	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

GENERAL

Alloy 300 M is a modified 4340 (Code 1206) high-strength low-alloy steel, which is capable of providing somewhat higher strength than 4340 alloy along with good toughness. The modifications, which consist of higher contents of silicon, molybdenum, and carbon plus a small addition of vanadium, provide improved hardenability and resistance to softening during tempering; furthermore, they increase to above 600 F the tempering-temperature range for tempered-martensite embrittlement (also known as 500 F embrittlement). Consequently, 300 M is generally used after it has been oil quenched and then tempered at approximately 600 F, which provides tensile strength of 270–300 ksi and good toughness. It is normally not recommended for use at temperatures above 600 F. For aerospace applications requiring optimum properties, the vacuum-arc remelted alloy is generally used, but relatively recent investigations have shown that electroslag remelting also provides excellent quality. Although it is not recommended for applications in which high-efficiency weld joints are critical, it can be welded with conventional techniques and proper preheat and postheat treatments. The alloy is most suitable for applications requiring a combination of ultrahigh strength and good toughness in heavy sections at moderate temperatures. Typical applications include aircraft landing gear, airframe parts, fasteners, gears, and shafts. (14,18,27,28,37)

1.01 Commercial Designation

300 M.

1.02 Alternate Designations

Tricent (obsolete), 4340 M (obsolete), UNS K44220 (standard grade covered by AMS 6419B; see Table 1.04), UNS K44540 (slightly lower carbon grade covered by AMS 6417C; see Table 1.04).

1.03 Specifications

Table 1.03.

1.04 Composition

Table 1.04.

1.05 Heat Treatment

1.051 Normalize, 1650 to 1725 F, air cool. In section sizes up to at least 1.0 in., the alloy is air hardening, which results in normalized properties quite similar to oil quenched (see Figure 3.0212).(13,26,27)

1.052 Temper after normalizing for improved machinability 1200 to 1250 F, 1 hour minimum, air cool. Charging into tempering furnace should be done before the steel reaches room temperature. (26)

1.053 Spheroidize anneal, 1430 F, cool to 1200 F at a rate no faster than 10 F per hour, cool to 900 F no faster than 20 F per hour, air cool. (26–28)

1.054 Harden. Traditionally the alloy has been hardened by austenitizing at 1575 to 1625 F and oil quenching to below 160 F; AMS specifications (29,30), for example, require austenitization at 1600 F. For minimum distortion, 300 M parts are sometimes quenched from the austenitizing temperature into salt at about 400 F, held 10 minutes, and then air cooled. Recent investigations have shown that fracture toughness can be improved with increased austenitizing temperatures up to 2200 F when subsequent tempering temperatures are below 700 F. (See Figures 3.02722, 3.02723, 3.02726, and Table 3.02727.) On the other hand, increased austenitizing temperatures tend to cause decreases in tensile ductility and notch impact resistance. (See Figures 3.0215, 3.0233, 3.0335, and Tables 3.0217 and 3.0234.) (26–28)

1.055 Temper after hardening, 525–625 F, 2 hours minimum, air cool; double temper is recommended. Tempering within this range provides the optimum combination of high strength and toughness; consequently, tempering at other temperatures is not normally recommended. The AMS specifications (29,30) require double tempering at 575 F. Like other heat-treatable low-alloy steels, tensile strength and hardness decrease continuously with increasing tempering temperatures up to about 1200 F while corresponding increases occur in ductility and toughness except in the tempered-martensite-embrittlement (TEM) range, which is about 700 to 900 F for 300 M alloy. Tempering within that range should be especially avoided. (22, 26–28)

1.056 The time required for complete austenitization during normalizing and hardening treatments increases with increasing section size.

1.0561 Times recommended for austenitization of various section sizes in gaseous and salt-bath environments during normalizing and hardening treatments, Figure 1.0561.

1.057 At elevated temperatures, the alloy is highly susceptible to decarburization, which is detrimental to mechanical properties, particularly fatigue resistance. Consequently, austenitizing should be carried out in controlled endothermic atmosphere, salt bath, or vacuum. (26,37)

1.06 Hardness

1.061 Effect of tempering temperature on hardness, Figure 1.061.

1.062 End-quench hardenability, Figure 1.062.

1.063 Hardness of spheroidize-annealed alloy: RB 96, BHN 215 (28).

1.07 Forms and Conditions Available

1.071 It is available mostly in relatively heavy wrought forms such as bars, forging billets, forgings, and tubing; it has also been produced in the form of plate, sheet, wire, and castings. (26–28,37)

1.072 The different wrought products are furnished by the mills in various conditions including cold-finished, hot-finished, spheroidize annealed, and normalized and tempered. (29,30)

1.08 Melting and Casting Practice

1.081 Although the alloy has been produced by the conventional electric-furnace method, for aerospace applications vacuum-arc remelting has been the most common melting practice; but electroslag remelting has also been shown to provide excellent results (see Tables 3.0213 and 3.0235 and Figures 3.0214, 3.0232, and 3.02721).

1.09 **Special Considerations**

1.091 Like other high-strength low-alloy steels, 300 M is susceptible to hydrogen embrittlement as a result of acid pickling or plating operations; generally, the higher the strength, the greater the susceptibility. Baking for about 2 to 6 hours at temperatures of 375 to 550 F is generally recommended for relieving the embrittlement, although longer baking times up to as much as 100 hours have been found necessary to eliminate hydrogen completely from certain types of electroplated samples. (28,40)

1.092 In moist environments, fully heat-treated 300 M is susceptible to stress-corrosion cracking, which is believed to be a result of cathodically released hydrogen. This phenomenon is common to high-strength martensitic steels. For 300 M, in various aqueous environments at room temperature, K_{Iscc} values ranging from about 10 to 18 have been reported. For smooth specimens, uniform tensile stresses above 115 ksi in the short-transverse orientation are capable of inducing stress-corrosion cracking. See Section 2.032 for more details. (14,16)

1.093 The fatigue-crack growth rate of 300 M is markedly increased by aqueous environments and by decreasing cyclic frequency. (See Figures 3.057 and 3.059.) These effects are also believed to be a result of cathodically released hydrogen. (1,16)

1.094 After the alloy has been quenched and tempered to obtain optimum properties, any heating above the tempering range (525–625 F) causes a deterioration of mechanical properties.

1.095 Like other high-strength martensitic steels the notch strength and toughness generally decrease with decreasing temperature. The severity of the decrease in these properties and the temperature range in which it occurs vary with heat treatment, notch sharpness, and section size and configuration. (See Figures 3.0331–3.0335, 3.03711, 3.03712, and 3.03721.)

2 PHYSICAL AND ENVIRONMENTAL EFFECTS

2.01 **Thermal Properties**

Only a limited amount of specific data has been published on the thermal and other physical properties of 300 M. Because of their similarity of chemical composition and metallurgical characteristics, 300 M and 4340 (Code 1206) are believed to be quite similar in these properties.

2.011 Melting range.

2.012 Phase changes.

2.0121 Time-temperature-transformation diagram, Figure 2.0121.

2.0122 Above 1500 F, the steel consists of stable austenite; upon very slow cooling the austenite transforms to ferrite and carbide, but upon rapid cooling it transforms to martensite.

2.0123 The critical points for heating and cooling rates of 400 F per hour are as follows: (28)

Ac1 1400 F (start of transformation during heating)
Ac3 1480 F (completion of transformation during heating)
Ar3 785 F (start of transformation during cooling)
Ar1 650 F (completion of transformation during cooling)

2.013 Thermal conductivity, 21.7 Btu/ft/hr ft^2 F at RT. (27) (See Figure 2.013, Code 1206.)

2.014 Thermal expansion, 6.3×10^{-6} in./in./F at RT. (27) (See Figure 2.014, Code 1206.)

2.015 Specific heat, 0.107 Btu/lb/F at RT. (27)

2.016 Thermal diffusivity.

2.02 **Other Physical Properties**

2.021 Density, 0.283 lb/in.^{3} at RT. (27)

2.022 Electrical properties (see Figure 2.0221, Code 1206).

2.023 Magnetic properties. Alloy is ferromagnetic.

2.024 Emittance.

2.025 Damping capacity.

2.03 **Chemical Environment**

2.031 Like most other steels, 300 M is susceptible to rusting under most atmospheric conditions. For long exposures, protective measures such as paint or certain types of electroplate are desirable. However, cathodic protection (use of sacrificial anodes) or an anodic electroplate can be detrimental to high-strength steels of this type because of their possible accelerating effect on stress-corrosion cracking as discussed in the following section.

2.032 When heat-treated to its usual high strength level, 300 M is susceptible to stress-corrosion cracking in moist environments. Certain inhibitors, piperazine and piperidine for example, have been shown to be effective in preventing or retarding the cracking. Cathodic protection, however, or any other type of galvanic coupling to an anodic metal (zinc or cadmium electroplating, for example) may result in the release of hydrogen at the surface of the steel, which is believed to induce or accelerate the cracking.

2.0321 Effect of stress intensity on time to stress-corrosion failure of vacuum-arc remelted bar in a 1.0 molar aqueous sodium chloride solution at room temperature, Figure 2.0321.

2.0322 Effects of variations in tempering temperature and environment on stress-corrosion crack-growth rate of forging under constant load at room temperature, Figure 2.0322.

2.0323 Effect of variations in temperature on stress-corrosion crack-growth rate in deionized water, Figure 2.0323.

2.0324 Effects of organic inhibitors, piperazine and piperidine, on resistance to stress-corrosion cracking in an 0.1 molar solution of sodium chloride in distilled water at room temperature, Table 2.0324.

2.0325 Resistance to stress corrosion in a 3.5 percent aqueous solution of sodium chloride at room temperature, Table 2.0325.

2.0326 Uniform threshold tensile stresses ($K_t = 1$) above which 300 M is susceptible to stress-corrosion cracking in a 3.5 percent aqueous sodium chloride solution at room temperature, Table 2.0326.

2.04 **Nuclear Environment**

3 MECHANICAL PROPERTIES

3.01 Specified Mechanical Properties

3.011 AMS specified properties for products and conditions furnished by steel mills, Table 3.011.

3.012 Specified tensile properties for fully heat-treated products. Table 3.012.

3.02 Mechanical Properties at Room Temperature

3.021 Tension – stress-strain diagrams – tension properties.

3.0211 Effect of tempering temperature on the transverse tensile properties of a vacuum-arc melted billet, Figure 3.0211.

3.0212 Effects of tempering temperature on tensile properties of oil-quenched plate and of normalized plate (air cooled from austenitizing temperature) of two thicknesses, Figure 3.0212.

3.0213 Tensile properties in different orientations of forging produced from electroslag remelted ingot originally 20 in. in diameter, Table 3.0213.

3.0214 Effect of tempering temperature on the longitudinal tensile properties of electroslag remelted and vacuum-arc remelted forged plate, Figure 3.0214.

3.0215 Effect of austenitizing temperature on the tensile properties of vacuum-arc remelted bar, Figure 3.0215.

3.0216 Effect of tempering temperature on the tensile properties of vacuum-arc remelted plate after several different austenitizing treatments, Figure 3.0216.

3.0217 Effects of various austenitizing treatments on tensile properties and on grain size, Table 3.0217.

3.0218 Effect on transverse tensile properties of very fine austenite grain size obtained by short cyclic austenitization at relatively low temperature. Table 3.0218.

3.0219 Effects of austenitizing temperature and tempering temperature on the longitudinal tensile properties of vacuum-arc remelted plate austempered at 600 F, Table 3.0219.

3.02110 Tensile properties of spheroidize-annealed alloy, Table 3.02110.

3.02111 Effect of tempering temperature on the tensile properties of sheet, Figure 3.02111.

3.02112 Effect of tempering temperature on the tensile properties of bar of various diameters heat treated in full size, Figure 3.02112.

3.022 Compression – stress-strain diagrams – compression properties (see Figures 3.0321 and 3.0322).

3.023 Impact.

3.0231 Effect of tempering temperature on the Charpy V-notch impact resistance of oil-quenched plate and of normalized plate (air cooled from austenitizing temperature) of two thicknesses. Figure 3.0231.

3.0232 Effect of tempering temperature on the Charpy V-notch impact resistance of electroslag remelted and vacuum-arc remelted forged plate, Figure 3.0232.

3.0233 Effect of austenitizing temperature on the Izod impact resistance of vacuum-arc remelted bar, Figure 3.0233.

3.0234 Effects of various austenitizing treatments on Charpy V-notch impact resistance and on grain size, Table 3.0234.

3.0235 Room-temperature Charpy V-notch impact properties in different orientations of forging produced from electroslag remelted ingot, originally 20 in. in diameter, Table 3.0235.

3.024 Bending.

3.025 Torsion and shear.

3.0251 Shear strength determined on double-shear pin type specimens machined from a forging and then heat treated at 1600 F 1 hr, OQ + 575 F 2 + 2 hr, AC:

(L) F_{su} = 179.0 ksi
(T) F_{su} = 179.2 ksi.

3.026 Bearing.

3.027 Stress concentration.

3.0271 Notch properties.

3.02711 Effect of tempering temperature on the sharp notch strength of sheet, Figure 3.02711.

3.02712 Effects of stress concentration and melting practice on the notch strength of sheet, Figure 3.02712.

3.02713 Effects of stress concentration and specimen size and orientation on notch-strength ratio of bar, Figure 3.02713.

3.02714 Effect of surface crack size on crack strength of vacuum-arc melted 1/2 in. plate (F_{tu} = 290 ksi), Figure 3.02714.

3.02715 Effect of surface crack size on crack strength of vacuum-arc melted 1/2 in. plate (F_{tu} = 270 ksi), Figure 3.02715.

3.02716 Effect of surface crack size on crack strength of vacuum-arc melted 1/2 in. plate (F_{tu} = 220 ksi), Figure 3.02716.

3.02717 Effect of surface crack size on crack strength of vacuum-arc melted 7/8 in. plate (F_{tu} = 290 ksi), Figure 3.02717.

3.02718 Effect of surface crack size on crack strength of vacuum-arc melted forging heat treated to three different strength levels, Figure 3.02718.

3.02719 Effect of surface crack size on crack strength of two vacuum-arc melted billets with different carbon contents, Figure 3.02719.

3.027110 Notch tensile strength of vacuum-arc remelted billets, Table 3.027110.

3.0272 Fracture toughness.

3.02721 Effect of tempering temperature on the fracture toughness of electroslag remelted and vacuum-arc remelted forged plate. Figure 3.02721.

3.02722 Effect of tempering temperature on the fracture toughness of vacuum-melted plate after several different austenitizing treatments, Figure 3.02722.

3.02723 Effects of austenitizing temperature and tempering temperature on the fracture toughness and corresponding tensile properties of vacuum-arc melted bar, Figure 3.02723.

3.02724 Effect on fracture toughness of tempering temperature and of very fine austenite grain size obtained by short cyclic austenitization at relatively low temperatures, Figure 3.02724.

3.02725 Effect of tempering temperature on the fracture toughness of oil-quenched plate and of normalized plate (air cooled from austenitizing temperature) of two thicknesses. Figure 3.02725.

3.02726 Effect of austenitizing temperature on the fracture toughness of vacuum-arc remelted bar. Figure 3.02726.

3.02727 Effects of various austenitizing treatments on fracture toughness and grain size. Table 3.02727.

3.02728 Effects of austenitizing temperature and tempering temperature on the fracture toughness of vacuum-arc remelted plate austempered at 600 F, Table 3.02728.

3.028 Combined properties.

3.03 Mechanical Properties at Various Temperatures

3.031 Tension – stress-strain diagrams – tension properties.

3.0311 Tensile stress-strain curves at room and cryogenic temperatures, Figure 3.0311.

3.0312 Effect of temperatures from -423 to 700 F on tensile properties of bar, Figure 3.0312.

3.0313 Effect of elevated temperatures on the tensile properties of a large forging oil quenched and tempered at 575 F, Figure 3.0313.

3.0314 Effect of elevated temperatures on the tensile properties of vacuum-arc melted billet oil quenched and tempered at 750 F, Figure 3.0314.

3.0315 Effects of a rapid strain rate (6 in./in./min) and a short holding time (10 sec) at temperature on tensile properties of sheet in the temperature range 800 to 1200 F, Figure 3.0315.

3.032 Compression – stress-strain diagrams – compression properties.

3.0321 Effect of elevated temperatures on the compressive yield strength of a large forging oil quenched and tempered at 575 F, Figure 3.0321.

3.0322 Effect of elevated temperature on the compressive yield strength of vacuum-arc melted billet oil quenched and tempered at 750 F, Figure 3.0322.

3.033 Impact.

3.0331 Effect of low temperatures down to -423 F on notch impact properties of bars with two carbon contents, Figure 3.0331.

3.0332 Effects of low temperatures and different orientations on the impact resistance of bar of various diameters, Figure 3.0332.

3.0333 Effect of low temperatures on the notch impact resistance of a forging, Figure 3.0333.

3.0334 Effect of test temperatures from -60 to 340 F and of tempering temperatures up to 1200 F on the Charpy V-notch impact resistance of normalized 1.0-in. thick plate (air cooled from austenitizing temperature), Figure 3.0334.

3.0335 Effects of variations in austenitizing treatment on notch-impact-transition curves of vacuum-arc remelted bar, Figure 3.0335.

3.034 Bending.

3.035 Torsion and shear.

3.036 Bearing.

3.037 Stress concentration.

3.0371 Notch properties.

3.03711 Effect of low temperatures on notch strength of bar, Figure 3.03711.

3.03712 Effect of temperatures from 400 to -320 F on tensile (K_t = 1), sharp notch (K_t = 12), and crack (K_t = 17) strength of sheet, Figure 3.03712.

