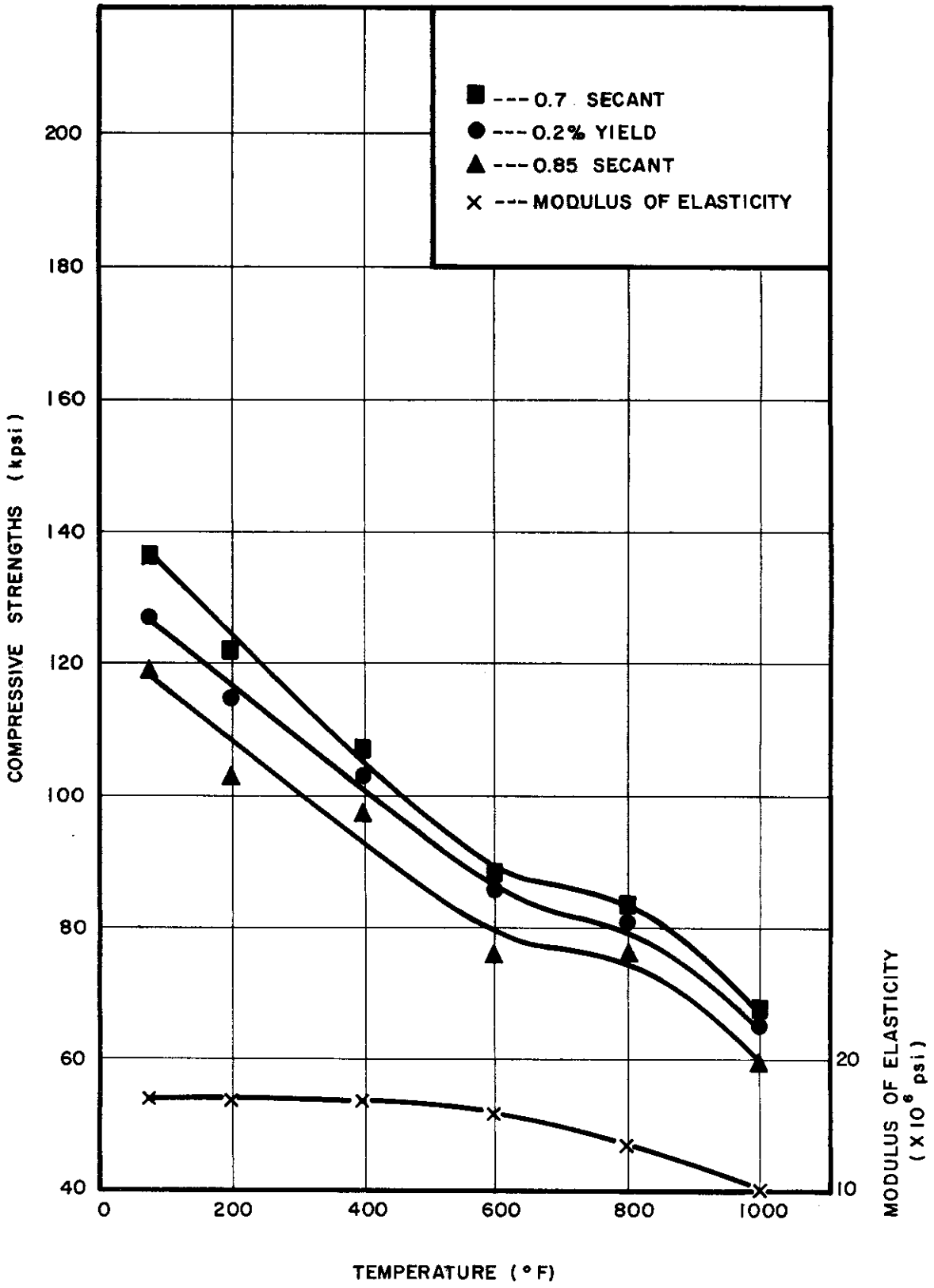


Figure 50. Compressive Properties vs. Temperature, Ti 155A, Heat 2

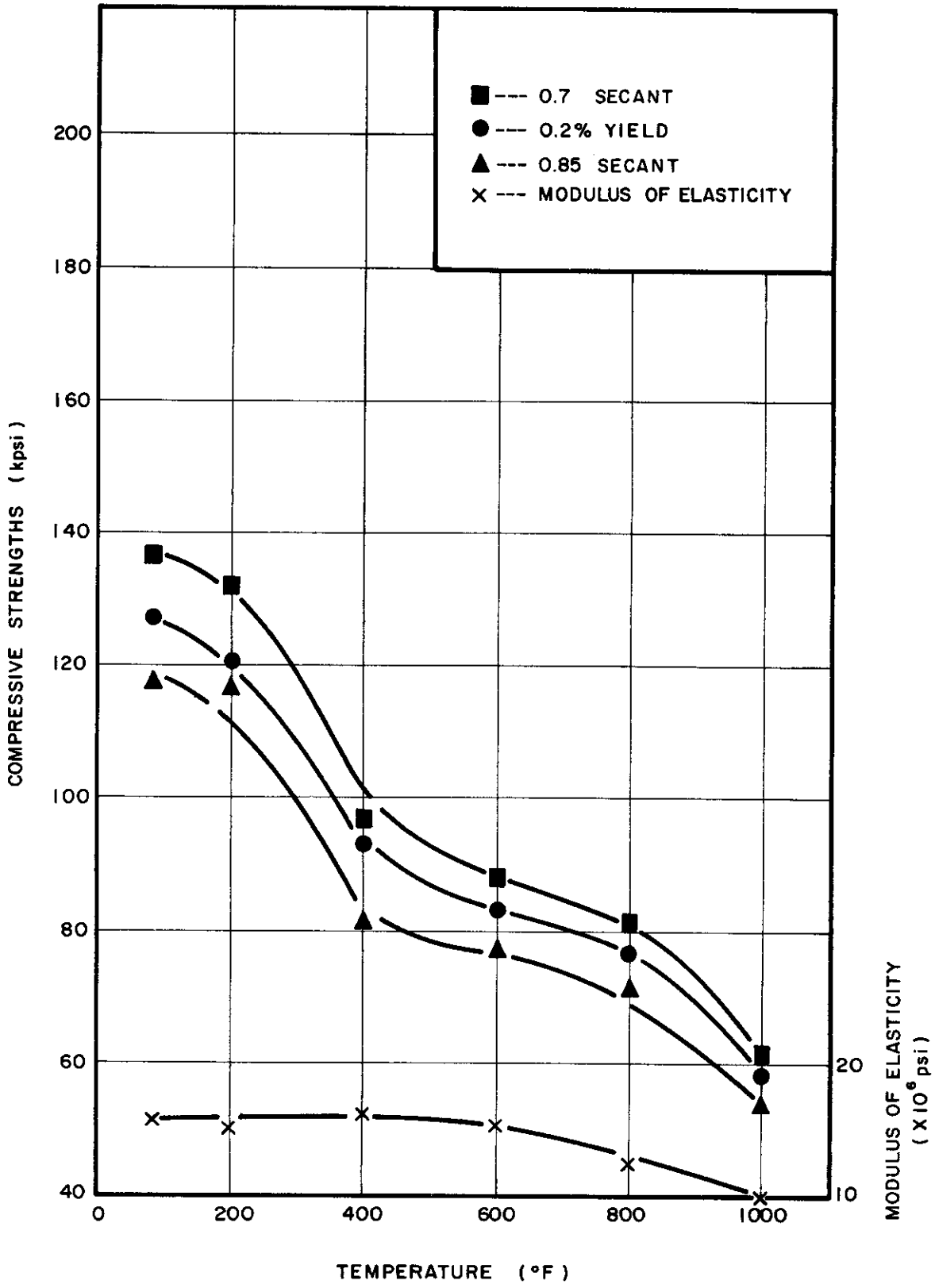


Figure 51. Compressive Properties vs. Temperature, Ti 155A, Heat 3

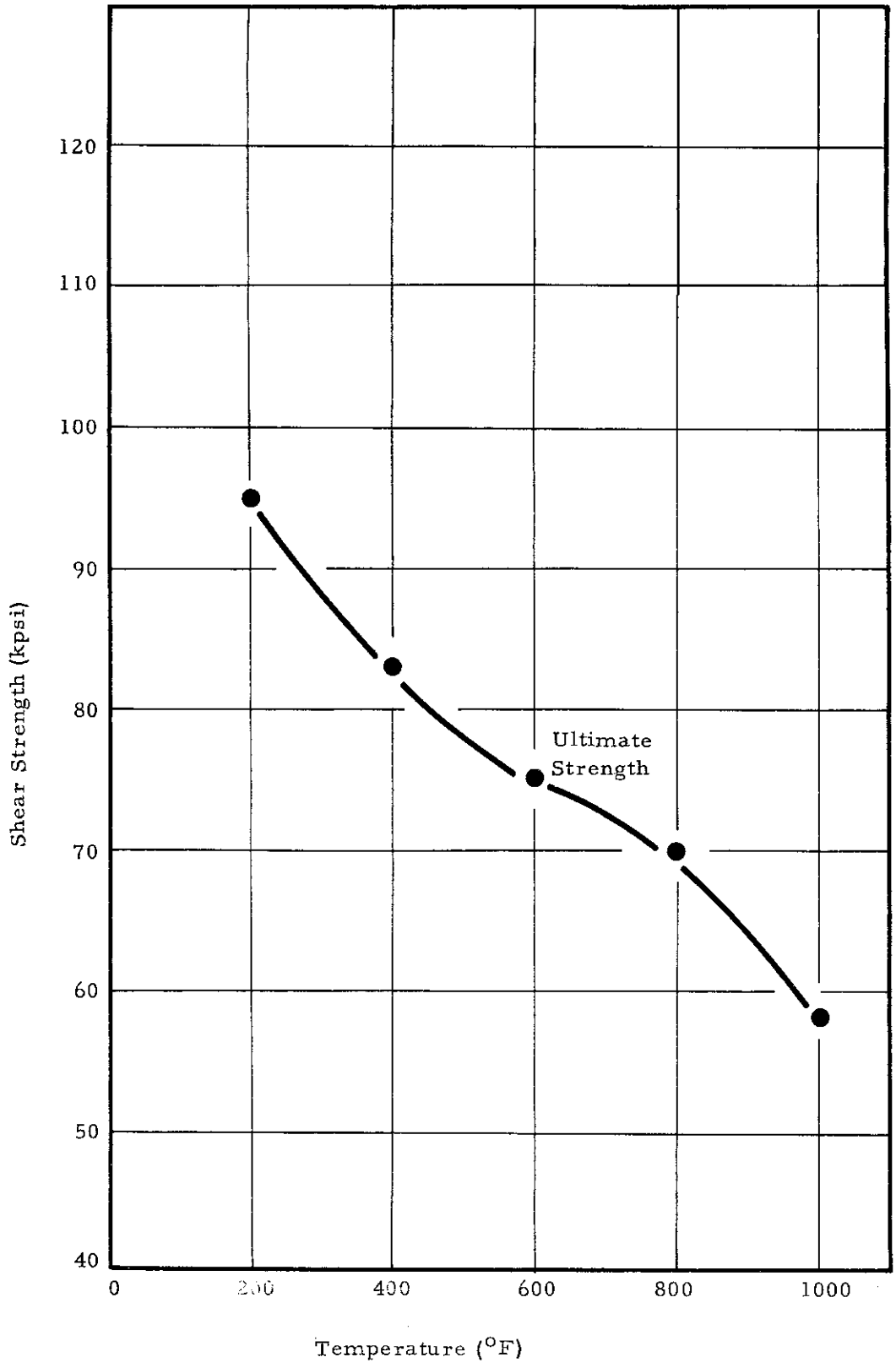


Figure 52. Pin Shear Properties vs. Temperature, Ti 155A, Heat 1

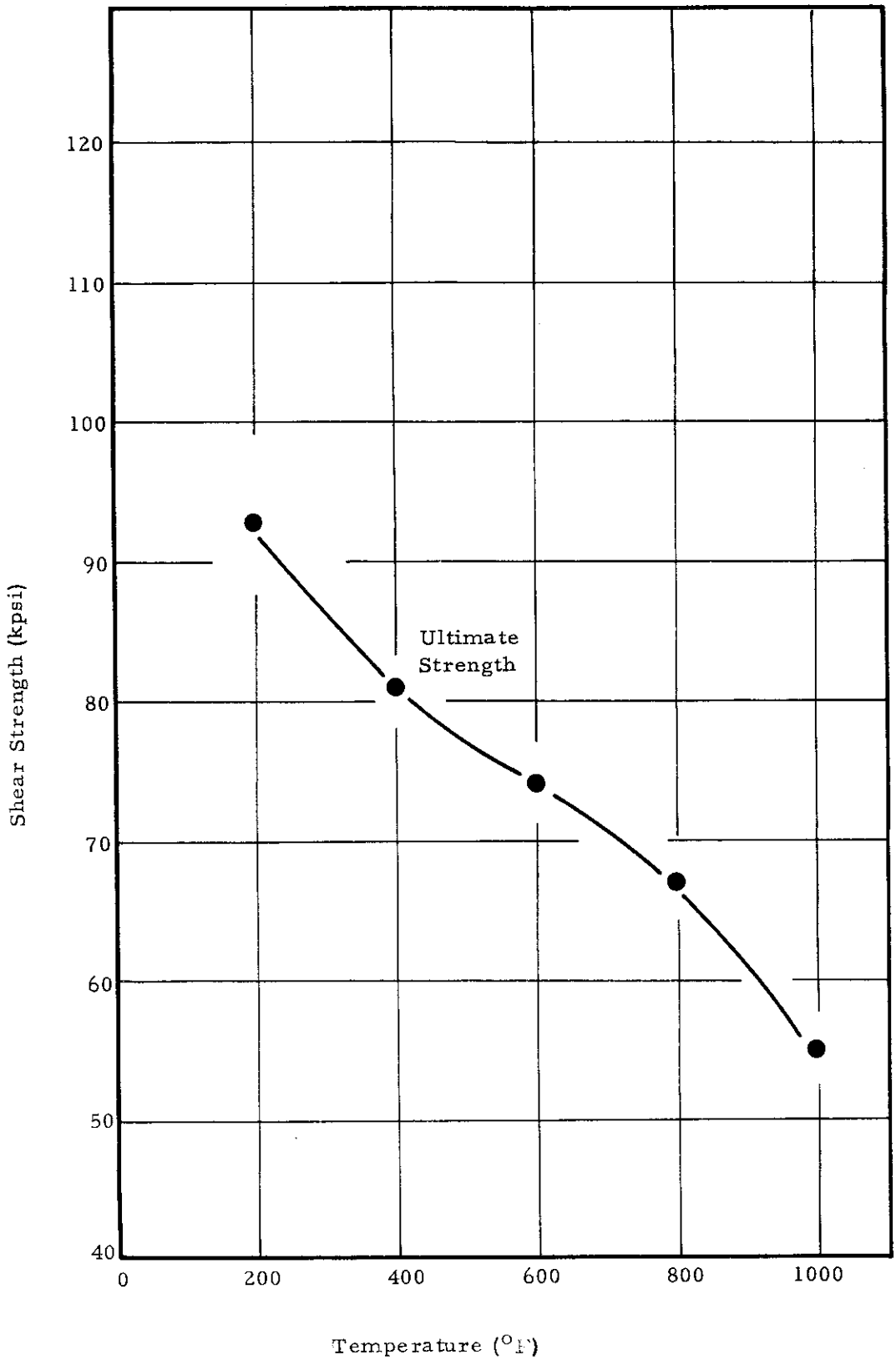


Figure 53. Pin Shear Properties vs. Temperature, Ti 155A, Heat 2

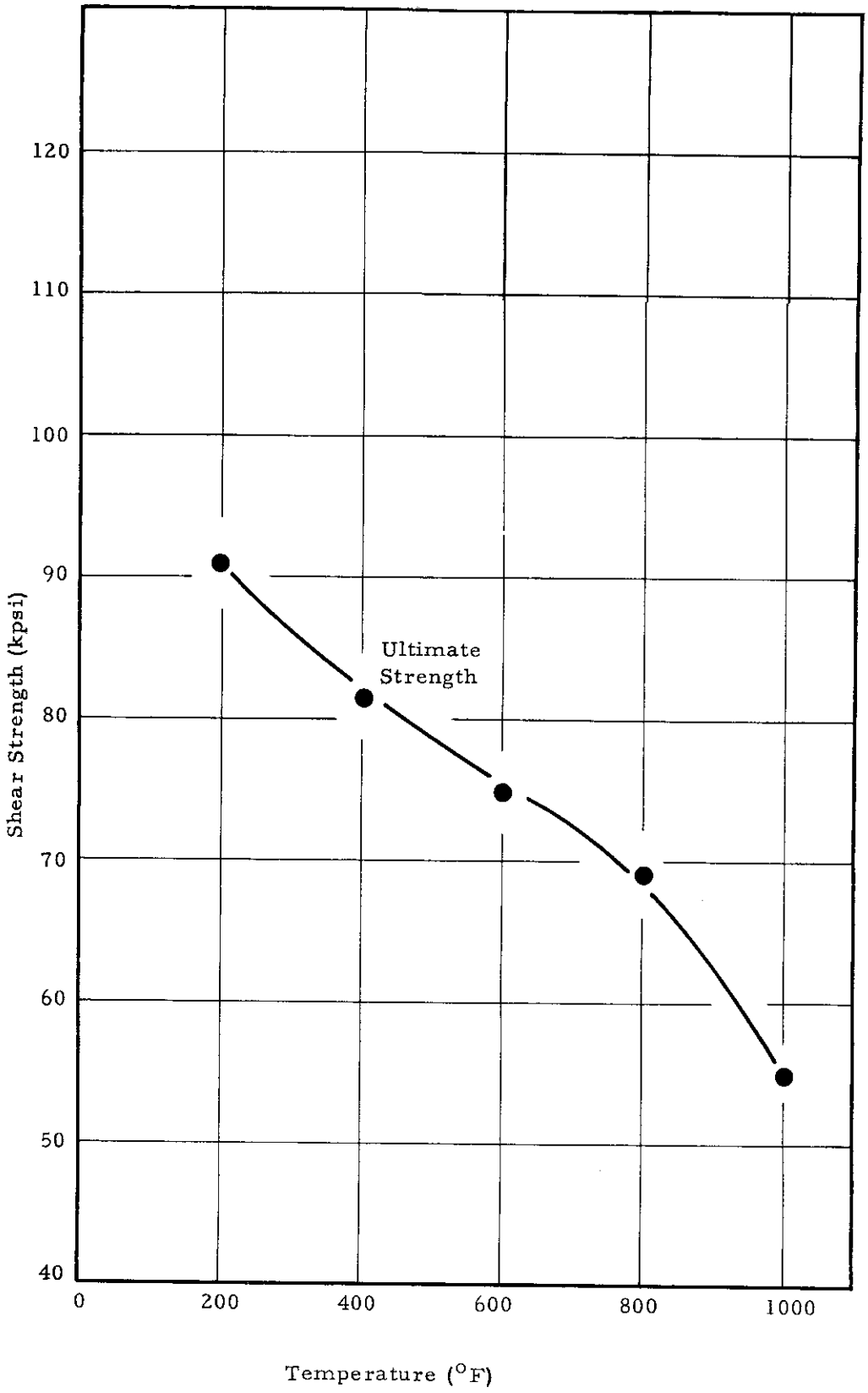


Figure 54. Pin Shear Properties vs. Temperature, Ti 155A, Heat 3

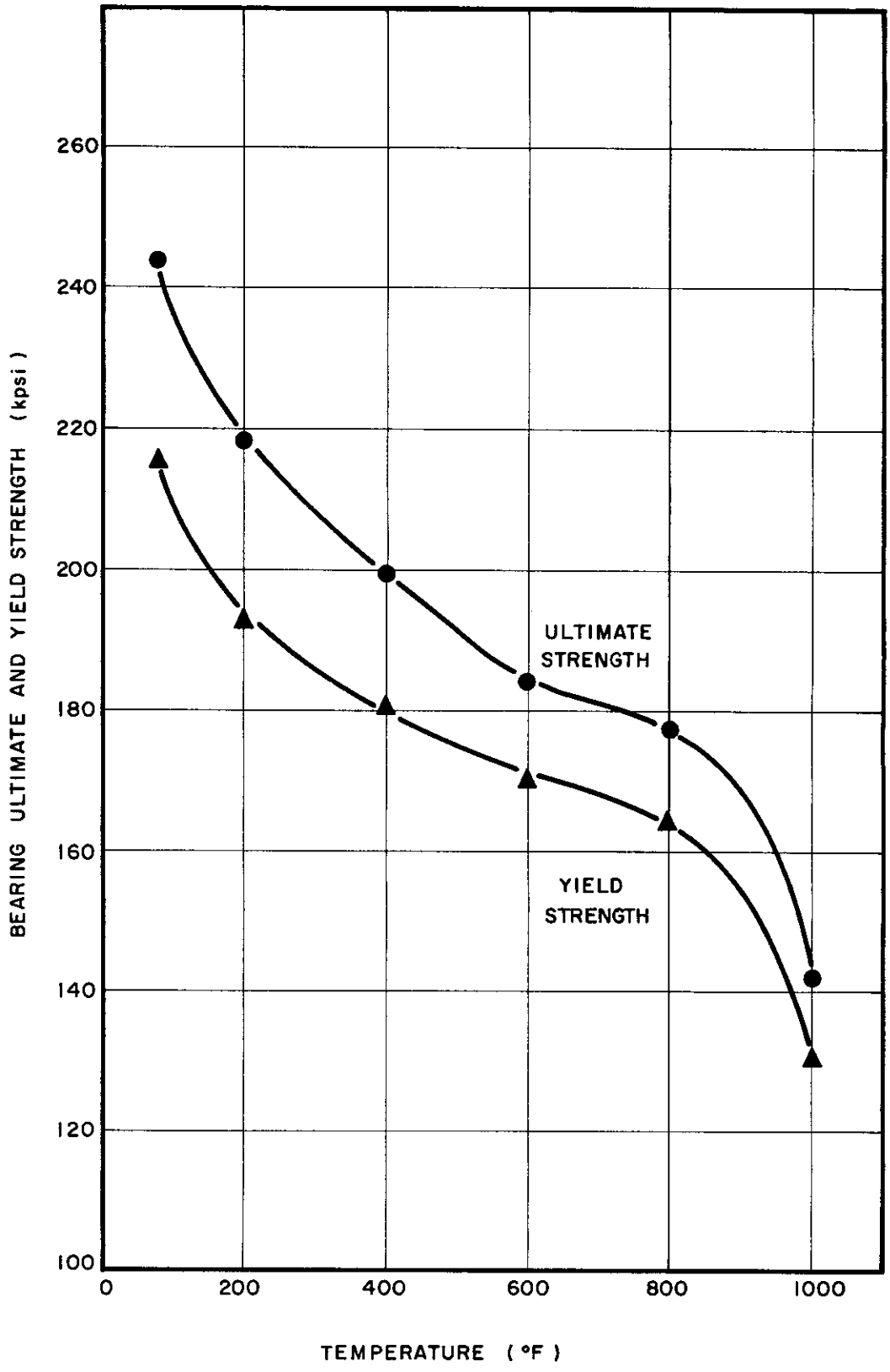


Figure 55. Bearing Properties vs. Temperature, e/D = 1.5, Ti 155A, Heat 1

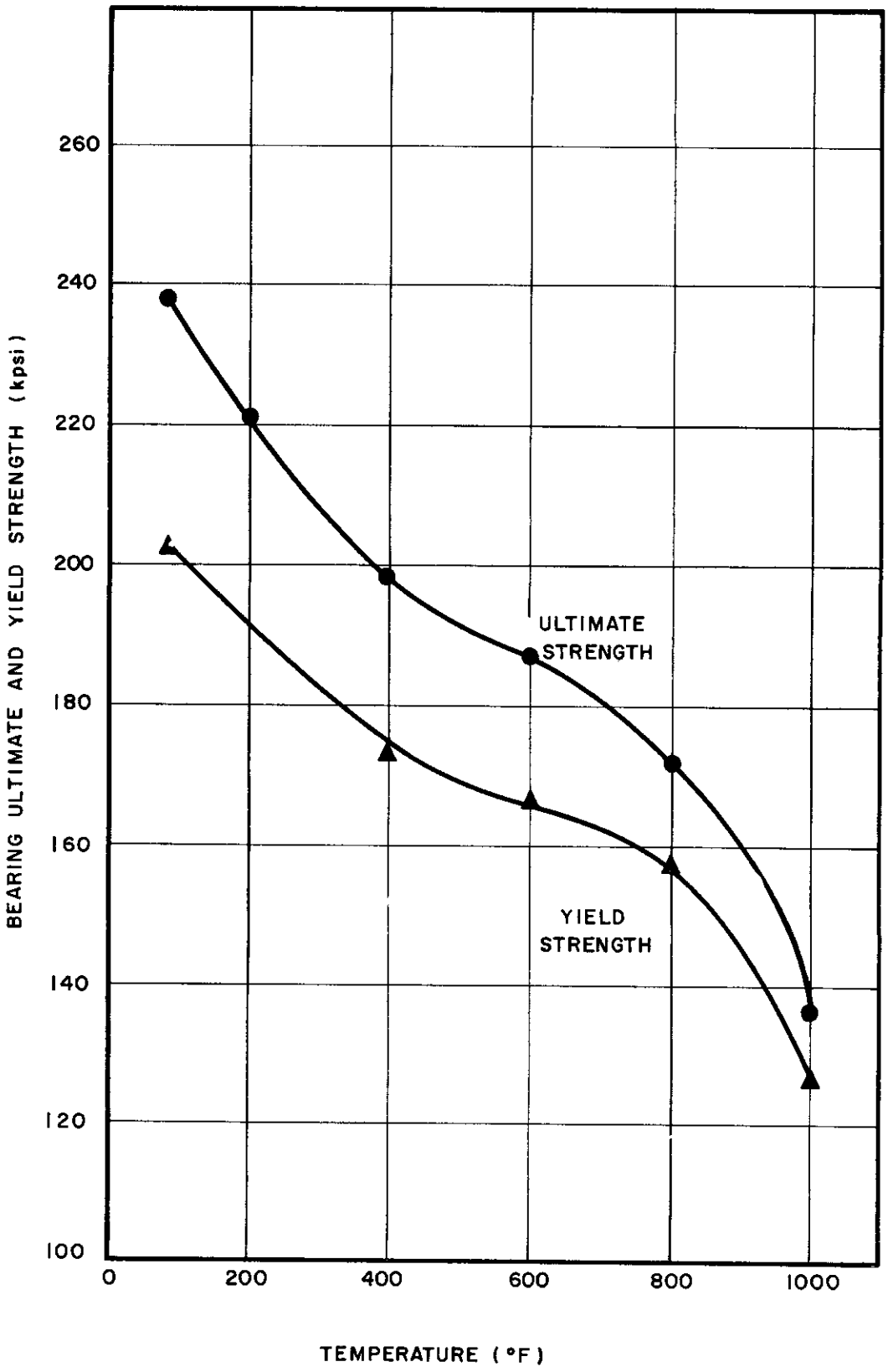


Figure 56. Bearing Properties vs. Temperature, e/D = 1.5, Ti 155A, Heat 2

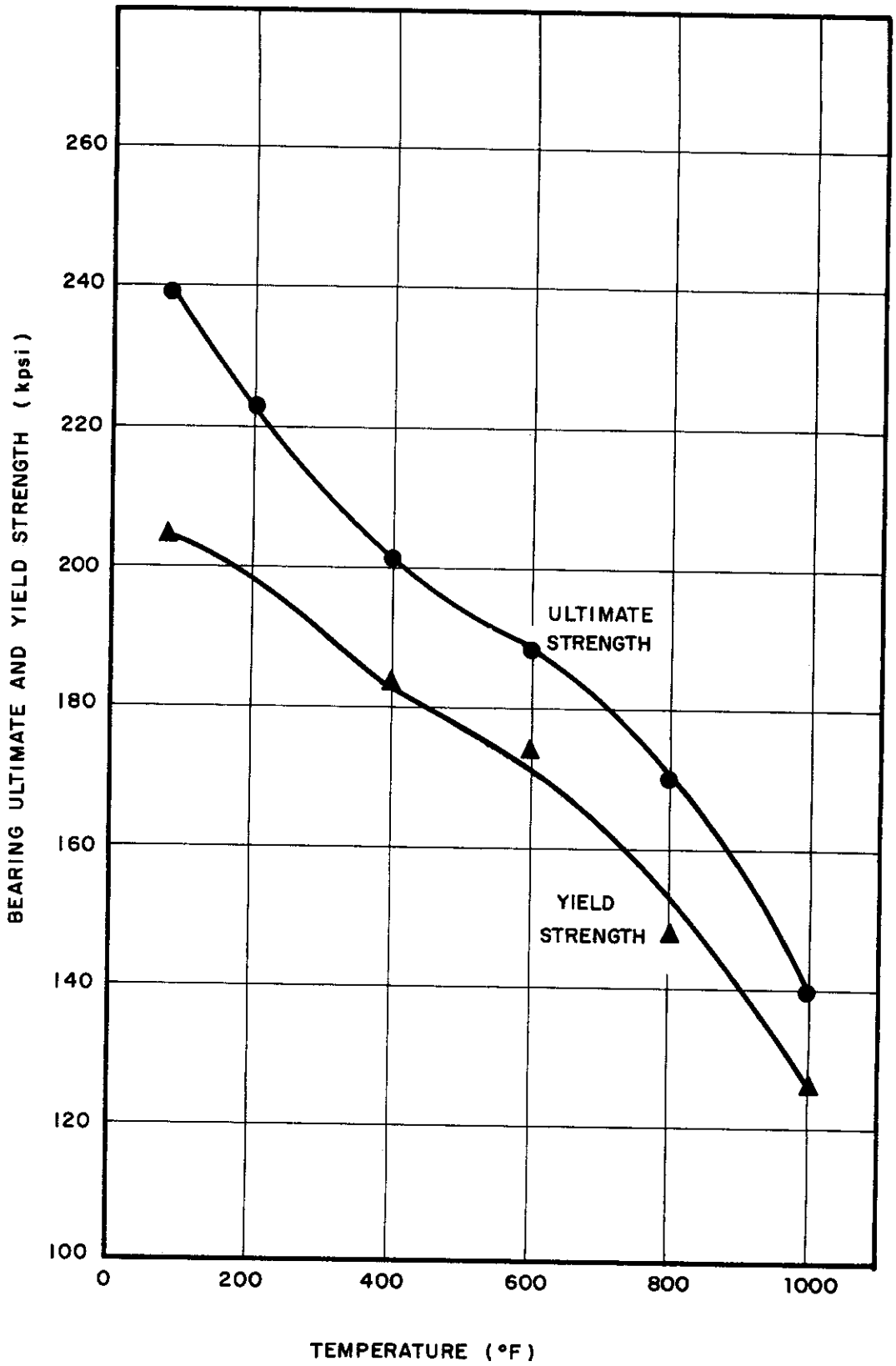


Figure 57. Bearing Properties vs. Temperature, e/D = 1.5, Ti 155A, Heat 3

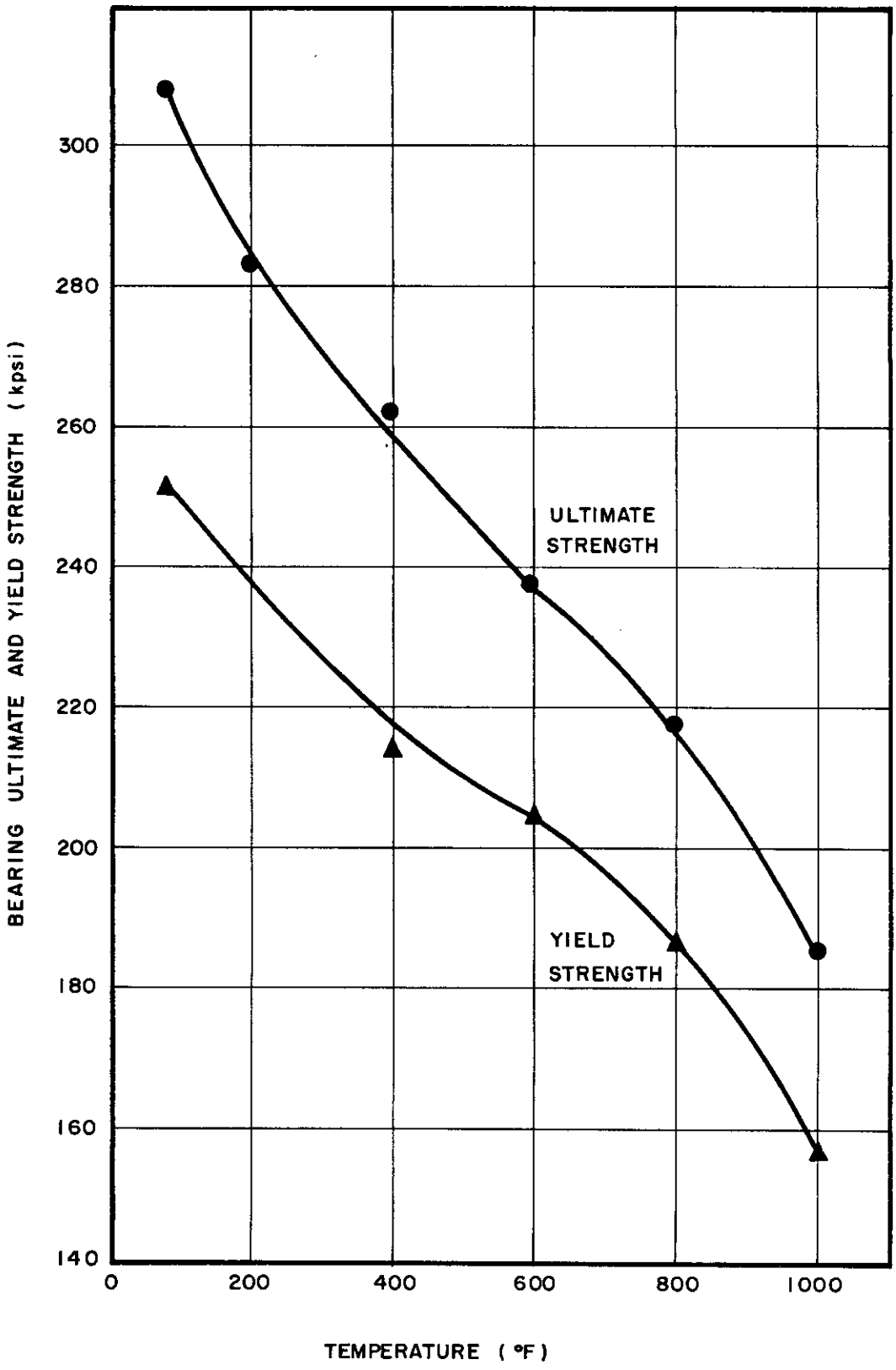


Figure 58. Bearing Properties vs. Temperature, e/D = 2.0, Ti 155A, Heat 1

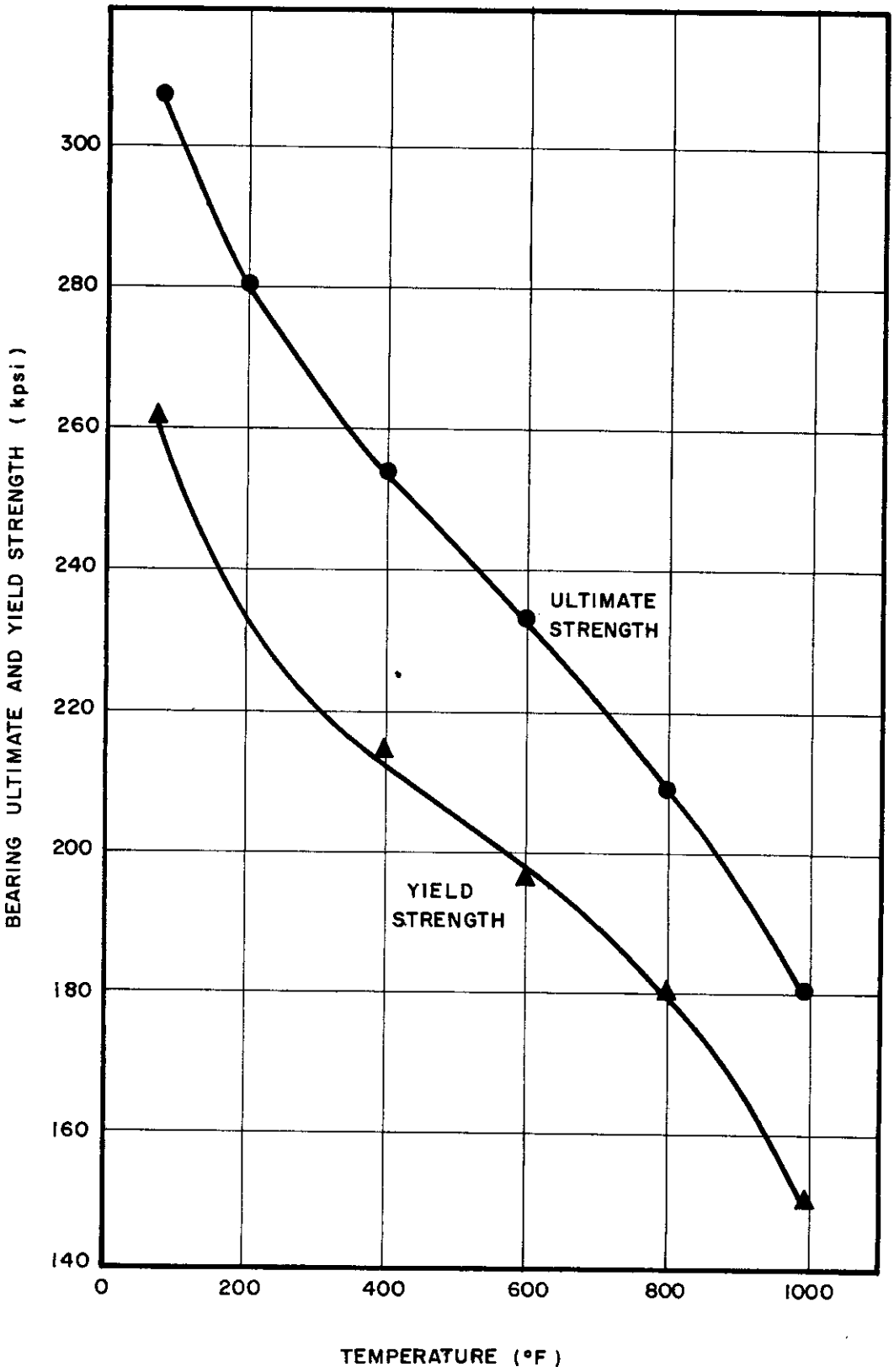


