Fe
17 Cr
4 Ni
3 Mo

AM-350

1 **GENERAL**
This alloy is one of a series of age hardening steels which combines high strength at temperatures up to 800F and higher with the corrosion resistance of stainless steels. In the annealed condition, the alloy is soft and ductile, having many of the desirable forming characteristics of the austenitic stainless steels. In the hardened condition it possesses the high strength and hardness characteristic of the martensitic stainless steels. It is designed primarily for light sections, and is available in sheet, strip, bar, and wire. A companion alloy, AM 355, having slightly lower chromium and higher carbon content, is best suited for heavy sections such as forgings, billets, bars, and plate.

1.01 Commercial Designation
AM-350.

1.02 Alternate Designations
UNS S35000.

1.03 Specifications
Table 1.03.

1.04 Composition
AMS Compositions, Table 1.04.

1.05 Heat Treatment

1.051 For maximum formability and stability, anneal to Condition H.

1.0511 Heat to 1850 to 1975F, air cool or quench in oil or water at rate rapid enough to prevent precipitation of chromium carbides.

1.0512 Sheet and strip, 3/4 hour minimum per inch thickness, rapid air cool to 80F maximum.

1.0513 Forging stock, 1 hour minimum per inch thickness, oil or water quench to 80F maximum.

1.0514 Strip and sheet supplied from mill in Condition H.

1.0515 Bars and forgings should not be annealed to Condition H because of resulting lack of response to heat treatment in larger sizes.

1.052 To prepare alloy for maximum response to subsequent hardening, anneal to Condition L.

1.0521 Heat to 1685 to 1735F, air cool or quench in oil or water, rapid cooling not mandatory, but very slow cooling rates should be avoided.

1.0522 Sheet and strip, 3/4 hour minimum per inch thickness (4 minutes minimum), rapid air cool to 80F maximum.

1.0523 Bars and forgings, 1 hour minimum per inch of thickness, oil or water quench to 80F maximum.

1.053 For best machining equalize and overtemper bar 3 hours at 1425F ± 50F, cool to 80F maximum, 3 hours at 1075F ± 25F.

1.054 For material Condition L, reducing the temperature to -100F causes transformation of austenite to martensite. One method of hardening is, therefore, to reduce the temperature to -100F allowing a minimum of 3 hours to permit the transformation to be completed. Subsequent tempering for 3 hours minimum at 850 to 1050F produces good strength and ductility. This treatment of subcooling and tempering is designated SCT.

1.0541 For highest strength and good ductility use Condition SCT-850. Anneal to Condition L; subcool to -100F, 3 hours minimum; temper 825 to 875F, 3 hours minimum. Higher tempering temperatures, up to 1000F, may be used to increase room temperature impact resistance or to improve machinability. For Condition SCT-1000, age at 975 to 1025F, 3 hours minimum. Effect of aging temperature on tensile properties of sheet in SCT Condition, Fig. 1.0541.

1.055 Alternate method of hardening alloy is by double aging, DA. Starting from either Condition H or Condition L, age at 1350 to 1400F, 2 hours, air cool to 80F maximum, + 850 to 1050F, 3 hours.

1.056 Condition DADF, for improved stress corrosion resistance, consists of Condition SCT followed by subzero freeze at -100F for 3 hours minimum. See section 2.033.

1.057 Hardening may also be accomplished by cold rolling and tempering, CRT. Condition H + cold roll 20 to 45 percent, + temper 700 to 950F.

1.0571 Effect of tempering temperature, test temperature, and prior exposure on properties of sheet cold rolled 30 percent prior to tempering, Fig. 1.0571.

1.0572 Effect of tempering temperature, test temperature, prior exposure, and test direction on notch properties of sheet cold rolled 30 percent prior to tempering, Fig. 1.0572.

1.058 Dimensional changes occur during heat treatment, see section 2.017.

1.06 Hardness

1.061 Effect of test temperature on Brinell hardness of alloy in Conditions SCT and DA, Fig. 1.061.

1.062 Alloy hardness fully in large section sizes after heat treating to either Conditions SCT or DA.

1.07 Forms and Conditions Available

1.071 Alloy is available in sheet, strip, foil, bar, wire, and forgings. Companion alloy AM-355 is, however, preferred in heavy sections such as bar and forgings.

1.072 Sheet, strip, foil, forgings stock, and wire are available in Condition H. Bars and wire are also available in the equalized and tempered Conditions.

1.08 Melting Practice
Electric arc furnace melt followed by argon-oxygen-decarburizing (AOD). Consumable electrode remelt or electroslag remelt are optional.

1.09 Special Considerations

1.091 Heating to temperature above those specified for Condition H should be avoided because of excessive delta ferrite formation and loss of response to hardening.

1.092 Annealing of heavy bar and forging to Condition H may result in loss of response to heat treating.

1.093 Forging of heavy sections should be finished at about 1750F to ensure adequate response to heat treating.

1.094 CRT has optimum stress corrosion resistance. SCT requires either a minimum of 10 percent delta ferrite or a 1000F temper for optimum stress corrosion resistance.

1.095 Dimensional changes during heat treatment require special consideration, see 2.017.

2 PHYSICAL AND CHEMICAL PROPERTIES

2.01 **Thermal Properties**

2.011 Melting range 2500 to 2550F.

2.012 Phase changes. Alloy at temperature above 1100F starts reverting to austenite. Reversion essentially completed at approximately 1600F. Upon cooling austenite transforms to martensite. On rapid cooling from 1710F, the M_s point is between 80 and 200 F. The austenite is substantially transformed to martensite by cooling to -110F. Holding 3 hours at -110F is desirable since an isothermal transformation component is present. On cooling from 1375F, as in DA treatment, the M_s point is between 250 and 400F and cooling to RT is desirable for substantial transformation to martensite. In both hardening treatments approximately 10 to 20 percent austenite is retained in the structure. This austenite is thermally stable.

2.0121 Time-temperature-transformation diagrams.

2.013 Thermal conductivity, Fig. 2.013.

2.014 Thermal expansion, Fig. 2.014.

2.015 Specific heat, 0.12 Btu per lb F.

2.016 Thermal diffusivity.

2.017 Dimensional changes during various heat treatments, Table 2.017.

2.02 **Other Physical Properties**

2.021 Density. Table 2.021.

2.022 Electrical properties.

2.0221 Electrical resistivity at room temperature for various conditions, Table 2.0221.

2.0222 Electrical resistivity of bar in SCT Condition, Fig. 2.0222.

2.023 Magnetic properties. Alloy is ferromagnetic. Typical magnetic properties, Table 2.023.

2.024 Emittance.

2.0241 Effect of test temperature and surface condition on total normal emittance and on spectral normal emittance at $\gamma = 0.665$, Fig. 2.0241.

2.025 Damping capacity.

2.03 **Chemical Environments**

2.031 Corrosion resistance.

2.0311 General corrosion resistance approaches that of austenitic stainless steels.

2.0312 Intergranular attack may occur in Condition DA.

2.032 Oxidation resistance. Comparable to that of austenitic stainless steels.

2.033 Stress corrosion resistance. Tests on 0.020 and 0.060 inch sheet, heat treated to yield strengths of 160 to 198 ksi (standard SCT, modified SCT with annealing temperature 1975F instead of 1925F, and DADF in which a subzero freeze of -100F for 3 hours was added to the SCT treatment), and tested at stress levels of 80 percent F_{ty} did not fail after 1000 hours exposure to two types of stress-corrosion tests:

a) Exposure to semi-industrial atmosphere of Seattle, Washington
b) Alternate immersion in a 3.5 percent NaCl solution. No stress-corrosion cracking was obtained on 0.060 inch welded sheet (both automatic and manual weldments) when exposed for 1000 hours at 80 percent F_{ty} (16).

2.0331 More severe stress corrosion than alternate immersion in a NaCl solution are produced by:

a) exposure to seashore air environment and
b) salt spray.

When exposed to to beach atmosphere at El Segundo, Calif., the SCT-850 alloy is susceptible to stress corrosion cracking. This tendency is detectable at 30-40 percent of F_{ty} and becomes very severe at 60-90 percent of F_{ty}. Susceptibility to stress corrosion cracking becomes even more severe when the alloy in the SCT Condition is heated for 1000 hours at 650F prior to stress corrosion testing. Stress corrosion cracking starts from surface pits with microfissures penetrating along the delta ferrite and possible prior austenite boundaries as a result of some electrochemical (or combination of electrochemical and mechanical) action. Groups of microfissures are formed in positions approximately perpendicular to the direction of tensile load. When the microfissures sufficiently penetrate into the metal they are joined together by breaking down of the bridges of metal separating them (17, p. 369, 374). Effect of several stress corrosion environments on time to failure of unnotched sheet in SCT-850 Condition, Fig. 2.0331.
The stress corrosion resistance of AM-350 SCT with an 850F temper is considerably improved if a minimum of 60 percent delta ferrite is present in the structure. Further improvement is achieved by tempering at 1000F.

2.0332 In the SCT-850 Condition, the alloy is also susceptible to corrosion fatigue at room temperature. At 110 ksi maximum stress (R = 0.2), corrosion fatigue life was 16 percent of air fatigue life. There was no significant effect of frequency (100 cpm~1800 cpm) on fatigue life either in air or in synthetic seawater environments (17, p. 369). Effect of synthetic seawater environment and cyclic frequency on axial fatigue of sheet in SCT-850 Condition, Fig. 2.0332.

2.0333 Exposure for 1000 hours at 650F and braze cycling increased susceptibility to stress corrosion cracking of SCT-850 sheet. Surface condition was also found to be important. Vapor honing and passivation reduced susceptibility to stress corrosion cracking. Welding had no effect (17, p. 11-12).

2.0334 Good resistance to stress corrosion cracking was obtained by alloy in CRT Condition. However, welded CRT alloy showed tendency to initiate stress corrosion cracks at root of pre-existing fatigue cracks. Effect of stress, precracking, and alternate immersion in synthetic seawater, on stress corrosion cracking of

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AM-350 CRT subjected to prior exposure of 650F for 1000 hours, Fig. 2.0334.

2.04 Nuclear Properties

3 MECHANICAL PROPERTIES

3.01 Specified Mechanical Properties
3.011 AMS specified mechanical properties for strip, sheet, and tubing, Table 3.011.
3.012 AMS specified mechanical properties for bars and forgings, Table 3.012.
3.013 Producer's specified mechanical properties, Table 3.013.

3.02 Mechanical Properties at Room Temperature
See also 3.03.
3.021 Tension.
3.0211 Stress-strain diagrams, see 3.0311.
3.0212 Effect of exposure time and temperature on room temperature tensile properties of sheet from three heats in Condition H-1900, Fig. 3.0212.
3.0213 Effect of stretching and subsequent aging to Condition SCT-850 on tensile properties of sheet in Condition L, Fig. 3.0213.
3.0214 Effect of tempering temperature and test direction on notch strength of sheet, Fig. 3.0214.
3.0215 Effect of percent cold draw and of tempering time and temperature on tensile properties of wire, Fig. 3.0215.
3.022 Compression, see 3.032.
3.0221 Stress-strain diagrams, see 3.032.
3.023 Impact, see 3.033.
3.024 Bending.
3.025 Torsion and shear.
3.026 Bearing, see 3.036.
3.027 Stress concentration, see 3.037.
3.0271 Notch properties, see 3.0214.
3.0272 Fracture toughness.
3.028 Combined properties.

3.03 Mechanical Properties at Various Temperatures
3.031 Tension.
3.0311 Stress-strain diagrams.
3.03111 Tensile and compressive stress-strain curves for sheet in L annealed Condition at room and elevated temperatures, Fig. 3.03111.
3.03112 Stress-strain curves for sheet in SCT Condition at room and elevated temperature, Fig. 3.03112.
3.03113 Stress-strain curves for sheet in DA Condition at room and elevated temperature, Fig. 3.03113.
3.03114 Stress-strain curves for sheet in SCT Condition at low temperature, Fig. 3.03114.
3.03115 Stress-strain curves for sheet in 20 percent CRT Condition at temperatures between -110 to 650F, Fig. 3.03115.
3.03116 Stress-strain curves of sheet in 30 percent CRT Condition at temperature between -110 to 650F, Fig. 3.03116.
3.0312 Effect of test temperature and prior exposure to stress and temperature on tensile properties of sheet in L annealed Condition, Fig. 3.0312.
3.0313 Effect of test temperature on tensile properties of sheet rolled from two heats in Condition H-1900, Fig, 3.0313.
3.0314 Effect of test temperature on tensile properties of sheet in Condition DA, Fig. 3.0314.
3.0315 Effect of test temperature on tensile properties of sheet in Condition SCT, Fig. 3.0315.
3.0316 Effect of low test temperature on tensile properties of sheet in Condition SCT, Fig. 3.0316.
3.0317 Effect of test temperature on transverse tensile properties of sheet in CRT Condition, Fig. 3.0317.
3.0318 Effect of test temperature, cold reduction, and prior exposure on tensile properties of sheet in CRT Condition, Fig. 3.0318. See also Fig. 1.0571 and 1.0572.
3.032 Compression.
3.0321 Compressive stress-strain curves for sheet in L annealed Condition at room and elevated temperatures, see Fig. 3.03111.
3.0322 Stress-strain curves in compression for sheet in DA Condition at room and elevated temperatures, Fig. 3.0322.
3.0323 Stress-strain curves in compression for sheet in SCT Condition at room and elevated temperatures, Fig. 3.0323.
3.0324 Effect of test temperature on compressive yield strength of sheet in Condition H, DA, and SCT, Fig. 3.0324.
3.033 Impact.
3.0331 Effect of test temperature on Charpy V impact properties of alloy in SCT Condition, Fig. 3.0331.
3.034 Bending.
3.035 Torsion and shear.
3.0351 Effect of test temperature on shear strength of sheet in L annealed Condition, Fig. 3.0351.
3.0352 Effect of test temperature on shear strength of sheet in Condition SCT-850, Fig. 3.0352.
3.036 Bearing.
3.0361 Effect of test temperature on bearing properties of sheet in annealed Condition, Fig. 3.0361.
3.0362 Effect of test temperature on bearing properties of sheet in Condition SCT-850, Fig. 3.0362.
3.037 Stress concentration.
3.0371 Effect of low test temperature on notch strength and notch strength ratio of sheet in SCT Condition, Fig. 3.0371.
3.0372 Effect of net section area and test temperature on net section strength of sheet in DA Condition, Fig. 3.0372.
3.0373 Effect of net section area and test temperature on net section strength of sheet in CRT Condition, Fig. 3.0373.
3.0374 Effect of test temperature, cold reduction, test direction, and prior exposure on ratio of sharp notch strength to yield strength of sheet in CRT Condition, Fig. 3.0374.
3.0375 Effect of test temperature, amount of cold work, tempering conditions, and testing direction on notch tensile strength after exposure to coating of natural sea salt while under stress at high temperature, Fig. 3.0375.
3.0376 Effect of crack length fraction, method of producing crack, prior exposure, and test temperature on residual strength and net section strength of sheet in CRT Condition, Fig. 3.0376.
3.0377 Effect of test temperature on fracture toughness and residual strength ratio of three heats of sheet in Condition SCT, Fig. 3.0377.