3.0372 Fracture toughness.

3.03721 Effect of low temperatures on the fracture toughness and corresponding tensile properties of vacuum-arc remelted bar, Figure 3.03721.

3.03722 Effect of low temperatures on fracture toughness of plate, Table 3.03722.

3.038 Combined properties.

3.04 Creep and Creep Rupture

3.05 Fatigue Properties

3.051 Fatigue life of longitudinally ground and shot-peened specimens from forged billet heat treated to high strength level, Figure 3.051.

3.052 Fatigue life of notched specimens from forged billet heat treated to high strength level, Figure 3.052.

3.053 Fatigue life of smooth and notched bar, Figure 3.053.

3.054 Effect of elevated temperatures on fatigue life of smooth and notched specimens from large forging oil quenched and tempered at 575 F, Figure 3.054.

3.055 Effect of variations in tempering temperature and associated strength levels on fatigue-crack growth rate of vacuum-arc remelted plate in an air environment, Figure 3.055.

3.056 Effects of variations in austenitizing temperature and stress ratio (R) on fatigue-crack growth rate of vacuum-arc remelted plate in an air environment, Figure 3.056.

3.057 Effects of variations in frequency and environment on fatigue-crack growth rate, Figure 3.057.

3.058 Fatigue-crack growth rate of vacuum-arc remelted plate in environments of air and of dry hydrogen at frequencies of 5 and 50 cps, Figure 3.058.

3.059 Effects of various environments and a sodium borate, sodium nitrite inhibitor on fatigue-crack growth rate of plate heat treated to a high strength level, Figure 3.059.

3.06 Elastic Properties

3.061 Poisson's ratio, 0.32 at RT (3).

3.062 Modulus of elasticity.

3.0621 Effect of elevated temperatures on modulus of elasticity in tension and compression of a large forging oil quenched and tempered at 575 F, Figure 3.0621.

3.0622 Effect of elevated temperatures on modulus of elasticity determined in both tension and compression on a vacuum-arc melted billet oil quenched and tempered at 750 F, Figure 3.0622.

3.0623 Effect of low temperatures on modulus of elasticity of bar, Figure 3.0623.

3.063 Modulus of rigidity, 11.0 – 11.4 x 10^3 ksi at RT. (3,25)

3.064 Tangent modulus.

3.065 Secant modulus.

4 FABRICATION

4.01 Forming

4.011 Cold forming. (See Section 4.011, 4340, Code 1206.)

4.012 Forging and other hot-working characteristics are similar to those of 4340, Code 1206. The optimum temperature range for these operations is 2250 to 1950 F; 1700 F should be the absolute minimum for hot working. (27,28,37)

4.02 Machining and Grinding

300 M can best be machined when its hardness is in the range Brinell 200 to 250, which requires a spheroidizing heat treatment. Under these

conditions its machinability rating is 45 percent based on a 100 percent rating for cold-rolled B1112 steel. In the hardened-and-tempered condition (Rockwell C52–55), machining is possible using heavy equipment, rigid tool support, carbide tooling, and suitable cutting fluids. The speeds and feeds must be carefully controlled to prevent excessive surface heating and the formation of untempered martensite on the machined surface. A flood of coolant is recommended for most machining operations. (27,37)

4.03 **Joining**

4.031 Welding is generally not recommended for critical applications. Because of its alloy content and associated hardenability, fusion welds are susceptible to underbead cracking, heat-affected-zone embrittlement, and thermal-stress cracking. Nevertheless, weld strength approaching that of the base metal can be obtained with proper welding techniques such as the use of low-hydrogen electrodes, adequate preheat and interpass temperatures, and full postweld quench-and-temper heat treatment. (27,28,37)

4.032 Comparison of tensile properties of parent metal and flash-butt weld joint (no filler metal) in tubing, Table 4.032.

4.04 **Surface Treatment**
(See 4140, Code 1203.)

4.041 Nitriding would not normally be desirable because nitriding temperatures, which are above the optimum tempering temperature range, would be detrimental to base-metal properties.

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Alloy	300 M
Specification	Forms
AMS 6417C	Bars, Forgings, Tubing, Consumable-Electrode Melted
AMS 6419B	Bars, Forgings, Tubing, Premium Quality, Consumable-Electrode Melted
MIL-S-8844C, Class 3	Bars, Reforging Stock, Mechanical Tubing, Premium Quality, Vacuum Melted
ASTM A579, Grade 32	Superstrength Alloy Steel Forgings

TABLE 1.03. SPECIFICATIONS (29–32)

Alloy	300 M					
Specification	AMS 6417C		AMS 6419B		MIL-S-8844C	
	Percent		Percent		Percent	
Element	Min	Max	Min	Max	Min	Max
Carbon	0.38	0.43	0.40	0.45	0.40	0.45
Manganese	0.60	0.90	0.60	0.90	0.65	0.90
Silicon	1.45	1.80	1.45	1.80	1.45	1.80
Phosphorus	–	0.010	–	0.010	–	0.010
Sulfur	–	0.010	–	0.010	–	0.010
Chromium	0.70	0.95	0.70	0.95	0.70	0.95
Nickel	1.65	2.00	1.65	2.00	1.65	2.00
Molybdenum	0.30	0.50	0.30	0.50	0.35	0.45
Vanadium	0.05	0.10	0.05	0.10	0.05	–
Copper	–	0.35	–	0.35	–	–

TABLE 1.04. COMPOSITION (29–31)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

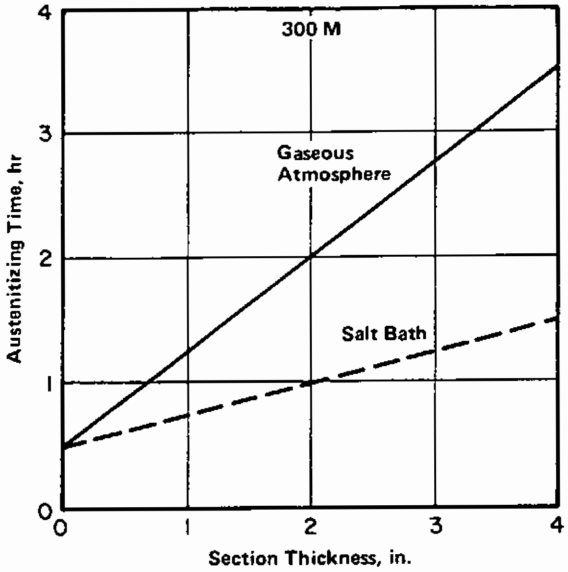


FIGURE 1.0561. TIMES RECOMMENDED FOR AUSTENITIZATION OF VARIOUS SECTION SIZES IN GASEOUS AND SALT-BATH ENVIRONMENTS DURING NORMALIZING AND HARDENING TREATMENTS (38)

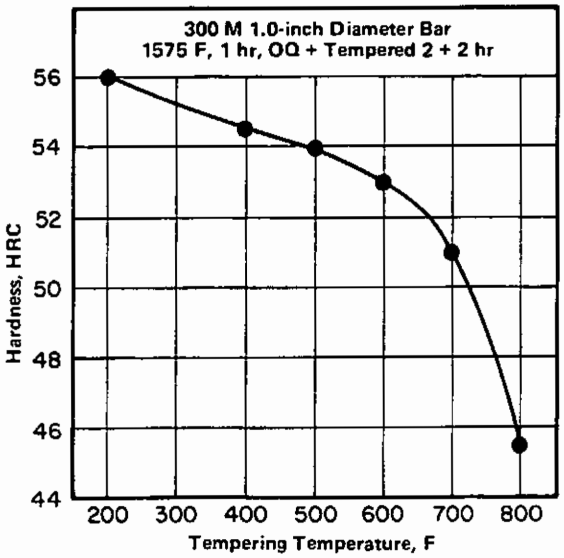


FIGURE 1.061. EFFECT OF TEMPERING TEMPERATURE ON HARDNESS (26)

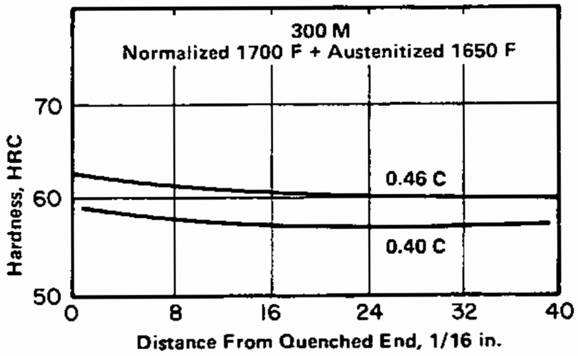


FIGURE 1.062. END-QUENCH HARDENABILITY (39)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

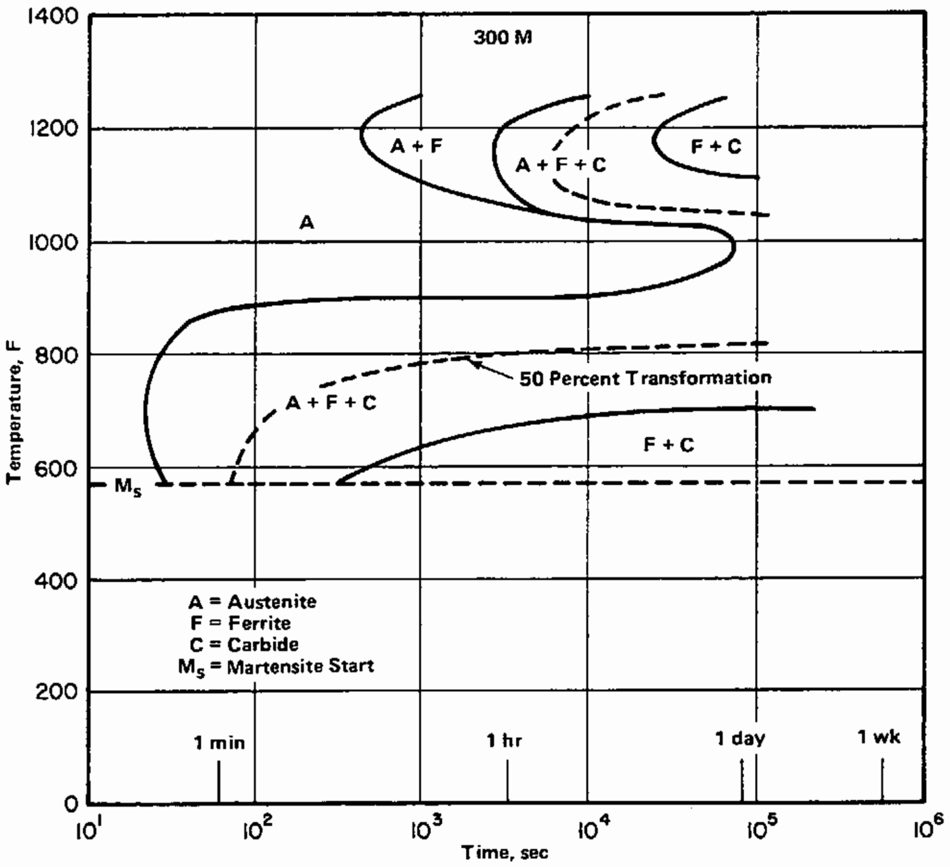


FIGURE 2.0121. TIME-TEMPERATURE-TRANSFORMATION DIAGRAM (2)

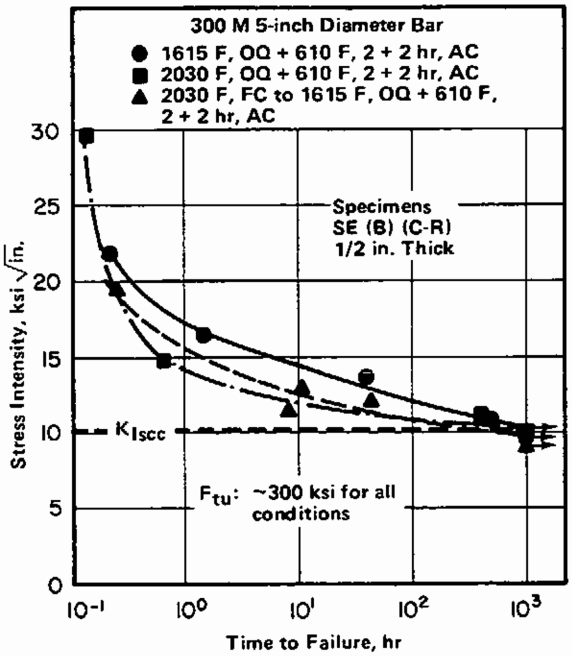


FIGURE 2.0321. EFFECT OF STRESS INTENSITY ON TIME TO STRESS-CORROSION FAILURE OF VACUUM-ARC REMELTED BAR IN A 1.0 MOLAR AQUEOUS SODIUM CHLORIDE SOLUTION AT ROOM TEMPERATURE (11)

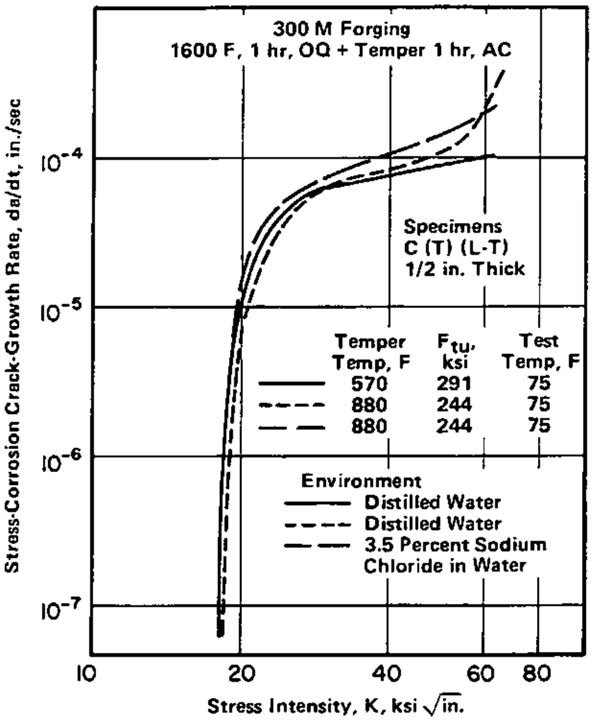


FIGURE 2.0322. EFFECTS OF VARIATIONS IN TEMPERING TEMPERATURE AND ENVIRONMENT ON STRESS-CORROSION CRACK-GROWTH RATE OF FORGING UNDER CONSTANT LOAD AT ROOM TEMPERATURE (21)

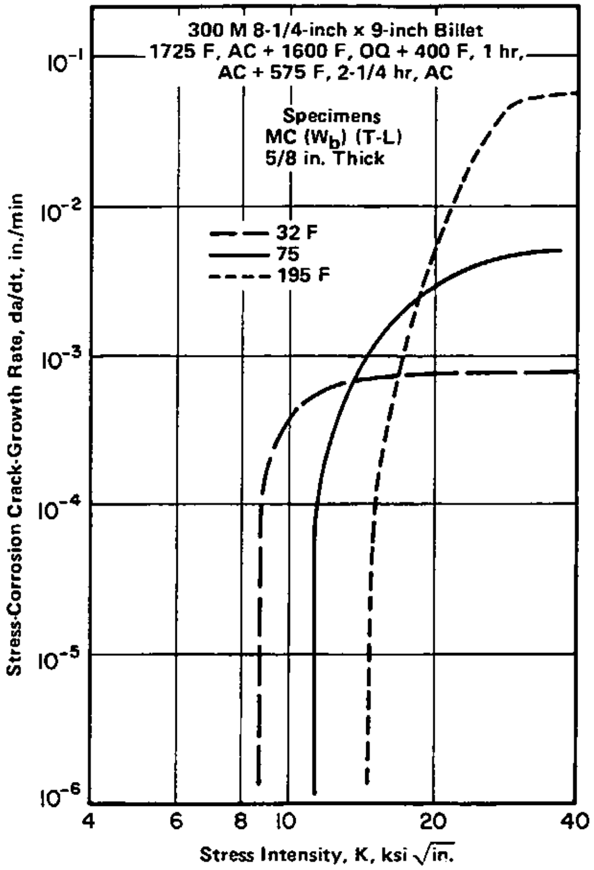


FIGURE 2.0323. EFFECT OF VARIATIONS IN TEMPERATURE ON STRESS-CORROSION CRACK-GROWTH RATE IN DEIONIZED WATER (36)

Alloy	300 M
Form	1 Inch x 2 Inch Bar
Condition	1600 F, 1 hr, OQ + 575 F, 2 + 2 hr, AC
Environment	K_{Iscc}, ksi $\sqrt{in.}$
Aqueous Solution, 0.1 molar sodium chloride	16
Aqueous Solution, 0.1 molar sodium chloride plus 1.0 molar piperazine	55
Aqueous Solution, 0.1 molar sodium chloride plus 1.0 molar piperidine	60

Notes: K_{Iscc} specimens, C(T)(T-L) 0.75 inch thick.
F_{tu}, 270–300 ksi.
Both greater and smaller concentrations of inhibitors were less effective in increasing K_{Iscc}.