Figure 59. Bearing Properties vs. Temperature, e/D = 2.0, Ti 155A, Heat 2

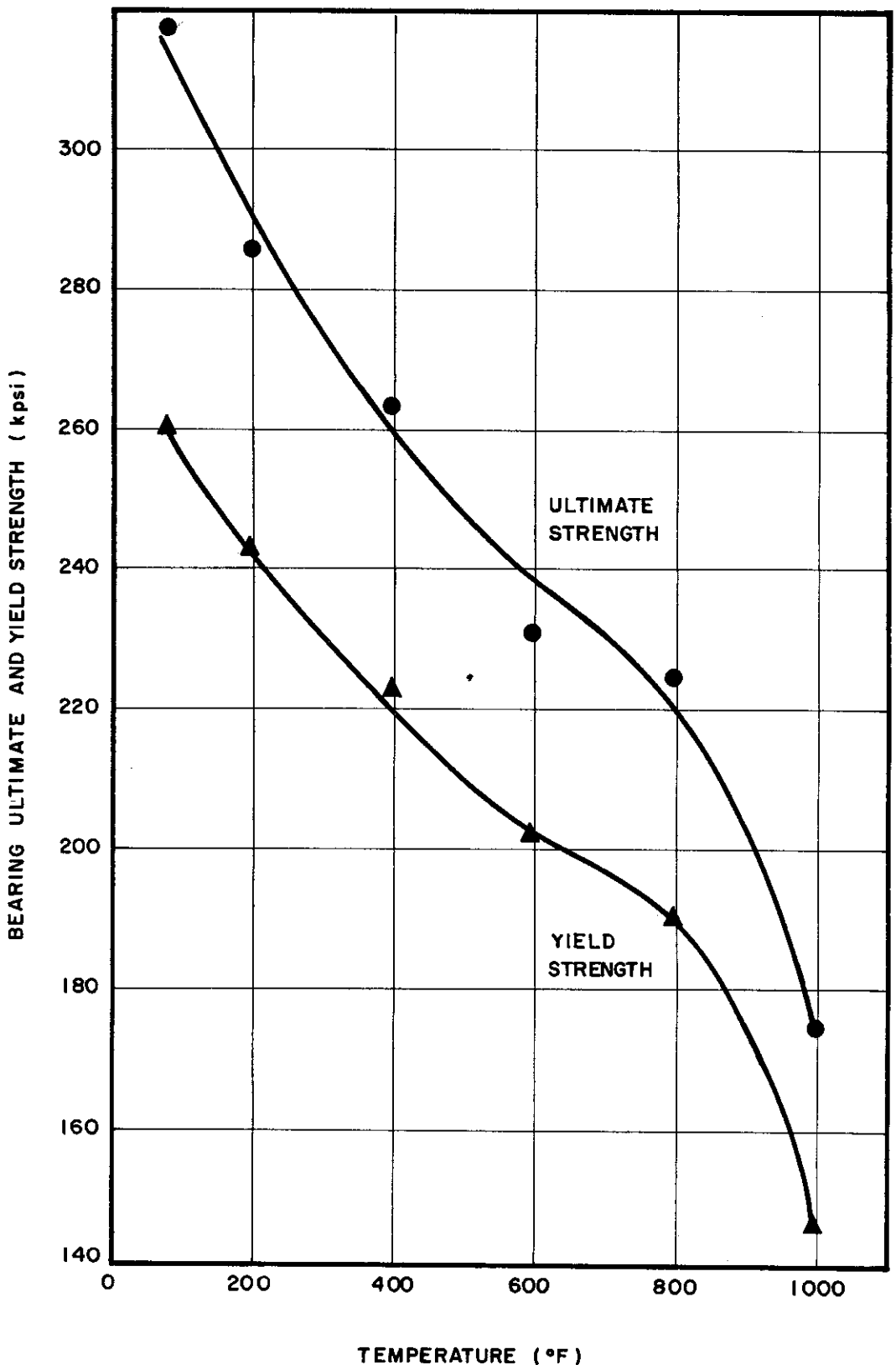


Figure 60. Bearing Properties vs. Temperature, e/D = 2.0, Ti 155A, Heat 3

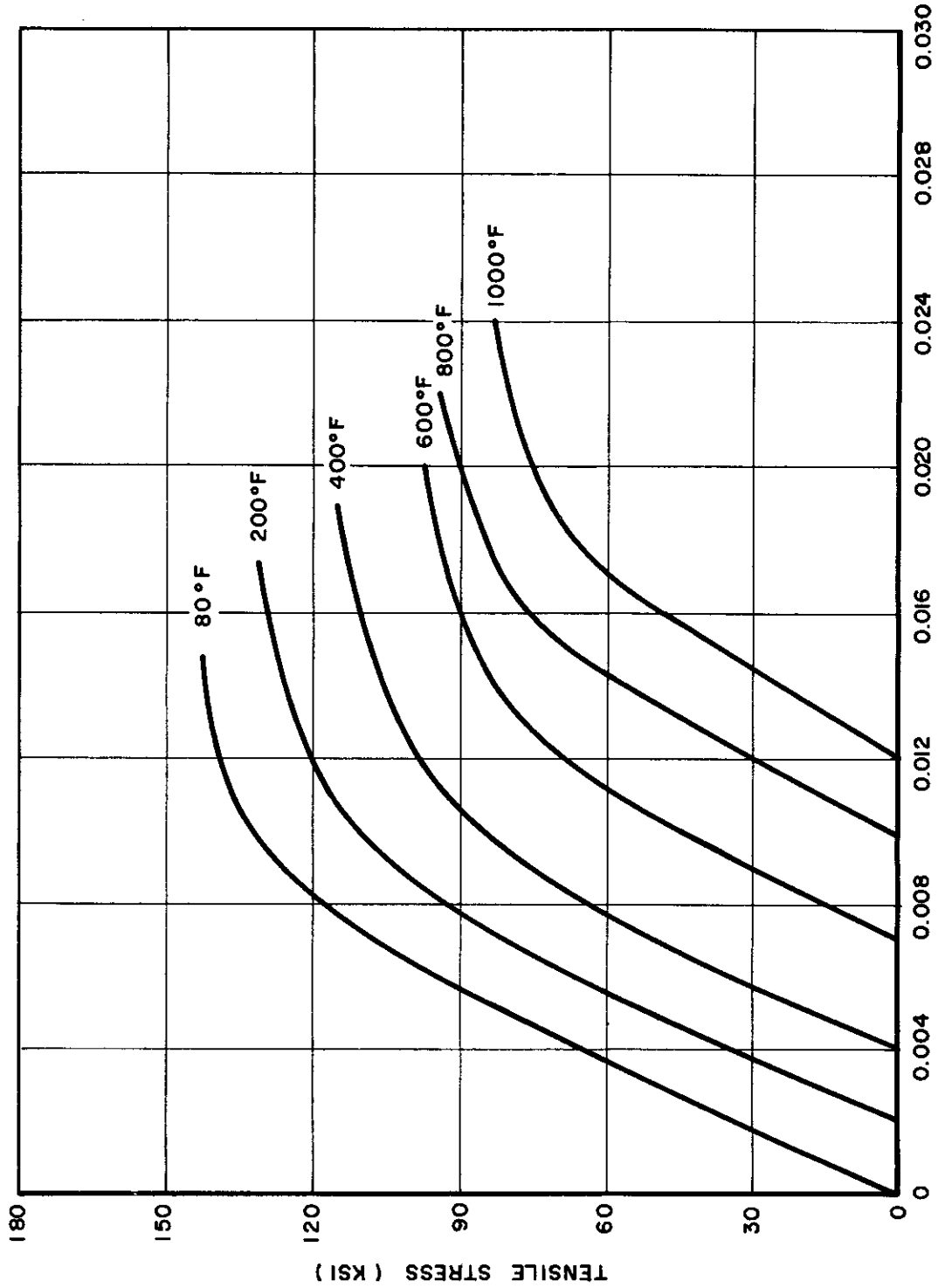


Figure 61. Typical Tensile Stress-Strain Curves, Ti 155A, Heat 1

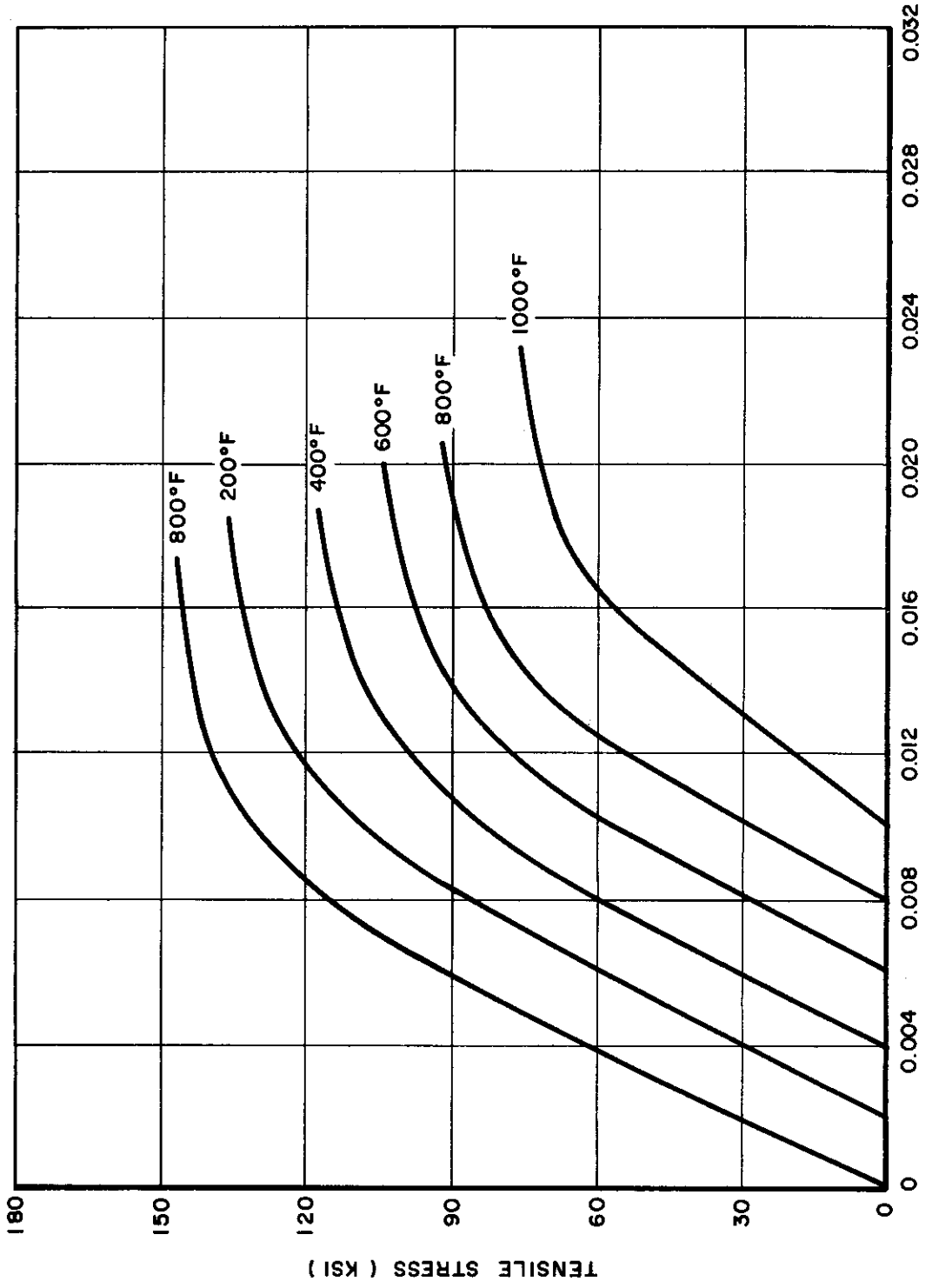


Figure 62. Typical Tensile Stress-Strain Curves, Ti 155A, Heat 2

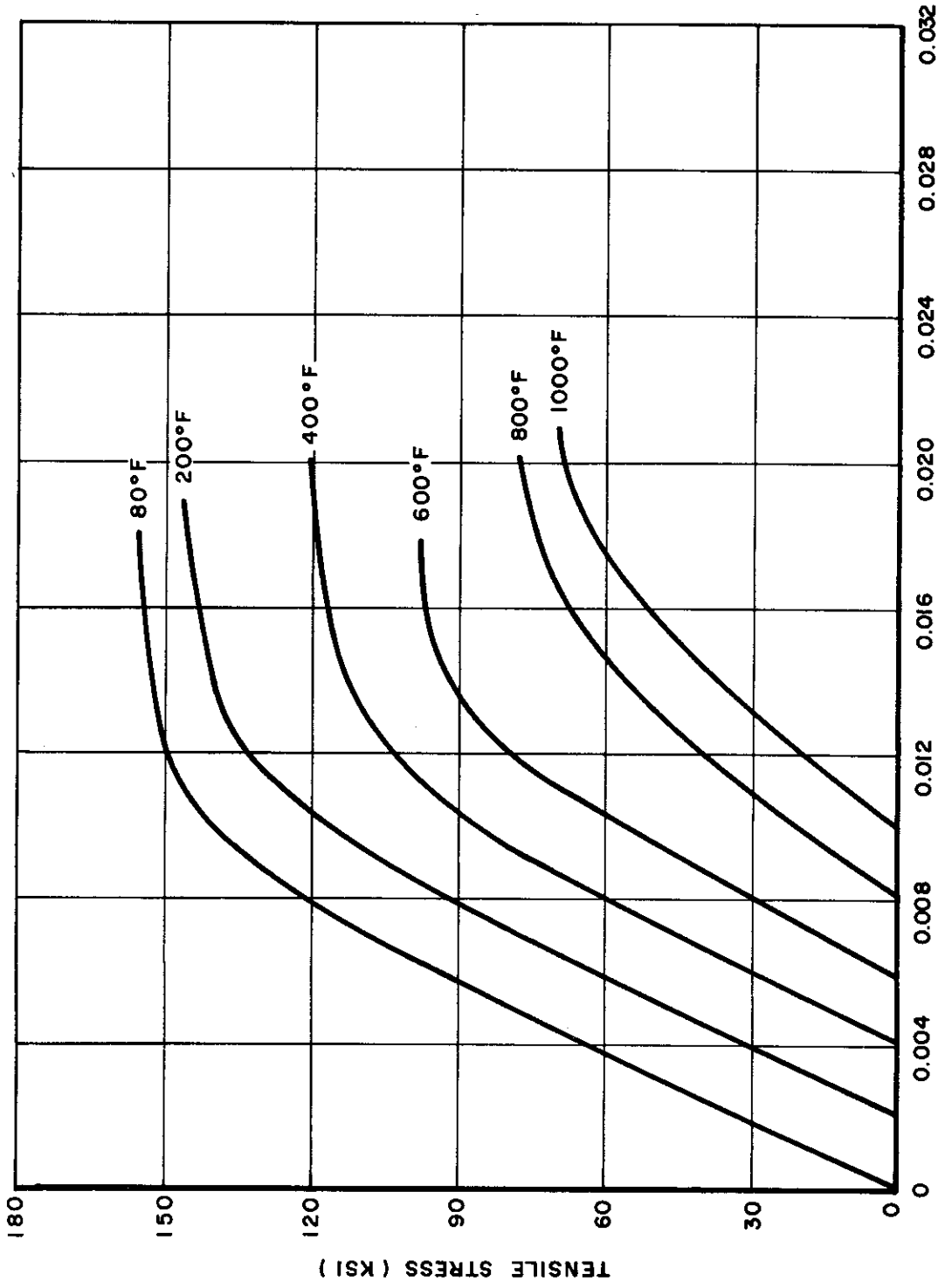


Figure 63. Typical Tensile Stress-Strain Curves, Ti 155A, Heat 3

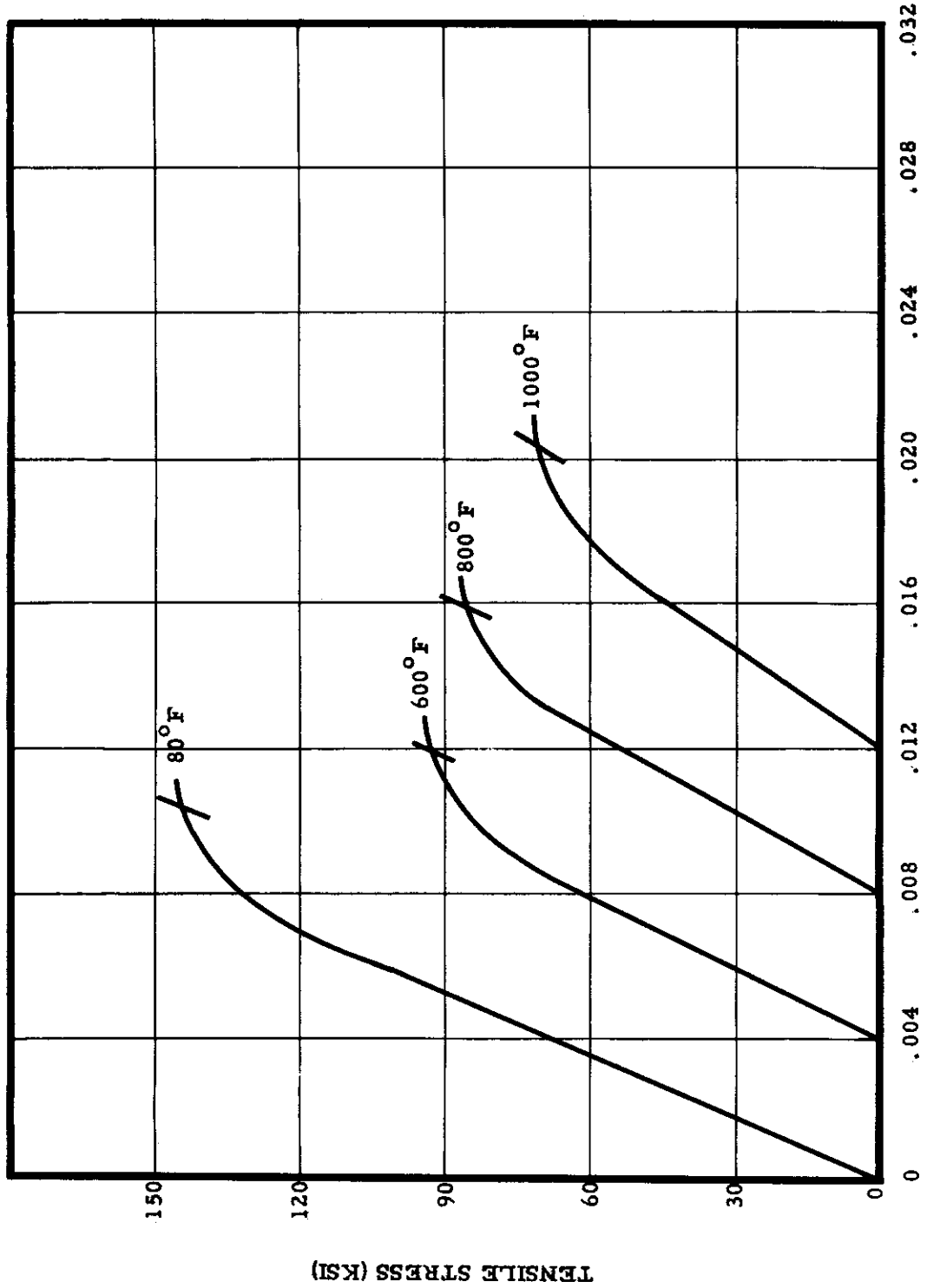


Figure 64. Nonstressed Stability Stress-Strain Curves for Ti 155A, Heat 1

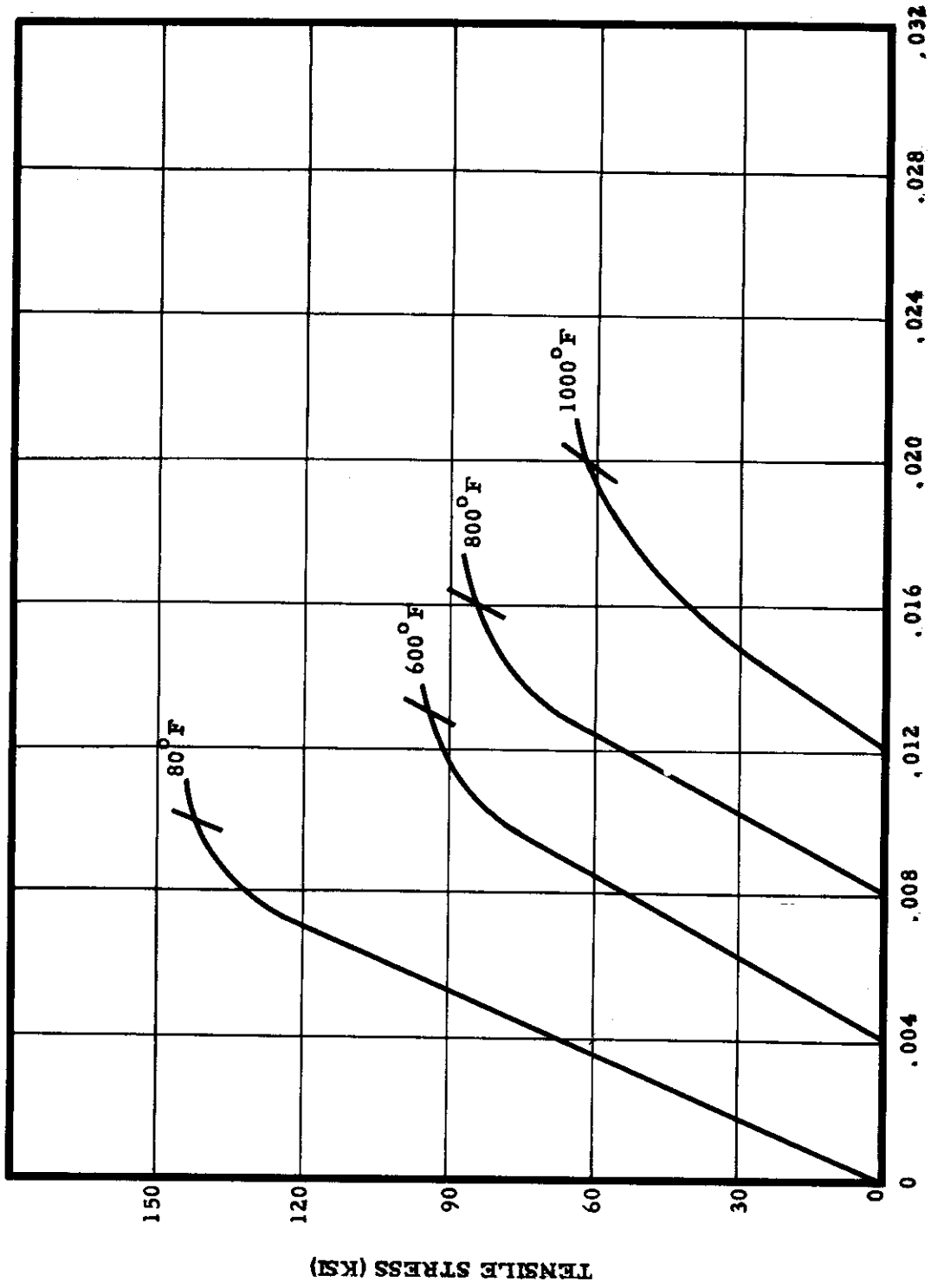


Figure 65. Nonstressed Stability Stress-Strain Curves for Ti 155A, Heat 2

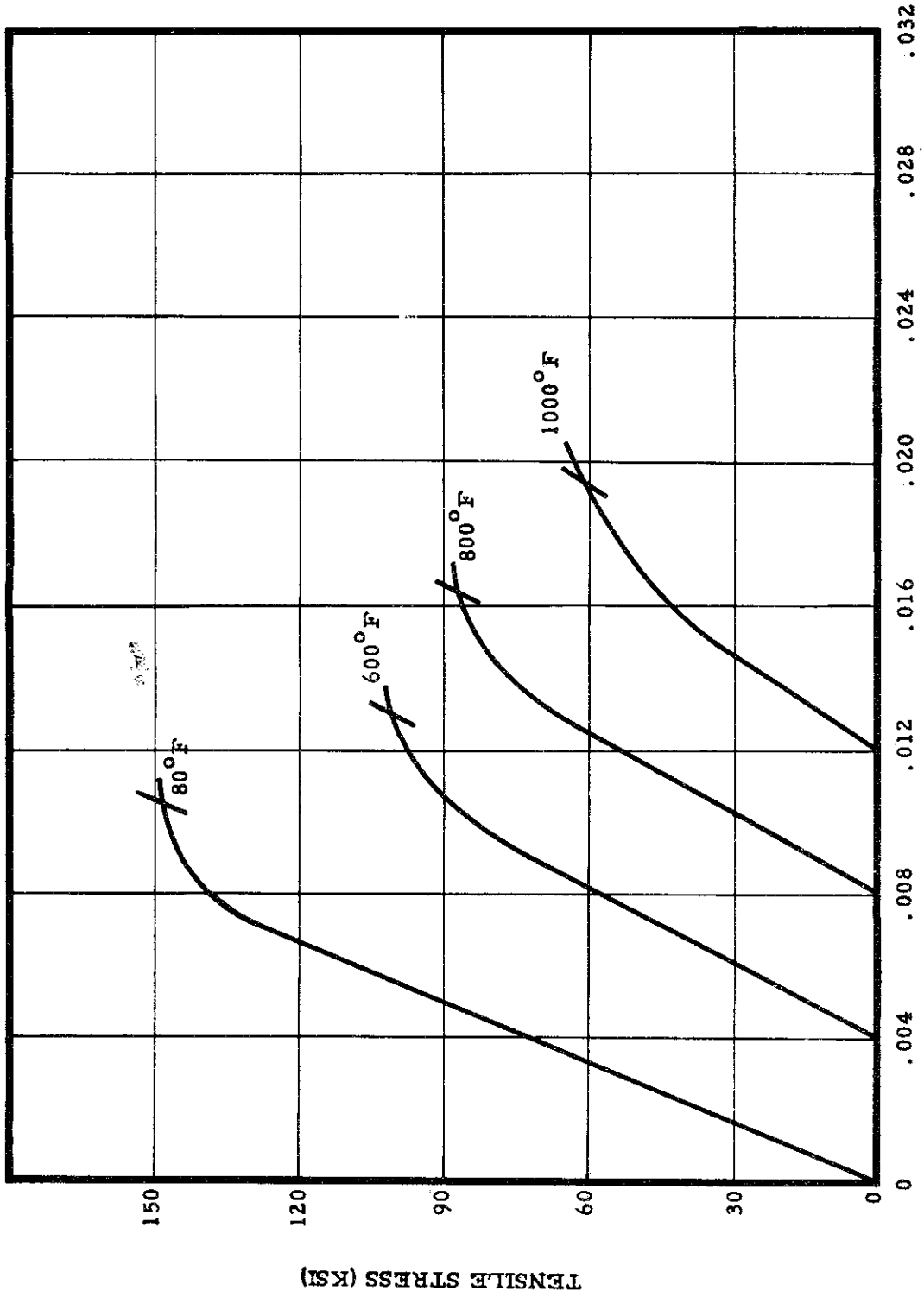


Figure 66. Nonstressed Stability Stress-Strain Curves for Ti 155A, Heat 3

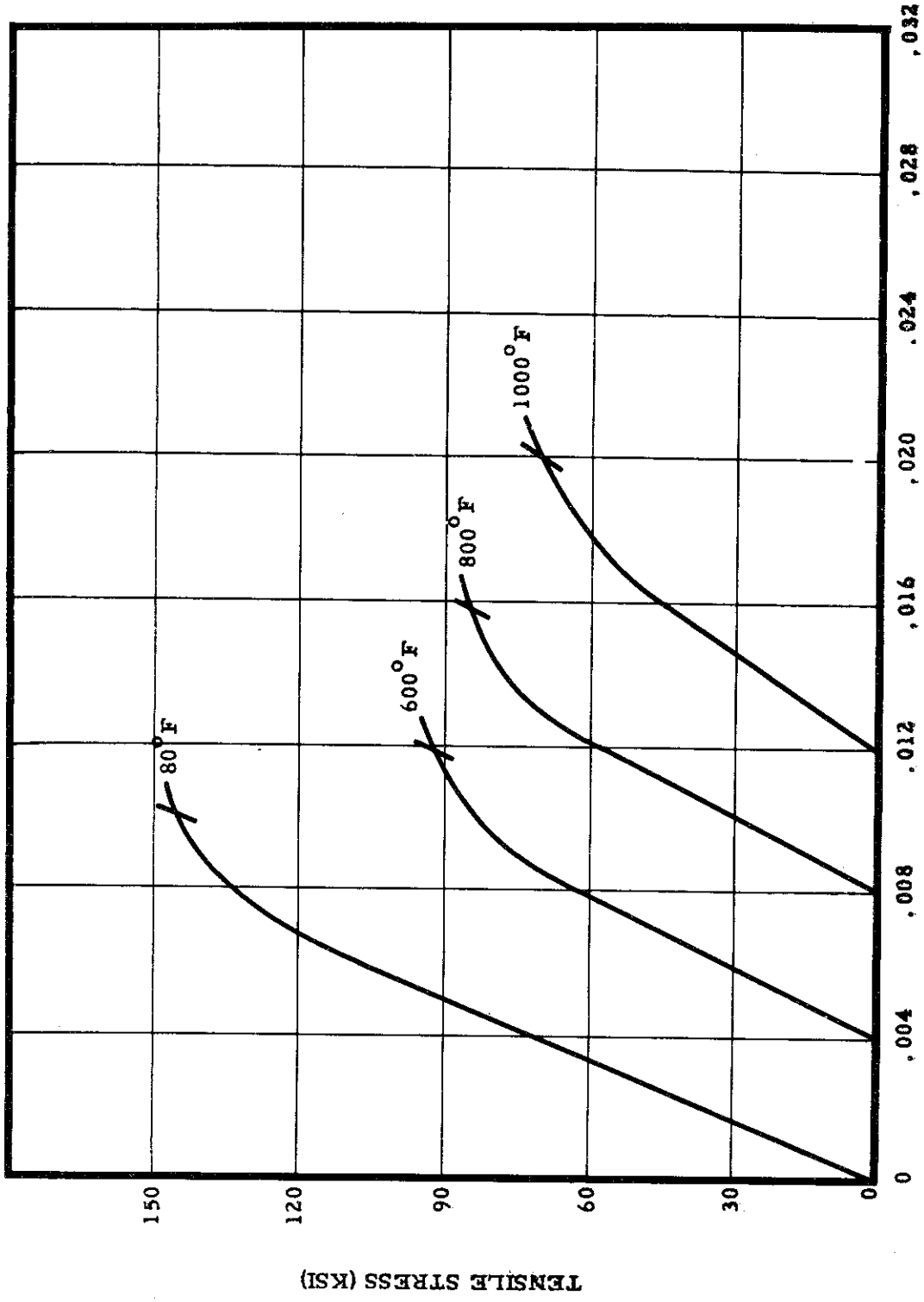


Figure 67. Stressed Stability Stress-Strain Curves for Ti 155A, Heat 1

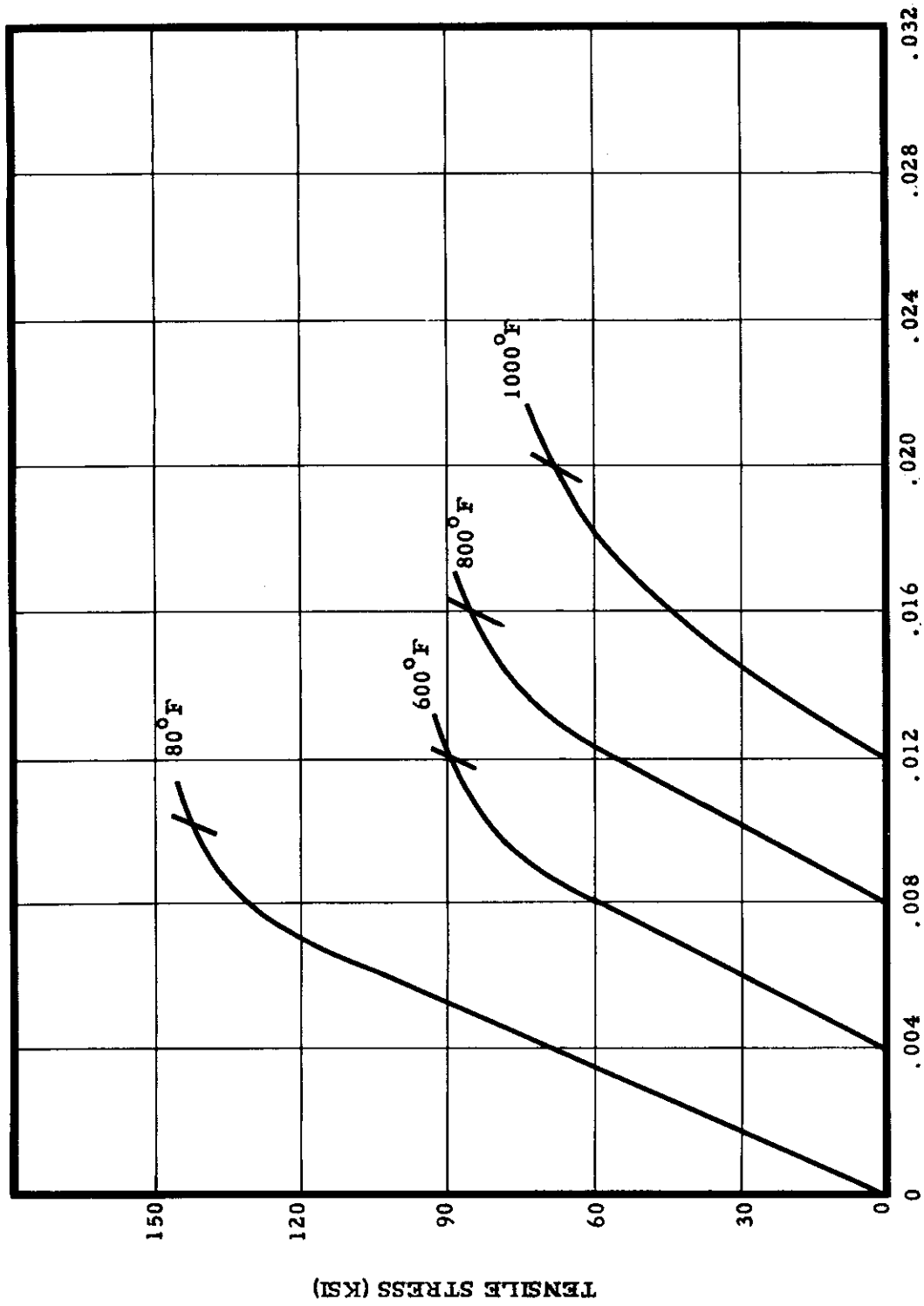


Figure 68. Stressed Stability Stress-Strain Curves for Ti 155A, Heat 2

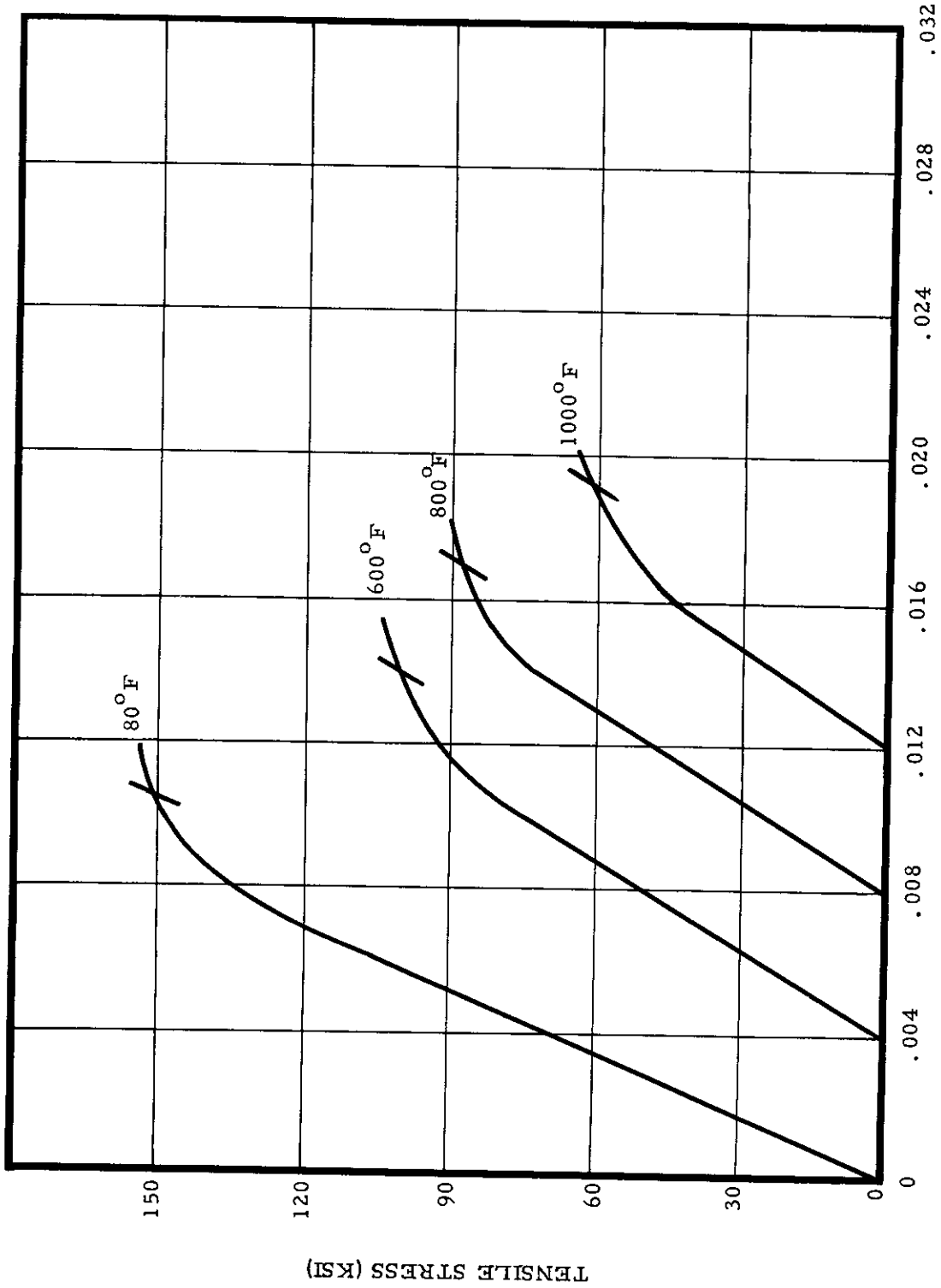