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17 Cr
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3.0378 Effect of test temperature on fracture toughness and residual strength ratio of sheet in Condition CRT, Fig. 3.0378.
3.038 Combined properties.

3.04 Creep and Creep Rupture Properties
3.041 General.
3.042 Creep rupture properties.
3.0421 Creep rupture properties at 800 to 1000F of alloy in DA Condition, Fig. 3.0421.
3.0422 Creep rupture properties at 800 and 900F of sheet in SCT Condition, Fig. 3.0422.
3.043 Creep deformation.
3.0431 Minimum creep rate curves at 600, 700, and 800F for sheet in SCT Condition, Fig. 3.0431.
3.0432 Total creep curves at 800F for sheet in Condition SCT, Fig. 3.0432.
3.0433 Isochronous stress-strain curves for sheet in Condition SCT at 600 to 800F, Fig. 3.0433.

3.05 Fatigue Properties
3.051 Fatigue curves for sheet in Condition SCT, Fig. 3.051.
3.052 Fatigue properties in Condition SCT (850F) at 550F, 650F, and 800F, Fig. 3.052.
3.053 Effect of stress and test temperature on the fatigue of brazed lap joints in Condition SCT, Fig. 3.053.
3.054 Crack propagation rate as a function of the stress intensity factor for AM-350 CRT, Fig. 3.054.
3.055 Fatigue behavior of smooth and notched sheet in Condition SCT with salt coating, Table 3.055.
3.056 Effect of joining method and of stress concentration on fatigue behavior at room temperature of sheet in Condition CRT, Fig. 3.056.
3.057 Effect of test temperature and prior exposure on fatigue behavior of smooth and notched sheet in Condition CRT, Fig. 3.057.
3.058 Effect of joining method and of stress concentration on fatigue behavior at 550F of sheet in Condition CRT, Fig. 3.058.
3.059 Effect of joining method and of stress concentration on fatigue behavior at 800F of sheet in Condition CRT, Fig. 3.059.

3.06 Elastic Properties
3.061 Poisson's ratio.
3.062 Modulus of elasticity.
3.0621 Modulus of elasticity at various temperatures of alloy in Condition SCT 850 and DA, Fig. 3.0621.
3.0622 Effect of test temperature and prior exposure to stress and temperature on elastic modulus of sheet in annealed Condition, Fig. 3.0622.
3.063 Modulus of rigidity at room and elevated temperatures, Fig. 3.063.

4. FABRICATION

4.01 Forming
4.011 General. Condition H has a formability similar to that of austenitic steels except for a higher rate of strain hardening due to martensite formation. Condition L is even less stable. It strain hardens more rapidly and therefore possesses inferior forming characteristics. Alloy in Conditions H and L can be formed with advantage at 300F or higher due to absence of martensite formation and correspondingly decreased rate of strain hardening. The heat treated Condition SCT permits minor forming operations, including bending, straightening and dimpling, while Condition DA is still more difficult to form.
4.012 Bending. Bend factor for Condition SCT = 3, for Condition DA = 5.
4.013 Sheet formed in Condition H needs a subsequent full heat treatment. If it is possible to form the alloy in Condition L, subsequent aging to Condition SCT will produce about the same properties as obtained without the strain hardening due to forming.
4.014 Straightening of parts to be heat treated to Condition SCT is performed preferably after cooling to -100F to reduce the dimensional changes occurring during heat treating. Stretched parts show little dimensional changes.
4.015 Forging. Starting temperature 2100F maximum. Finishing temperature should be about 1750F to ensure adequate response to heat treating. Before heat treating, forgings should be equalized at 1375F.

4.02 Machining and Grinding
4.021 General. Machining properties of AM-350 are similar to those of austenitic stainless steels. Rigid supports, positive cuts, and adequate cooling are required.
4.022 Conditions H and L do not machine well because of their initial softness and their high rate of strain hardening. For best machining, it is recommended that the alloy be subjected to an equalizing treatment with a resulting hardness of about 35 RC (see Section 1.053).
4.023 Allowance must be made for growth on subsequent heat treatment. For extreme dimensional accuracy, finish machining should be done on material in Condition SCT or DA, which machine in a manner similar to low alloy steels of equal hardness.

4.03 Joining
4.031 Welding.
4.0311 General. AM-350 can be welded by all the conventional methods used for chromium-nickel stainless steels. Gas tungsten-arc, gas metal-arc, covered electrode, submerged arc or flash welding can be used to produce sound welds with good ductility. It is easier to weld martensitic steels because they do not require preheating or postheating to minimize cracking. As-welded AM-350 can be hardened by the DA treatment (see 1.055) without reannealing. To obtain proper response to the SCT treatment, AM-350 must be reannealed at 1675 to 1775F prior to hardening. To obtain greatest weld strength, AM-355 weld filler metal should be used. Where ductility is more important

Fe
17 Cr
4 Ni
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than strength requirements, austenitic welding rods such as AISI Type 308, 309 or 310 can be used. Heat treated welds having 90 to 100 percent joint efficiency in light gage material can be obtained without filler metal. AM-350 may be electric resistance welded in either the hardened or annealed condition. Resistance welding may precede or follow hardening to obtain high strength joints. Spot welding of hardened sheet can be performed by proper selection of current and electrode size to give tension shear values equal to and tension impact and fatigue strength values higher than those of welded and subsequently hardened material.

When joining wrought AM-350 to AM-355 castings, highest strength can be obtained in the weld and heat affected zones by heating at 1375 to 1475F for 3 hrs, air cooling to 80F maximum, reannealing at 1675 to 1775F followed by rapid cooling. This is followed by the normal SCT treatment.

4.0312 The properties of AM-350 sheet welded with AM-350 or AM-355 filler metal, Table 4.0312.

4.0313 Tensile properties of sheet welded transverse to the rolling direction and given several post-weld treatments Table 4.0313.

4.0314 Elevated temperature properties of AM-350 sheet welded transverse to the rolling direction, Fig. 4.0314.

4.0315 Room temperature shear strength of spot welded AM-350 sheet, .024 in. thick, Table 4.0315.

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38 AMS 5775 A (April 15, 1978)
39 AMS 5774 B (July 1, 1981)

AMS	Form	Condition
5745	Bars and Forgings	Heat treated to F_{tu} = 165 ksi min
5546	Sheet and Strip, Cold Rolled, Tempered	
5548	Sheet and Strip, High Temperature Annealed	
5554	Steel Tubing, Seamless	
5775	Welding Electrodes, Covered	
5774	Welding Wire	

TABLE 1.03. AMS SPECIFICATIONS

Alloy	Fe-17Cr-4Ni-3Mo	
	Percent	
	Min	Max
C(a)	0.07	0.11
Mn	0.50	1.25
Si	–	0.050
P	–	0.040
S	–	0.030
Cr	16.00	17.00
Ni	4.00	5.00
Mo	2.50	3.25
Ni	0.07	0.13

(a) AMS 5554 (37), AMS 5774B (38) & AMS 5775A (39) give 0.08 to 0.12 C

TABLE 1.04. AMS COMPOSITIONS (18)(19)(20)(37)(38)(39)

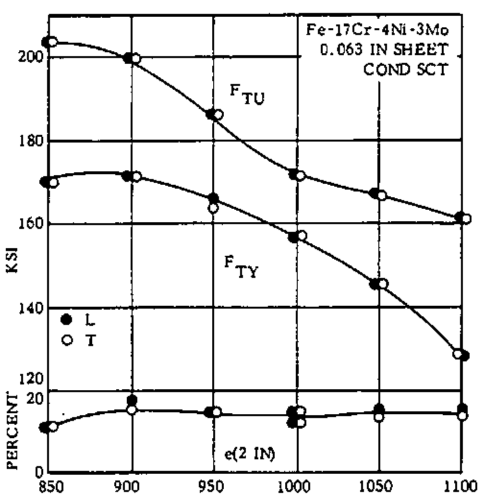

FIG. 1.0541 EFFECT OF AGING TEMPERATURE ON TENSILE PROPERTIES OF SHEET IN SCT CONDITION (21)

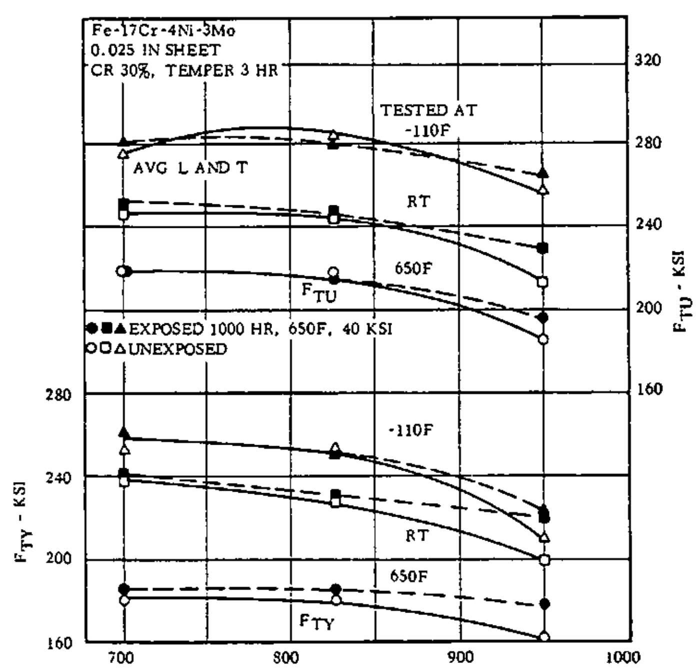

FIG. 1.0571 EFFECT OF TEMPERING TEMPERATURE, TEST TEMPERATURE AND PRIOR EXPOSURE ON TENSILE PROPERTIES OF SHEET COLD ROLLED 30 PERCENT PRIOR TO TEMPERING (12, p. 843)

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17 Cr
4 Ni
3 Mo

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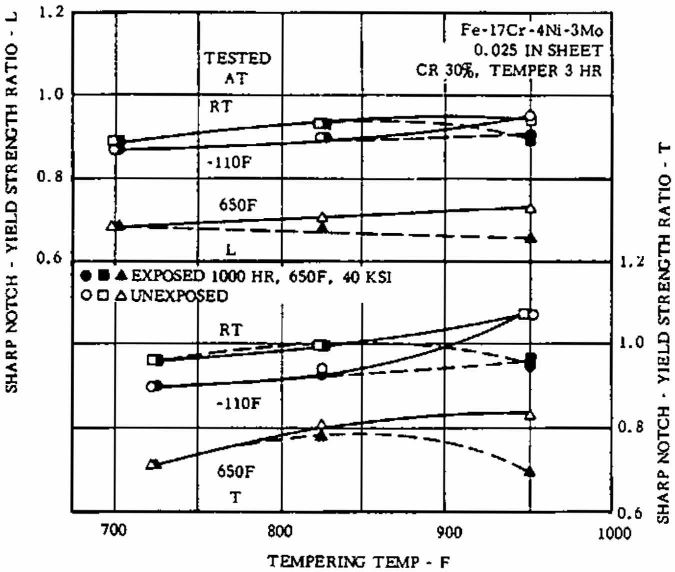

FIG. 1.0572 EFFECT OF TEMPERING TEMPERATURE, TEST TEMPERATURE PRIOR EXPOSURE AND TEST DIRECTION ON NOTCH PROPERTIES OF SHEET COLD ROLLED 30 PERCENT PRIOR TO TEMPERING (12, p. 843)

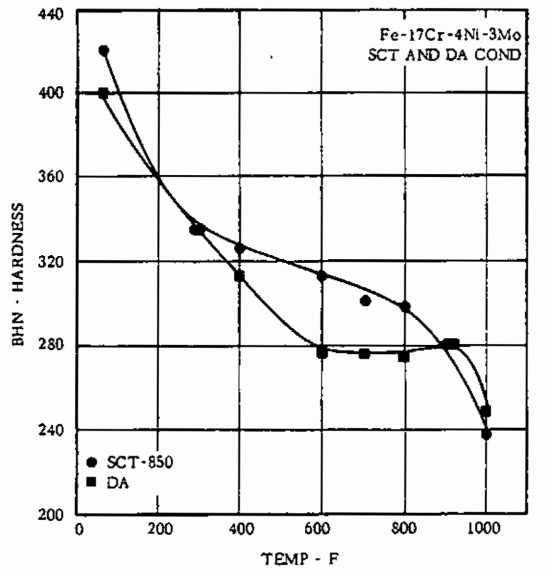

FIG. 1.061 EFFECT OF TEST TEMPERATURE ON BRINELL HARDNESS OF ALLOY IN CONDITIONS SCT AND DA (2)