TABLE 2.0324. EFFECTS OF ORGANIC INHIBITORS, PIPERAZINE AND PIPERIDINE, ON RESISTANCE TO STRESS-CORROSION CRACKING IN AN 0.1 MOLAR SOLUTION OF SODIUM CHLORIDE IN DISTILLED WATER AT ROOM TEMPERATURE (4)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

Alloy	300 M	
Form	4-Inch x 6-Inch x 6-Inch Forging	
Condition	1700 F, AC + 1600 F, OQ + 570 F, 2 + 2 hr, AC	
Specimen	K_{Iscc}, ksi $\sqrt{in.}$	F_{tu}, ksi
SE (T) (L-T), 0.2 in. thick	11	291
SE (T) (S-T), 0.2 in. thick	11	293

TABLE 2.0325. RESISTANCE TO STRESS CORROSION IN A 3.5 PERCENT AQUEOUS SOLUTION OF SODIUM CHLORIDE AT ROOM TEMPERATURE (10)

Alloy	300 M
Form	Plate
Condition	Quenched and Tempered to F_{tu} 280–300 ksi
Orientation	Threshold Stress, ksi
L	170
T	136
ST	115

TABLE 2.0326. UNIFORM THRESHOLD TENSILE STRESSES (K_t = 1) ABOVE WHICH 300 M IS SUSCEPTIBLE TO STRESS-CORROSION CRACKING IN 3.5 PERCENT AQUEOUS SODIUM CHLORIDE SOLUTION AT ROOM TEMPERATURE (16)

Alloy	300 M			
Source	Form	Condition	F_{tu}, ksi (Max)	Hardness (Max)
AMS 6417C and AMS 6419B	Bars <0.501 in.[(a)]	Cold Finished	130	–
	>0.500 in.[(a)]	Hot Finished		241 BHN
		Cold Finished		262 BHN
	Forgings	Normalized and Tempered		248 BHN
	Tubing	Cold Finished		25 HRC
		Hot Finished and Annealed		99 HRB

(a) Nominal diameter or distance between parallel sides.

TABLE 3.011. AMS SPECIFIED PROPERTIES FOR PRODUCTS AND CONDITIONS FURNISHED BY STEEL MILLS (29,30)

Alloy	300 M						
Form	Bars, Forgings, Tubing						
Condition	1700 F, 1 hr, AC + 1600 F, 1 hr, OQ + 575 F, 2 + 2 hr, AC						
Source	Nominal Cross Sectional Area, in.^{2}	Orientation[(a)]	F_{ty}, ksi (Min)	F_{tu}, ksi (Min)	e (4D), percent (Min)	RA, percent (Min)	
						Average	Single
AMS 6417C	All	L	220	270	8	–	30
	Up to 100 incl.	T	220	270	–	30	25
	Over 100 to 144 incl.	T	220	270	–	25	20
	Over 144 to 225 incl.	T	220	270	–	20	15
	Over 225	T	220	270	–	15	10
AMS 6419B	All	L	230	280	7	–	25
	Up to 100 incl.	T	230	280	–	30	25
	Over 100 to 144 incl.	T	230	280	–	25	20
	Over 144 to 225 incl.	T	230	280	–	20	15
	Over 225	T	230	280	–	15	10
MIL-S-8844C	Up to 100 incl.	T	230	280	6	30	25
	Over 100 to 144 incl.	T	230	280	5	25	20
	Over 144	T	230	280	4	20	15

(a) The AMS transverse tensile property requirements apply only to products from which tensile specimens not less than 2.50 inch in length can be taken. The AMS specifications state that testing in the longitudinal orientation is not required on products tested in the transverse orientation.

TABLE 3.012. SPECIFIED TENSILE PROPERTIES FOR FULLY HEAT-TREATED PRODUCTS (29–31)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

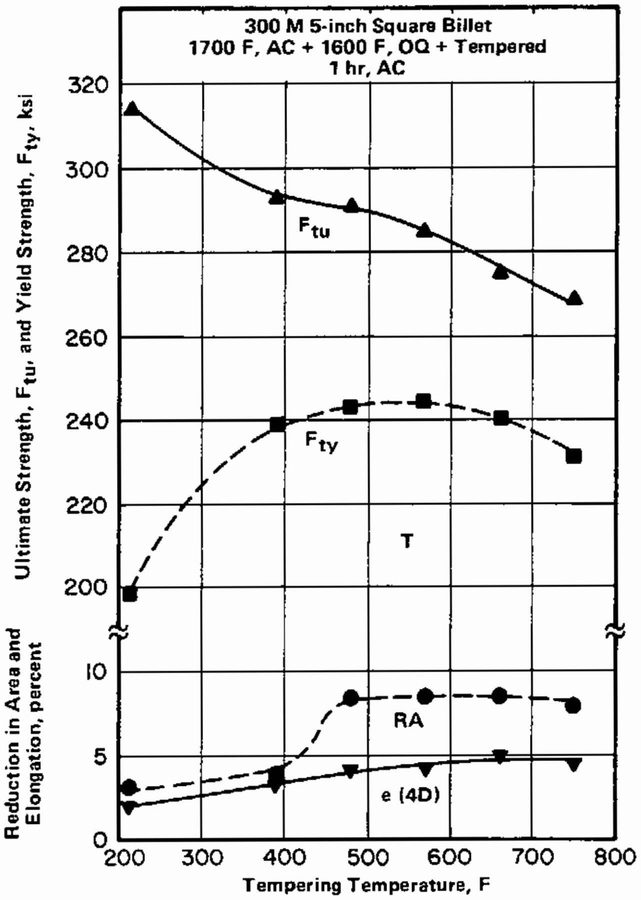


FIGURE 3.0211. EFFECT OF TEMPERING TEMPERATURE ON THE TRANSVERSE TENSILE PROPERTIES OF A VACUUM-ARC MELTED BILLET (12)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

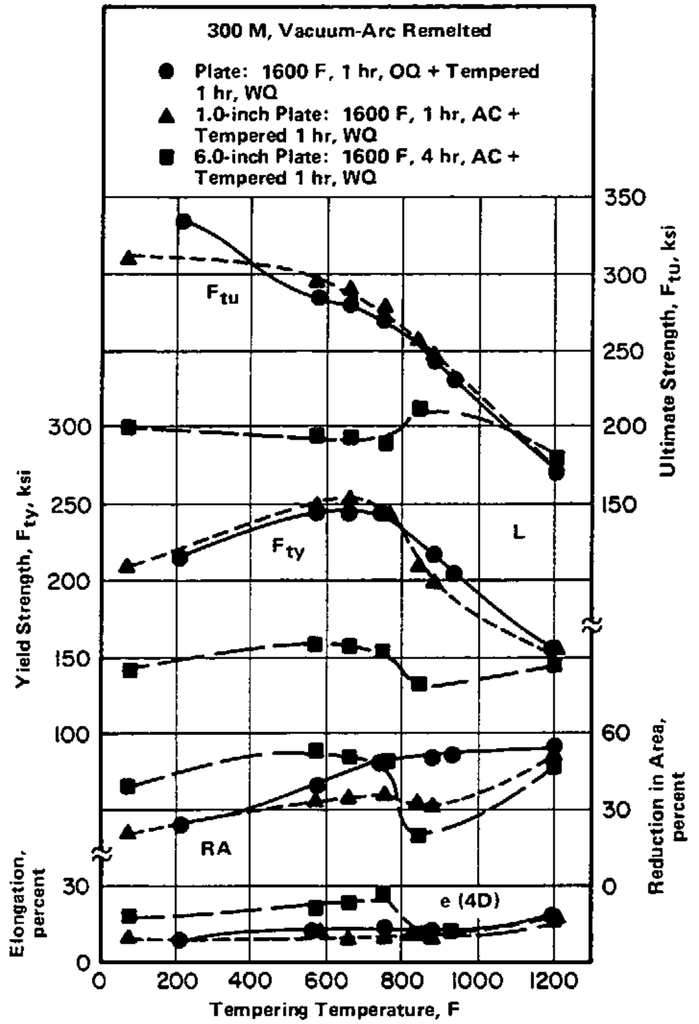


FIGURE 3.0212. EFFECTS OF TEMPERING TEMPERATURE ON TENSILE PROPERTIES OF OIL-QUENCHED PLATE AND OF NORMALIZED PLATE (AIR-COOLED FROM AUSTENITIZING TEMPERATURE) OF TWO THICKNESSES (13)

Alloy	300 M				
Form	4-Inch x 6-Inch x 6-Inch Forging				
Condition	1700 F, AC + 1600 F, OQ + 570 F, 2 + 2 hr, AC				
Orientation	F_{ty}, ksi	F_{tu}, ksi	e (4D), percent	RA, percent	Hardness, HRC
L	245	291	10.6	44.2	55
LT	252	295	7.8	30.2	55
ST	246	293	5.9	19.9	55

TABLE 3.0213. TENSILE PROPERTIES IN DIFFERENT ORIENTATIONS OF FORGING PRODUCED FROM ELECTROSLAG REMELTED INGOT ORIGINALLY 20 INCH IN DIAMETER (7,10)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

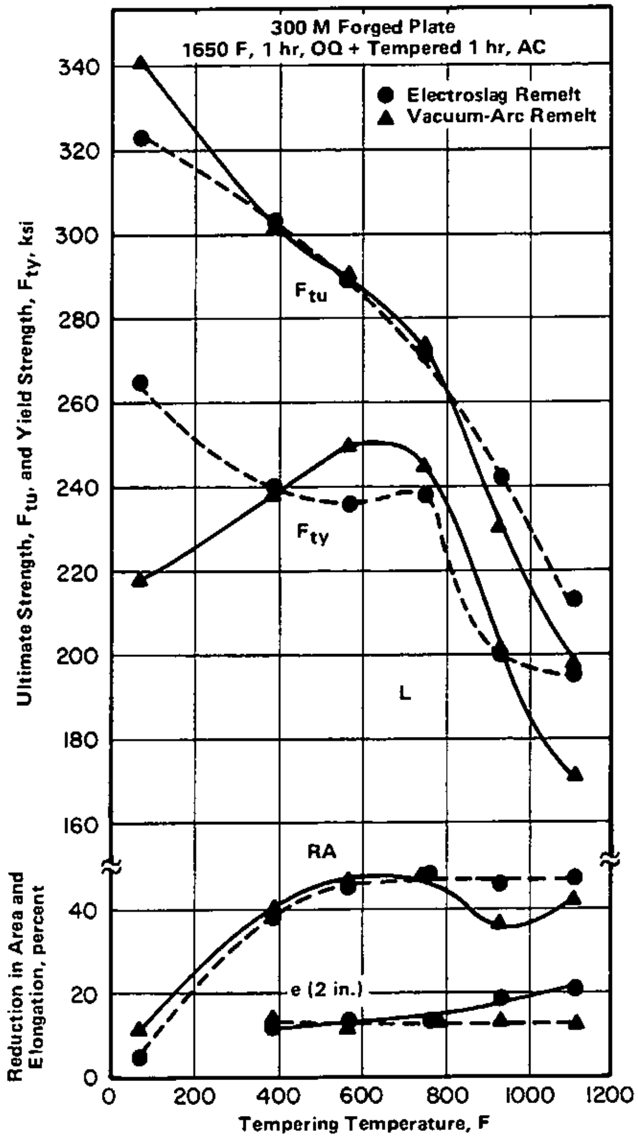


FIGURE 3.0214. EFFECT OF TEMPERING TEMPERATURE ON THE LONGITUDINAL TENSILE PROPERTIES OF ELECTROSLAG REMELTED AND VACUUM-ARC REMELTED FORGED PLATE (18)

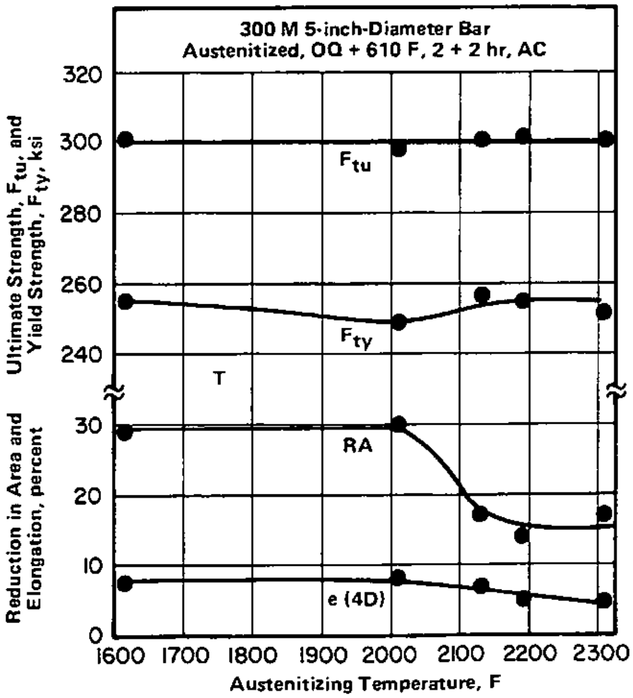


FIGURE 3.0215. EFFECT OF AUSTENITIZING TEMPERATURE ON THE TENSILE PROPERTIES OF VACUUM-ARC REMELTED BAR (11)

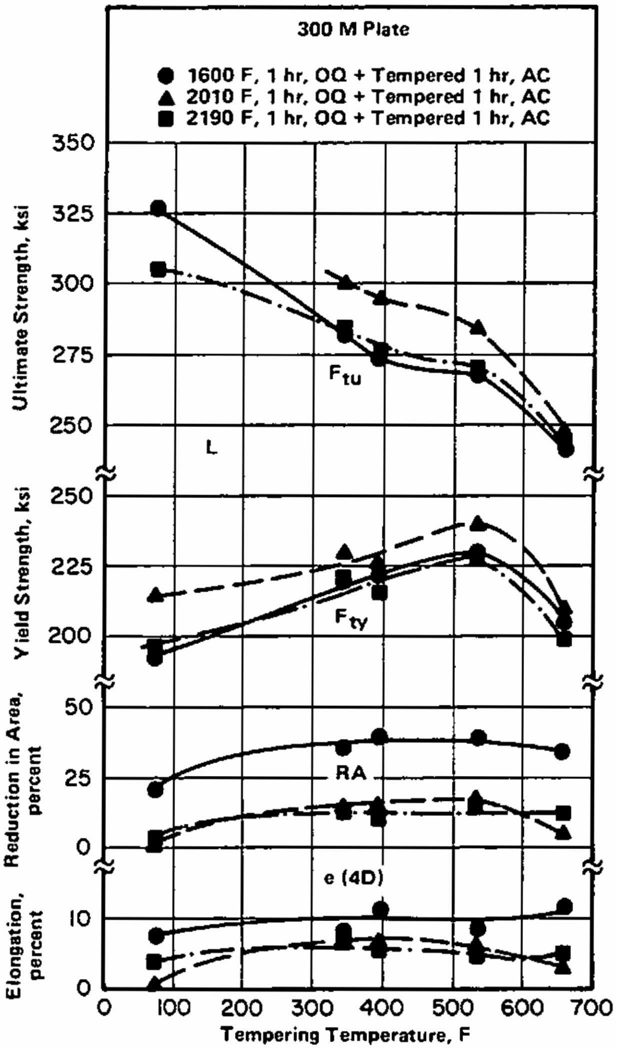


FIGURE 3.0216. EFFECT OF TEMPERING TEMPERATURE ON THE TENSILE PROPERTIES OF VACUUM-ARC REMELTED PLATE AFTER SEVERAL DIFFERENT AUSTENITIZING TREATMENTS (6)

Alloy	300 M			
Form	Bar			
Condition	F_{ty}, ksi	F_{tu}, ksi	e (4D), percent	ASTM Grain Size No.(a)
1600 F, 1 hr, OQ + 535 F, 1 hr, WQ	228	268	8.4	8
1600 F, 1 hr, OQ + 1200 F, 1 hr, Heat to 1570 F, 2 min, OQ + 535 F, 1 hr, WQ	251	282	10.0	9
1600 F, 1 hr, OQ + 1570 F, 3 min, OQ (4 Cycles) + 535 F, 1 hr, WQ	256	291	12.0	10
2190 F, 1 hr, OQ + 535 F, 1 hr, WQ	254	270	4.6	2
2190 F, 1 hr, FC to 1600 F, 5 min, OQ + 1200 F, 1 hr, Heat to 1570 F, 2 min, OQ + 535 F, 1 hr, WQ	236	268	11.0	4

(a) Austenitic grain size.

TABLE 3.0217. EFFECTS OF VARIOUS AUSTENITIZING TREATMENTS ON TENSILE PROPERTIES AND ON GRAIN SIZE (34)

Alloy	300 M				
Form	5-Inch Diameter Bar, Vacuum-Arc Remelted				
Condition	Austenitized + Tempered at 610 F, 2 + 2 hr, AC				
Austenitizing Treatment[(a)]	ASTM Grain Size No.	F_{ty}, ksi	F_{tu}, ksi	e (4D), percent	RA, percent
1615 F, 1 hr, OQ	7.5	253	302	6.5	26
1570 F, 2-1/2 min, OQ (Repeated 4 Times)	11.0	269	314	7.5	29

(a) Heat treatment carried out on specimen blanks approximately 1/2 inch thick.

