

Fe 18 Cr 8 Ni

Type 301
Type 302

1.061	Substantial hardening can be produced in meta-stable austenitic steels such as Types 301 and 302 by deformation below the M_d temperature (highest temperature for deformation-induced martensitic transformation) to produce alpha-prime martensite. Type 301 is less stable than Type 302 and produces more martensite and greater hardening, as shown in Figures 1.062 and 1.063. Essentially no martensite is produced in either steel on deformation at 330 F, but martensite is produced in both steels by deformation at or below room temperature. Cooling to liquid-nitrogen temperature (-320 F) without deformation produces about 12 percent alpha-prime martensite in Type 301 and 4 percent in Type 302. For a given degree of deformation applied at various temperatures, the hardness is linearly related to the content of strain-induced alpha-prime martensite, as shown in Figure 1.064. Short-time (2 minute) annealing at elevated temperatures causes reductions in both amount of martensite and hardness, as shown in Figures 1.065 and 1.066. It is concluded from these data that the A_{c1} temperature for both steels is in the range 1020 to 1110 F. The A_{c3} temperature for Type 301 is 1380 to 1470 F and for Type 302 is 1290 to 1380 F (55).	1.09 1.091	high cleanliness and low gas content are required (57). Special Considerations Types 301 and 302 become subject to severe intergranular corrosion after heating in the temperature range 800 to 1500 F. This sensitization, which also occurs after welding, is attributed to precipitation of chromium carbide at the grain boundaries which causes depletion of chromium from the matrix in the intergranular regions. Corrosion resistance can be restored by annealing to re-solution the chromium carbides. See 2.032. Improved strength properties can be obtained by cold working at cryogenic temperatures rather than at room temperature. (See Section 3.0217.) Increased tensile ductility and drawing properties can be achieved in Type 301 by deforming at 130 to 140 F, just below the M_d temperature. The improved ductility is related to the strain-induced martensitic transformation, which increases work hardening and resistance to necking. (See Section 3.03154.) Although these steels are generally considered to have good resistance to hydrogen embrittlement, the notch strength of Type 301 is decreased considerably in hydrogen as compared to air. Further, high contents of dissolved hydrogen in Type 301, such as obtainable by electrolytic charging, can cause crack growth under constant load. (See Section 2.034.) The 300-grade stainless steels, including Types 301 and 302, are subject to salt-water corrosion in crevices or under deposits. Corrosion is reduced or eliminated in turbulent seawater or when cathodic protection is present. (See Section 2.0312.)
1.062	Hardness and martensite contents of Type 301 after rolling to various reductions at 330 F to -320 F, Figure 1.062.	1.092	
1.063	Hardness and martensite contents of Type 302 after rolling to various reductions at 330 F to -320 F, Figure 1.063.	1.093	
1.064	Effect of strain-induced martensite content on hardness, Figure 1.064.	1.094	
1.065	Hardness and martensite contents of Type 301 after cold rolling followed by heat treatment at 1020 to 1560 F, Figure 1.065.	1.095	
1.066	Hardness and martensite contents of Type 302 after rolling followed by heat treatment at 1020 to 1560 F, Figure 1.066.	2	PHYSICAL AND CHEMICAL PROPERTIES
1.067	Effect of extrusion temperature on hardness, Figure 1.067.	2.01	Thermal Properties
1.068	AISI typical values for hardness, Table 1.068.	2.011	Melting ranges are 2250 to 2590 F for Type 301 and 2550 to 2590 F for Type 302 (51).
1.069	Effect of low test temperature on hardness of extra-hard cold-rolled sheet, Figure 1.069.	2.012	Phase changes.
1.0610	Effect of aging temperature on hardness of 67 percent cold-rolled sheet, Figure 1.0610.	2.0121	Time-temperature-transformation diagrams.
1.0611	Effect of hydrogen environment at elevated temperature on surface hardness of half-hard sheet, Figure 1.0611.	2.0122	Transformation temperatures, Table 2.0122.
1.07	Forms and Conditions Available	2.013	Thermal conductivity, Figure 2.013.
1.071	Alloy is available in the full commercial range of sizes and conditions for various forms as follows:	2.014	Thermal expansion: (a) Type 301, (b) Type 302, Figure 2.014.
1.0711	Type 301 sheet with strip, annealed, 1/4 H, 1/2 H, 3/4 H, full H, extra H, and stress-relieved tempers.	2.015	Specific heat, Figure 2.015.
1.0712	Type 302 bar, annealed and two standard tempers.	2.016	Thermal diffusivity, Figure 2.016.
1.0713	Type 302 wire, annealed and three standard tempers.	2.02	Other Physical Properties
1.08	Melting and Casting Practice	2.021	Density, Figure 2.021.
	Electric furnace air melt. Induction and consumable-electrode vacuum melts and remelts are also available. Vacuum-arc and electroslag consumable-electrode remelting are used where	2.022	Electrical properties.
		2.0221	Electrical resistivity, Figure 2.0221.
		2.023	Magnetic properties.
		2.0231	These alloys are nonmagnetic in the annealed (fully austenitic) condition. However, the alloys become magnetic on cold working due to the deformation-induced transformation from non-magnetic austenite to magnetic alpha-prime martensite. The extent of magnetization on cold working decreases with increasing nickel content in Series 300 stainless steels, as shown in Figure

2.0232. This is a result of nickel stabilization of the austenite phase.

2.0232 Effect of composition and reduction on magnetic permeability and tensile strength of 300 series sheet, Figure 2.0232.

2.024 Emission, Figure 2.024.

2.025 Damping capacity.

2.03 **Chemical Environments**

2.031 General corrosion.

2.0311 General corrosion resistance of Type 301, like that of all austenitic stainless steels, is very high, but it is at the lower end of the corrosion scale for 18-8 steels; Type 302 is slightly superior to Type 301.

2.0312 The 300 series stainless steels can undergo deep localized crevice corrosion in mechanical crevices or under deposits in quiescent seawater. The differences in performance of the various grades of 300 stainless steels under these conditions are not of practical significance. Cathodic protection can be effectively accomplished with iron, zinc, aluminum, or magnesium anodes or by an impressed electrical current system. Multi-component assemblies containing different alloys frequently offer built-in cathodic protection. Turbulent seawater with sufficient agitation to keep austenitic stainless steels free of deposits, either biological or inorganic, permits stainless steel to remain passive and corrosion-free. Chloride stress-corrosion cracking is not a problem in ambient-temperature seawater (64).

2.0313 Corrosion in tropical environments for times up to 16 years, Table 2.0313.

2.0314 Based on galvanic current data and corrosion rates, Type 301 is considered compatible with graphite-epoxy composite materials in aerated neutral 3.5 percent NaCl solution at room temperature (66).

2.032 Intergranular corrosion.

2.0321 A potentially serious problem against which precautions should be taken is intergranular corrosion of "sensitized" alloy. Sensitization occurs when these steels are heated in the temperature range 800 to 1500 F. The sensitization time depends primarily on temperature but is also influenced by the chemical and metallurgical characteristics of the alloy, such as carbon content and grain size. Sensitization is most generally attributed to depletion of chromium from regions adjacent to the grain boundaries because of precipitation of chromium-rich (Fe,Cr)₂₃C₆ carbides. During welding, the heat-affected zone reaches the critical temperature range for a short time, promoting nucleation of chromium-rich carbides at the grain boundaries. If a welded component operates below the temperature range for normal sensitization (for example, 600 to 800 F), the previously nucleated carbides grow, but the low temperature prevents further nucleation and restricts chromium diffusion from the grain interiors. However, after extended time periods, such as 10 years, low-temperature sensitization occurs and increases the probability of intergranular stress-corrosion cracking. If material has been sensitized either by welding or by exposure, it should be fully annealed

to re-solution the precipitated chromium-rich carbides. This anneal will restore the original corrosion resistance. Self-healing and restoration of corrosion resistance can also occur on heating for very long times in the sensitization temperature range. Self-healing occurs by diffusion of chromium from the grain interiors into the depleted zones. The time-temperature conditions for sensitization of Type 302 are shown in Figure 2.0322 (67).

2.0322 Effects of heat treatment on susceptibility to intergranular stress-corrosion cracking in polythionic acid and in acid copper sulfate, Figure 2.0322.

2.0323 Effect of prior exposure temperature and time on average corrosion rate in boiling nitric acid of cold-rolled sheet, Figure 2.0323.

2.033 Stress-corrosion cracking.

2.0331 Stress cracking may be pronounced in these steels in the formed condition, if high residual stresses are present. The tendency to stress cracking depends primarily on the value of tensile strength developed. Severely formed parts, particularly in the harder tempers of Type 301, should be immediately annealed or stress relieved to prevent cracking.

The susceptibility of cold-worked material to stress corrosion cracking may be related in part to the presence of deformation-induced martensite. The hcp epsilon martensite phase corrodes more rapidly than the matrix austenite phase (69,70). Stress-corrosion cracking may occur in certain media, primarily in hot chlorides, if residual stresses are present. Under normal atmospheric conditions no stress corrosion is observed, even in extra hard sheet. Stress-corrosion cracking can result, for example, from surface contamination with zinc chloride from solder flux (71,72).

2.0332 Stress-corrosion cracking may occur in certain media, primarily in hot chlorides, if residual stresses are present. Under normal atmospheric conditions no stress corrosion is observed, even in extra hard sheet. Stress-corrosion cracking can result, for example, from surface contamination with zinc chloride from solder flux (71,72).

2.0333 Effects of cold reduction on yield stress in air and on threshold corrosion stress in boiling 0.5N NaCl + 0.1N NaNO₂ aqueous solution, Figure 2.0333.

2.034 Hydrogen embrittlement.

2.0341 Although austenitic stainless steels are generally considered to have good resistance to hydrogen embrittlement, the notch tensile strength of Type 301 is reduced considerably when tested in hydrogen rather than in air. The detrimental effect is lessened when oxygen is present as an impurity in the hydrogen atmosphere, as shown in Figure 2.0342. Oxygen reacts with surface adsorption sites and, if in sufficient quantity, will completely inhibit the adsorption of hydrogen and thus prevent embrittlement (74).

2.0342 Effects of oxygen impurity in hydrogen on notch strength of Type 301, Figure 2.0342.

2.0343 Sustained-load crack growth is observed in material charged to 13 wt ppm hydrogen or more, as shown in Figure 2.0344. The crack-growth rate at a given stress intensity factor increases strongly with increasing hydrogen content. The fracture surface of material which has failed by slow crack growth exhibits brittle transgranular cleavage. Material containing less than 3 wt ppm hydrogen exhibits ductile fracture upon reaching a critical load and

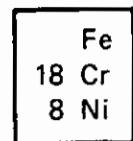
Fe
18 Cr
8 Ni

Type 301
Type 302

Fe
18 Cr
8 Ni

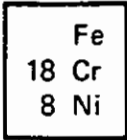
Type 301 2.0344
Type 302 2.035

- 2.0351 Air oxidation of Type 302 is slight at 1202 and 1292 F, as shown in Figure 2.0352. There is no subsurface oxide penetration at these temperatures. At 1382 F oxide penetration occurs but the surface oxide is still quite protective. Oxidation begins to increase sharply with temperature above 1472 F and the time dependence on an arithmetic basis approaches linearity at 1562 F, indicating a nonprotective scale. Type 302 is considered suitable for continuous service at temperatures up to 1600 F and for intermittent service up to 1700 F (75).
- 2.0352 Time dependence of oxidation of Type 302 in air at elevated temperatures, Figure 2.0352.
- 2.04 **Nuclear Environments**
- 2.041 Effect of irradiation exposure on tensile properties and hardness of alloy, Table 2.041.
- 3 **MECHANICAL PROPERTIES**
- 3.01 **Specified Mechanical Properties**
- 3.011 AMS-specified mechanical properties, Table 3.011.
- 3.02 **Mechanical Properties at Room Temperature**
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- 3.0211 Stress-strain curves for sheet and strip cold rolled to different temper, Figure 3.0211.
- 3.0212 Stress-strain curves for sheet and strip cold rolled to full-hard and extra-hard tempers, Figure 3.0212.
- 3.0213 Percentage cold reduction and corresponding tensile strength for various tempers of Type 301 and Type 302, Table 3.0213.
- 3.0214 Effect of rolling reduction and composition on tensile properties of 300 series steels, Figure 3.0214.
- 3.0215 Effect of cold reduction on tensile properties of Type 301, Figure 3.0215.
- 3.0216 Effects of cold work on tensile properties of Type 302, Figure 3.0216.
- 3.0217 Cold working at cryogenic temperatures increases the tensile strength to a greater degree than equivalent working at room temperature. The ductility of material cryogenically rolled to a given strength is higher than that of material rolled at room temperature to the same strength, as shown in Figures 3.0218 and 3.0219. The effects of cold rolling on tensile properties are primarily through the amount of martensite produced. The amount of cold work introduced into the matrix has an additional strengthening effect, as shown in Figures 3.02110 and 3.02111. Heat treating cold-worked material at 550 F further increases the yield strength, as shown in Figures 3.02112 and 3.02113.
- 3.0218 Effect of cold reduction at room and cryogenic temperatures on tensile properties of Type 301, Figure 3.0218.
- 3.0219 Effect of cold reduction at room and cryogenic temperatures on tensile properties of Type 302, Figure 3.0219.
- 3.02110 Relationship between tensile properties and martensite content for Type 301, Figure 3.02110.
- 3.02111 Relationship between tensile properties and martensite content for Type 302, Figure 3.02111.
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- 3.02115 Effect of cyclic exposure stress on room-temperature tensile properties of 60 percent reduced sheet exposed at 600 and 900 F, Figure 3.02115.
- 3.02116 Effect of exposure at low temperature on room-temperature tensile properties of extra-hard cold-rolled sheet, Figure 3.02116.
- 3.02117 Effects of extrusion temperature on longitudinal tensile properties of Type 301, Figure 3.02117.
- 3.02118 Effects of extrusion temperature on longitudinal tensile properties of Type 302, Figure 3.02118.
- 3.02119 Effect of stretching on tensile yield strength of Type 302, Figure 3.02119.
- 3.022 Compression – stress-strain curves – compression properties.
- 3.0221 Effect of stretching on compressive yield strength of Type 302, Figure 3.0221.
- 3.023 Impact.
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- 3.0232 Relation between impact energy and tensile strength for cold-rolled Type 302, Figure 3.0232.
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- 3.025 Torsion and shear.
- 3.026 Bearing.
- 3.027 Stress concentration.
- 3.0271 Notch properties.
- 3.02711 Effect of cold rolling and test direction on notch strength of sheet, Figure 3.02711.
- 3.02712 Effect of exposure at low temperature on room-temperature notch strength of extra-hard cold-rolled sheet, Figure 3.02712.
- 3.02713 Effect of test direction in relation to rolling direction on tensile properties and notch strength of 60 percent cold-reduced sheet, Figure 3.02713.
- 3.0272 Fracture toughness.
- 3.028 Combined properties.
- 3.03 **Mechanical Properties at Various Temperatures**
- 3.031 Tension – stress-strain curves – tension properties.
- 3.0311 Stress-strain curves.
- 3.03111 The stress-strain curves for Types 301 and 302 are influenced by the deformation-induced transformation of austenite to martensite. The work-hardening rate (slope of the stress-strain curve) for Type 302



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Type 302

- at -112 F is compared to that of the structurally stable Type 310 alloy in Figure 3.03112. Type 302 is metastable at this temperature and exhibits an increase in work-hardening rate between about 4 and 20 percent strain due to the martensitic transformation. The Type 310 alloy shows a continuous decrease in work-hardening rate with increasing strain. Stress-strain curves for annealed Types 301 and 302 at temperatures near and below M_d are shown in Figures 3.03113 and 3.03114, respectively. Both stable (continuously decreasing work-hardening rate) and metastable (decreasing and increasing work-hardening rate) curves are seen, depending on test temperature. Type 301 shows increasing work hardening due to martensite formation at 68 F and lower, while Type 302 exhibits martensitic hardening up to at least 77 F (77,78).
- 3.03112 Tensile work-hardening rates for Types 302 and 310 at -112 F, Figure 3.03112.
 - 3.03113 Stress-strain curves for annealed Type 301, Figure 3.03113.
 - 3.03114 True stress-strain curves for annealed Type 302 at room and cryogenic temperatures, Figure 3.03114.
 - 3.03115 Stress-strain curves for Type 301 full-hard and full-hard stress-relieved sheet at room and elevated temperatures, Figure 3.03115.
 - 3.03116 Stress-strain curves in tension for various temperatures and exposure times for 60 percent cold-reduced sheet, Figure 3.03116.
 - 3.03117 Stress-strain curves in tension at low temperatures of extra-hard cold-rolled sheet, Figure 3.03117.
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 - 3.03121 Effect of cold rolling on tensile properties of Type 301 sheet at room temperature and -320 F, Figure 3.03121.
 - 3.03122 Effect of percent reduction on tensile properties of sheet tested at room temperature and -423 F, Figure 3.03122.
 - 3.03123 Effect of low temperature and percent cold reduction on tensile properties of sheet, Figure 3.03123.
 - 3.03124 Effect of low rolling temperature on tensile properties at room temperature and -320 F of reduced sheet, Figure 3.03124.
 - 3.03125 Effect of low rolling temperature on tensile properties at room temperature and -423 F of 10 percent reduced sheet, Figure 3.03125.
 - 3.03126 Effect of rolling temperature on tensile properties at room temperature and -423 F of 65 percent reduced sheet, Figure 3.03126.
 - 3.03127 Effect of test direction on tensile strength of cold-rolled sheet at room and cryogenic temperatures, Figure 3.03127.
 - 3.0313 Prior exposure and strain-rate effects on tension properties.
 - 3.03131 Tensile ductility of Types 301 and 302 is affected by strain rate, temperature, and phase stability, as well as microstructure. For constant microstructure, Type 302 exhibits a minimum in elongation at room temperature at a strain rate of about 200 min^{-1} . A similar but less pronounced minimum is noted for uniform reduction in area, as shown in Figure 3.03132. The ductility at all strain rates from 0.02 to $19,000 \text{ min}^{-1}$ is good, ranging from 40 to 80 percent elongation. Similar behavior is exhibited at liquid-nitrogen temperature, with the ductility values being slightly less than those at room temperature, as shown in Figure 3.03133. Type 301 is less stable than Type 302 with respect to martensite formation during deformation and has slightly less ductility at room temperature, as shown in Figure 3.03134 (80).
 - 3.03132 Effects of strain rate on tensile ductility of Type 302 at room temperature, Figure 3.03132.
 - 3.03133 Effects of strain rate on tensile ductility of Type 302 at -321 F, Figure 3.03133.
 - 3.03134 Effects of strain rate on tensile ductility of Type 301 at room temperature, Figure 3.03134.
 - 3.03135 Effect of test temperature, strain rate, and holding time on tensile properties of Type 301 1/2-hard sheet, Figure 3.03135.
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 - 3.03137 Effect of test temperature, strain rate, and holding time on tensile properties of 45 percent reduced sheet, Figure 3.03137.
 - 3.03138 Effect of test temperature, strain rate, and holding time on tensile properties of 60 percent reduced sheet, Figure 3.03138.
 - 3.03139 Effect of test temperature and exposure time on tensile properties of 60 percent cold-reduced sheet, Figure 3.03139.
 - 3.031310 Effect of test temperature and prior exposure on tensile properties of 34 percent cold-reduced sheet, Figure 3.031310.
 - 3.031311 Effect of test temperature and prior exposure on tensile properties of 51 percent cold-reduced sheet, Figure 3.031311.
 - 3.031312 Effect of test temperature and prior exposure on tensile properties of 60 percent cold-reduced sheet, Figure 3.031312.
 - 3.0314 Stress-relief effects on tension properties.
 - 3.03141 Effect of test temperature, test direction, and stress relief on tensile properties of Type 301 full-hard sheet, Figure 3.03141.
 - 3.03142 Effect of test temperature, test direction, and stress relief on tensile properties of Type 301 extra-hard sheet, Figure 3.03142.
 - 3.03143 Effect of stress relief and test temperature on tensile properties of cold-rolled sheet, Figure 3.03143.
 - 3.0315 Elevated-test-temperature effects on tension properties.
 - 3.03151 Effect of test temperature on tensile strength of annealed Type 302 sheet, Figure 3.03151.
 - 3.03152 Effect of test temperature on tensile properties of Type 301 1/2-hard sheet, Figure 3.03152.
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 - 3.03154 Type 301 shows a tensile elongation peak at about 130 F, as shown in Figure 3.03155. The maximum elongation is slightly greater for small-grain-size material and slower deformation rate, but the temperature effect remains unchanged. As shown in Figure 3.03156, the temperature for maximum



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- elongation appears to be slightly higher in biaxial straining as compared to uniaxial straining. The elongation peak is related to the strain-induced transformation of austenite to cubic alpha-martensite, which occurs through an intermediate hexagonal epsilon-martensite phase. The volume fraction of epsilon compared to alpha is negligible above about 15 percent strain. The strain-induced martensitic transformation increases the rate of work hardening so that the material is better able to resist necking during straining. The occurrence of a sharp elongation peak at a temperature just below M_d apparently indicates that the distribution of strain-induced martensite is most uniform at this temperature. The temperature dependence of martensite content for Type 301 is shown in Figure 3.03157. The strain dependence of martensite content for Types 301 and 302 is sigmoidal, as shown in Figures 3.03158 and 3.03159. The amount of martensite formed, for example, at 32 F is much greater for Type 301 than for Type 302, reflecting the lower phase stability of Type 301.
- 3.03155 Effects of grain size, strain rate, and temperature on tensile elongation of Type 301, Figure 3.03155
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- 3.031610 Effects of cryogenic temperatures and melt method on tensile properties of 70 percent reduced sheet, Figure 3.031610.
- 3.032 Compression – stress-strain diagrams – compression properties.
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- 3.03213 Stress-strain curves in compression for Type 301 extra-hard and extra-hard stress-relieved sheet at room and elevated temperatures, Figure 3.03213.
- 3.0322 Effect of test temperature on compressive yield strength of Type 301 annealed sheet, Figure 3.0322.
- 3.0323 Effect of test temperature and test direction on compressive yield strength of Type 301 1/2-hard sheet, Figure 3.0323.
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- 3.0332 Impact energy of Type 301 bar at room and cryogenic temperatures, Figure 3.0332.
- 3.0333 The impact energy of heat-treated cast Type 302 (CF-20) decreases with decreasing test temperature, as shown in Figure 3.0334. Carbide precipitation, caused by heat treating in the sensitizing temperature range, lowers the impact energy at cryogenic temperatures (83).
- 3.0334 Effect of sensitizing heat treatments on the impact energy of cast Type 302 at cryogenic temperatures, Figure 3.0334.
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- 3.037112 Effect of low rolling temperature on notch strength at room temperature and -423 F of 10 percent reduced sheet, Figure 3.037112.
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- 3.037141 Effect of test temperature on net fracture stress of full-hard sheet, Figure 3.037141.
- 3.037142 Effect of percent cold reduction on edge-cracked properties of sheet at room temperature and -110 F, Figure 3.037142.
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- 3.037152 Effect of low temperature on notch strength of extra-hard cold-rolled sheet, Figure 3.037152.
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- 3.037156 Effect of low test temperature and thickness on notch strength of 60 percent reduced sheet, Figure 3.037156.
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- 3.0372 Fracture toughness.
- 3.03721 Effect of low test temperature on fracture toughness of 60 percent cold-reduced sheet, Figure 3.03721.
- 3.03722 Effect of initial notch length on fracture toughness of 60 percent cold-reduced sheet at room temperature, -320, and -423 F, Figure 3.03722.

- 3.03723 The crack strength of Type 302 sheet is significantly affected by orientation with respect to the rolling direction, as shown in Figure 3.03724. At an angle of 90 degrees to the rolling direction, or transverse, the crack strength is about 10 percent less at room temperature and 34 percent less at -320 and -423 F than at 0 degrees to the rolling direction. However, the crack strength at an angle of 11 degrees to the rolling direction is not degraded. The 11-degree angle equals the helix angle at which some liquid-propellant rocket tanks have been spiral welded (79).
- 3.03724 Effects of center crack and test direction on tensile strength of cold-rolled sheet at room and cryogenic temperatures, Figure 3.03724.
- 3.04 **Creep and Creep Rupture Properties**
- 3.041 Creep curves for Type 302 annealed sheet at 1200 to 1600 F, Figure 3.041.
- 3.042 Short-time total strain curves for annealed Type 302 at 1200 to 1800 F, Figure 3.042.
- 3.043 Creep and creep-rupture curves for Type 301 1/2-hard sheet at 1200 to 1500 F, Figure 3.043.
- 3.044 Creep-rupture curves for Type 301 full-hard and stress-relieved sheet at 800 to 1200 F, Figure 3.044.
- 3.045 Creep-rupture curves for Type 301 extra-hard and stress-relieved sheet at 800 to 1200 F, Figure 3.045.
- 3.046 Creep curves for Type 301 60 percent reduced sheet under cyclic load at 600 and 900 F, Figure 3.046.
- 3.047 Creep and creep rupture curves for Type 301 60 percent reduced sheet at 600 and 900 F, Figure 3.047.
- 3.048 Creep and creep-rupture curves for 80 percent cold-reduced sheet at 1000, 1200, and 1400 F, Figure 3.048.
- 3.049 Creep-rupture properties of cast Type 302, Figure 3.049.
- 3.0410 Stress relaxation at room and slightly elevated temperatures, Figure 3.0410.
- 3.05 **Fatigue Properties**
- 3.051 Cyclic stress-strain curves for annealed Type 301 at temperatures between M_s and M_d , Figure 3.051.
- 3.052 Strain-controlled fatigue behavior of annealed rod at room temperature, Figure 3.052.
- 3.053 Bending fatigue behavior of cold-worked and of annealed sheet at room temperature, Figure 3.053.
- 3.054 S-N curves in flexure for extra-full-hard sheet at low temperatures, Figure 3.054.
- 3.055 Axial tension fatigue behavior of smooth and notched sheet at room and cryogenic temperatures, Figure 3.055.
- 3.056 Aging for up to 26,300 hours at 550 F has little effect on the room-temperature fatigue behavior of smooth or notched Type 301, as seen by comparison of Figures 3.057 and 3.058 (89,90).
- 3.057 Effects of notches on fatigue behavior of sheet, Figure 3.057.
- 3.058 Fatigue behavior of smooth and notched sheet at room temperature after aging for 26,300 hours at 550 F, Figure 3.058.
- 3.059 Low cycle S-N curves for complex welded joints of 60 percent cold-rolled sheet, Figure 3.059.

Fe
18 Cr
8 Ni

Type 301
Type 302

Fe
18 Cr
8 Ni

Type 301
Type 302

- 3.0510 S-N curves for uniaxial and biaxial sheet for R = 0.50, Figure 3.0510.
- 3.0511 S-N curves for uniaxial and biaxial sheet for R = 0.10, Figure 3.0511.
- 3.0512 Effects of fusion and spot welding on fatigue behavior of sheet, Figure 3.0512.
- 3.0513 Fatigue behavior of welded sheet at room temperature after aging for 26,300 hours at 550 F, Figure 3.0513.
- 3.0514 Type 301 alloy is unstable under stress, with the austenite phase transforming martensitically to alpha-prime to a much greater extent than the more stable Type 302 alloy. This stress-induced martensitic phase transformation can lead to remarkable work hardening. The effect of martensite formation on the fatigue crack-growth rate (FCGR) is shown in Figure 3.0515. For annealed material cycled to a maximum stress of 10.9 ksi, the FCGR of Type 301 is only about one-half that of Type 302. However, at a higher maximum stress of 21.5 ksi or in the 19 percent cold-worked condition (shown in Figure 3.0516), the two alloys have similar FCGR's. The difference in FCGR's for the annealed materials at low stress is related to alloy stability. The less stable Type 301 alloy forms more martensite during loading, resulting in greater work hardening and a lower FCGR. Cold rolling of annealed strip from 0.060 in. thick to reductions of 20, 27, and 40 percent resulted in formation of 10, 20, and 30 vol percent alpha-prime martensite in Type 301 and 0.5 to 2.5 vol percent in Type 302, as determined by magnetic measurements (59).
- 3.0515 Fatigue crack-growth behavior at room temperature for Types 301 and 302 annealed sheet tested at two different stress levels, Figure 3.0515.
- 3.0516 Fatigue crack-growth behavior at room temperature for Types 301 and 302 cold-rolled sheet tested at two different stress levels, Figure 3.0516.
- 3.0517 Fatigue crack-growth rates in hydrogen are more rapid than those in argon or in air. The enhancement is greater in Type 301 than in Type 302 because of hydrogen embrittlement of the alpha-prime martensite phase, which forms to a greater extent in Type 301. At a maximum stress of 18.3 ksi, the FCGR for Type 301 is higher by a factor of about six in hydrogen as compared to air, while the factor for the more stable Type 302 alloy is about three. At a slightly higher maximum stress of 19.8 ksi, rates for the two alloys are almost identical in argon but Type 301 is inferior to Type 302 in hydrogen, as shown in Figures 3.0518 and 3.0519. The FCGR's are decreased by cold work in both argon and hydrogen, but cold-worked alloys are more degraded by hydrogen than annealed alloys (90). The FCGR in hydrogen is thought to be controlled by the rate of supply of hydrogen to the highly stressed region ahead of the crack. Hydrogen permeability has been shown to be greater in Type 301 than Type 302 in the temperature range 400 to 600 F. Also, the permeability of hydrogen is increased under stress for Type 302. These factors are consistent with the above observation on enhancement of FCGR's by hydrogen (91,92).
- 3.0518 Fatigue crack-growth behavior at room temperature for Types 301 and 302 annealed sheet tested in dry hydrogen, dry argon, and air, Figure 3.0518.
- 3.0519 Fatigue crack-growth behavior at room temperature for annealed and cold-worked sheet tested in argon and in hydrogen, Figure 3.0519.
- 3.06 **Elastic Properties**
- 3.061 Poisson's ratio.
- 3.062 Modulus of elasticity.
- 3.0621 Modulus of elasticity for Type 301 1/2-hard sheet at room and elevated temperatures, Figure 3.0621.
- 3.0622 Modulus of elasticity in tension for Type 301 full-hard and extra-hard sheet, Figure 3.0622.
- 3.0623 Effect of low test temperature on modulus of elasticity for 60 percent reduced sheet, Figure 3.0623.
- 3.0624 Effect of test temperature, strain rate, and holding time on modulus of elasticity in tension of 45 and 60 percent reduced sheet, Figure 3.0624.
- 3.0625 Effect of temper on modulus of elasticity in tension and compression for Type 301 sheet, Figure 3.0625.
- 3.0626 Modulus of elasticity in compression for Type 301 full-hard and extra-hard sheet, Figure 3.0626.
- 3.0627 Effect of test temperature on modulus of elasticity in compression of 45 and 60 percent reduced sheet, Figure 3.0627.
- 3.063 Modulus of rigidity.
- 3.0631 Modulus of rigidity, Figure 3.0631.
- 3.0632 Effects of cold reduction and temperature on modulus of rigidity, Figure 3.0632.
- 3.064 Tangent modulus.
- 3.0641 Tangent modulus curves in compression for Type 301 sheet in various conditions, Figure 3.0641.
- 3.0642 Tangent modulus curves for 60 percent cold-reduced sheet for various exposure times and temperatures, Figure 3.0642.
- 4 **FABRICATION**
- 4.01 **Forming**
- 4.011 **General.** Although Types 301 and 302 in annealed condition possess a tensile strength relatively high compared to that of other ductile metals, they are readily formable because of their low yield strength. In fact, the high elongation of Type 301 permits particularly severe forming in certain operations, such as bending, stretch forming, and deep drawing. On the other hand, their high rate of strain hardening leads to a large springback which increases with increasing temper conditions, to a pronounced tendency to buckle and wrinkle under compressive strains, and to considerable difficulties in removing distortions. These characteristics call for forming techniques which differ slightly from those used for other metals. The forming of sheet becomes necessarily more difficult with increasing temper; 1/4-hard sheet can still be fabricated readily by many forming techniques, while the forming of 3/4-hard and full-hard sheet is restricted primarily to straight bending.
- Stress cracking of deep drawn and spun sheet parts occurs if the resulting local hardening and residual

stresses are high. Such parts require immediate stress relief by full annealing.

4.012 Bending and stretching.

4.0121 Practical bend factors for sheet, Table 4.0121.

4.0122 For effect of stretching on yield strength, see Figures 3.02119 and 3.0221.

4.013 Forging. Starting temperature 2300 F maximum, finishing temperature 1500 F, minimum.

4.014 Deep drawing is enhanced under thermal conditions depressing the amount of strain-induced martensite formed (see Figure 3.03156).

4.015 Extrusion. For effect of extrusion temperature on tensile properties, see Figures 3.02117 and 3.02118.

4.02 **Machining and Grinding**
Because of their high rate of strain hardening, 18-8 stainless steels require maximum feed at relatively low surface speeds during machining operations. Their high strength necessitates the use of rigid supports of both the tools and the work and very sharp tools. Their turning speeds are approximately 50 percent of those for mild carbon steels. A highly concentrated sulfur-base oil in ample quantity should be used as a coolant.

4.03 **Joining**

4.031 These steels can be readily welded by all techniques, but the weld and heat-affected zone becomes susceptible to intergranular corrosion, unless annealed after welding. For fusion welding, Type 308 electrodes or filler rod are generally used.

4.032 Hard tempers of Type 301 sheet are generally unsuitable for fusion welding and brazing. However, spot welding is possible in hard tempers. Cracking in spot welds can be greatly reduced by the introduction of nickel foil between the faying surfaces. The effect of nickel is to reduce martensite formation in the spot-weld region.

4.05 **Surface Treatment**

4.051 Cleaning. These steels exhibit maximum corrosion resistance only when thoroughly clean, as the corrosion resistance depends on maintaining a thin dense film of chromium oxide. Both preventive measures and removal of all foreign matter from the surfaces by conventional cleaning methods prior to any heating are particularly important.

4.052 Descaling is generally done in a solution of nitric and hydrofluoric acids. Molten caustic soda baths are also widely used for descaling. For removing heavy scale, sand or vapor blasting should precede pickling.

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Fe
18 Cr
8 Ni

Type 301
Type 302

Fe	
18 Cr	30
8 Ni	
Type 301	31
Type 302	

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Fe
18 Cr
8 Ni

Type 301
Type 302

Fe 18 Cr 8 Ni

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Type 301
Type 302

Alloy Type	AMS Specification	Form
301	5517G	Sheet, strip, 125 ksi
	5518F	Sheet, strip, 150 ksi
	5519H	Sheet, strip, 185 ksi
302	5358B	Investment castings
	5500B	Sheet, laminated
	5515H	Sheet, strip, plate, ST
	5516J	Sheet, strip, plate, ST
	5600B	Sheet, laminated
	5636C	Bar, 100 ksi
	5637D	Bar, 125 ksi
	5688G	Wire, spring temper
5693	Wire, cryogenically drawn	

TABLE 1.03. SPECIFICATIONS (1-9, 52-54)

Alloy	Type 301				Type 302					
	5517G		5518F, 5519H		5358B		5500B, 5516J, 5600B, 5636C, 5637D, 5688G, 5693		5515H	
	Percent		Percent		Percent		Percent		Percent	
Element	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Chromium	17.00	-	16.00	18.00	17.00	19.00	17.00	19.00	17.00	19.00
Nickel	7.00	-	6.00	8.00	8.00	10.00	8.00	10.00	7.00	10.00
Manganese	-	2.00	-	2.00	-	1.50	-	2.00	-	2.00
Silicon	-	1.00	-	1.00	-	2.00	-	1.00	-	1.00
Carbon	-	0.15	-	0.15	-	0.25	-	0.15	0.08	0.15
Molybdenum	-	0.75	-	0.75	-	0.75	-	0.75(a)	-	0.75
Copper	-	0.75	-	0.75	-	0.75	-	0.75(a)	-	0.75
Phosphorus	-	0.040	-	0.040	-	0.04	-	0.040	-	0.040
Sulfur	-	0.030	-	0.030	-	0.03	-	0.030	-	0.030

(a) AMS 5500B specifies 0.50 max molybdenum and 0.50 max copper.