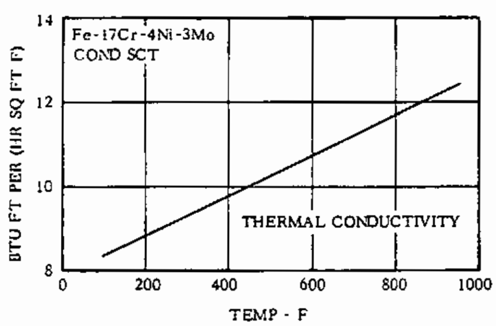

FIG. 2.013 THERMAL CONDUCTIVITY (1, p. 8)

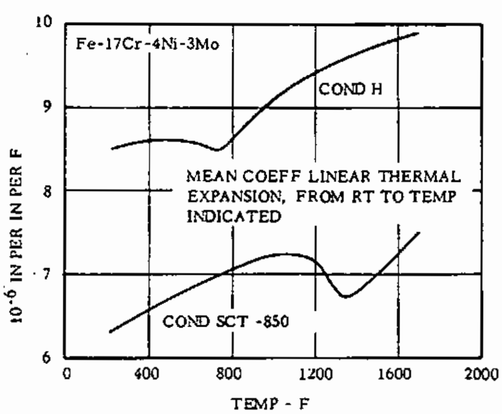

FIG. 2.014 THERMAL EXPANSION (1, p. 4)

Alloy	Fe-17Cr-4Ni-3Mo
Form	0.039 to 0.062 in. Sheet, L and T. (Average of 4 heats)
Condition or Treatment	Dimensional change in./in.
H + 1375F, 2 hr, AC	+0.0045
+ 850F, 3 hr, AC	-0.0002
H to DA	+0.0043
H to L	+0.0015
L + 1375F, 2 hr, AC	+0.0036
+ 850F, 3 hr, AC	-0.0002
L to DA	+0.0034
H to L to DA	+0.0049
L + -100F, 3 hr	+0.0034
+ 850F, 3 hr, AC	-0.0002
L to SCT	+0.0032
H to L to SCT	+0.0047

TABLE 2.017. DIMENSIONAL CHANGES DURING VARIOUS HEAT TREATMENTS (2) (22)

Fe
17 Cr
4 Ni
3 Mo

AM-350

Alloy	Fe-17Cr-4Ni-3Mo	
Condition	lb/cu in.	gr/cu cm
H	0.286	7.92
SCT-850	0.282	7.81

TABLE 2.021. DENSITY (1, p.8)

Alloy	Fe-17Cr-4Ni-3Mo
Condition	Electrical resistivity, microhm - in.
H	28.0
SCT	31.9
DA	32.7

TABLE 2.0221. ELECTRICAL RESISTIVITY AT ROOM TEMPERATURE FOR VARIOUS CONDITIONS (3, p.17)

Alloy	Fe-17Cr-4Ni-3Mo		
Condition	H	SCT	DA
Induction at 200 oersteds - gausses	1700	8600	9980
- Max	14	76	115
Permeability - Initial	12	18	18

TABLE 2.023. TYPICAL MAGNETIC PROPERTIES (2)

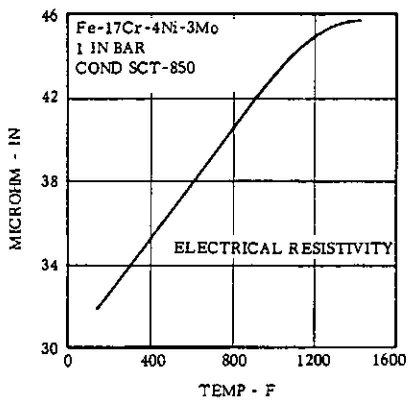

FIG. 2.0222 ELECTRICAL RESISTIVITY OF BAR IN SCT CONDITION (1, p. 8)

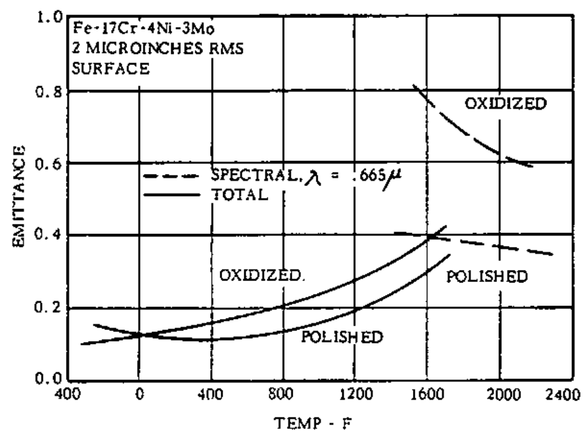

FIG. 2.0241 EFFECT OF TEST TEMPERATURE AND SURFACE CONDITION ON TOTAL NORMAL EMITTANCE AND ON SPECTRAL NORMAL EMITTANCE AT λ = 0.665 (15, p. 74, 75)

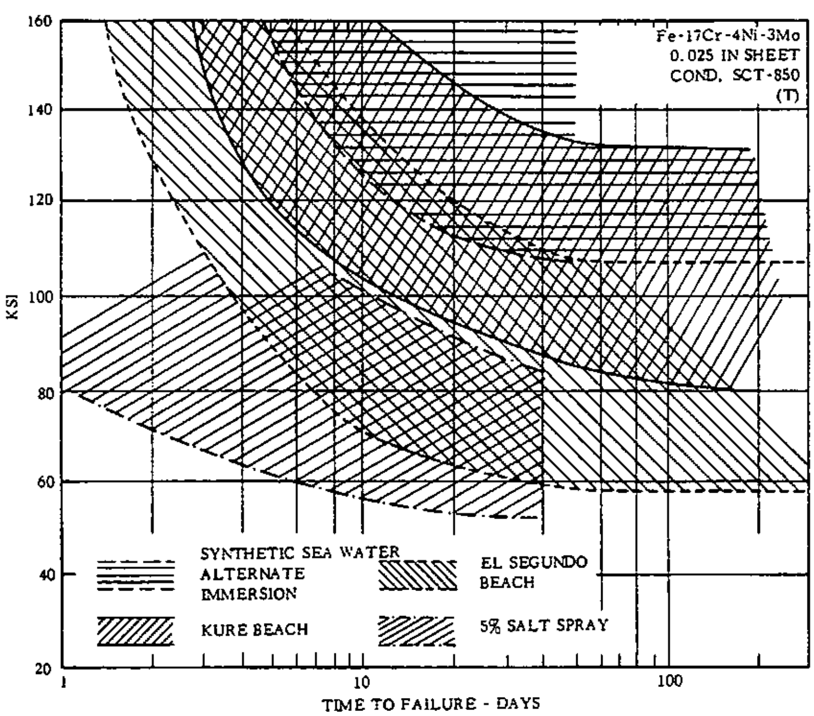

FIG. 2.0331 EFFECT OF SEVERAL STRESS CORROSION ENVIRONMENTS ON TIME TO FAILURE OF UNNOTCHED SHEET IN SCT-850 CONDITION (17, Fig. 15)

Fe
17 Cr
4 Ni
3 Mo

AM-350

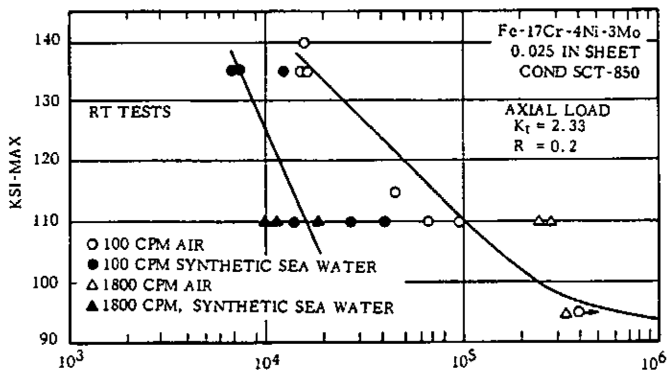

FIG. 2.0332 EFFECT OF SYNTHETIC SEA WATER ENVIRONMENT AND CYCLIC FREQUENCY ON AXIAL FATIGUE OF SHEET IN SCT-850 CONDITION (17, p. 297)

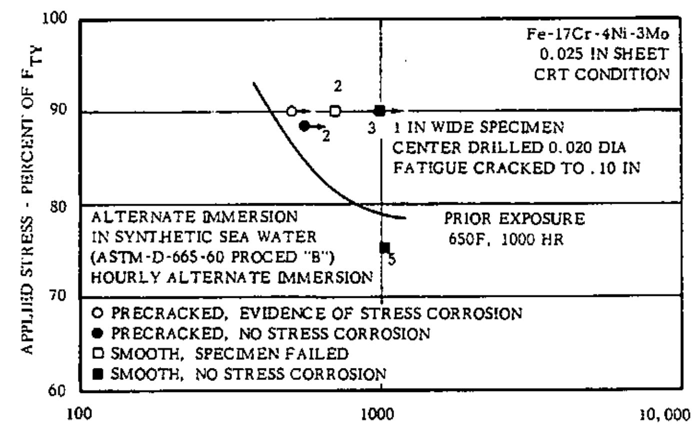

FIG. 2.0334 EFFECT OF APPLIED STRESS, PRECRACKING AND ALTERNATE IMMERSION IN SYNTHETIC SEA WATER ON RESISTANCE TO STRESS CORROSION CRACKING OF ALLOY IN CRT CONDITION SUBJECTED TO PRIOR EXPOSURE OF 650F FOF 1000 HR (17, Fig. 97)

Alloy	Fe-17Cr-4Ni-1Mo														
Form	Sheet & Strip			Sheet & Strip						Sheet & Strip					Tubing
Condition	Cold Rolled & Temper			Annealed						SCT 850					DA
Thickness - in.	<0.010	0.010 to 0.080	>0.080 to 0.125	0.0005 to 0.0015	>0.0015 to 0.002	>0.002 to 0.005	>0.005 to 0.0100	>0.0100 to 0.0200	>0.0200 to 0.1875	0.0005 to 0.0015	>0.0015 to 0.002	>0.002 to 0.0100	>0.0100 to 0.0500	>0.0500 to 0.1875	-
F_{tu}, (min)-ksi	200	200	200	200	197	194	191	188	185	185-215	185-215	185-215	185-215	185-215	165
F_{ty}, (min)-ksi	180	180	180	90	88	86	84	82	80	150	150	150	150	150	130
e, 2 in. (min)-per	6	8	10	8	9	10	12	14	20	2	4	6	8	10	10
Hardness															
RC (min)	43	43	43							42	42	42	42	42	-
RC (max)	–	–	–	25	25	25	25	25	25	48	48	48	48	48	-

TABLE 3.011. AMS SPECIFIED MECHANICAL PROPERTIES FOR STRIP, SHEET & TUBING (19)(20)(37)

Fe
17 Cr
4 Ni
3 Mo

AM-350

Alloy	Fe-17Cr-4Ni-1Mo
Form	Bars & Forgings
Condition	SCT 1000
F_{tu}, (min)-ksi	165
F_{ty}, (min)-ksi	140
e (4D) (min) percent	10
RA (min) percent	20
Hardness, RC	38
(min)	38
(max)	48

TABLE 3.012. AMS SPECIFIED MECHANICAL PROPERTIES FOR BARS & FORGINGS (18)

Alloy	Fe-17Cr-4Ni-3Mo					
Form	Bar		Sheet			
Condition	SCT 850	DA	L*	H	SCT 850	DA
Thickness - in						
F_{tu}, -min-ksi	185	165	200	185	185	165
-max-ksi	-	-	-	-	-	-
F_{ty}, -min-ksi	150	135	80	75	150	135
-max-ksi	-	-	-	-	-	-
e(2in) min-percent	10	10	15	20	10	8
RA -percent	20	20	-	-	-	-
Hardness						
RA -min	-	-	-	-	-	-
-max	-	-	-	-	-	-
RC -min	34	36	-	25	-	-
-max	48	46	-	-	-	-

(*) After re-anneal of Condition H by customer at 1710 ± 25F

TABLE 3.013. PRODUCER'S SPECIFIED MECHANICAL PROPERTIES (3)

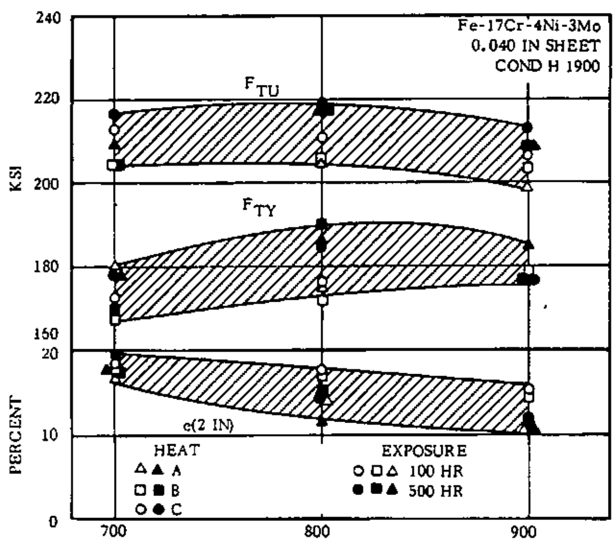

FIG. 3.0212 EFFECT OF EXPOSURE TIME AND TEMPERATURE ON ROOM TEMPERATURE TENSILE PROPERTIES OF SHEET FROM THREE HEATS IN CONDITION H-1900 (13, p. 3-4)

