1. GENERAL
Ti-8Mn is an alpha beta type titanium alloy that has good elevated temperature strength and stability up to 600 F. The alloy is heat treatable, but it is used in the annealed condition only. It is available primarily in form of sheet and plate. The alloy possesses good formability, but its weldability is limited.

1.01 Commercial Designation. 8Mn Titanium Alloy.

1.02 Alternate Designations. Ti-8Mn, MST-8Mn, C-110M, RS-110A.

1.03 Specifications. Table 1.03.

TABLE 1.03

AMS	Form	Military
4908A	Sheet, strip, plate	MIL-T-009046 (ASG) Cl-1

1.04 Composition. Table 1.04.

TABLE 1.04

Source	AMS (1)	
	Percent	
	Min	Max
Manganese	6.50	9.00
Carbon	-	0.20
Oxygen	-	0.20*
Nitrogen	-	0.07
Hydrogen	-	0.015
Other elements, total	-	0.60**
Titanium	Balance	

* If determined
** Need not be reported

1.05 Heat Treatment
1.051 Anneal. 1300 F, 1 hr, cool 300 F per hr maximum to 1050 F maximum.
1.052 Stress relief. Below 700 F or at 1000 F. Stress relief at 700 to 850 F may result in notch sensitivity.
1.053 Heat treat. 1250 to 1400 F, 1/2 to 2 hr, water quench or air cool +900 to 950 F, 1 to 8 hr. This treatment can increase tensile strength by as much as 75 ksi.

1.06 Hardenability. Although this alloy is heat treatable, heat treatment is not recommended because of poor reproducibility of mechanical properties.

1.07 Forms and Conditions Available
1.071 Alloy is available in the full commercial range of sizes for sheet, strip and plate.
1.072 Other wrought products can be produced, but are not generally used.

1.08 Melting and Casting Practice. Consumable electrode double vacuum melt.

1.09 Special Considerations. See Ti, Commercially Pure.

2. PHYSICAL AND CHEMICAL PROPERTIES

2.01 Thermal Properties
2.011 Melting range. 2730 to 2970F.
2.012 Phase changes. This alloy transforms on cooling from beta to alpha + beta at 1425 to 1525 F.
2.013 Thermal conductivity, Fig. 2.013.
2.014 Thermal expansion, Fig. 2.014.
2.015 Specific heat, Fig. 2.015.
2.02 Other Physical Properties
2.021 Density. 0.170 to 0.171 lb per cu in. 4.70 to 4.73 gr per cu cm.
2.022 Electrical resistivity, Fig. 2.022.
2.023 Magnetic properties. Alloy is nonmagnetic. Permeability at 20 oersteds, 1.00005.

2.03 Chemical Properties. See Ti, Commercially Pure. Only different or complementary information listed below.
2.031 Hydrogen embrittlement
2.0311 Effect of hydrogen content on tensile properties of sheet, Fig. 2.0311.
2.0312 Effect of hydrogen content on creep rupture curves for notched sheet, Fig. 2.0312.
2.0313 Effect of test temperature on tensile properties of sheet with various hydrogen contents, Fig. 2.0313.

2.04 Nuclear Properties

3. MECHANICAL PROPERTIES

3.01 Specified Mechanical Properties
3.011 AMS specified mechanical properties, Table 3.011.

TABLE 3.011

Source	AMS (1)
Alloy	Ti-8Mn
Form	Sheet, strip, plate
Condition	Ann
F_{tu}, min - ksi	120
F_{ty}, min - ksi	110
max - ksi	140
e, min - percent	10

3.02 Mechanical Properties at Room Temperature. See 3.03 also.
3.021 Hardness. Annealed sheet, 33 to 36 RC.
3.022 Effect of stretching on tensile and compressive yield strengths of annealed sheet (Bauschinger effect), Fig. 3.022.