Figure 69. Stressed Stability Stress-Strain Curves for Ti 155A, Heat 3

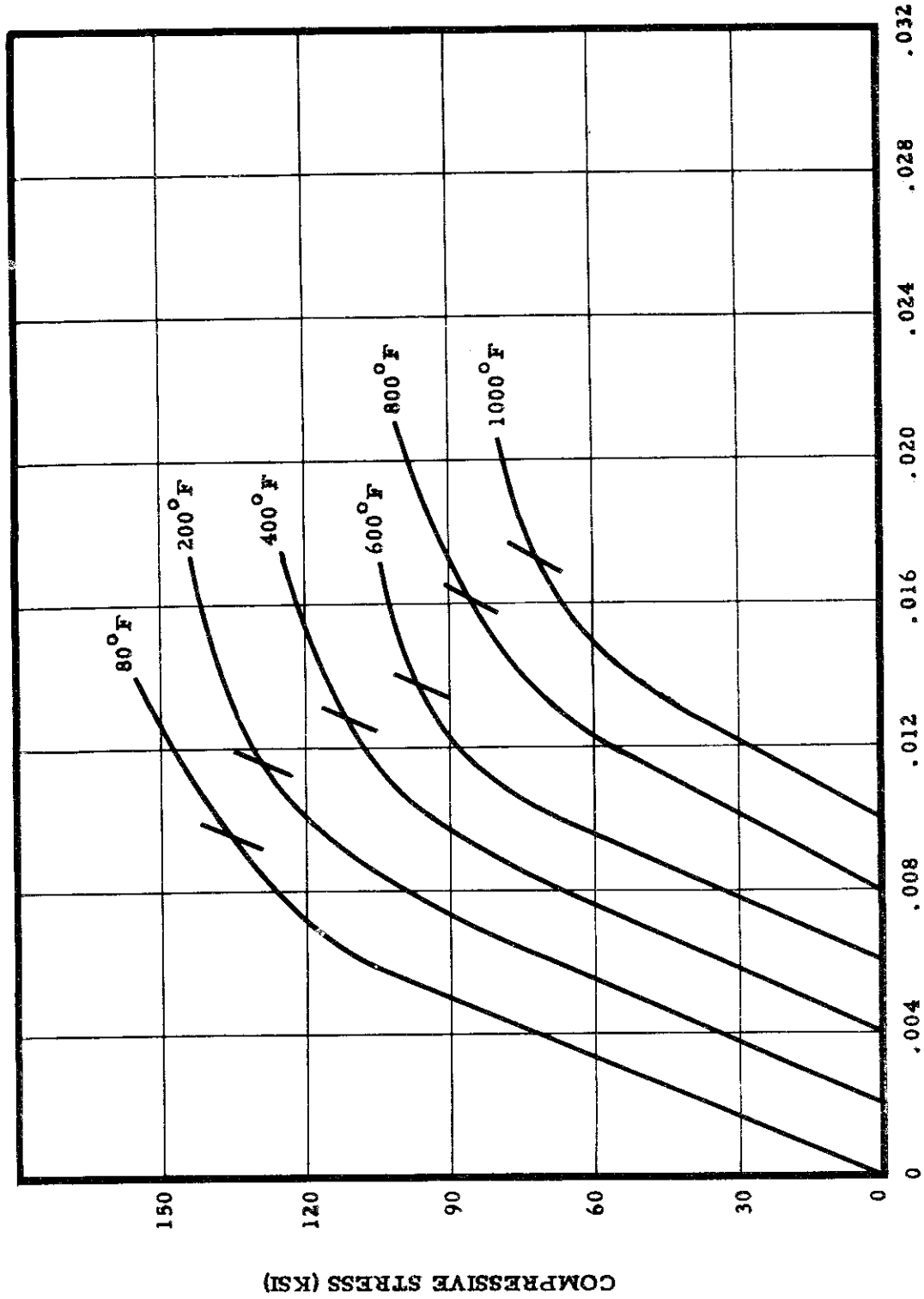


Figure 70. Compression Stress-Strain Curves of Ti 155A, Heat 1

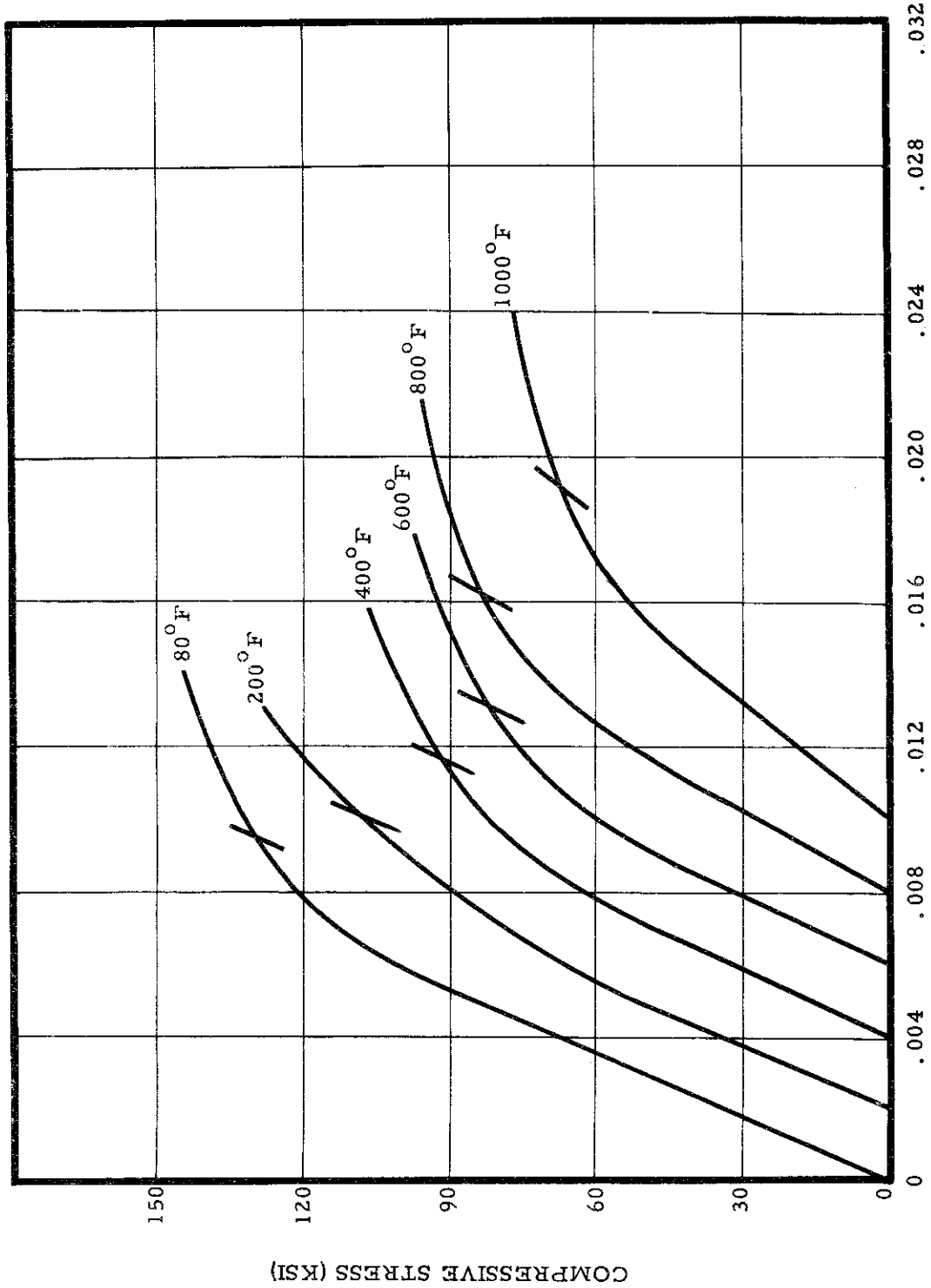


Figure 71. Compression Stress-Strain Curves of Ti 155A, Heat 2

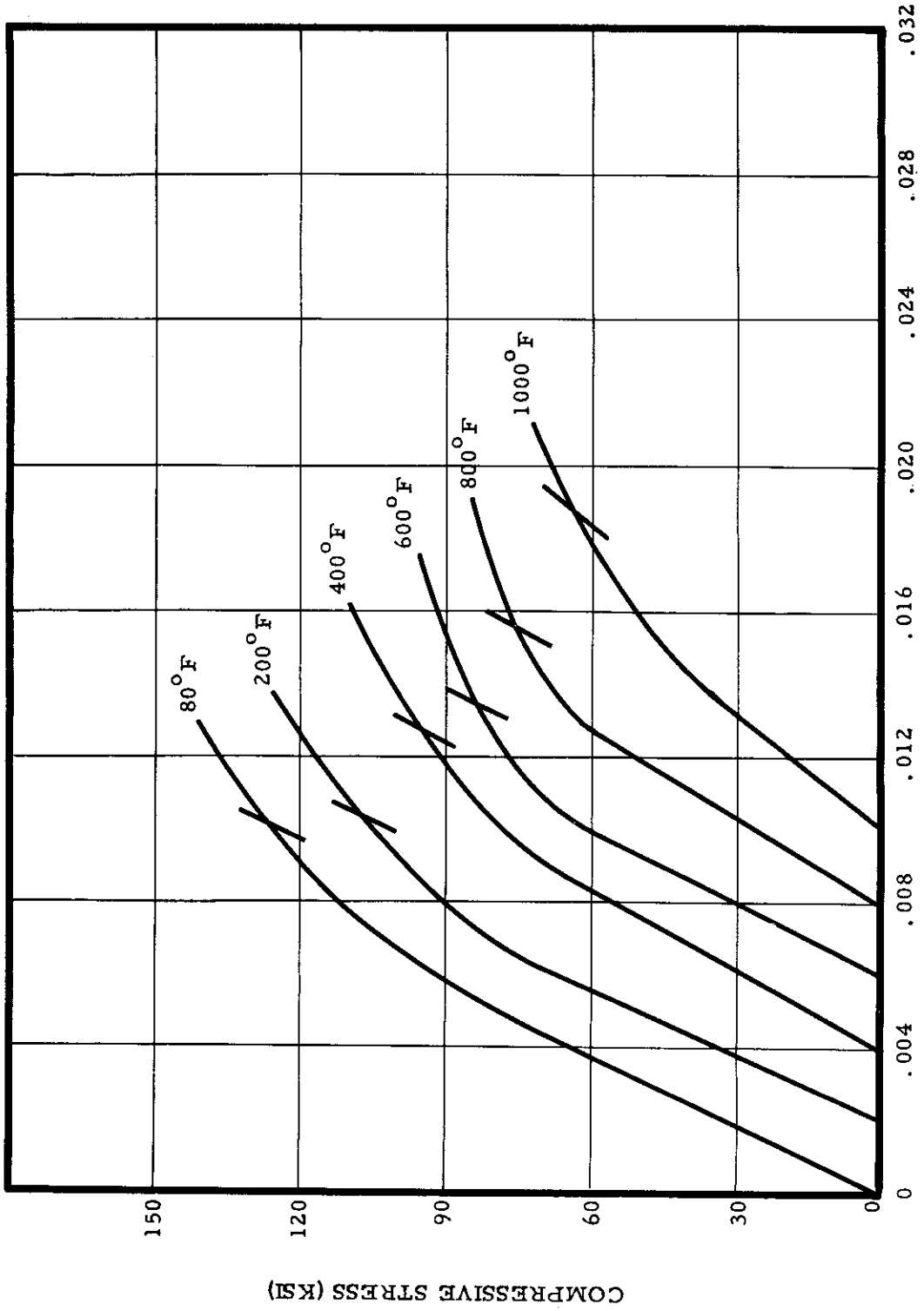


Figure 72. Compression Stress-Strain Curves of Ti 155A, Heat 3

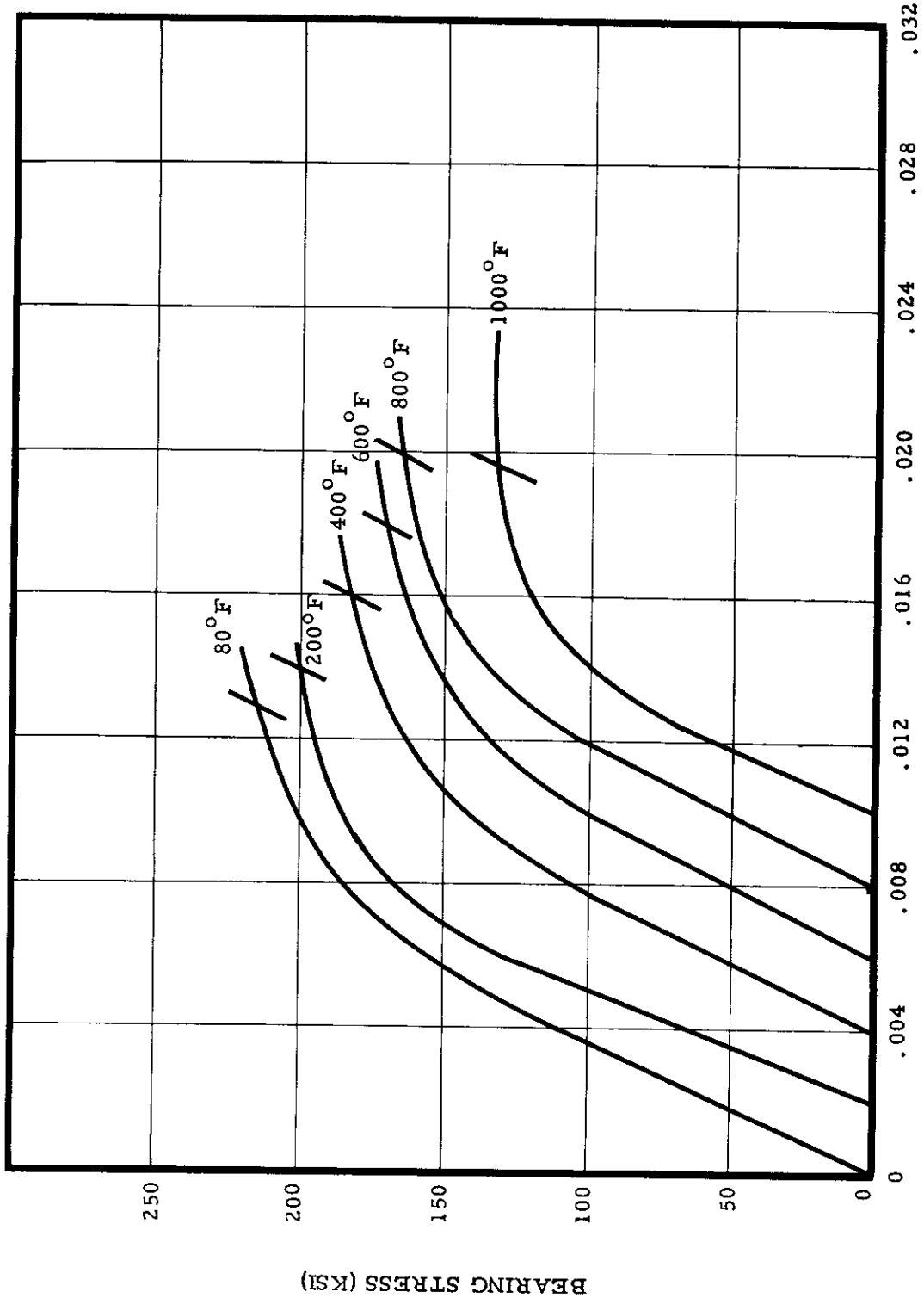


Figure 73. Bearing Stress-Deformation Curves for e/D = 1.5, for Ti 155A, Heat 1

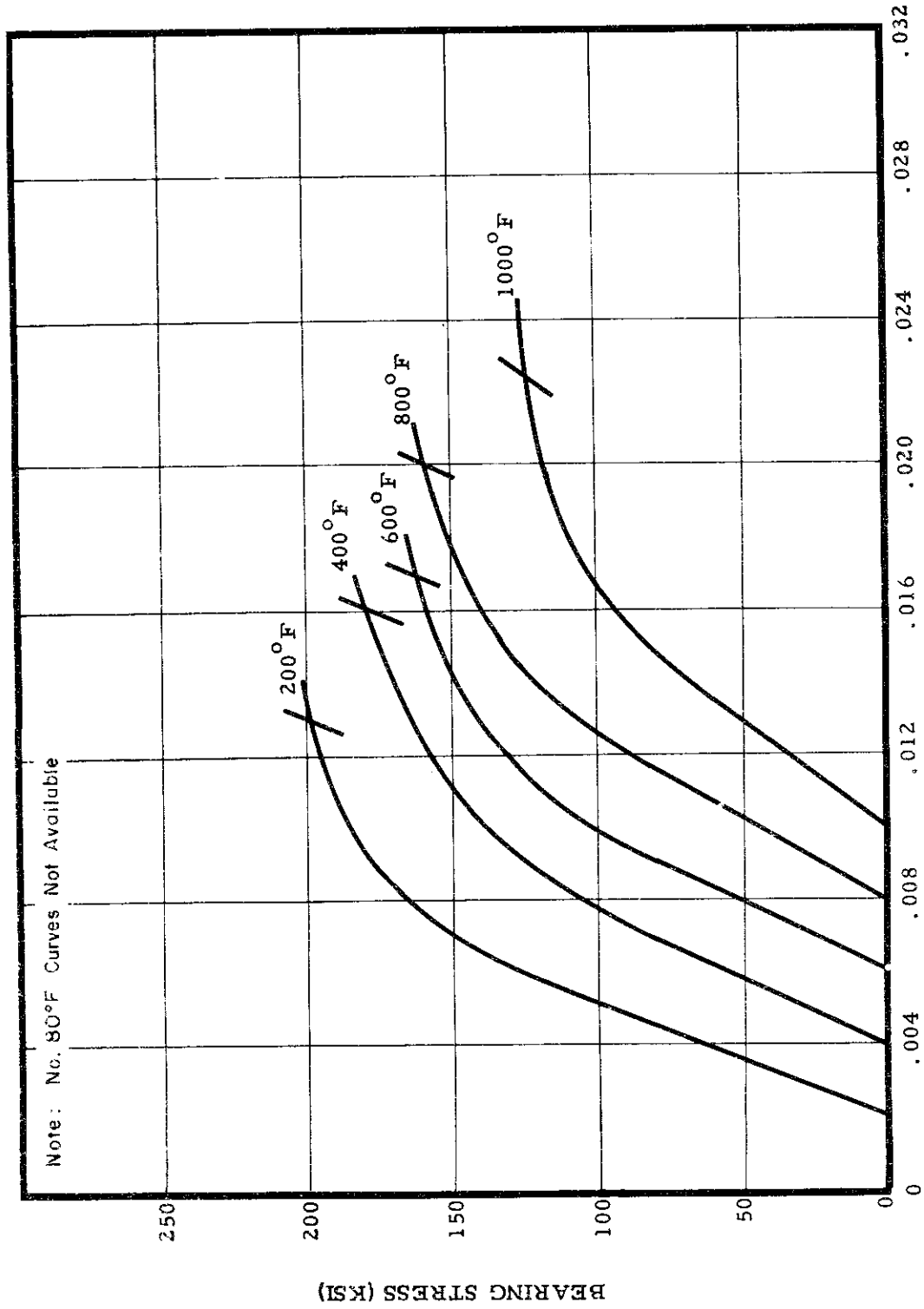


Figure 74. Bearing Stress-Deformation Curves for e/D = 1.5, for Ti 155A, Heat 2

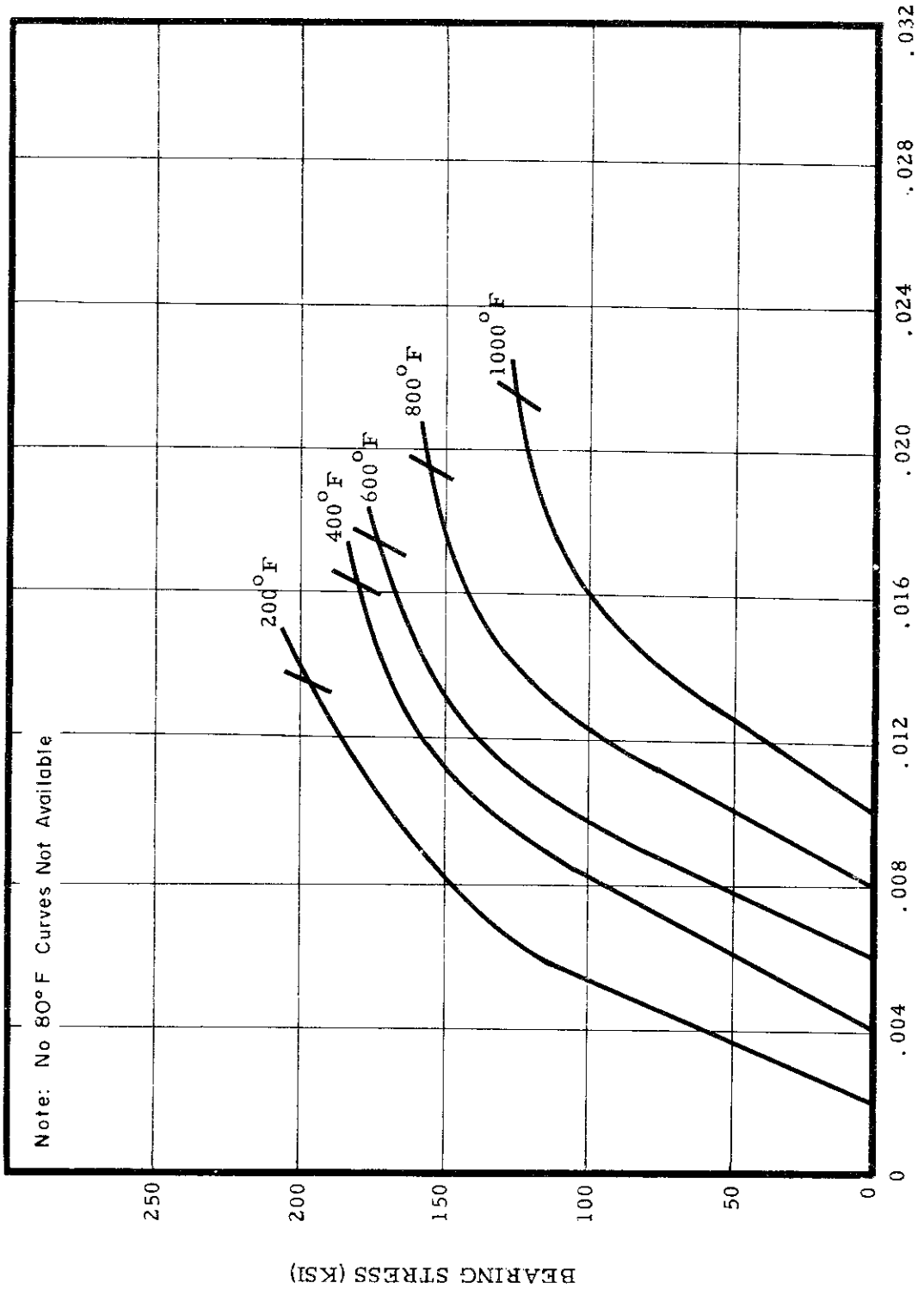


Figure 75. Bearing Stress-Deformation Curves for e/D = 1.5, for Ti 155A, Heat 3

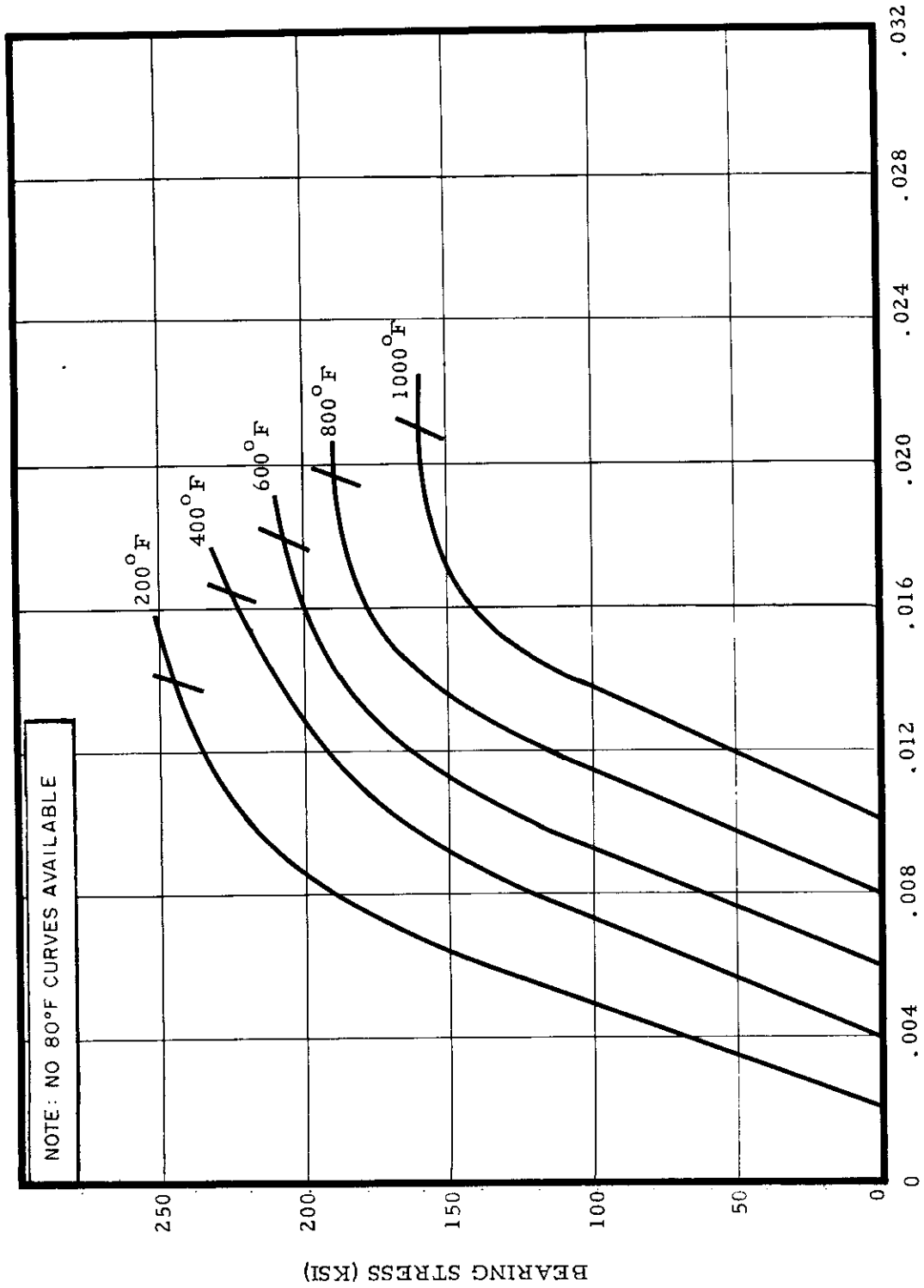


Figure 76. Bearing Stress-Deformation Curves for e/D = 2.0, for Ti 155A, Heat 1

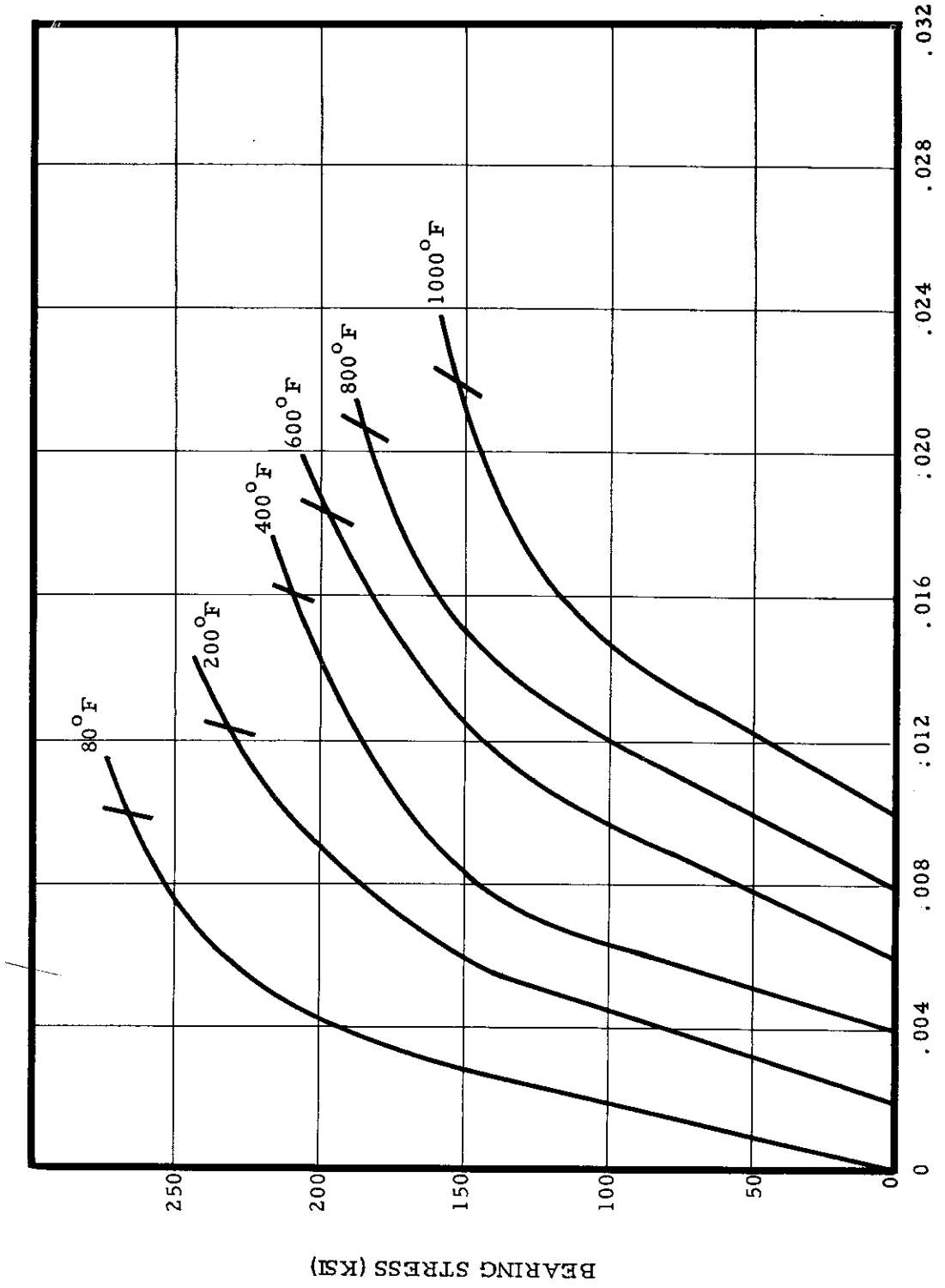


Figure 77. Bearing Stress-Deformation Curves for e/D = 2.0, for Ti 155A, Heat 2

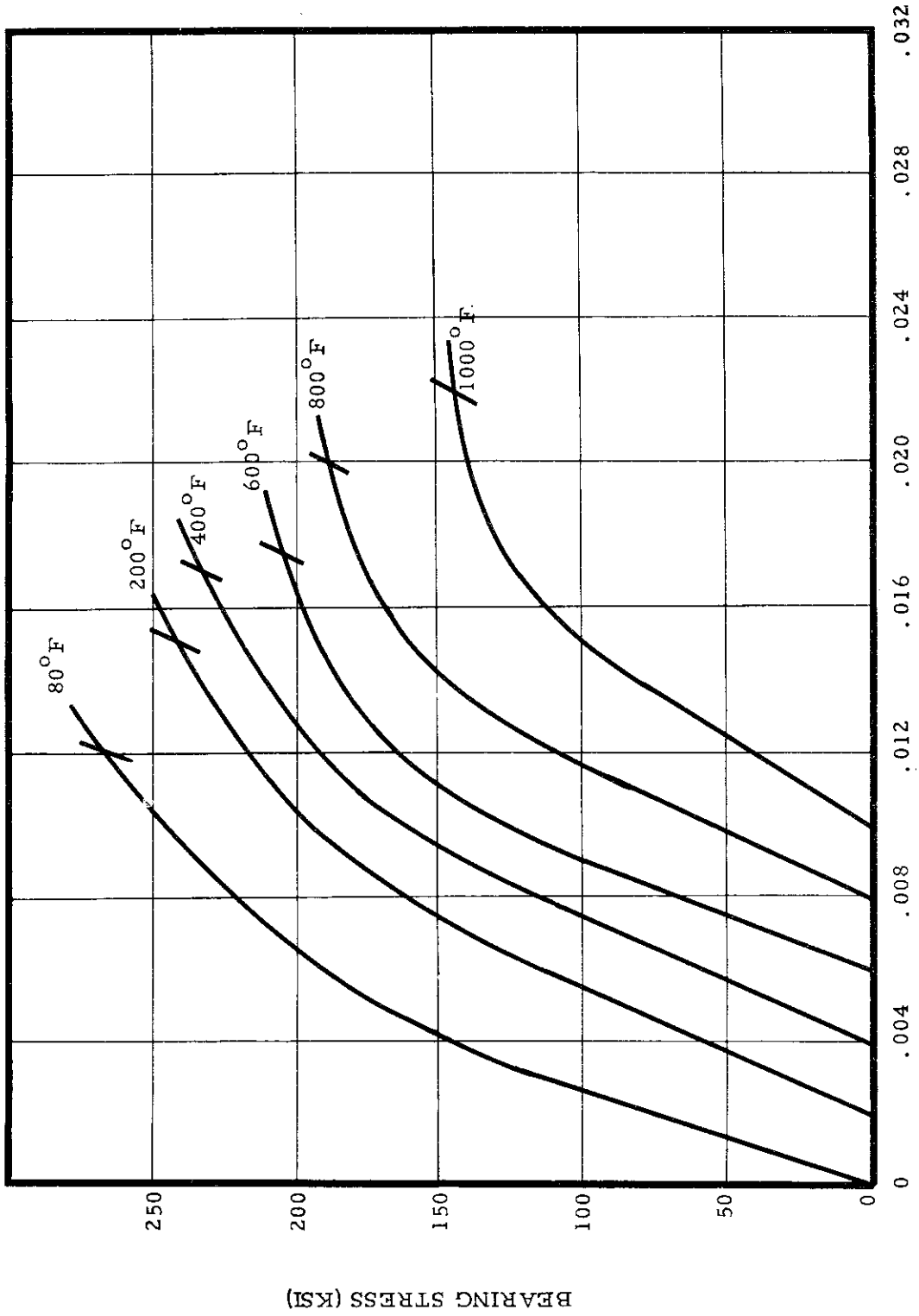