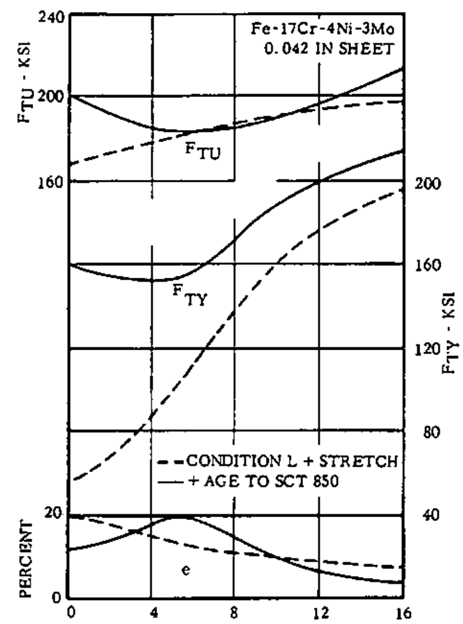

FIG. 3.0213 EFFECT OF STRETCHING AND SUBSEQUENT AGING TO CONDITION SCT 850 ON TENSILE PROPERTIES OF SHEET IN CONDITION L (1)

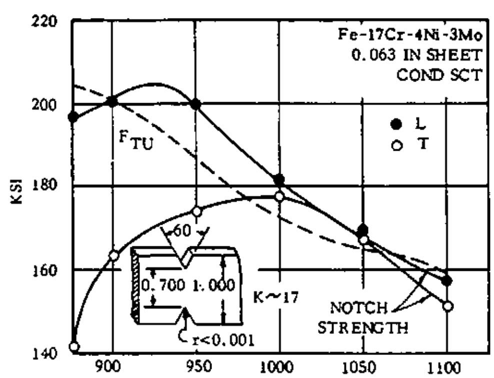

FIG. 3.0214 EFFECT OF TEMPERING TEMPERATURE AND TEST DIRECTION ON NOTCH STRENGTH OF SHEET (27)

Fe
17 Cr
4 Ni
3 Mo

AM-350

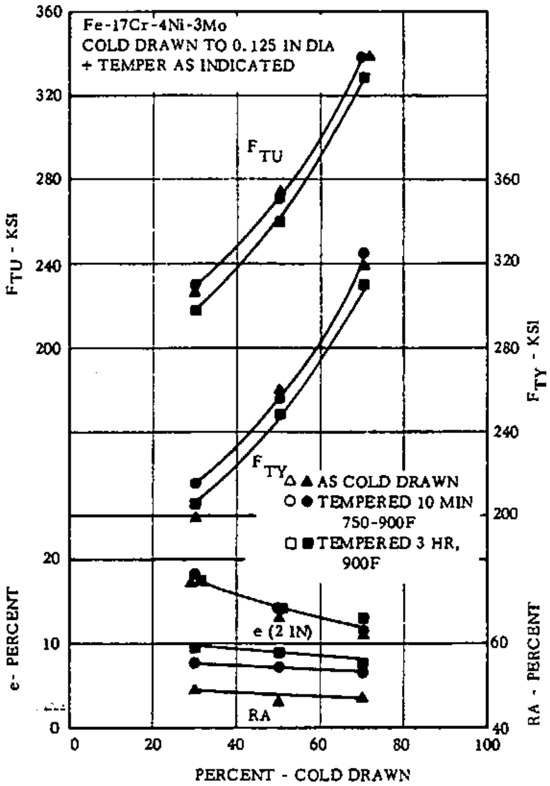

FIG. 3.0215 EFFECT OF PERCENT COLD DRAW AND OF TEMPERING TIME AND TEMPERATURE ON TENSILE PROPERTIES OF WIRE

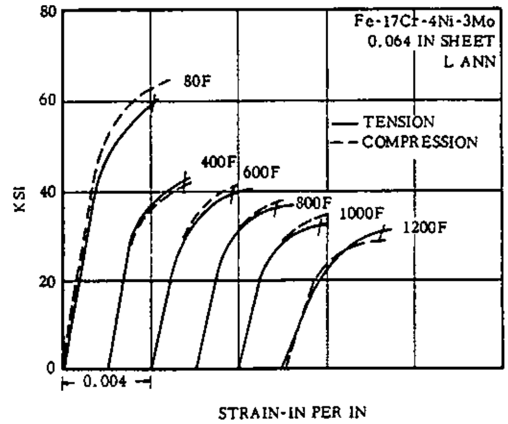

FIG. 3.03111 TENSILE AND COMPRESSIVE STRESS-STRAIN CURVES FOR SHEET IN ANNEALED CONDITION AT ROOM AND ELEVATED TEMPERATURES (10, Figs. 65, 66)

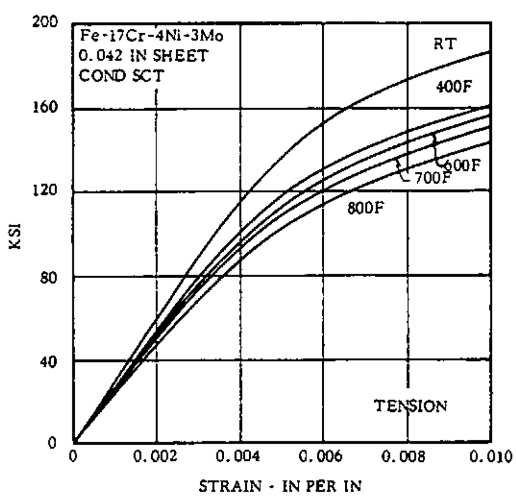

FIG. 3.03112 STRESS-STRAIN CURVES FOR SHEET IN SCT CONDITION AT ROOM AND ELEVATED TEMPERATURES (23)

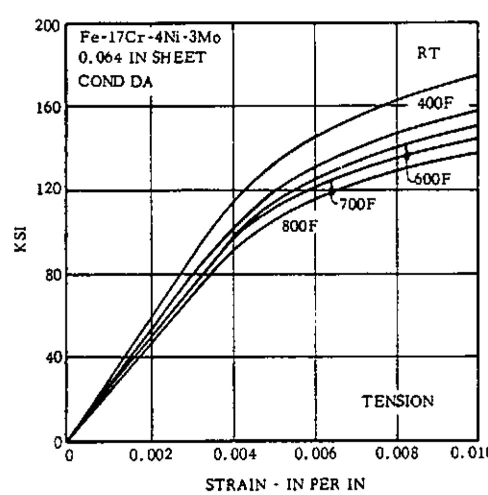

FIG. 3.03113 STRESS-STRAIN CURVES FOR SHEET IN DA CONDITION AT ROOM AND ELEVATED TEMPERATURES (23)

Fe
17 Cr
4 Ni
3 Mo

AM-350

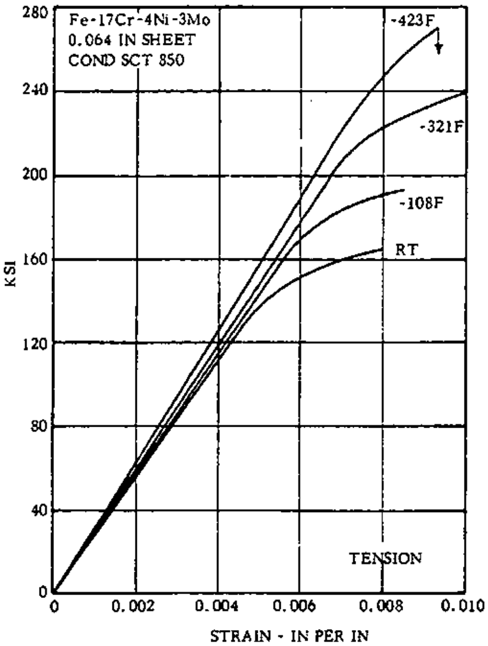

FIG. 3.03114 STRESS-STRAIN CURVES FOR SHEET IN SCT CONDITION AT LOW TEMPERATURES (24)

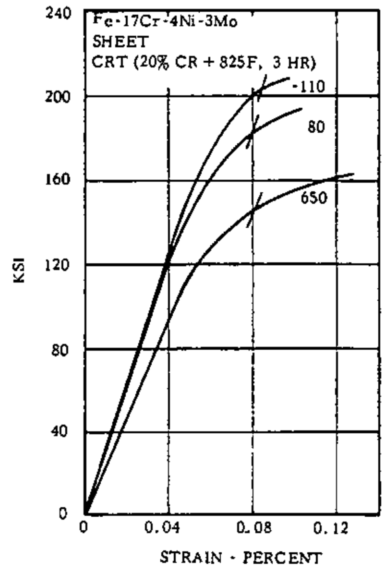

FIG. 3.03115 STRESS-STRAIN CURVES FOR SHEET IN 20 PERCENT CRT CONDITION AT TEMPERATURES BETWEEN -110 AND 650F

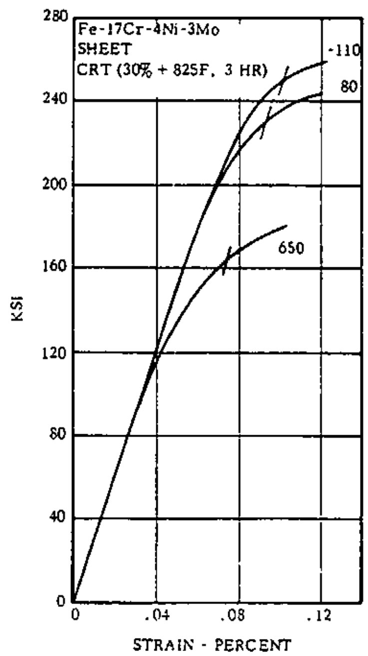

FIG. 3.03116 STRESS-STRAIN CURVES FOR SHEET IN 30 PERCENT CRT CONDITION AT TEMPERATURES BETWEEN -110 AND 650F

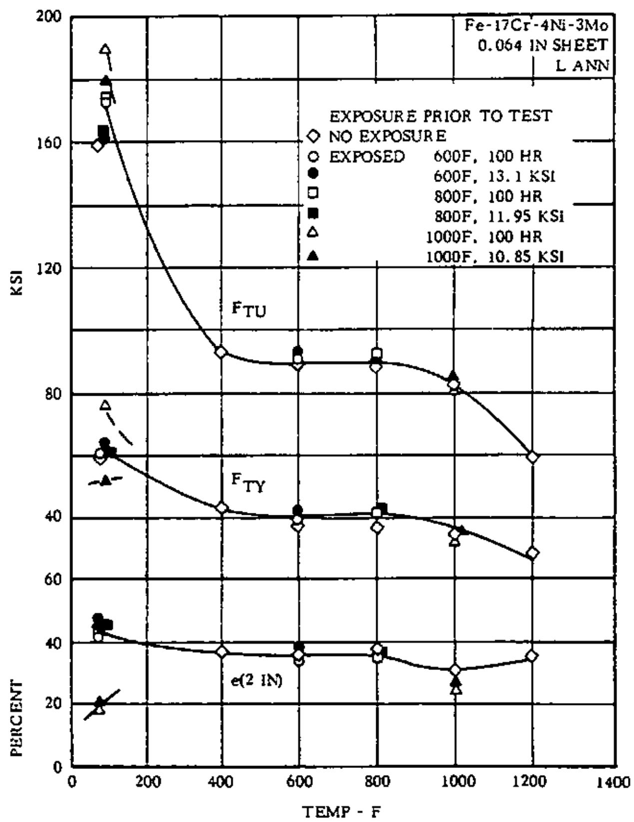

FIG. 3.0312 EFFECT OF TEST TEMPERATURE AND PRIOR EXPOSURE TO STRESS AND TEMPERATURE ON TENSILE PROPERTIES OF SHEET IN ANNEALED CONDITION (10, Fig. 22, 24, 25)

Fe
17 Cr
4 Ni
3 Mo

AM-350

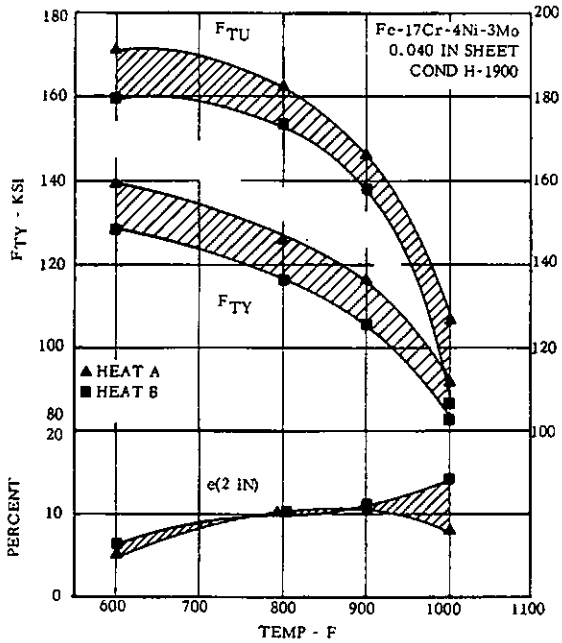

FIG. 3.0313 EFFECT OF TEST TEMPERATURE ON TENSILE PROPERTIES OF SHEET ROLLED FROM TWO HEATS IN CONDITION H-1900
(13, p. 1-2)