TABLE 3.0218. EFFECT ON TRANSVERSE TENSILE PROPERTIES OF VERY FINE AUSTENITE GRAIN SIZE OBTAINED BY SHORT CYCLIC AUSTENITIZATION AT RELATIVELY LOW TEMPERATURE (8)

Alloy	300 M				
Form	Plate				
Austemper Treatment	Temper, F	F_{ty}, ksi	F_{tu}, ksi	e (4D), percent	RA, percent
1600 F, 1 hr, SQ to 600 F, 1 hr, OQ	None	102	220	16.9	12.0
	345 (1 hr)	112	214	17.5	30.2
	535 (1 hr)	133	192	24.0	40.8
2190 F, 1 hr, SQ to 600 F, 1 hr, OQ	None	96	201	10.7	13.2
	345 (1 hr)	114	183	13.8	26.5
	535 (1 hr)	132	166	12.5	43.6

TABLE 3.0219. EFFECTS OF AUSTENITIZING TEMPERATURE AND TEMPERING TEMPERATURE ON THE LONGITUDINAL TENSILE PROPERTIES OF VACUUM-REMELTED PLATE AUSTEMPERED AT 600 F (6)

Alloy	300 M
Form	All Wrought Forms
Condition	Spheroidize Annealed (Sect. 1.053)
F_{ty}, ksi	71
F_{tu}, ksi	111
e (2 in.), percent	28.3
RA, percent	56

TABLE 3.02110. TENSILE PROPERTIES FOR SPHEROIDIZE-ANNEALED ALLOY (28)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

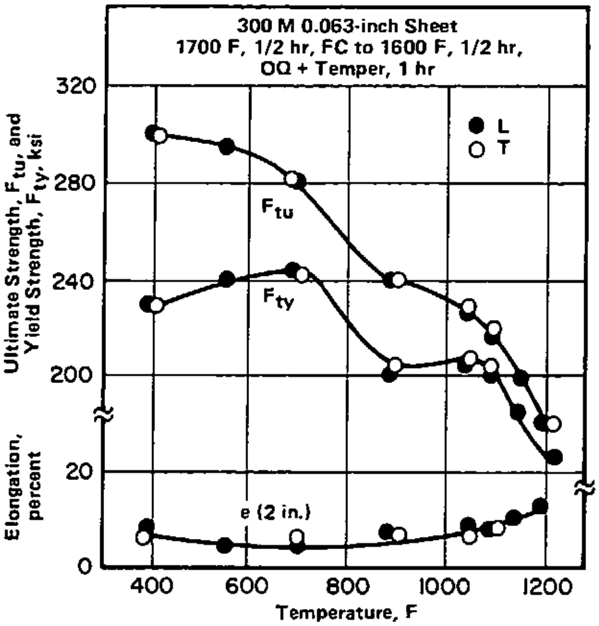


FIGURE 3.02111. EFFECT OF TEMPERING TEMPERATURE ON THE TENSILE PROPERTIES OF SHEET (41)

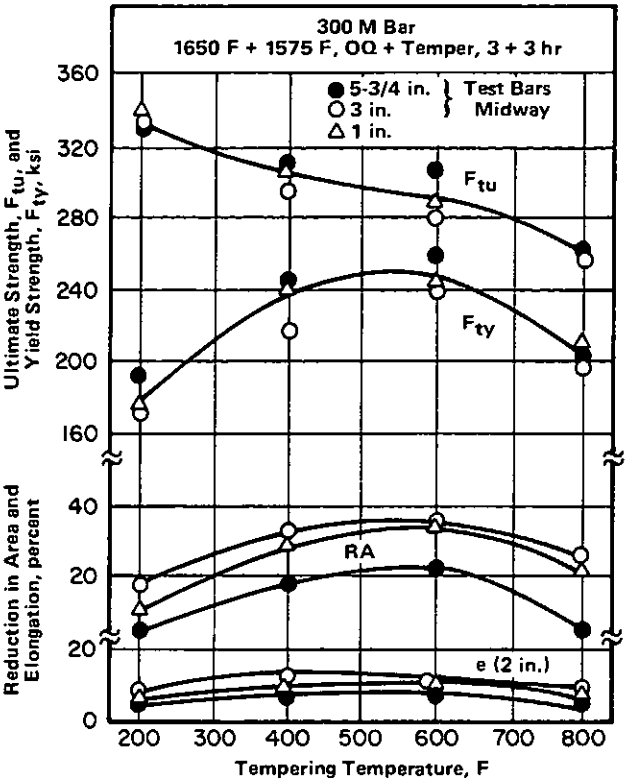


FIGURE 3.02112. EFFECT OF TEMPERING TEMPERATURE ON THE TENSILE PROPERTIES OF BAR OF VARIOUS DIAMETERS HEAT TREATED IN FULL SIZE (42)

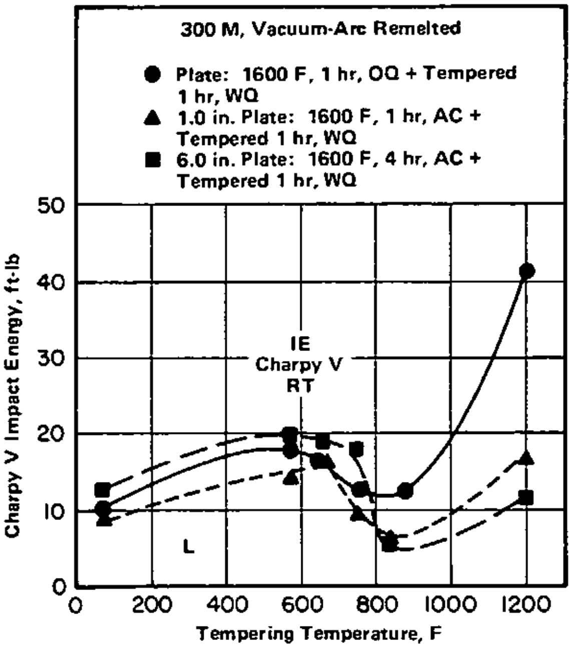


FIGURE 3.0231. EFFECT OF TEMPERING TEMPERATURE ON THE CHARPY V-NOTCH IMPACT RESISTANCE OF OIL-QUENCHED PLATE AND OF NORMALIZED PLATE (AIR COOLED FROM AUSTENITIZING TEMPERATURE) OF TWO THICKNESSES (13,35)

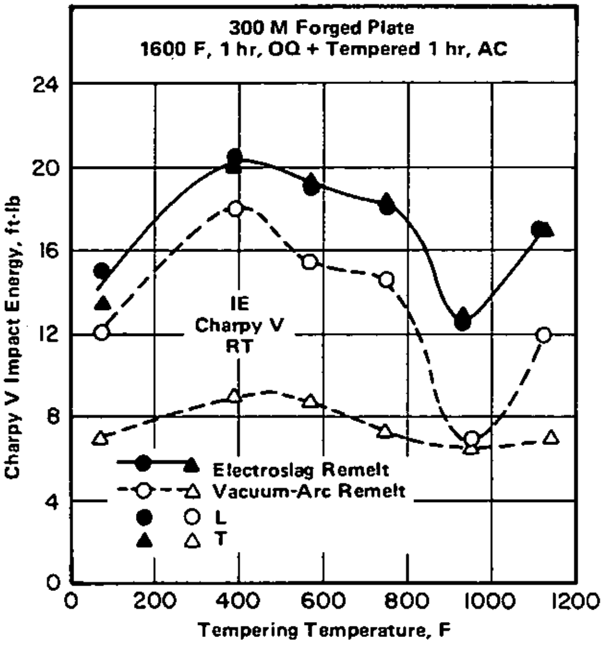


FIGURE 3.0232. EFFECT OF TEMPERING TEMPERATURE ON THE CHARPY V-NOTCH IMPACT RESISTANCE OF ELECTROSLAG REMELTED AND VACUUM-ARC REMELTED FORGED PLATE (18)

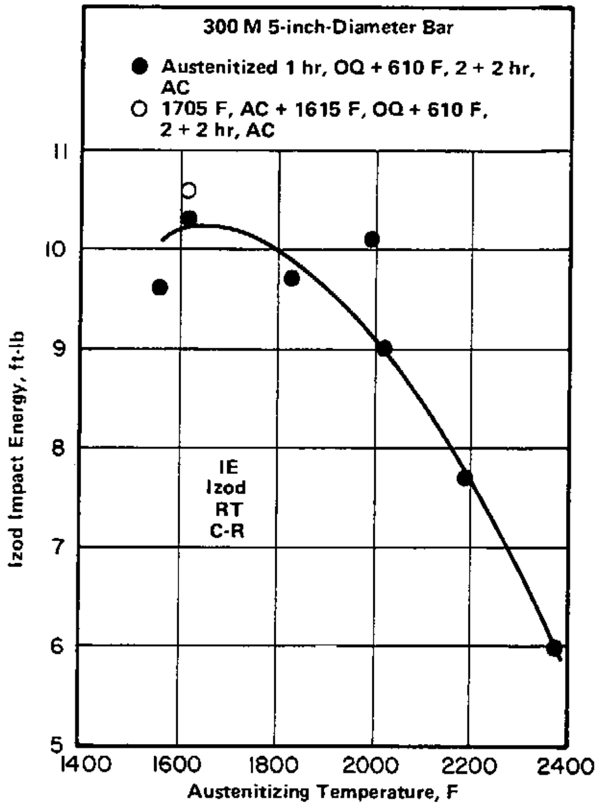


FIGURE 3.0233. EFFECT OF AUSTENITIZING TEMPERATURE ON THE IZOD IMPACT RESISTANCE OF VACUUM-ARC REMELTED BAR (11)

Alloy	300 M	
Form	Bar	
Condition	ASTM Grain Size No.(a)	IE Charpy V, ft-lb
1600 F, 1 hr, OQ + 535 F, 1 hr, WQ	8	20.0
1600 F, 1 hr, OQ + 1200 F, 1 hr, Heat to 1570 F, 2 min, OQ + 535 F, 1 hr, WQ	9	20.0
1600 F, 1 hr, OQ + 1570 F, 3 min, OQ (4 Cycles) + 535 F, 1 hr, WQ	10	22.2
2190 F, 1 hr, OQ + 535 F, 1 hr, WQ	2	13.0
2190 F, 1 hr, FC to 1600 F, 5 min, OQ + 1200 F, 1 hr, Heat to 1570 F, 2 min, OQ + 535 F, 1 hr, WQ	4	18.5

(a) Austenite grain size.

TABLE 3.0234. EFFECTS OF VARIOUS AUSTENITIZING TREATMENTS ON CHARPY V-NOTCH IMPACT RESISTANCE AND ON GRAIN SIZE (33,34)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

Alloy	300 M	
Form	4-Inch x 6-Inch x 6-Inch Forging	
Condition	1700 F, AC + 1600 F, OQ + 570 F, 2 + 2 hr, AC	
Orientation	Charpy-V Impact Energy, ft-lb	Hardness, HRC
L	19.7	55
LT	14.7	55
ST	11.2	55

Note: See Table 3.012 for comparable tensile properties.

TABLE 3.0235. ROOM-TEMPERATURE CHARPY V-NOTCH IMPACT PROPERTIES IN DIFFERENT ORIENTATIONS OF FORGING PRODUCED FROM ELECTROSLAG REMELTED INGOT, ORIGINALLY 20 INCH IN DIAMETER (7,10)

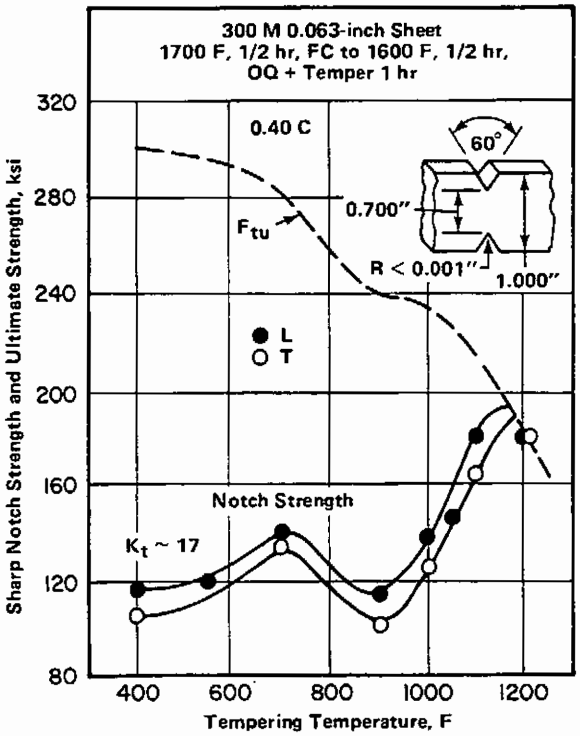


FIGURE 3.02711. EFFECT OF TEMPERING TEMPERATURE ON THE SHARP NOTCH STRENGTH OF SHEET (41)

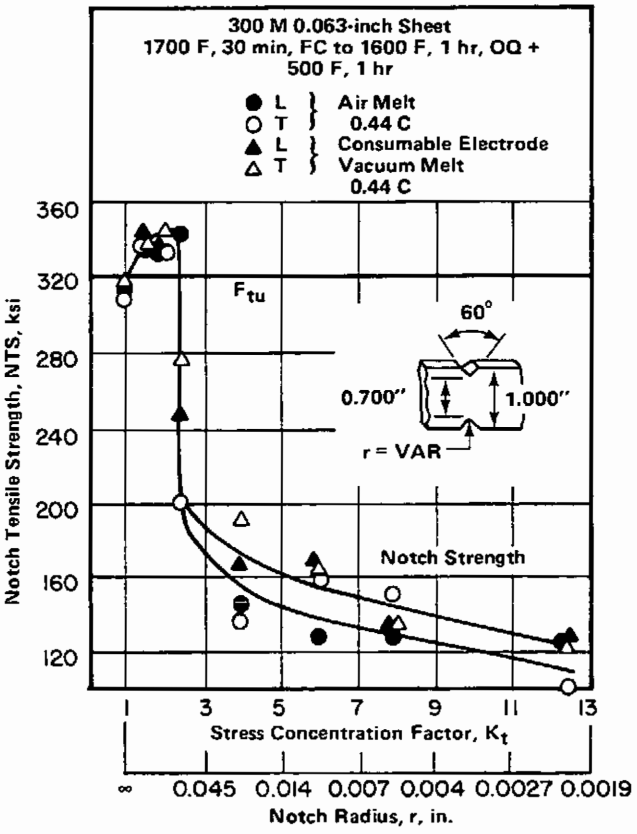


FIGURE 3.02712. EFFECTS OF STRESS CONCENTRATION AND MELTING PRACTICE ON THE NOTCH STRENGTH OF SHEET (43)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

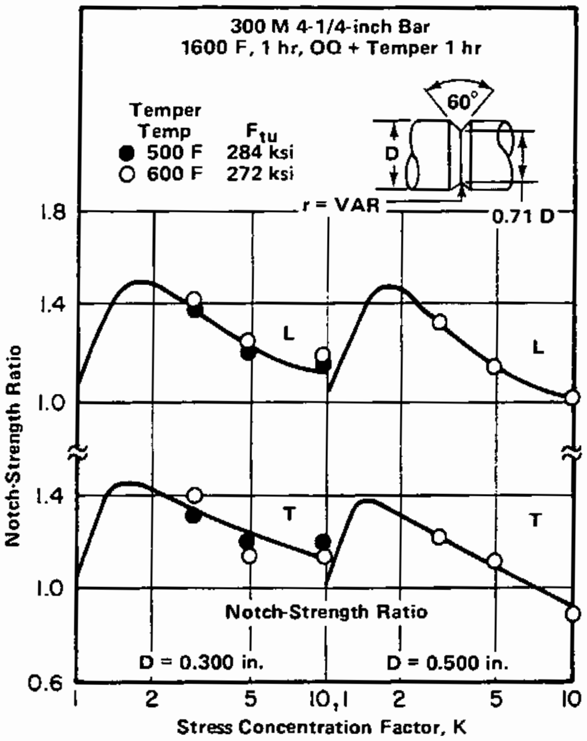


FIGURE 3.02713. EFFECTS OF STRESS CONCENTRATION AND SPECIMEN SIZE AND ORIENTATION ON NOTCH-STRENGTH RATIO OF BAR (44)

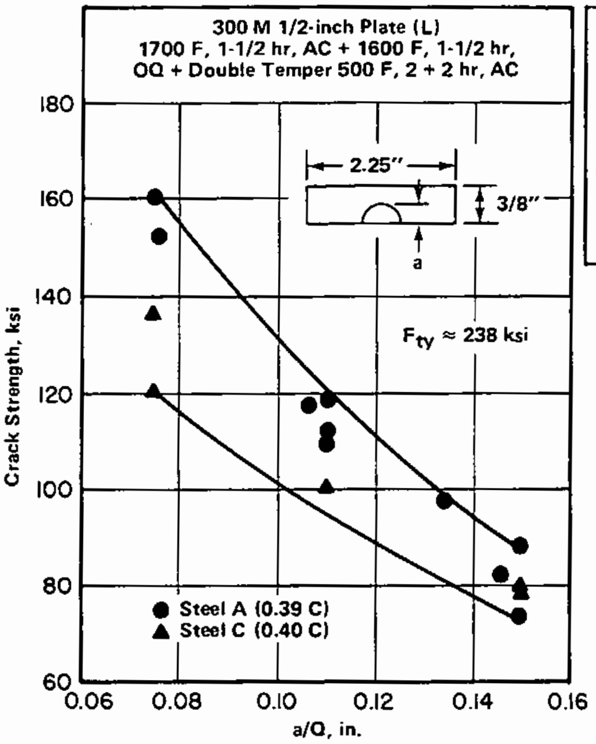


FIGURE 3.02714. EFFECT OF SURFACE CRACK SIZE ON CRACK STRENGTH OF VACUUM-ARC MELTED 1/2-INCH PLATE (F_{tu} = 290 KSI) (45)