Figure 78. Bearing Stress-Deformation Curves for e/D = 2.0, for Ti 155A, Heat 3

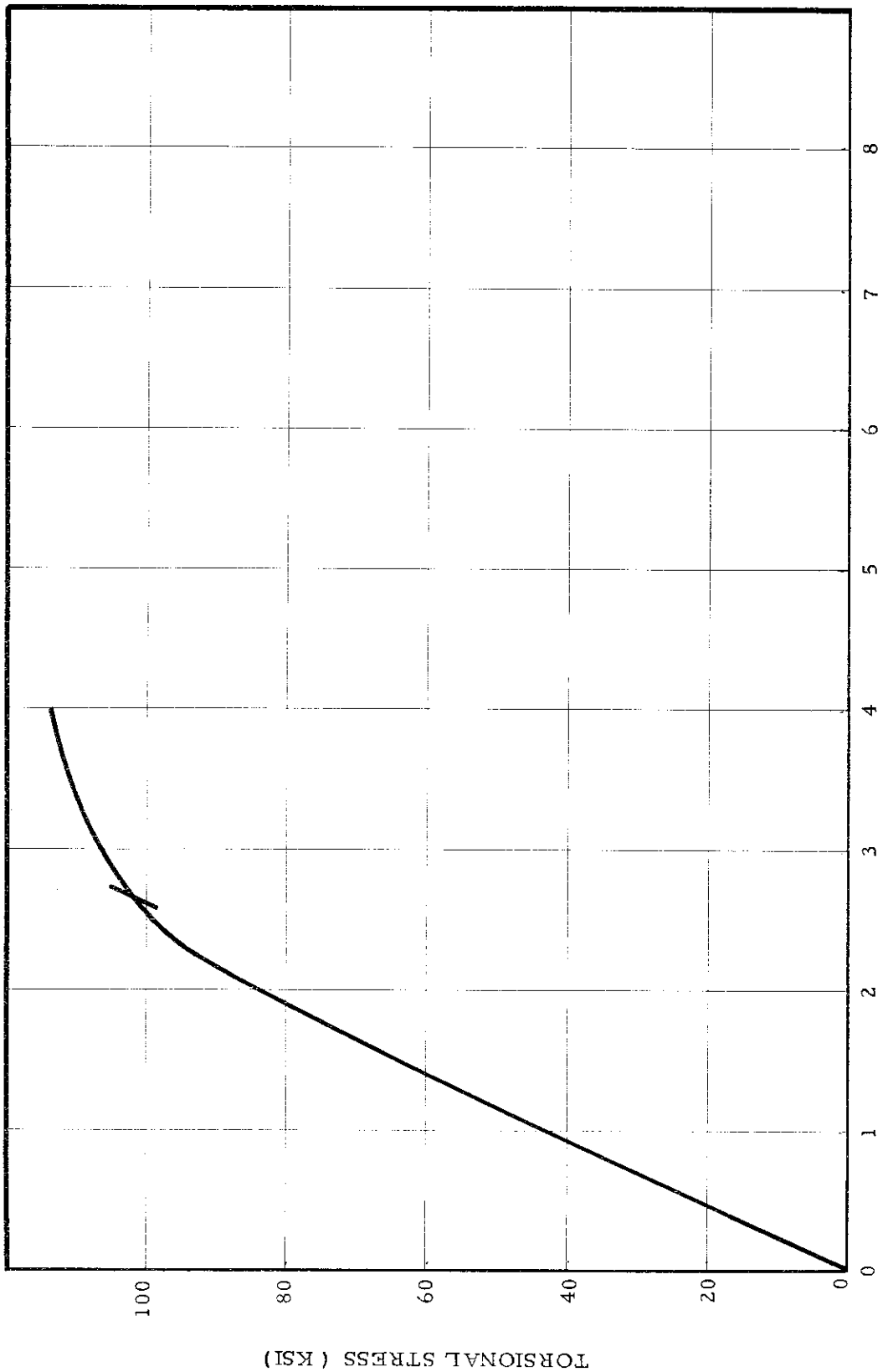


Figure 79. Room Temperature Torsion Curve for Ti 155A, Heat 1

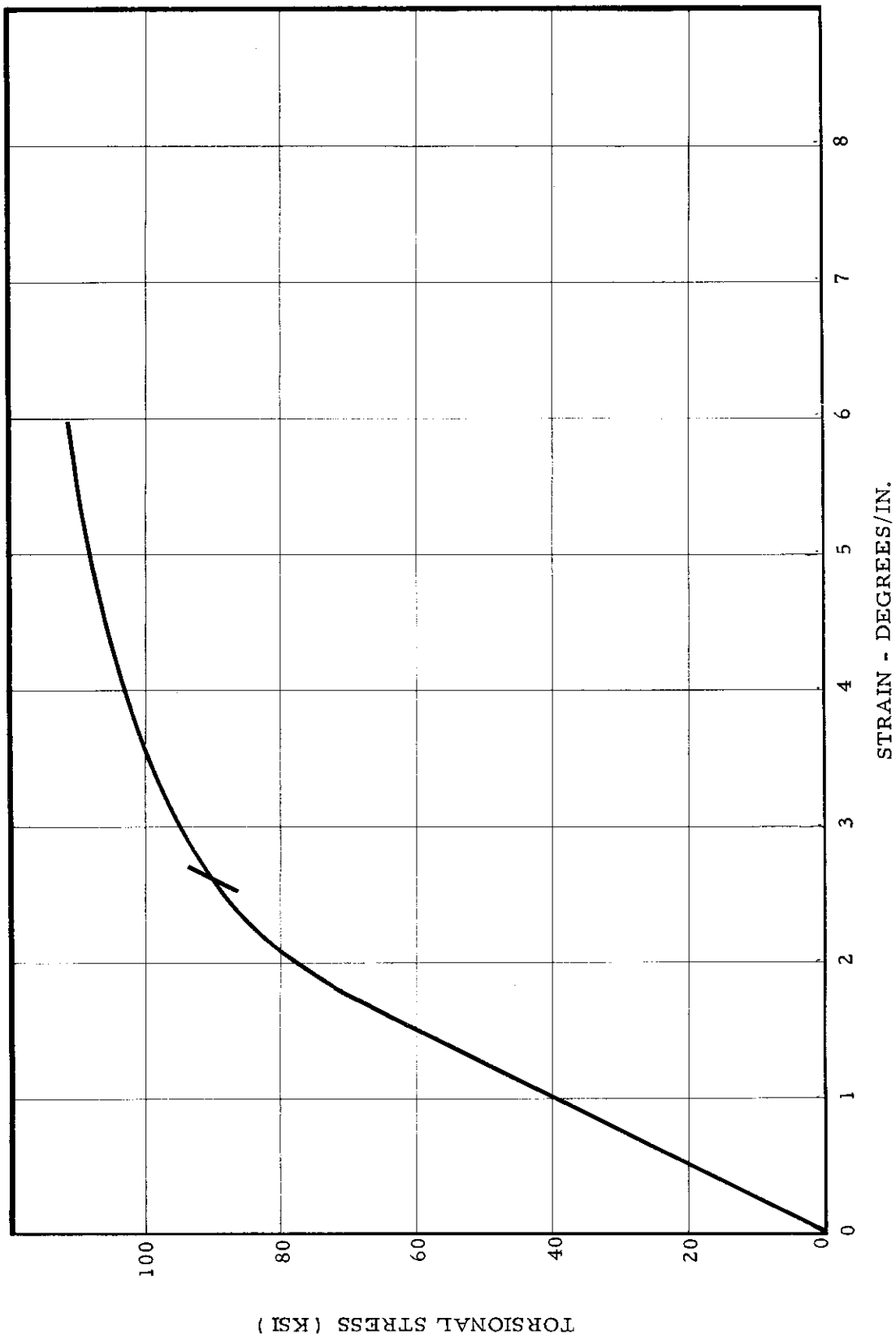


Figure 80. Room Temperature Torsion Curve for Ti 155A, Heat 2

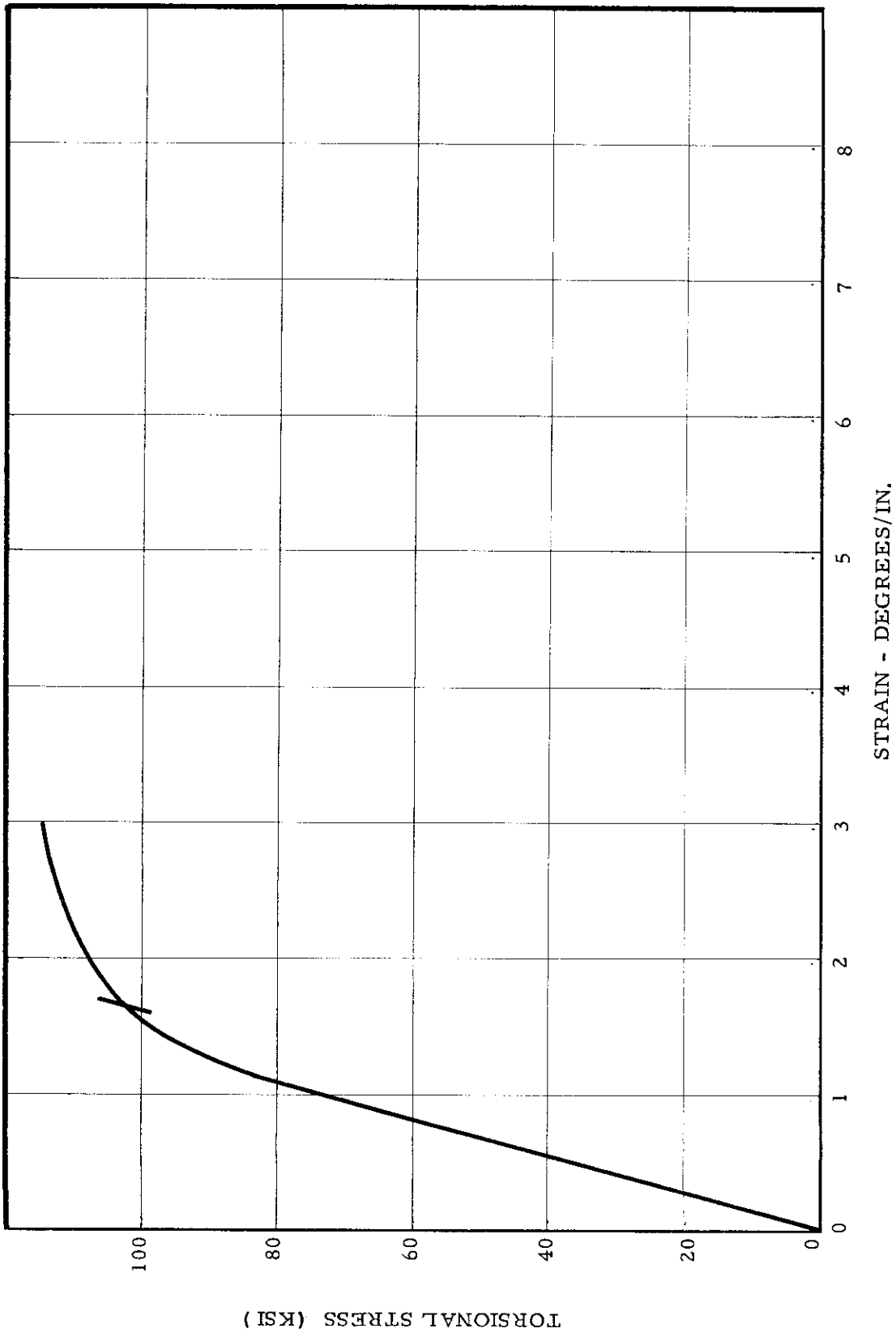


Figure 81. Room Temperature Torsion Curve for Ti 155A, Heat 3

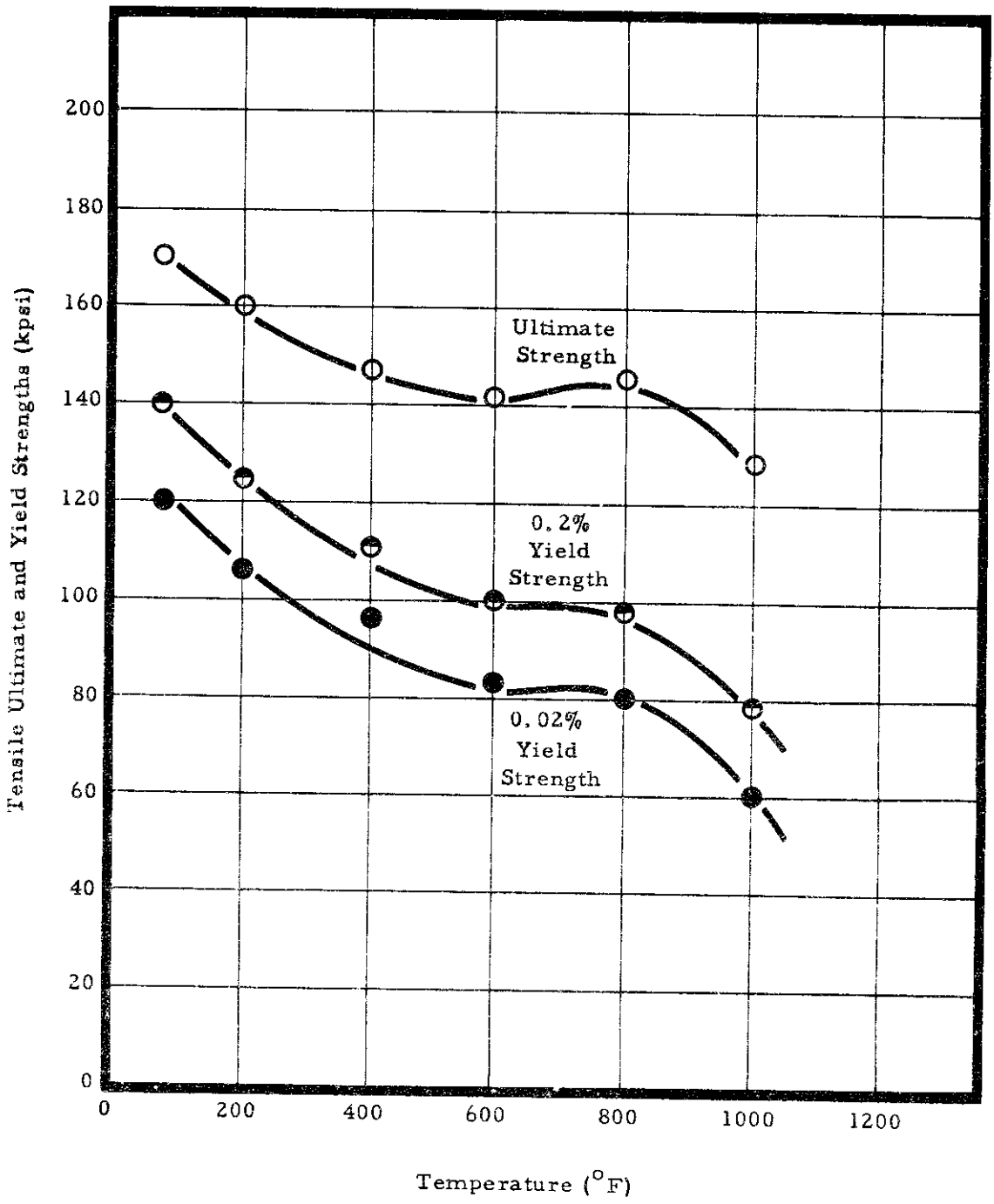


Figure 82. Tensile Properties vs. Temperature of C135AMo, Heat 1

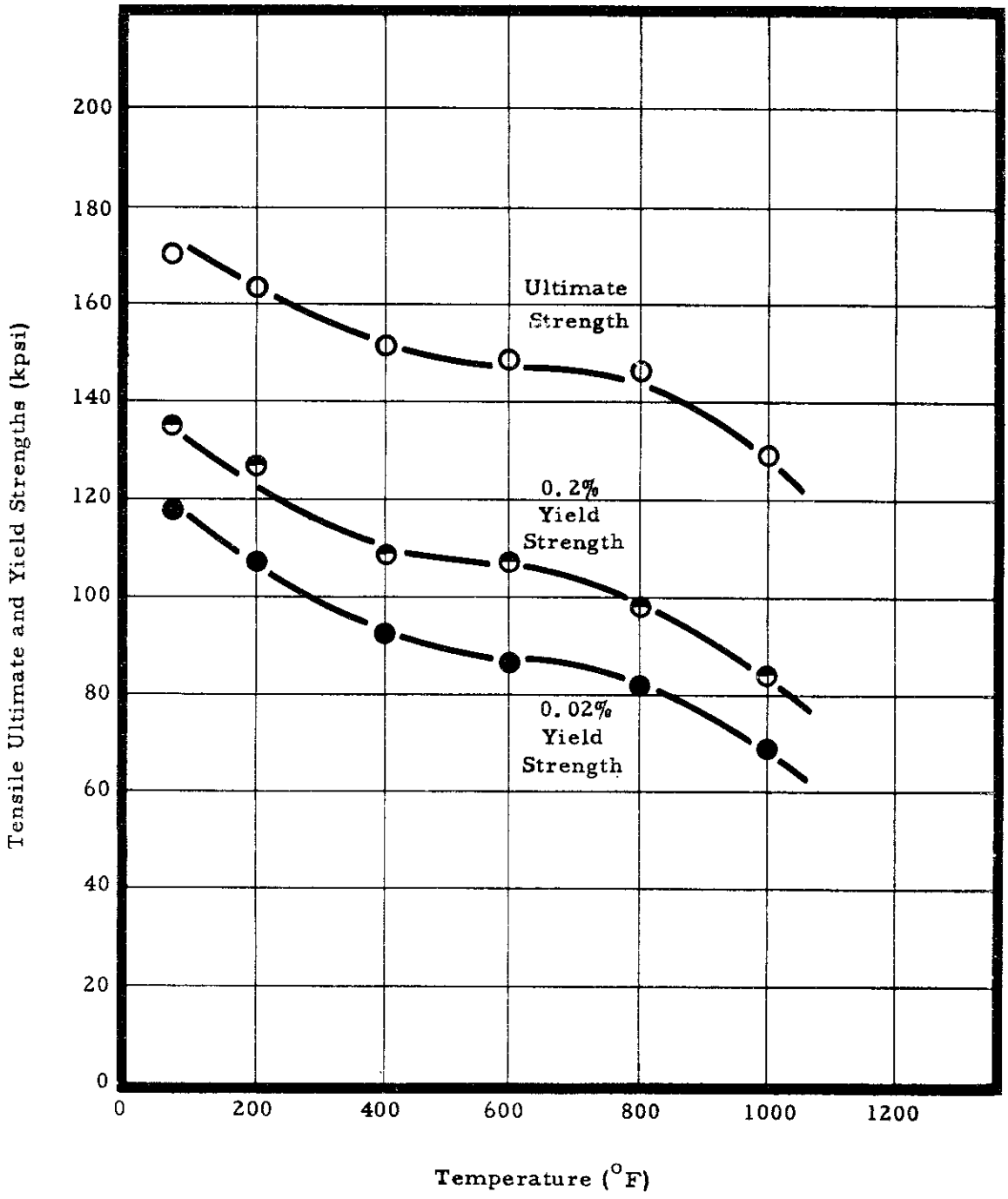


Figure 83. Tensile Properties vs. Temperature of C135AMo, Heat 2

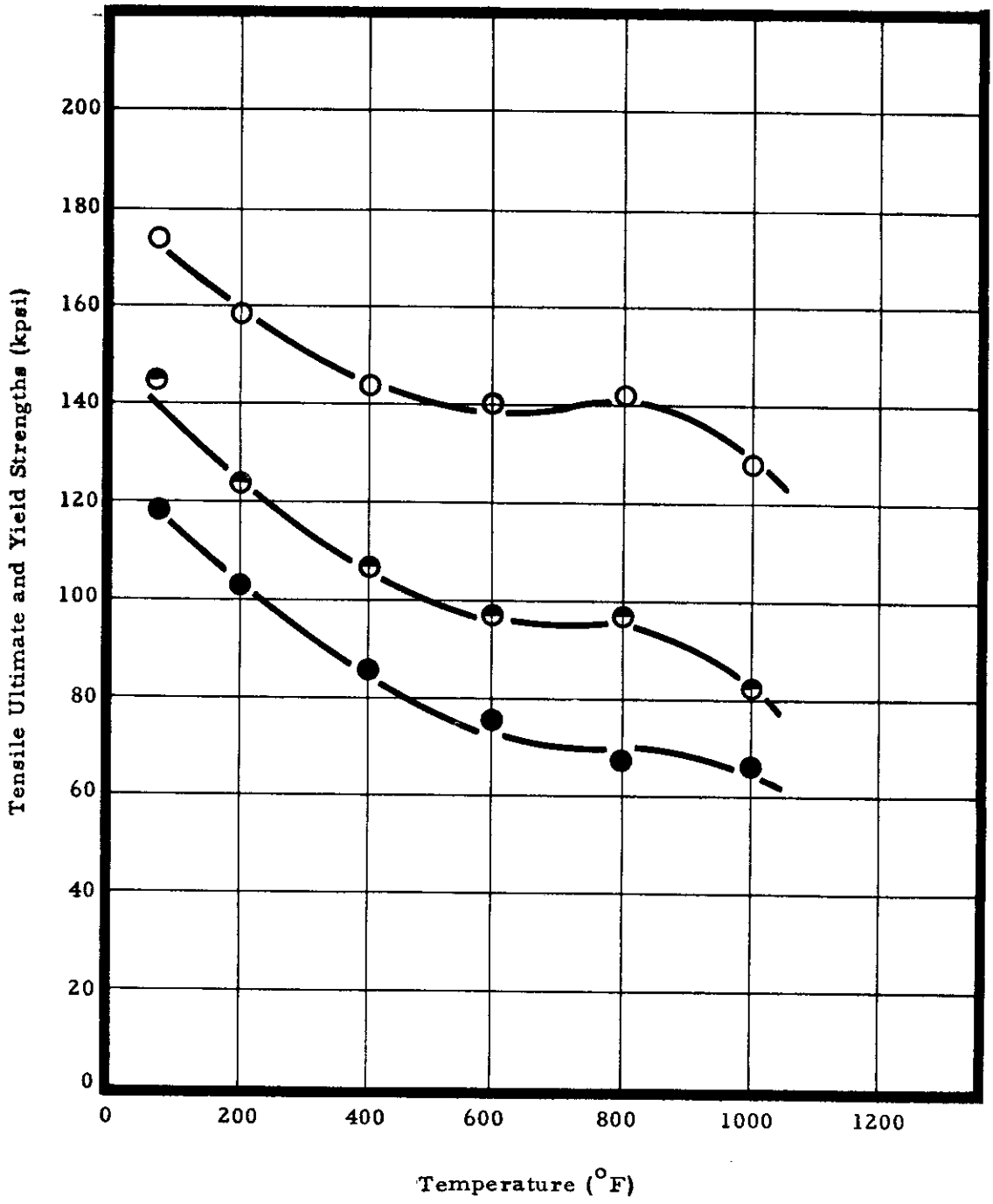


Figure 84. Tensile Properties vs. Temperature of C135AMo, Heat 3

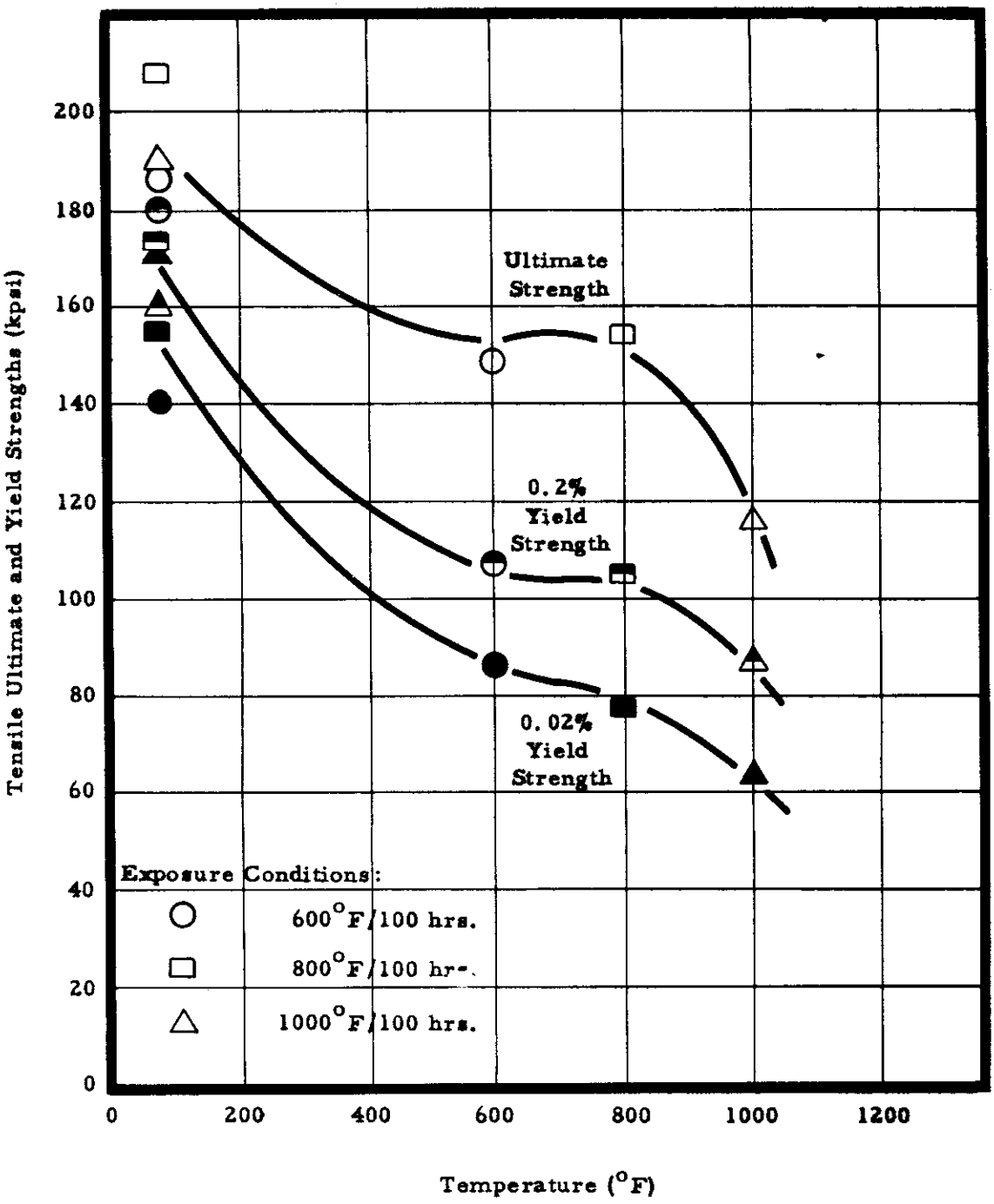


Figure 85. Tensile Properties vs. Temperature, Nonstressed Stability, C135AMo, Heat 1

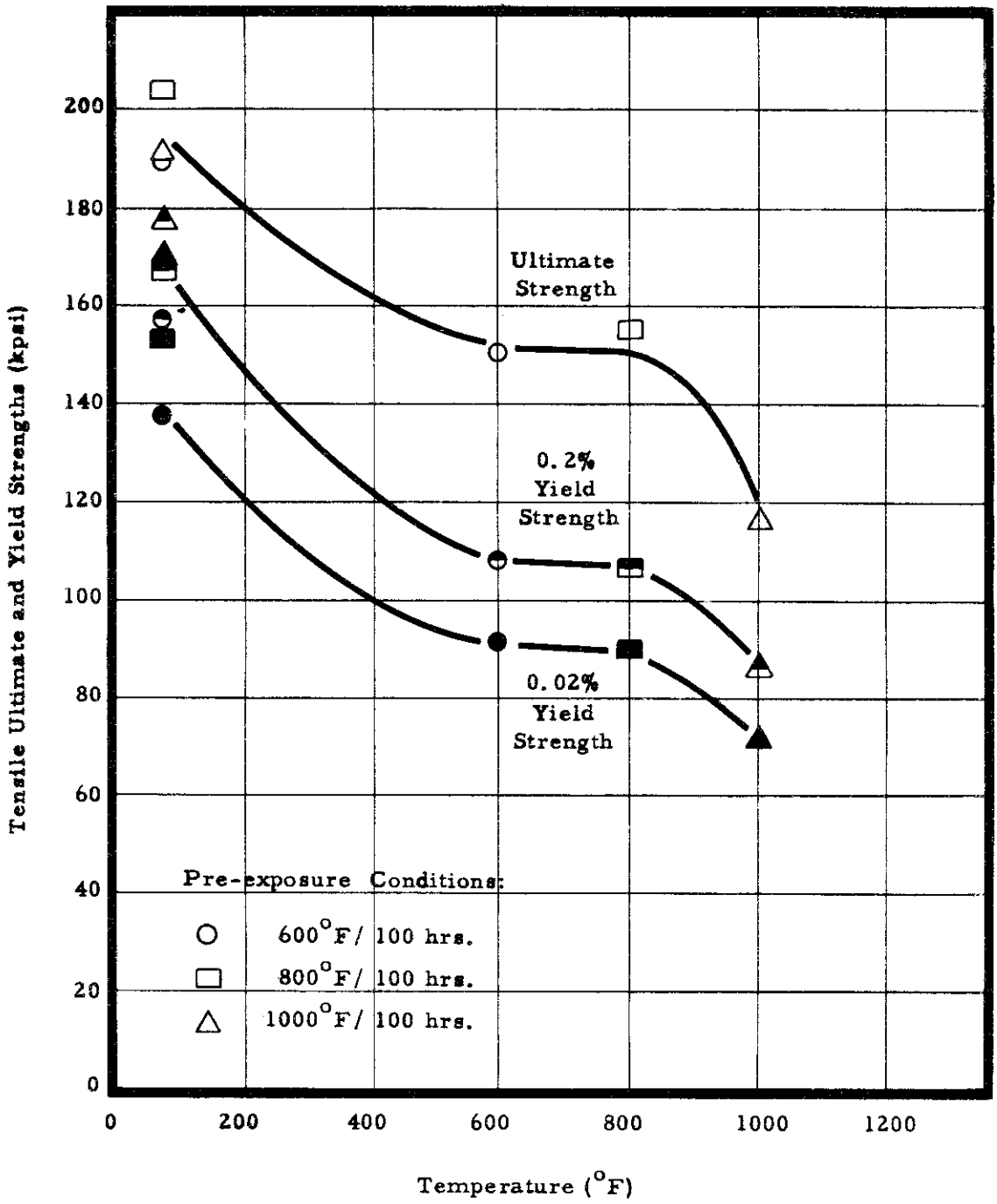


Figure 86. Tensile Properties vs. Temperature, Nonstressed Stability, C135AMo, Heat 2

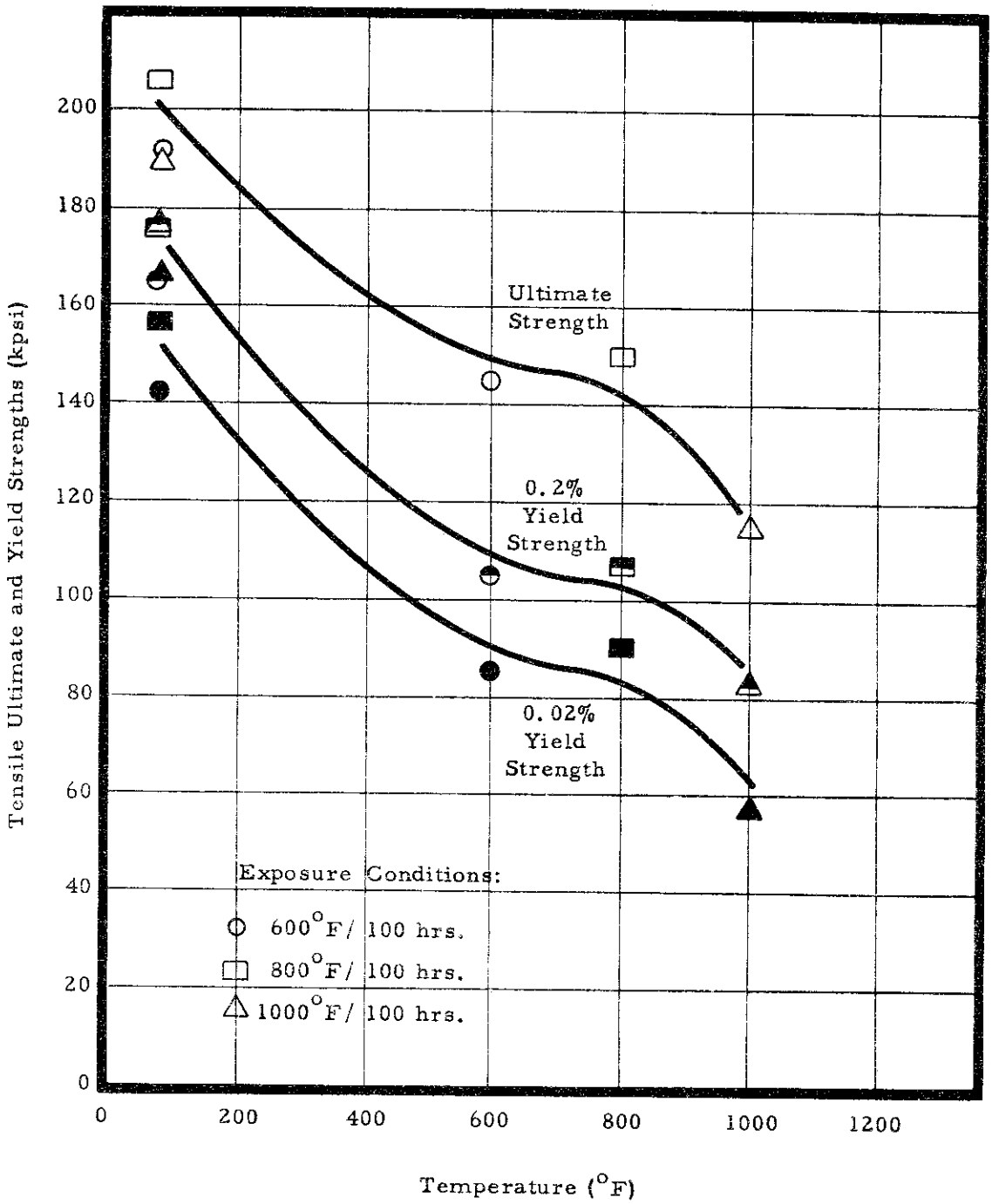


Figure 87. Tensile Properties vs. Temperature, Nonstressed Stability, C135AMo, Heat 3