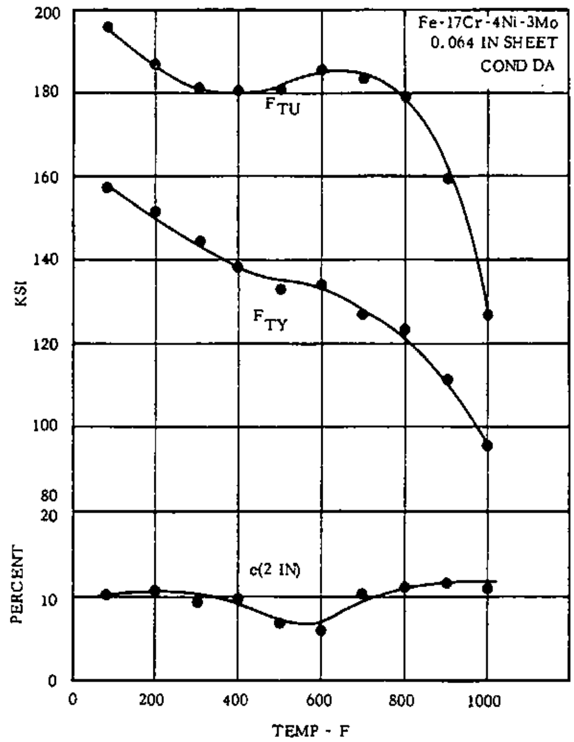

FIG. 3.0314 EFFECT OF TEST TEMPERATURE ON TENSILE PROPERTIES OF SHEET IN DA CONDITION
(23)

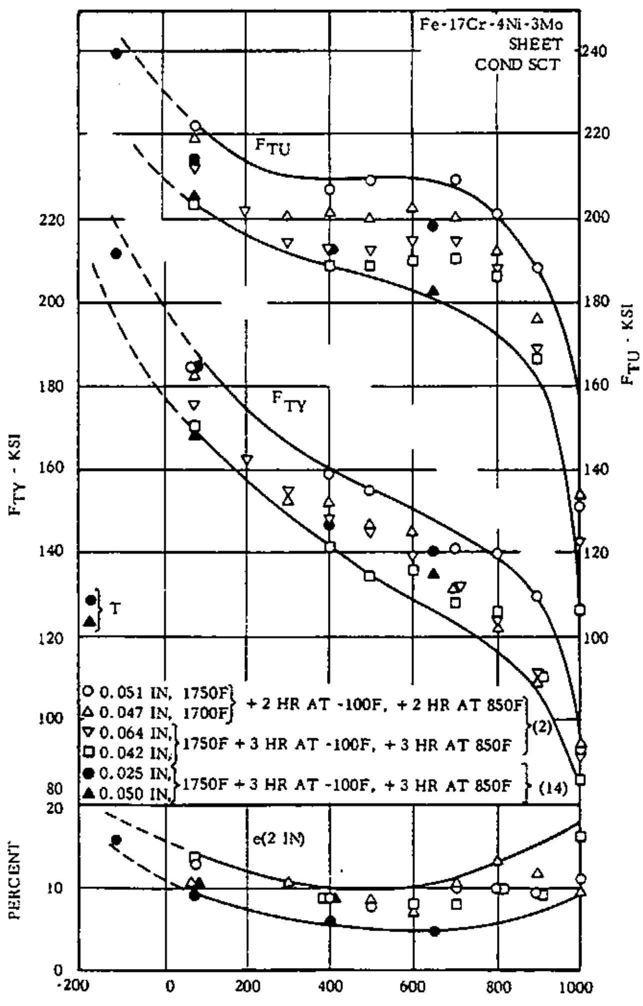

FIG. 3.0315 EFFECT OF TEST TEMPERATURE ON TENSILE PROPERTIES OF SHEET IN SCT CONDITION
(2) (14, p. 36)

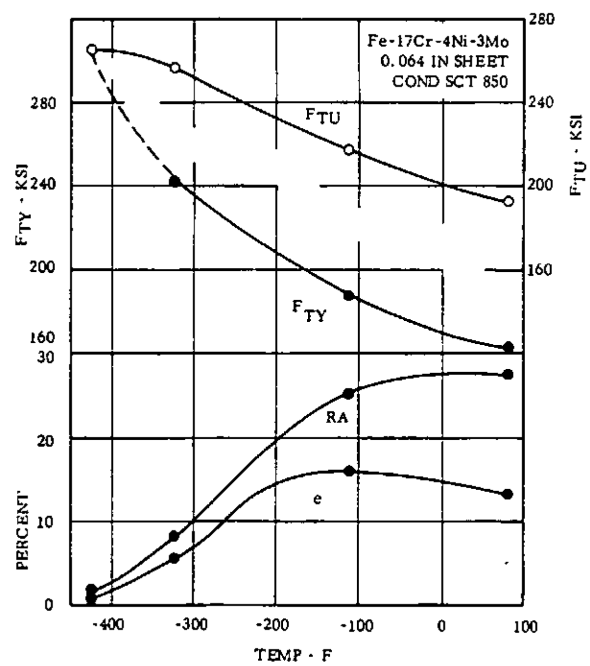

FIG. 3.0316 EFFECT OF LOW TEST TEMPERATURE ON TENSILE PROPERTIES OF SHEET IN SCT CONDITION
(28)

Fe
17 Cr
4 Ni
3 Mo

AM-350

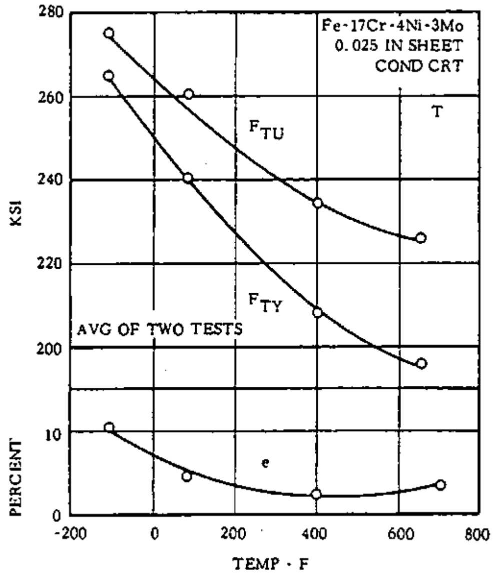

FIG. 3.0317 EFFECT OF TEST TEMPERATURE ON TRANSVERSE TENSILE PROPERTIES OF SHEET IN CRT CONDITION (14, p. 43)

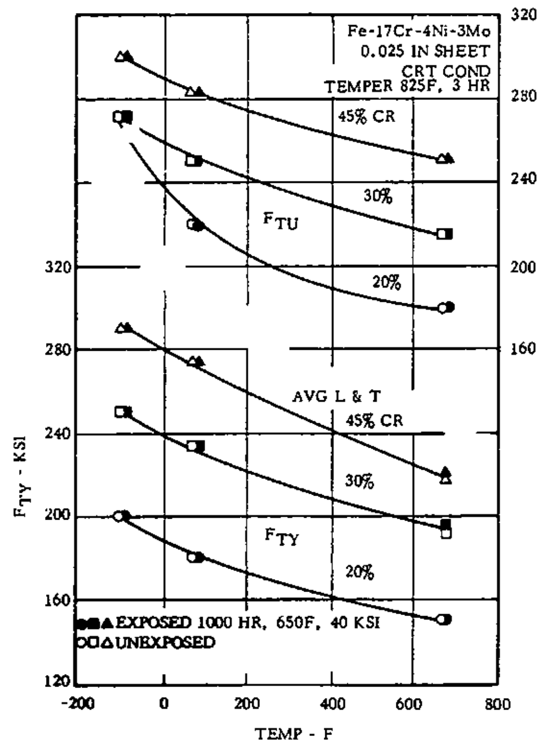

FIG. 3.0318 EFFECT OF TEST TEMPERATURE, COLD REDUCTION AND PRIOR EXPOSURE ON TENSILE PROPERTIES OF SHEET IN CRT CONDITION (12, p. 844)

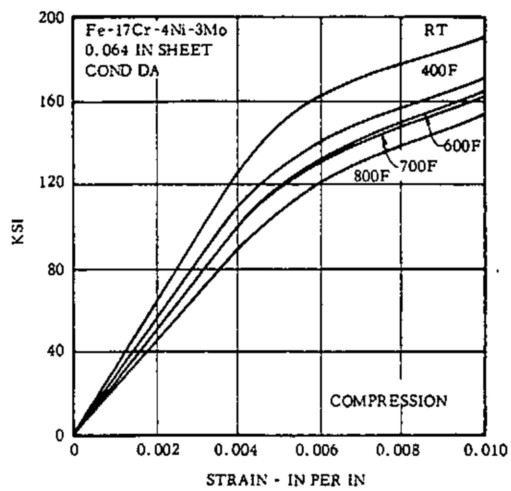

FIG. 3.0322 STRESS STRAIN CURVES IN COMPRESSION FOR SHEET IN DA CONDITION AT ROOM AND ELEVATED TEMPERATURES (23)

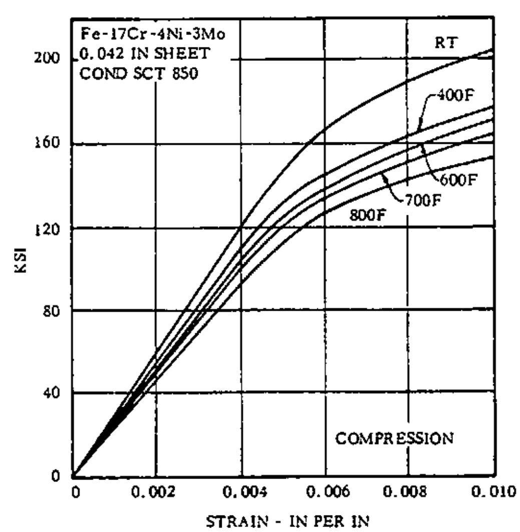

FIG. 3.0323 STRESS-STRAIN CURVES IN COMPRESSION FOR SHEET IN SCT CONDITION AT ROOM AND ELEVATED TEMPERATURES (23)

Fe
17 Cr
4 Ni
3 Mo

AM-350

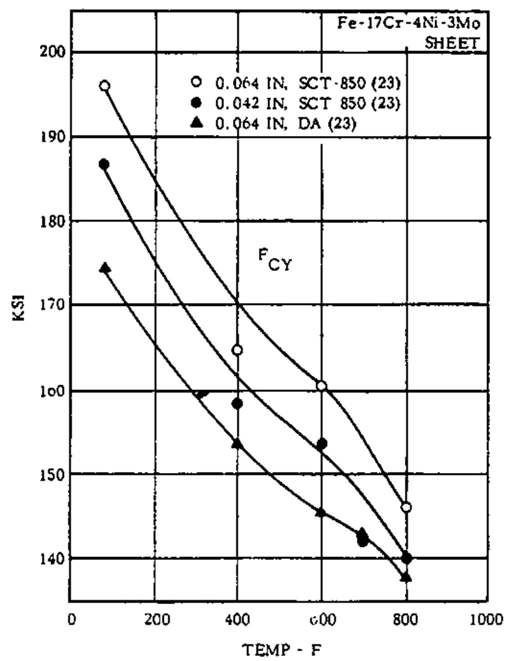

FIG. 3.0324 EFFECT OF TEST TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF SHEET IN CONDITIONS H, DA AND SCT (23)

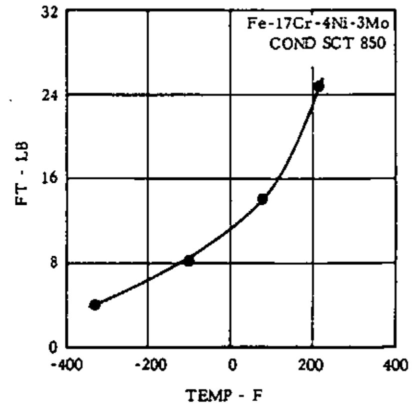

FIG. 3.0331 EFFECT OF TEST TEMPERATURE ON CHARPY V IMPACT PROPERTIES OF ALLOY IN SCT CONDITION (5, p. A-2-3)

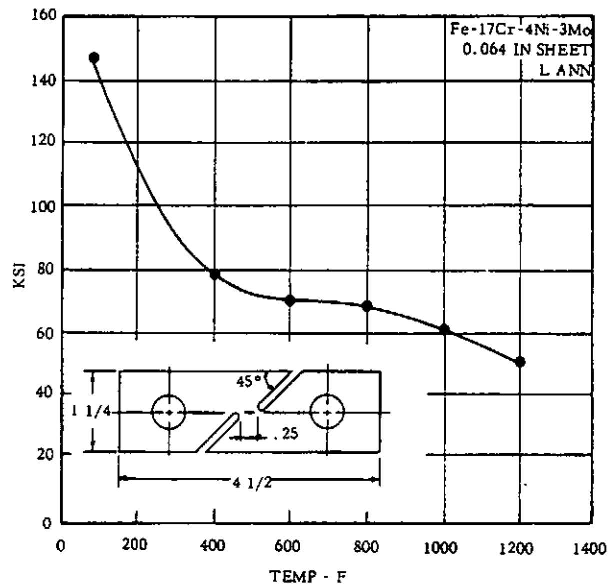

FIG. 3.0351 EFFECT OF TEST TEMPERATURE ON SHEAR STRENGTH OF SHEET IN ANNEALED CONDITION (10, Fig. 29)

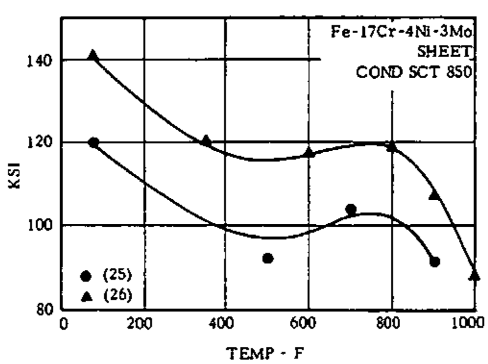

FIG. 3.0352 EFFECT OF TEST TEMPERATURE ON SHEAR STRENGTH OF SHEET IN CONDITION SCT 850 (25)(26)