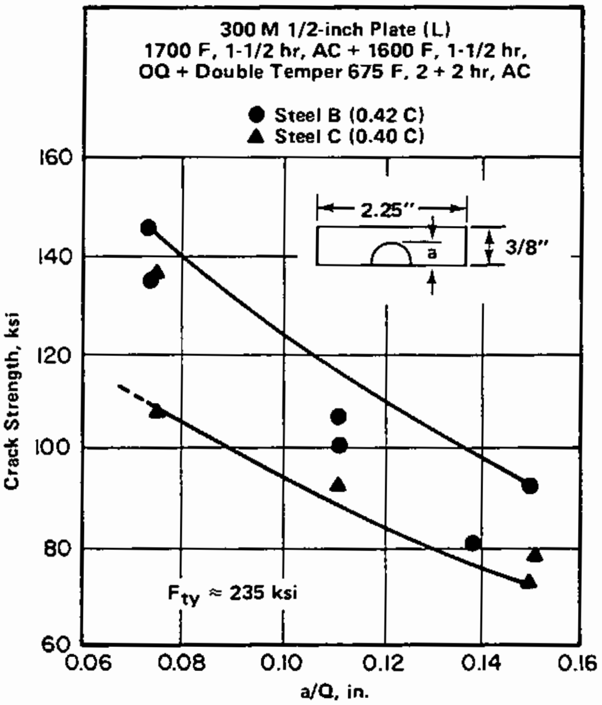


FIGURE 3.02715. EFFECT OF SURFACE CRACK SIZE ON CRACK STRENGTH OF VACUUM-ARC MELTED 1/2-INCH PLATE (F_{tu} = 270 KSI) (45)

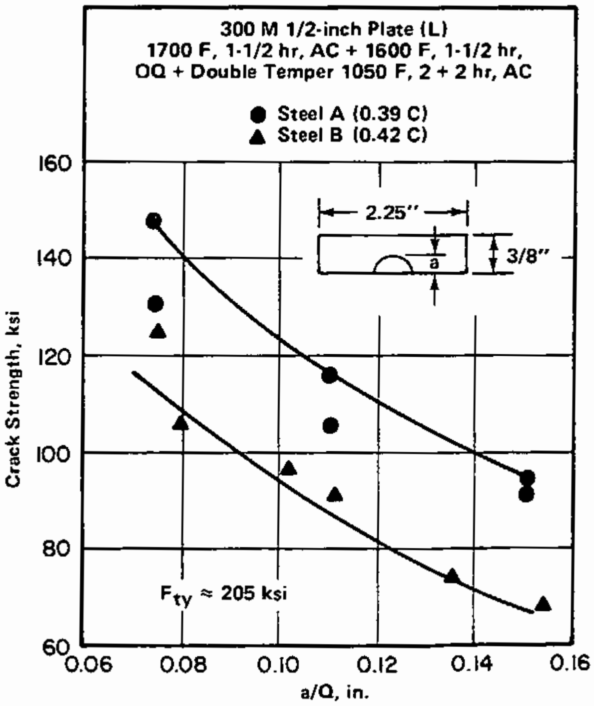


FIGURE 3.02716. EFFECT OF SURFACE CRACK SIZE ON CRACK STRENGTH OF VACUUM-ARC MELTED 1/2-INCH PLATE (F_{tu} = 220 KSI) (45)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

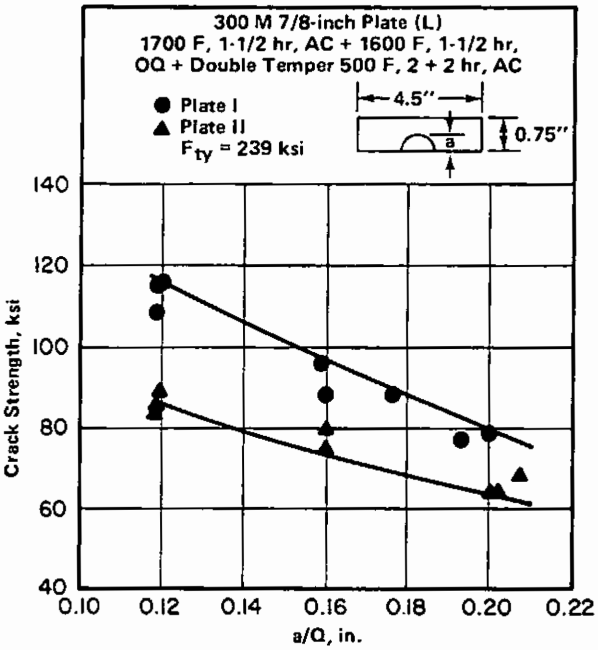


FIGURE 3.02717. EFFECT OF SURFACE CRACK SIZE ON CRACK STRENGTH OF VACUUM-ARC MELTED 7/8 INCH PLATE (F_{tu} = 290 KSI) (45)

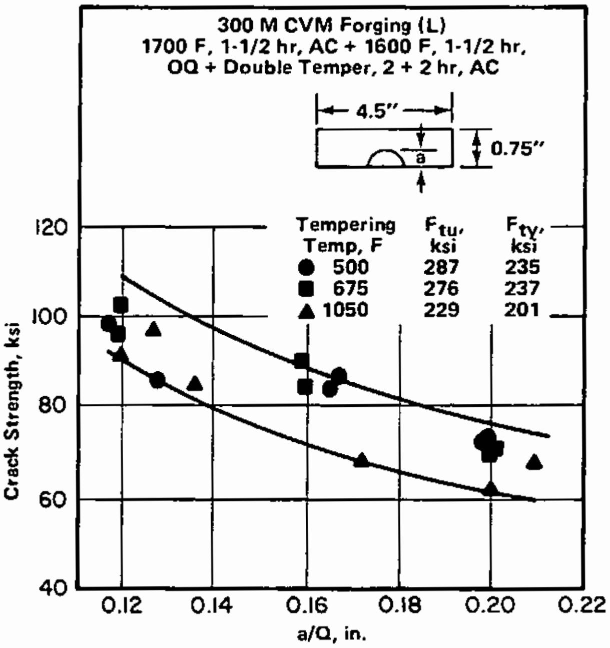


FIGURE 3.02718. EFFECT OF SURFACE CRACK SIZE ON CRACK STRENGTH OF VACUUM-ARC MELTED FORGING HEAT TREATED TO THREE DIFFERENT STRENGTH LEVELS (45)

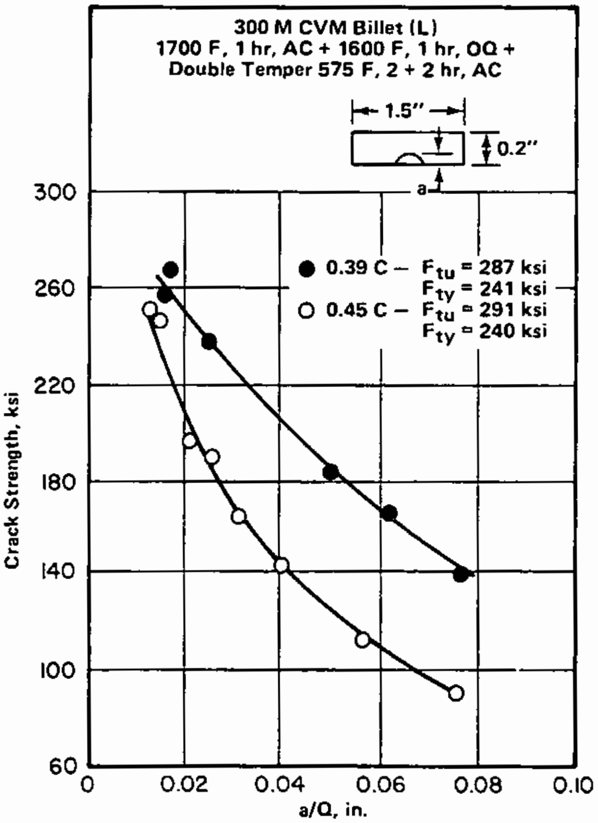
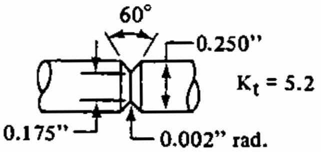


FIGURE 3.02719. EFFECT OF SURFACE CRACK SIZE ON CRACK STRENGTH OF TWO VACUUM-ARC MELTED BILLETS WITH DIFFERENT CARBON CONTENTS (45)

Alloy	300 M			
Form	6-Inch Diameter Billets			
Condition	1600 F, OQ + Temper 2 + 2 hr, AC			
Tempering Temperature, F	Orientation	NTS, ksi	F_{tu}, ksi	NSR
550	L	425	288	1.75
	T	401	291	1.65
575	L	363	272	1.60
	T	395	274	1.74

Note 1: Notch specimen configuration



Note 2: The 550 F and 575 F tempers represent two different heats of steel; minor variations in composition, as well as the difference in tempering temperature, could account for some of the variations in strength.

TABLE 3.027110. NOTCH TENSILE STRENGTH OF VACUUM-ARC REMELTED BILLETS (24)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

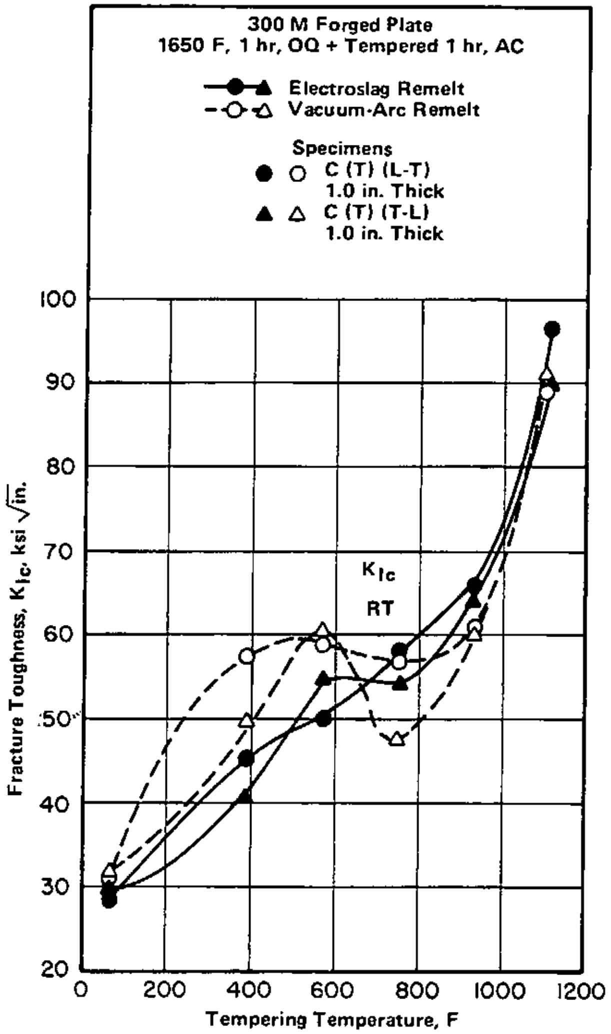


FIGURE 3.02721. EFFECT OF TEMPERING TEMPERATURE ON THE FRACTURE TOUGHNESS OF ELECTROSLAG REMELTED AND VACUUM-ARC REMELTED FORGED PLATE (18)

Note: See Figure 3.0214 for comparable longitudinal tensile properties.

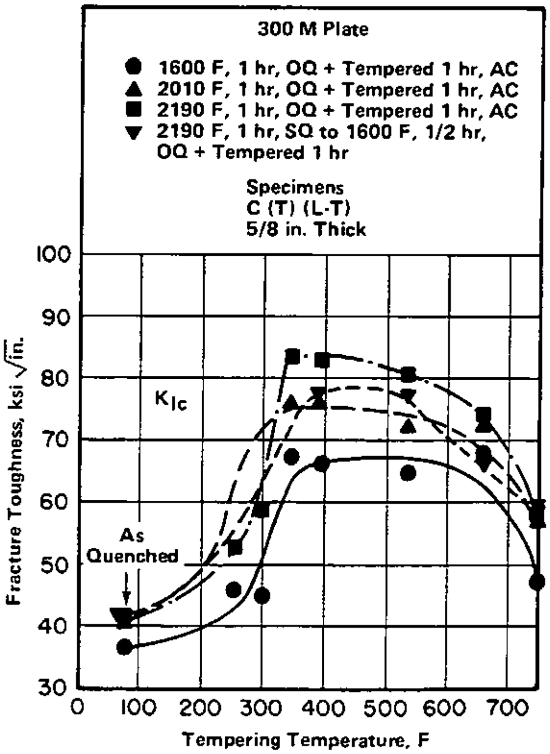


FIGURE 3.02722. EFFECT OF TEMPERING TEMPERATURE ON THE FRACTURE TOUGHNESS OF VACUUM-REMELTED PLATE AFTER SEVERAL DIFFERENT AUSTENITIZING TREATMENTS (5,6)

Note: Figure 3.0216 shows comparable tensile properties for most test conditions.

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

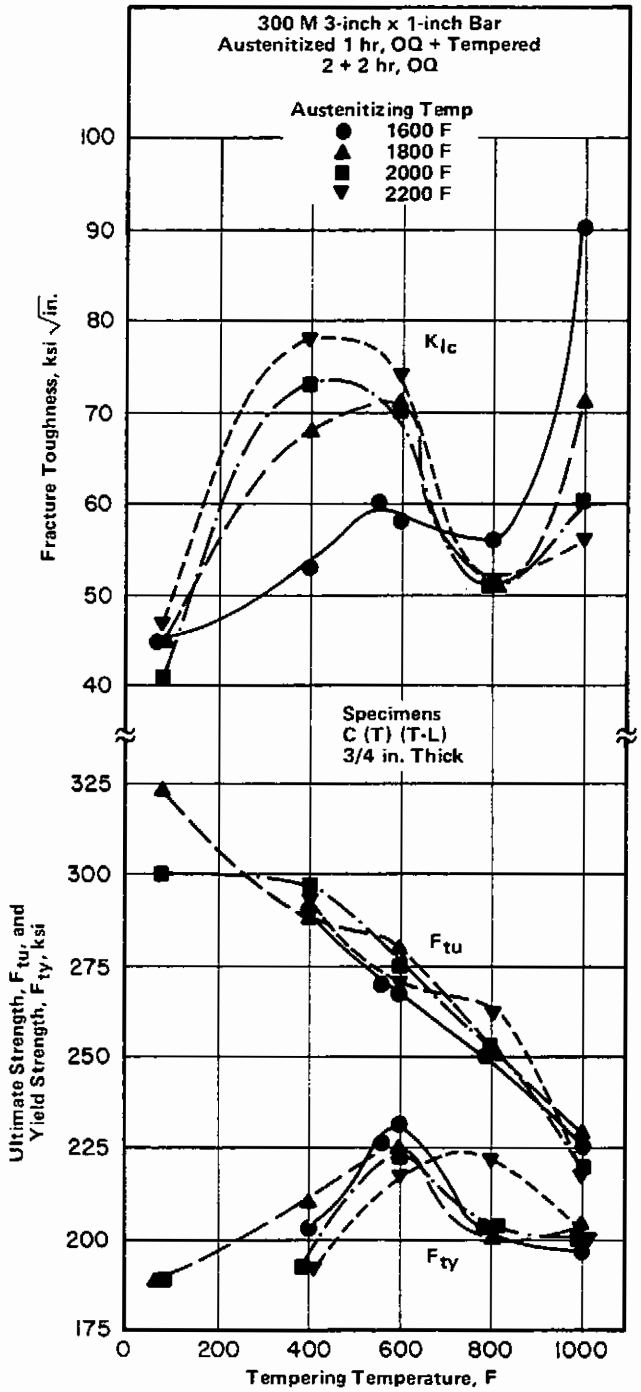


FIGURE 3.02723. EFFECTS OF AUSTENITIZING TEMPERATURE AND TEMPERING TEMPERATURE ON THE FRACTURE TOUGHNESS AND CORRESPONDING TENSILE PROPERTIES OF VACUUM-ARC MELTED BAR (23)

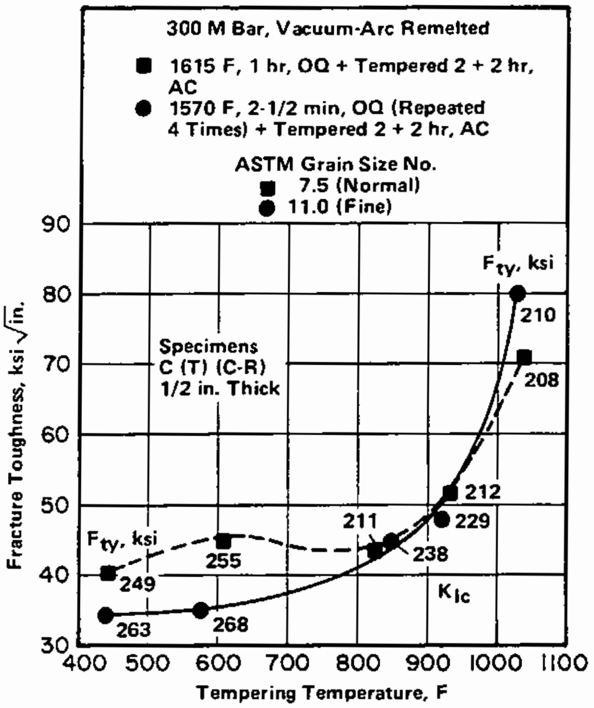


FIGURE 3.02724. EFFECT ON FRACTURE TOUGHNESS OF TEMPERING TEMPERATURE AND OF VERY FINE AUSTENITE GRAIN SIZE OBTAINED BY SHORT CYCLIC AUSTENITIZATION AT RELATIVELY LOW TEMPERATURES (8,9)

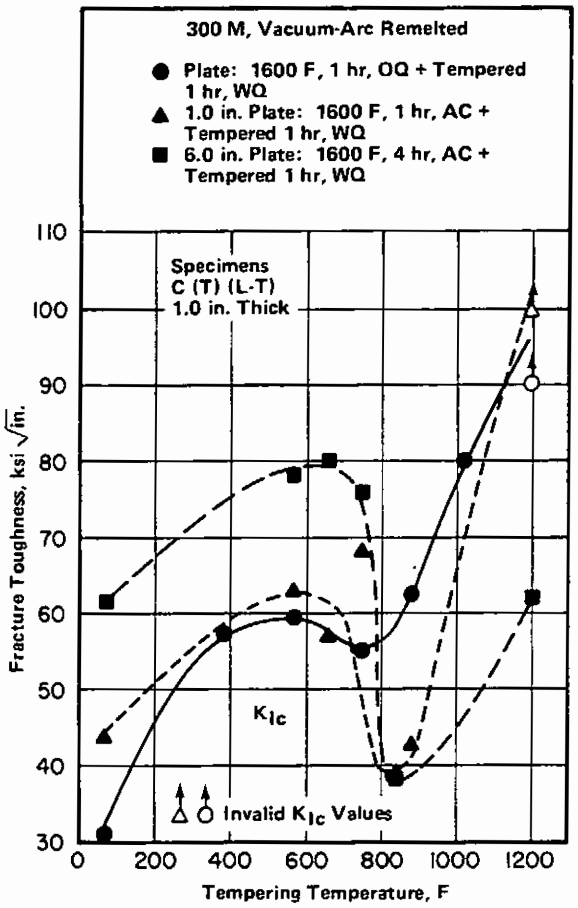


FIGURE 3.02725. EFFECT OF TEMPERING TEMPERATURE ON THE FRACTURE TOUGHNESS OF OIL-QUENCHED PLATE AND OF NORMALIZED PLATE (AIR COOLED FROM AUSTENITIZING TEMPERATURE) OF TWO THICKNESSES (13,35)

Note: Comparable tensile properties given in Figure 3.0212.