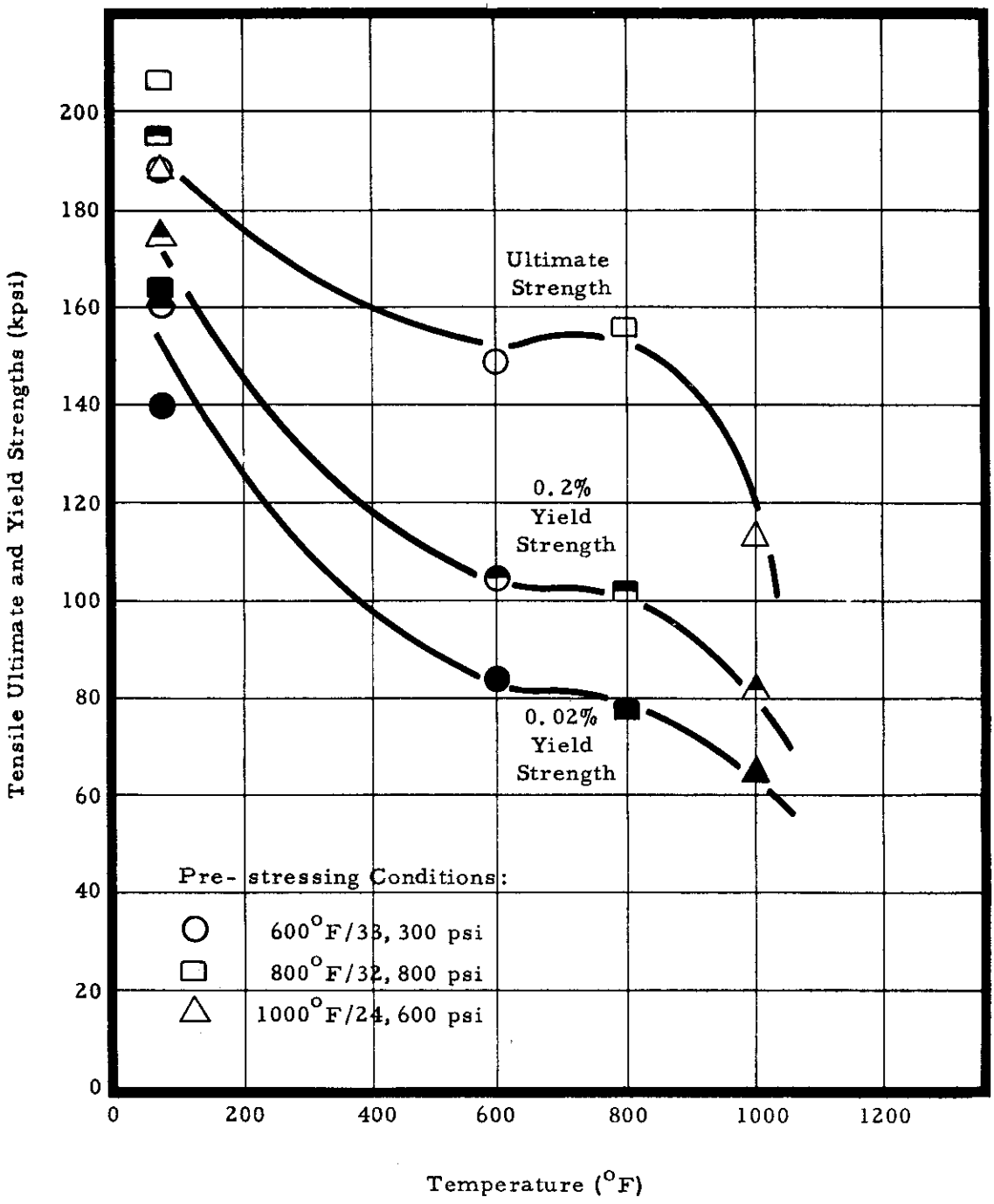


Figure 88. Tensile Properties vs. Temperature, Stressed Stability, C135AMo, Heat 1

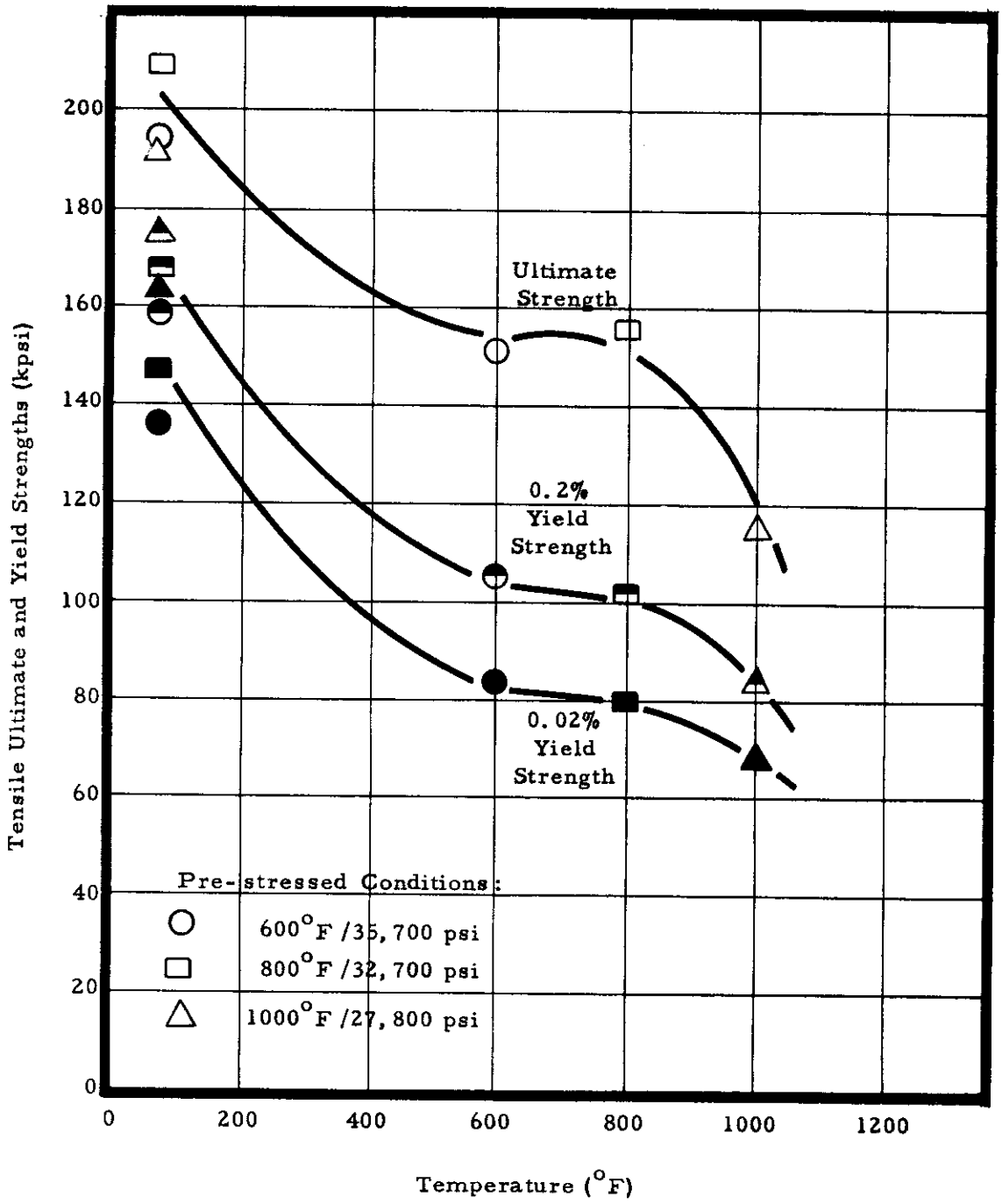


Figure 89. Tensile Properties vs. Temperature, Stressed Stability, C135AMo, Heat 2

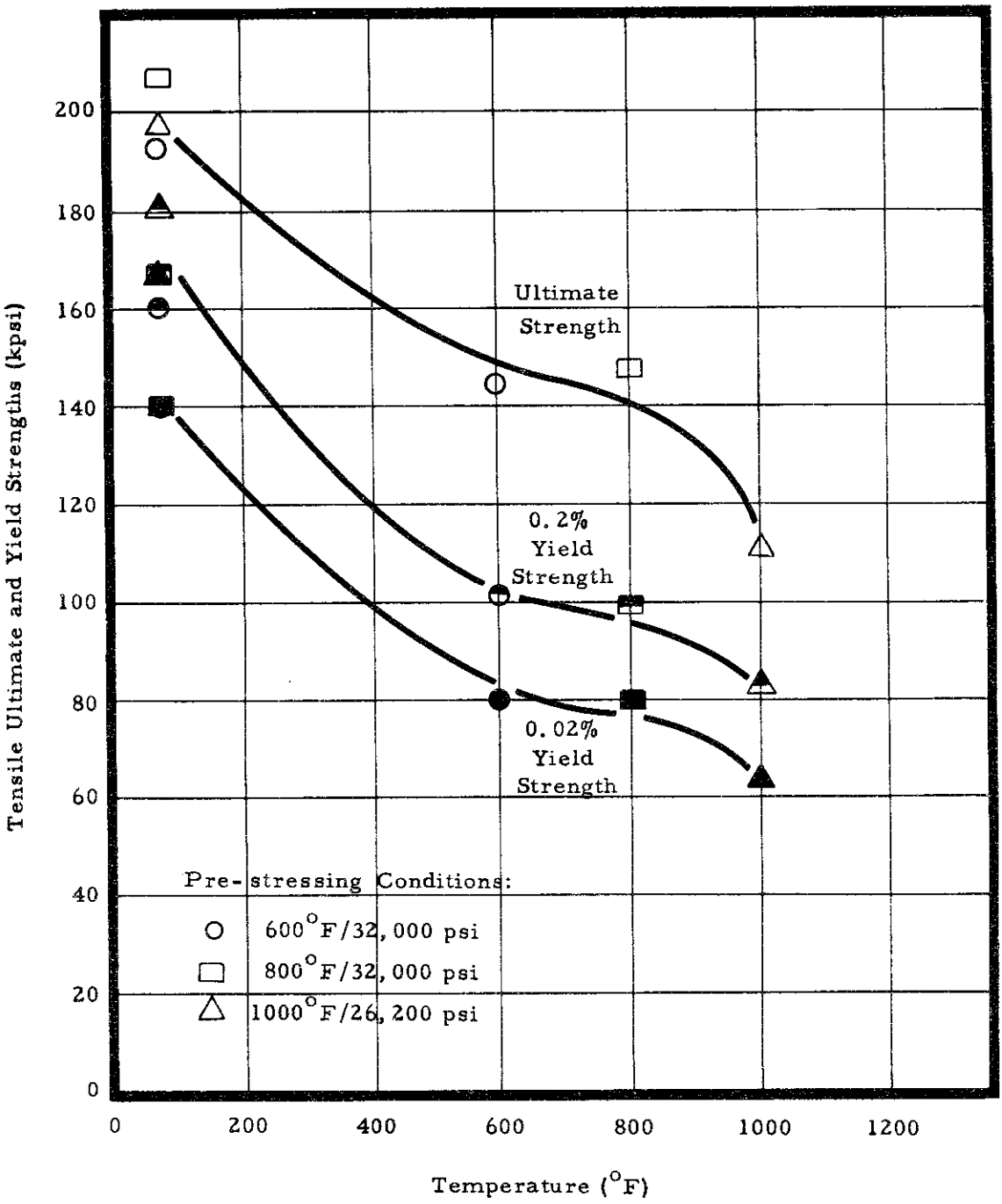


Figure 90. Tensile Properties vs. Temperature, Stressed Stability, C135AMo, Heat 3