Fe
17 Cr
4 Ni
3 Mo

AM-350

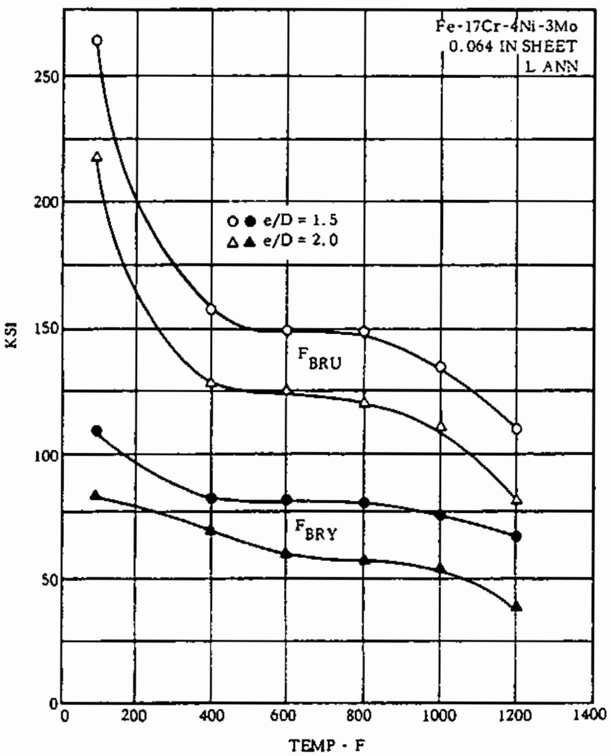

FIG. 3.0361 EFFECT OF TEST TEMPERATURE ON BEARING PROPERTIES OF SHEET IN ANNEALED CONDITION (10)

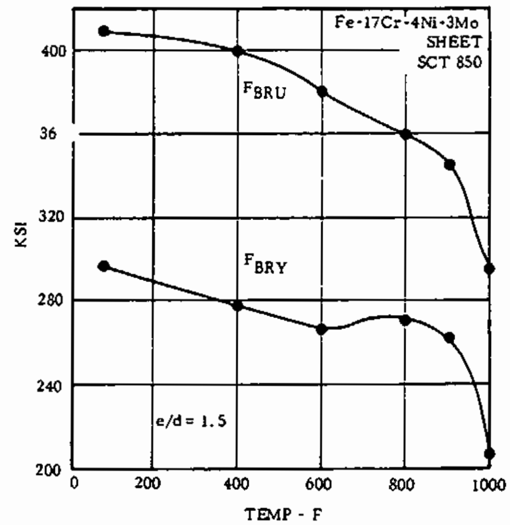

FIG. 3.0362 EFFECT OF TEST TEMPERATURE ON BEARING PROPERTIES OF SHEET IN CONDITION SCT 850 (25)

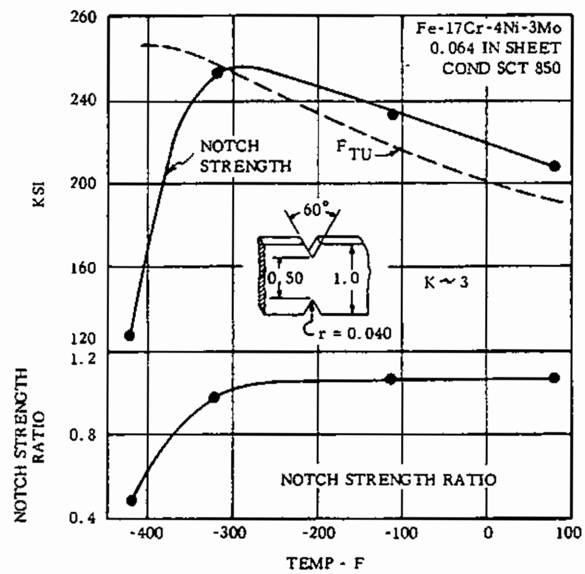

FIG. 3.0371 EFFECT OF LOW TEST TEMPERATURE ON NOTCH STRENGTH AND NOTCH STRENGTH RATIO OF SHEET IN SCT CONDITION (24)

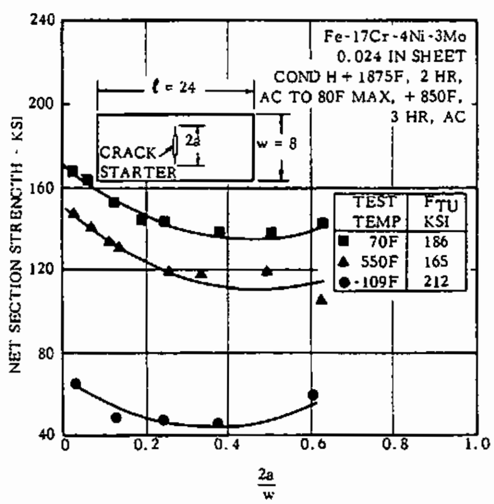

FIG. 3.0372 EFFECT OF NET SECTION AREA AND TEST TEMPERATURE ON NET SECTION STRENGTH OF SHEET IN DA CONDITION (7, Tbl. 2,3,5)

Fe
17 Cr
4 Ni
3 Mo

AM-350

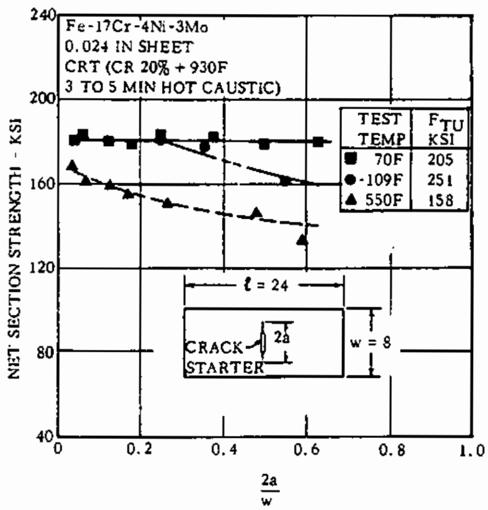

FIG. 3.0373 EFFECT OF NET SECTION AREA AND TEST TEMPERATURE ON NET SECTION STRENGTH OF SHEET IN CRT CONDITION (7, p. 11-13)

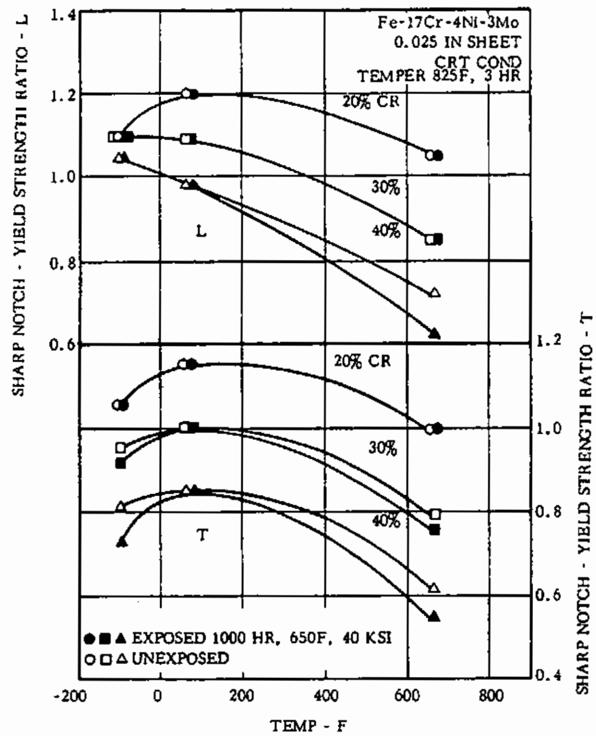

FIG. 3.0374 EFFECT OF TEST TEMPERATURE, COLD REDUCTION, TEST DIRECTION AND PRIOR EXPOSURE ON RATIO OF SHARP NOTCH STRENGTH TO YIELD STRENGTH OF SHEET IN CRT CONDITION (12, p. 844)

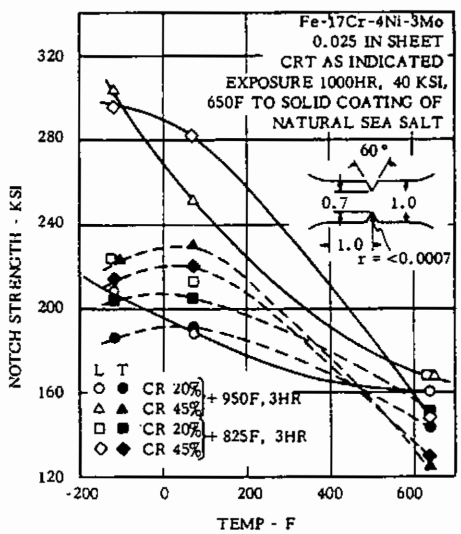

FIG. 3.0375 EFFECT OF TEST TEMPERATURE, AMOUNT OF COLD WORK, TEMPERING CONDITIONS AND TESTING DIRECTION ON NOTCH TENSILE STRENGTH AFTER EXPOSURE TO COATING OF NATURAL SEA SALT WHILE UNDER STRESS AT HIGH TEMPERATURE (4, p. 99)

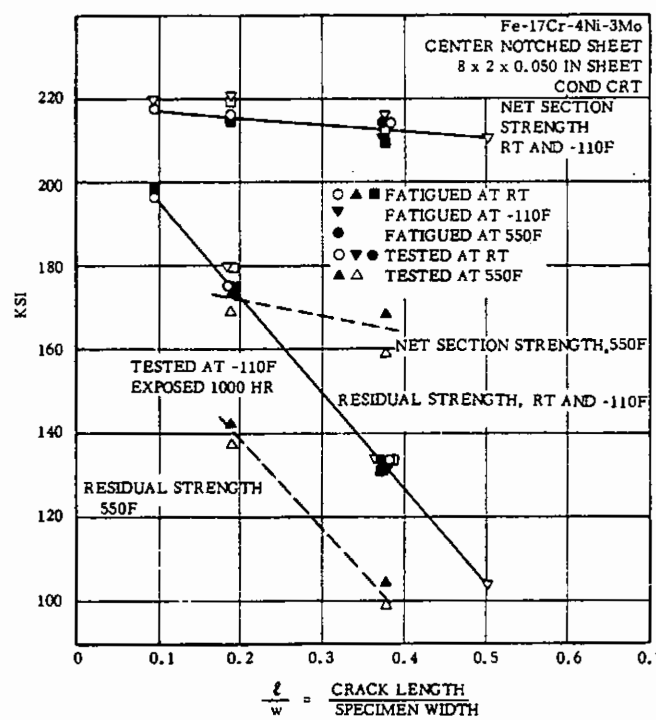

FIG. 3.0376 EFFECT OF CRACK LENGTH FRACTION, METHOD OF PRODUCING CRACK, PRIOR EXPOSURE AND TEST TEMPERATURE ON RESIDUAL STRENGTH AND NET SECTION STRENGTH OF SHEET IN CRT CONDITION (8, p. 26, 27)

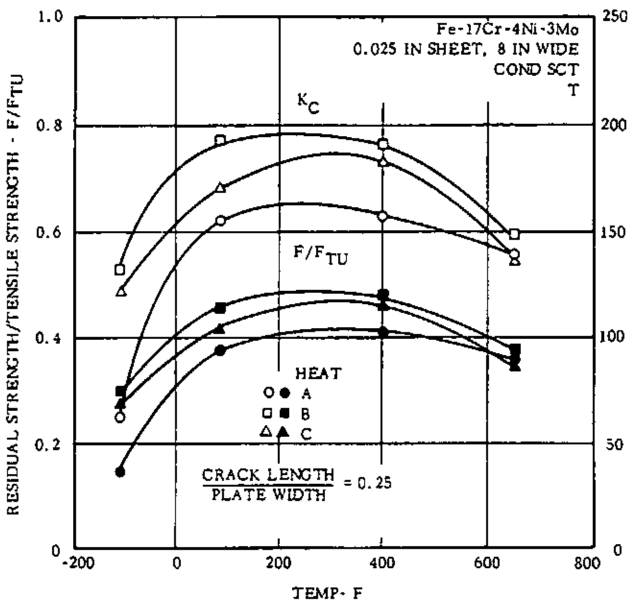

FIG. 3.0377 EFFECT OF TEST TEMPERATURE ON FRACTURE TOUGHNESS AND RESIDUAL STRENGTH RATIO OF THREE HEATS OF SHEET IN CONDITION SCT (14, p. 105)

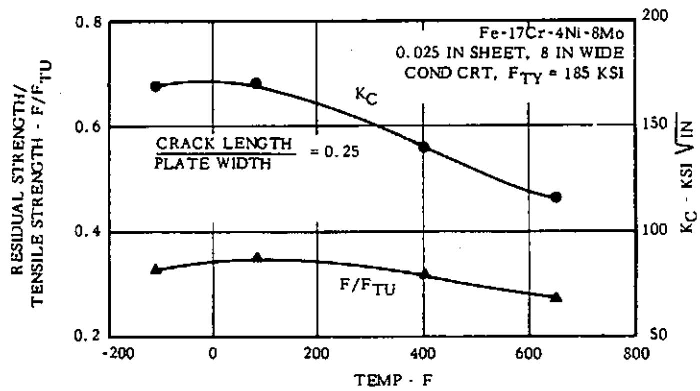

FIG. 3.0378 EFFECT OF TEST TEMPERATURE ON FRACTURE TOUGHNESS AND RESIDUAL STRENGTH RATIO OF SHEET IN CONDITION CRT (14, p. 143)