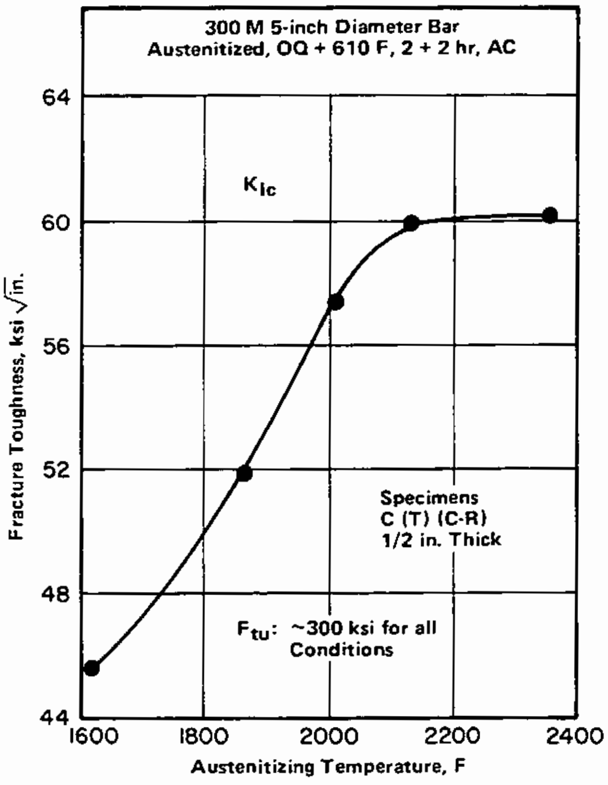


FIGURE 3.02726. EFFECT OF AUSTENITIZING TEMPERATURE ON THE FRACTURE TOUGHNESS OF VACUUM-ARC REMELTED BAR (11)

Alloy	300 M	
Form	Bar	
Condition	ASTM Grain Size No.(a)	K_{Ic}, ksi $\sqrt{in.}$(b,c)
1600 F, 1 hr, OQ + 535 F, 1 hr, WQ	8	51.0
1600 F, 1 hr, OQ + 1200 F, 1 hr, Heat to 1570 F, 1 min, OQ + 535 F, 1 hr, WQ	9	80.1
1600 F, 1 hr, OQ + 1570 F, 3 min, OQ (4 Cycles) + 535 F, 1 hr, WQ	10	49.1
2190 F, 1 hr, OQ + 535 F, 1 hr, WQ	2	82.8
2190 F, 1 hr, FC to 1600 F, 5 min, OQ + 1200 F, 1 hr, Heat to 1570 F, 2 min, OQ + 535 F, 1 hr, WQ	4	90.1

(a) Austenitic grain size.
(b) Specimens, C (T) (L-R), 5/8 inch thick.
(c) See Tables 3.0217 and 3.0234 for comparable tensile and impact properties.

TABLE 3.02727. EFFECTS OF VARIOUS AUSTENITIZING TREATMENTS ON FRACTURE TOUGHNESS AND GRAIN SIZE (33,34)

Alloy	300 M	
Form	Plate	
Austemper Treatment	Temper, F	K_{Ic}, ksi $\sqrt{in.}$
1600 F, 1 hr, SQ to 600 F, 1 hr, OQ	None	43.2
	390 (1 hr)	60.7
2190 F, 1 hr, SQ to 600 F, 1 hr, OQ	660 (1 hr)	54.7
	750 (1 hr)	39.5

Notes: K_{Ic} specimens, C (T) (L-T), 5/8 inch thick.
See Table 3.0219 for some information on tensile properties of austempered plate, although tempering temperatures are different.

TABLE 3.02728. EFFECTS OF AUSTENITIZING TEMPERATURE AND TEMPERING TEMPERATURE ON THE FRACTURE TOUGHNESS OF VACUUM-ARC REMELTED PLATE AUSTEMPERED AT 600 F (6)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

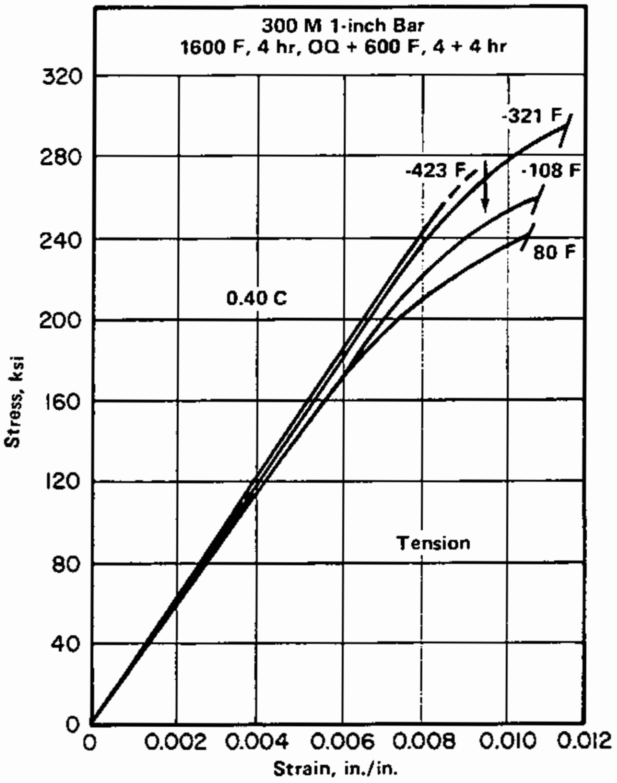


FIGURE 3.0311. TENSILE STRESS-STRAIN CURVES AT ROOM AND CRYOGENIC TEMPERATURES (45)

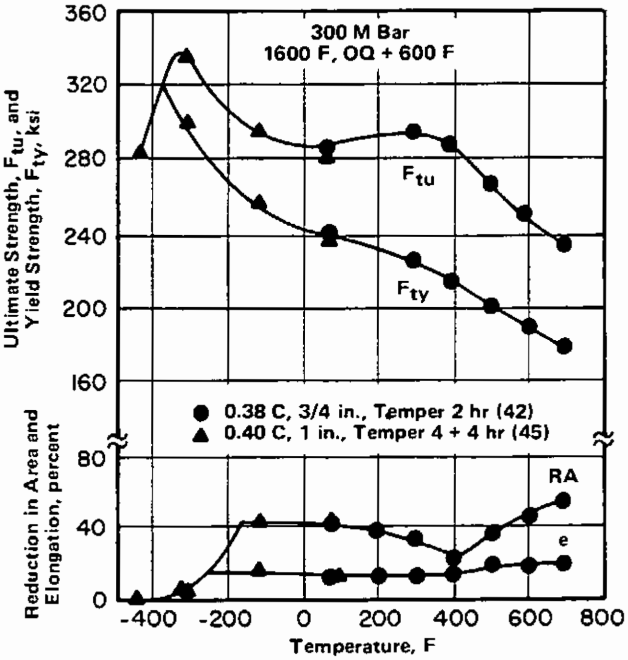


FIGURE 3.0312. EFFECT OF TEMPERATURES FROM -423 TO 700 F ON TENSILE PROPERTIES OF BAR (42,45)

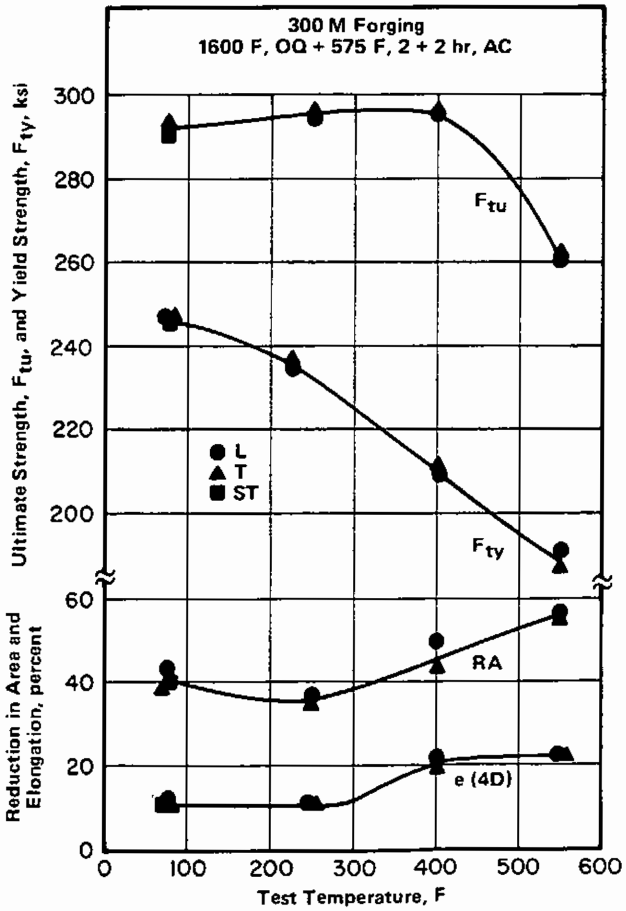


FIGURE 3.0313. EFFECT OF ELEVATED TEMPERATURES ON THE TENSILE PROPERTIES OF A LARGE FORGING OIL QUENCHED AND TEMPERED AT 575 F (20)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

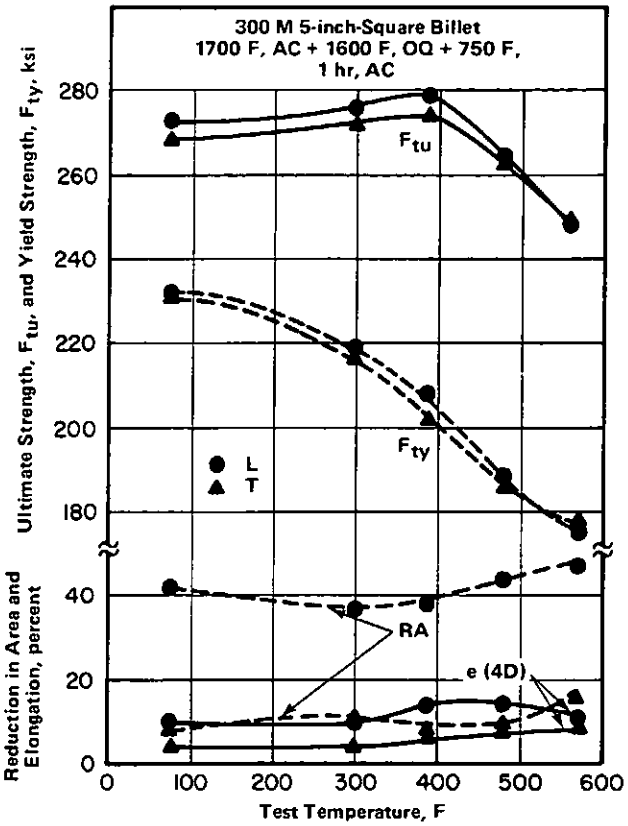


FIGURE 3.0314. EFFECT OF ELEVATED TEMPERATURES ON THE TENSILE PROPERTIES OF VACUUM-ARC MELTED BILLET OIL QUENCHED AND TEMPERED AT 750 F (12)

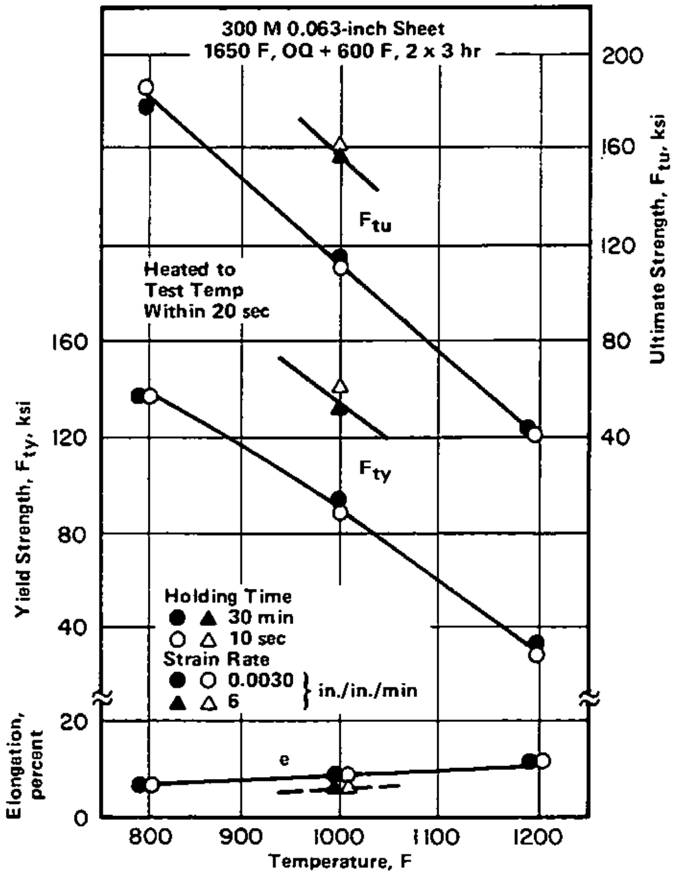


FIGURE 3.0315. EFFECTS OF A RAPID STRAIN RATE (6 IN./IN./MIN) AND A SHORT HOLDING TIME (10 SEC) AT TEMPERATURE ON TENSILE PROPERTIES IN THE TEMPERATURE RANGE 800 TO 1200 F (46)

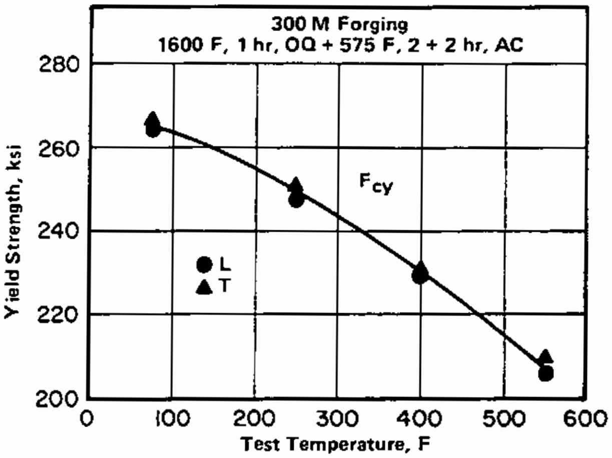


FIGURE 3.0321. EFFECT OF ELEVATED TEMPERATURES ON THE COMPRESSIVE YIELD STRENGTH OF A LARGE FORGING OIL QUENCHED AND TEMPERED AT 575 F (20)

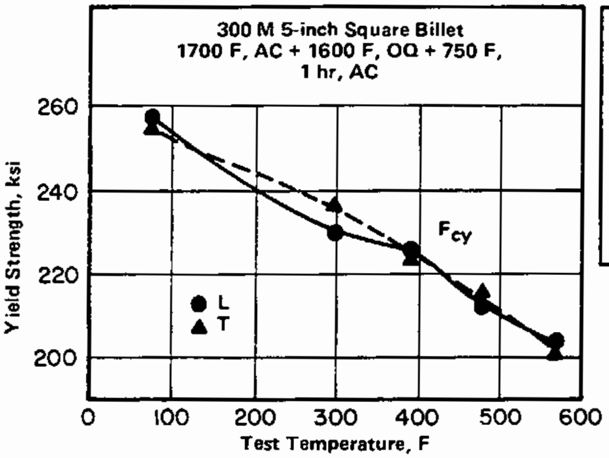


FIGURE 3.0322. EFFECT OF ELEVATED TEMPERATURES ON THE COMPRESSIVE YIELD STRENGTH OF VACUUM-ARC MELTED BILLET OIL QUENCHED AND TEMPERED AT 750 F (12)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

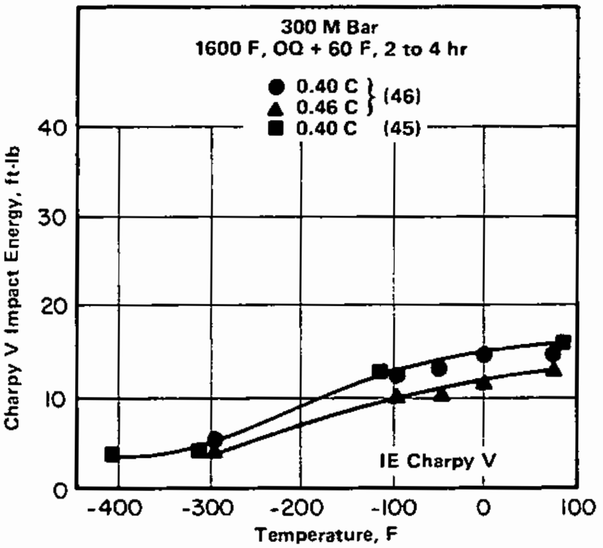


FIGURE 3.0331. EFFECT OF LOW TEMPERATURES DOWN TO -423 F ON NOTCH IMPACT PROPERTIES OF BARS WITH TWO CARBON CONTENTS (45,46)

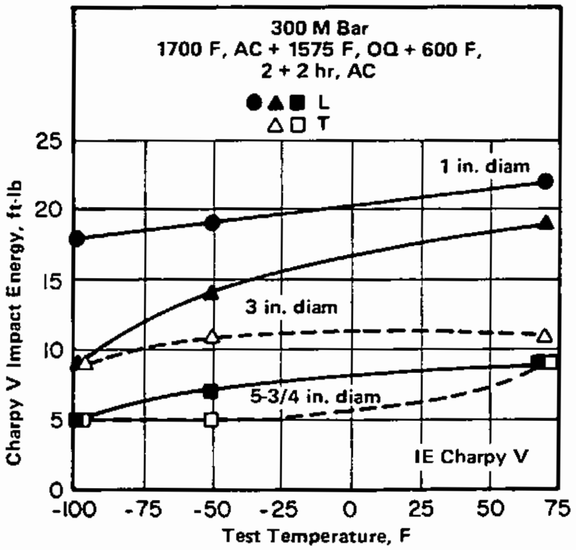


FIGURE 3.0332. EFFECTS OF LOW TEMPERATURES AND DIFFERENT ORIENTATIONS ON THE IMPACT RESISTANCE OF BAR OF VARIOUS DIAMETERS (28)

Note: The specimens were machined after heat treatment from the center of the 1.0-inch-diameter bar and from the mid-radius of the larger bars.