3.03 Mechanical Properties at Various Temperatures
3.031 Short time tension properties
3.0311 Stress strain curves for annealed sheet, Fig. 3.0311.
3.0312 Effect of test temperature on tensile properties of annealed sheet, Fig. 3.0312.
3.0313 Effect of low test temperature on tensile properties of annealed sheet, Fig. 3.0313.
3.032 Short time properties other than tension
3.0321 Stress strain curves in compression for annealed sheet, Fig. 3.0321.
3.0322 Effect of test temperature on compressive yield strength of annealed sheet, Fig. 3.0322.
3.0323 Effect of test temperature on bearing properties of annealed sheet, Fig. 3.0323.
3.0324 Effect of test temperature on shear strength of annealed sheet, Fig. 3.0324.
3.033 Static stress concentration effects. Effect of test temperature on notch strength of annealed sheet, Fig. 3.033.

3.04 Creep and Creep Rupture Properties
3.041 Creep and creep rupture curves at 600 to 800 F for annealed sheet, Fig. 3.041.
3.042 Short time total strain curves at 800 to 1200 F for annealed sheet, Fig. 3.042.

3.05 Fatigue Properties
3.051 Room temperature fatigue strength of annealed sheet, Table 3.051.

TABLE 3.051

Source	(2)						
Form	Sheet						
Condition	Ann						
Temp F	Method	Stress Ratio		Stress Concentration	Fatigue Strength-ksi at Cycles		
		A	R		10^5	10^6	10^7
RT	Direct Stress	0.6	0.25	Smooth K = 1	85	85	85

	Ti
8	Mn

3.06 Elastic Properties

3.061 Modulus of elasticity at room and elevated temperatures, Fig. 3.061.

3.052 Modulus of elasticity at room and low temperatures, Fig. 3.062.

3.053 Tangent modulus curves in compression at room and elevated temperatures, Fig. 3.053.

4. FABRICATION. See Ti, Commercially Pure. Only different or complementary information is given below.

4.01 Forming and Casting

4.011 General. 500 to 600 F is the optimum range for formability, and forming in this range reduces spring back, notch sensitivity and power required. Forming at 1000 to 1200F is also common, but a post forming anneal is required.

4.012 Forging. Starting temperature, 1700 F maximum, finishing temperature, 1450 F minimum. To obtain optimum properties, reductions equivalent to 25 to 40 percent should be performed in the alpha +beta range in the final forging operation. Subsequent reheating, such as required for sizing operations, should not exceed a temperature of about 200 F below the beta to alpha +beta transformation temperature.

4.03 Welding. Ti-8Mn is not recommended for any kind of fusion welding. Spot welding has been employed, although shear tests generally indicate poor weld characteristics.

4.04 Heating and Heat Treating. See Ti-6Al-4V.

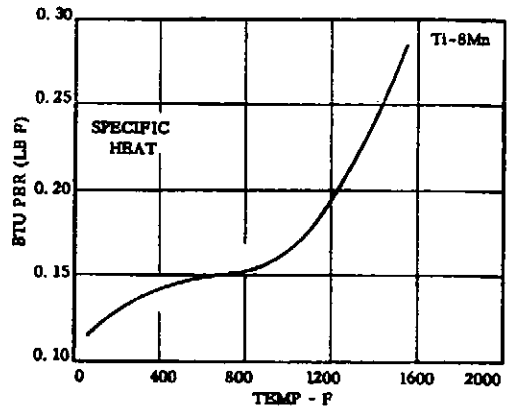

FIG. 2.015 SPECIFIC HEAT

(6, p. III-1-13)

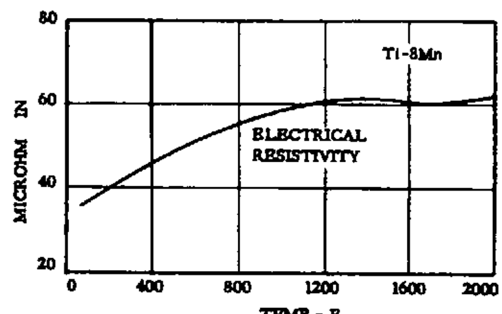

FIG. 2.022 ELECTRICAL RESISTIVITY

(3, p. W-3)