TABLE 1.04. COMPOSITION (1-9, 52-54)

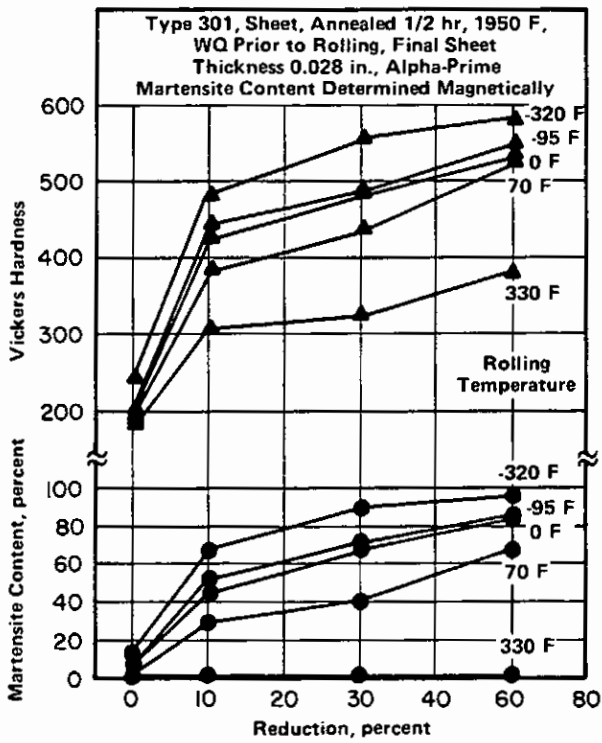


FIGURE 1.062. HARDNESS AND MARTENSITE CONTENTS OF TYPE 301 AFTER ROLLING TO VARIOUS REDUCTIONS AT 330 F TO -320 F (55)

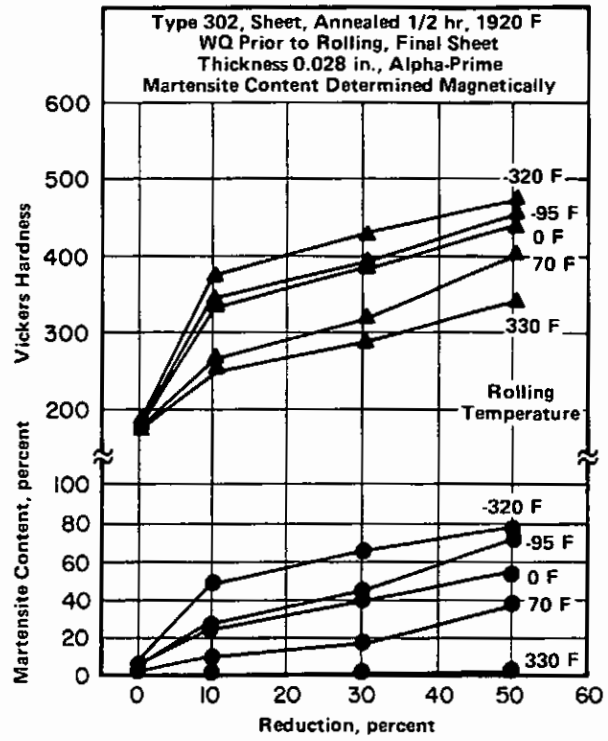


FIGURE 1.063. HARDNESS AND MARTENSITE CONTENTS OF TYPE 302 AFTER ROLLING TO VARIOUS REDUCTIONS AT 330 F TO -320 F (55)

Fe
 18 Cr
 8 Ni
 Type 301
 Type 302

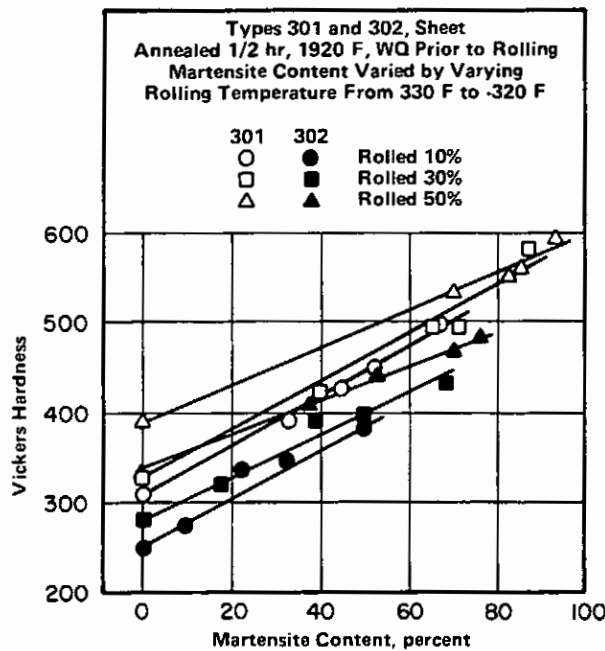


FIGURE 1.064. EFFECT OF STRAIN-INDUCED MARTENSITE CONTENT ON HARDNESS (55)

Fe
18 Cr
8 Ni

Type 301
Type 302

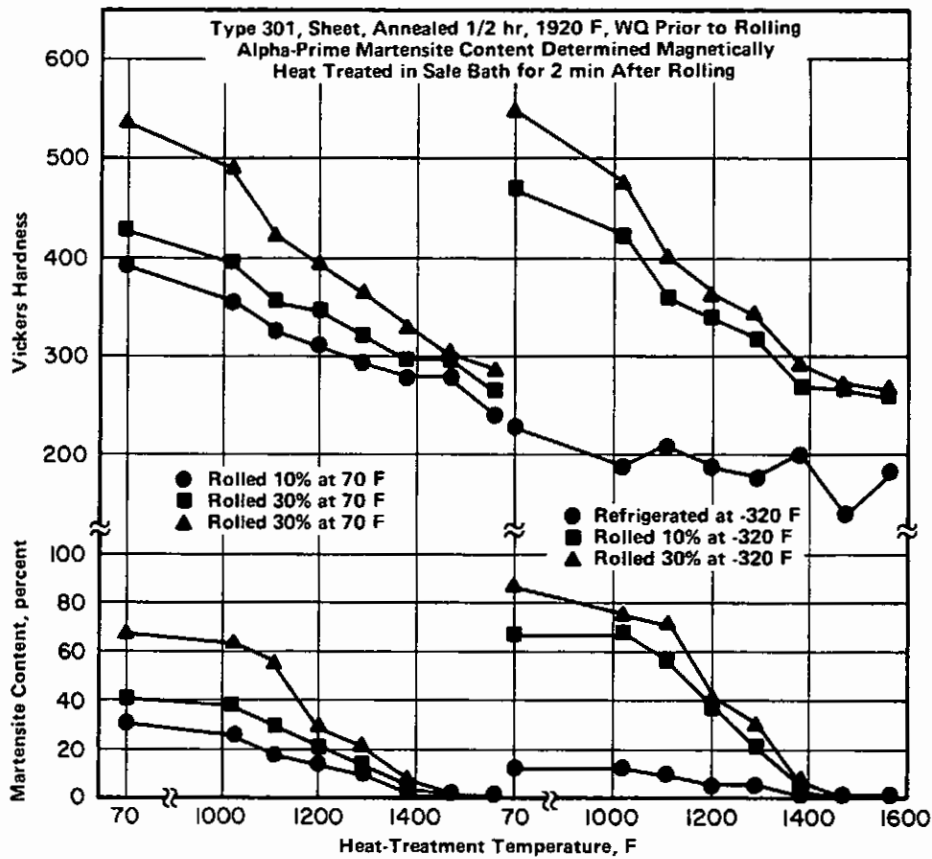


FIGURE 1.065. HARDNESS AND MARTENSITE CONTENTS OF TYPE 301 AFTER COLD ROLLING FOLLOWED BY HEAT TREATMENT AT 1020 TO 1560 F (55)

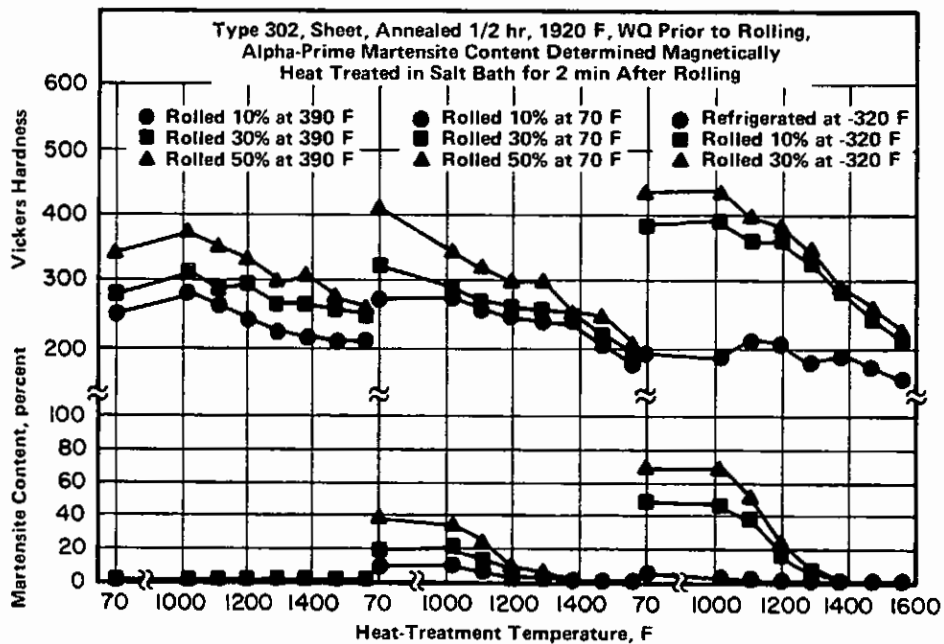


FIGURE 1.066. HARDNESS AND MARTENSITE CONTENTS OF TYPE 302 AFTER ROLLING FOLLOWED BY HEAT TREATMENT AT 1020 TO 1560 F (55)

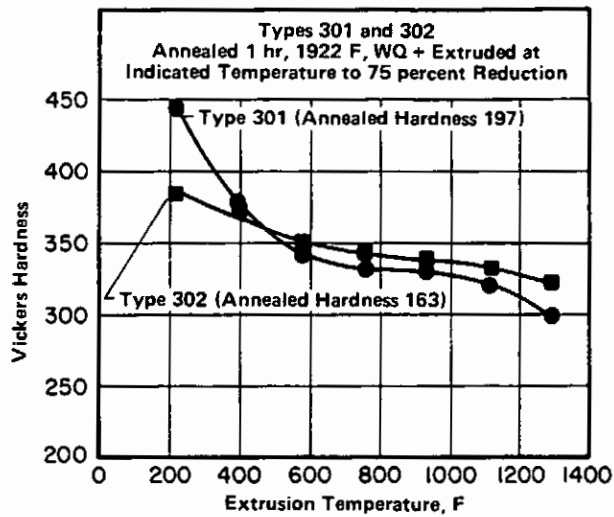
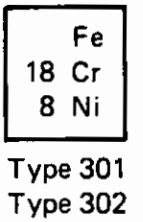


FIGURE 1.067. EFFECT OF EXTRUSION TEMPERATURE ON HARDNESS (56)

Form	Sheet, Strip					Plate
	Anneal	1/4 H	1/2 H	3/4 H	Full H	Anneal
Hardness						
Type 301	85 RB	25 RC	32 RC	37 RC	41 RC	165 BHN
Type 302	85 RB	25 RC	-	-	-	80 RB
Form	Bar			Wire		
	Anneal	CD	High Tension	Anneal	Soft	Hard
Hardness						
Type 301	-	-	-	-	-	-
Type 302	150 BHN	212 BHN	240-277 BHN	83 RB	95 RB	33 RC

TABLE 1.068. AISI TYPICAL VALUES FOR HARDNESS (10)

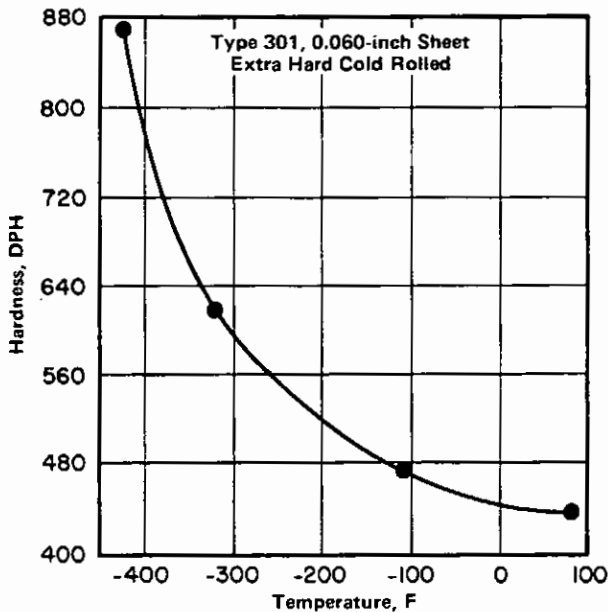


FIGURE 1.069. EFFECT OF LOW TEST TEMPERATURE ON HARDNESS OF EXTRA-HARD COLD-ROLLED SHEET (32)

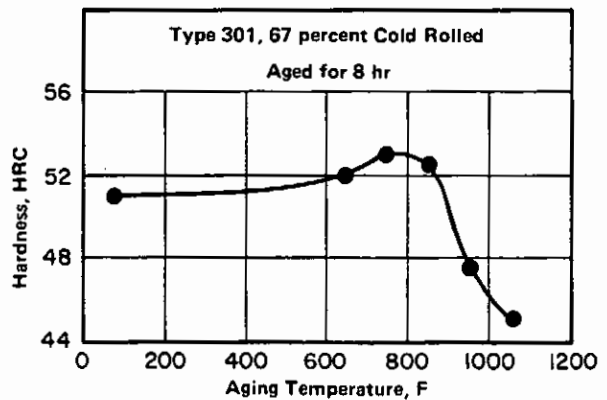
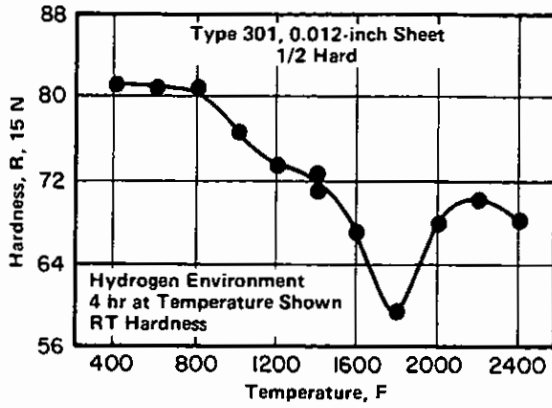


FIGURE 1.0610. EFFECT OF AGING TEMPERATURE ON HARDNESS OF 67 PERCENT COLD-ROLLED SHEET (43)

Fe
18 Cr
8 Ni

Type 301
Type 302



Phase Change	Temperature, F	
	Type 301	Type 302
M_s	-35 to -112	-251
M_d	135 to 194	-8
A_{c1}	1020 to 1110	1020 to 1110
A_{c3}	1380 to 1470	1290 to 1380

TABLE 2.0122. TRANSFORMATION TEMPERATURES (55,58,59)

FIGURE 1.0611. EFFECT OF HYDROGEN ENVIRONMENT AT ELEVATED TEMPERATURE ON SURFACE HARDNESS OF HALF-HARD SHEET (29)

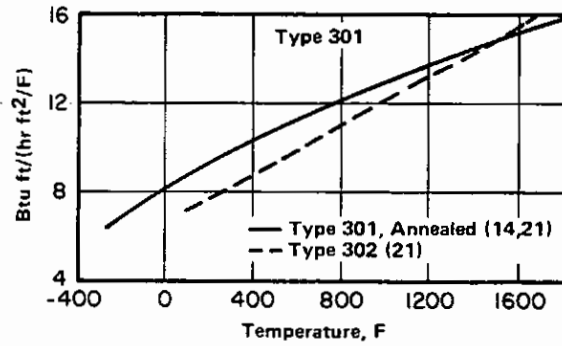
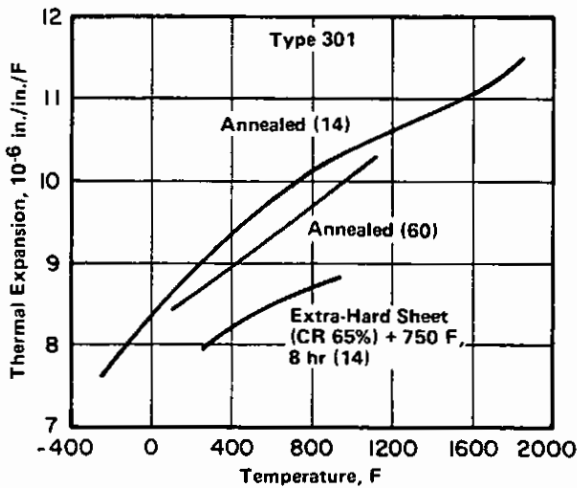
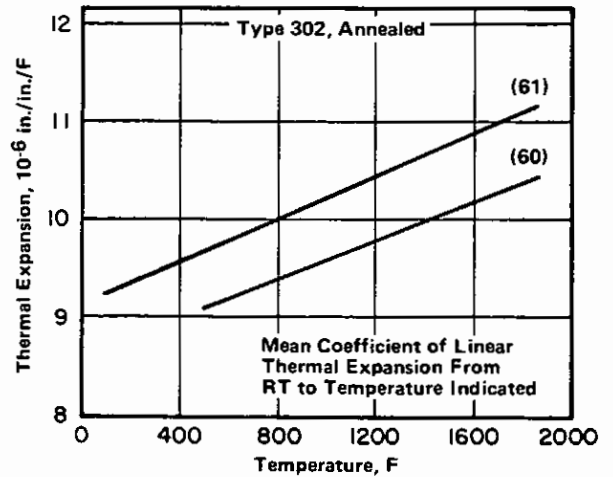


FIGURE 2.013. THERMAL CONDUCTIVITY (14,21)



(a) Type 301



(b) Type 302

FIGURE 2.014. THERMAL EXPANSION (60,61)

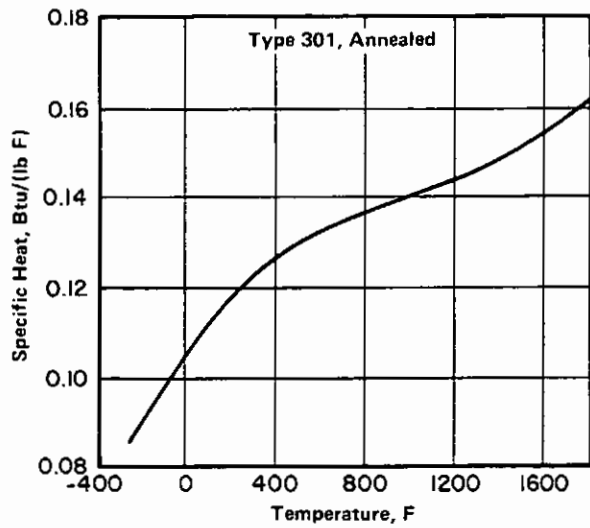


FIGURE 2.015. SPECIFIC HEAT (14)

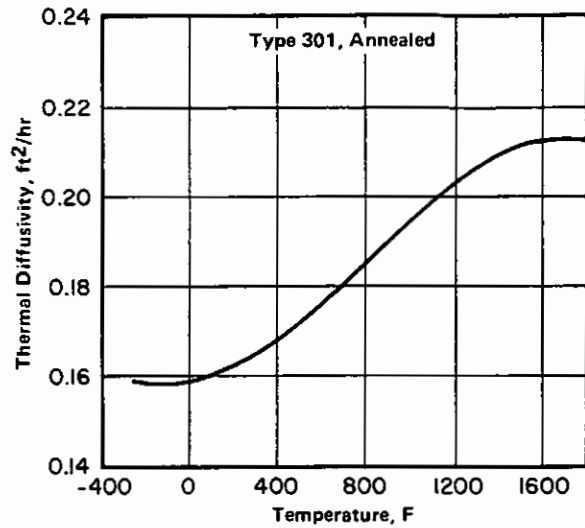


FIGURE 2.016. THERMAL DIFFUSIVITY (14)

Fe
18 Cr
8 Ni

Type 301
Type 302

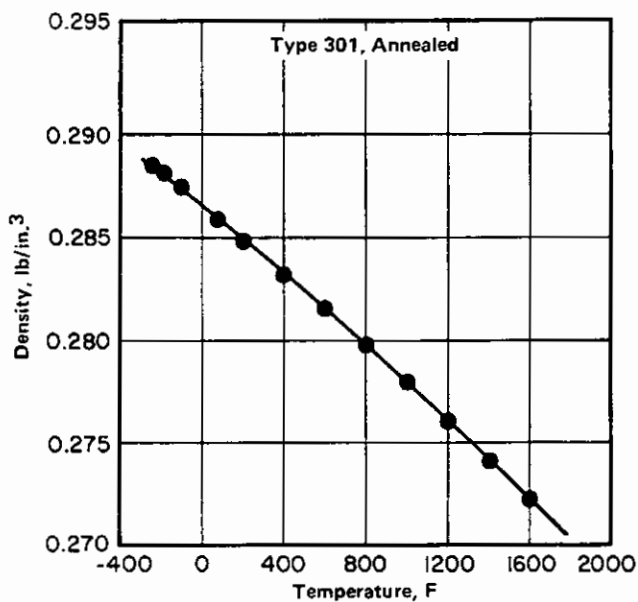


FIGURE 2.021. DENSITY (62)

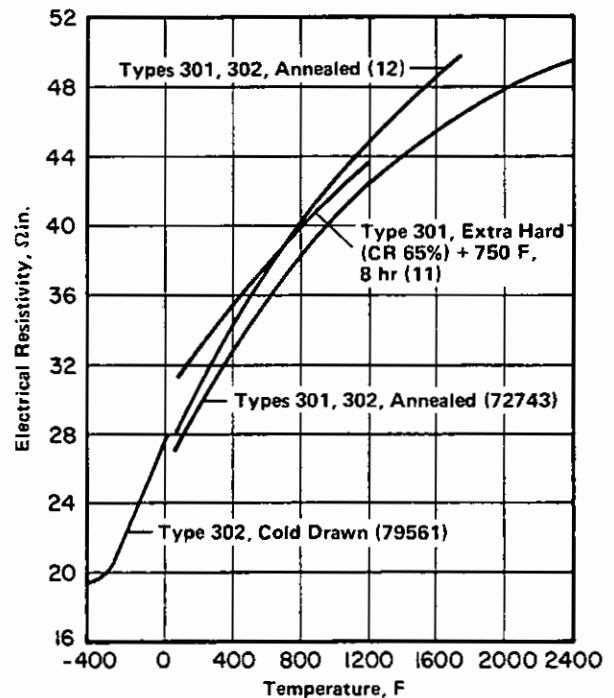


FIGURE 2.0221. ELECTRICAL RESISTIVITY (63)

Fe
 18 Cr
 8 Ni
 Type 301
 Type 302

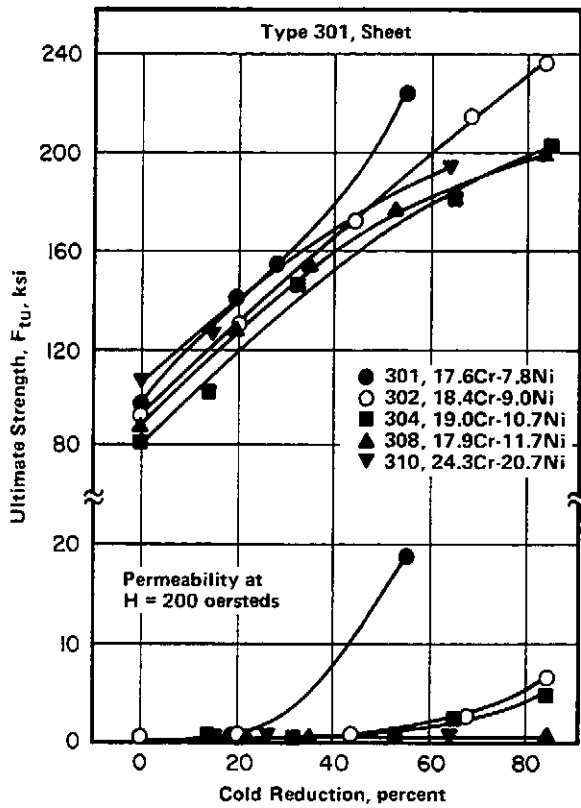


FIGURE 2.0232. EFFECT OF COMPOSITION AND REDUCTION ON MAGNETIC PERMEABILITY AND TENSILE STRENGTH OF 300 SERIES SHEET (22)

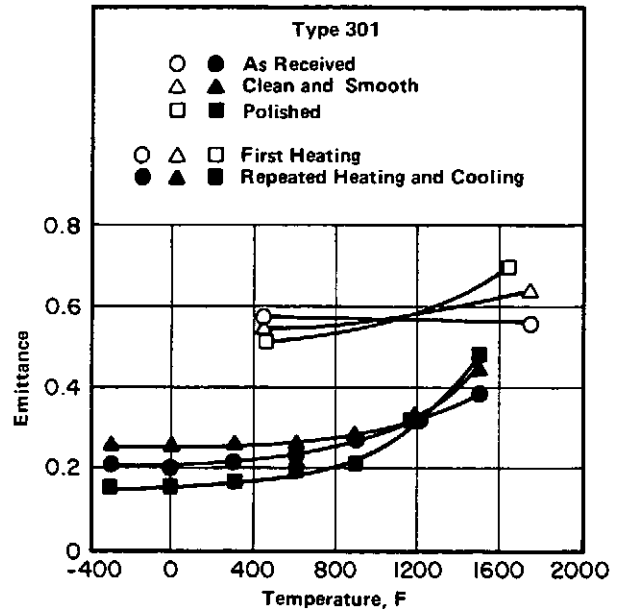


FIGURE 2.024. EMITTANCE (40)

Alloy Type	Exposure ^(a)	General Corrosion						Steady State Rate, mpy	Pitting Penetration, mils ^(c)		
		Weight Loss, g/dm ²			Average Penetration, mils				1 Yr	8 Yr	16 Yr
		1 Yr	8 Yr	16 Yr	1 Yr	8 Yr	16 Yr				
302	S	2.9	11.0	18.7	1.51	5.51	9.51	(b)	70 (P)	140	151 (P)
	M	0.4	1.8	3.3	0.2	0.9	1.6	(b)	6	58	50 (110)
	L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<5	<5	<5 (<5)
301	A	0.01	0.01	0.03	0.01	0.01	0.02	0.01	<5	<5	<5 (<5)
	B	0.00	0.01	0.00	0.00	0.00	0.00	0.00	<5	<5	<5 (<5)

- (a) S - seawater immersion
- M - seawater at mean tide level for intermittent immersion
- L - freshwater immersion
- A - tropical marine atmospheric exposure
- B - tropical inland atmospheric exposure
- Panels for aqueous exposures measured 9 x 9 x 0.25 inch; those for atmospheric exposures measured 4 x 8 x 0.063 inch.
- (b) Deep local pitting; average penetration not appropriate.
- (c) Twenty pit average as determined from the five deepest pits on each surface of duplicate panels. The deepest pit during the 16-year exposure is shown in parentheses. Perforation is shown by a "P".

TABLE 2.0313. CORROSION IN TROPICAL ENVIRONMENTS FOR TIMES UP TO 16 YEARS (65)

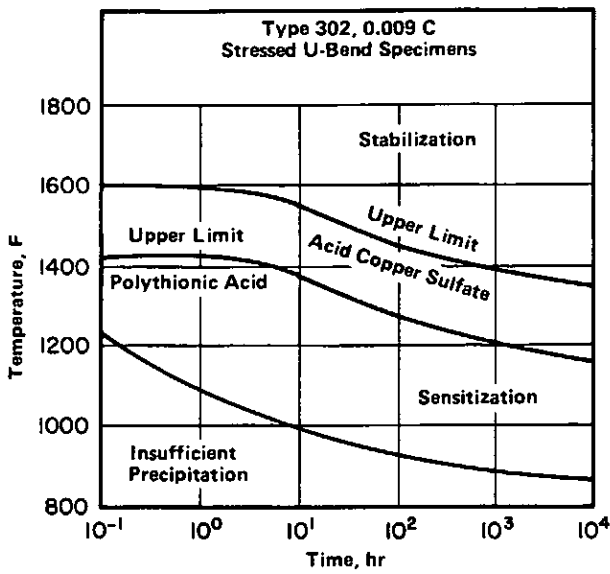


FIGURE 2.0322. EFFECTS OF HEAT TREATMENT ON SUSCEPTIBILITY TO INTERGRANULAR STRESS CORROSION CRACKING IN POLYTHIONIC ACID AND IN ACID COPPER SULFATE (68)

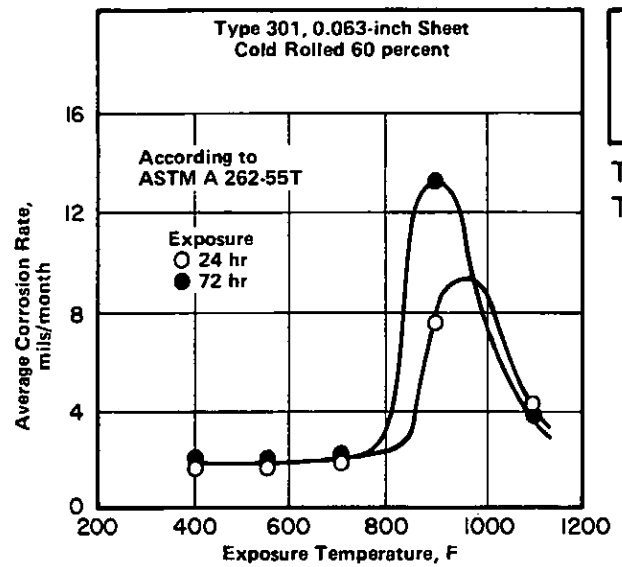


FIGURE 2.0323. EFFECT OF PRIOR EXPOSURE TEMPERATURE AND TIME ON AVERAGE CORROSION RATE IN BOILING NITRIC ACID OF COLD-ROLLED SHEET (18)

Fe
18 Cr
8 Ni
Type 301
Type 302

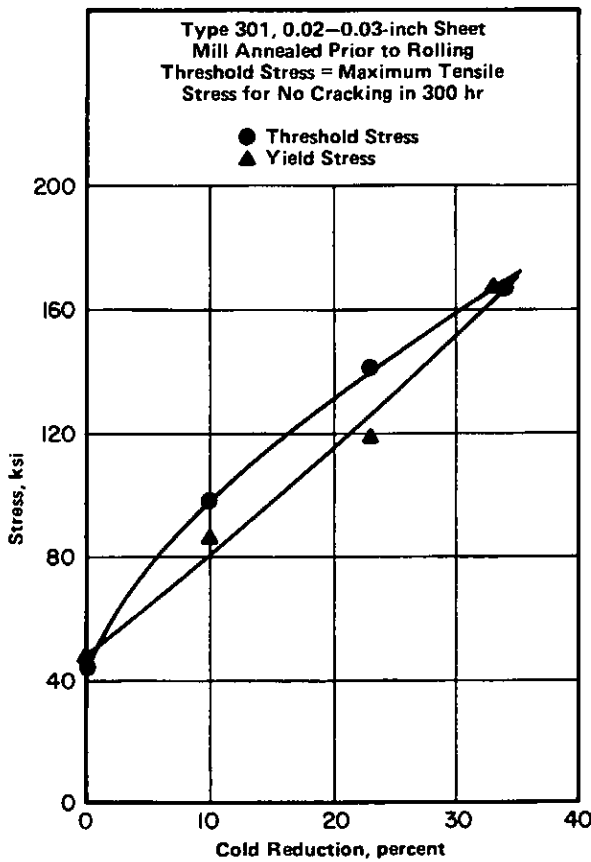


FIGURE 2.0333. EFFECTS OF COLD REDUCTION ON YIELD STRESS IN AIR AND ON THRESHOLD CORROSION STRESS IN BOILING 0.5N NaCl + 0.1N NaNO₂ AQUEOUS SOLUTION (72)

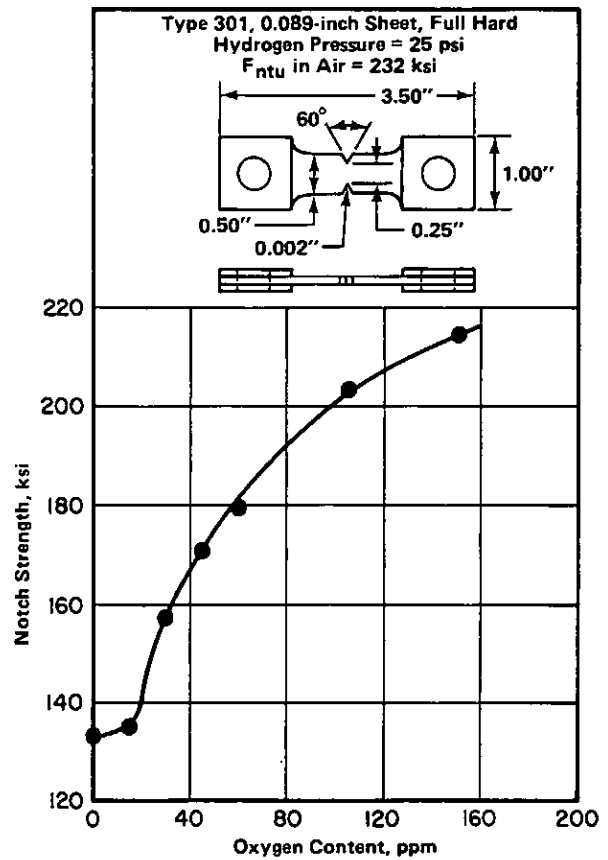


FIGURE 2.0342. EFFECTS OF OXYGEN IMPURITY IN HYDROGEN ON NOTCH STRENGTH OF TYPE 301 (74)

Fe
18 Cr
8 Ni

Type 301
Type 302

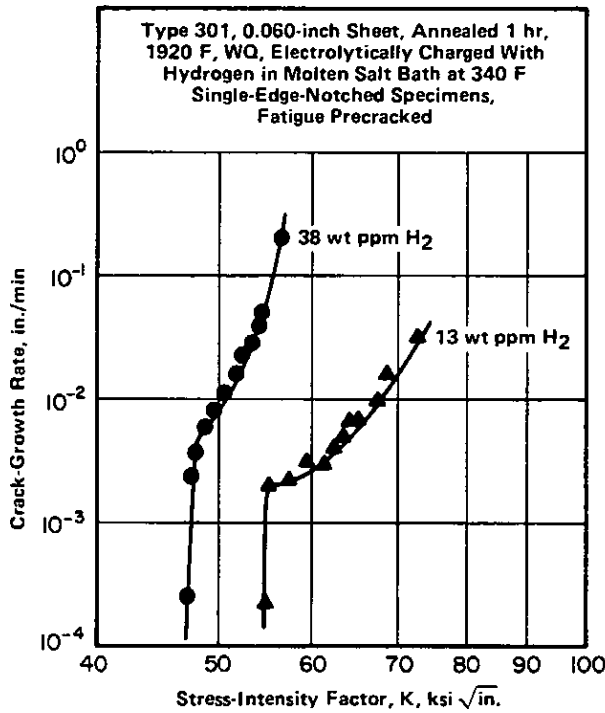


FIGURE 2.0344. SUSTAINED-LOAD CRACK-GROWTH RATE OF HYDROGEN-CHARGED TYPE 301 (73)

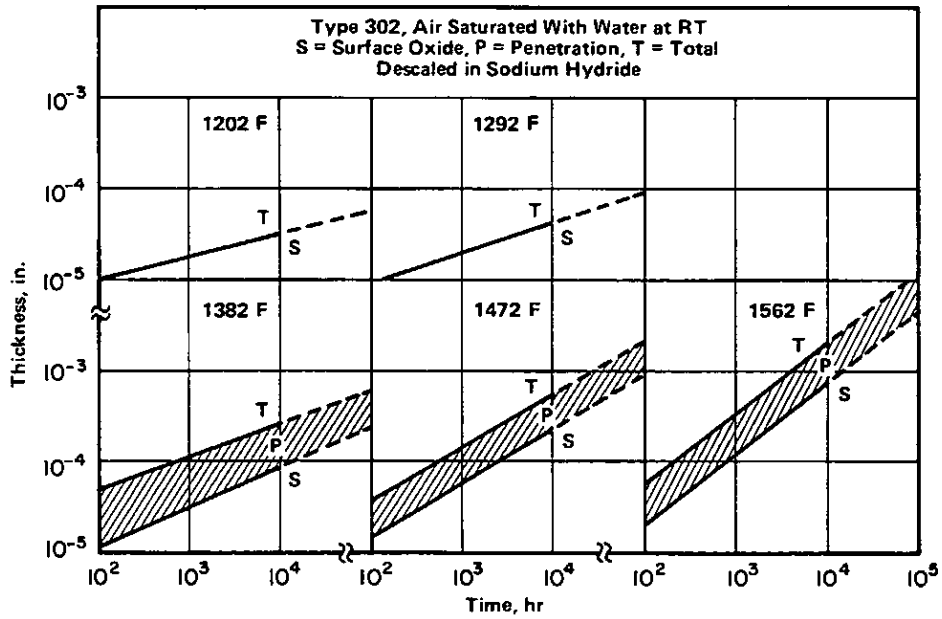


FIGURE 2.0352. TIME DEPENDENCE OF OXIDATION OF TYPE 302 IN AIR AT ELEVATED TEMPERATURES (75)

Alloy	Type 301				Type 302	
	Annealed		60% (Cold Worked)		Annealed	
Irradiation Temperature, F	200	-	-416	-	200	-
Irradiation Exposure, n(m ⁻²)	3.9 x 10 ⁹	Control	2.0 x 10 ¹⁷	Control	3.9 x 10 ⁹	Control
Test Temperature, F	RT		-423		RT	
F _{tu} , ksi	113.2	98.7	284	391	111.3	95.5
F _{ty} , ksi	87.0	38.4	284	300	84.0	33.8
e, percent	50.0	56.0	8	13	-	-
RA, percent	81.0	83.0	-	-	-	-
Hardness, HRB	94	94	-	-	-	-

Fe
18 Cr
8 Ni

Type 301
Type 302

TABLE 2.041. EFFECT OF IRRADIATION EXPOSURE ON TENSILE PROPERTIES AND HARDNESS OF ALLOY (35)

Alloy	Types 301 and 302										
	AMS Spec	Product Form	Condition(d)	Thickness, in.	F _{tu} , ksi		F _{ty} , ksi		El., percent,	RA, percent,	Hardness, Max
					Min	Max	Min	Max	Min	Min	
3517G	Sheet, strip	CR, 125 ksi	-	125	150	75	-	25	-	-	
5518F	Sheet, strip	CR, 150 ksi	<0.015	150	-	110	-	15	-	-	
			>0.015	150	-	110	-	18	-	-	
5519H	Sheet, strip	CR, 185 ksi	<0.015	185	-	140	-	8	-	-	
			>0.015	185	-	140	-	9	-	-	
5358B	Investment cast	SHT	-	-	-	-	-	-	-	174 HB	
5515H	Sheet, strip, plate	SHT	<0.025	-	120	-	-	50	-	-	
			≥0.025	-	120	-	-	55	-	-	
5516J	Sheet, strip, plate	SHT	0.002 ≤ 0.003	75	110	36	60	30	-	-	
			>0.003 ≤ 0.004	75	105	36	60	35	-	-	
			>0.004 ≤ 0.176	75	100	36	60	40	-	-	
			>0.176	75	100	-	-	40	-	-	
5636C	Bar	CD, 100 ksi	-	100	-	60	-	32	50	-	
5637D	Bar	CD, 125 ksi	-	125	-	100	-	17	45	-	
5688G	Wire	Spring temper	0.009-0.394(a)	142	355	-	-	-	-	-	
5693	Wire	Cryogenically drawn	0.050-0.148(b)	275	310	-	-	-	-	-	
			0.050-0.148(c)	245	280	-	-	-	-	-	
		SR	0.050-0.148(b)	290	340	-	-	-	-	-	
			0.050-0.148(c)	260	310	-	-	-	-	-	

Note: The original AMS documents should be consulted for complete specification details.