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

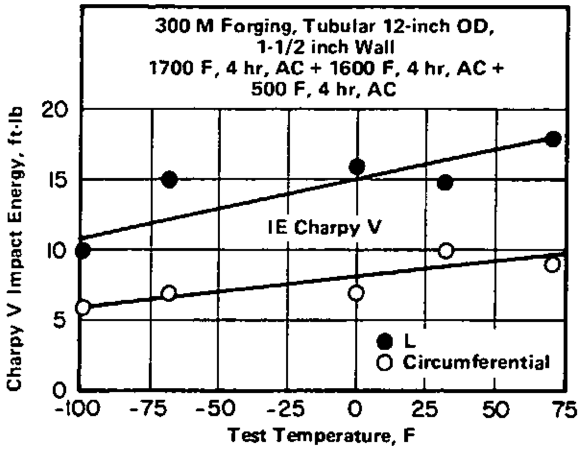


FIGURE 3.0333. EFFECT OF LOW TEMPERATURES ON THE NOTCH IMPACT RESISTANCE OF A FORGING (28)

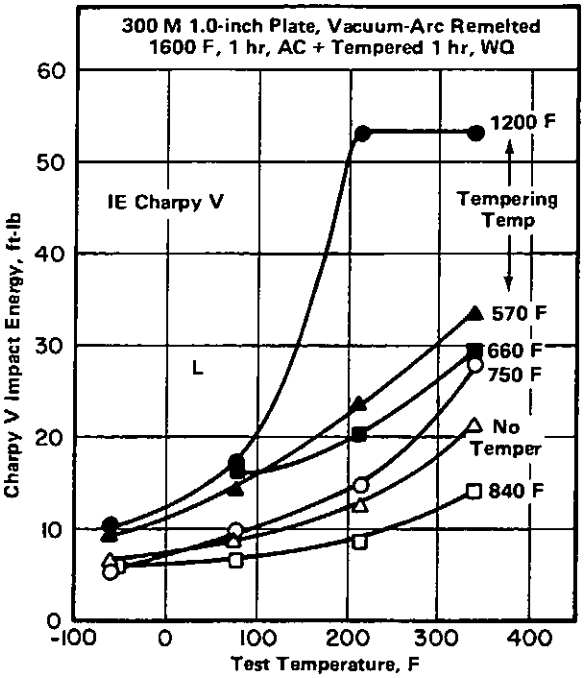


FIGURE 3.0334. EFFECTS OF TEST TEMPERATURES FROM -60 F TO 340 F AND OF TEMPERING TEMPERATURES UP TO 1200 F ON THE CHARPY V-NOTCH IMPACT RESISTANCE OF NORMALIZED 1.0-INCH-THICK PLATE (AIR-COOLED FROM AUSTENITIZING TEMPERATURE) (13)

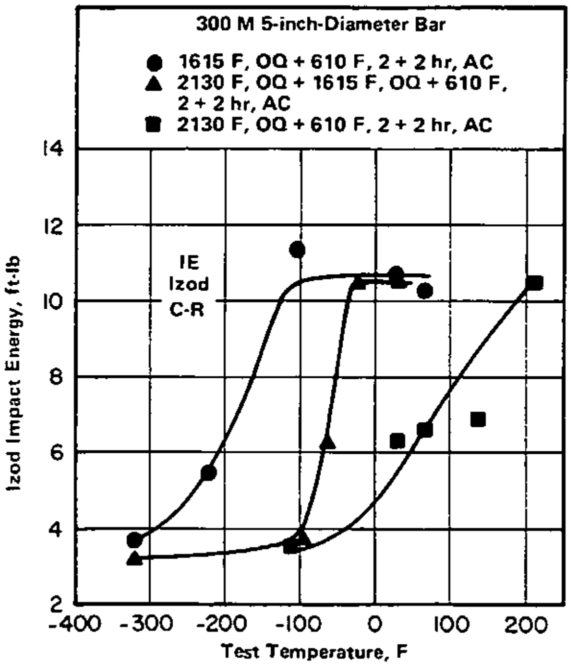


FIGURE 3.0335. EFFECTS OF VARIATIONS IN AUSTENITIZING TREATMENT ON NOTCH-IMPACT-TRANSITION CURVES OF VACUUM-ARC REMELTED BAR (11)

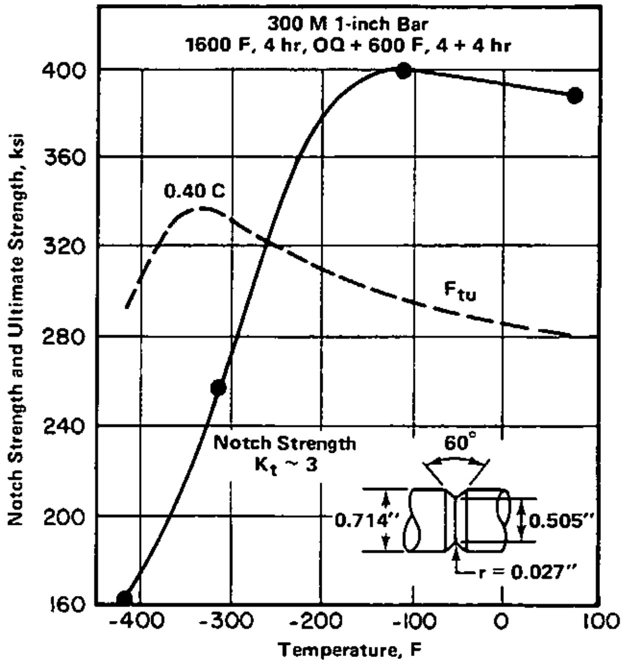


FIGURE 3.03711. EFFECT OF LOW TEMPERATURES ON NOTCH STRENGTH OF BAR (45)

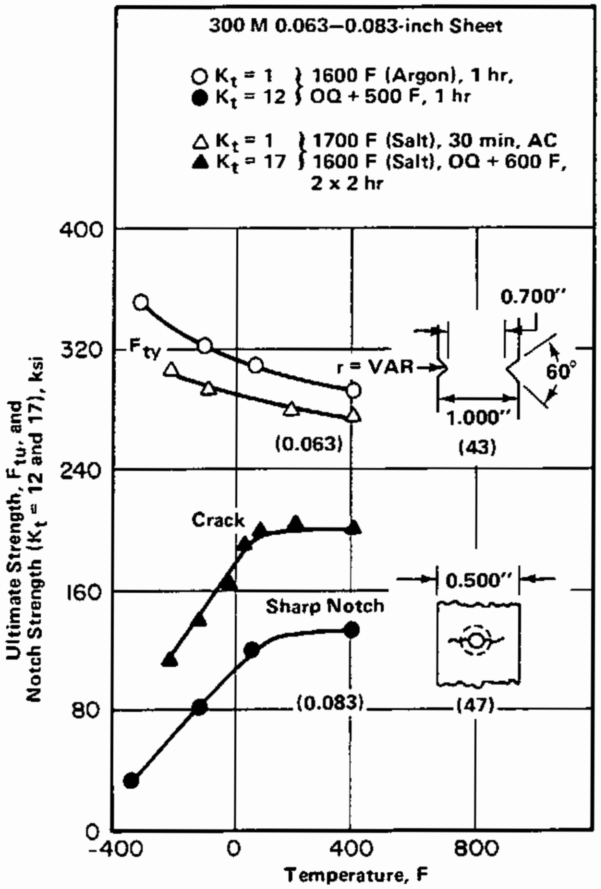


FIGURE 3.03712. EFFECT OF TEMPERATURES FROM 400 TO -320 F ON TENSILE (K_t = 1), SHARP-NOTCH (K_t = 12), AND CRACK (K_t = 17) STRENGTH OF SHEET (43,47)

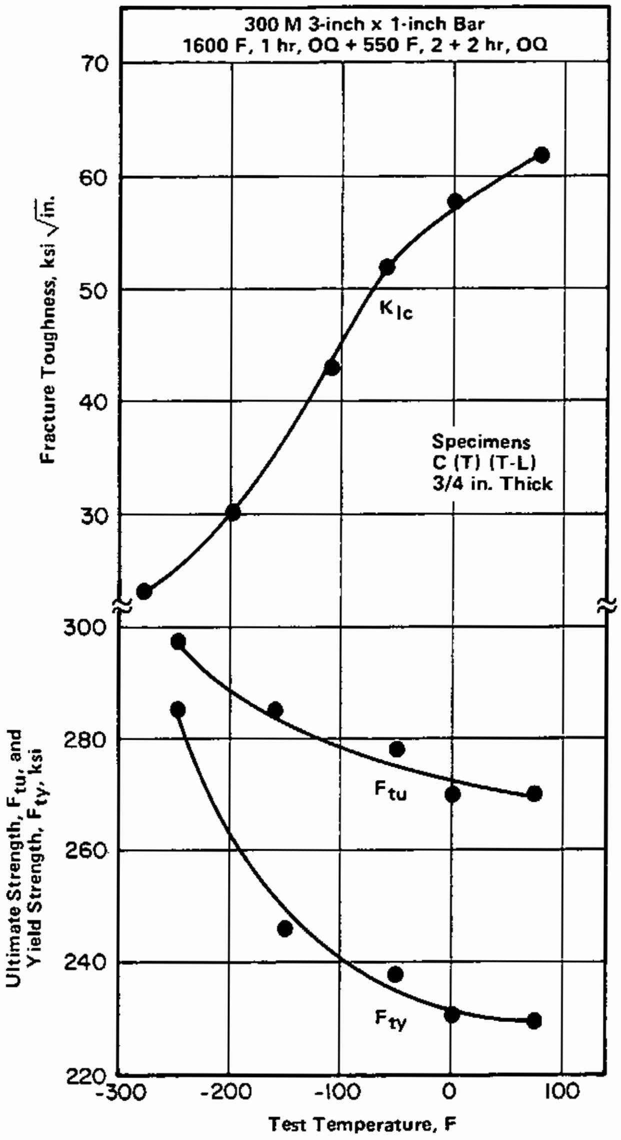


FIGURE 3.03721. EFFECT OF LOW TEMPERATURES ON THE FRACTURE TOUGHNESS AND CORRESPONDING TENSILE PROPERTIES OF VACUUM-ARC REMELTED BAR (23)

Fe
0.43 C
1.8 Ni
1.6 Si
0.8 Cr
0.4 Mo
\+ V

300 M

Alloy	300 M	
Form	Plate	
Condition	1600 F, 1 hr, OQ + 575 F, 2 + 2 hr, AC	
Temperature, F	K_{Ic}, ksi $\sqrt{in.}$	F_{ty}, ksi
70	62	230
0	58	231
-65	43	245

Note: Specimen C (T) (L-T), 3/4 inch thick.

TABLE 3.03722. EFFECT OF LOW TEMPERATURES ON FRACTURE TOUGHNESS OF PLATE (17)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

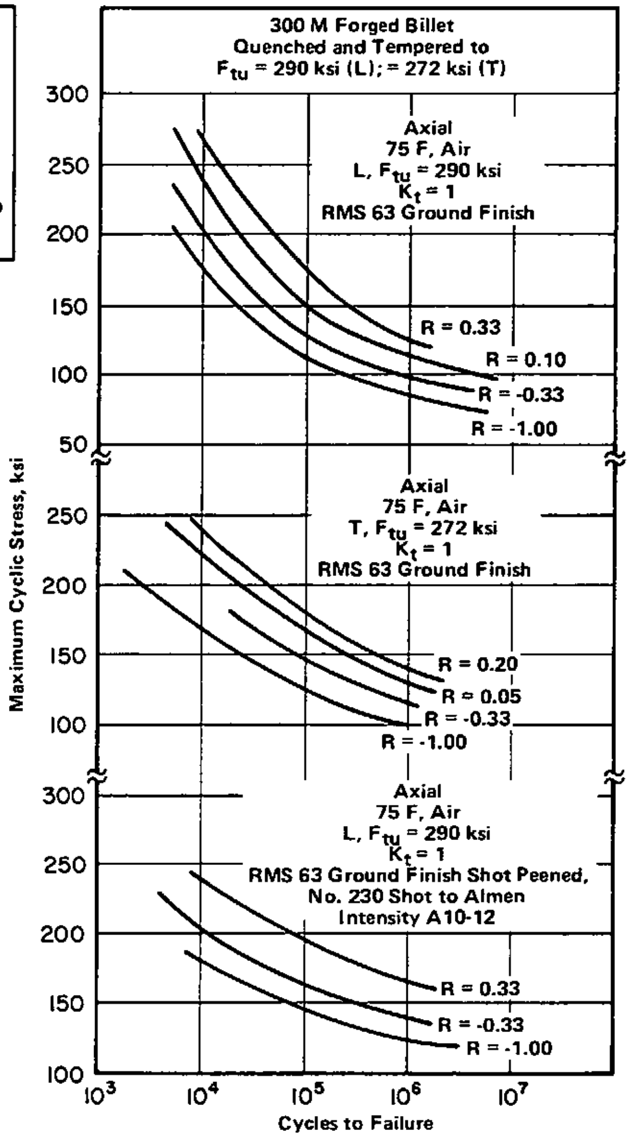


FIGURE 3.051. FATIGUE LIFE OF LONGITUDINALLY GROUND AND SHOT-PEENED SPECIMENS FROM FORGED BILLET HEAT TREATED TO HIGH STRENGTH LEVEL (3)

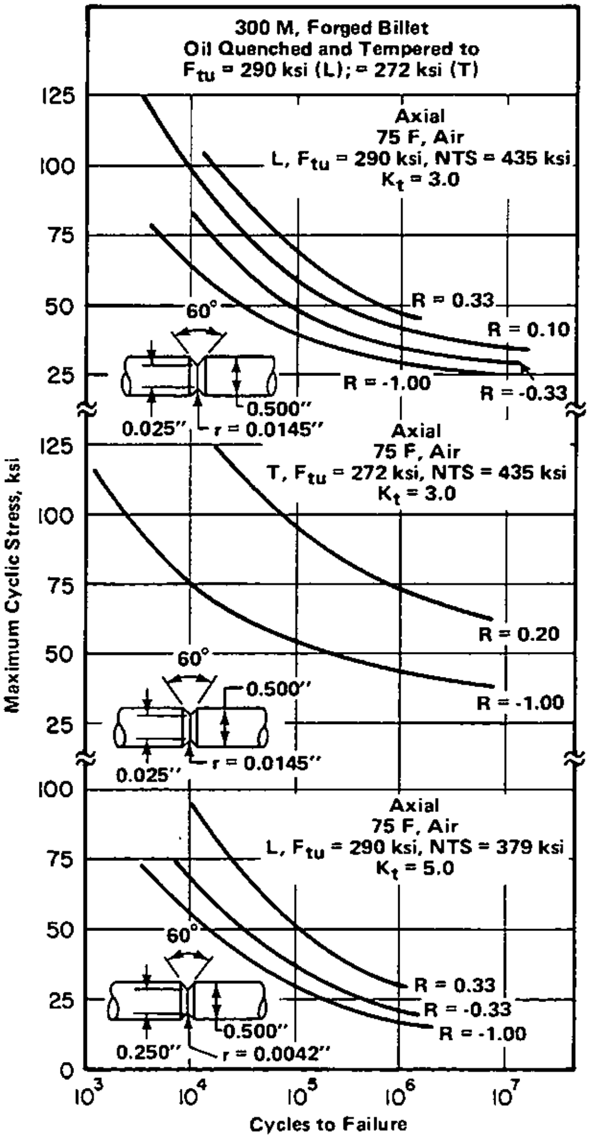


FIGURE 3.052. FATIGUE LIFE OF NOTCHED SPECIMENS FROM FORGED BILLET HEAT TREATED TO HIGH STRENGTH LEVEL (3)