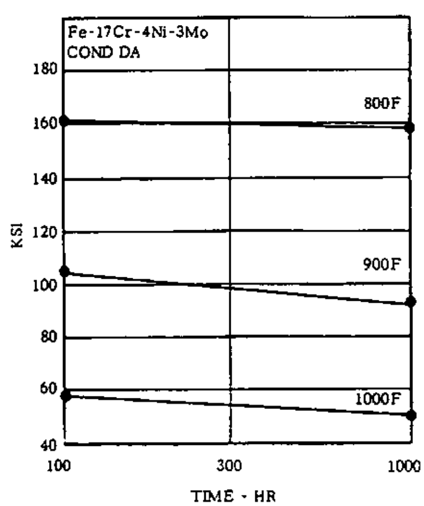

FIG. 3.0421 CREEP RUPTURE PROPERTIES AT 800 TO 1000F OF ALLOY IN DA CONDITION (5, p. A-1-2)

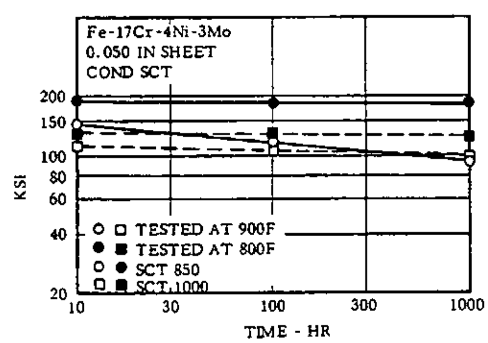

FIG. 3.0422 CREEP RUPTURE PROPERTIES AT 800 AND 900F OF SHEET IN SCT CONDITION (1, p. 7)

Fe
17 Cr
4 Ni
3 Mo

AM-350

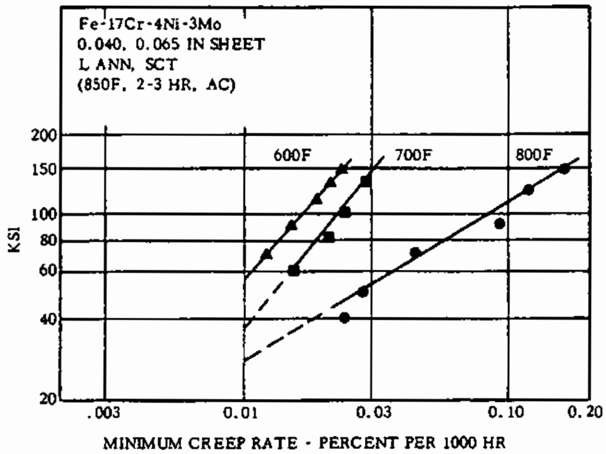

FIG. 3.0431 MINIMUM CREEP RATE CURVES AT 600, 700 AND 800F FOR SHEET IN SCT CONDITION (3, p. 48)

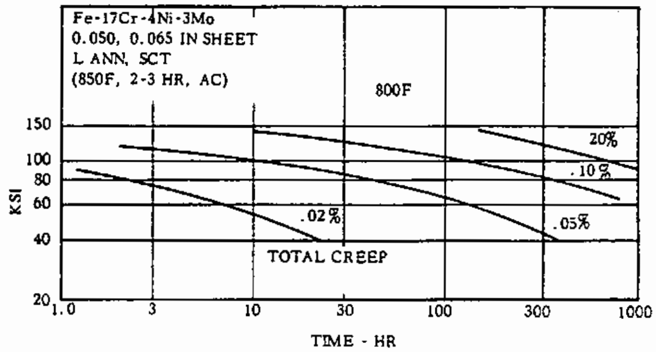

FIG. 3.0432 TOTAL CREEP CURVES AT 800F FOR SHEET IN SCT CONDITION (28)

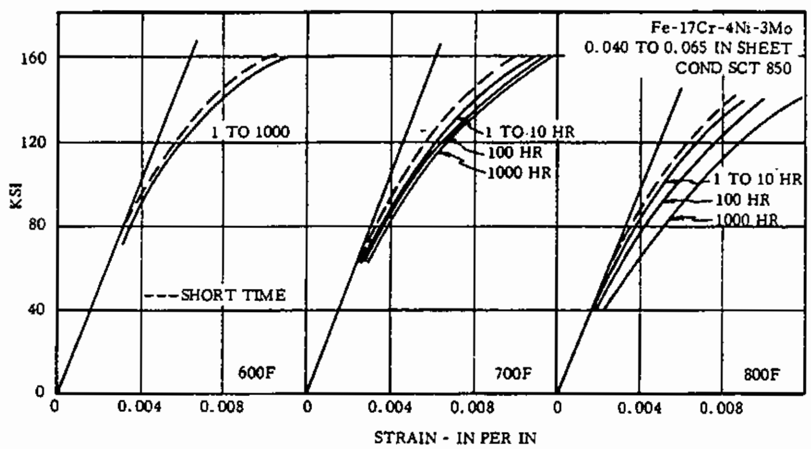

FIG. 3.0433 ISOCHRONOUS STRESS-STRAIN CURVES FOR SHEET IN CONDITION SCT AT 600 TO 800F (28)

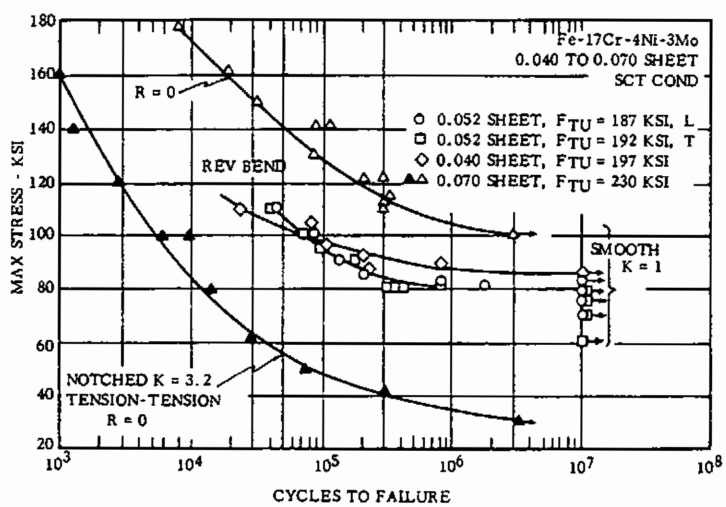

FIG. 3.051 FATIGUE CURVES FOR SHEET IN SCT CONDITION

(29) (Fig. 5, 6, 7)

Fe
17 Cr
4 Ni
3 Mo

AM-350

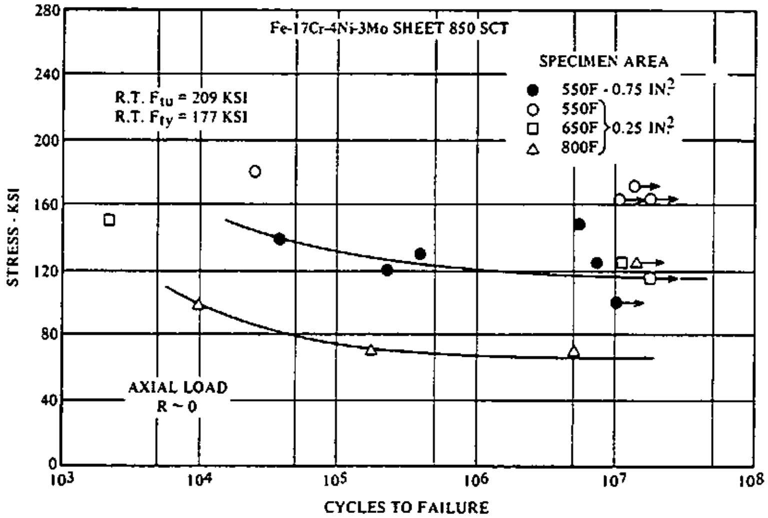

FIG. 3.052. S-N CURVE FOR SPECIMENS OF TWO SIZES HAVING RECTANGULAR CROSS SECTIONS & TESTED AT SEVERAL TEMPERATURES (23)

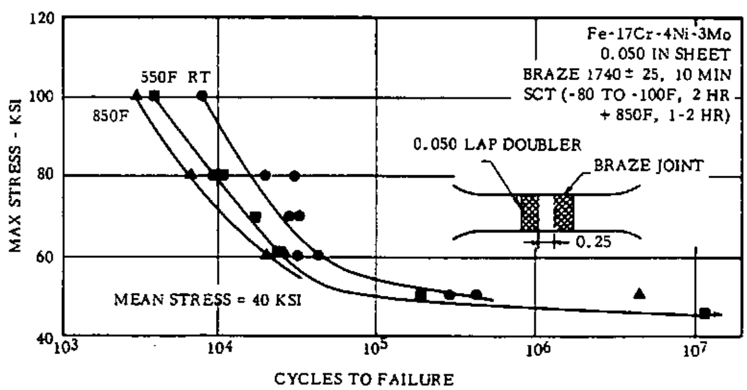

FIG. 3.053 EFFECT OF STRESS AND TEST TEMPERATURE ON FATIGUE OF BRAZED LAP JOINTS OF SHEET IN SCT CONDITION (9, p. 45)

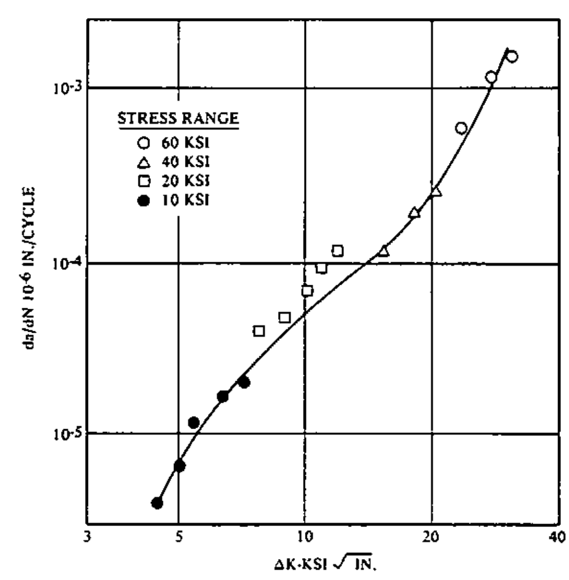

FIG. 3.054. CRACK PROPAGATION RATE AS A FUNCTION OF THE STRESS INTENSITY FACTOR RANGE FOR AM 350 CRT STAINLESS STEEL SHEET (33)

Alloy	Fe-17Cr-4Ni-1Mo			
Form	0.040 in sheet, smooth and notched, notched sheet 60°V, depth 0.010 inch, radius 0.005 inch machined across flat surface			
Condition	Brazed at 1900F cooled to RT,+ SCT-850 salt coated by dripping in hot concentrated 6 parts NaCl + 1 part $MgCl_2$ and drying			
Test Method	Cantilever beam, 650F in circulating air furnace			
	Maximum stress, ksi		Fracture	Surface condition
Test Condition	Smooth	Notched	time, hours	at 4700 hours
Bare surface, continuously exposed	58.3, 59.0, 59.1	160.3, 159.4	(a)	Slight bluing
Salt coated, Continuously exposed (b)	55.9, 55, 58.1	152.8, 148.4	(a)	Gold to brown color rust spots on 20 to 50 percent of surface
Brazed and salt coated, continuously exposed	51.6, 50.8, 52.1	129.5, 186	(a)	
Salt coated - 2 weeks at 650F, + 2 weeks in humidity cabinet at 100F intermittently	57.1 57.2 57.0 56.3		3360 3290 3290 2880	Surface heavily rusted, and two specimens had cracks other than failure

(a) Unbroken at 4700 hours (b) Salt coating appeared spotty at 4700 hours

TABLE 3.055. FATIGUE BEHAVIOR OF SMOOTH & NOTCHED SHEET WITH SALT COATING (4)

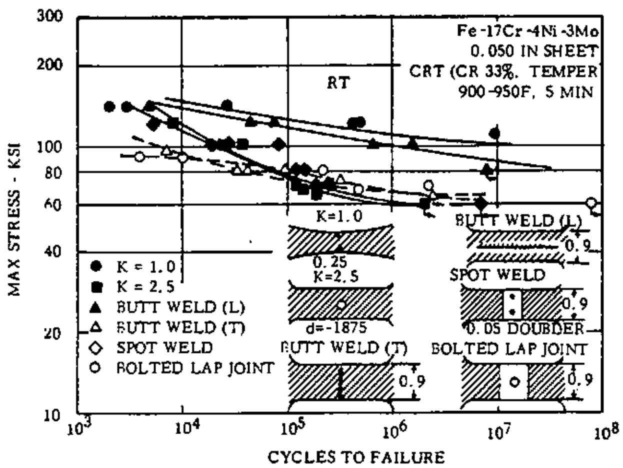

FIG. 3.056 EFFECT OF JOINING METHOD AND OF STRESS CONCENTRATION ON FATIGUE BEHAVIOR AT ROOM TEMPERATURE OF SHEET IN CONDITION CRT (9, p. 40-46)