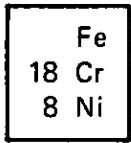
(a) Tensile strengths specified for numerous diameters and thicknesses in range 0.009-0.394 inch.

(b) Round wire.

(c) Square or rectangular wire.

(d) CR = cold rolled; SHT = solution heat treated; CD = cold drawn; SR = stress relieved.

TABLE 3.011. AMS SPECIFIED MECHANICAL PROPERTIES (1-9, 54)



Type 301
Type 302

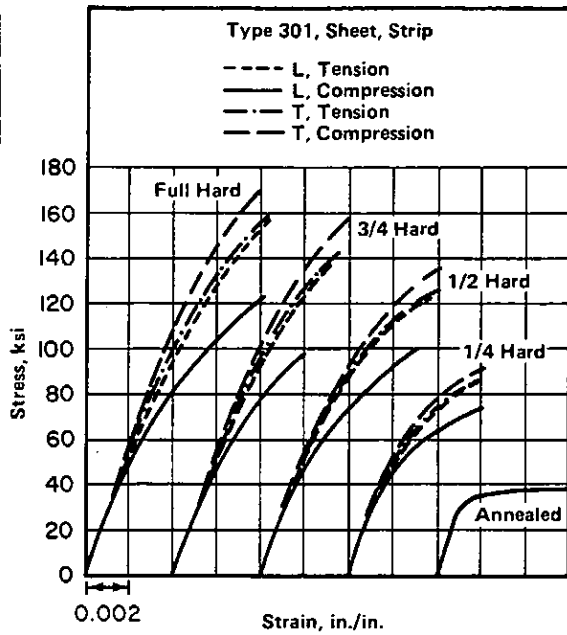


FIGURE 3.0211. STRESS-STRAIN CURVES FOR SHEET AND STRIP COLD ROLLED TO DIFFERENT TEMPER (20)

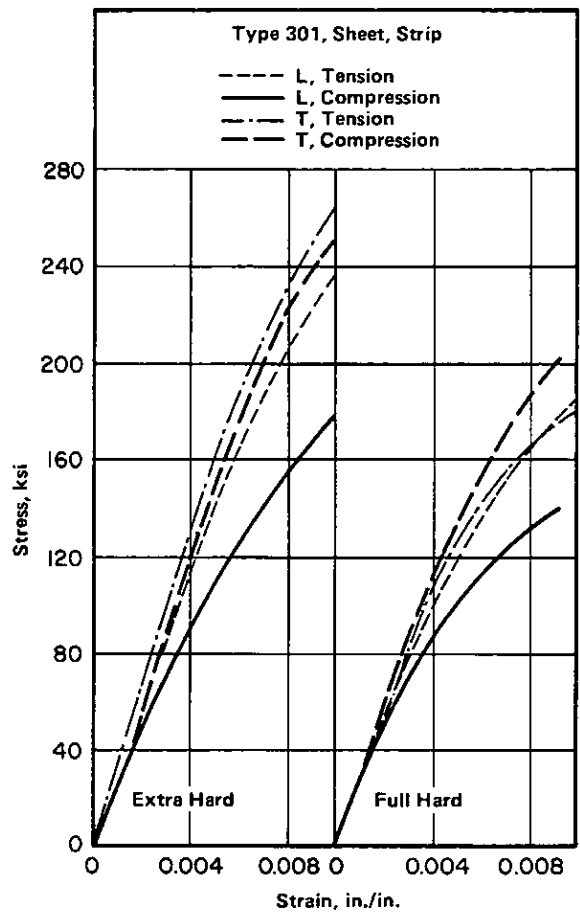


FIGURE 3.0212. STRESS-STRAIN CURVES FOR SHEET AND STRIP COLD ROLLED TO FULL-HARD AND EXTRA-HARD TEMPER (11)

Alloy	Type 301		Type 302	
	Percent Cold Reduction - Range	F _{tu} - Range, ksi	Percent Cold Reduction - Range	F _{tu} - Range, ksi
1/4 Hard	7-11	125-155	20-22	125-150
1/2 Hard	18-21	150-180	30-33	150-170
3/4 Hard	29-32	175-195	40	170-190
Full Hard	40	190-220	50	185-200
Extra Full Hard	65	240-275	-	-

TABLE 3.0213. PERCENTAGE COLD REDUCTION AND CORRESPONDING TENSILE STRENGTH FOR VARIOUS TEMPER OF TYPES 301 AND 302 (49)

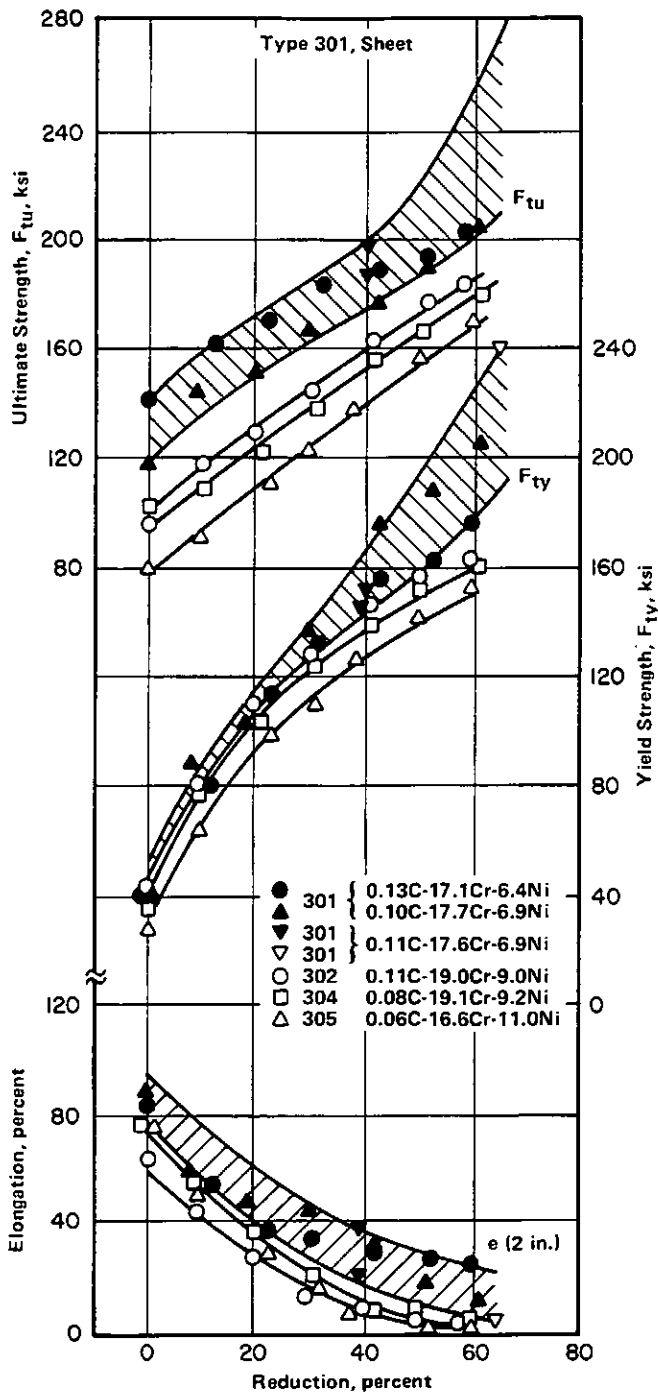


FIGURE 3.0214. EFFECT OF ROLLING REDUCTION AND COMPOSITION ON TENSILE PROPERTIES OF 300 SERIES STEELS (11)

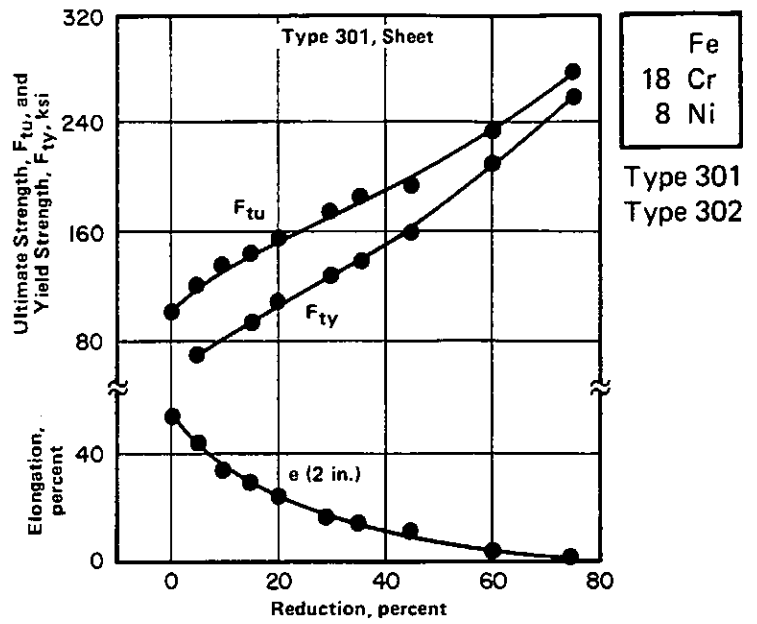


FIGURE 3.0215. EFFECT OF COLD REDUCTION ON TENSILE PROPERTIES OF TYPE 301 (28)

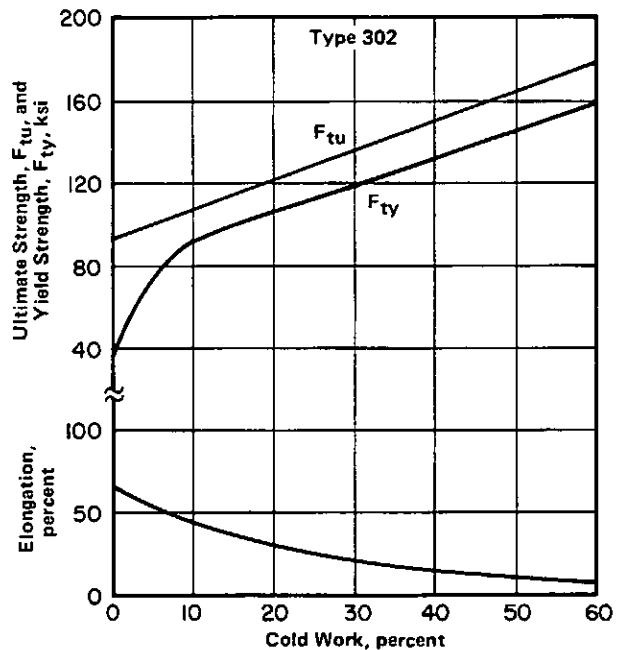


FIGURE 3.0216. EFFECTS OF COLD WORK ON TENSILE PROPERTIES OF TYPE 302 (76)

Fe
18 Cr
8 Ni

Type 301
Type 302

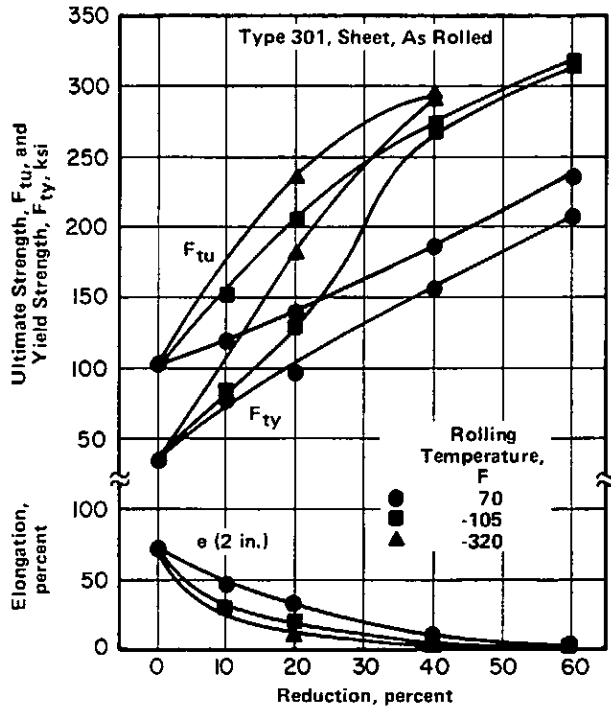


FIGURE 3.0218. EFFECT OF COLD REDUCTION AT ROOM AND CRYOGENIC TEMPERATURES ON TENSILE PROPERTIES OF TYPE 301 (76)

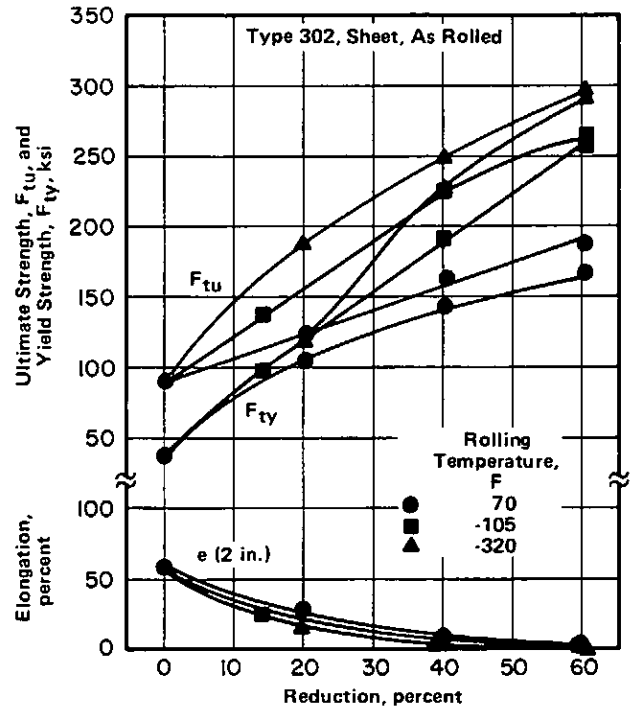


FIGURE 3.0219. EFFECT OF COLD REDUCTION AT ROOM AND CRYOGENIC TEMPERATURES ON TENSILE PROPERTIES OF TYPE 302 (76)

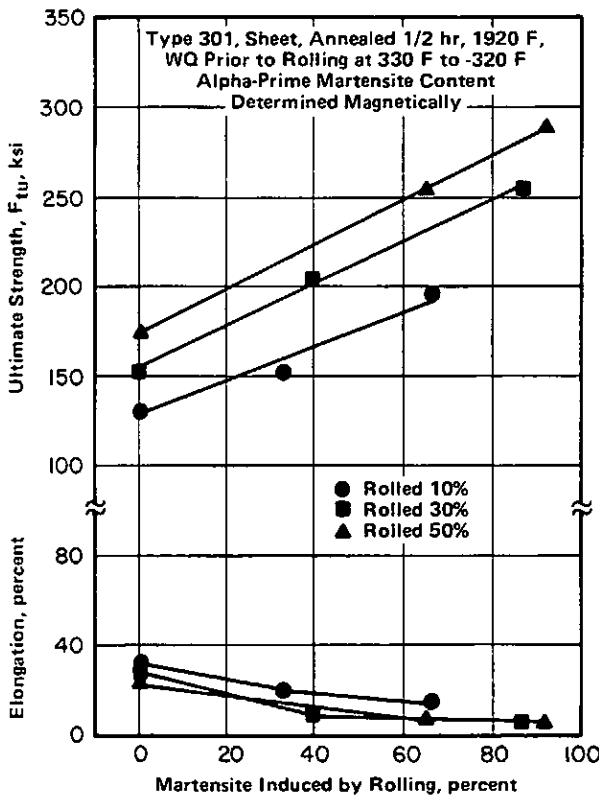


FIGURE 3.02110. RELATIONSHIP BETWEEN TENSILE PROPERTIES AND MARTENSITE CONTENT FOR TYPE 301 (55)

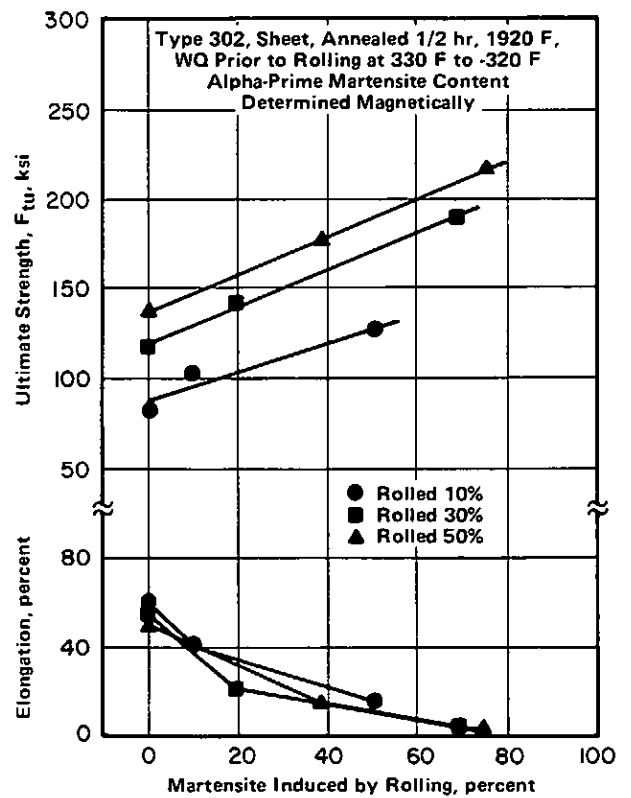


FIGURE 3.02111. RELATIONSHIP BETWEEN TENSILE PROPERTIES AND MARTENSITE CONTENT FOR TYPE 302 (55)

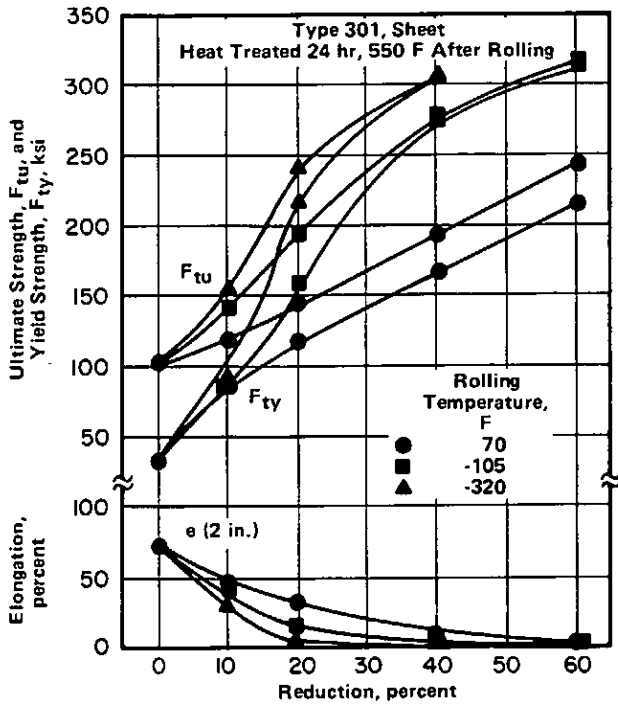


FIGURE 3.02112. EFFECT OF COLD REDUCTION AT ROOM AND CRYOGENIC TEMPERATURES PLUS HEAT TREATMENT ON TENSILE PROPERTIES OF TYPE 301 (76)

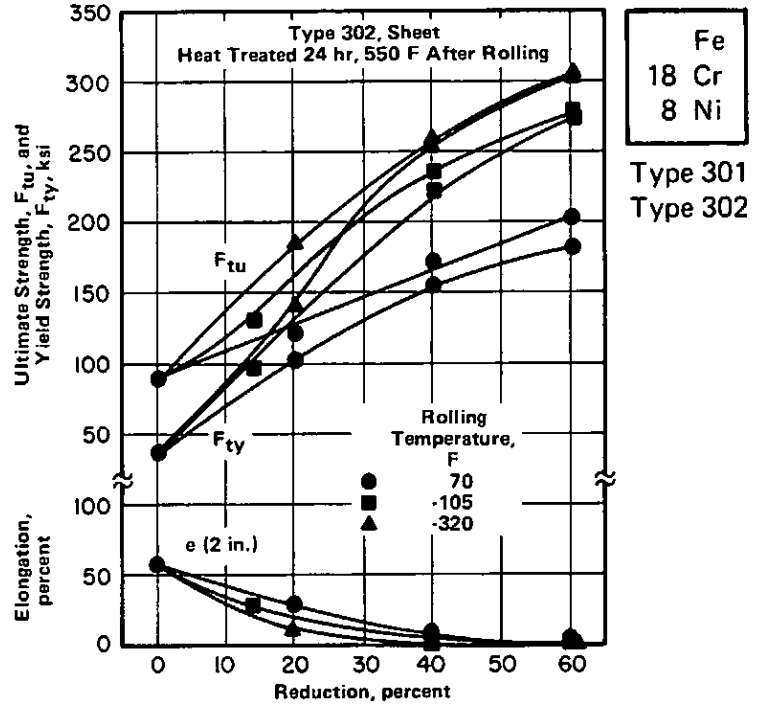


FIGURE 3.02113. EFFECT OF COLD REDUCTION AT ROOM AND CRYOGENIC TEMPERATURES PLUS HEAT TREATMENT ON TENSILE PROPERTIES OF TYPE 302 (76)

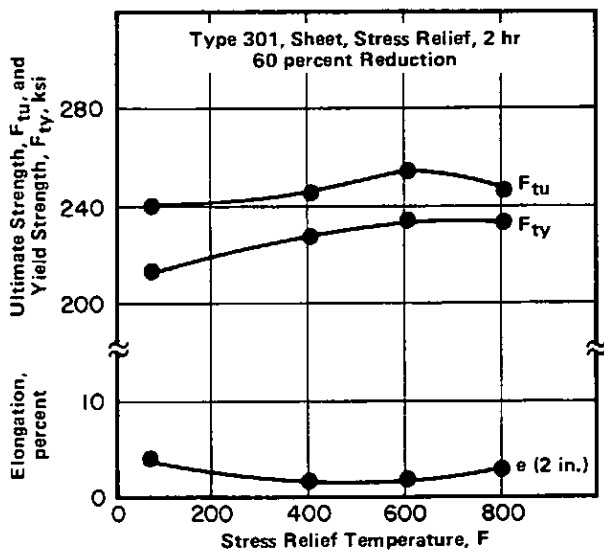


FIGURE 3.02114. EFFECT OF STRESS-RELIEF TEMPERATURE ON TENSILE PROPERTIES OF 60 PERCENT REDUCED SHEET (28)

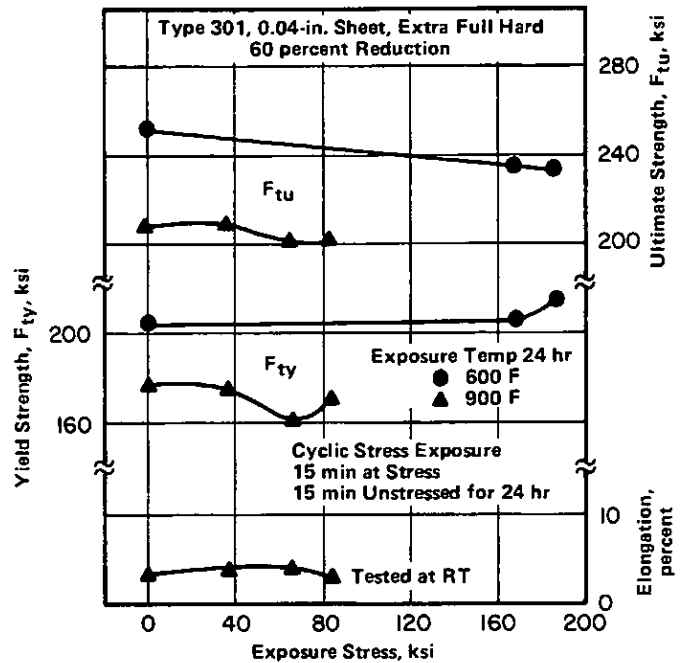


FIGURE 3.02115. EFFECT OF CYCLIC EXPOSURE STRESS ON ROOM-TEMPERATURE TENSILE PROPERTIES OF 60 PERCENT REDUCED SHEET EXPOSED AT 600 AND 900 F (27)

Fe
18 Cr
8 Ni

Type 301
Type 302

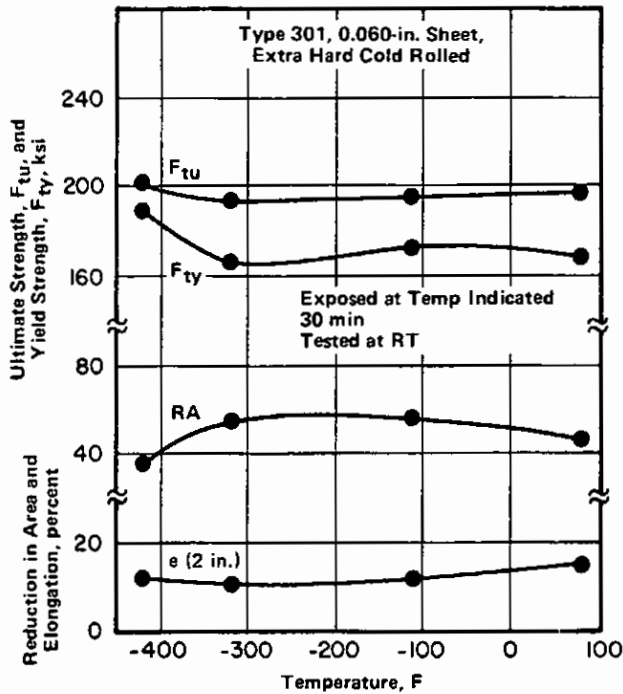


FIGURE 3.02116. EFFECT OF EXPOSURE AT LOW TEMPERATURE ON ROOM-TEMPERATURE TENSILE PROPERTIES OF EXTRA-HARD COLD-ROLLED SHEET (32)

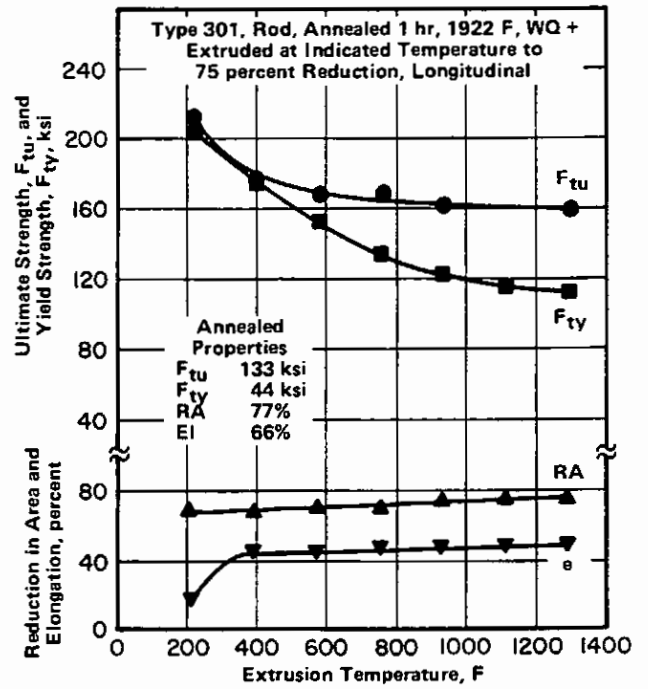


FIGURE 3.02117. EFFECTS OF EXTRUSION TEMPERATURE ON LONGITUDINAL TENSILE PROPERTIES OF TYPE 301 (56)

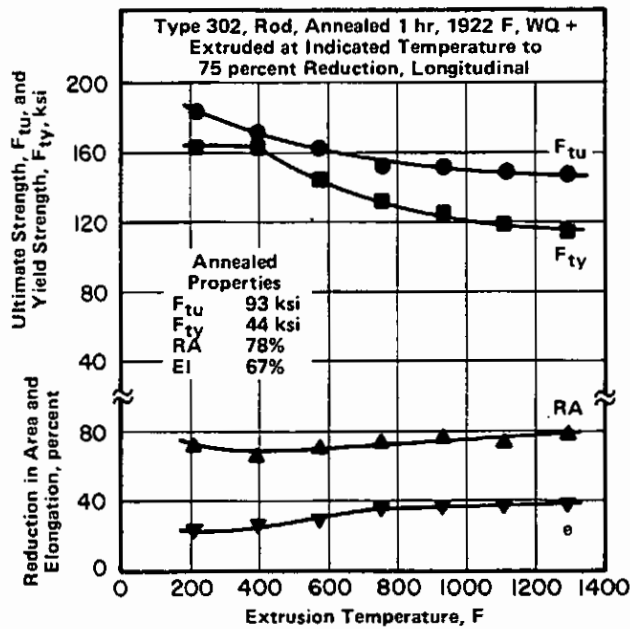


FIGURE 3.02118. EFFECTS OF EXTRUSION TEMPERATURE ON LONGITUDINAL TENSILE PROPERTIES OF TYPE 302 (56)

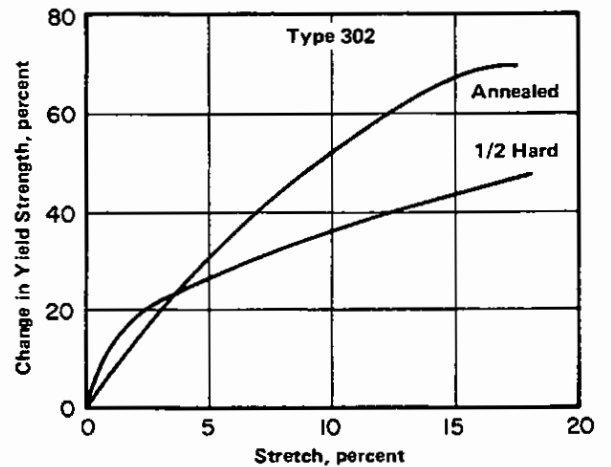
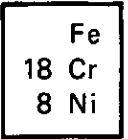


FIGURE 3.02119. EFFECT OF STRETCHING ON TENSILE YIELD STRENGTH OF TYPE 302 (76)



Type 301
Type 302

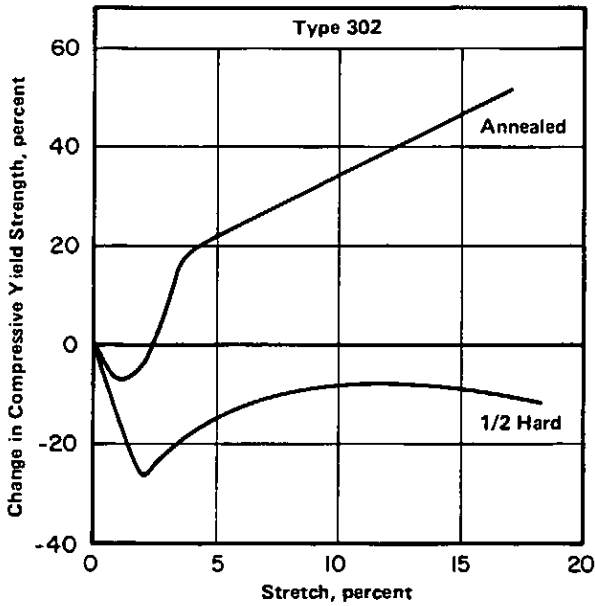


FIGURE 3.0221. EFFECT OF STRETCHING ON COMPRESSIVE YIELD STRENGTH OF TYPE 302 (76)

Type	Impact Energy, ft-lb		
	Izod	Charpy Keyhole Notch	Charpy V Notch
301(a)	70-120	90	110
302(a)	70-120	68-92	-
302B(a)	70-90	-	-
CF-20(b)	-	60	-

(a) Annealed.
(b) Heat treated at 2000 F plus water quench.