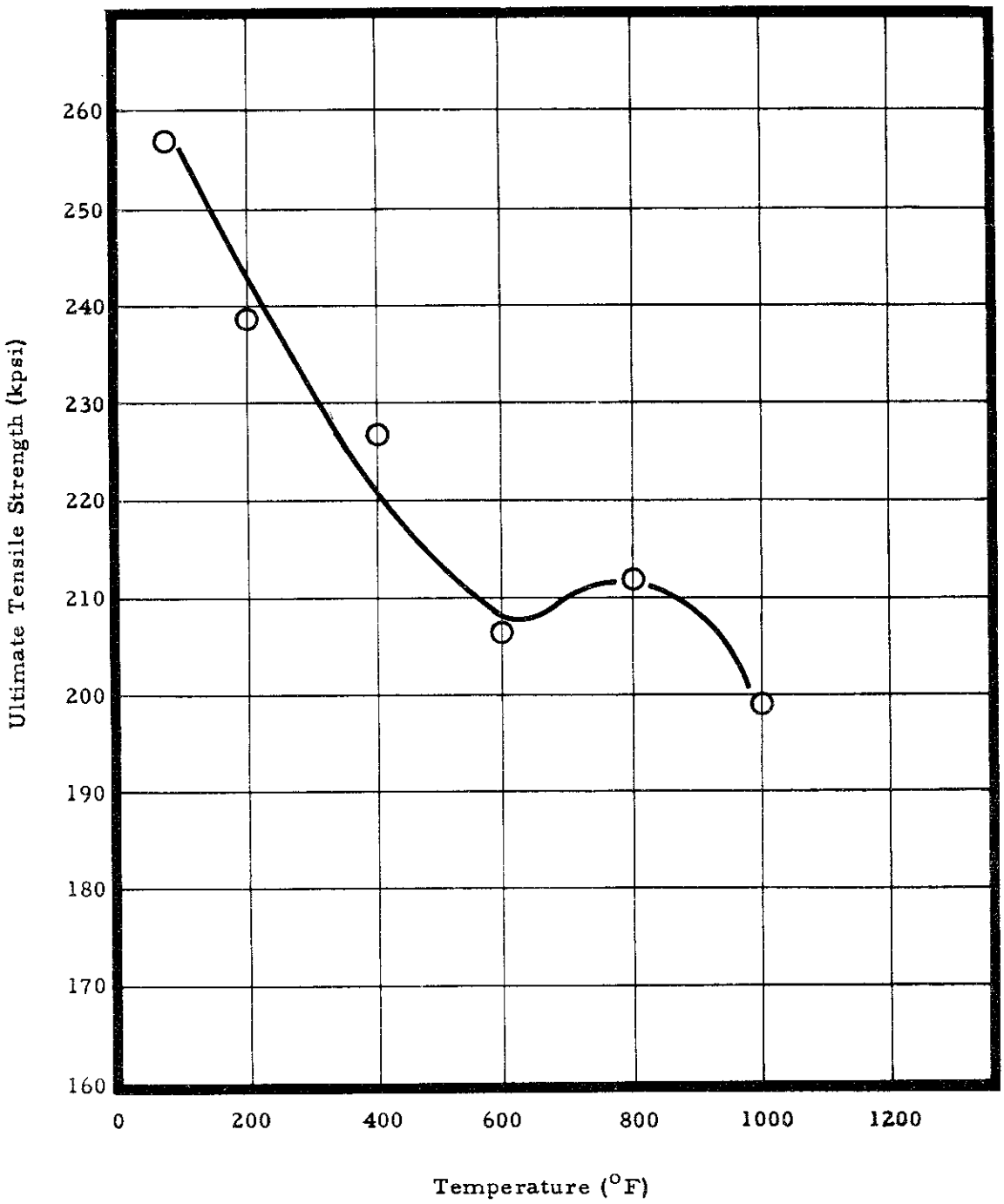


Figure 91. Notched Tensile Properties vs. Temperature, C135AMo, Heat 1

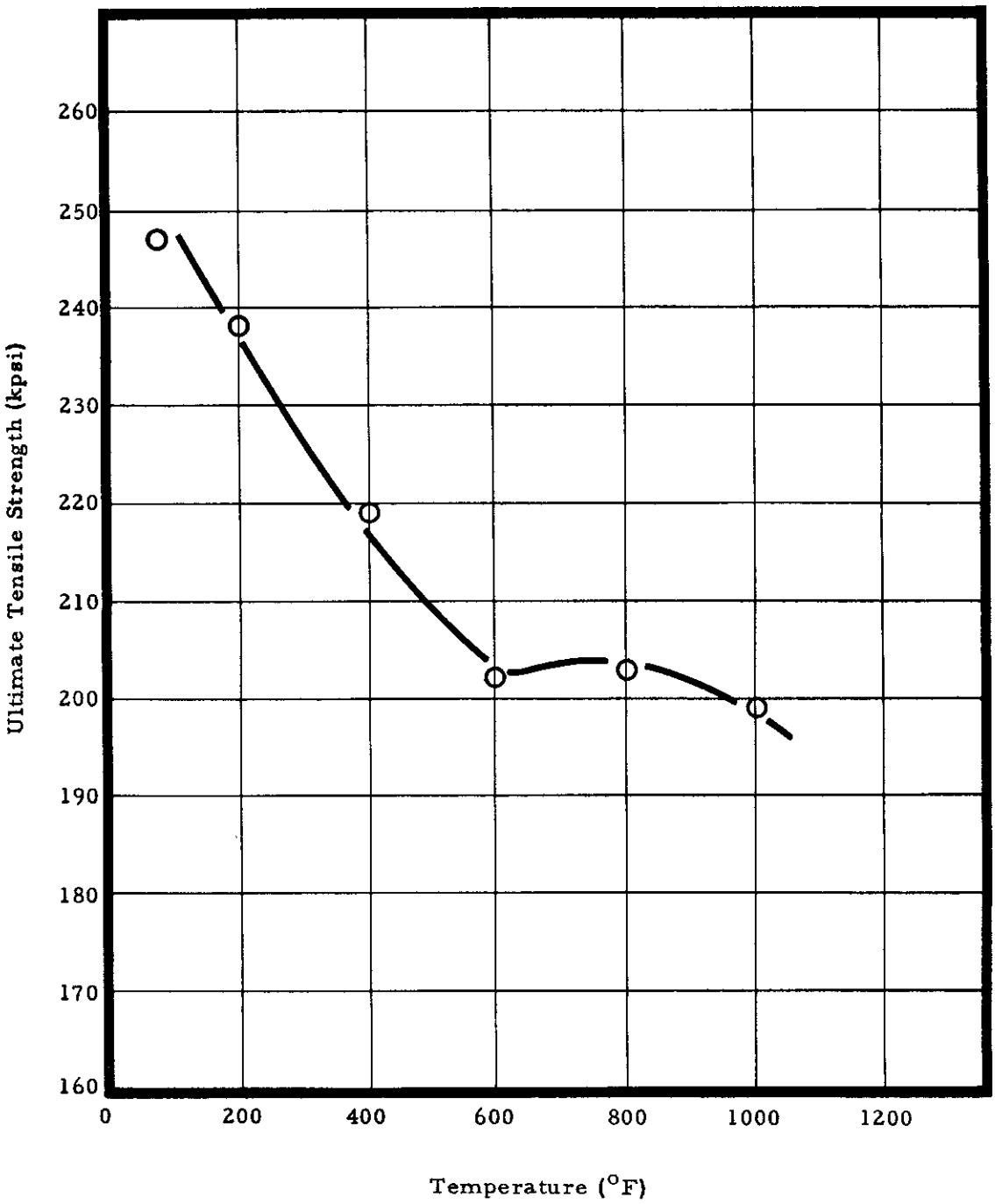


Figure 92. Notched Tensile Properties vs. Temperature, C135AMo, Heat 2

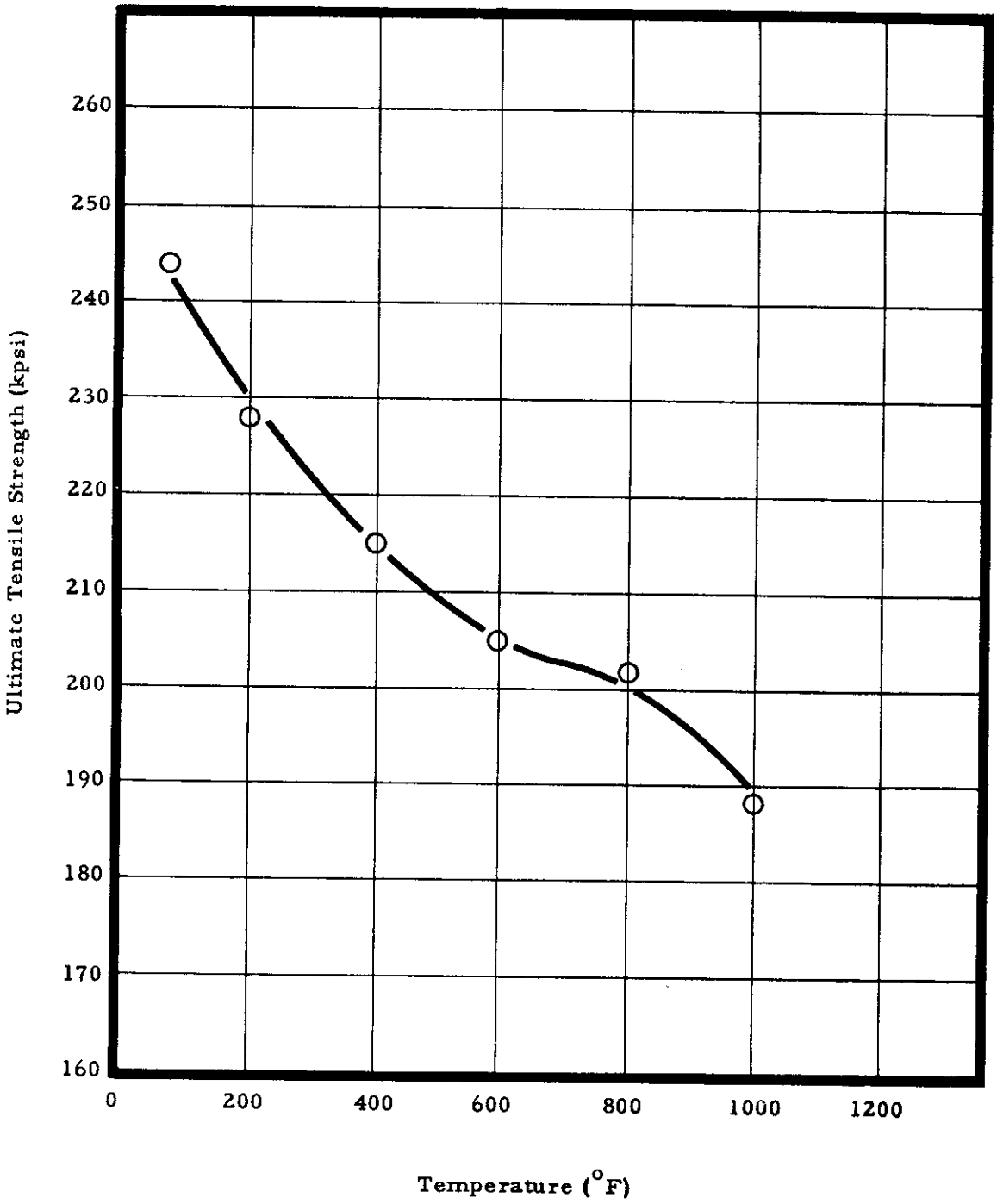


Figure 93. Notched Tensile Properties vs. Temperature, C135AMo, Heat 3

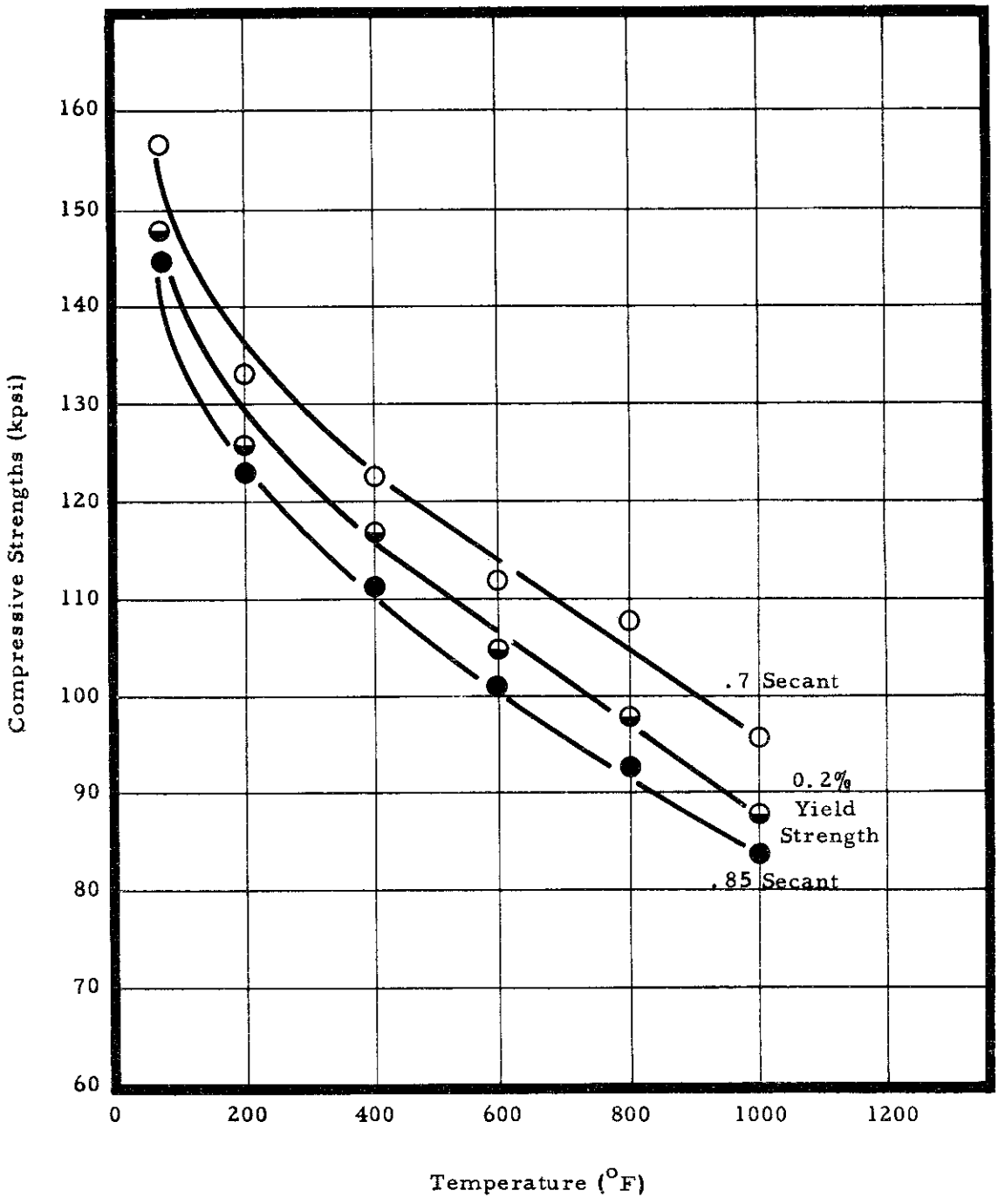


Figure 94. Compression Properties vs. Temperature, C135AMo, Heat 1

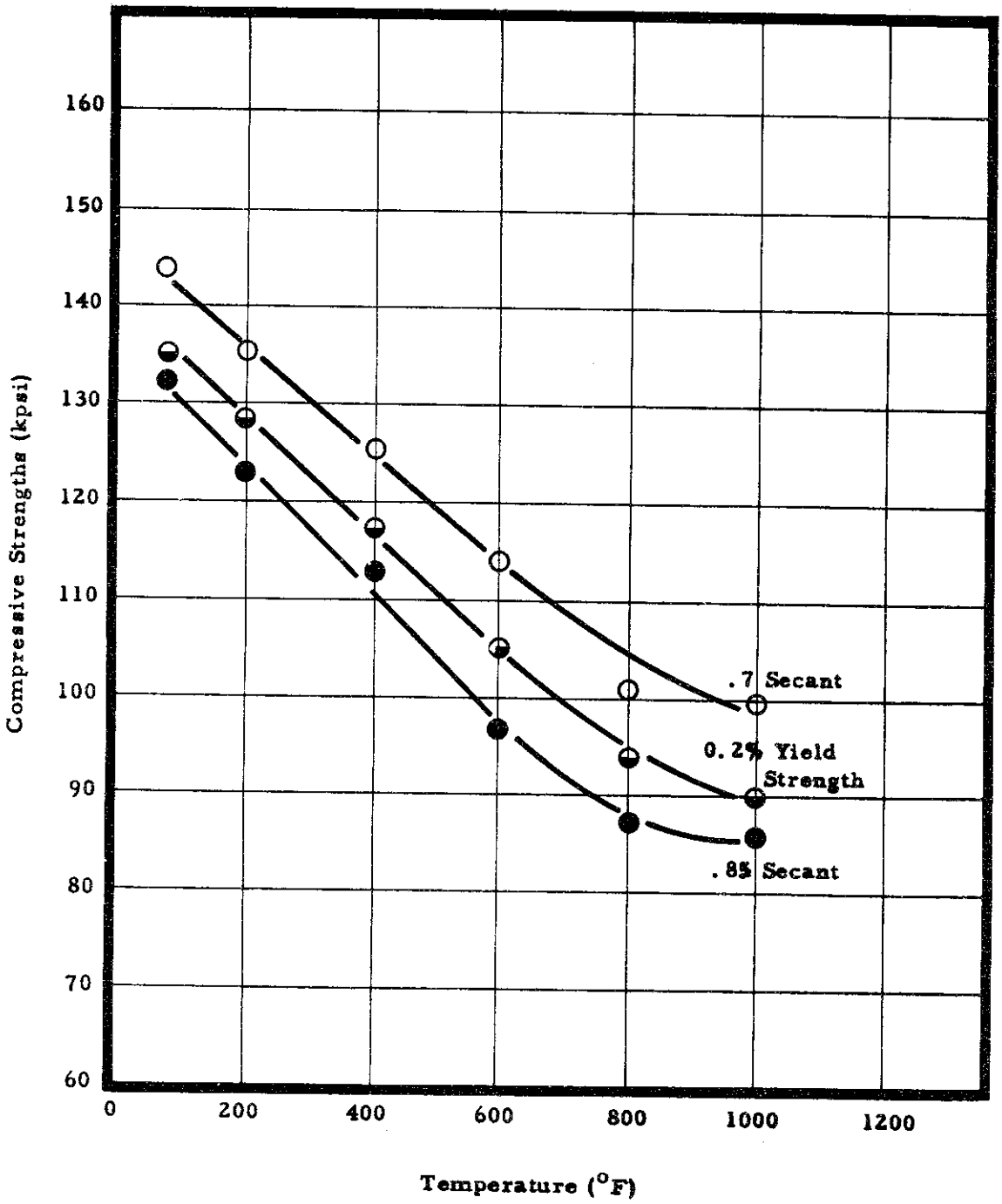


Figure 95. Compression Properties vs. Temperature, C135AMo, Heat 2

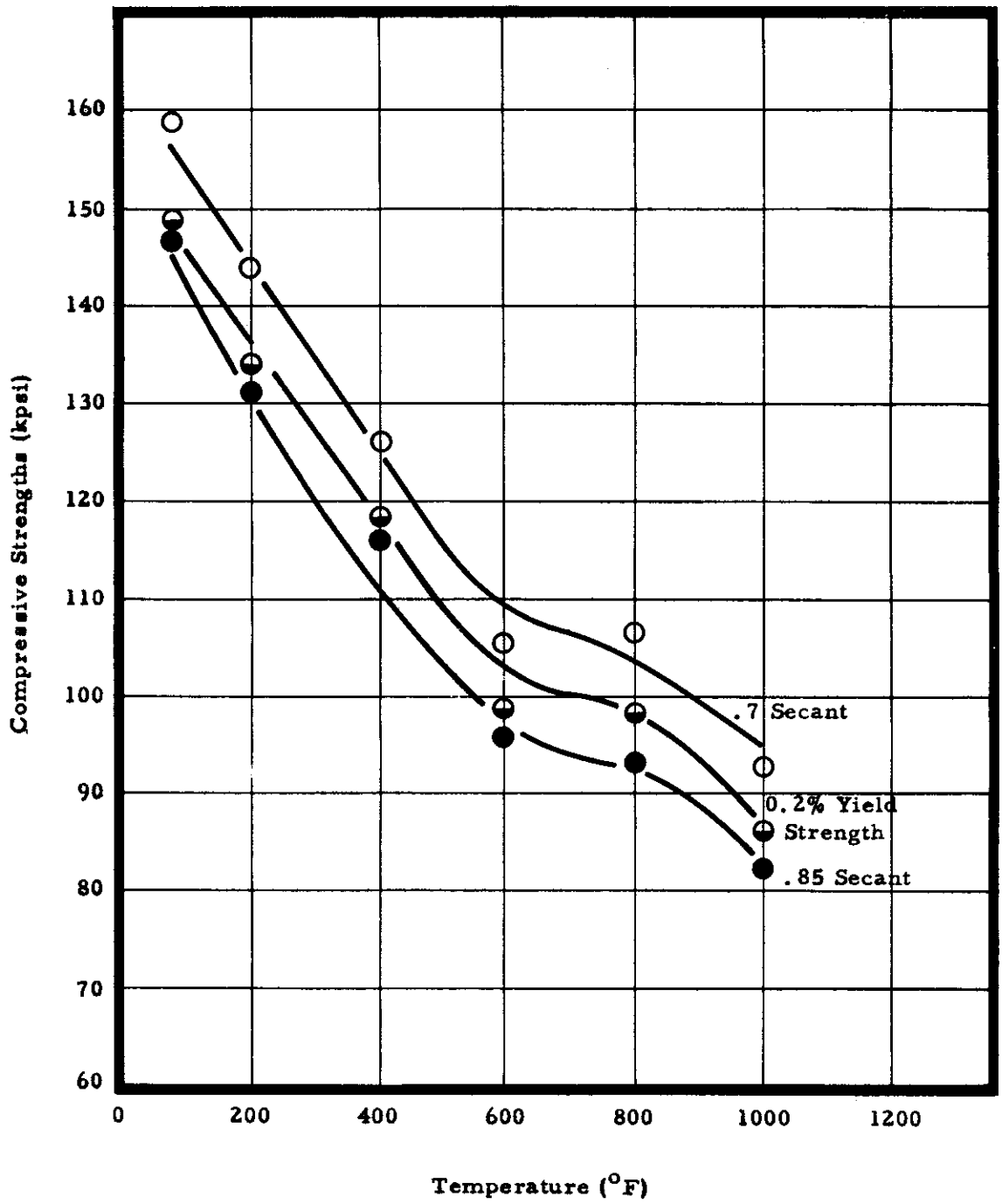


Figure 96. Compression Properties vs. Temperature, C135AMo, Heat 3

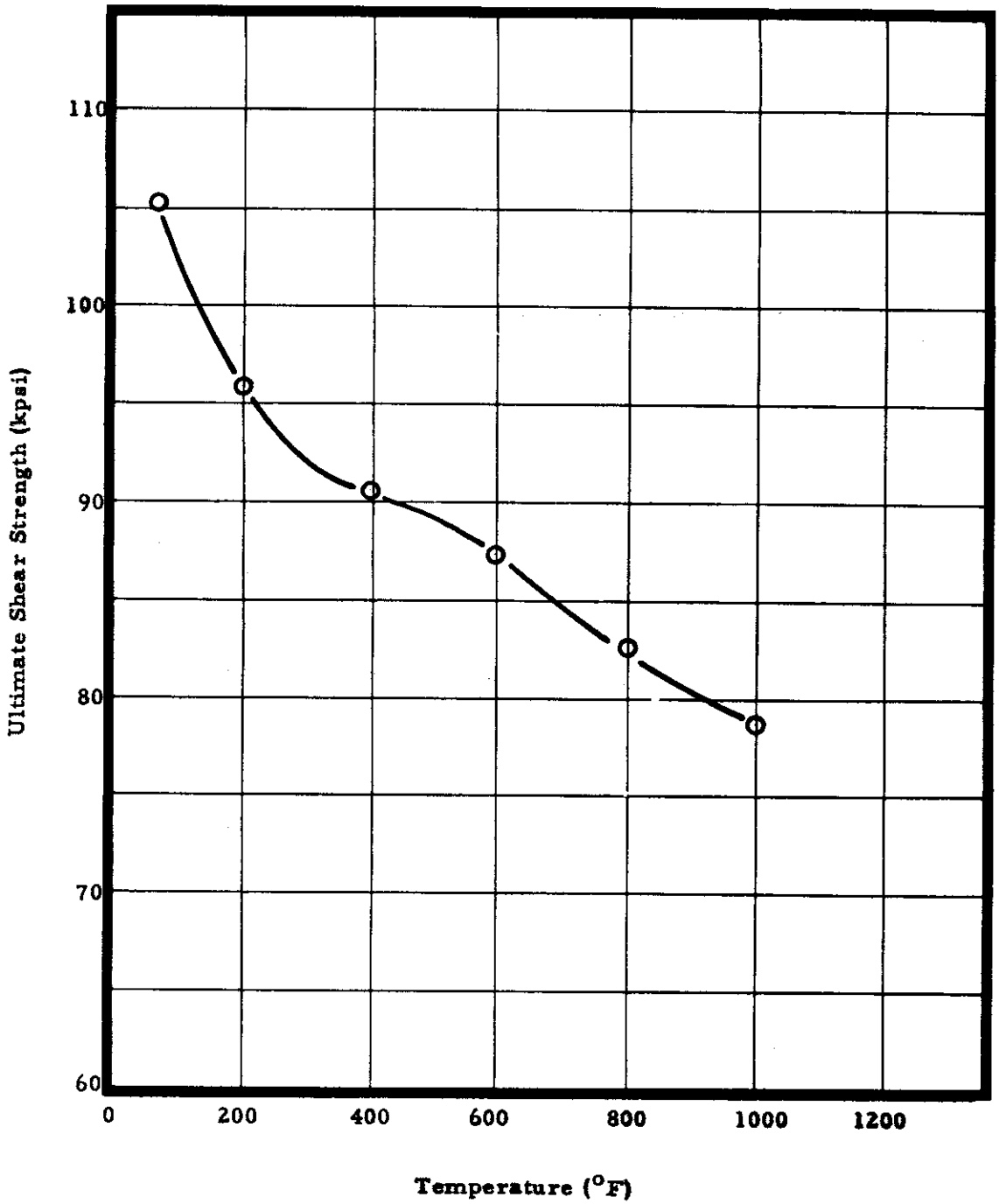


Figure 97. Shear Properties vs. Temperature, C135AMo, Heat 1

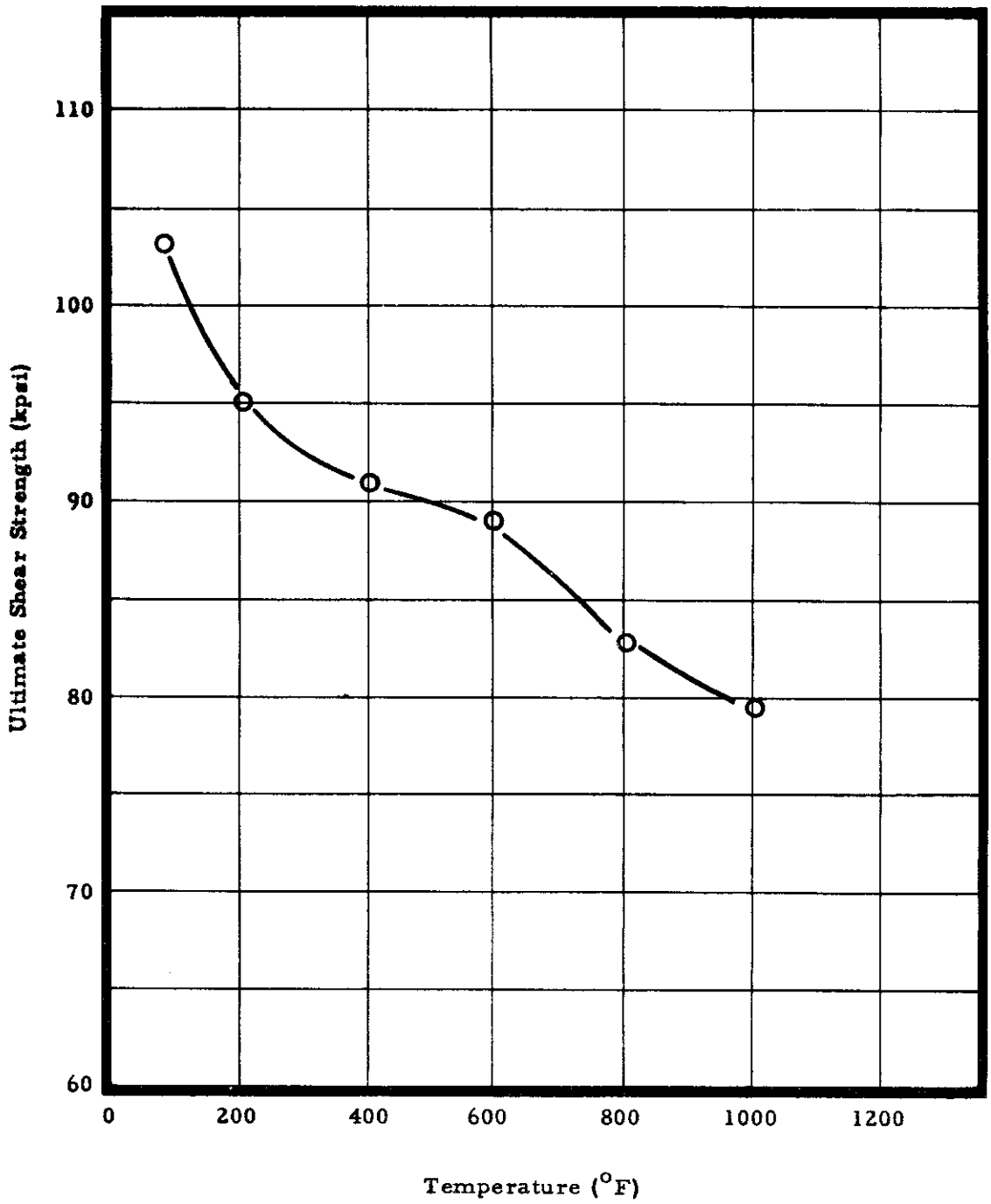


Figure 98. Shear Properties vs. Temperature, C135AMo, Heat 2

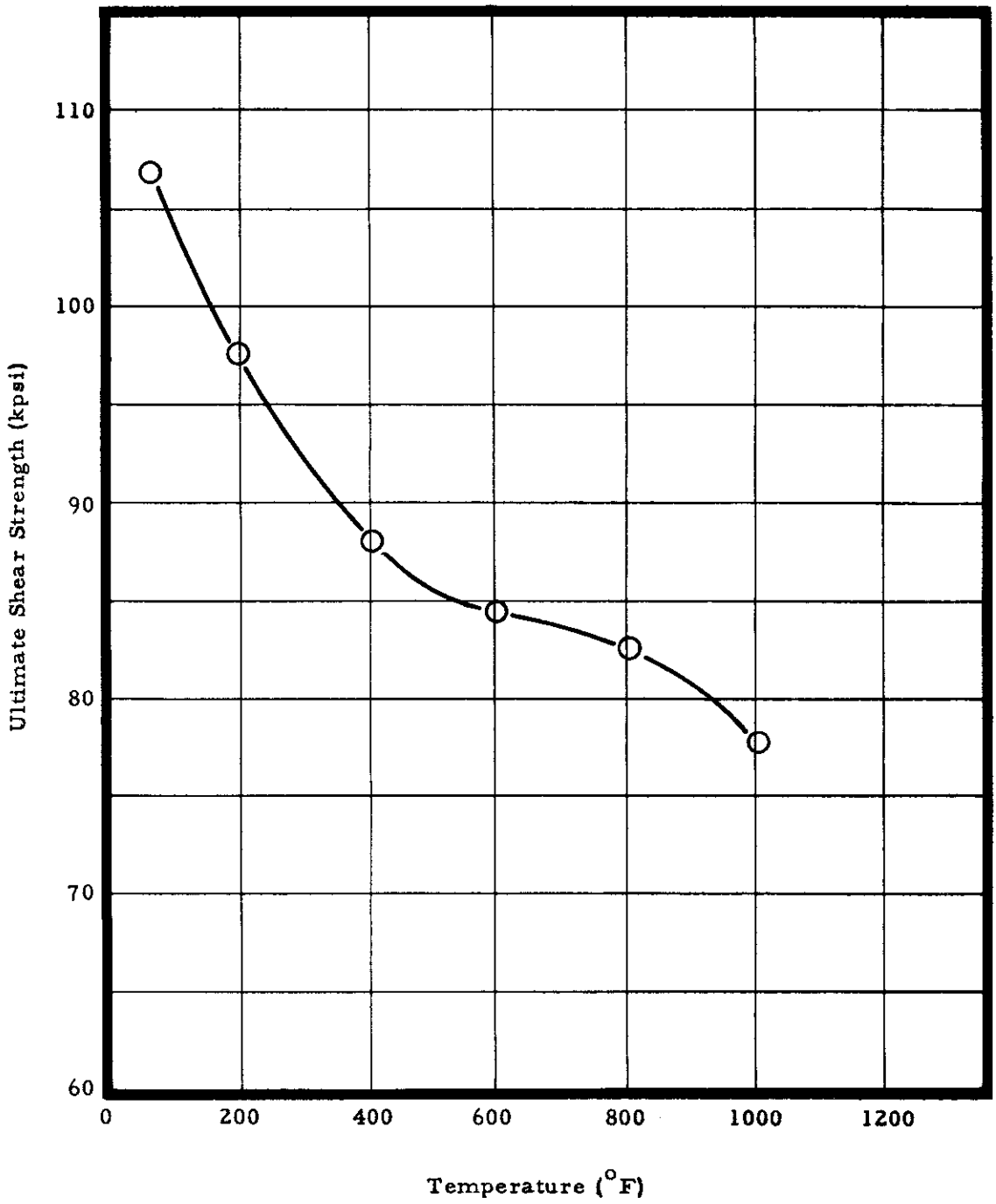


Figure 99. Shear Properties vs. Temperature, C135AMo, Heat 3

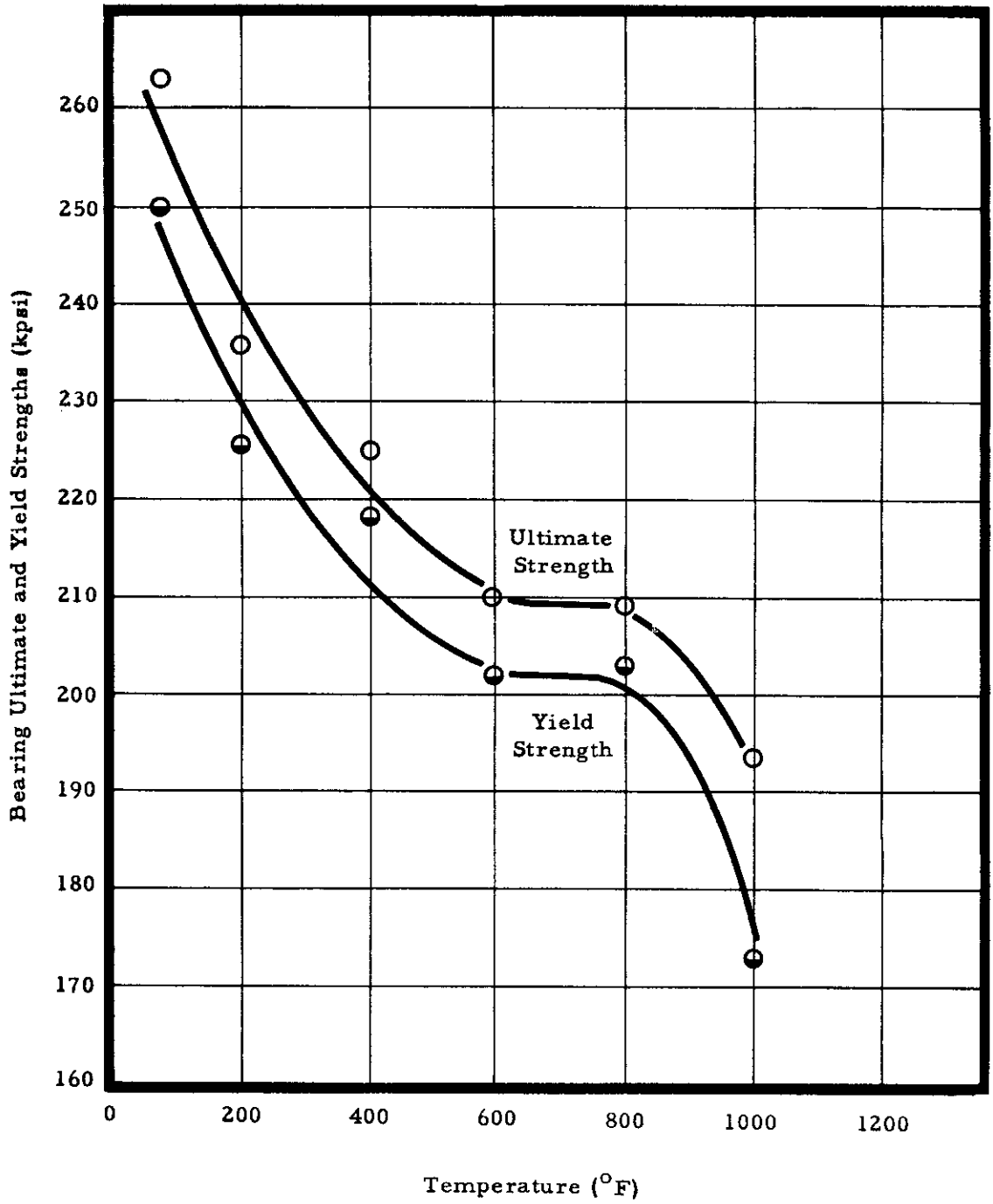


Figure 100. Bearing Properties vs. Temperature, e/D = 1.5, C135AMo, Heat 1

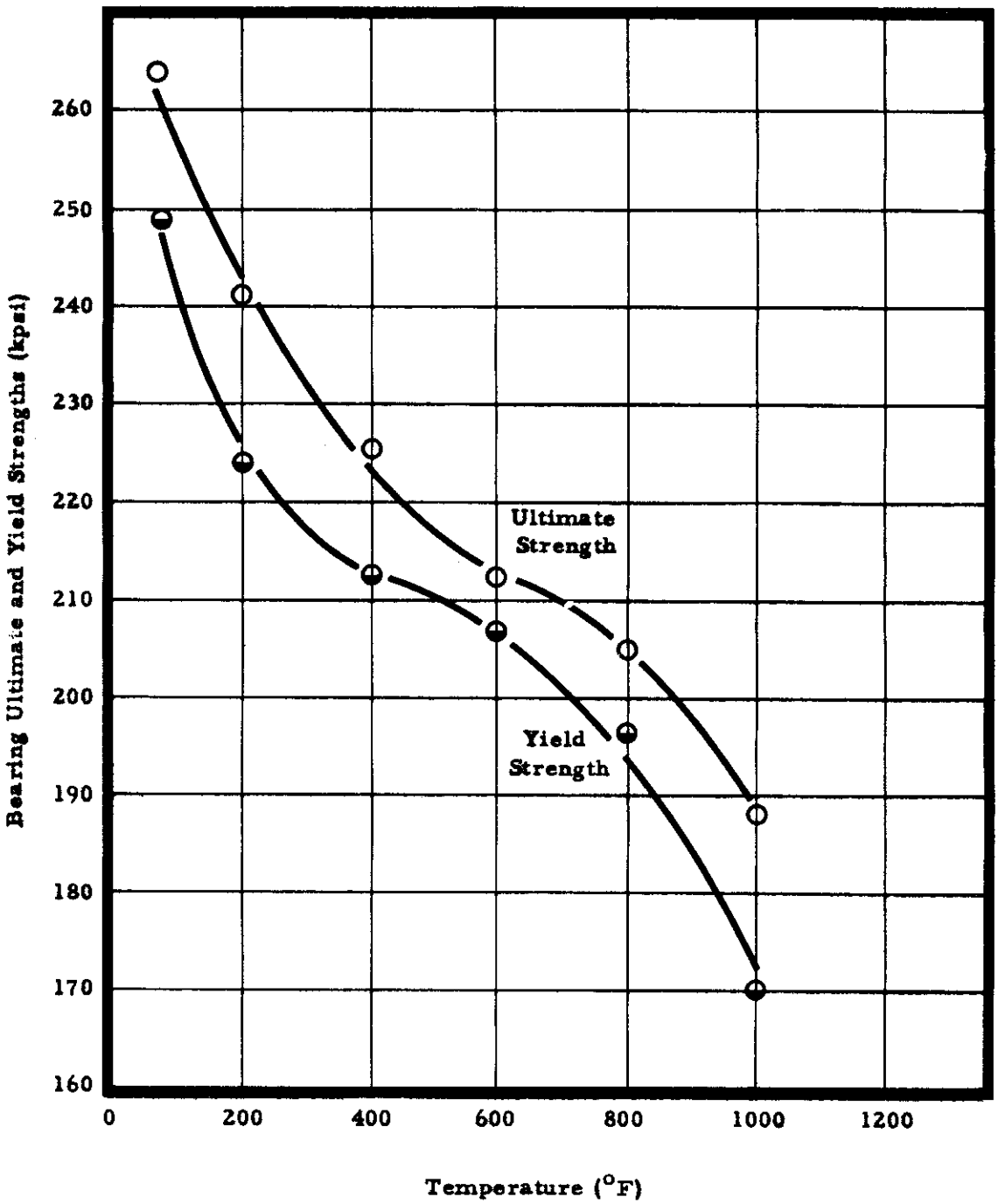


Figure 101. Bearing Properties vs. Temperature, e/D = 1.5, C135AMo, Heat 2

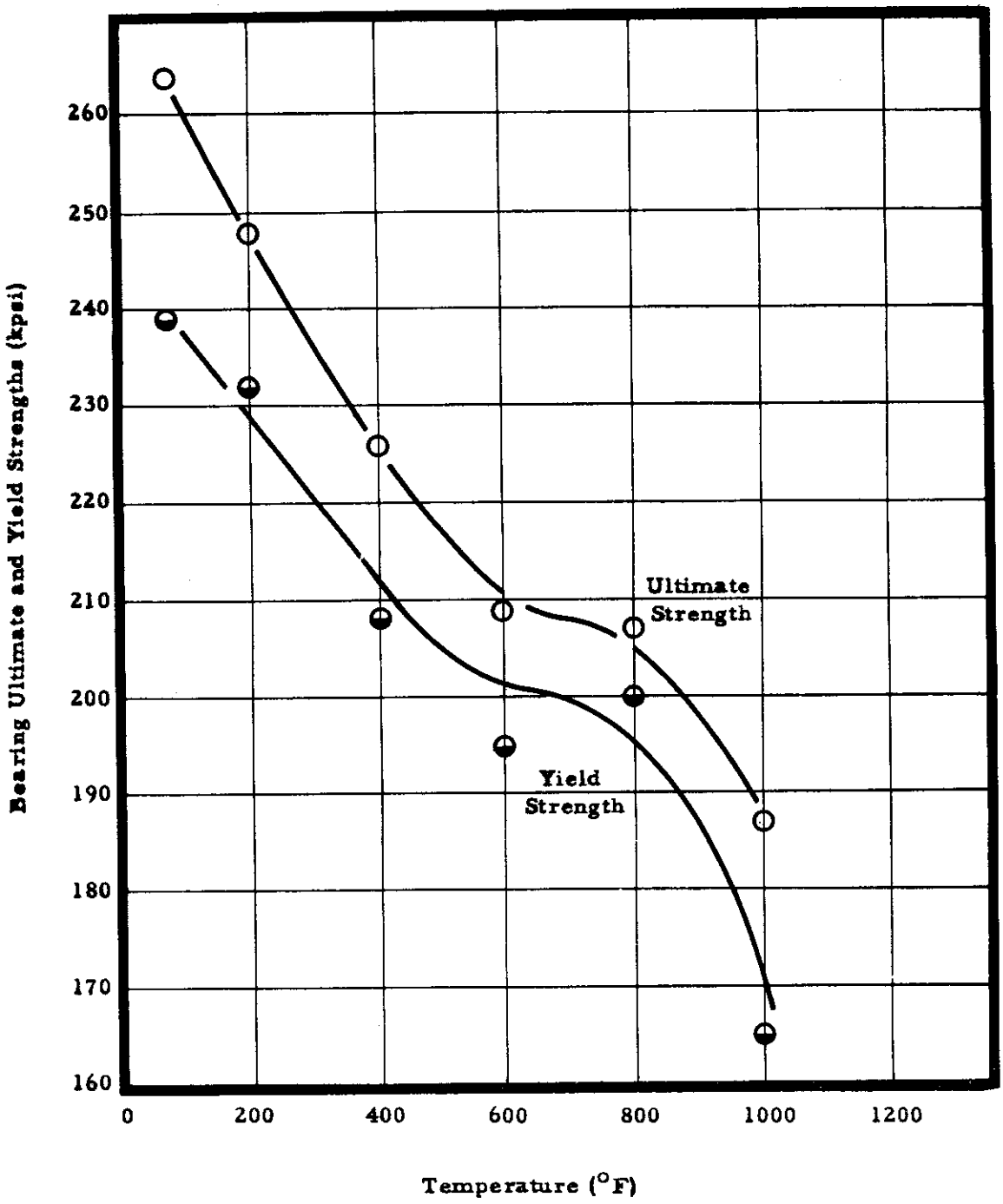


Figure 102. Bearing Properties vs. Temperature, e/D = 1.5, C135AMo, Heat 3