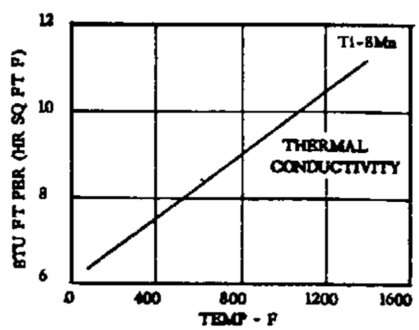

FIG. 2.013 THERMAL CONDUCTIVITY

(3, p. W-2)

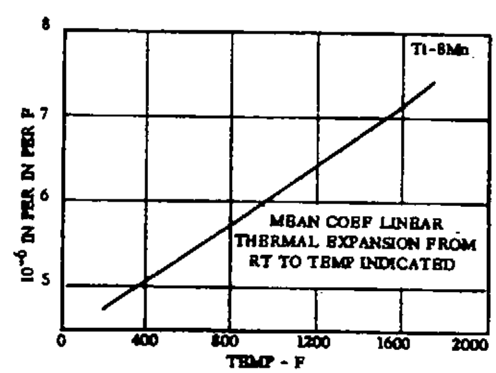

FIG. 2.014 THERMAL EXPANSION

(3, p. W-2)

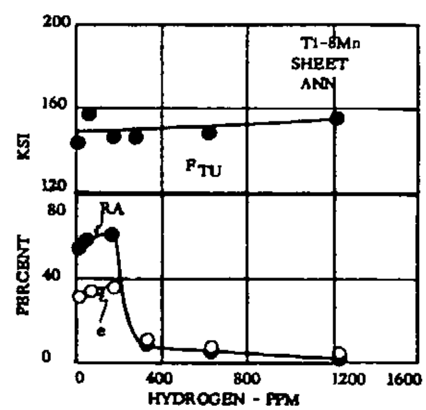

FIG. 2.031 EFFECT OF HYDROGEN CONTENT ON TENSILE PROPERTIES OF SHEET

(4)

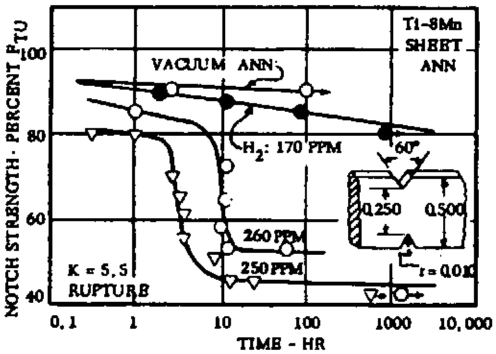

FIG. 2.0312 EFFECT OF HYDROGEN CONTENT ON CREEP RUPTURE CURVES FOR NOTCHED SHEET (4)

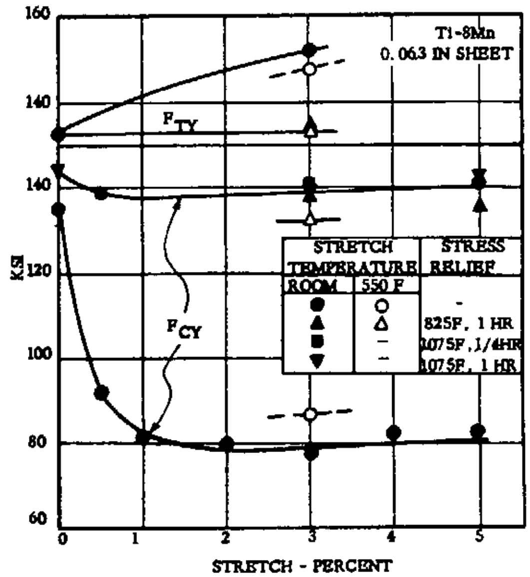

FIG. 3.022 EFFECT OF STRETCHING ON TENSILE AND COMPRESSIVE YIELD STRENGTHS OF ANNEALED SHEET (BAUSCHINGER EFFECT) (12)