TABLE 3.0231. IMPACT PROPERTIES AT ROOM TEMPERATURE (76)

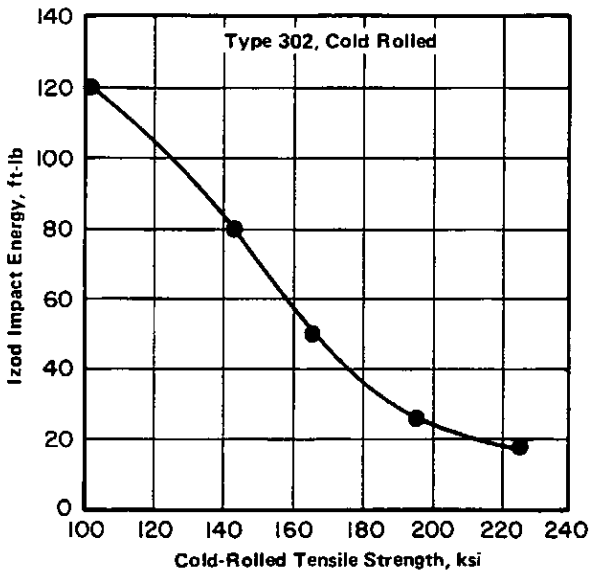


FIGURE 3.0232. RELATION BETWEEN IMPACT ENERGY AND TENSILE STRENGTH FOR COLD-ROLLED TYPE 302 (76)

Fe
18 Cr
8 Ni

Type 301
Type 302

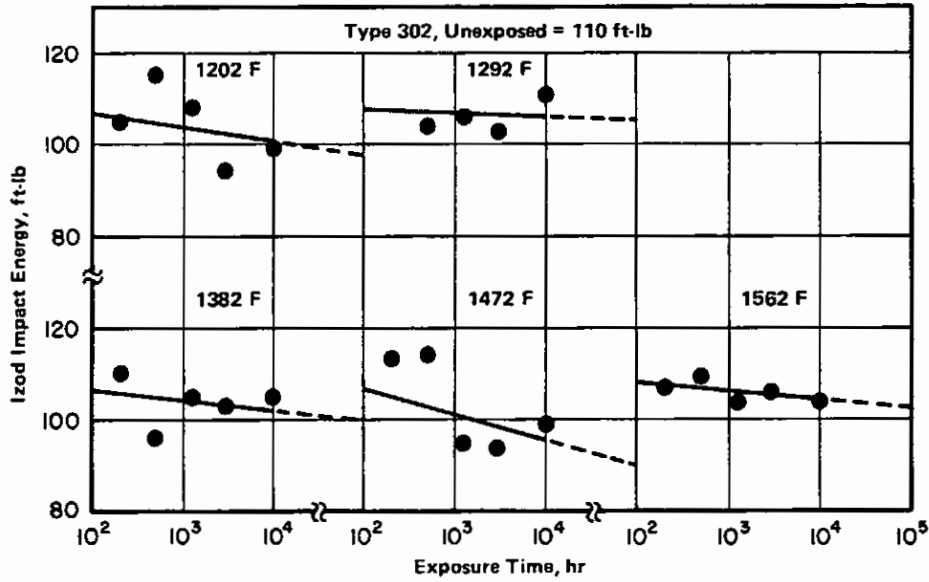


FIGURE 3.0233. EFFECTS OF EXPOSURE TIME IN AIR AT ELEVATED TEMPERATURES ON IMPACT ENERGY (75)

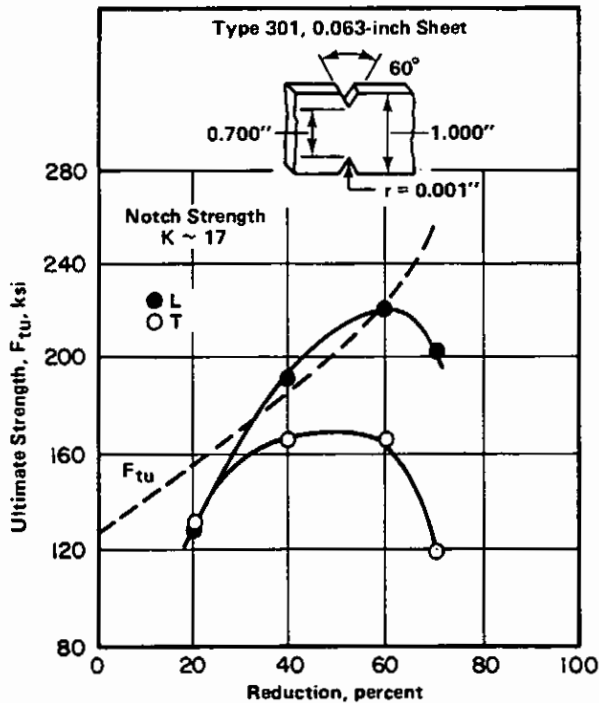


FIGURE 3.02711. EFFECT OF COLD ROLLING AND TEST DIRECTION ON NOTCH STRENGTH OF SHEET

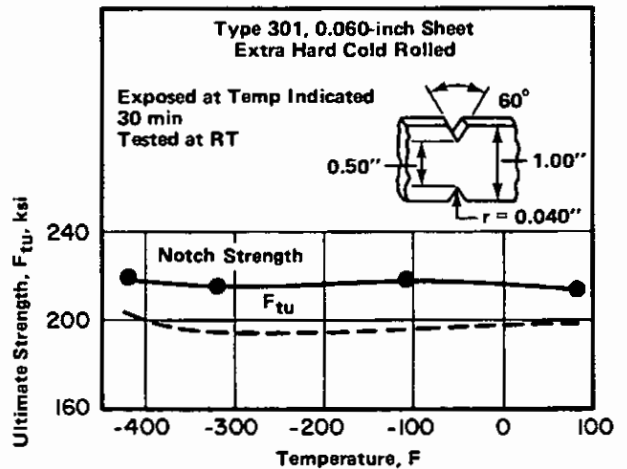


FIGURE 3.02712. EFFECT OF EXPOSURE AT LOW TEMPERATURE ON ROOM-TEMPERATURE NOTCH STRENGTH OF EXTRA-HARD COLD-ROLLED SHEET (32)

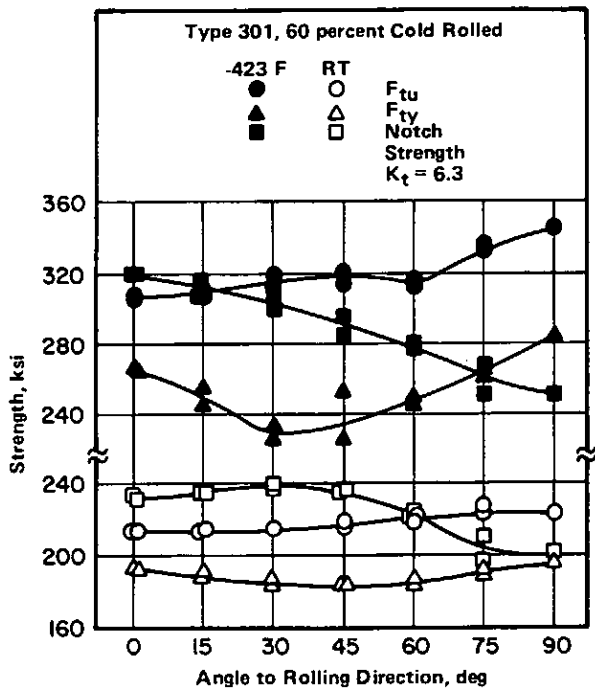


FIGURE 3.02713. EFFECT OF TEST DIRECTION IN RELATION TO ROLLING DIRECTION ON TENSILE PROPERTIES AND NOTCH STRENGTH OF 60 PERCENT COLD-REDUCED SHEET (48)

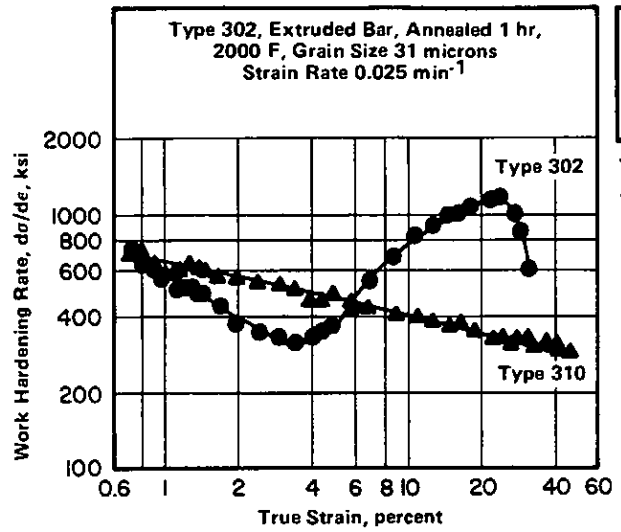


FIGURE 3.03112. TENSILE WORK-HARDENING RATES FOR TYPES 302 AND 310 AT -112 F (78)

Fe
18 Cr
8 Ni

Type 301
Type 302

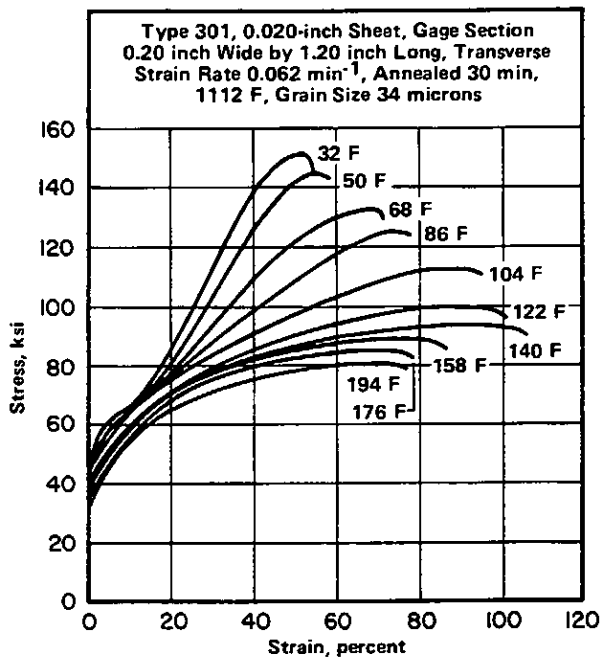


FIGURE 3.03113. STRESS-STRAIN CURVES FOR ANNEALED TYPE 301 (77)

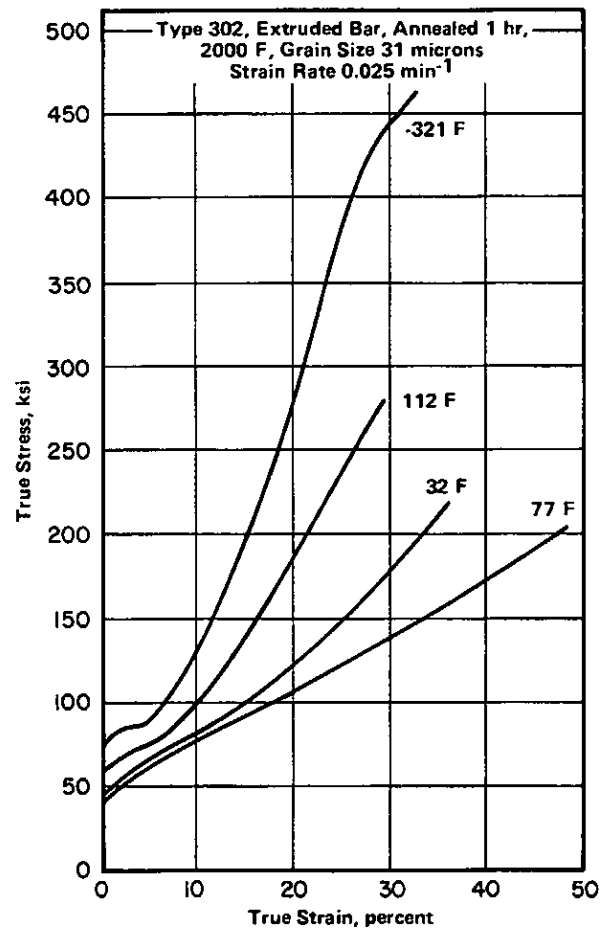


FIGURE 3.03114. TRUE STRESS-STRAIN CURVES FOR ANNEALED TYPE 302 AT ROOM AND CRYOGENIC TEMPERATURES (78)

Fe
18 Cr
8 Ni
Type 301
Type 302

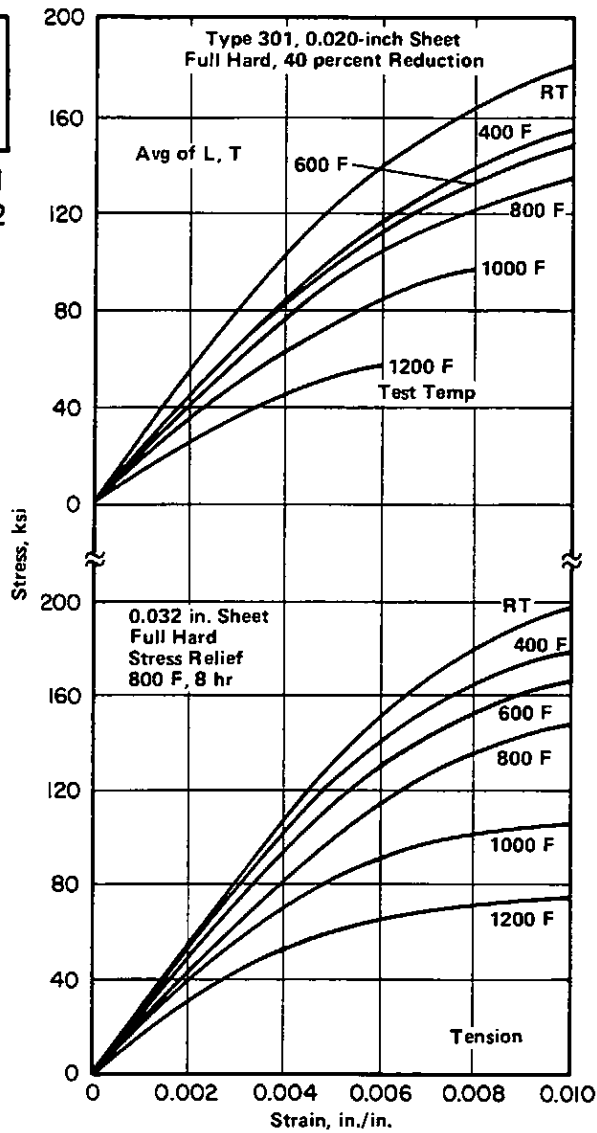


FIGURE 3.03115. STRESS-STRAIN CURVES FOR TYPE 301 FULL-HARD AND FULL-HARD STRESS-RELIEVED SHEET AT ROOM AND ELEVATED TEMPERATURES (11)

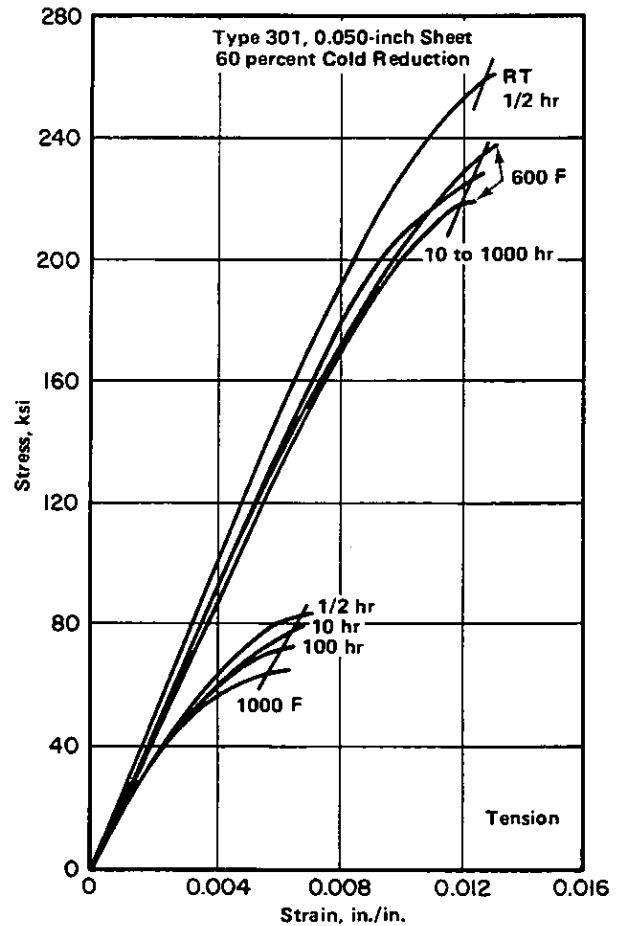
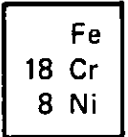


FIGURE 3.03116. STRESS-STRAIN CURVES IN TENSION FOR VARIOUS TEMPERATURES AND EXPOSURE TIMES FOR 60 PERCENT COLD-REDUCED SHEET (38)



Type 301
Type 302

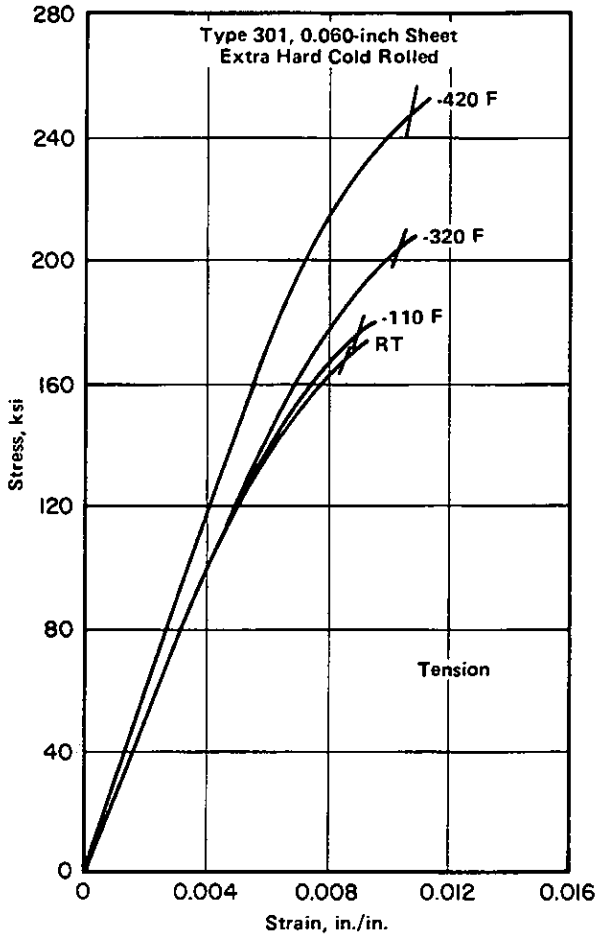


FIGURE 3.03117. STRESS-STRAIN CURVES IN TENSION AT LOW TEMPERATURES OF EXTRA-HARD COLD-ROLLED SHEET (32)

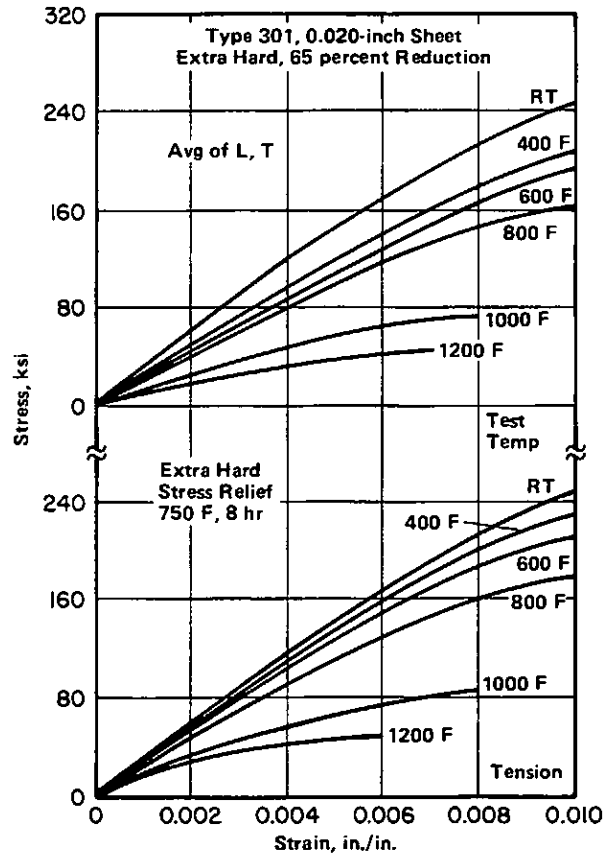


FIGURE 3.03118. STRESS-STRAIN CURVES FOR TYPE 301 EXTRA-HARD AND EXTRA-HARD STRESS-RELIEVED SHEET AT ROOM AND ELEVATED TEMPERATURES (11)

Fe
18 Cr
8 Ni

Type 301
Type 302

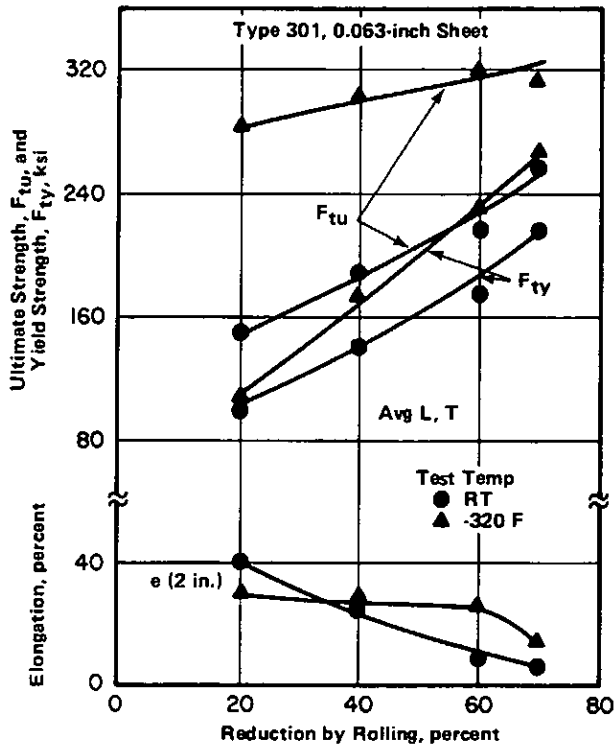


FIGURE 3.03121. EFFECT OF COLD ROLLING ON TENSILE PROPERTIES OF TYPE 301 SHEET AT ROOM TEMPERATURE AND -320 F (18)

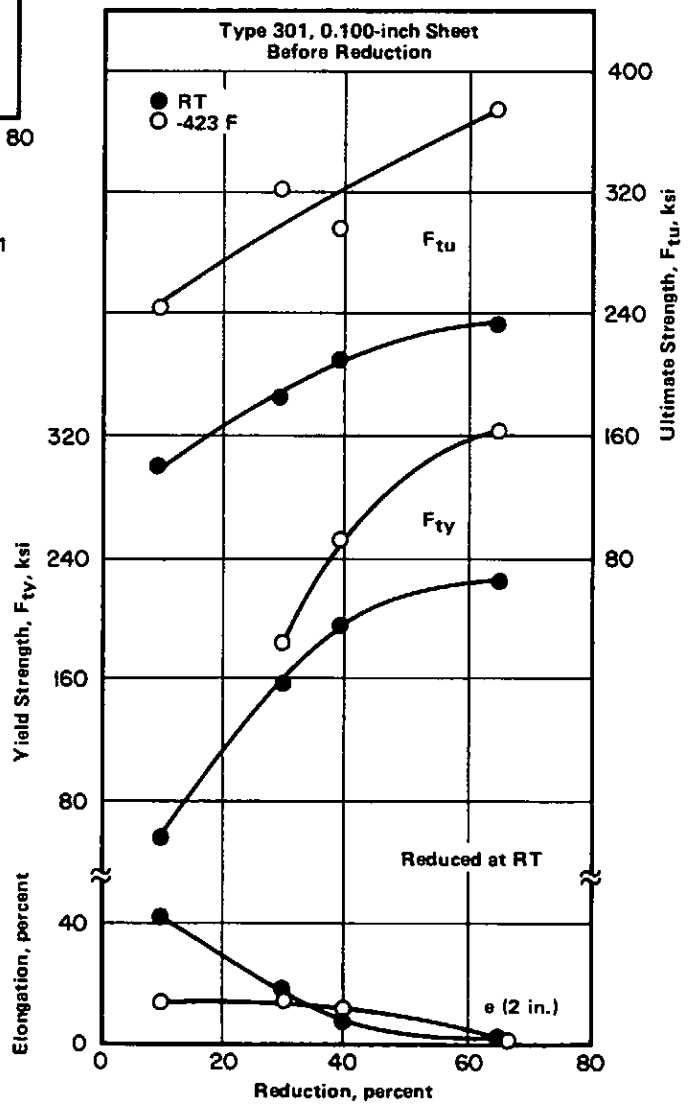


FIGURE 3.03122. EFFECT OF PERCENT REDUCTION ON TENSILE PROPERTIES OF SHEET TESTED AT ROOM TEMPERATURE AND -423 F (24)

Fe
18 Cr
8 Ni

Type 301
Type 302

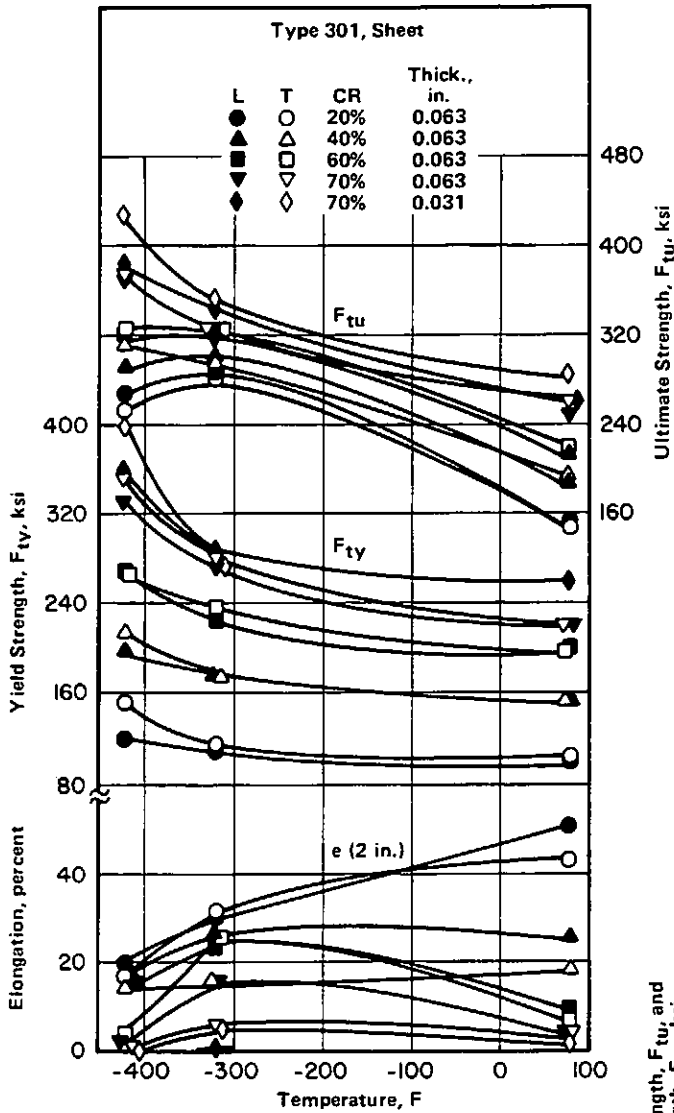


FIGURE 3.03123. EFFECT OF LOW TEMPERATURE AND PERCENT COLD REDUCTION ON TENSILE PROPERTIES OF SHEET (34)

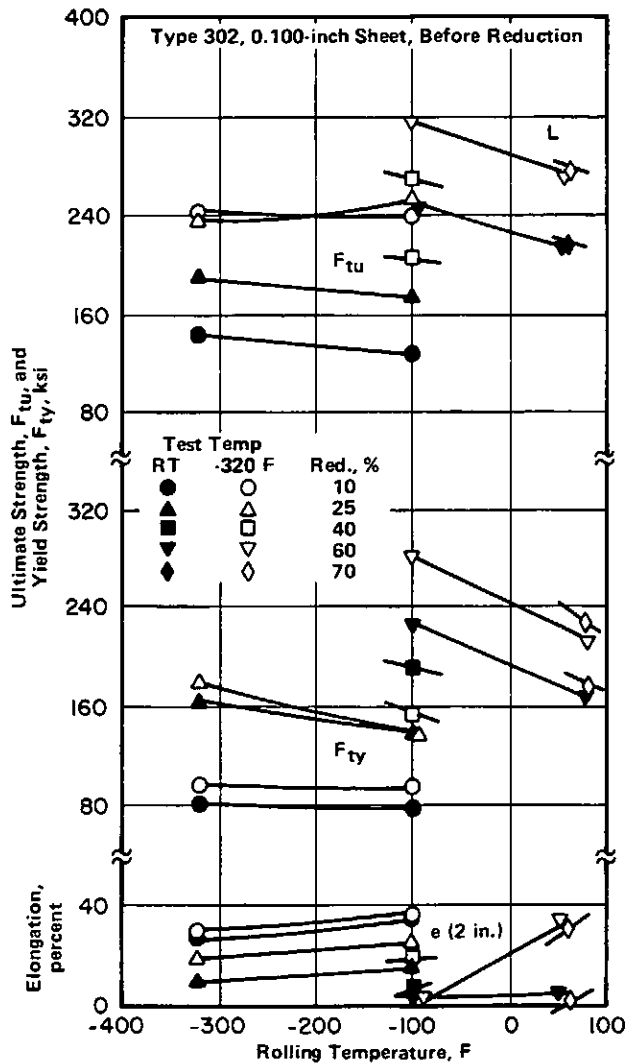


FIGURE 3.03124. EFFECT OF LOW ROLLING TEMPERATURE ON TENSILE PROPERTIES AT ROOM TEMPERATURE AND -320 F OF REDUCED SHEET (24)

Fe
18 Cr
8 Ni

Type 301
Type 302

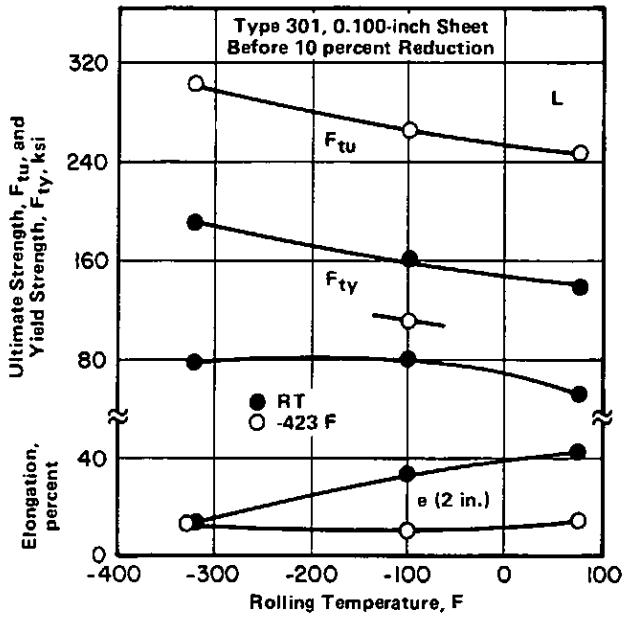


FIGURE 3.03125. EFFECT OF LOW ROLLING TEMPERATURE ON TENSILE PROPERTIES AT ROOM TEMPERATURE AND -423 F OF 10 PERCENT REDUCED SHEET (24)

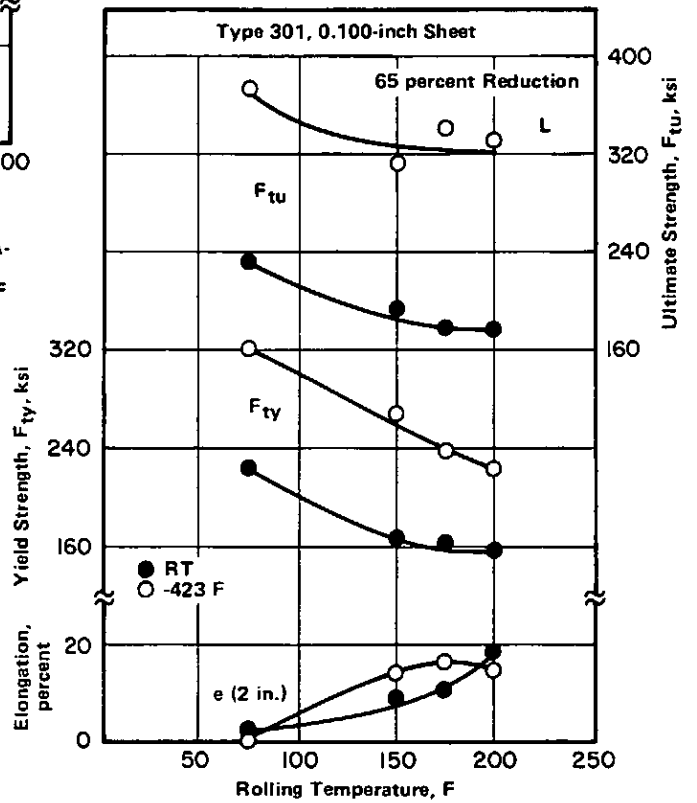


FIGURE 3.03126. EFFECT OF ROLLING TEMPERATURE ON TENSILE PROPERTIES AT ROOM TEMPERATURE AND -423 F OF 65 PERCENT REDUCED SHEET (24)

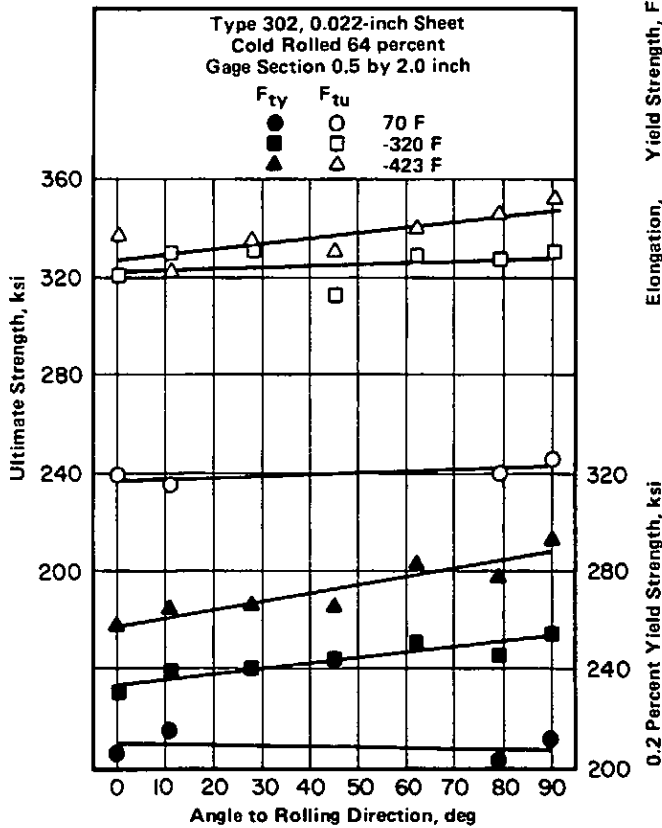


FIGURE 3.03127. EFFECT OF TEST DIRECTION ON TENSILE STRENGTH OF COLD-ROLLED SHEET AT ROOM AND CRYOGENIC TEMPERATURES (79)

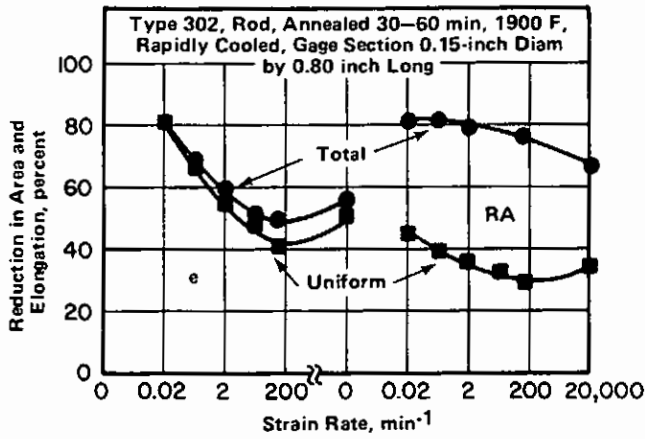


FIGURE 3.03132. EFFECTS OF STRAIN RATE ON TENSILE DUCTILITY OF TYPE 302 AT ROOM TEMPERATURE (80)

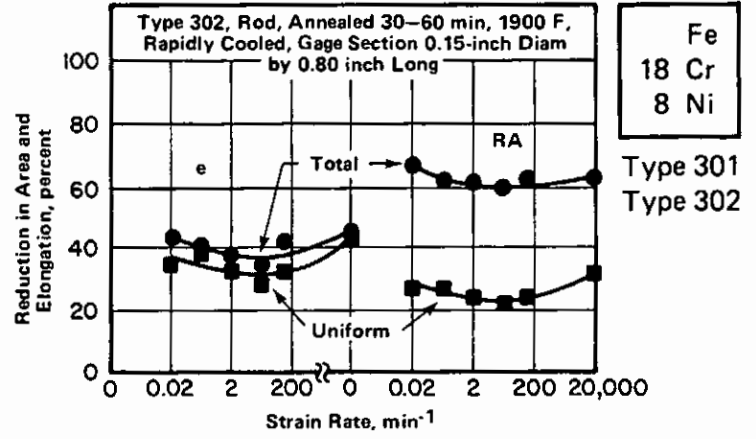


FIGURE 3.03133. EFFECTS OF STRAIN RATE ON TENSILE DUCTILITY OF TYPE 302 AT -321 F (80)

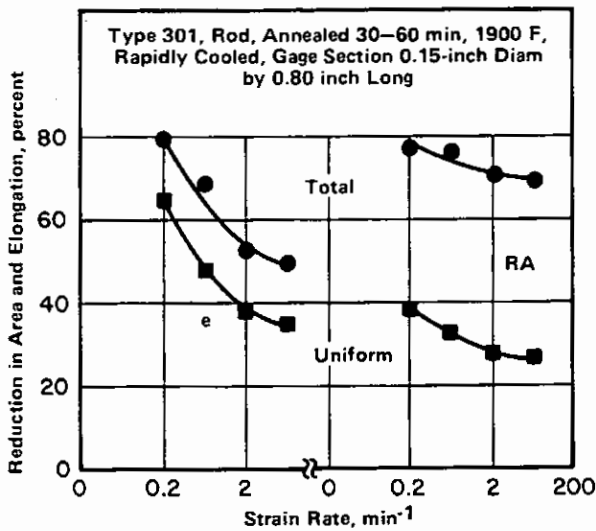


FIGURE 3.03134. EFFECTS OF STRAIN RATE ON TENSILE DUCTILITY OF TYPE 301 AT ROOM TEMPERATURE (80)