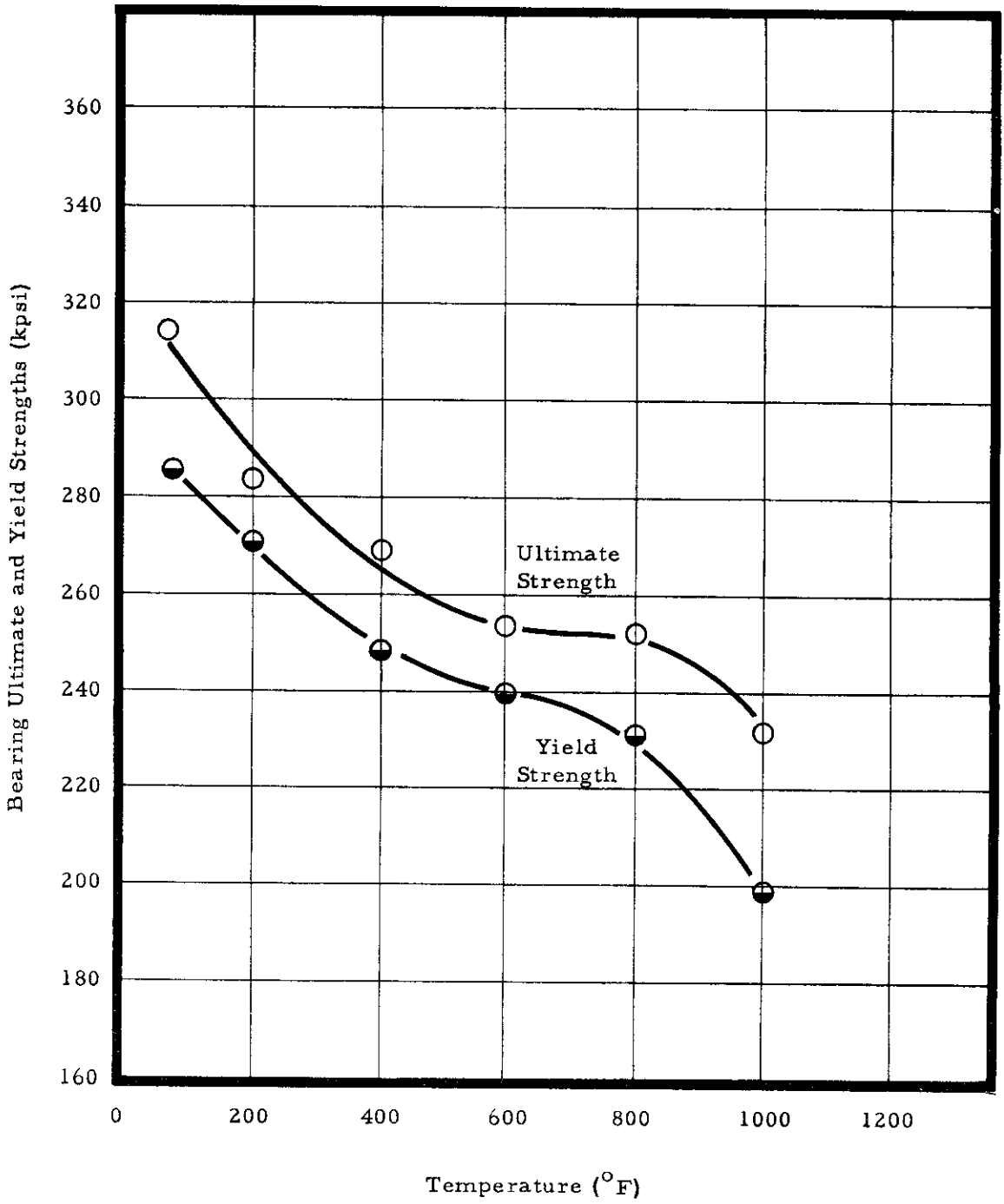


Figure 103. Bearing Properties vs. Temperature, e/D = 2.0, C135AMo, Heat 1

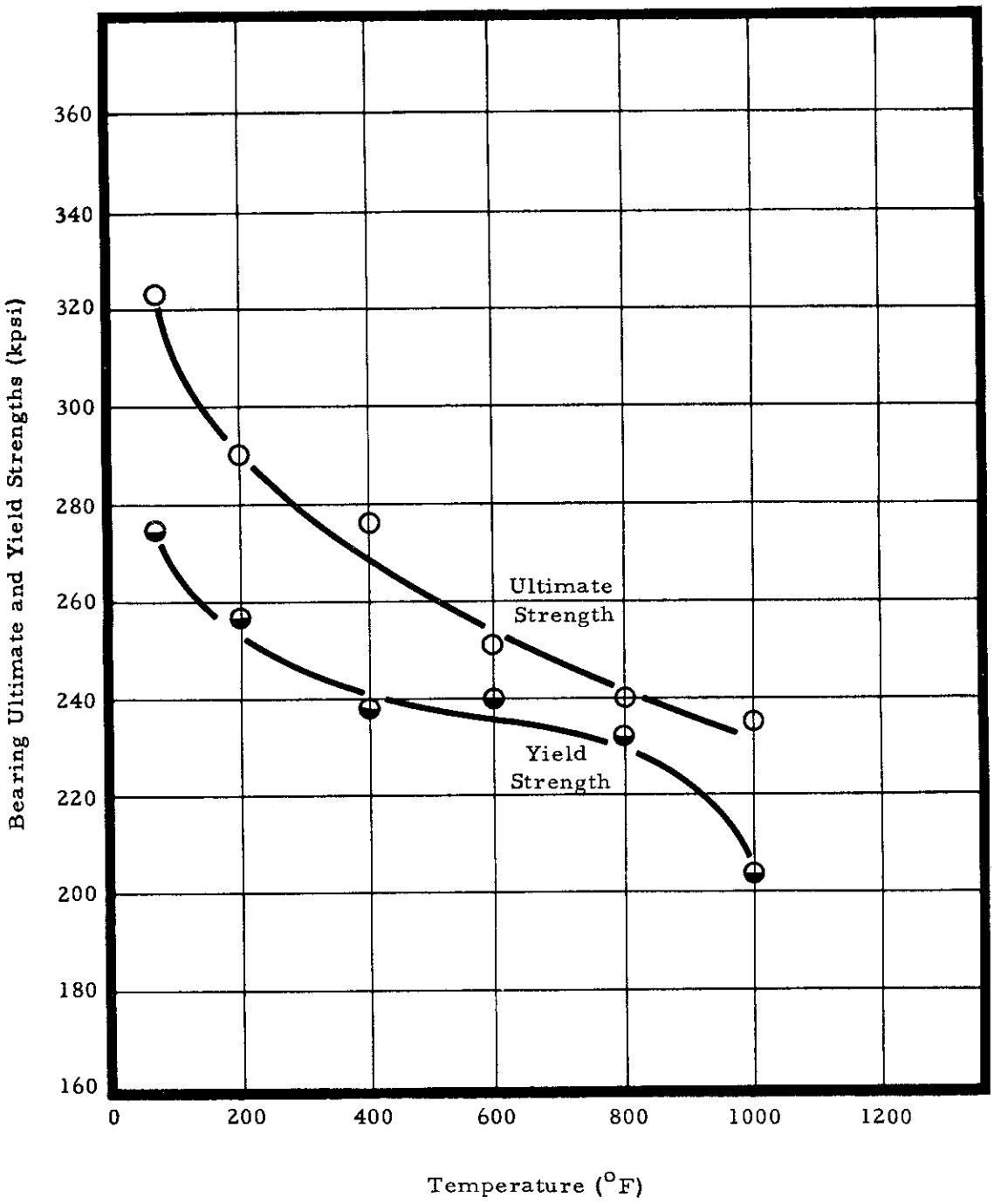


Figure 104. Bearing Properties vs. Temperature, e/D = 2.0, C135AMo, Heat 2

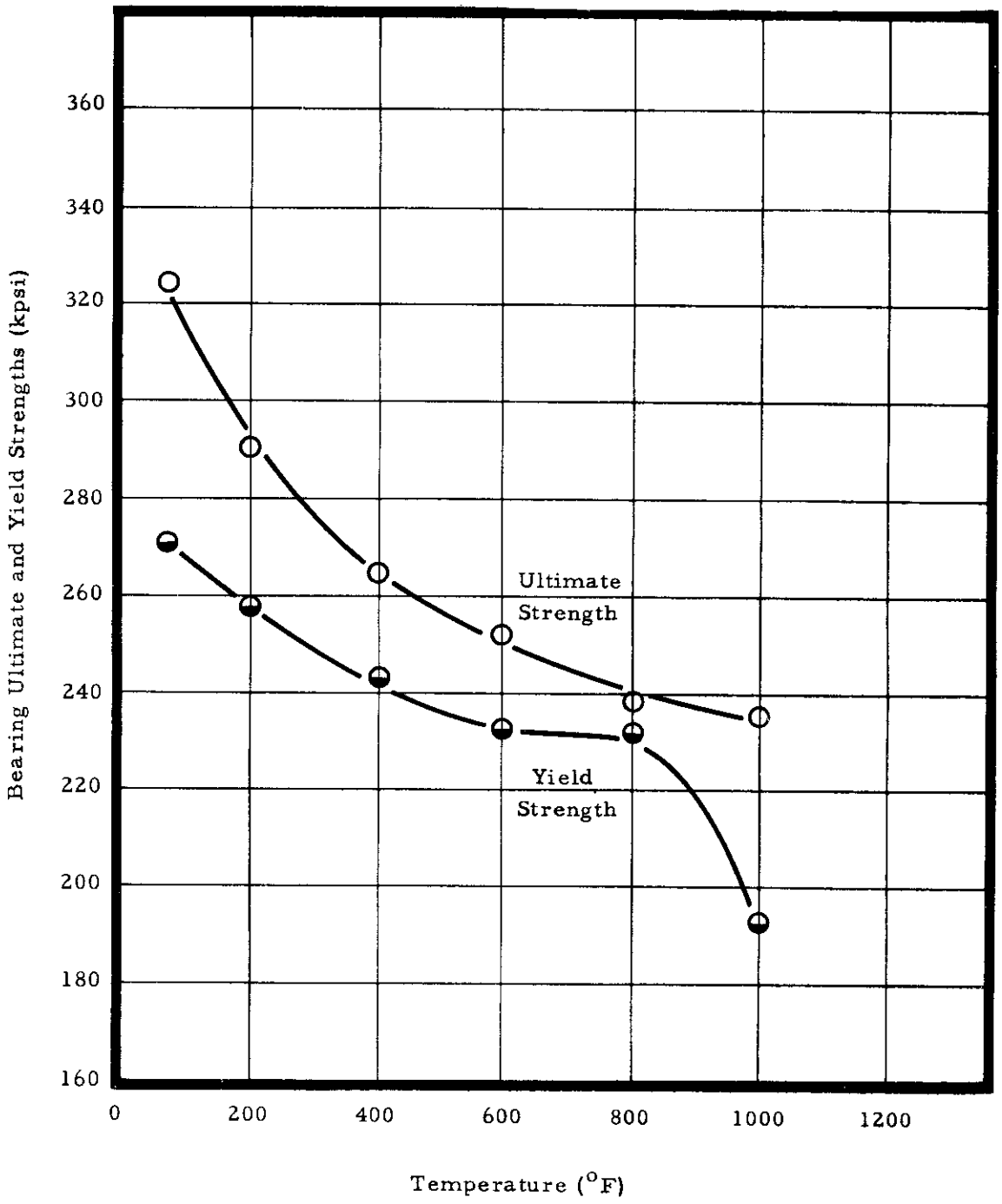


Figure 105. Bearing Properties vs. Temperature, e/D = 2.0, C135AMo, Heat 3

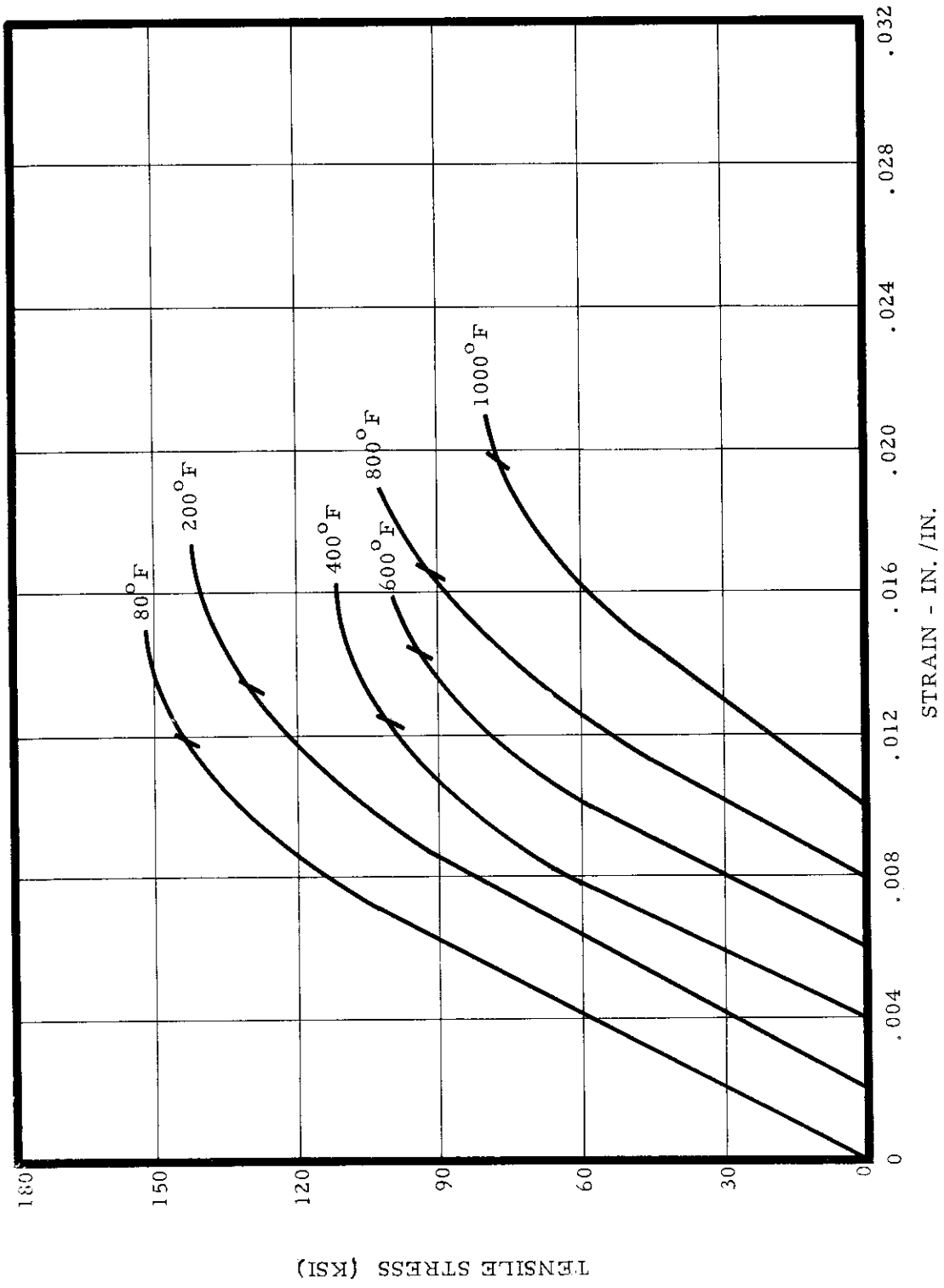


Figure 106. Tensile Stress-Strain Curves, C135AMo, Heat 1

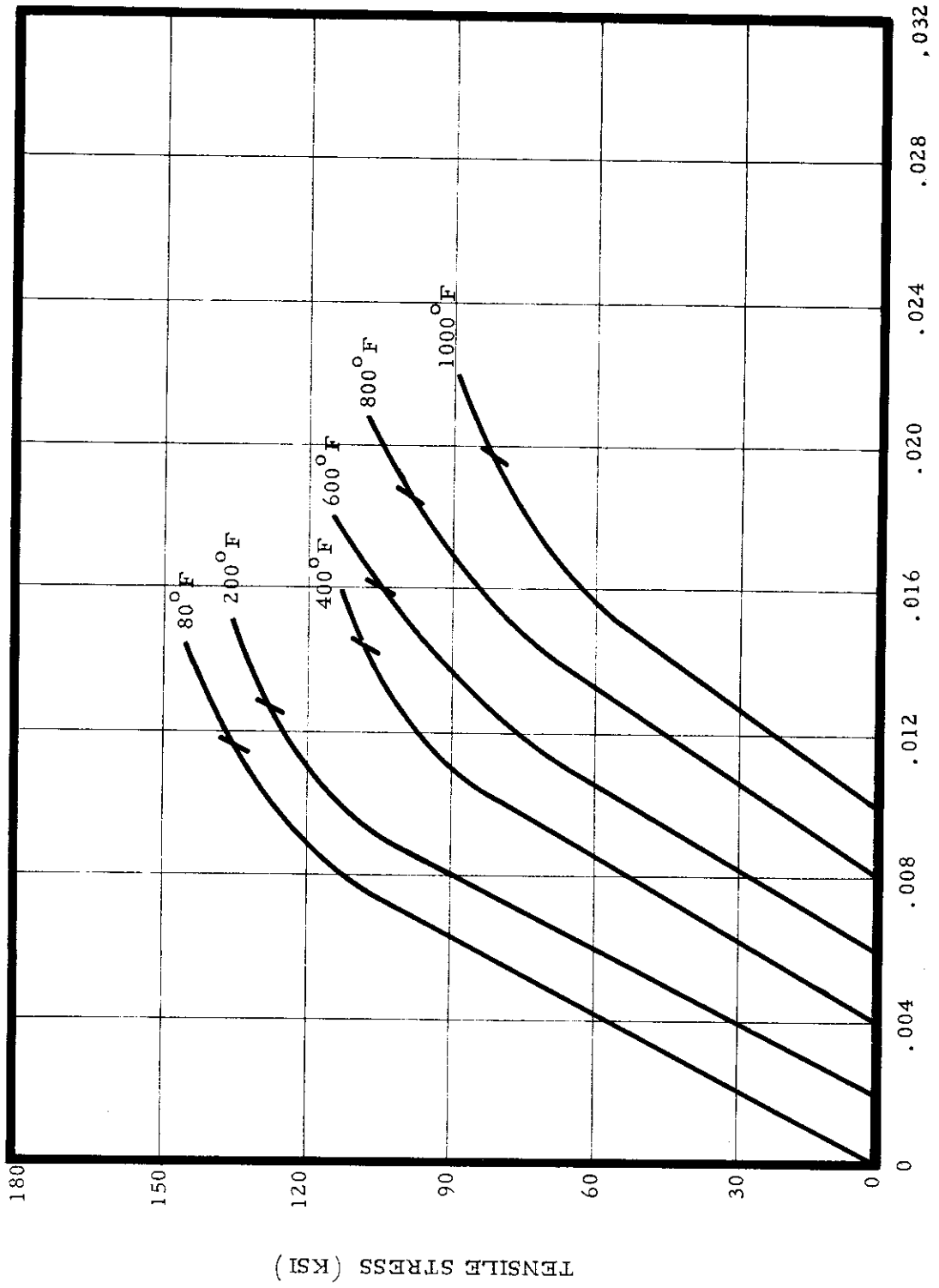


Figure 107. Tensile Stress-Strain Curves, C135AMo, Heat 2

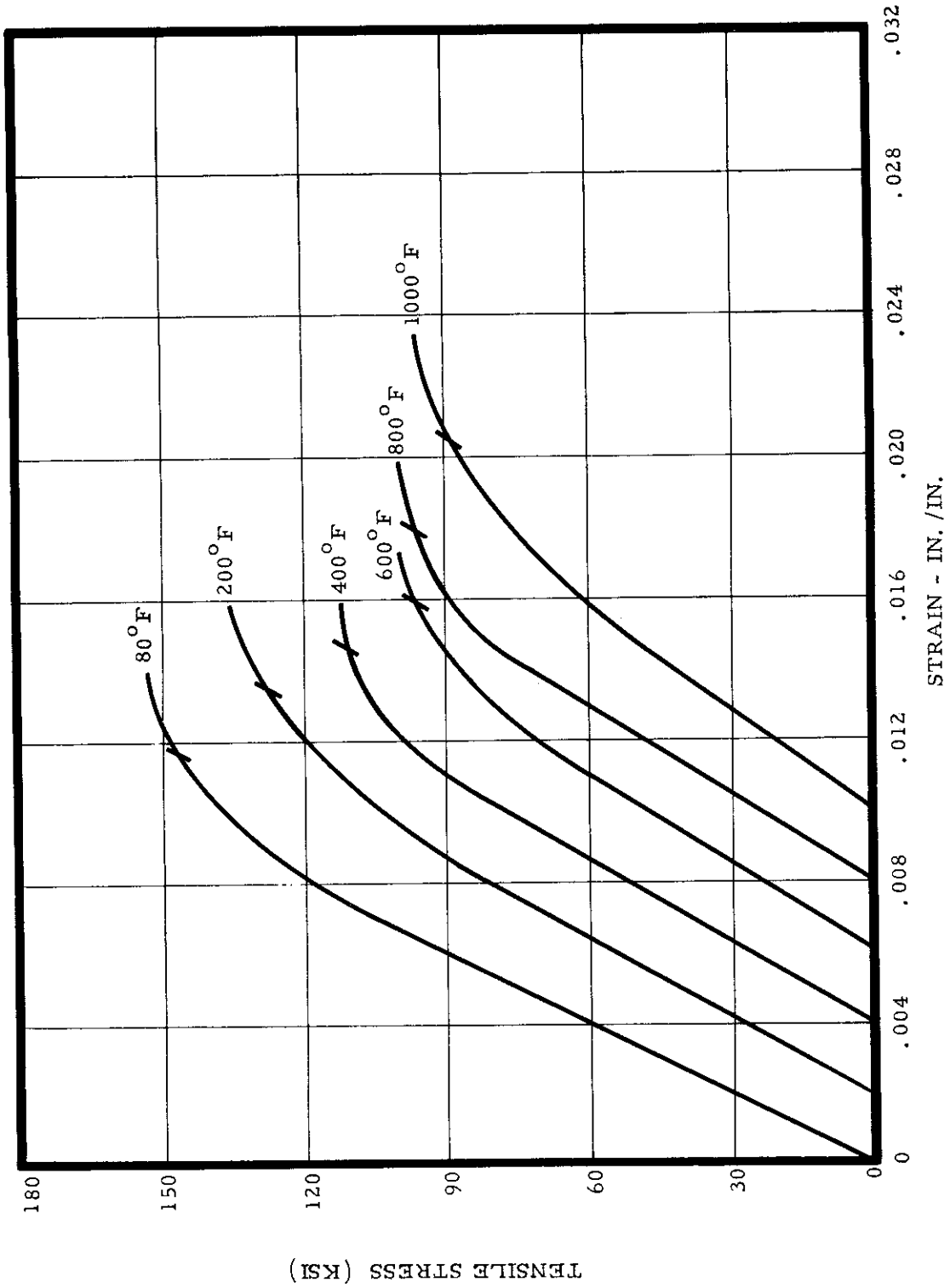


Figure 108. Tensile Stress-Strain Curves, C135AMo, Heat 3

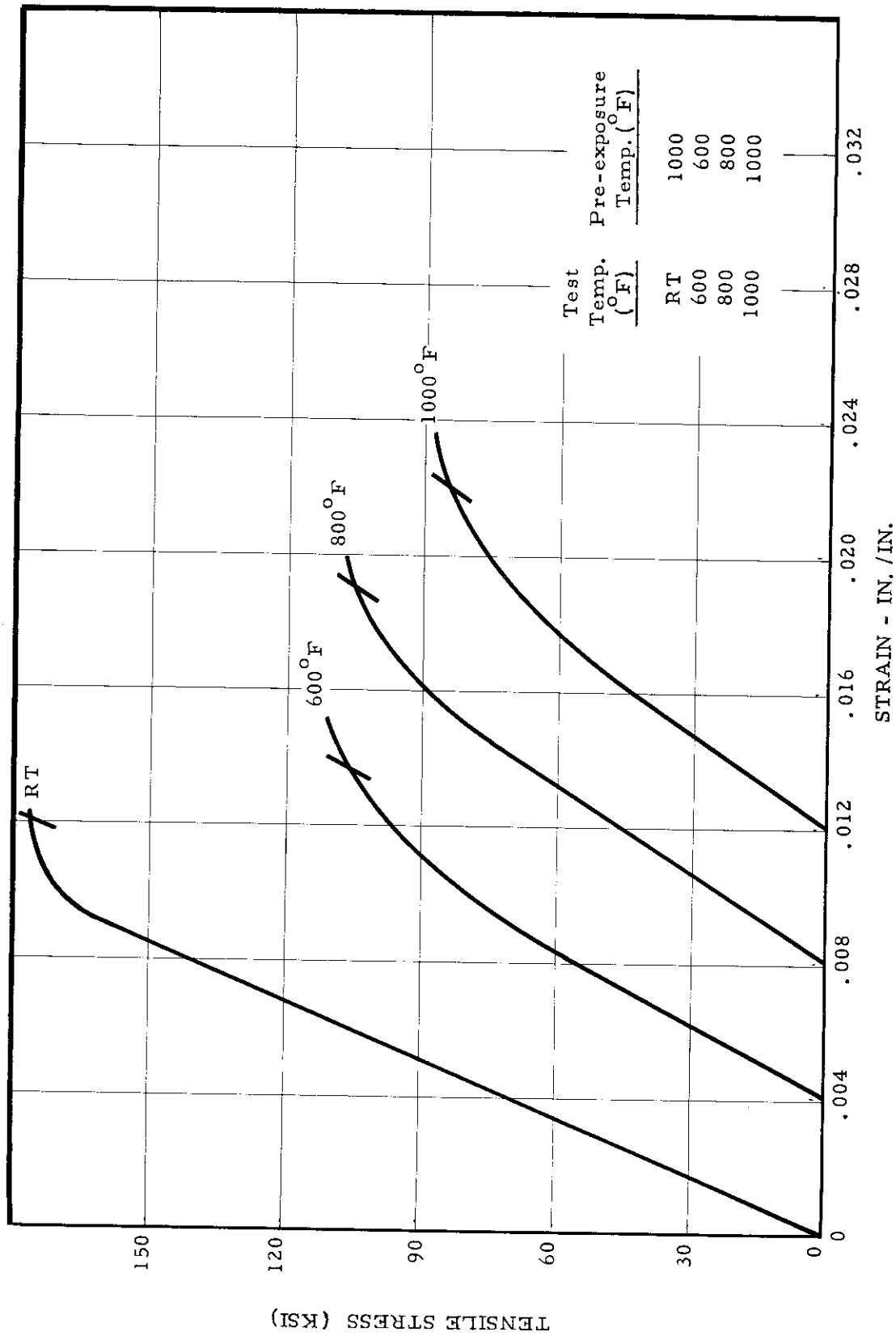


Figure 109. Nonstressed Stability Curves, C135AMo, Heat 1

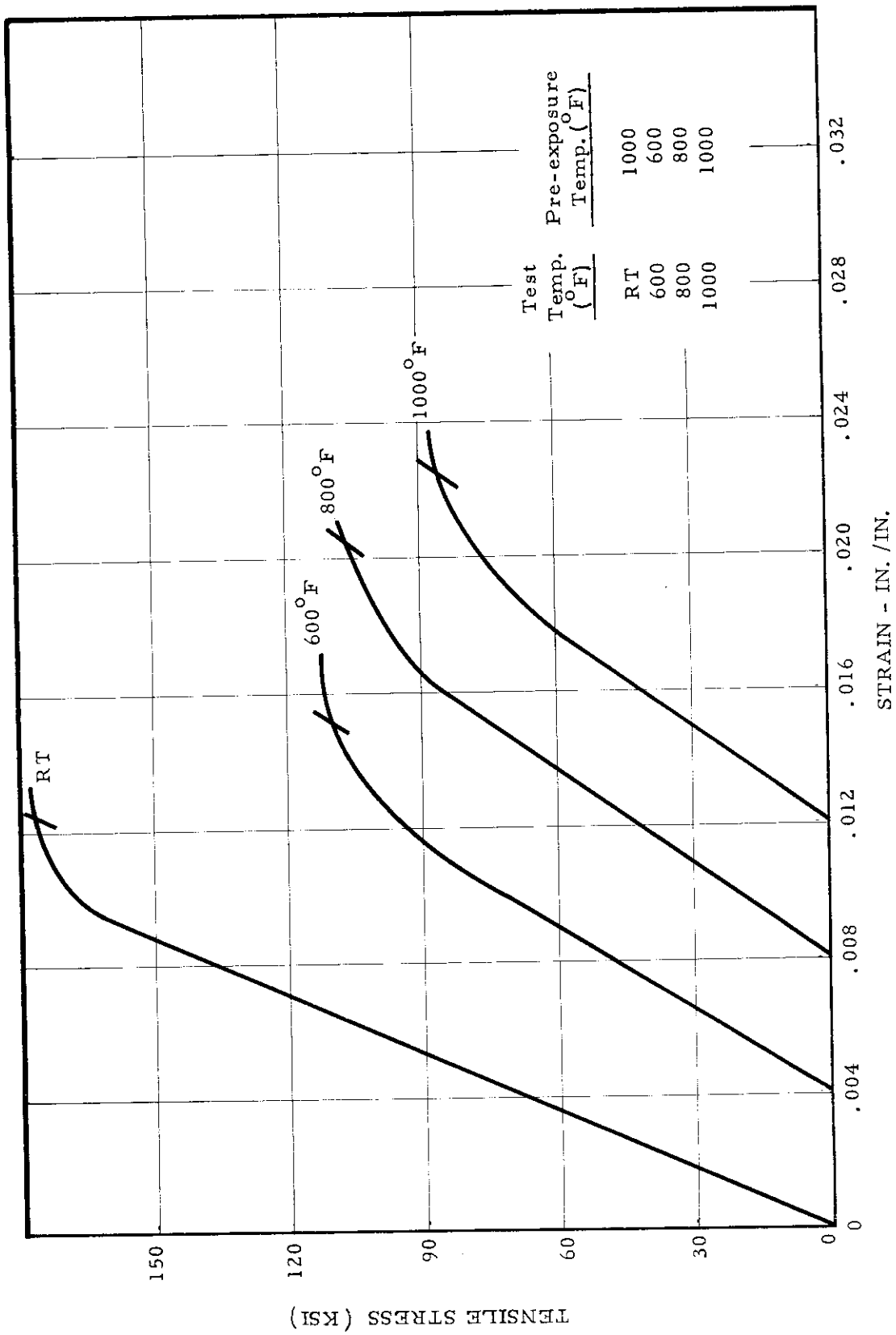


Figure 110. Nonstressed Stability Curves, C135AMo, Heat 2

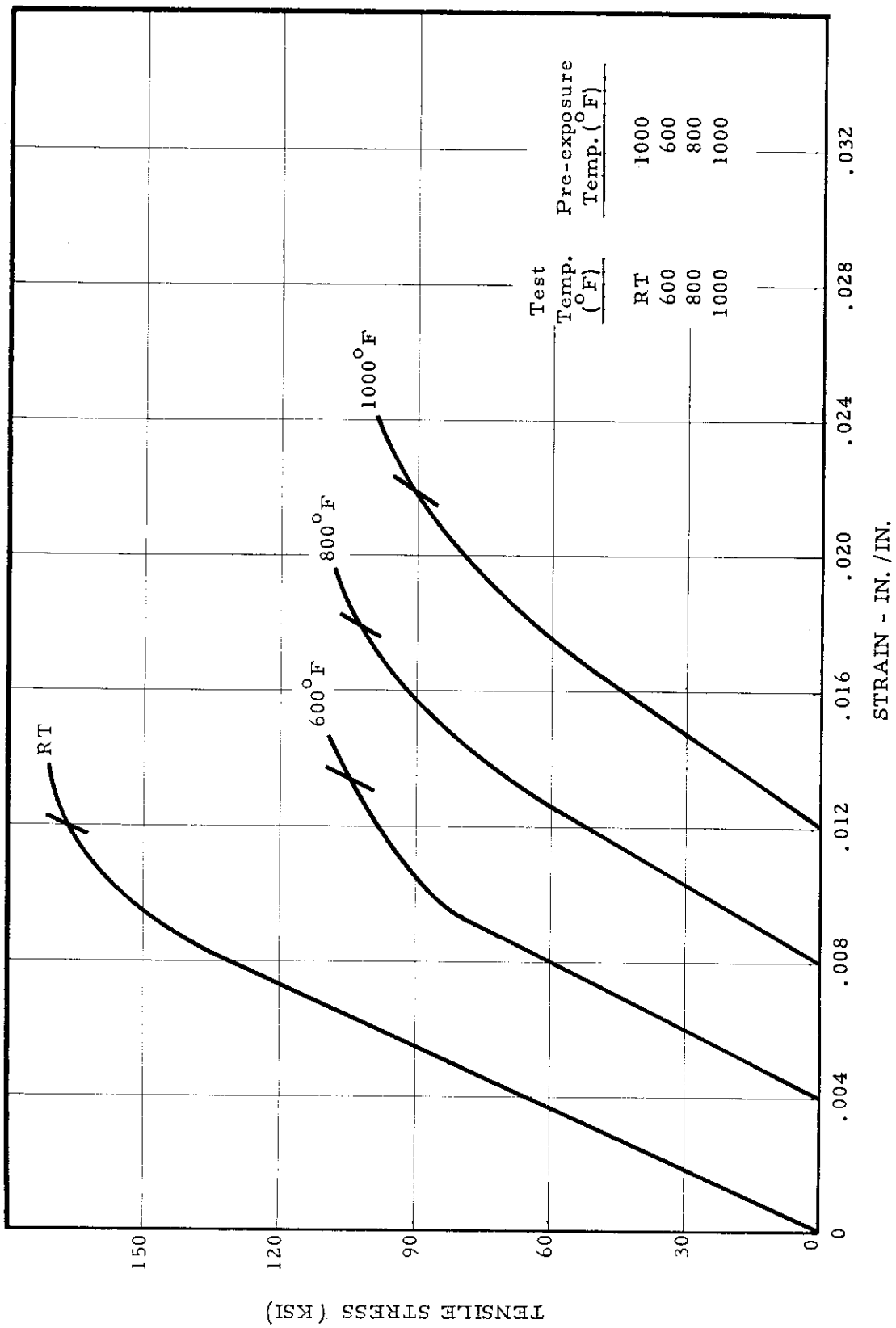


Figure 111. Nonstressed Stability Curves, C135AMo, Heat 3

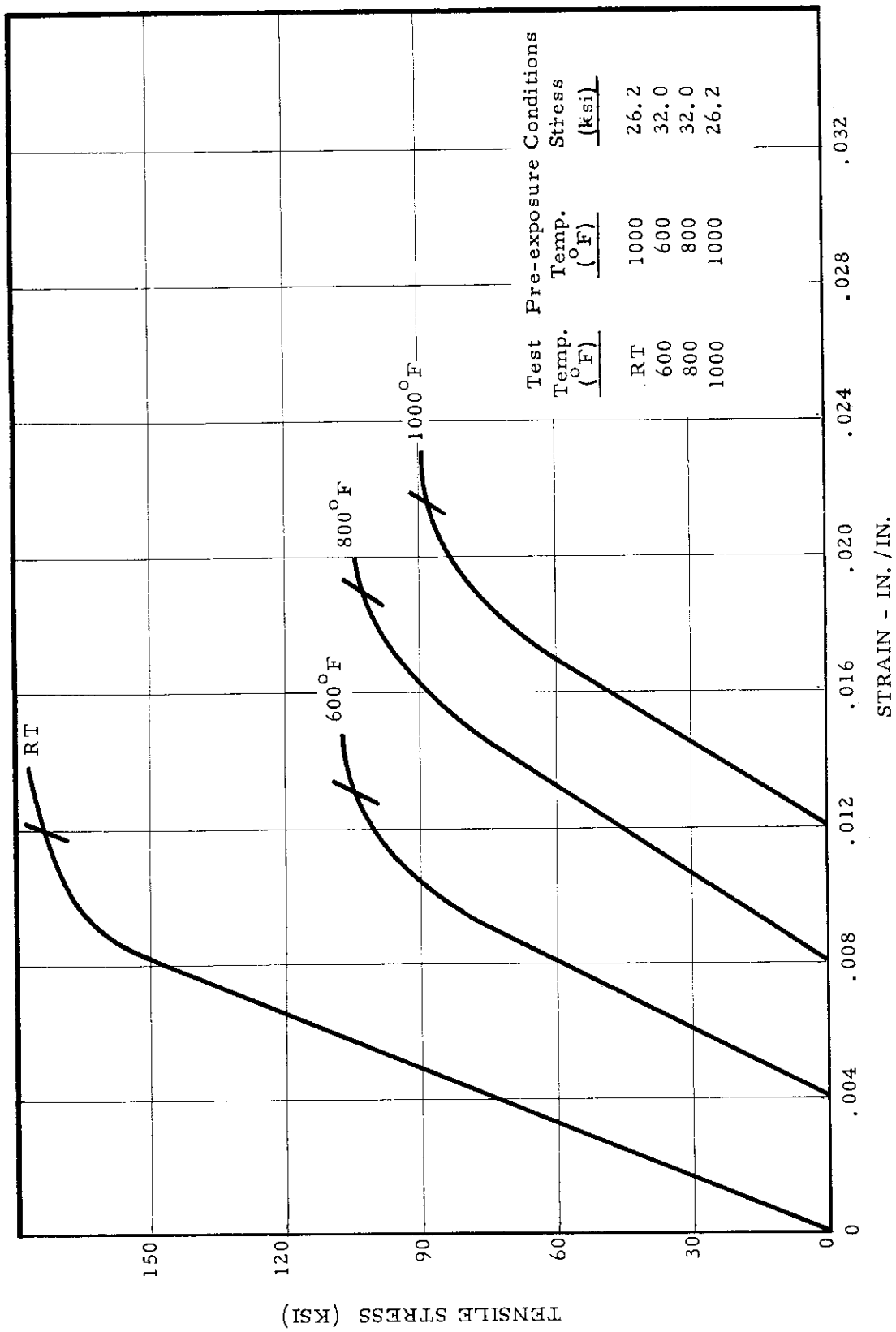


Figure 112. Stressed Stability Curves, C135AMo, Heat 1

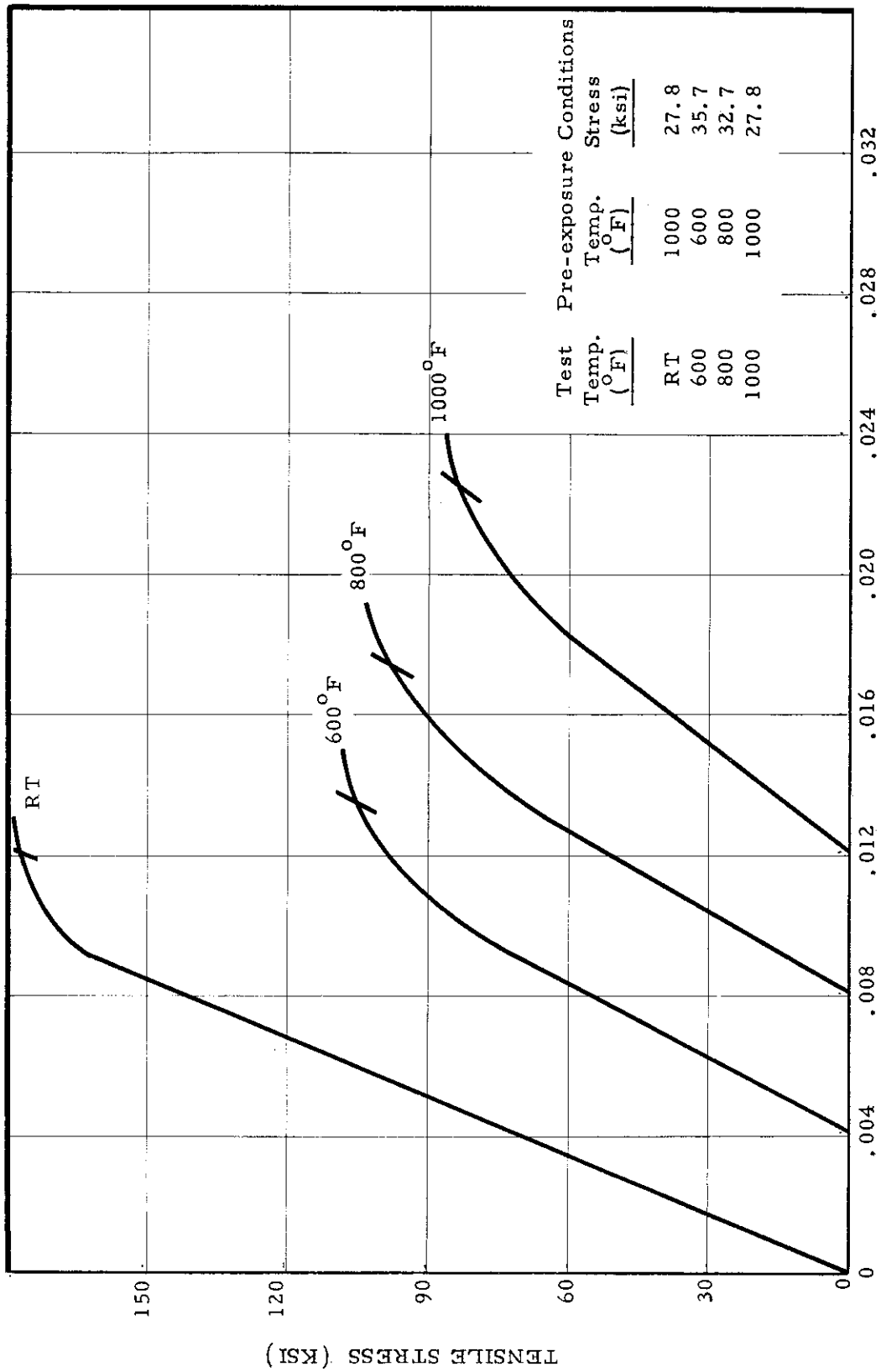


Figure 113. Stressed Stability Curves, C135AMo, Heat 2

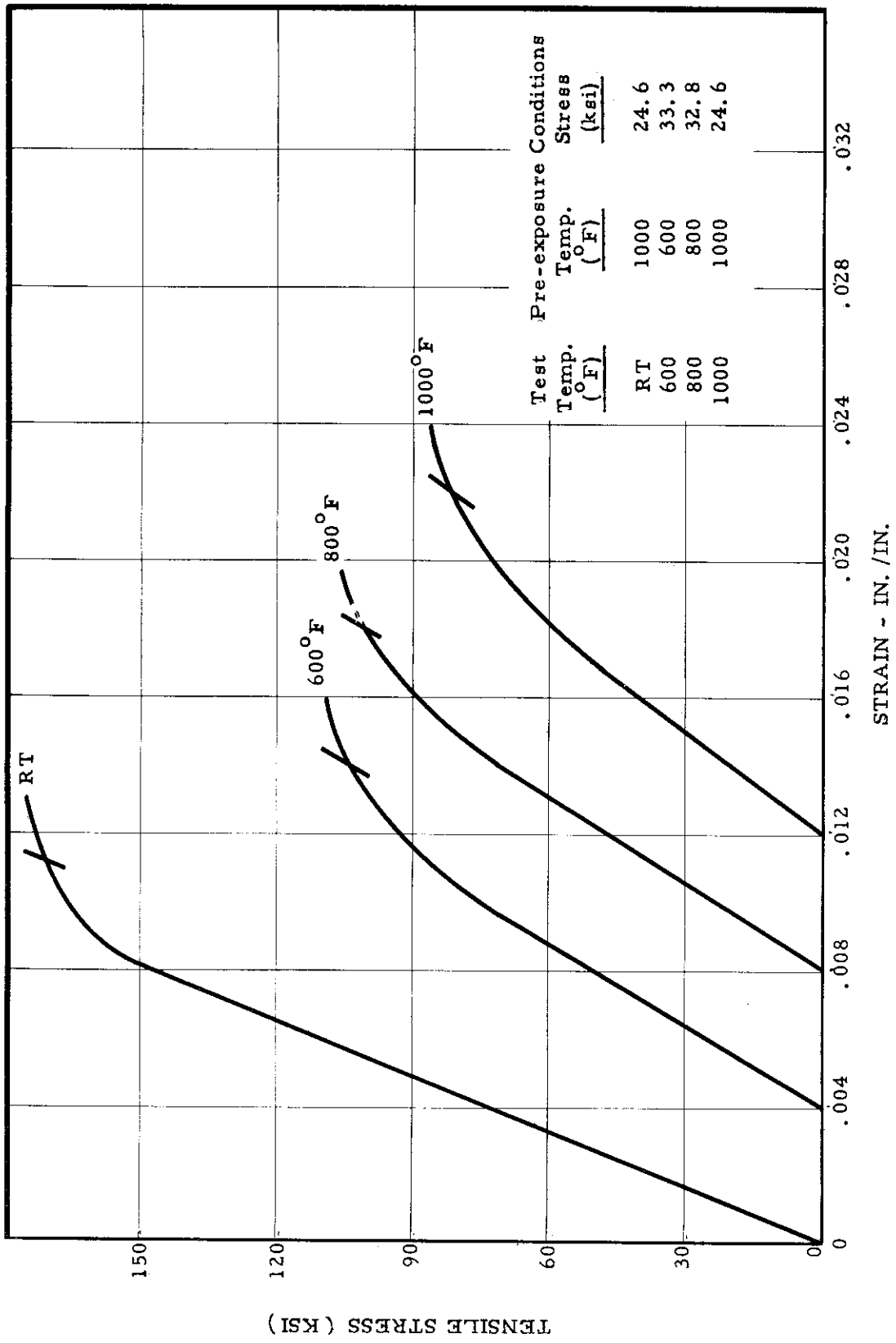


Figure 114. Stressed Stability Curves, C135AMo, Heat 3

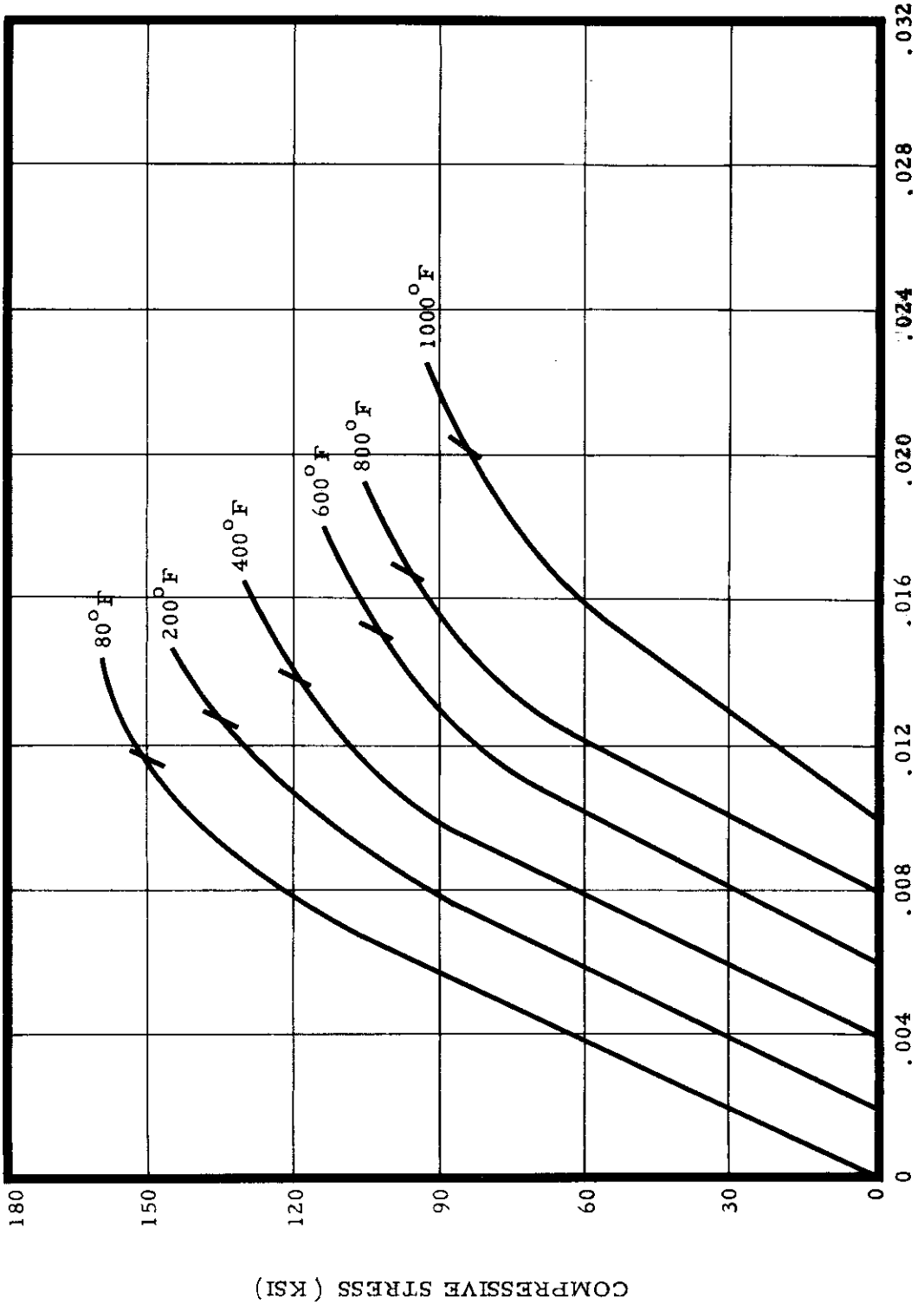