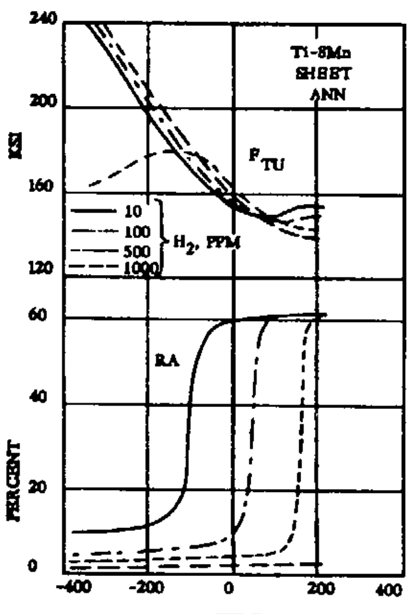

FIG. 2.0313 EFFECT OF TEST TEMPERATURE ON TENSILE PROPERTIES OF SHEET WITH VARIOUS HYDROGEN CONTENTS (5)

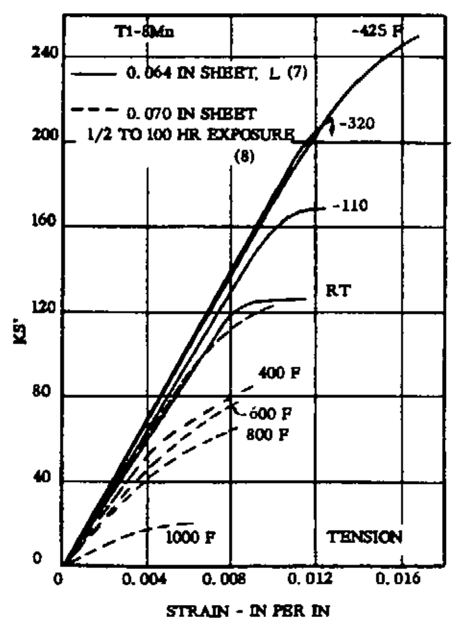

FIG. 3.0311 STRESS STRAIN CURVES FOR ANNEALED SHEET

(7, p. 43)(8)

	Ti
8	Mn

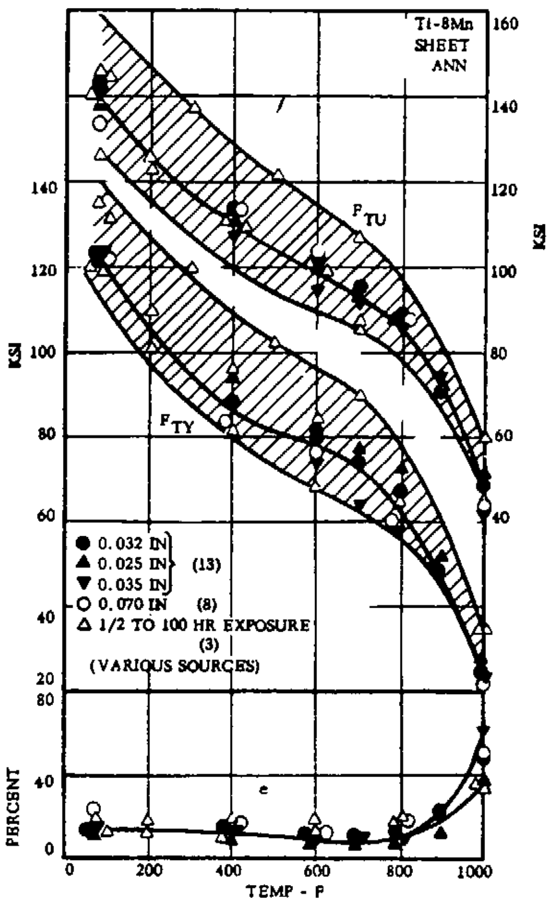

FIG. 3.0312 EFFECT OF TEST TEMPERATURE ON TENSILE PROPERTIES OF ANNEALED SHEET

(3)(8)(13)