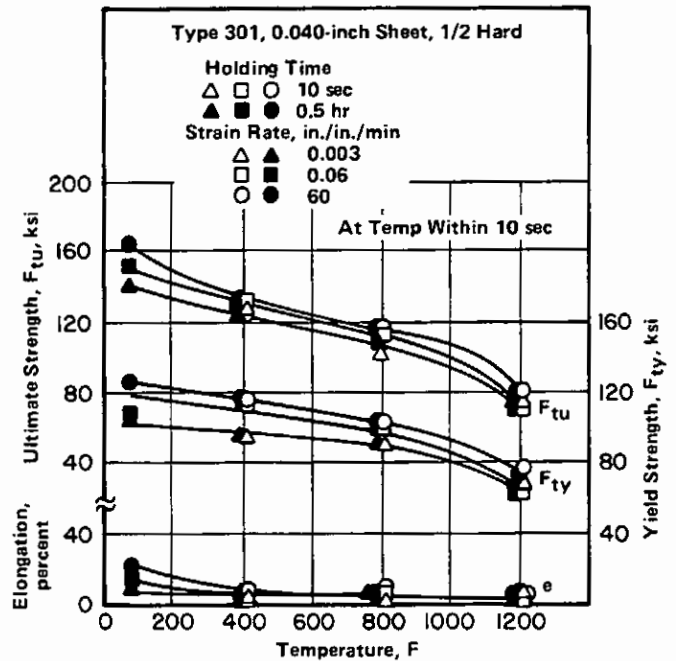


FIGURE 3.03135. EFFECT OF TEST TEMPERATURE, STRAIN RATE, AND HOLDING TIME ON TENSILE PROPERTIES OF TYPE 301 1/2-HARD SHEET (17)

Fe
18 Cr
8 Ni

Type 301
Type 302

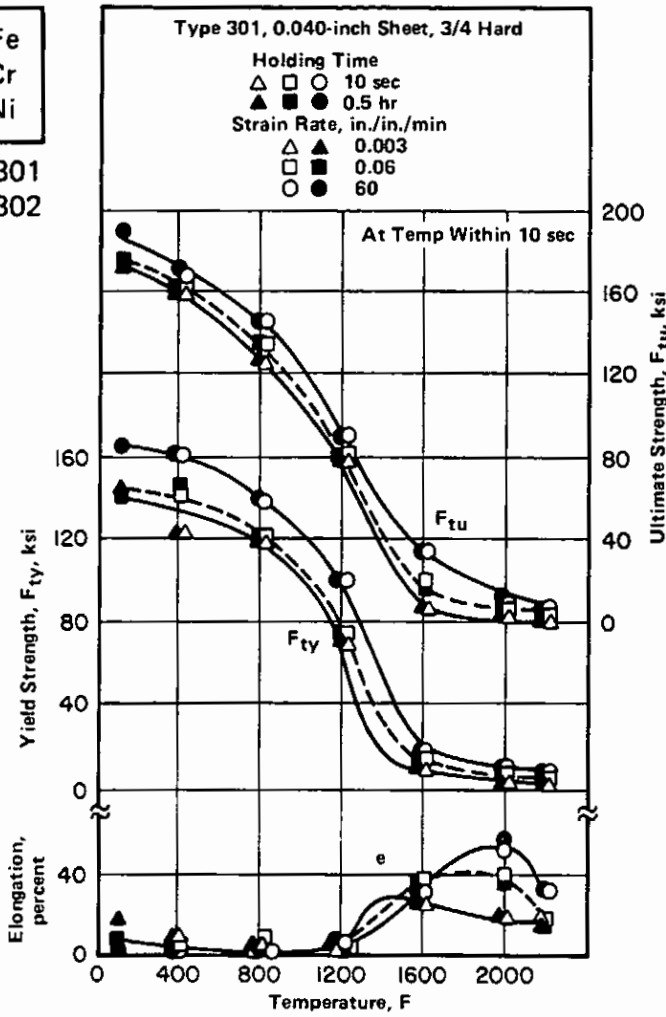


FIGURE 3.03136. EFFECT OF TEST TEMPERATURE, STRAIN RATE, AND HOLDING TIME ON TENSILE PROPERTIES OF TYPE 301 3/4-HARD SHEET (17)

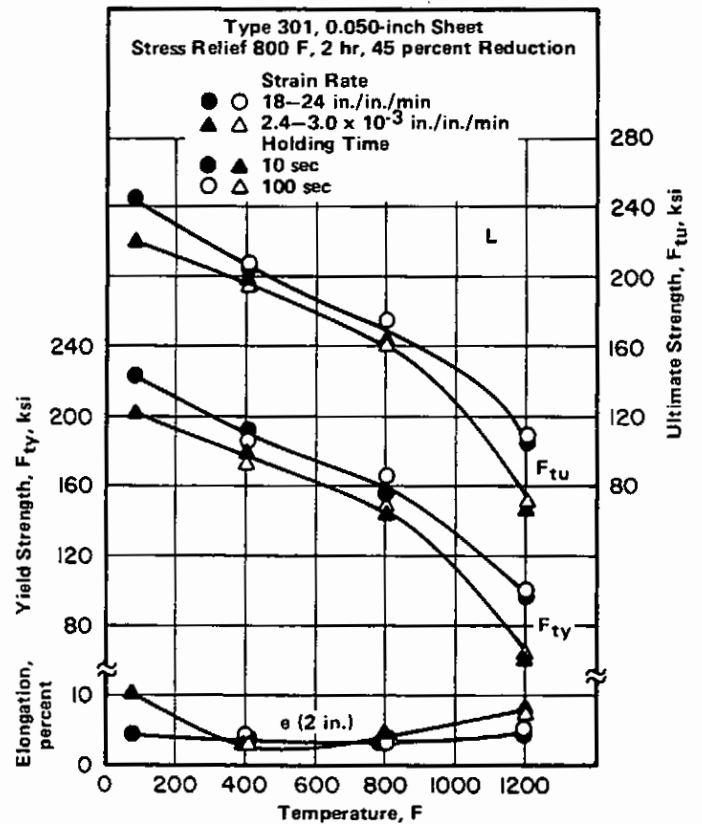


FIGURE 3.03137. EFFECT OF TEST TEMPERATURE, STRAIN RATE, AND HOLDING TIME ON TENSILE PROPERTIES OF 45 PERCENT REDUCED SHEET (28)

Fe
18 Cr
8 Ni

Type 301
Type 302

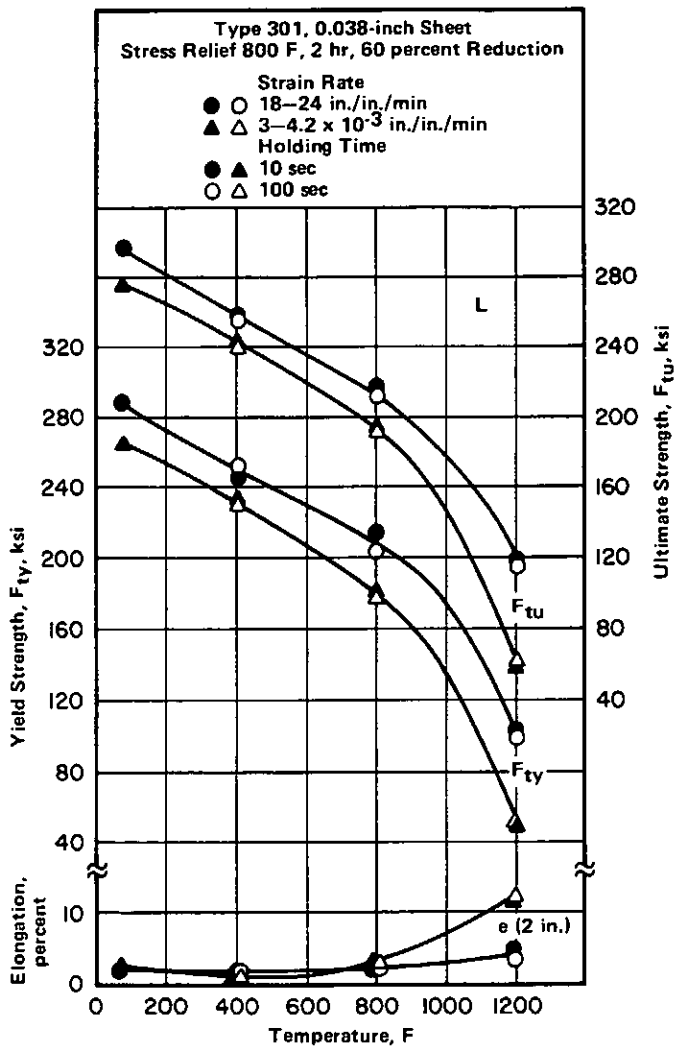


FIGURE 3.03138. EFFECT OF TEST TEMPERATURE, STRAIN RATE, AND HOLDING TIME ON TENSILE PROPERTIES OF 60 PERCENT REDUCED SHEET (28)

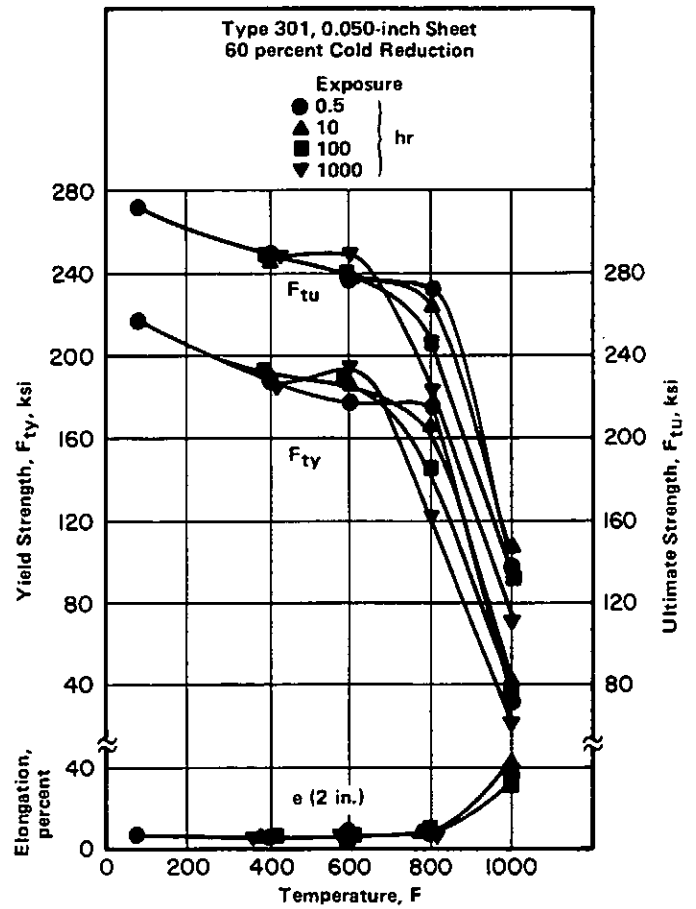


FIGURE 3.03139. EFFECT OF TEST TEMPERATURE AND EXPOSURE TIME ON TENSILE PROPERTIES OF 60 PERCENT COLD-REDUCED SHEET (38)

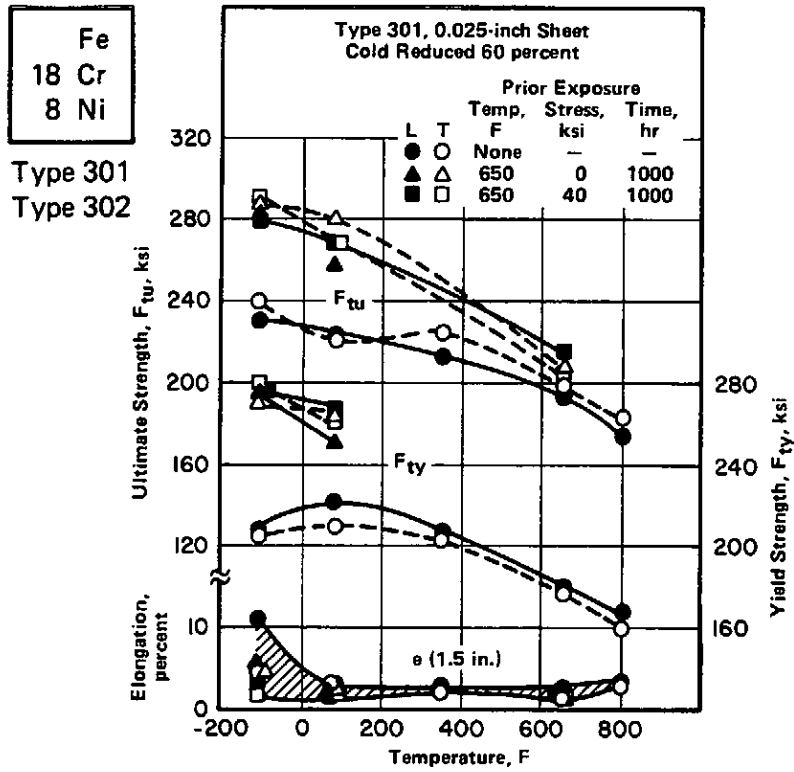


FIGURE 3.031312. EFFECT OF TEST TEMPERATURE AND PRIOR EXPOSURE ON TENSILE PROPERTIES OF 60 PERCENT COLD-REDUCED SHEET (45)

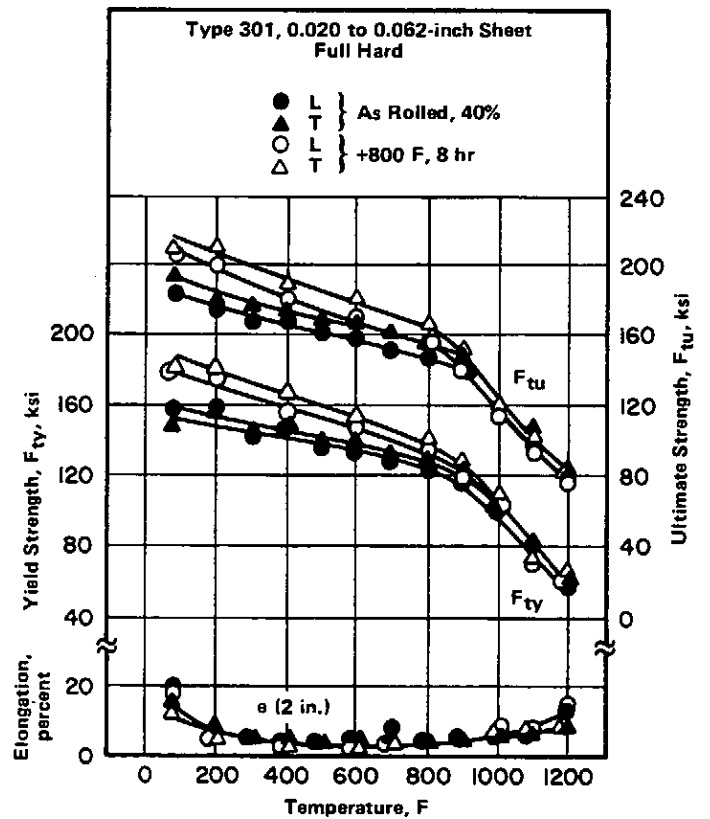
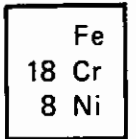


FIGURE 3.03141. EFFECT OF TEST TEMPERATURE, TEST DIRECTION, AND STRESS RELIEF ON TENSILE PROPERTIES OF TYPE 301 FULL-HARD SHEET (11)



Type 301
Type 302

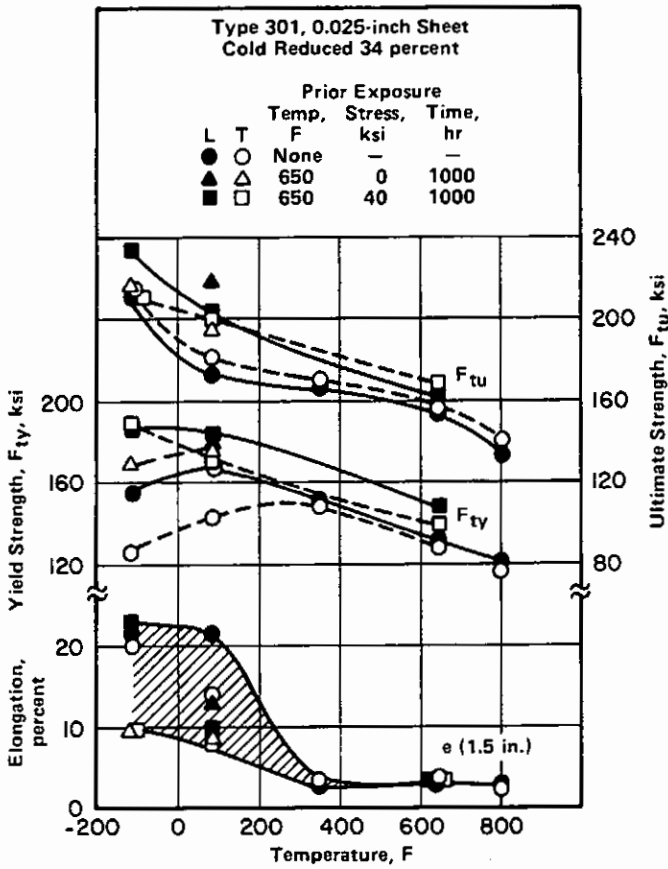


FIGURE 3.031310. EFFECT OF TEST TEMPERATURE AND PRIOR EXPOSURE ON TENSILE PROPERTIES OF 34 PERCENT COLD-REDUCED SHEET (45)

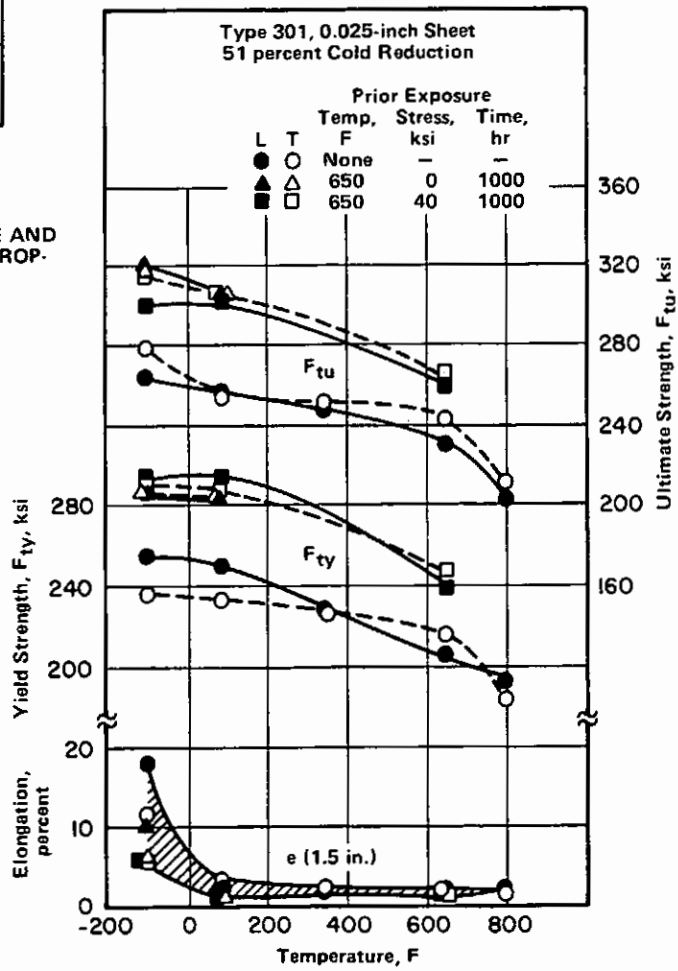


FIGURE 3.031311. EFFECT OF TEST TEMPERATURE AND PRIOR EXPOSURE ON TENSILE PROPERTIES OF 51 PERCENT COLD-REDUCED SHEET (45)

Fe
18 Cr
8 Ni

Type 301
Type 302

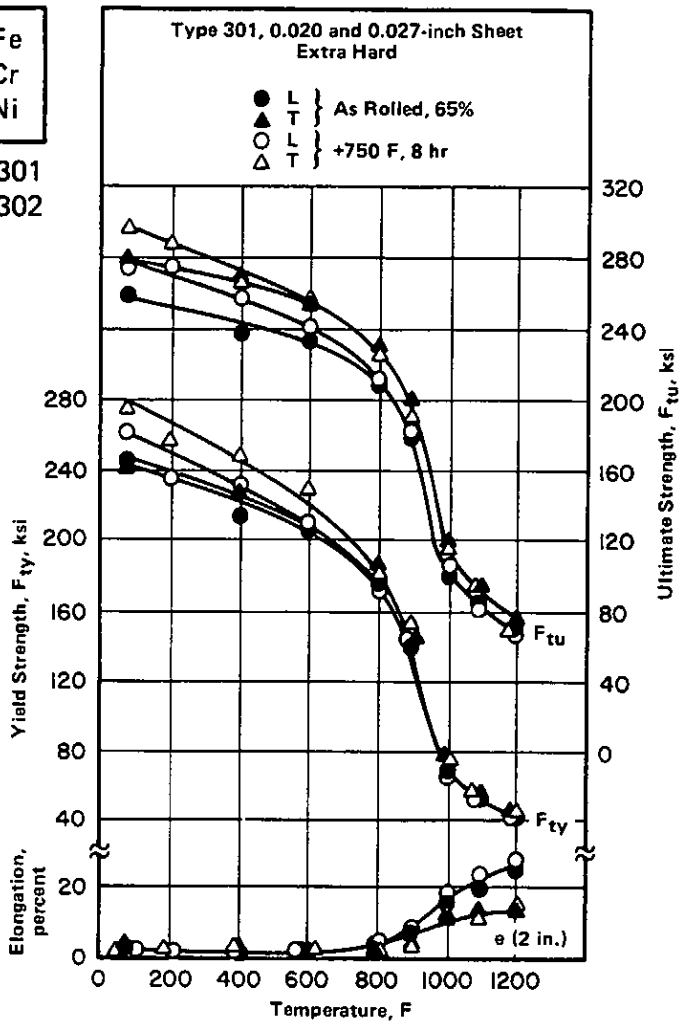


FIGURE 3.03142. EFFECT OF TEST TEMPERATURE, TEST DIRECTION, AND STRESS RELIEF ON TENSILE PROPERTIES OF TYPE 301 EXTRA-HARD SHEET (11)

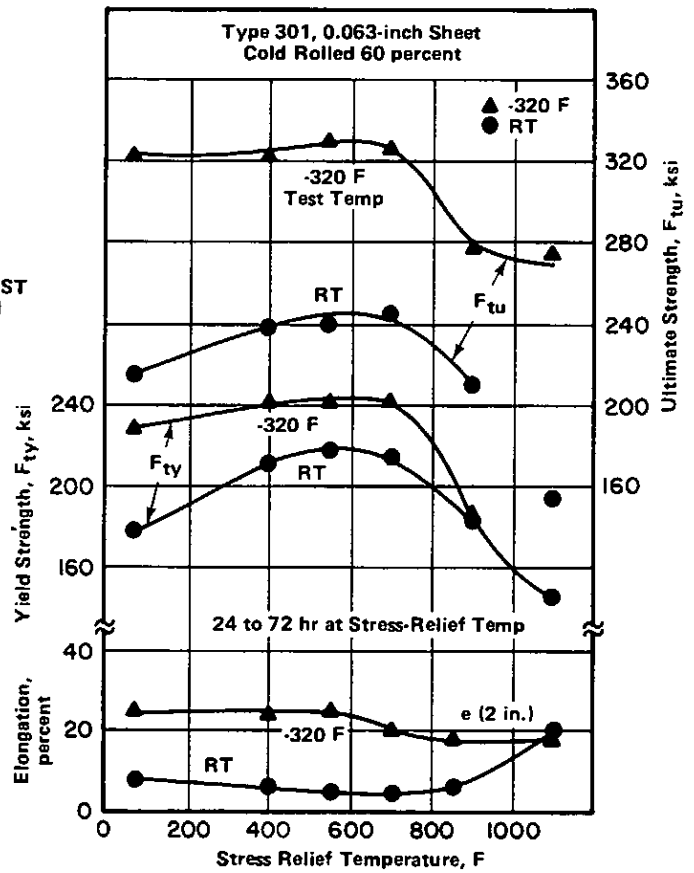
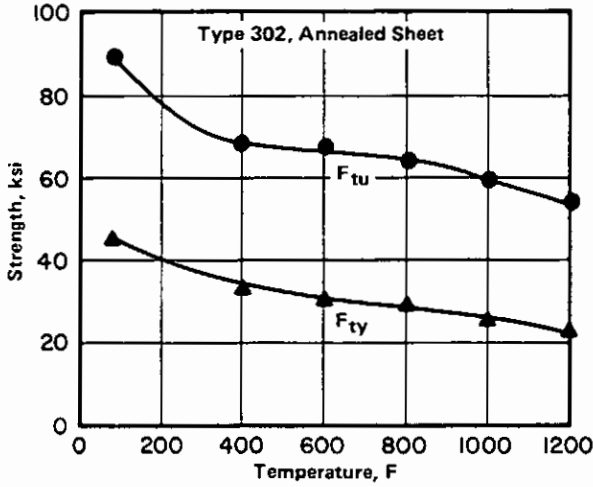


FIGURE 3.03143. EFFECT OF STRESS RELIEF AND TEST TEMPERATURE ON TENSILE PROPERTIES OF COLD-ROLLED SHEET (18)



Fe
 18 Cr
 8 Ni
 Type 301
 Type 302

FIGURE 3.03151. EFFECT OF TEST TEMPERATURE ON TENSILE STRENGTH OF ANNEALED TYPE 302 SHEET (62)

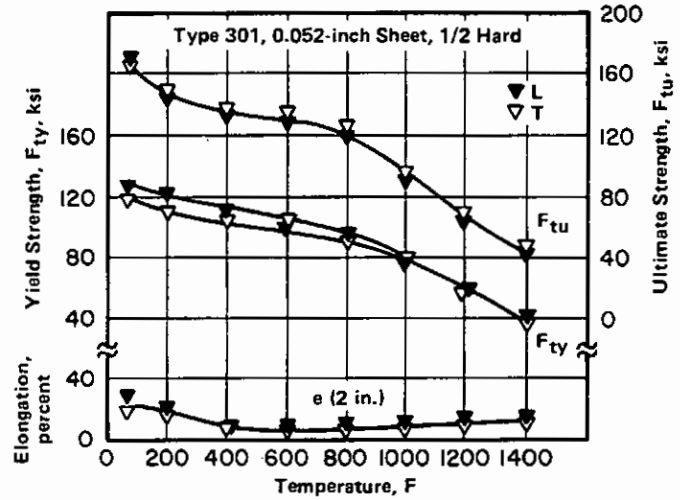


FIGURE 3.03152. EFFECT OF TEST TEMPERATURE ON TENSILE PROPERTIES OF TYPE 301, 1/2 HARD SHEET (11)

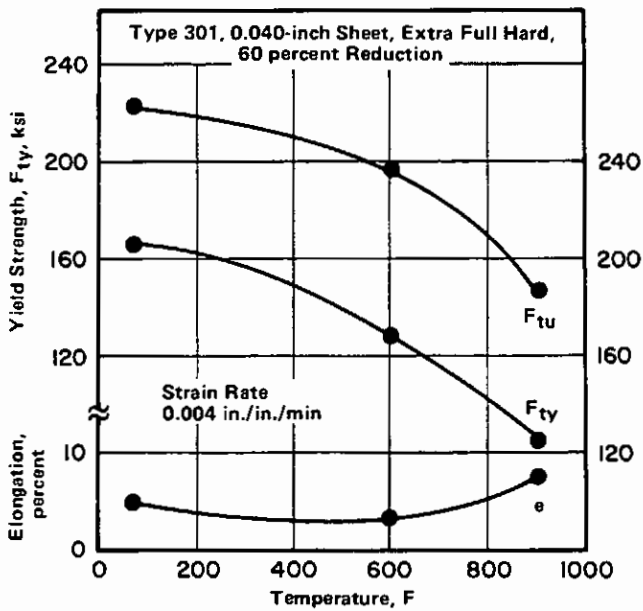


FIGURE 3.03153. EFFECT OF TEST TEMPERATURE ON TENSILE PROPERTIES OF 60 PERCENT REDUCED SHEET (26)

Fe
18 Cr
8 Ni

Type 301
Type 302

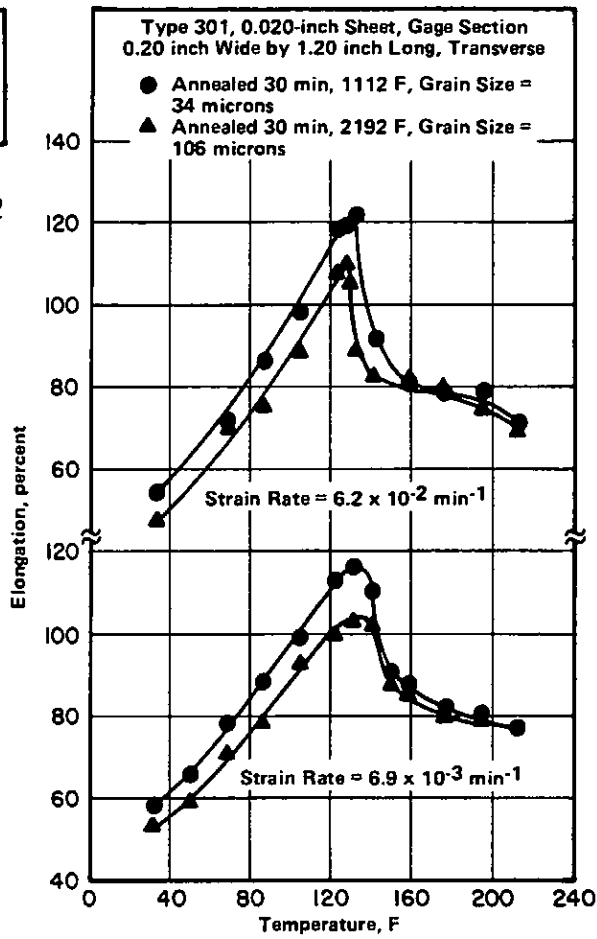


FIGURE 3.03155. EFFECTS OF GRAIN SIZE, STRAIN RATE, AND TEMPERATURE ON TENSILE ELONGATION OF TYPE 301 (77)

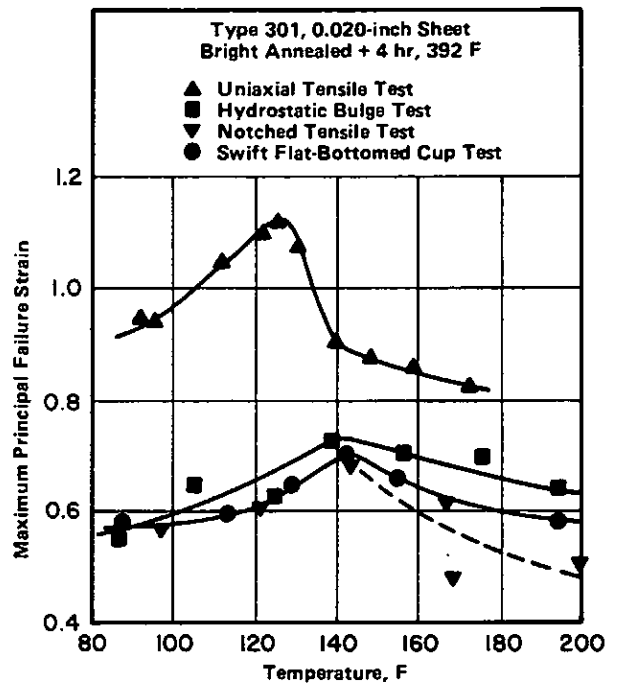


FIGURE 3.03156. EFFECTS OF TEMPERATURE ON FAILURE STRAIN FOR SEVERAL TYPES OF DEFORMATION (81)

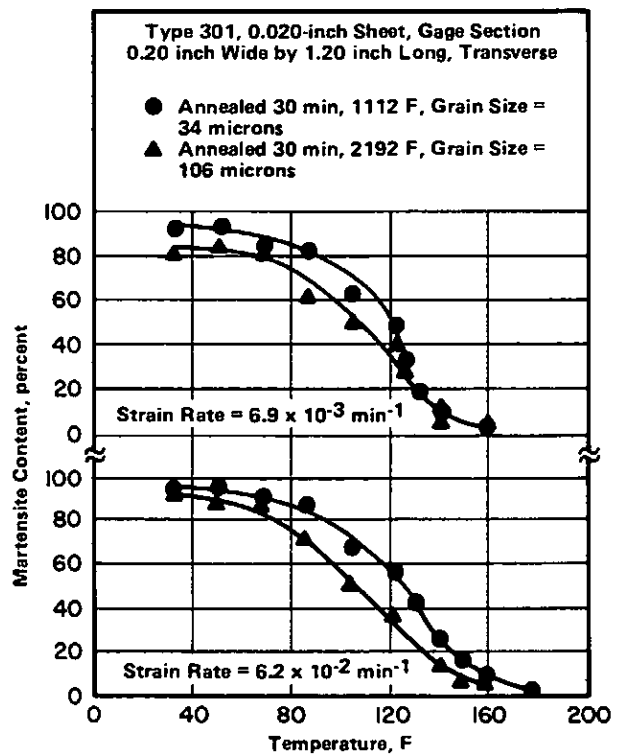


FIGURE 3.03157. EFFECTS OF GRAIN SIZE, STRAIN RATE, AND TEMPERATURE ON MARTENSITE CONTENT OF FRACTURED TENSILE SPECIMENS OF TYPE 301 (77)

Fe
18 Cr
8 Ni

Type 301
Type 302

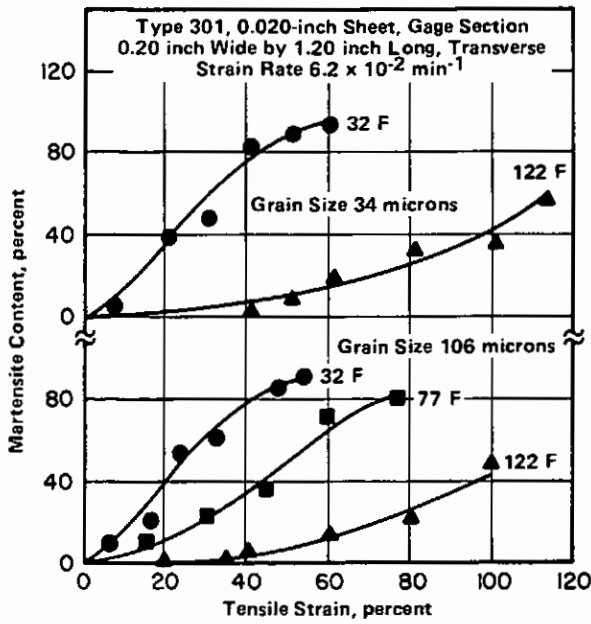


FIGURE 3.03158. EFFECTS OF GRAIN SIZE, TEST TEMPERATURE, AND TENSILE STRAIN ON MARTENSITE CONTENT OF TYPE 301 (77)

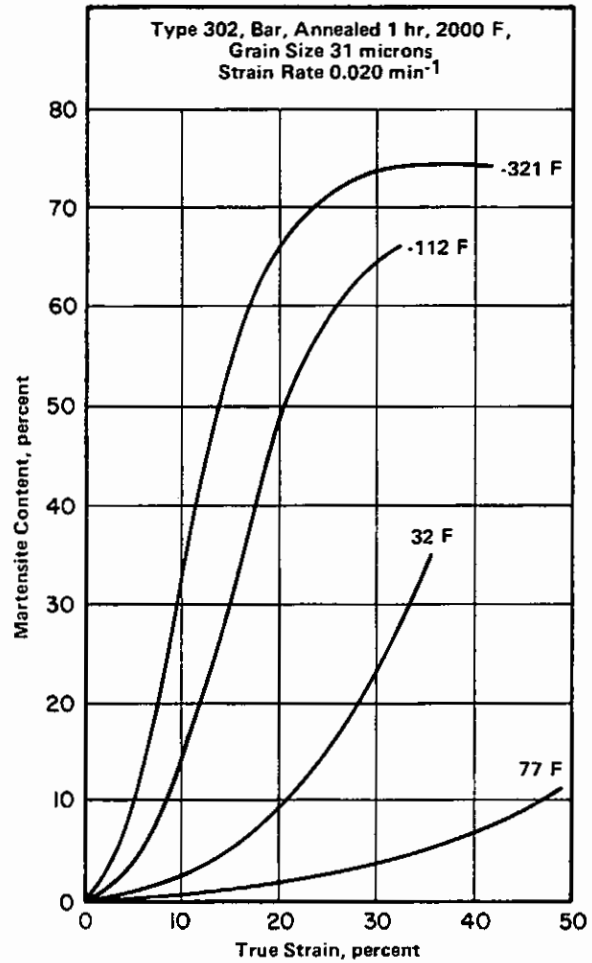


FIGURE 3.03159. EFFECTS OF TEST TEMPERATURE AND TRUE TENSILE STRAIN ON MARTENSITE CONTENT OF TYPE 302 (78)