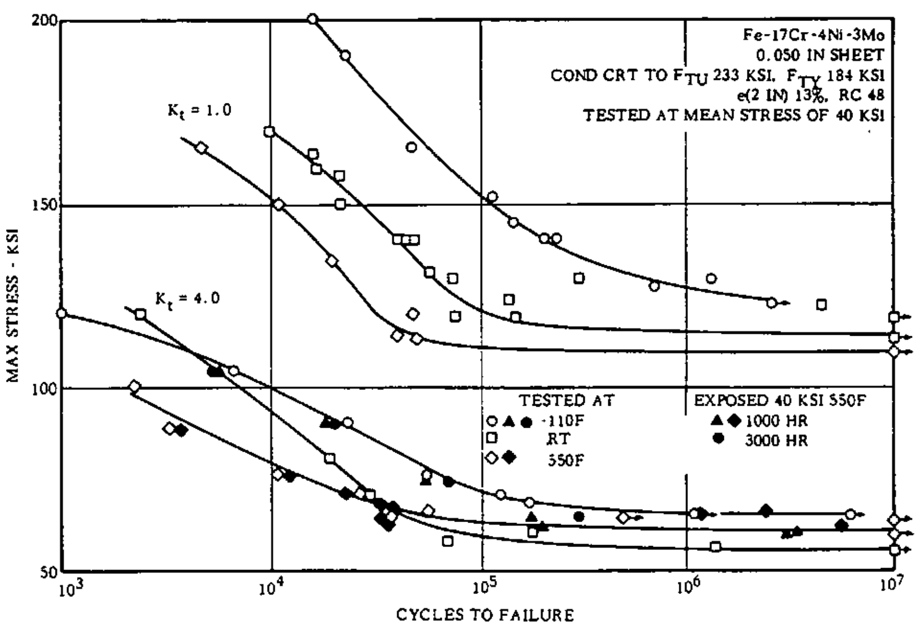

FIG. 3.057 EFFECT OF TEST TEMPERATURE AND PRIOR EXPOSURE ON FATIGUE BEHAVIOR OF SMOOTH AND NOTCHED SHEET IN CONDITION CRT (28, Fig. 16, 17, 18, 19)

Fe
17 Cr
4 Ni
3 Mo

AM-350

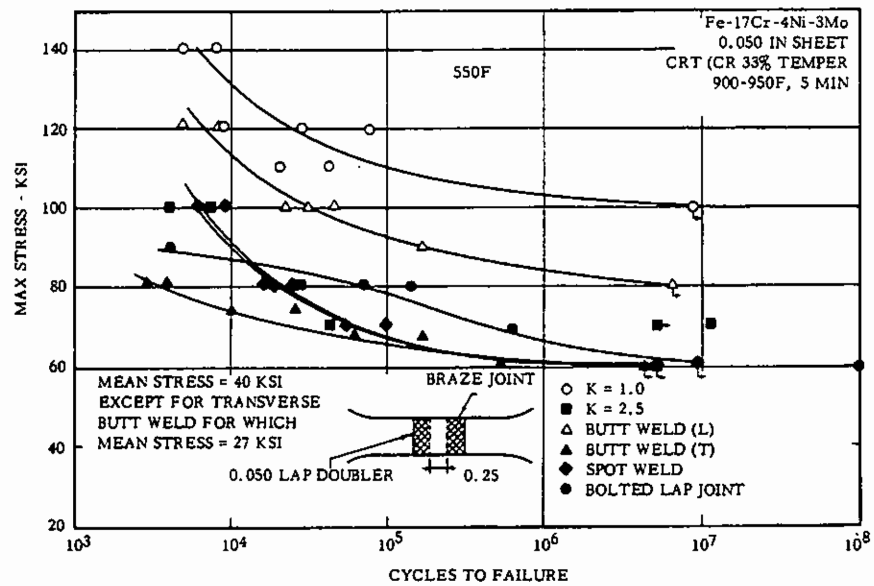

FIG. 3.058. EFFECT OF JOINING METHOD AND OF STRESS CONCENTRATION ON FATIGUE BEHAVIOR AT 550F OF SHEET IN CONDITION CRT (23, Fig. 5-9, 11)

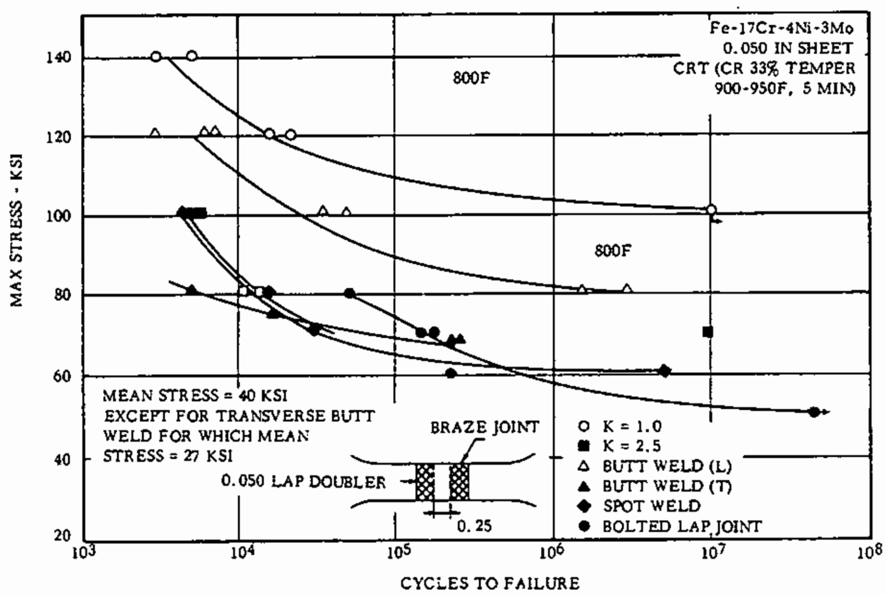

FIG. 3.059 EFFECT OF JOINING METHOD AND OF STRESS CONCENTRATION ON FATIGUE BEHAVIOR AT 800F OF SHEET IN CONDITION CRT (23, Fig. 5-9, 11)

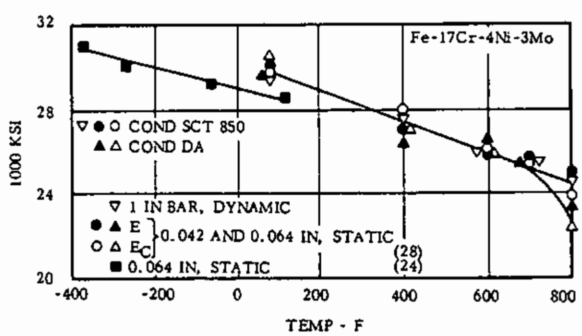

FIG. 3.0621 MODULUS OF ELASTICITY AT VARIOUS TEMPERATURES OF ALLOY IN CONDITIONS SCT 850 AND DA (24)(28)

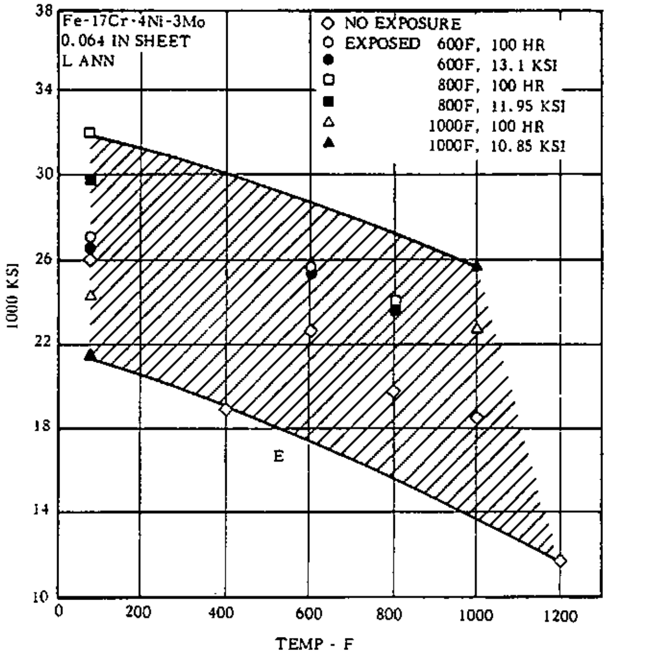

FIG. 3.0622 EFFECT OF TEST TEMPERATURE AND PRIOR EXPOSURE TO STRESS AND TEMPERATURE ON ELASTIC MODULUS OF SHEET IN ANNEALED CONDITION (10, Tbl. 6, 10, 14)

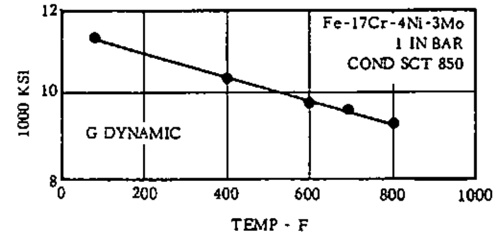

FIG. 3.063 MODULUS OF RIGIDITY AT ROOM AND ELEVATED TEMPERATURES (30)

Fe
17 Cr
4 Ni
3 Mo

AM-350

Alloy	Fe-17Cr-4Ni-3Mo				
Form	0.078-in. Sheet				
Condition	H-Annealed + GTA Weld + Heat Treatment				
Material	Heat Treatment	Yield Strength 0.2% Offset, ksi	Tensile Strength, ksi	Elong., in 2 in., %	Fracture
AM 350 with 350 Filler Metal	As Welded	83	145	6.5	in Weld
AM 350 with 355 Filler Metal	As Welded	62	136	12.0	in Weld
AM 350 with 350 Filler Metal	Welded + SCT (850 F)	87	148	6.0	in Weld
AM 350 with 355 Filler Metal	Welded + SCT (850 F)	90	153	8.0	in Weld
AM 350 with 350 Filler Metal	Welded + 1710 F + SCT (850 F)	165	191	4.0	in Weld
AM 350 with 355 Filler Metal	Welded + 1710 F + SCT (850 F)	169	199	9.0	Base Metal
AM 350 with 350 Filler Metal	Welded + DA	153	178	9.0	Base Metal
AM 350 with 355 Filler Metal	Welded + DA	157	184	8.0	Base Metal
AM 350 with 350 Filler Metal	Welded + 1710 F + DA	160	188	5.0	in Weld
AM 350 with 355 Filler Metal	Welded + 1710 F + DA	156	185	8.0	Base Metal

TABLE 4.0312. THE PROPERTIES OF AM 350 WELDED WITH AM 350 OR AM 355 FILLER METAL (34)

Alloy	Fe-17Cr-4Ni-3Mo			
Form	0.078-in. Sheet			
Condition	H-Annealed + GTA Welded with AM 350 Filler + Heat Treatment			
Post Weld Heat Treatment	Yield Strength 0.2% Offset, ksi	Tensile Strength, ksi	Elongation in 2 in., %	Elongation in 0.5 in., %
As Welded	83	145	6.5	27.0
Welded + SCT (850 F)	87	148	n.a.	n.a.
Welded + 1710 F + SCT (850 F)	165	191	4.0	19.0
Welded + 1710 F + SCT (1000 F)	145	165	11.0	n.a.
Welded + DA	153	178	9.0	7.0
Welded + 1710 + DA	160	180	n.a.	n.a.

TABLE 4.0313. TENSILE PROPERTIES OF SHEET WELDED TRANSVERSE TO ROLLING DIRECTION & GIVEN SEVERAL POST WELD TREATMENTS (35)

Fe
17 Cr
4 Ni
3 Mo

AM-350

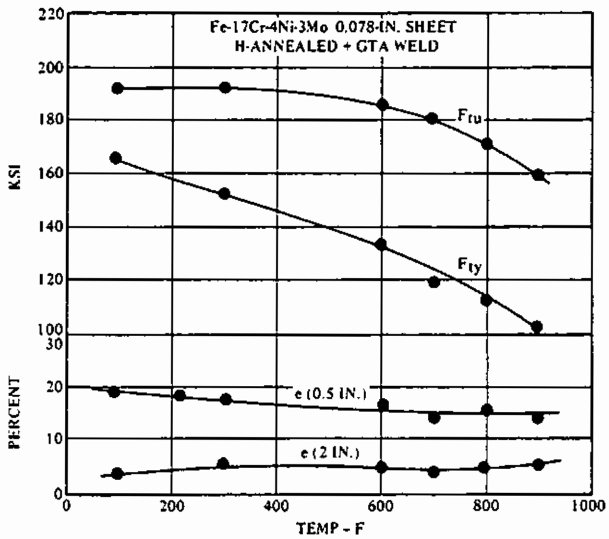

FIG. 4.0314. ELEVATED TEMPERATURE PROPERTIES OF SHEET WELDED TRANSVERSE TO THE ROLLING DIRECTION CONDITION: WELDED, 1710 F, SCT (850F) (35)

Alloy	Fe-17Cr-4Ni-3Mo					
Form	0.024-in. Sheet					
Condition	Electrode diam, in.	Electrode Force, pounds	Weld Time, cycles	Welding Current, amp	Weld diam, in.	Shear Strength, pounds
1750 F then welded	5/32	1200	10	8,500	5/32	1120
	5/32	1200	12	8,500	5/32	1090
	5/32	1200	14	8,500	5/32	1060
	5/32	1200	16	8,500	5/32	1065
	1/4	1200	24	10,500	7/32	1020
	1/4	1200	26	10,500	7/32	1000
	1/4	1200	28	10,500	7/32	1070
	1/4	1200	30	10,500	7/32	1140
1750 F, SCT (850 F) then welded	5/32	1200	12	7,500	5/32	1020
	5/32	1200	14	7,500	6/32	1000
	5/32	1200	16	7,500	6/32	1070
	5/32	1200	18	7,500	6/32	1140
	1/4	1200	12	9,500	6/32	1440
	1/4	1200	14	9,500	6/32	1445
	1/4	1200	16	9,500	7/32	1510
	1/4	1200	18	9,500	7/32	1500

TABLE 4.0315. TENSION SHEAR STRENGTH OF SPOT WELDED SHEET (36)