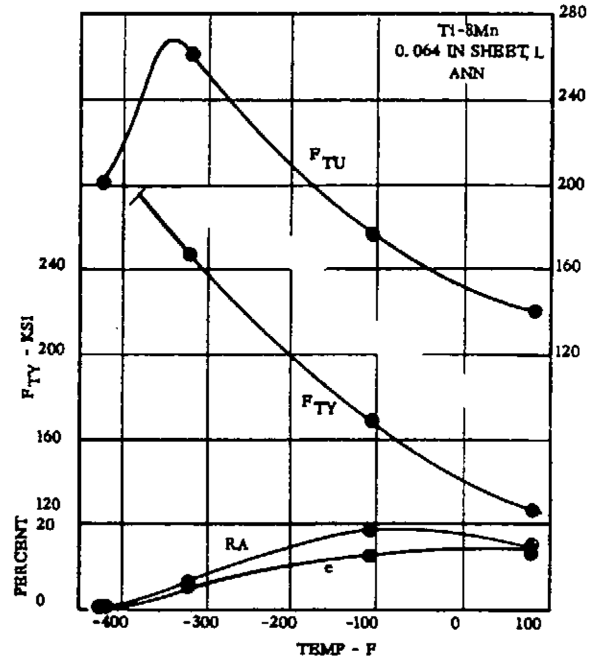

FIG. 3.0313 EFFECT OF LOW TEST TEMPERATURE ON TENSILE PROPERTIES OF ANNEALED SHEET

(7, p. 20)

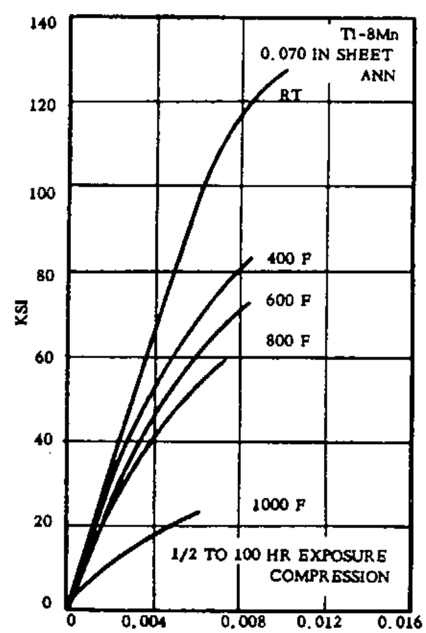

FIG. 3.0321 STRESS STRAIN CURVES IN COMPRESSION FOR ANNEALED SHEET

(8)

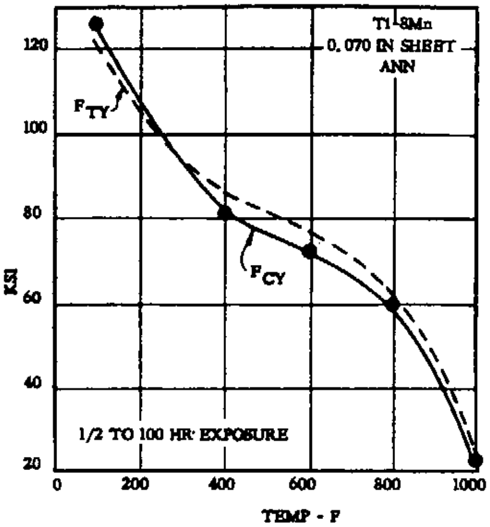

FIG. 3.0322 EFFECT OF TEST TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF ANNEALED SHEET (8)