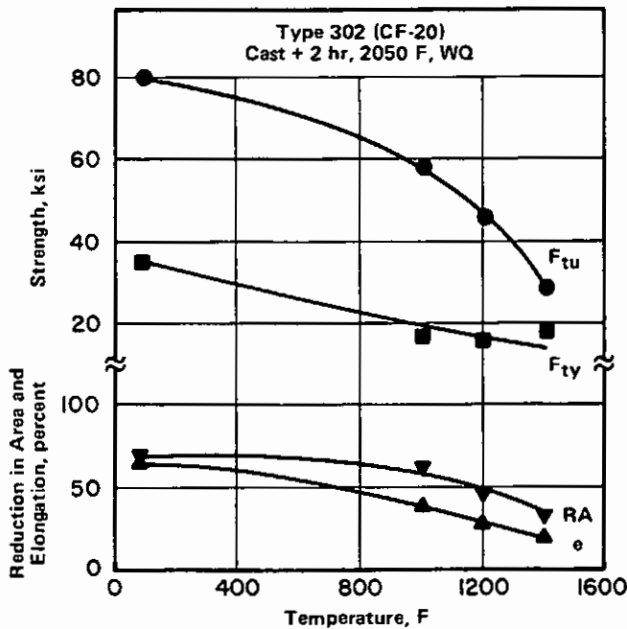


FIGURE 3.031510. EFFECTS OF TEMPERATURE ON TENSILE PROPERTIES OF CAST TYPE 302 (62)

Fe
18 Cr
8 Ni

Type 301
Type 302

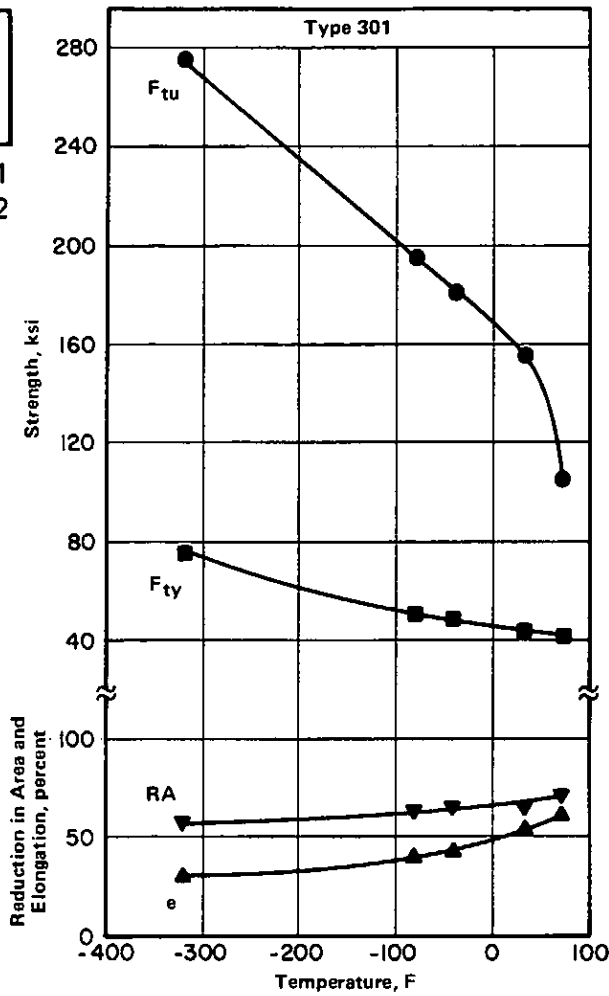


FIGURE 3.03161. EFFECT OF CRYOGENIC TEMPERATURES ON NOMINAL TENSILE PROPERTIES OF ANNEALED TYPE 301 SHEET, STRIP, PLATE, AND BAR (51)

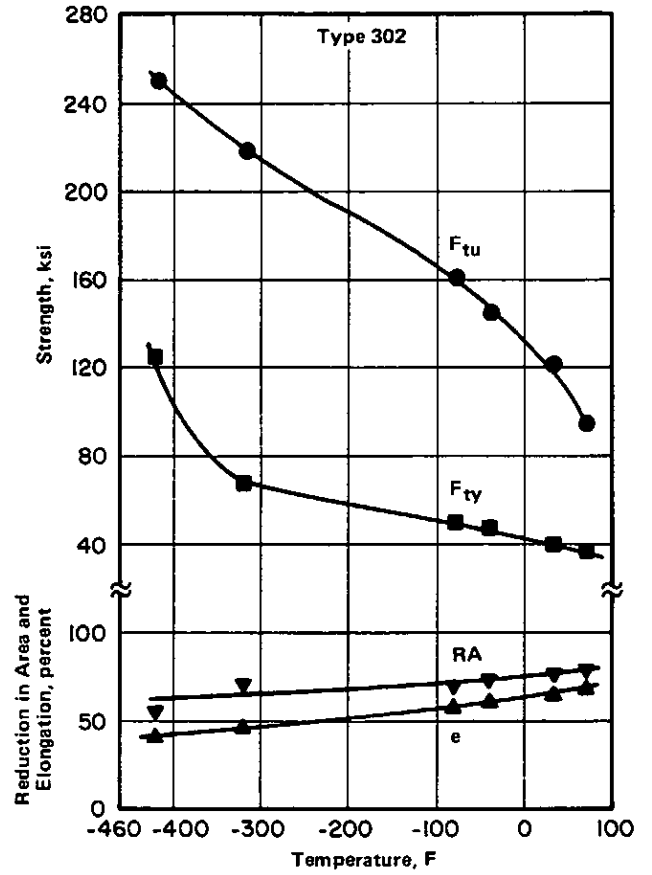


FIGURE 3.03162. EFFECT OF CRYOGENIC TEMPERATURES ON NOMINAL TENSILE PROPERTIES OF ANNEALED TYPE 302 SHEET, STRIP, PLATE, AND BAR (51)

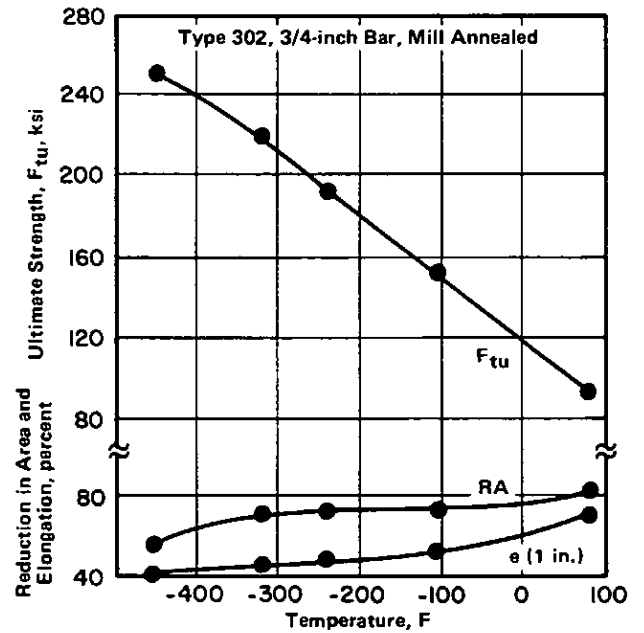


FIGURE 3.03163. EFFECT OF CRYOGENIC TEMPERATURES ON THE TENSILE PROPERTIES OF ANNEALED BAR (33)

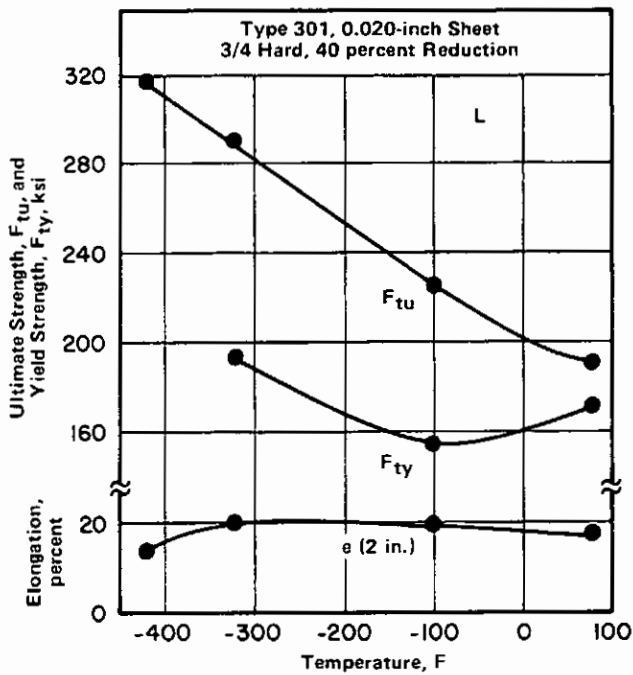


FIGURE 3.03164. EFFECT OF CRYOGENIC TEMPERATURES ON TENSILE PROPERTIES OF 40 PERCENT REDUCED SHEET (31)

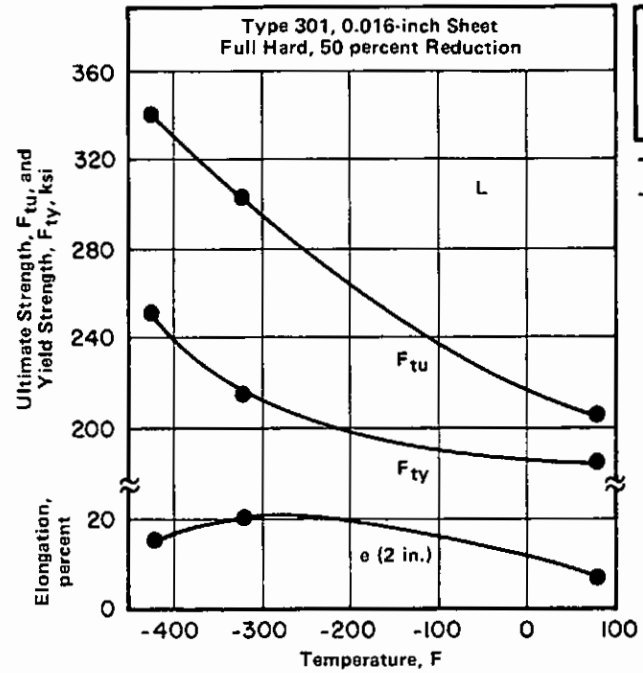


FIGURE 3.03165. EFFECT OF CRYOGENIC TEMPERATURES ON TENSILE PROPERTIES OF 50 PERCENT REDUCED SHEET (31)

Fe
18 Cr
8 Ni
Type 301
Type 302

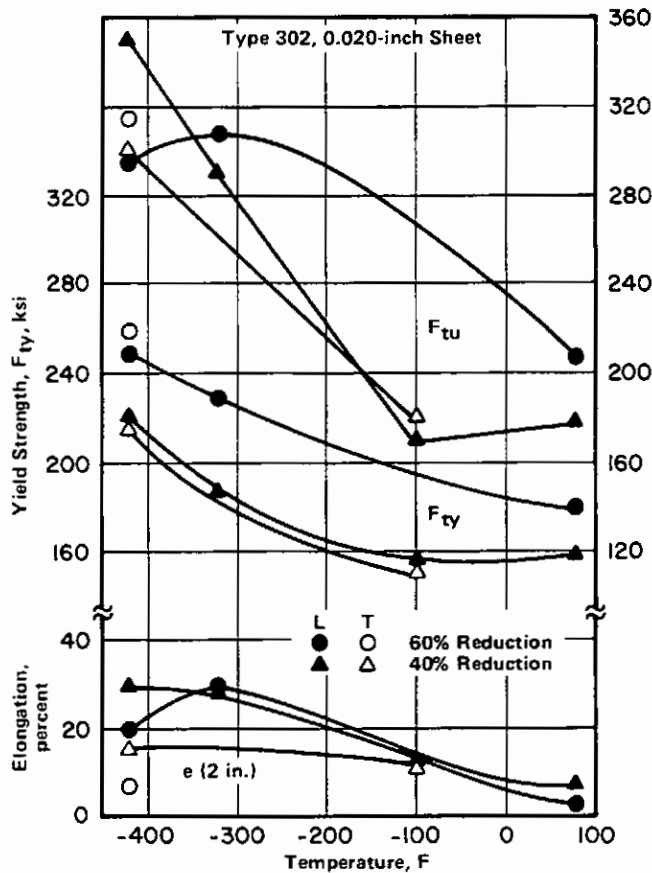


FIGURE 3.03166. EFFECT OF CRYOGENIC TEMPERATURES ON TENSILE PROPERTIES OF 40 AND 60 PERCENT REDUCED SHEET (31)

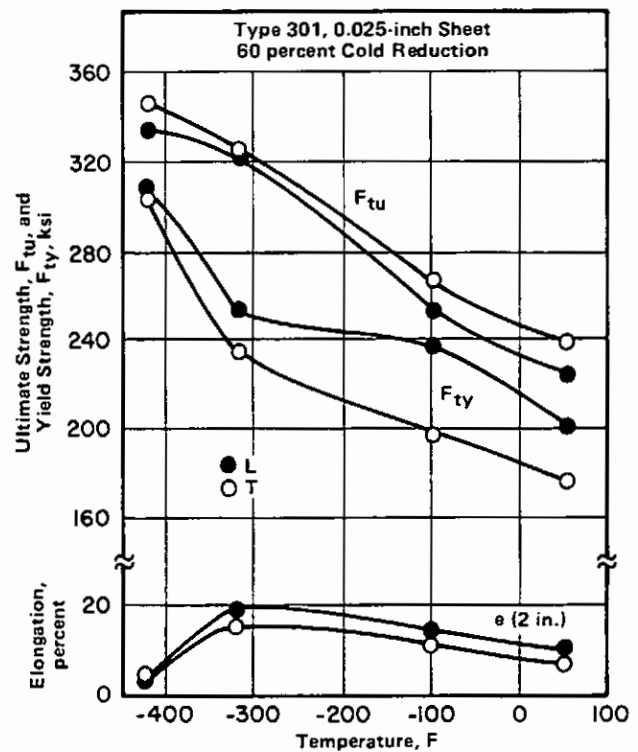


FIGURE 3.03167. EFFECT OF CRYOGENIC TEMPERATURES ON TENSILE PROPERTIES OF 60 PERCENT COLD-REDUCED SHEET (36)

Fe
18 Cr
8 Ni

Type 301
Type 302

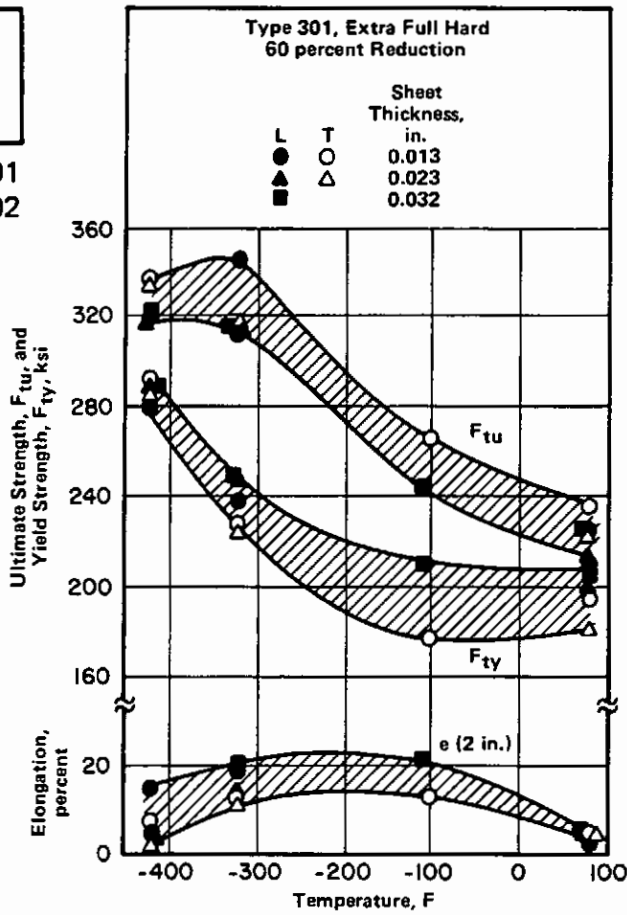


FIGURE 3.03168. EFFECTS OF CRYOGENIC TEMPERATURES AND THICKNESS ON TENSILE PROPERTIES OF 60 PERCENT REDUCED SHEET (31)

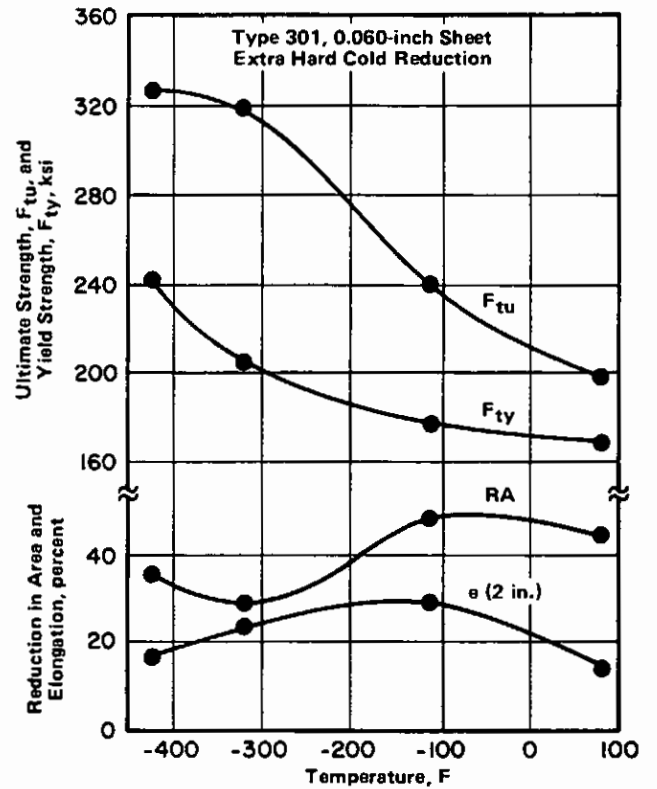


FIGURE 3.03169. EFFECT OF CRYOGENIC TEMPERATURES ON TENSILE PROPERTIES OF EXTRA-HARD COLD-ROLLED SHEET (32)

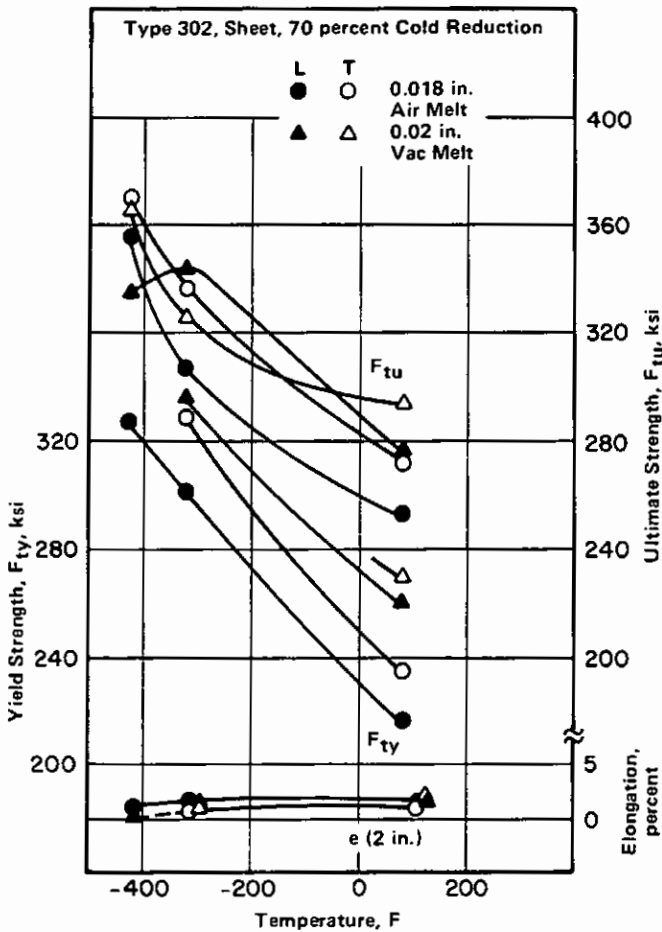


FIGURE 3.031610. EFFECTS OF CRYOGENIC TEMPERATURES AND MELT METHOD ON TENSILE PROPERTIES OF 70 PERCENT REDUCED SHEET (23)

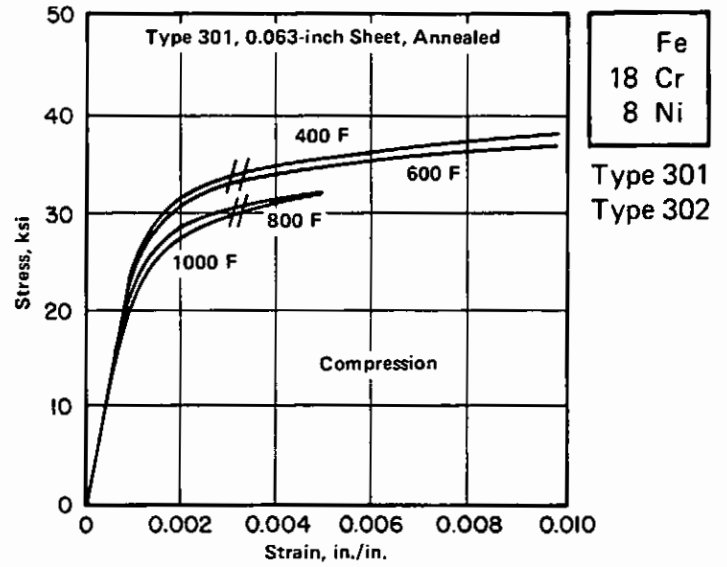


FIGURE 3.03211. STRESS-STRAIN CURVES IN COMPRESSION FOR TYPE 301 ANNEALED SHEET AT ELEVATED TEMPERATURES (19)

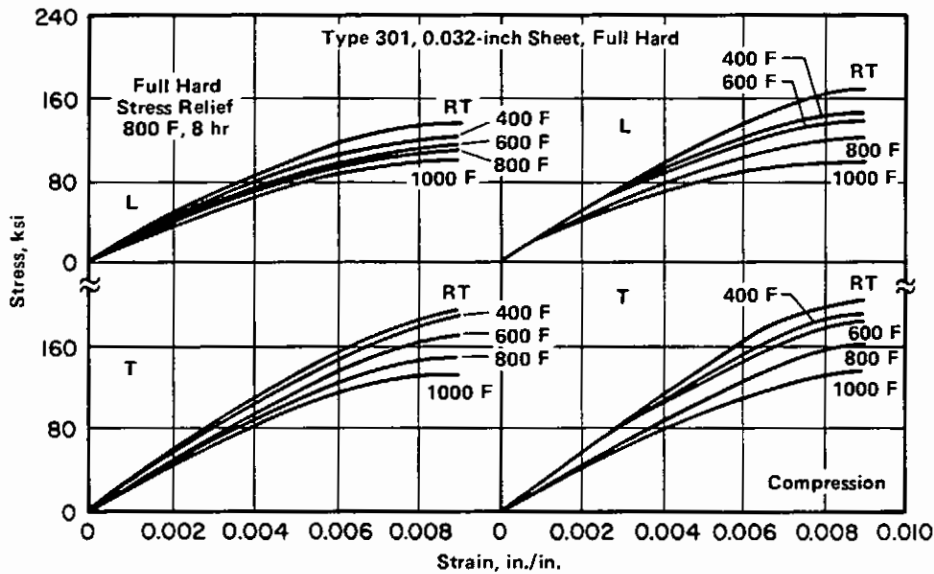


FIGURE 3.03212. STRESS-STRAIN CURVES IN COMPRESSION FOR TYPE 301 FULL-HARD AND FULL-HARD STRESS-RELIEVED SHEET AT ROOM AND ELEVATED TEMPERATURES (11)



Type 301
Type 302

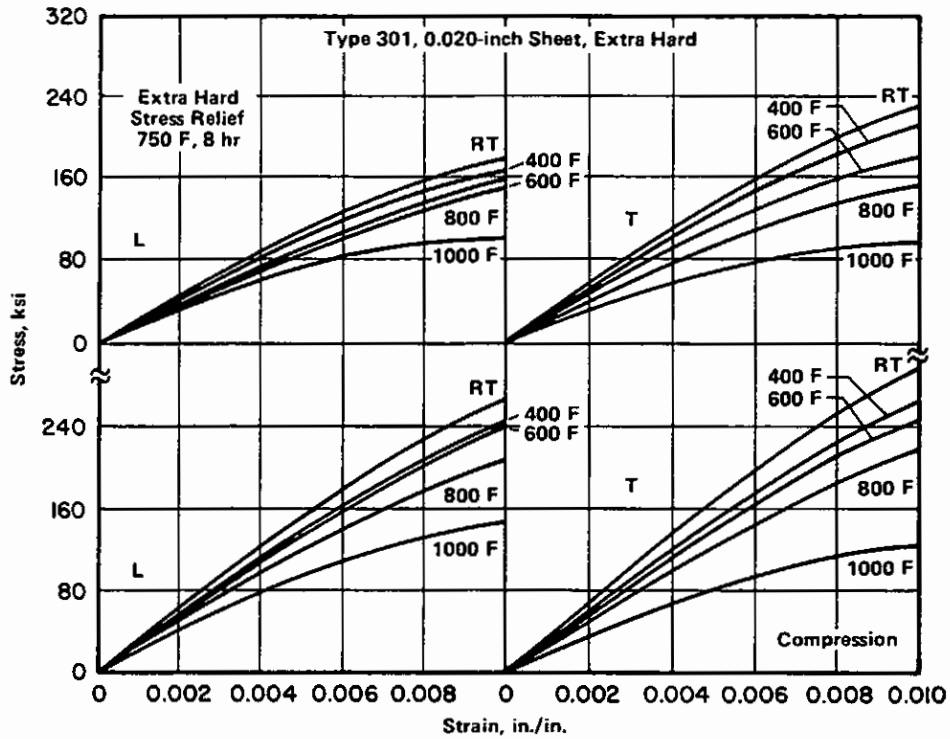


FIGURE 3.03213. STRESS-STRAIN CURVES IN COMPRESSION FOR TYPE 301 EXTRA-HARD AND EXTRA-HARD STRESS-RELIEVED SHEET AT ROOM AND ELEVATED TEMPERATURES (11)

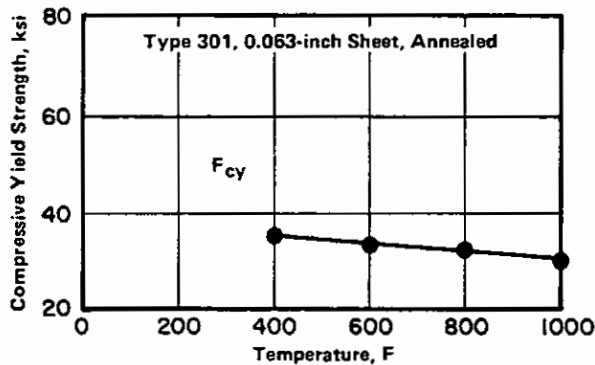


FIGURE 3.0322. EFFECT OF TEST TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF TYPE 301 ANNEALED SHEET (19)

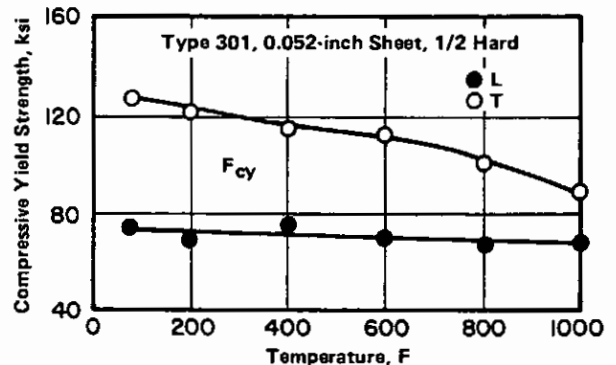


FIGURE 3.0323. EFFECT OF TEST TEMPERATURE AND TEST DIRECTION ON COMPRESSIVE YIELD STRENGTH OF TYPE 301 1/2-HARD SHEET (11)

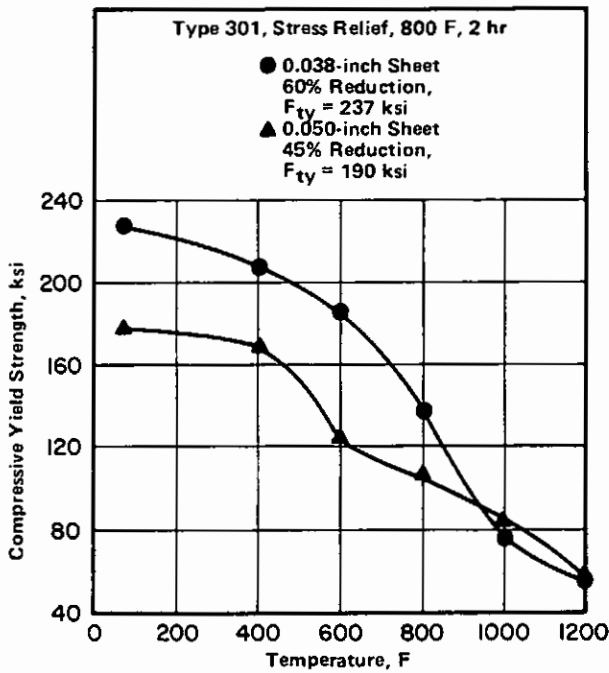
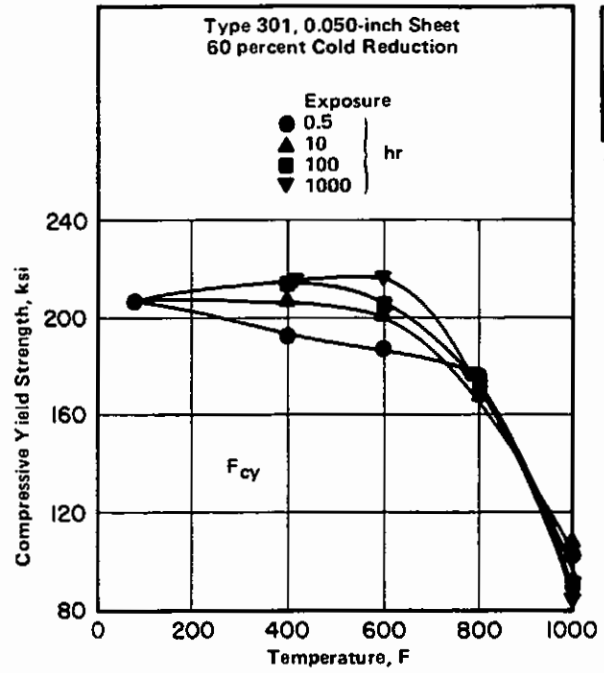


FIGURE 3.0324. EFFECT OF TEST TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF 45 AND 60 PERCENT REDUCED SHEET (28)



Fe
18 Cr
8 Ni

Type 301
Type 302

FIGURE 3.0325. EFFECT OF TEST TEMPERATURE AND EXPOSURE TIME ON COMPRESSIVE YIELD STRENGTH OF 60 PERCENT COLD-REDUCED SHEET (38)

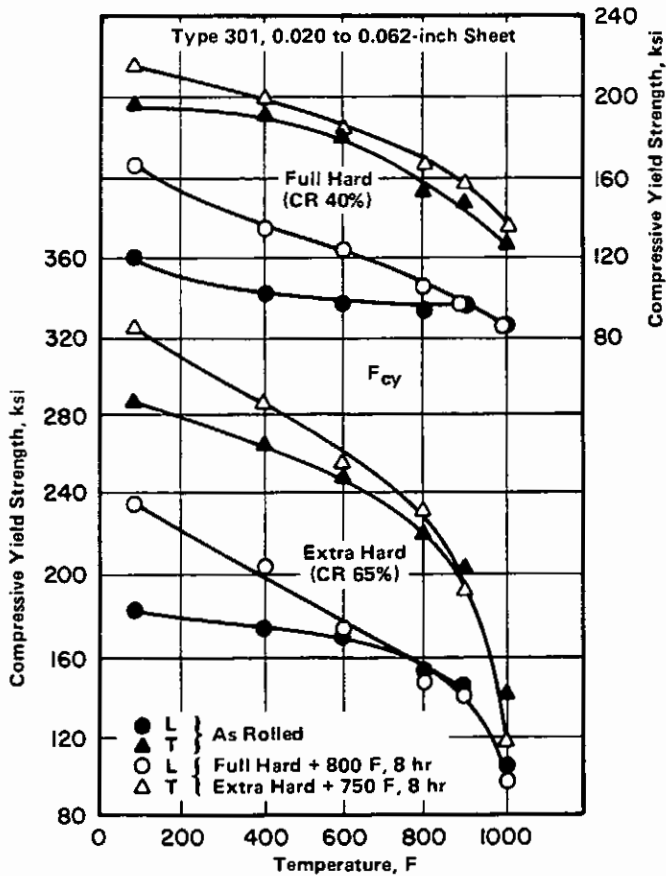


FIGURE 3.0326. EFFECT OF TEST TEMPERATURE, TEST DIRECTION, AND STRESS RELIEF ON COMPRESSIVE YIELD STRENGTH OF TYPE 301 FULL-HARD AND EXTRA-HARD SHEET (11)

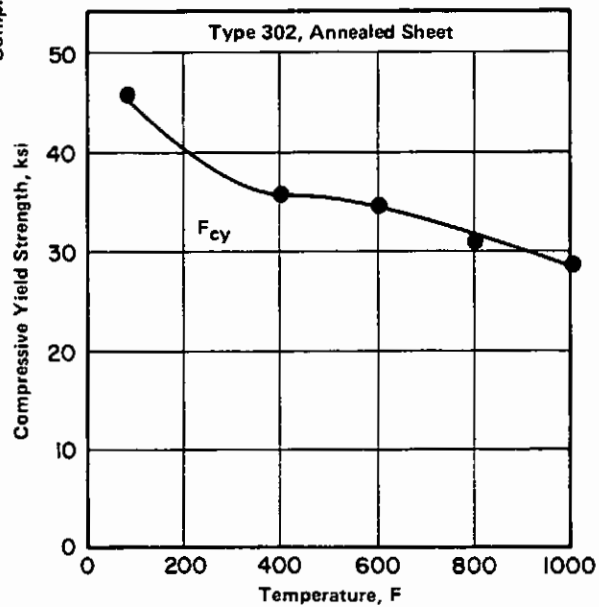


FIGURE 3.0327. EFFECT OF TEST TEMPERATURE ON COMPRESSIVE STRENGTH OF ANNEALED TYPE 302 SHEET (62)



Type 301
Type 302

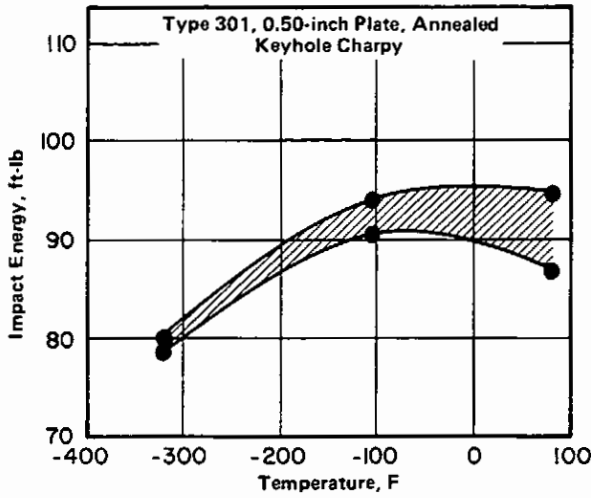


FIGURE 3.0331. IMPACT ENERGY OF TYPE 301 PLATE AT ROOM AND CRYOGENIC TEMPERATURES (82)