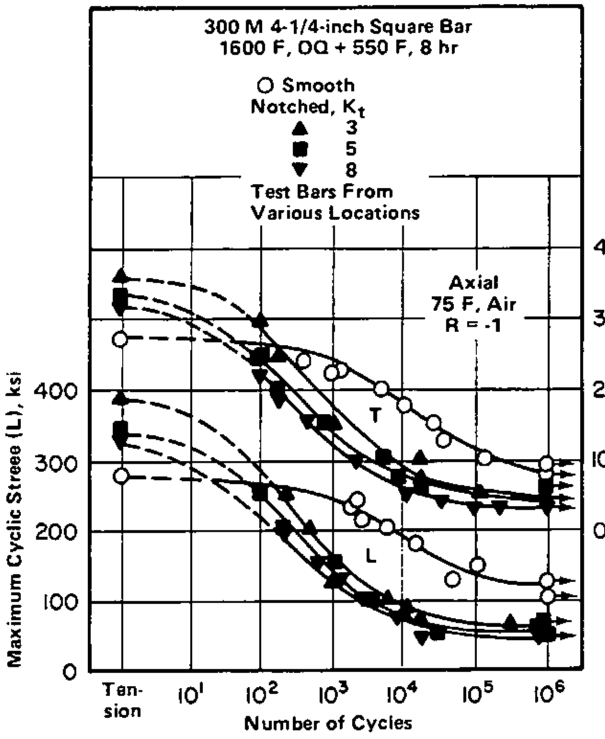


FIGURE 3.053. FATIGUE LIFE OF SMOOTH AND NOTCHED BAR (48)

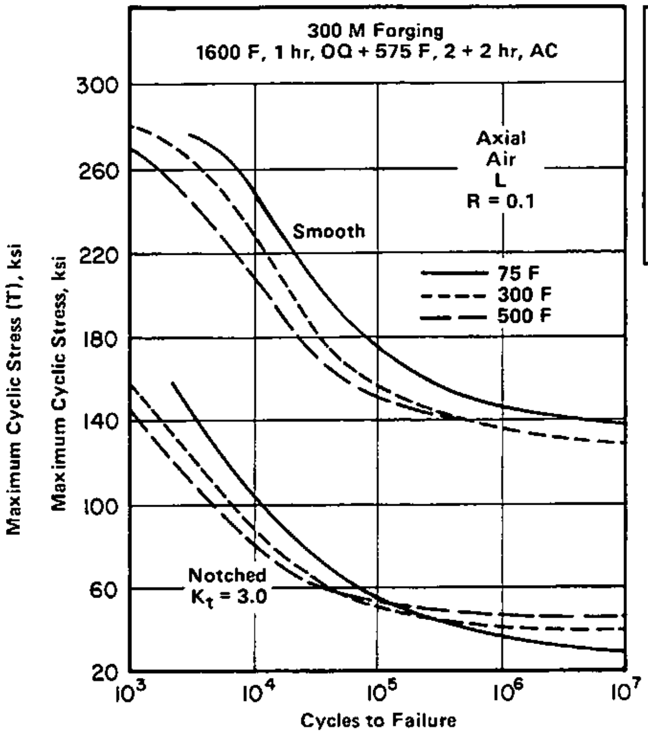


FIGURE 3.054. EFFECT OF ELEVATED TEMPERATURES ON FATIGUE LIFE OF SMOOTH AND NOTCHED SPECIMENS FROM LARGE FORGING OIL QUENCHED AND TEMPERED AT 575 F (20)

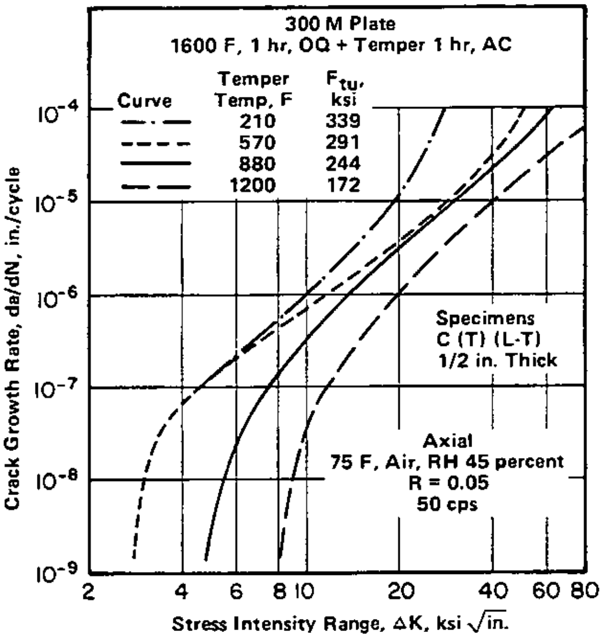


FIGURE 3.055. EFFECT OF VARIATIONS IN TEMPERING TEMPERATURE AND ASSOCIATED STRENGTH LEVELS ON FATIGUE-CRACK GROWTH RATE OF VACUUM-ARC REMELTED PLATE IN AN AIR ENVIRONMENT (15)

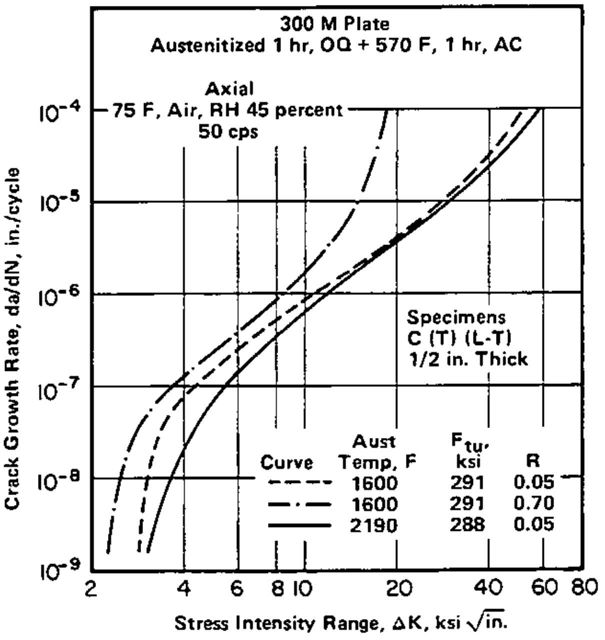


FIGURE 3.056. EFFECTS OF VARIATIONS IN AUSTENITIZING TEMPERATURE AND STRESS RATIO (R) ON FATIGUE-CRACK GROWTH RATE OF VACUUM-ARC REMELTED PLATE IN AN AIR ENVIRONMENT (15)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

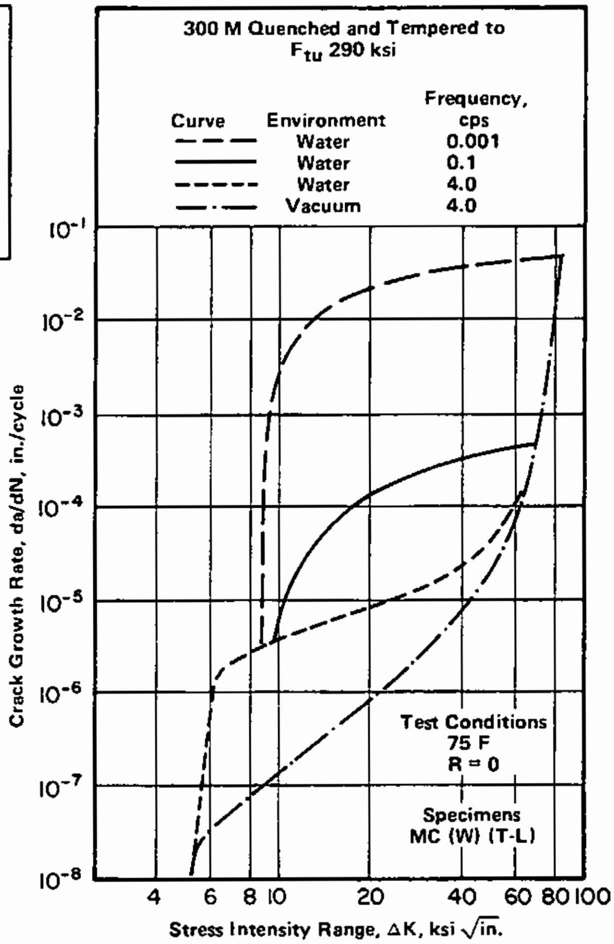


FIGURE 3.057. EFFECTS OF VARIATIONS IN FREQUENCY AND ENVIRONMENT ON FATIGUE-CRACK GROWTH RATE (16)

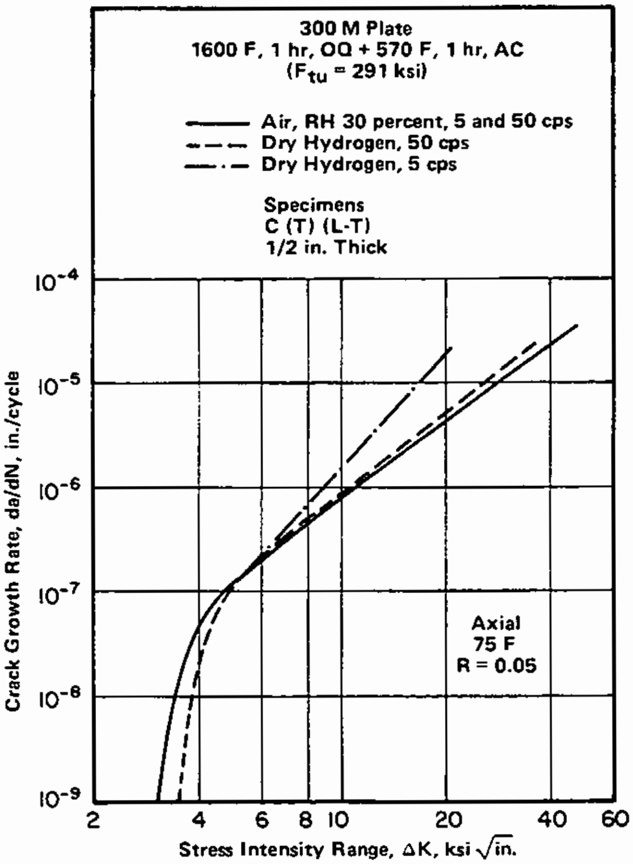


FIGURE 3.058. FATIGUE-CRACK GROWTH RATE OF VACUUM-ARC REMELTED PLATE IN ENVIRONMENTS OF AIR AND OF DRY HYDROGEN AT FREQUENCIES OF 5 AND 50 CPS (20)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

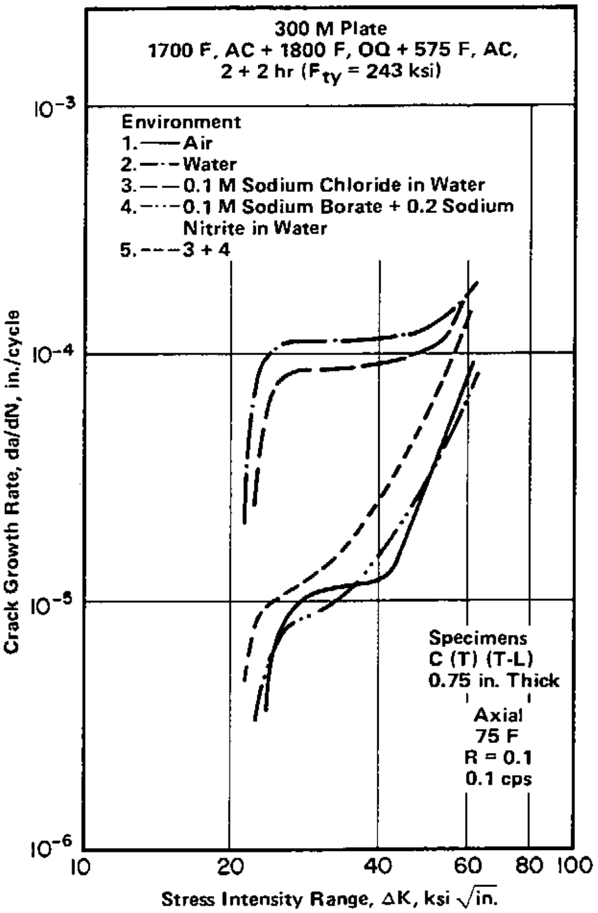


FIGURE 3.059. EFFECTS OF VARIOUS ENVIRONMENTS AND A SODIUM BORATE, SODIUM NITRITE INHIBITOR ON FATIGUE-CRACK GROWTH RATE OF PLATE HEAT TREATED TO A HIGH STRENGTH LEVEL (1)

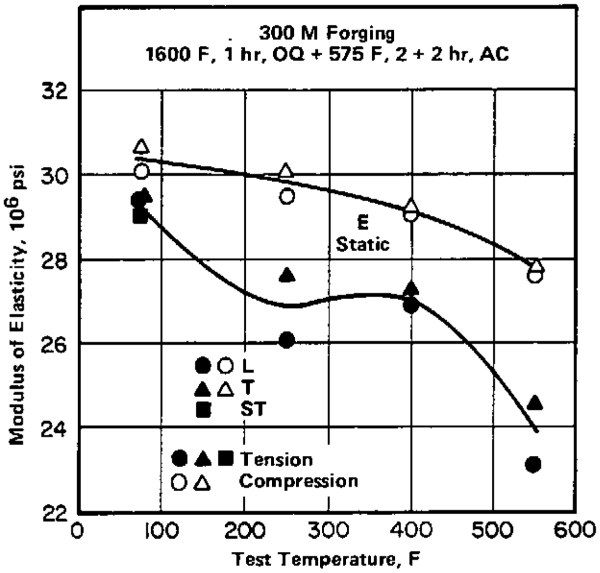


FIGURE 3.0621. EFFECT OF ELEVATED TEMPERATURES ON MODULUS OF ELASTICITY IN TENSION AND COMPRESSION OF A LARGE FORGING OIL QUENCHED AND TEMPERED AT 575 F (20)

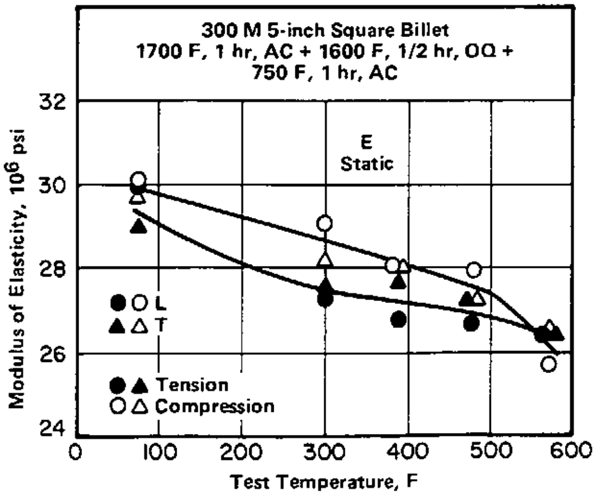


FIGURE 3.0622. EFFECT OF ELEVATED TEMPERATURES ON MODULUS OF ELASTICITY DETERMINED IN BOTH TENSION AND COMPRESSION ON A VACUUM-ARC MELTED BILLET OIL QUENCHED AND TEMPERED AT 750 F (12)

	Fe
0.43	C
1.8	Ni
1.6	Si
0.8	Cr
0.4	Mo
+	V

300 M

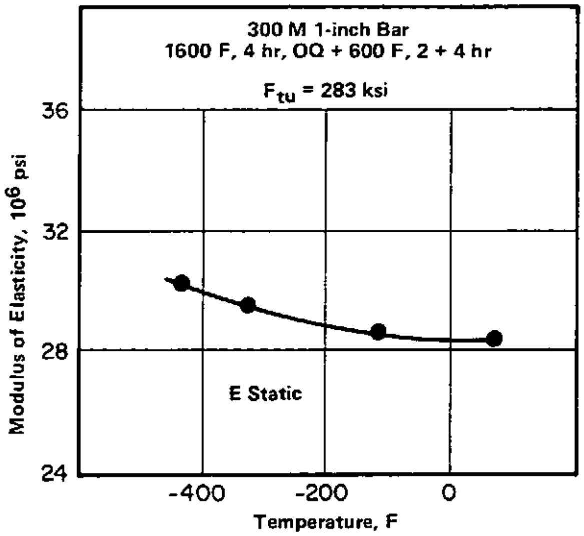


FIGURE 3.0623. EFFECT OF LOW TEMPERATURES ON MODULUS OF ELASTICITY OF BAR (44)

Alloy	300 M			
Form	Tube, 5-1/2 Inch OD x 3/4 Inch Wall			
Condition	Oil Quench and Temper (400 F) After Welding			
	F_{ty}, ksi	F_{tu}, ksi	e (4D), percent	RA, percent
Parent Metal	270.0	302.5	9	18
Across Weld	246.0	285.6	3	7

TABLE 4.032. COMPARISON OF TENSILE PROPERTIES OF PARENT METAL AND FLASH-BUTT WELD JOINT (NO FILLER METAL) IN TUBING (28)