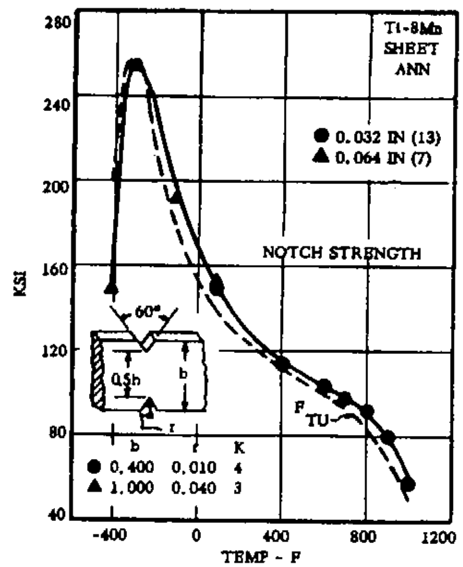

FIG. 3.033 EFFECT OF TEST TEMPERATURE ON NOTCH STRENGTH OF ANNEALED SHEET (7, p.29)(13)

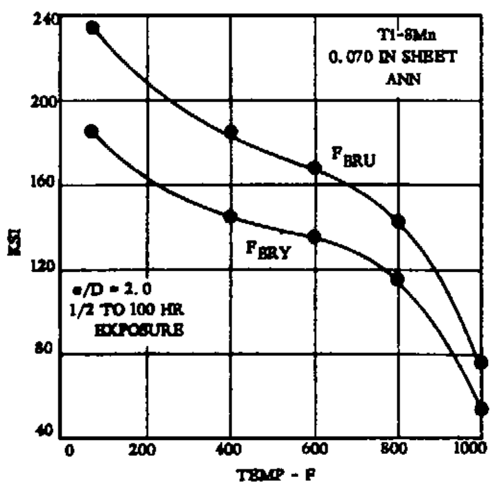

FIG. 3.0323 EFFECT OF TEST TEMPERATURE ON BEARING PROPERTIES OF ANNEALED SHEET (10)

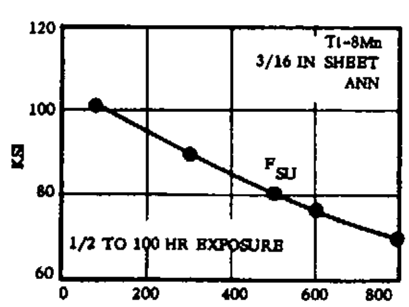

FIG. 3.0324 EFFECT OF TEST TEMPERATURE ON SHEAR STRENGTH OF ANNEALED SHEET (8)

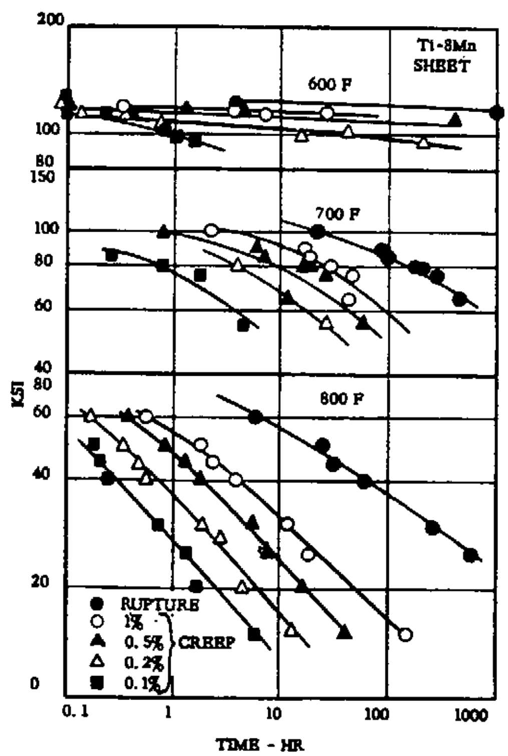

FIG. 3.041 CREEP AND CREEP RUPTURE CURVES AT 600 TO 800 F FOR ANNEALED SHEET (9)