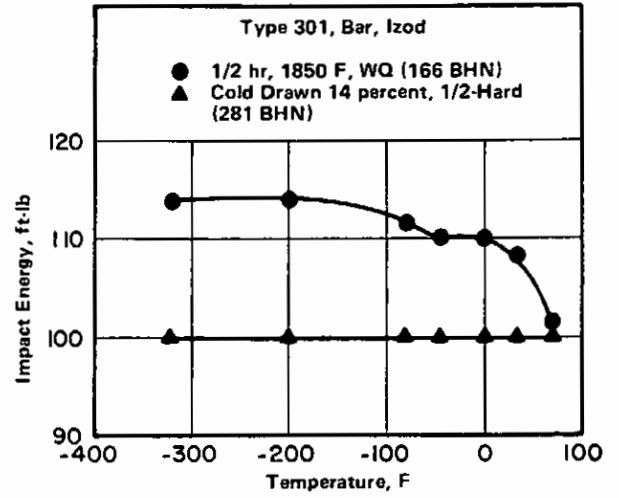


FIGURE 3.0332. IMPACT ENERGY OF TYPE 301 BAR AT ROOM AND CRYOGENIC TEMPERATURES (82)

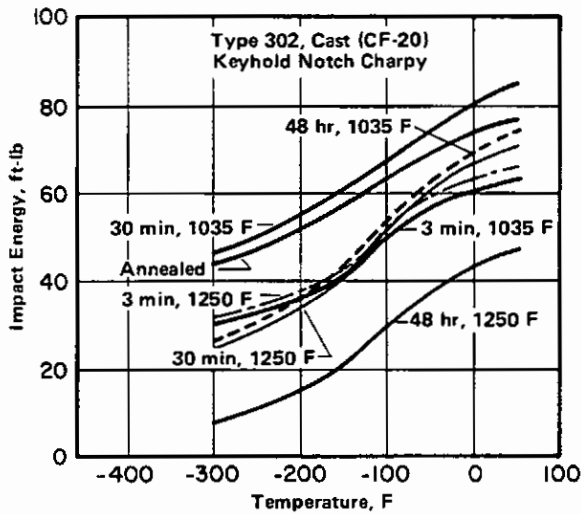


FIGURE 3.0334. EFFECT OF SENSITIZING HEAT TREATMENTS ON THE IMPACT ENERGY OF CAST TYPE 302 AT CRYOGENIC TEMPERATURES (83)

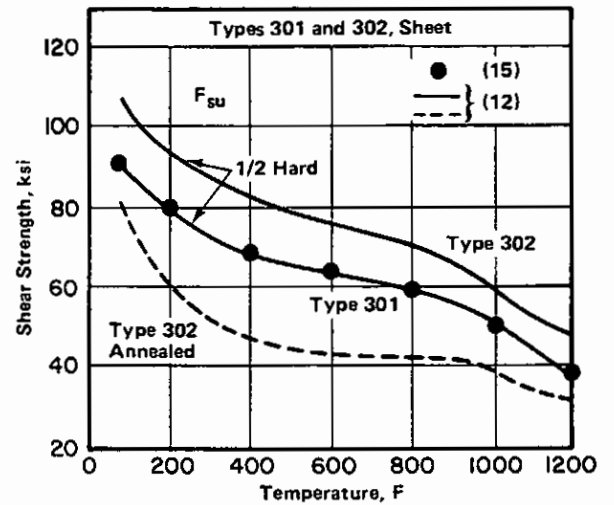


FIGURE 3.0351. EFFECT OF TEST TEMPERATURE ON SHEAR STRENGTH OF TYPES 301 AND 302 (12,15)

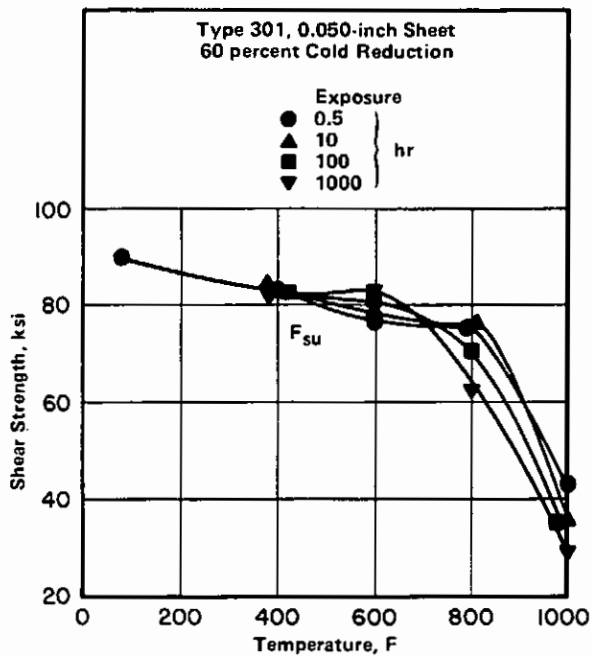


FIGURE 3.0352. EFFECT OF TEST TEMPERATURE AND EXPOSURE TIME ON SHEAR STRENGTH OF 60 PERCENT COLD-REDUCED SHEET (38)

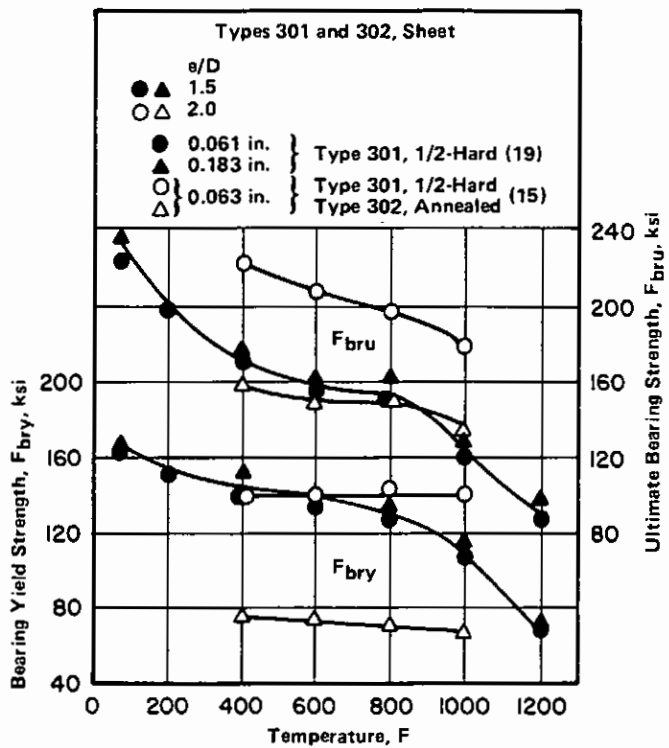


FIGURE 3.0361. EFFECT OF TEST TEMPERATURE ON BEARING PROPERTIES OF TYPES 301 AND 302 SHEET (15,19)

Fe
18 Cr
8 Ni

Type 301
Type 302

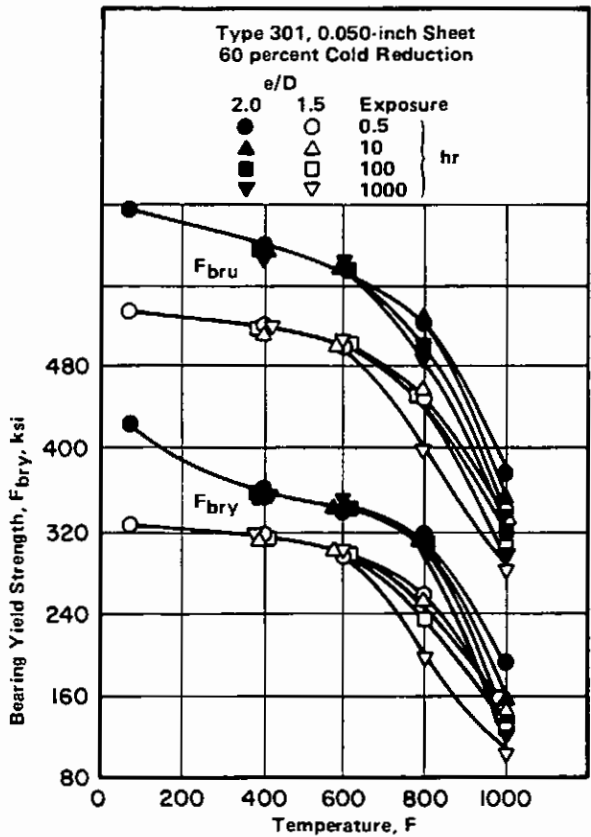


FIGURE 3.0362. EFFECT OF TEST TEMPERATURE AND EXPOSURE TIME ON BEARING PROPERTIES OF 60 PERCENT COLD-REDUCED SHEET (38)

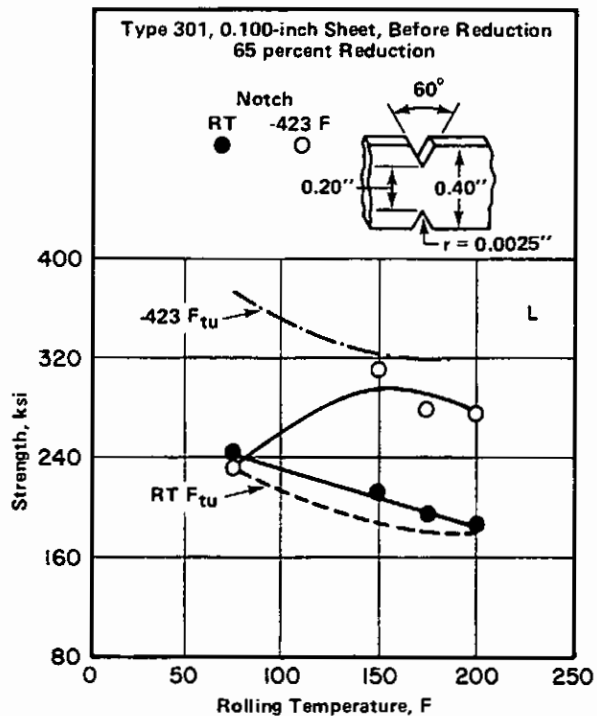
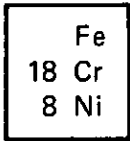


FIGURE 3.03711. EFFECT OF ROLLING TEMPERATURE ON NOTCH STRENGTH AT ROOM TEMPERATURE AND -423 F OF 65 PERCENT REDUCED SHEET (24)



Type 301
Type 302

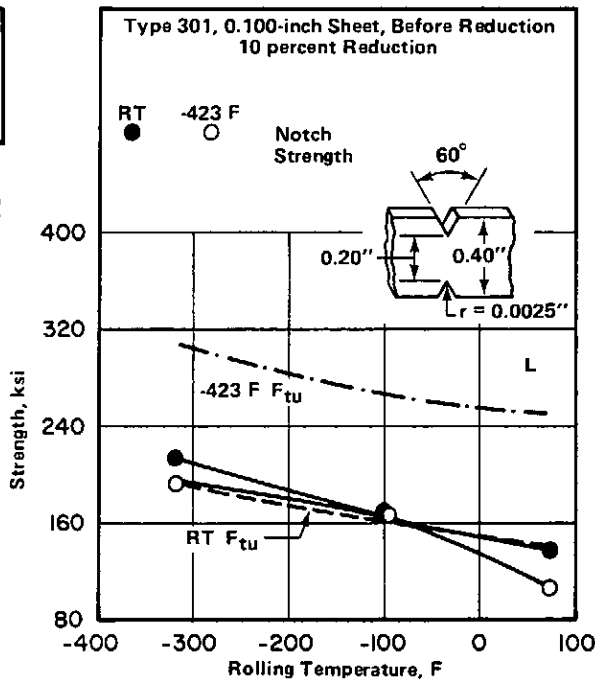


FIGURE 3.037112. EFFECT OF LOW ROLLING TEMPERATURE ON NOTCH STRENGTH AT ROOM TEMPERATURE AND -423 F OF 10 PERCENT REDUCED SHEET (24)

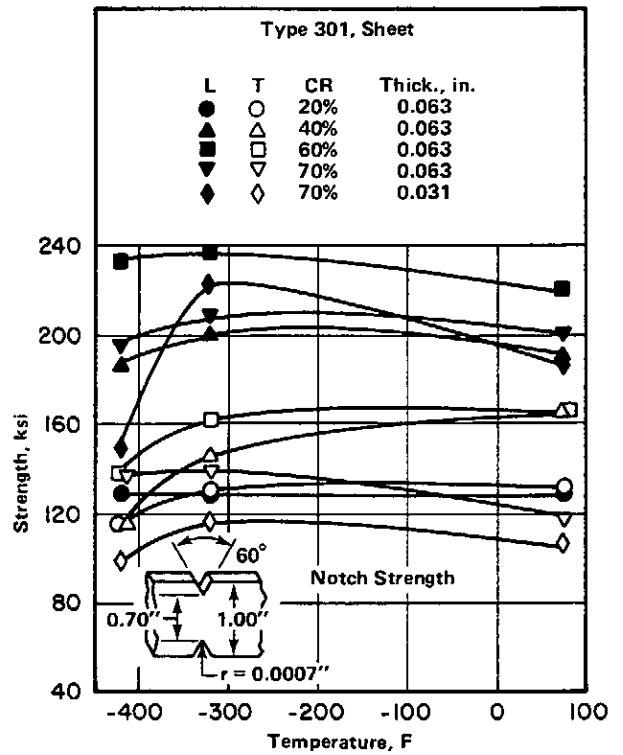


FIGURE 3.037113. EFFECT OF LOW TEMPERATURE AND PERCENT COLD REDUCTION ON NOTCH STRENGTH OF SHEET (34)

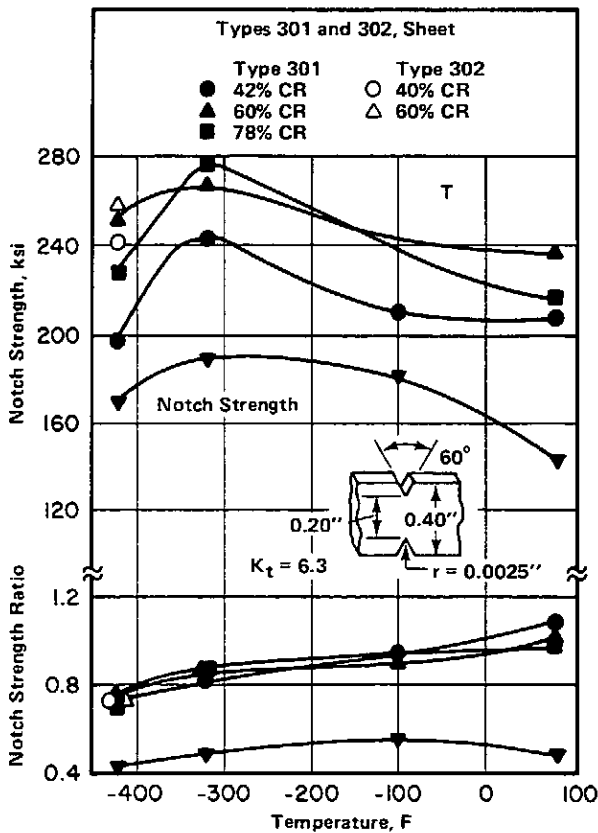


FIGURE 3.037114. EFFECT OF LOW TEMPERATURE AND PERCENT COLD REDUCTION ON NOTCH STRENGTH OF VARIOUS PERCENT REDUCED SHEET (25)

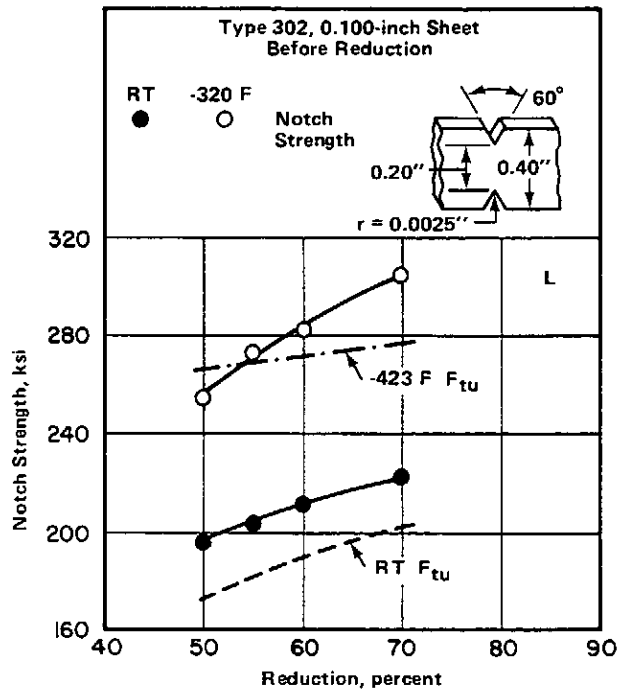


FIGURE 3.037115. EFFECT OF PERCENT COLD REDUCTION ON NOTCH STRENGTH OF SHEET TESTED AT ROOM TEMPERATURE AND -320 F (24)

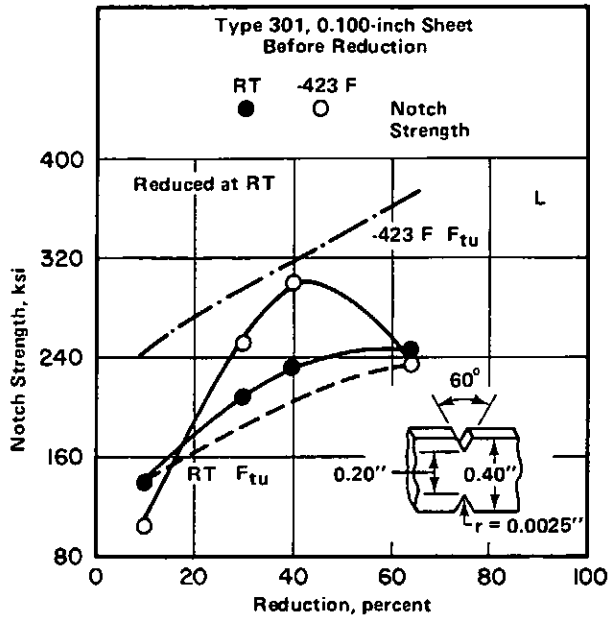
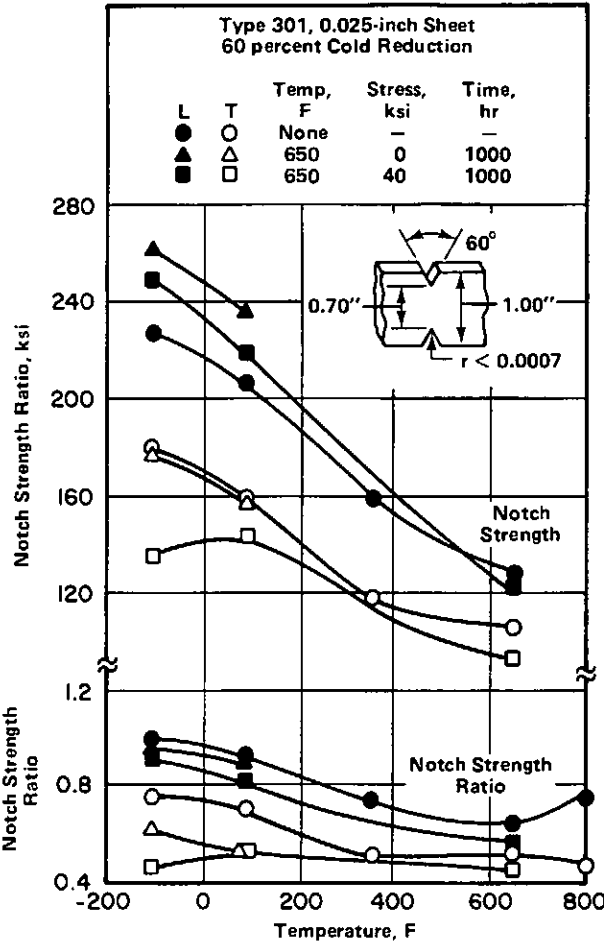


FIGURE 3.037116. EFFECT OF PERCENT COLD REDUCTION ON NOTCH STRENGTH OF SHEET TESTED AT ROOM TEMPERATURE AND -423 F (24)



Fe
18 Cr
8 Ni

Type 301
Type 302

FIGURE 3.037121. EFFECT OF TEST TEMPERATURE AND PRIOR EXPOSURE ON NOTCH PROPERTIES OF 60 PERCENT COLD-REDUCED SHEET (45)

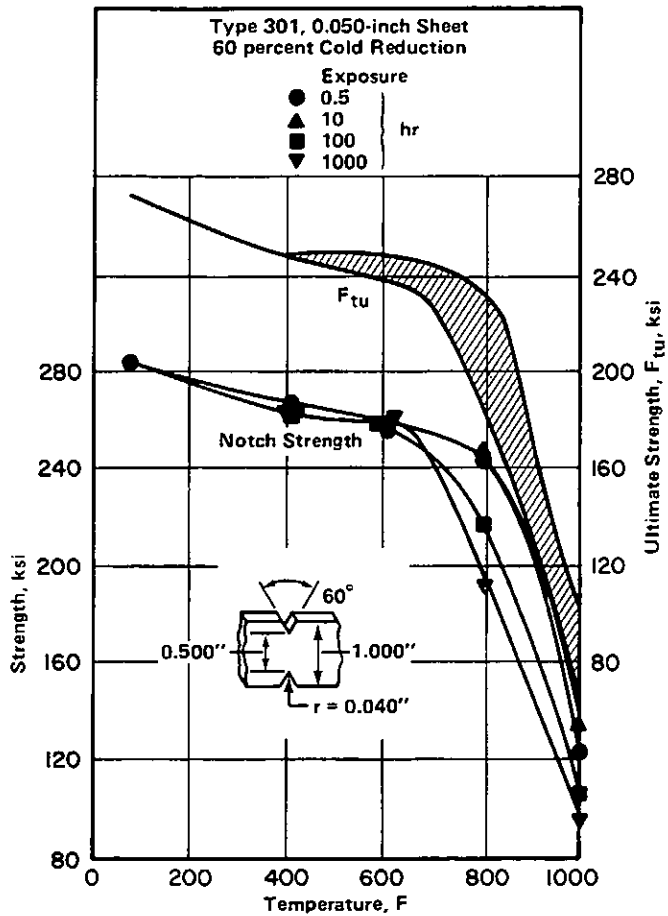


FIGURE 3.037122. EFFECT OF TEST TEMPERATURE AND EXPOSURE TIME ON NOTCH STRENGTH OF 60 PERCENT COLD-REDUCED SHEET (38)

Fe
18 Cr
8 Ni

Type 301
Type 302

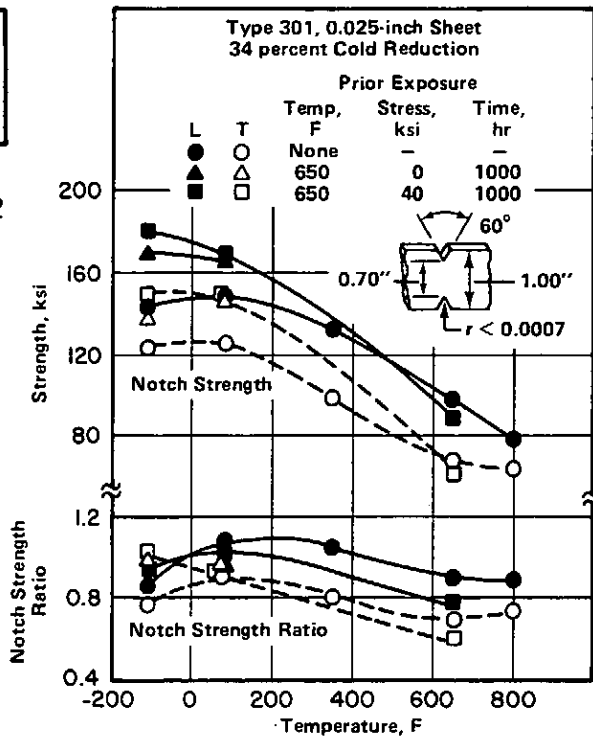


FIGURE 3.037123. EFFECT OF TEST TEMPERATURE AND PRIOR EXPOSURE ON NOTCH PROPERTIES OF 34 PERCENT COLD-REDUCED SHEET (45)

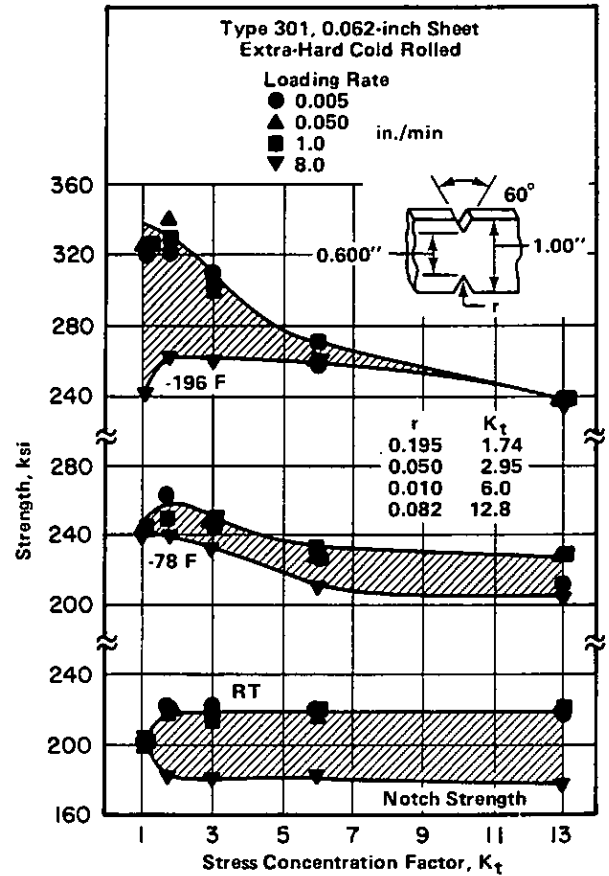


FIGURE 3.037124. EFFECT OF STRESS CONCENTRATION FACTOR, TEMPERATURE, AND LOADING RATE ON NOTCH STRENGTH OF EXTRA-HARD COLD-ROLLED SHEET (44)

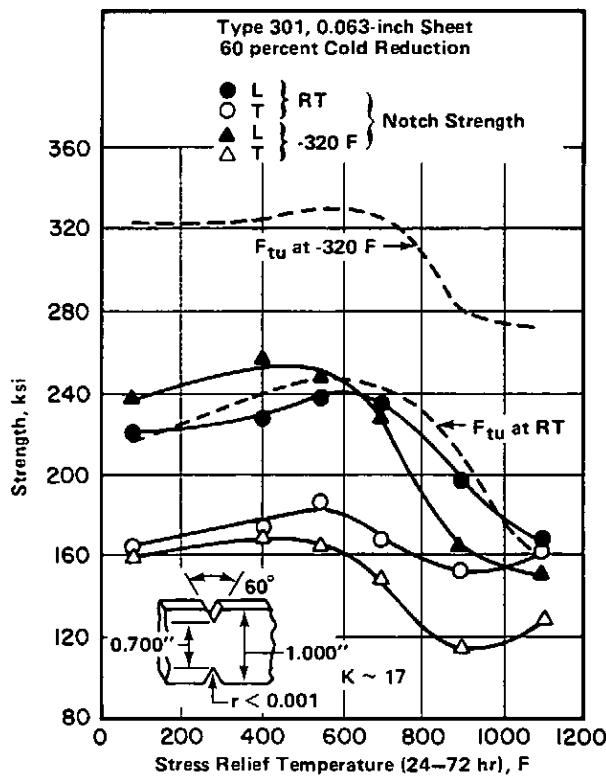


FIGURE 3.037131. EFFECT OF STRESS RELIEF AND LOW TEST TEMPERATURE ON NOTCH STRENGTH OF TYPE 301 SHEET (18)

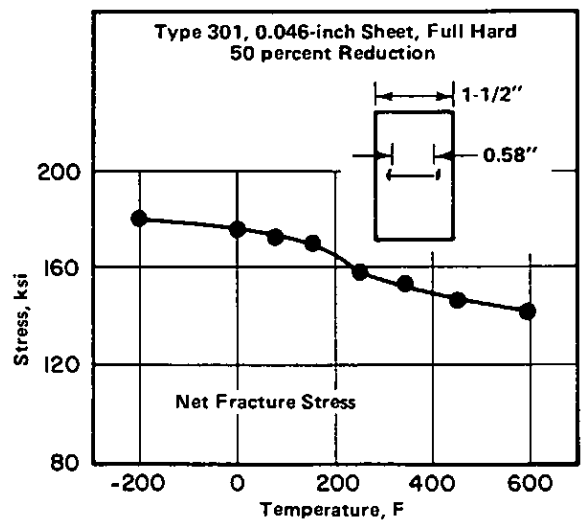


FIGURE 3.037141. EFFECT OF TEST TEMPERATURE ON NET FRACTURE STRESS OF FULL-HARD SHEET (30)

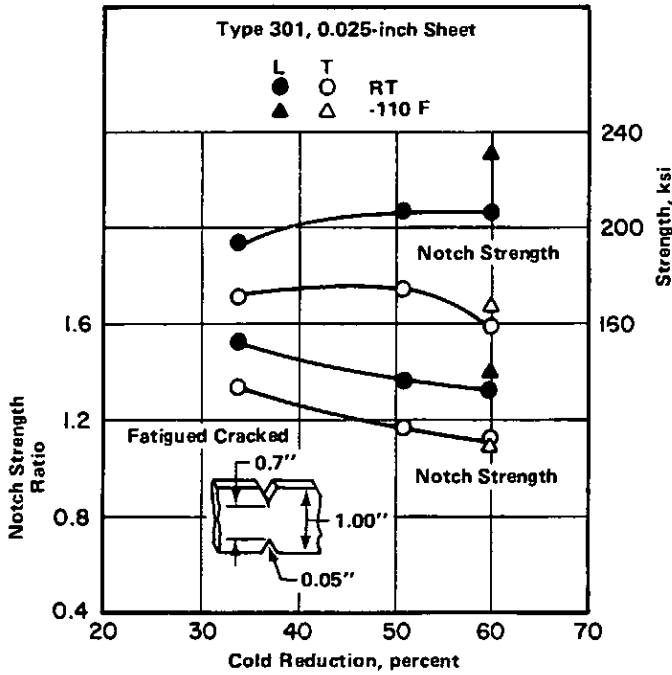
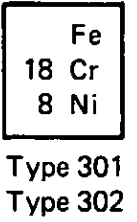


FIGURE 3.037142. EFFECT OF PERCENT COLD REDUCTION ON EDGE-CRACKED PROPERTIES OF SHEET AT ROOM TEMPERATURE AND -110 F (45)

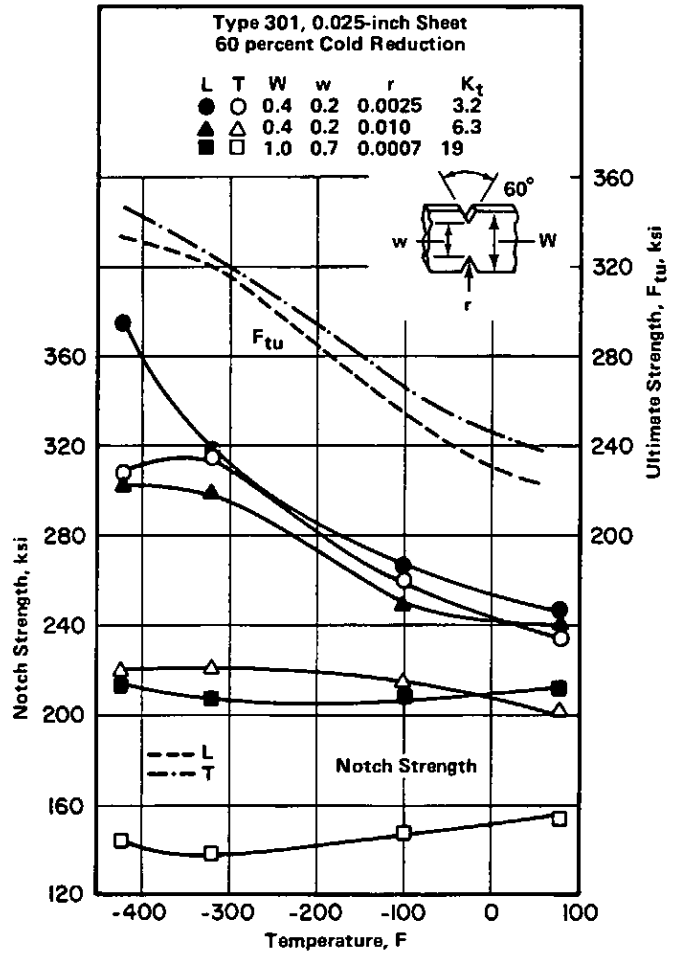


FIGURE 3.037151. EFFECT OF LOW TEST TEMPERATURE ON NOTCH STRENGTH OF 60 PERCENT COLD-REDUCED SHEET (36)

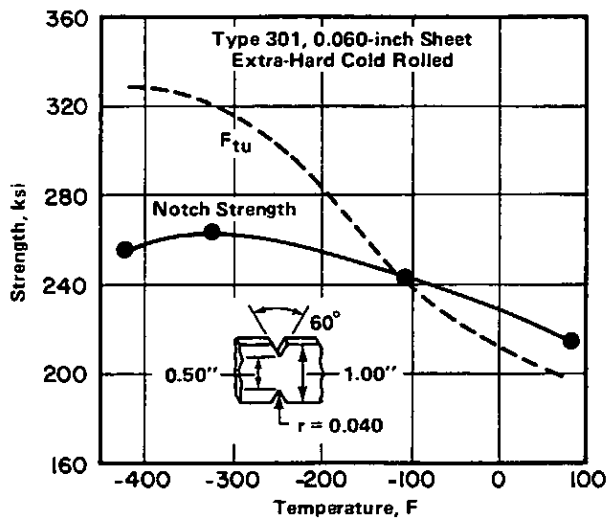


FIGURE 3.037152. EFFECT OF LOW TEMPERATURE ON NOTCH STRENGTH OF EXTRA-HARD COLD-ROLLED SHEET (32)

Fe
18 Cr
8 Ni

Type 301
Type 302

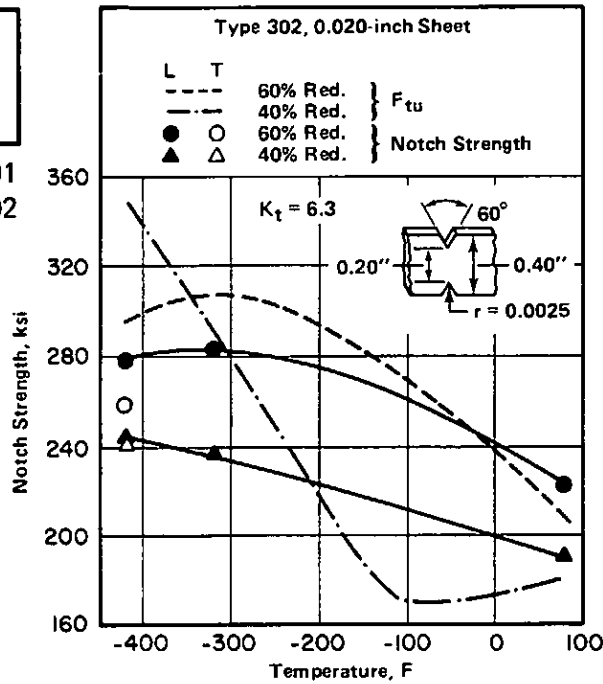


FIGURE 3.037153. EFFECT OF LOW TEST TEMPERATURE ON NOTCH STRENGTH OF 40 AND 60 PERCENT REDUCED TYPE 302 SHEET (31)

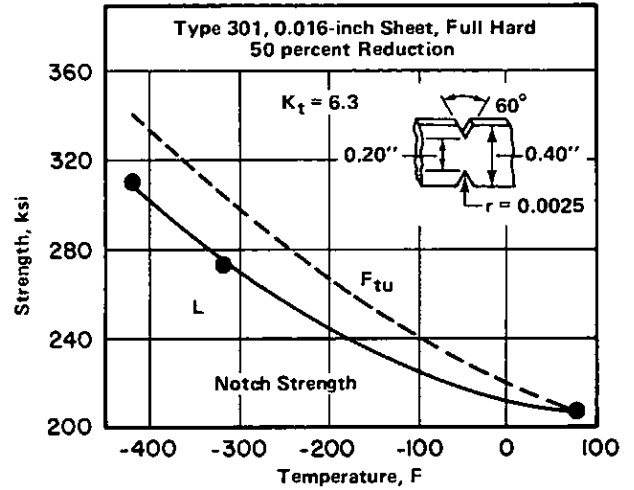


FIGURE 3.037154. EFFECT OF LOW TEST TEMPERATURE ON NOTCH STRENGTH OF 50 PERCENT REDUCED SHEET (31)