Figure 115. Compressive Stress-Strain Curves, C135AMo, Heat 1

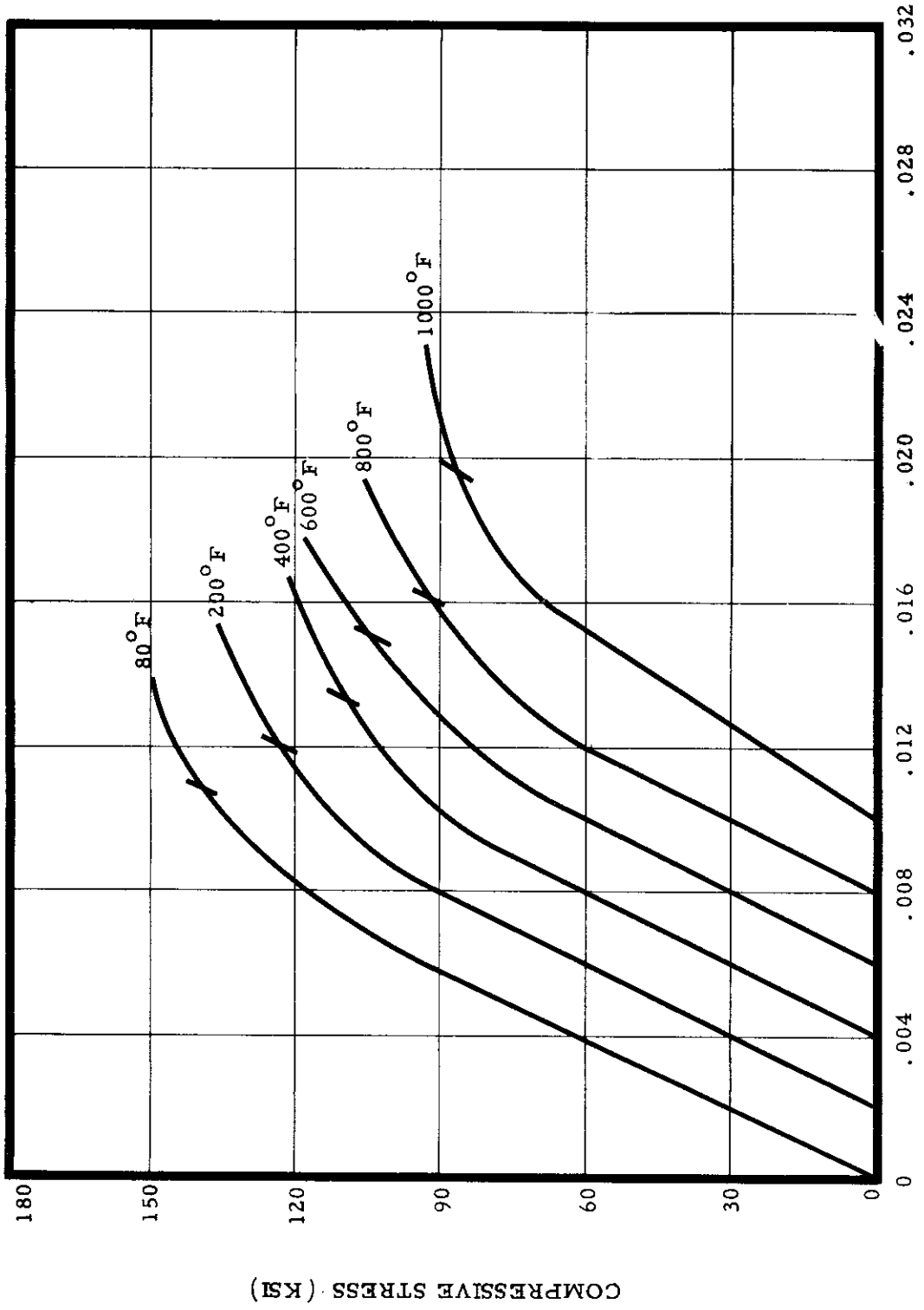


Figure 116. Compressive Stress-Strain Curves, C135AMo, Heat 2

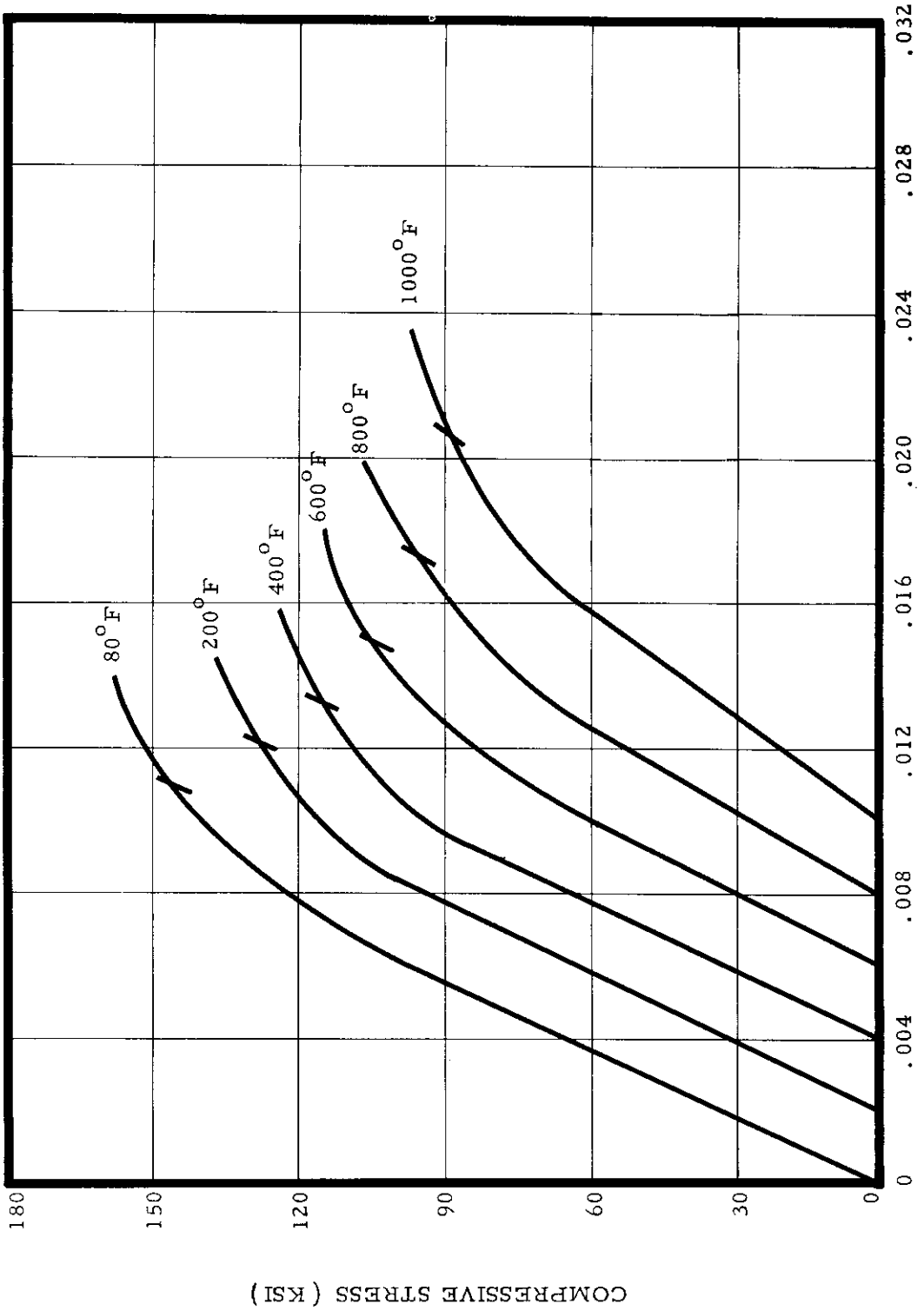


Figure 117. Compressive Stress-Strain Curves, C135AMo, Heat 3

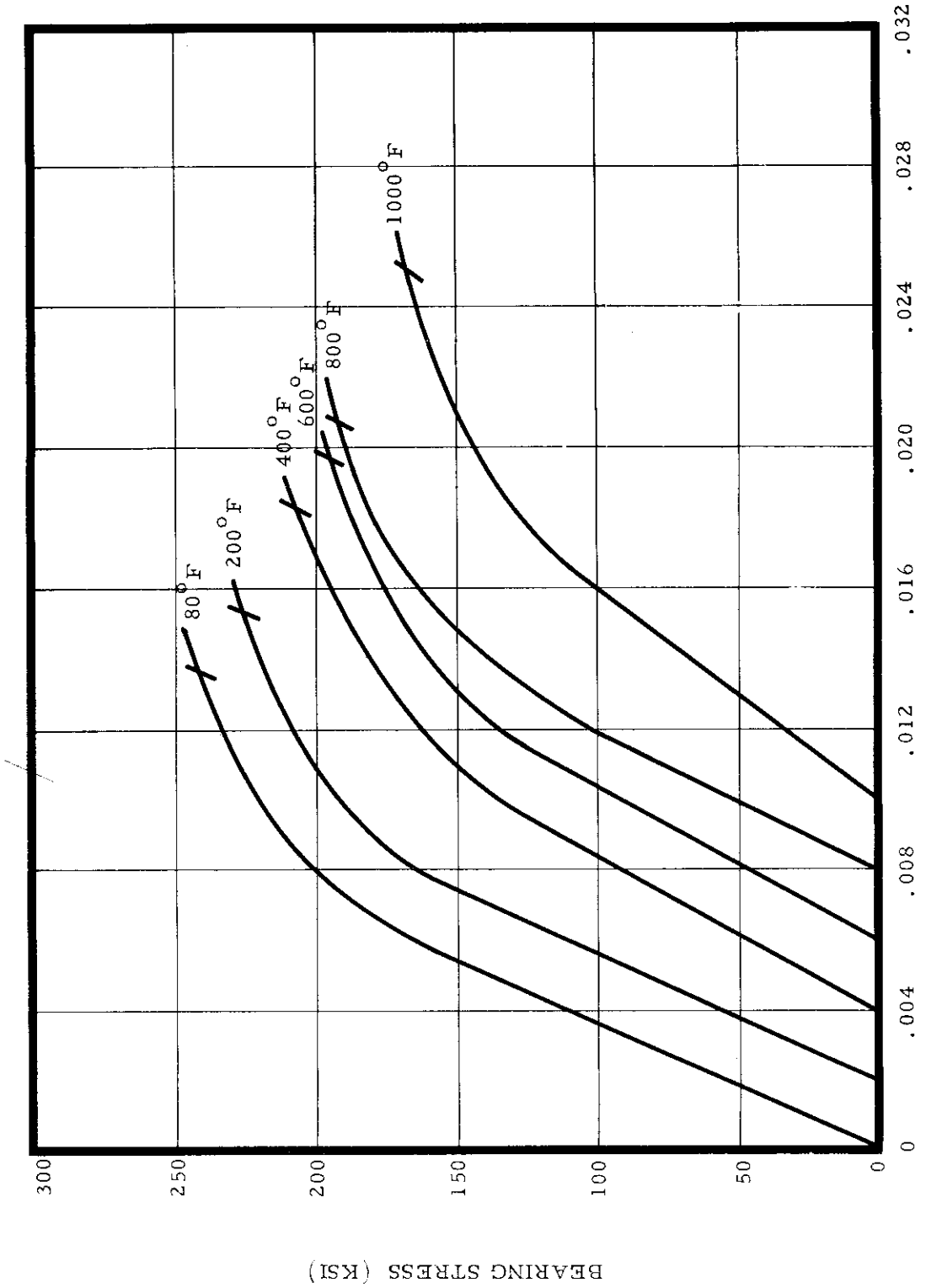


Figure 118. Bearing (e/D = 1.5) Stress-Deformation Curves, C135AMo, Heat 1

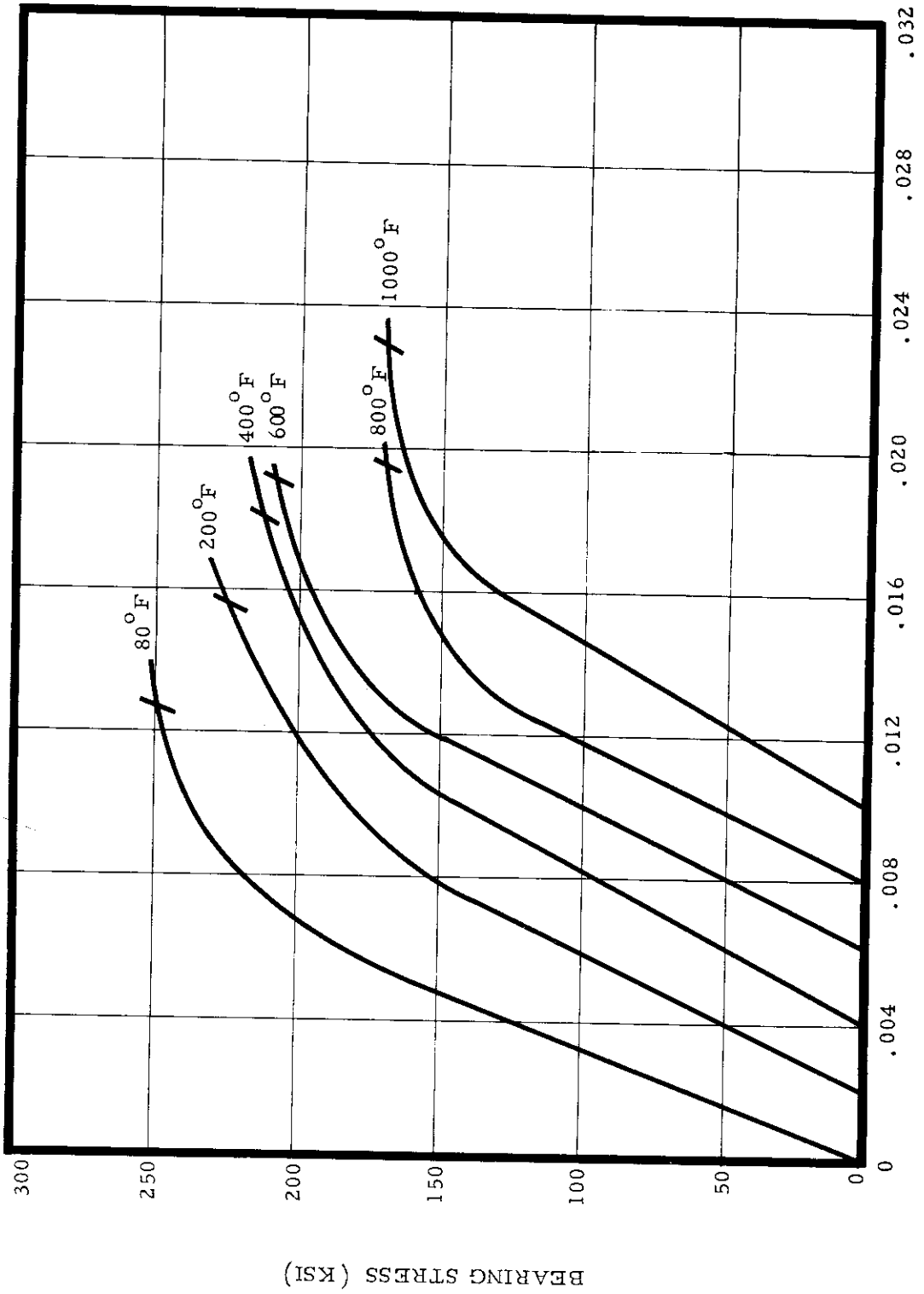


Figure 119. Bearing (e/D = 1.5) Stress-Deformation Curves, C135AMo, Heat 2

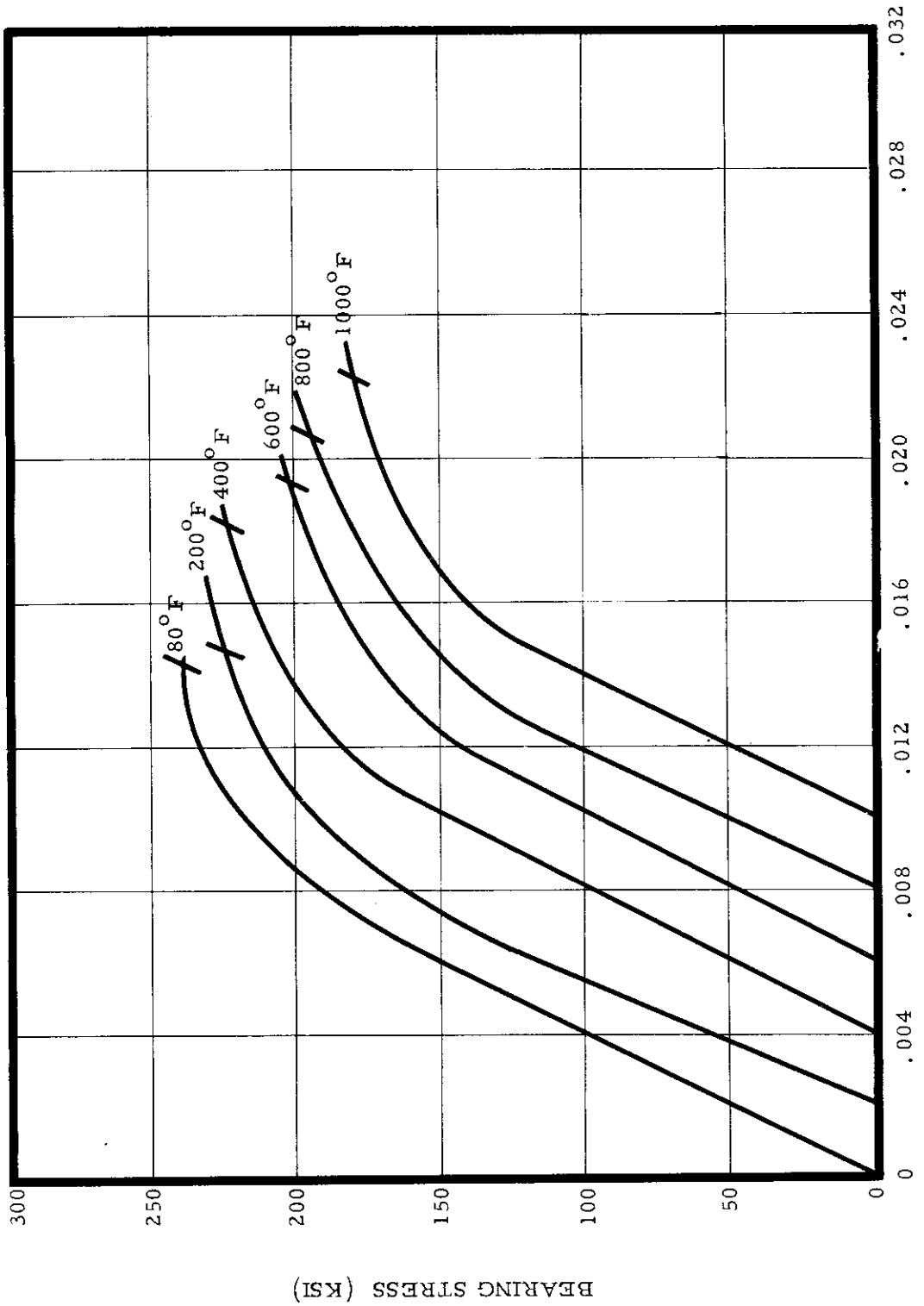


Figure 120. Bearing (e/D = 1.5) Stress-Deformation Curves, C135AMo, Heat 3

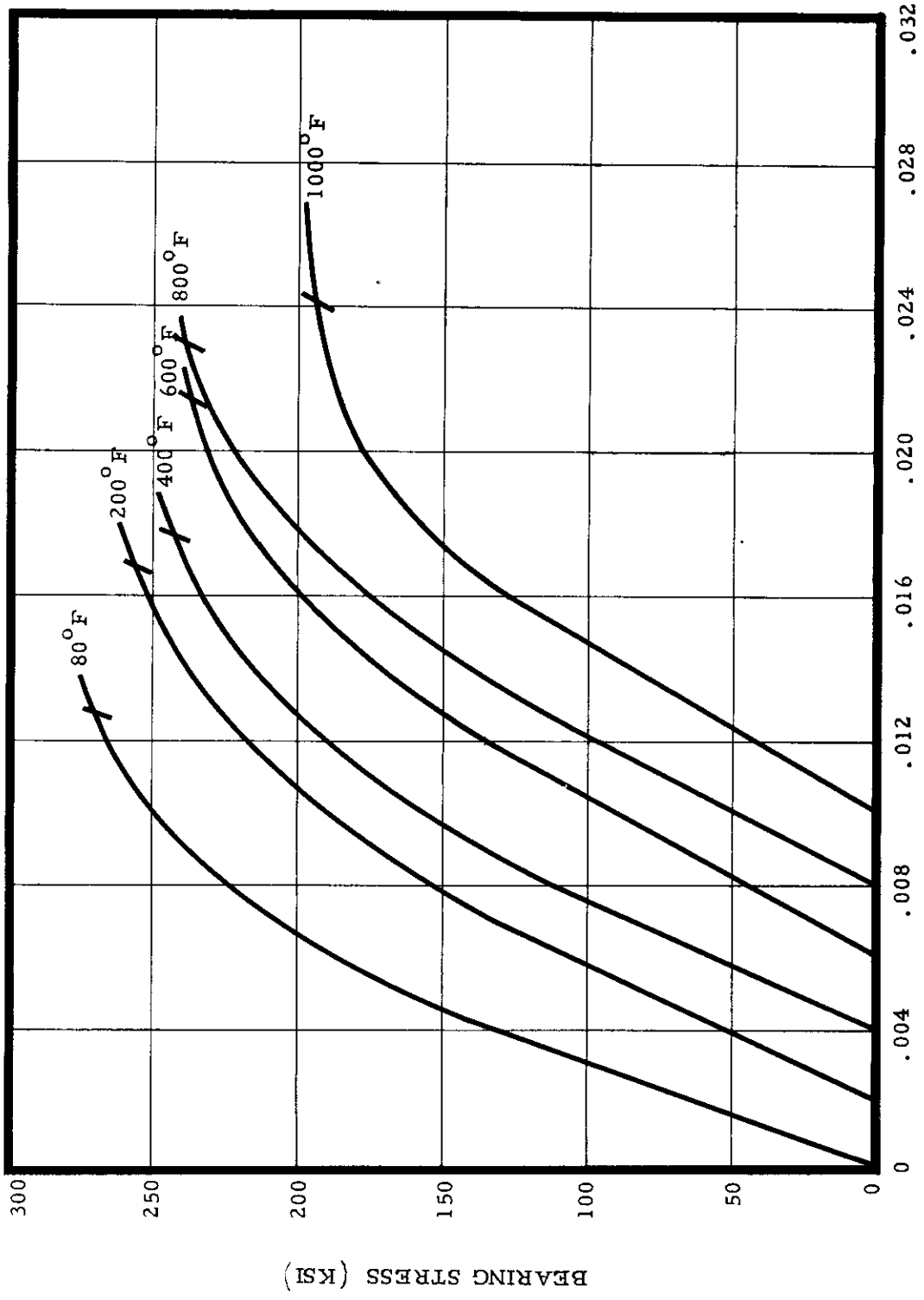


Figure 121. Bearing (e/D = 2.0) Stress-Deformation Curves, C135AMo, Heat 1

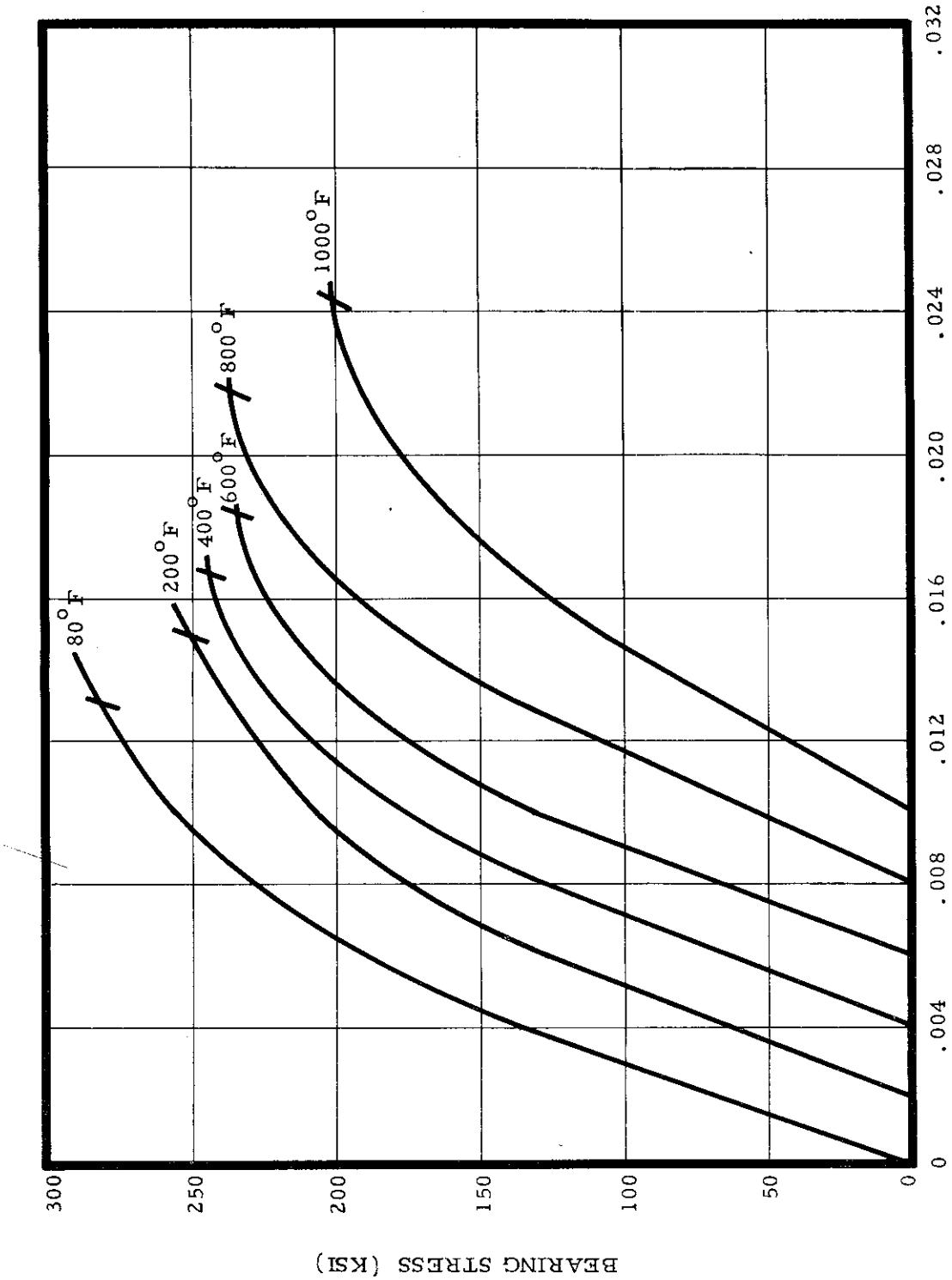


Figure 122. Bearing (e/D = 2.0) Stress-Deformation Curves, C135AMo, Heat 2

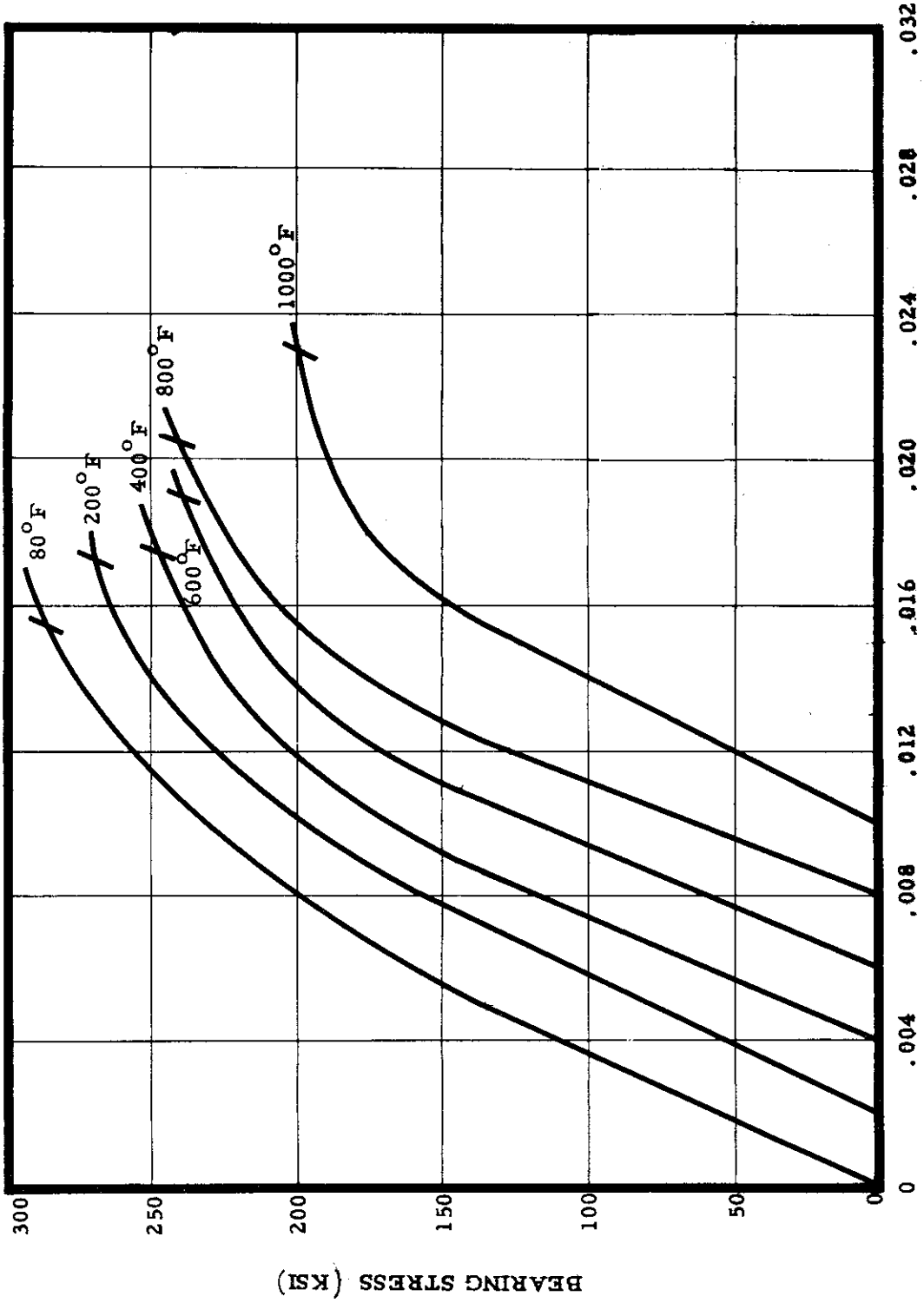


Figure 123. Bearing (e/D = 2.0) Stress-Deformation Curves, C135AMo, Heat 3

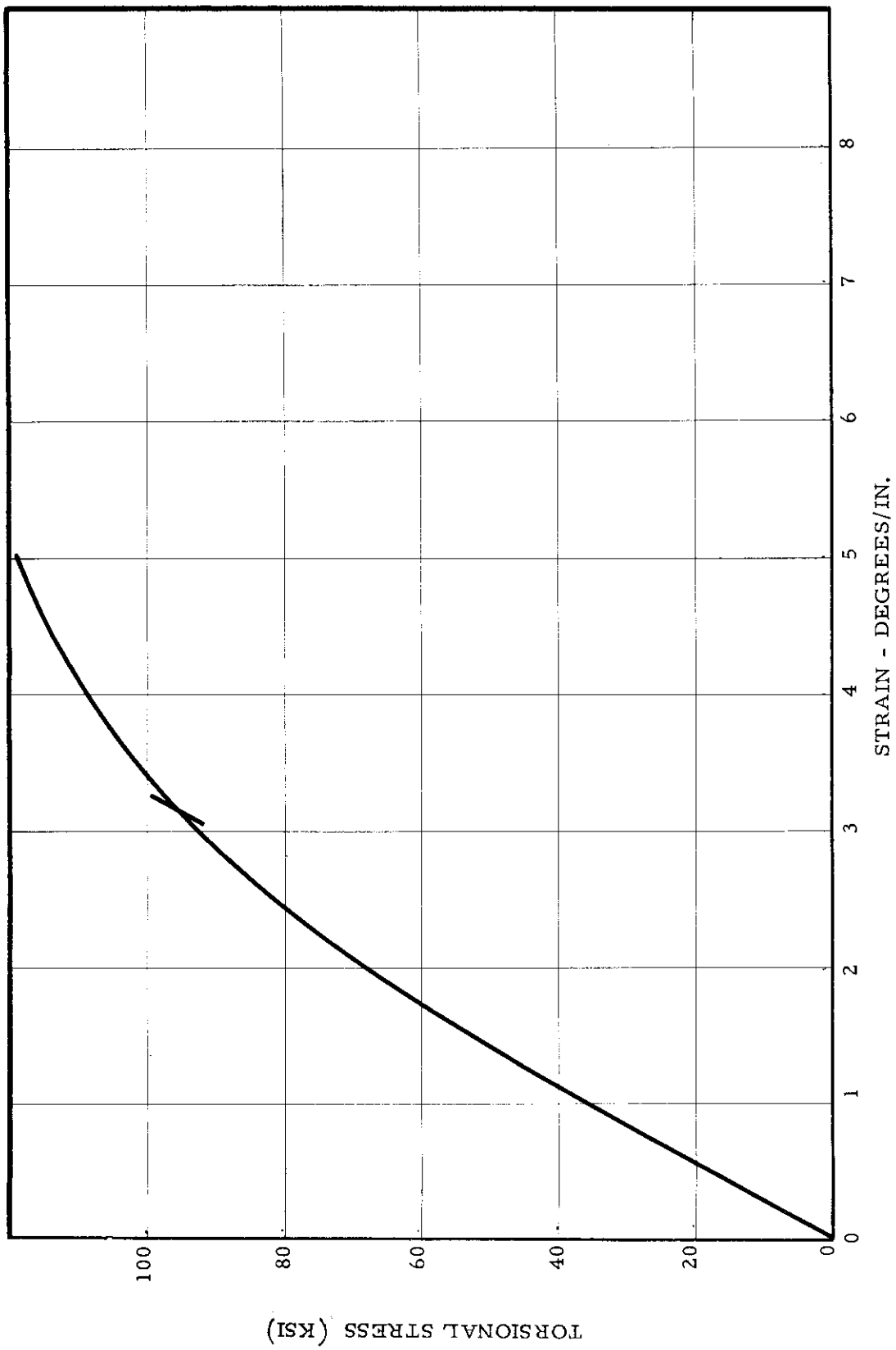


Figure 124. Room Temperature Torsion Curve, C135AMo, Heat 1

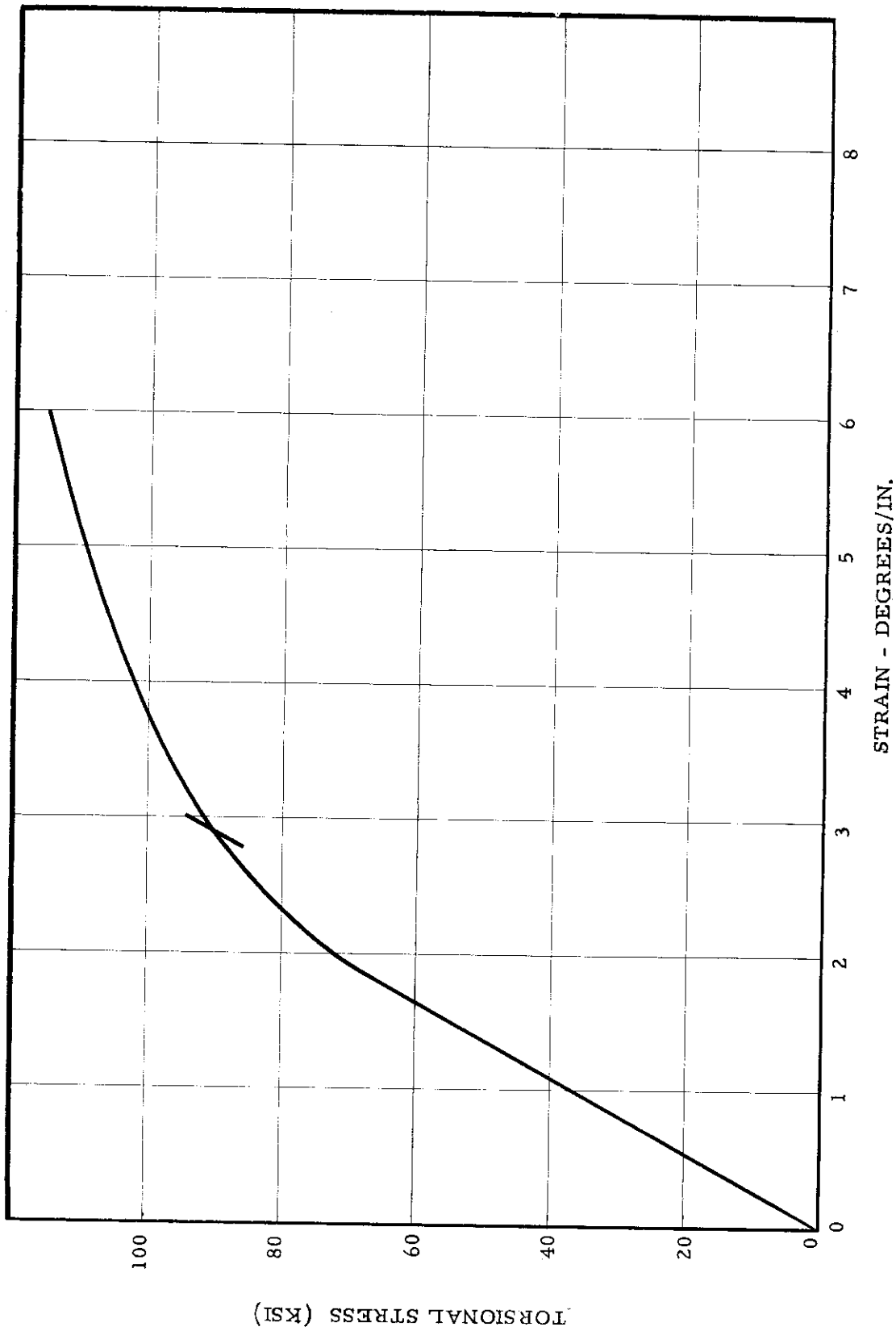


Figure 125. Room Temperature Torsion Curve, C135AMo, Heat 2

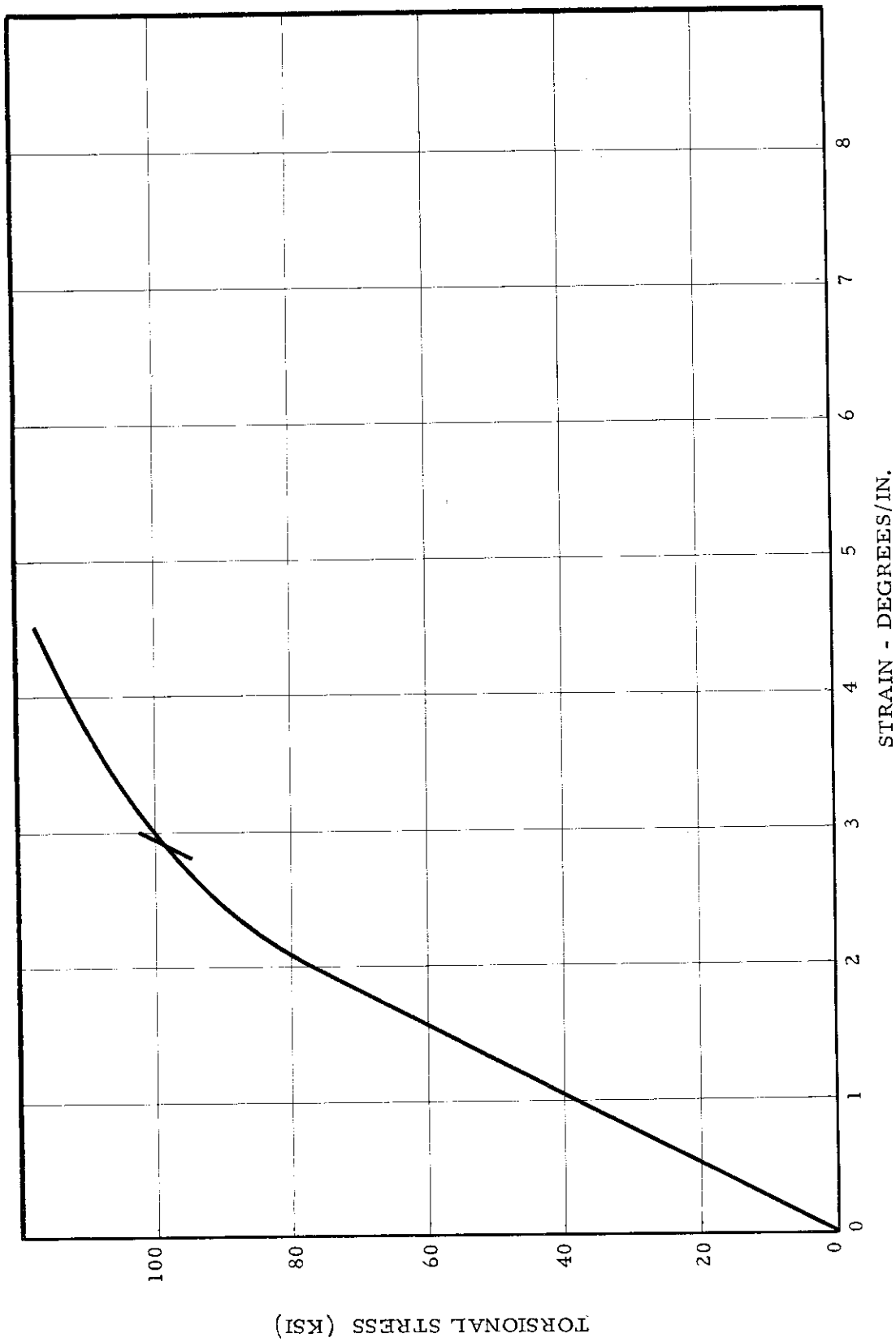


Figure 126. Room Temperature Torsion Curve, C135AMo, Heat 3