Ti
8 Mn

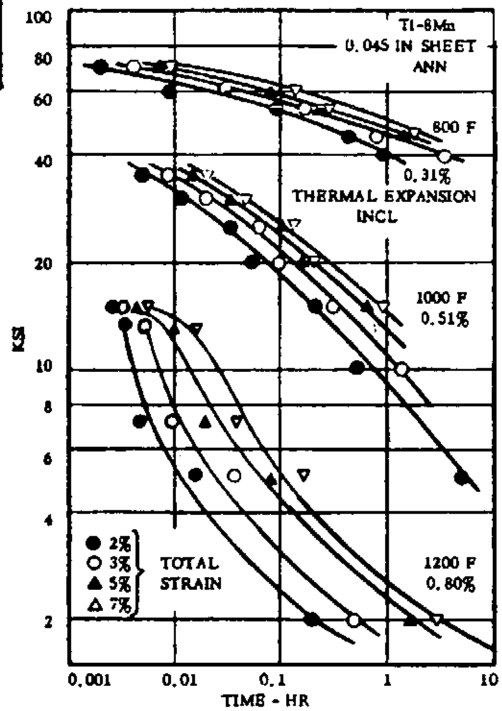

FIG. 3.042 SHORT TIME TOTAL STRAIN CURVES AT 800 TO 1200 F FOR ANNEALED SHEET (11)

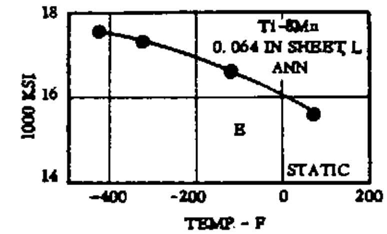

FIG. 3.062 MODULUS OF ELASTICITY AT ROOM AND LOW TEMPERATURES (7, p. 20)

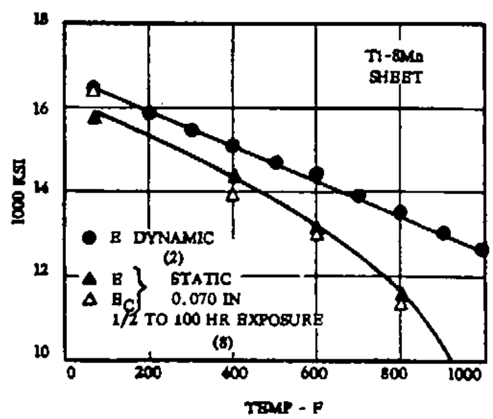

FIG. 3.061 MODULUS OF ELASTICITY AT ROOM AND ELEVATED TEMPERATURES (2)(8)

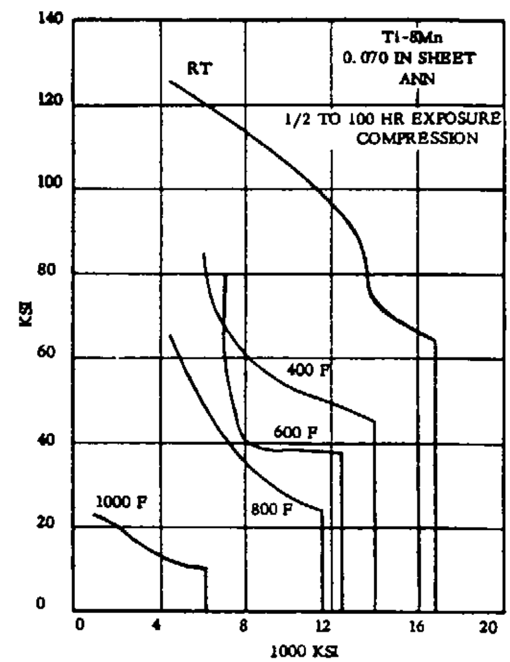

FIG. 3.063 TANGENT MODULUS CURVES IN COMPRESSION AT ROOM AND ELEVATED TEMPERATURES (8)

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