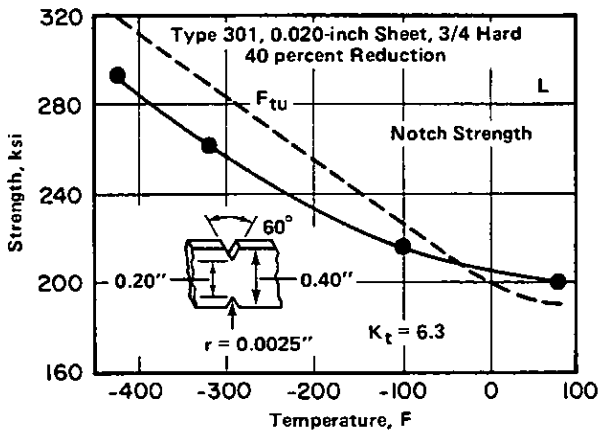


FIGURE 3.037155. EFFECT OF LOW TEST TEMPERATURE ON NOTCH STRENGTH OF 40 PERCENT REDUCED SHEET (31)

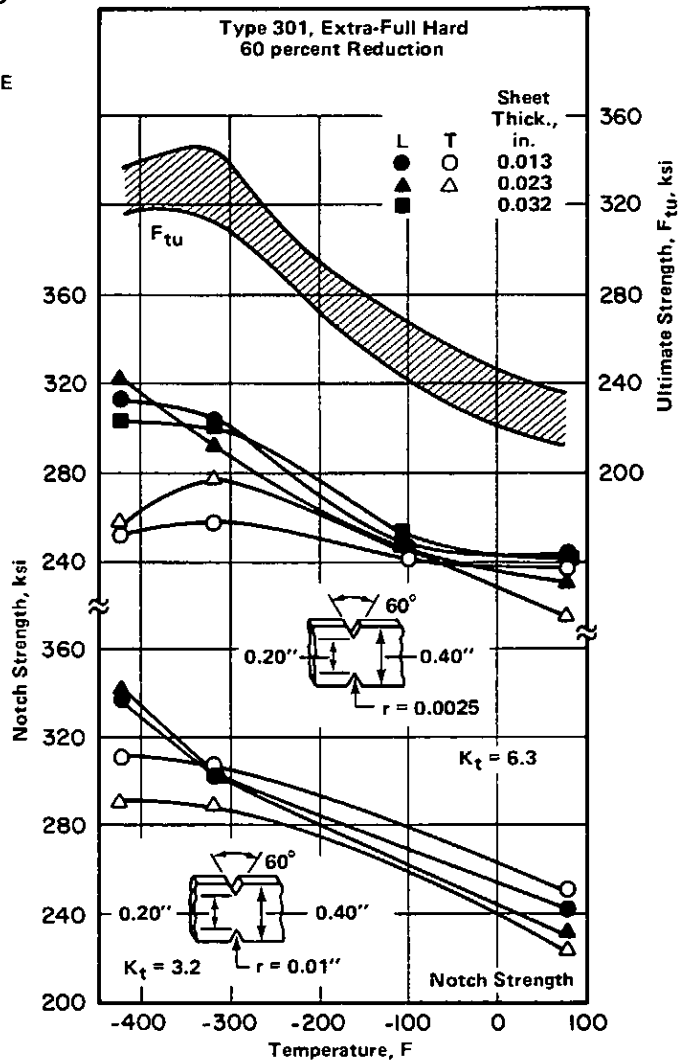


FIGURE 3.037156. EFFECT OF LOW TEST TEMPERATURE AND THICKNESS OF NOTCH STRENGTH OF 60 PERCENT REDUCED SHEET (31)

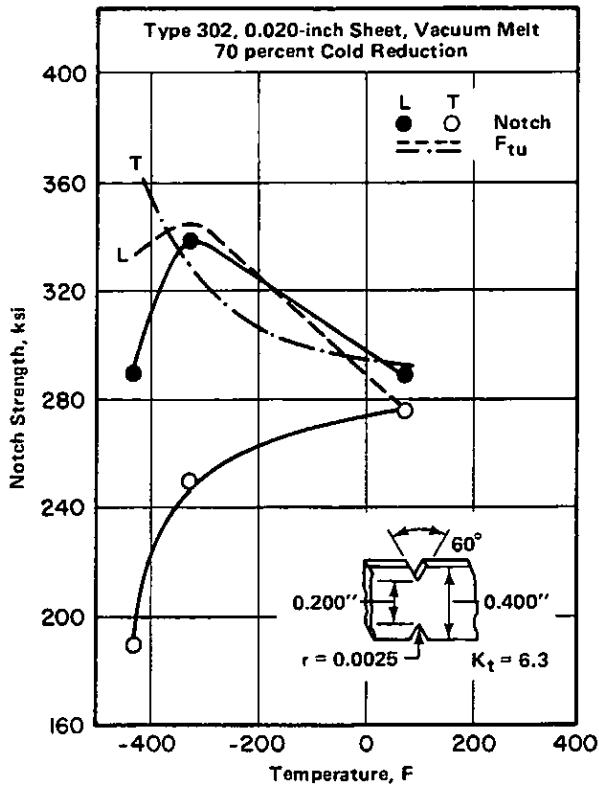


FIGURE 3.037157. EFFECT OF LOW TEST TEMPERATURE ON NOTCH STRENGTH OF 70 PERCENT REDUCED VACUUM-MELT SHEET (23)

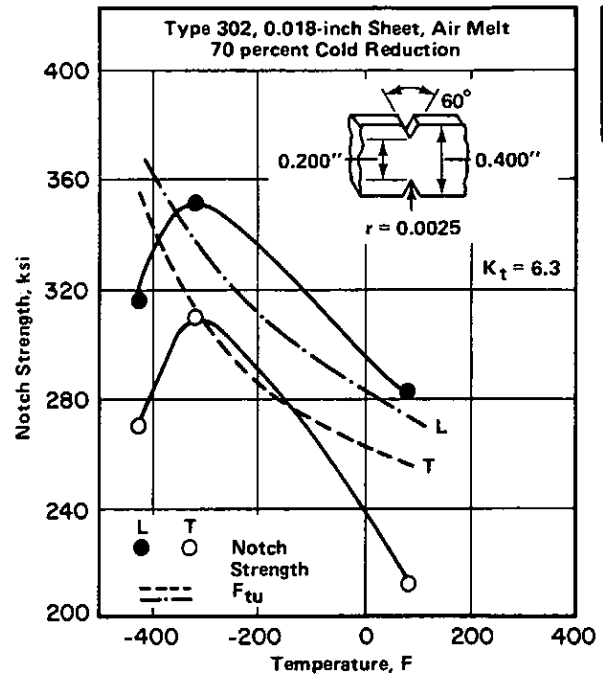


FIGURE 3.037158. EFFECT OF LOW TEST TEMPERATURE ON NOTCH STRENGTH OF 70 PERCENT REDUCED AIR-MELT SHEET (23)

Fe
 18 Cr
 8 Ni
 Type 301
 Type 302

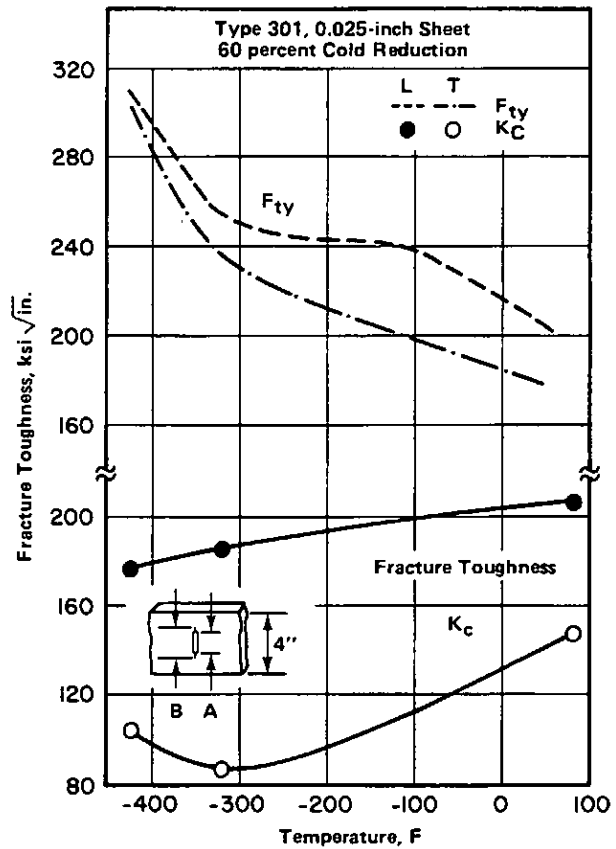


FIGURE 3.03721. EFFECT OF LOW TEST TEMPERATURE ON FRACTURE TOUGHNESS OF 60 PERCENT COLD-REDUCED SHEET (37)

A. Notch length 1.22 ± 0.03 .
 B. Critical crack length 1.19 to 2.02.
 Critical crack length telescopically measured.

Fe
18 Cr
8 Ni
Type 301
Type 302

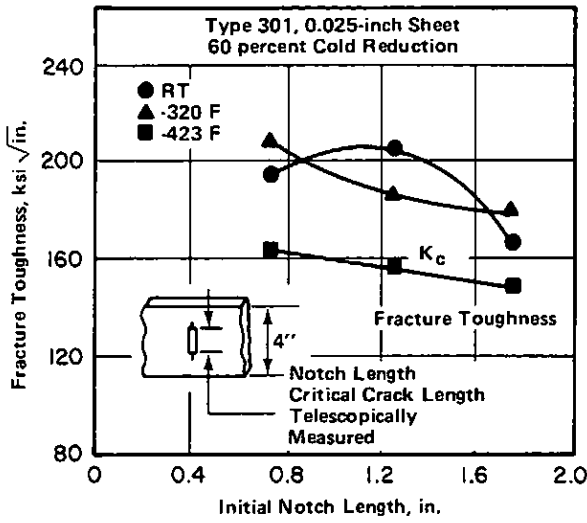


FIGURE 3.03722. EFFECT OF INITIAL NOTCH LENGTH ON FRACTURE TOUGHNESS OF 60 PERCENT COLD-REDUCED SHEET AT ROOM TEMPERATURE, -320, AND -423 F (37)

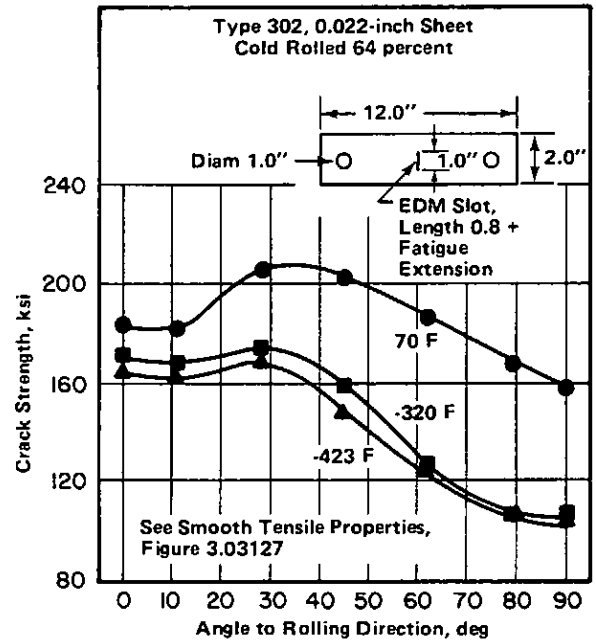


FIGURE 3.03724. EFFECTS OF CENTER CRACK AND TEST DIRECTION ON TENSILE STRENGTH OF COLD-ROLLED SHEET AT ROOM AND CRYOGENIC TEMPERATURES (79)

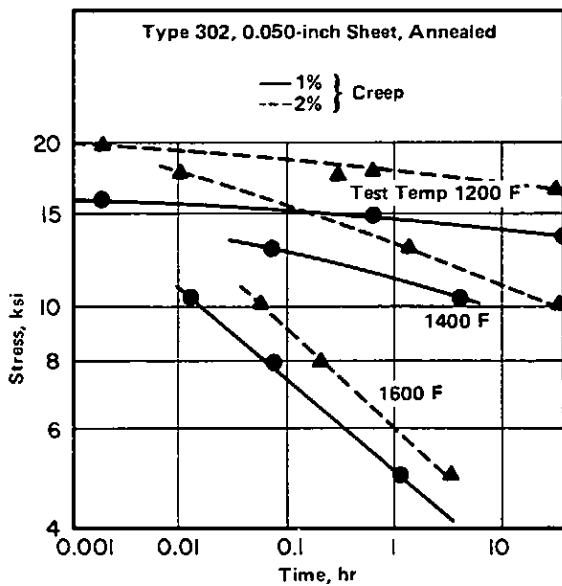


FIGURE 3.041. CREEP CURVES FOR TYPE 302 ANNEALED SHEET AT 1200 TO 1600 F (16)

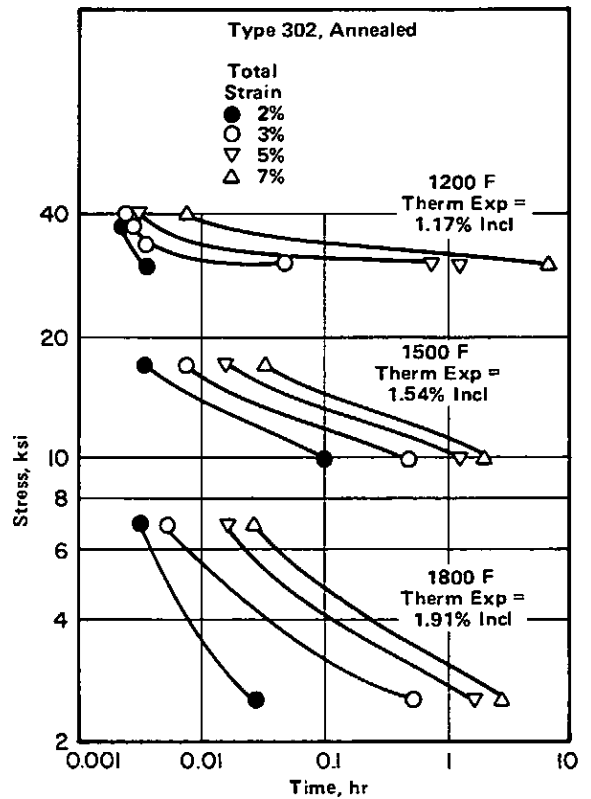


FIGURE 3.042. SHORT-TIME TOTAL STRAIN CURVES FOR ANNEALED TYPE 302 AT 1200 TO 1800 F (12)

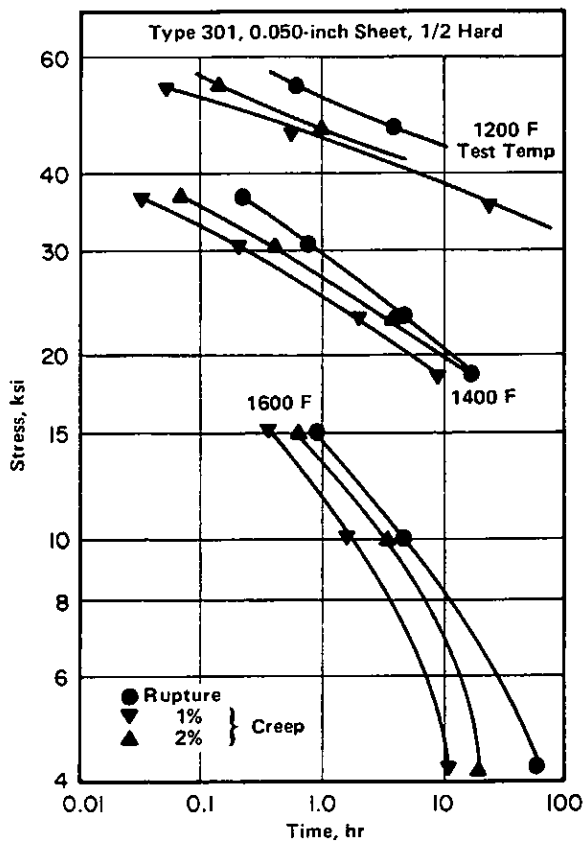


FIGURE 3.043. CREEP AND CREEP-RUPTURE CURVES FOR TYPE 301 1/2-HARD SHEET AT 1200 TO 1500 F (16)

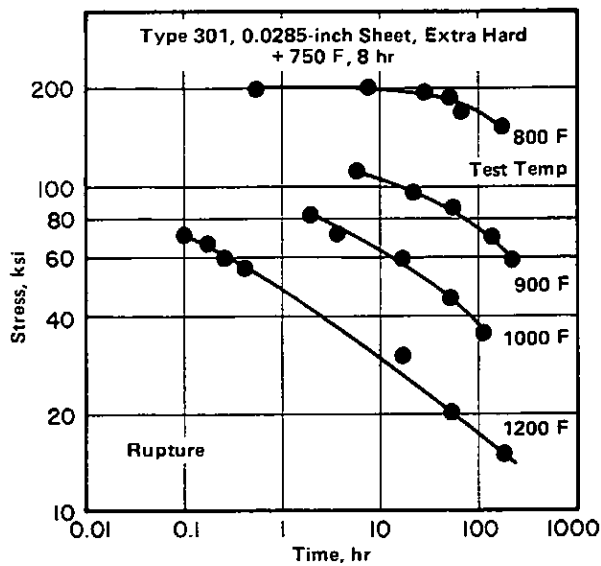


FIGURE 3.045. CREEP-RUPTURE CURVES FOR TYPE 301 EXTRA-HARD AND STRESS-RELIEVED SHEET AT 800 TO 1200 F (11)

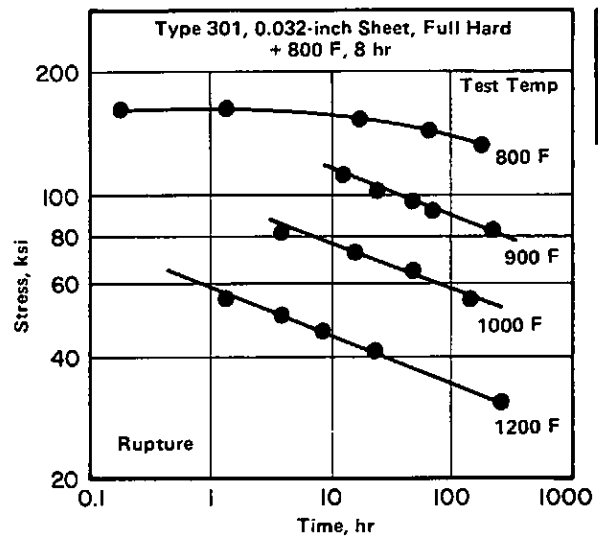


FIGURE 3.044. CREEP-RUPTURE CURVES FOR TYPE 301 FULL-HARD AND STRESS-RELIEVED SHEET AT 800 TO 1200 F (11)

Fe
18 Cr
8 Ni
Type 301
Type 302

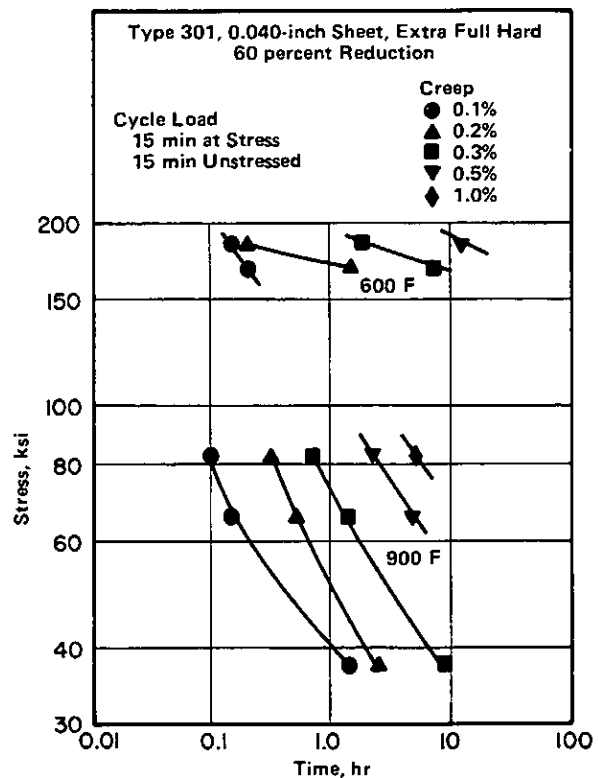


FIGURE 3.046. CREEP CURVES FOR TYPE 301 60 PERCENT REDUCED SHEET UNDER CYCLIC LOAD AT 600 AND 900 F (27)

Fe
18 Cr
8 Ni

Type 301
Type 302

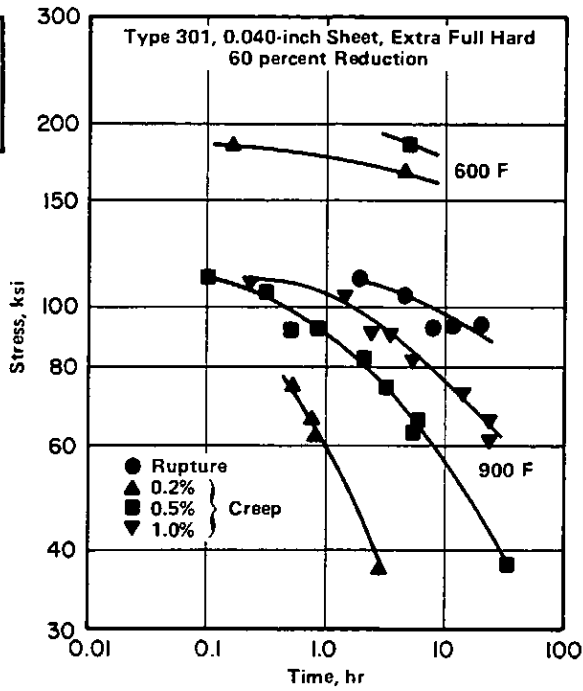


FIGURE 3.047. CREEP AND CREEP-RUPTURE CURVES FOR TYPE 301 60 PERCENT REDUCED SHEET AT 600 AND 900 F (26)

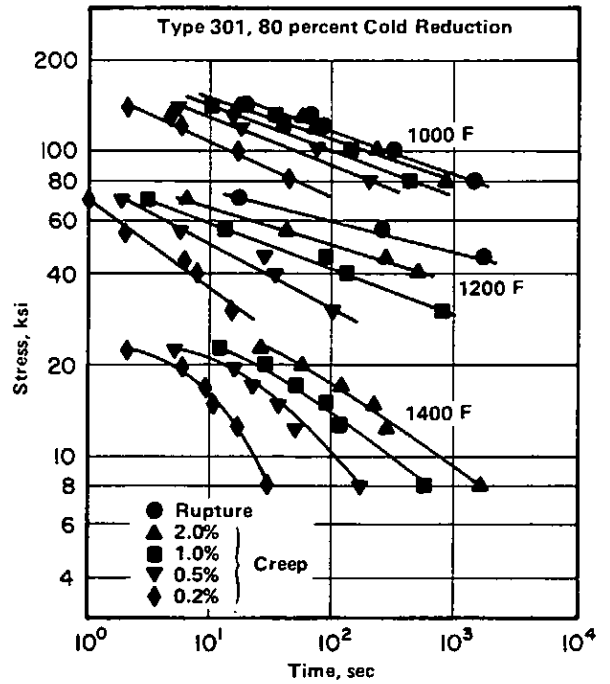


FIGURE 3.048. CREEP AND CREEP-RUPTURE CURVES FOR 80 PERCENT COLD-REDUCED SHEET AT 1000, 1200, AND 1400 F (47)

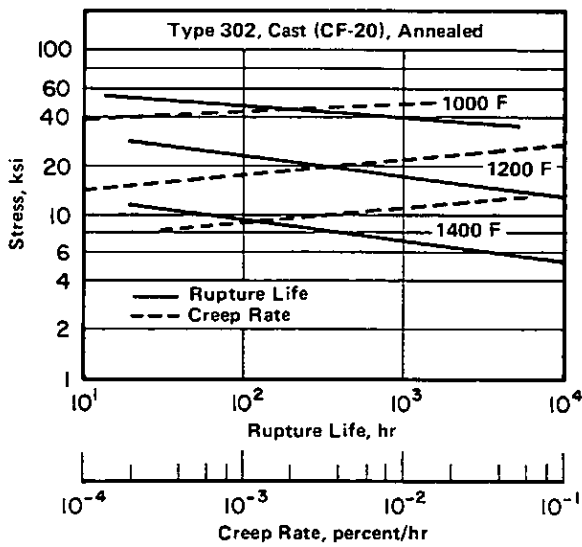


FIGURE 3.049. CREEP-RUPTURE PROPERTIES OF CAST TYPE 302 (62)

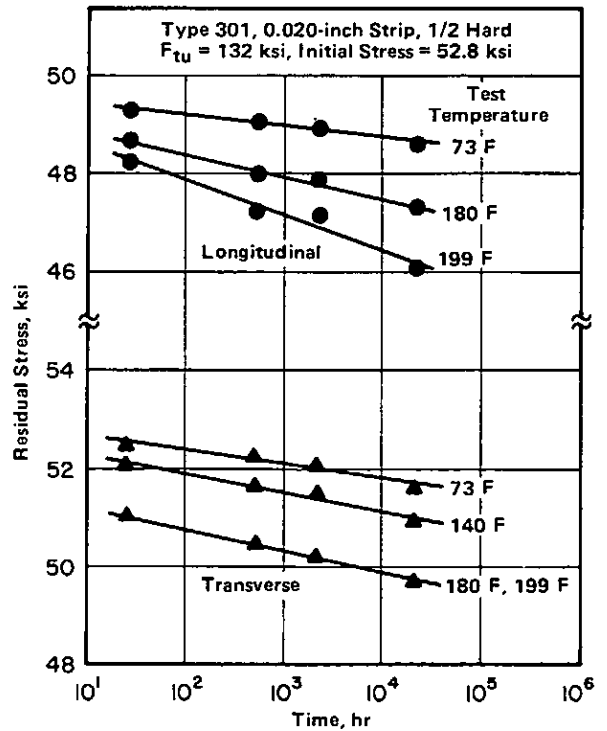


FIGURE 3.0410. STRESS RELAXATION AT ROOM AND SLIGHTLY ELEVATED TEMPERATURES (84)

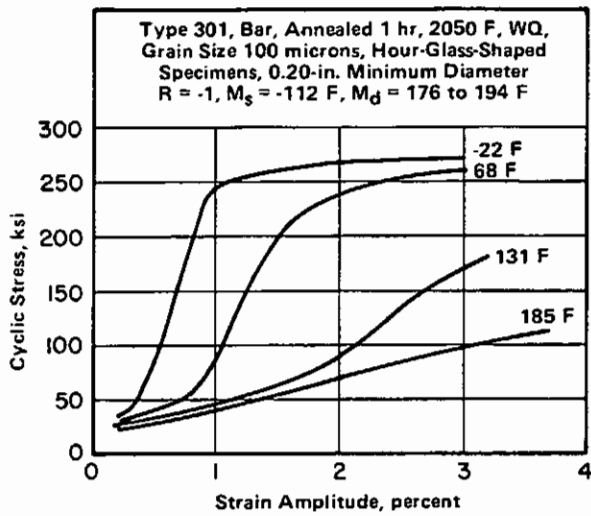


FIGURE 3.051. CYCLIC STRESS-STRAIN CURVES FOR ANNEALED TYPE 301 AT TEMPERATURES BETWEEN M_s AND M_d (58)

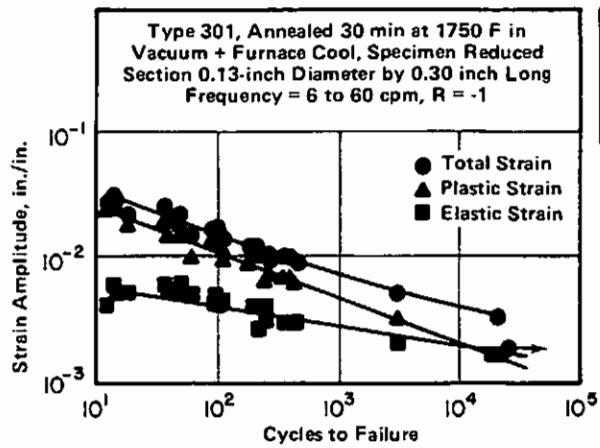


FIGURE 3.052. STRAIN-CONTROLLED FATIGUE BEHAVIOR OF ANNEALED ROD AT ROOM TEMPERATURE (85)

Fe
 18 Cr
 8 Ni
 Type 301
 Type 302

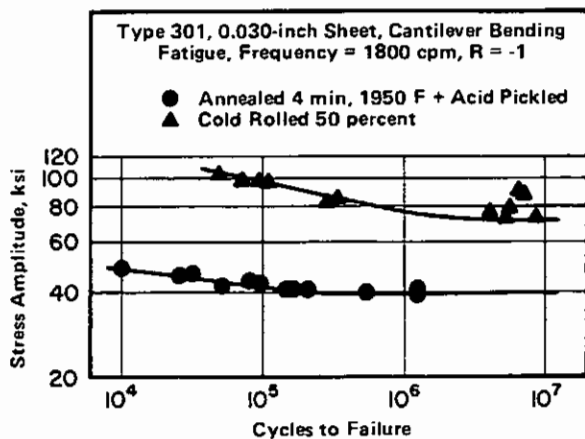


FIGURE 3.053. BENDING FATIGUE BEHAVIOR OF COLD-WORKED AND OF ANNEALED SHEET AT ROOM TEMPERATURE (86)

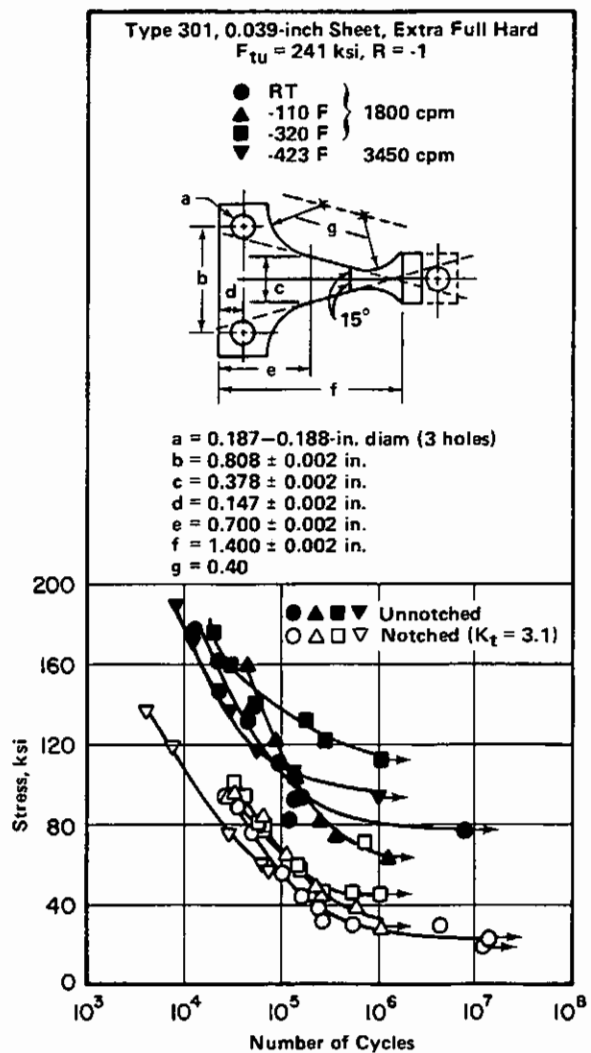


FIGURE 3.054. S-N CURVES IN FLEXURE FOR EXTRA-FULL-HARD SHEET AT LOW TEMPERATURES (39,42)

Fe
18 Cr
8 Ni

Type 301
Type 302

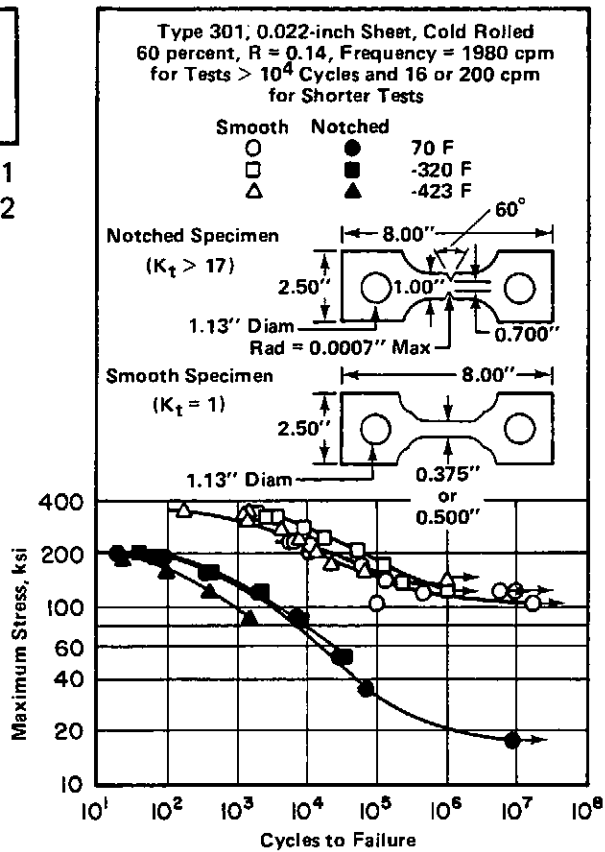


FIGURE 3.055. AXIAL TENSION FATIGUE BEHAVIOR OF SMOOTH AND NOTCHED SHEET AT ROOM AND CRYOGENIC TEMPERATURES (87)

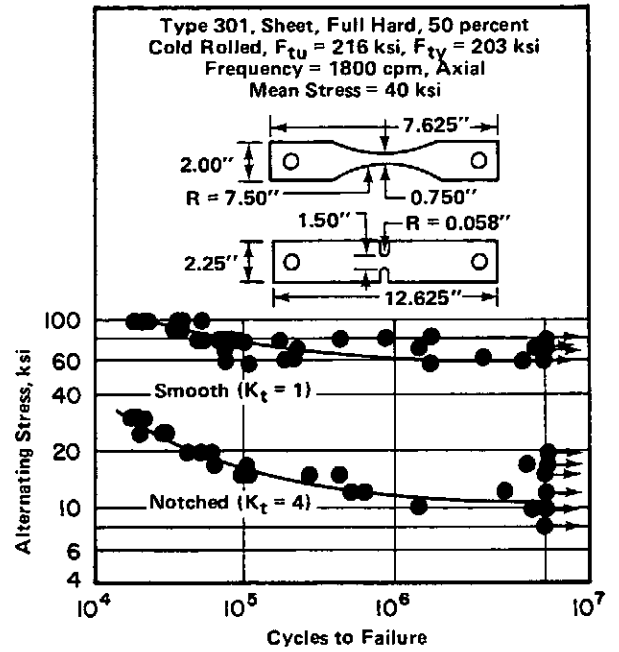


FIGURE 3.057. EFFECTS OF NOTCHES ON FATIGUE BEHAVIOR OF SHEET (89)

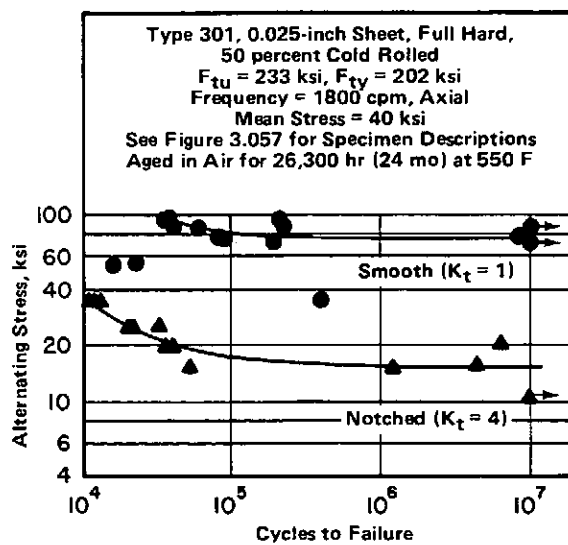


FIGURE 3.058. FATIGUE BEHAVIOR OF SMOOTH AND NOTCHED SHEET AT ROOM TEMPERATURE AFTER AGING FOR 26,300 HOURS AT 550 F (88)

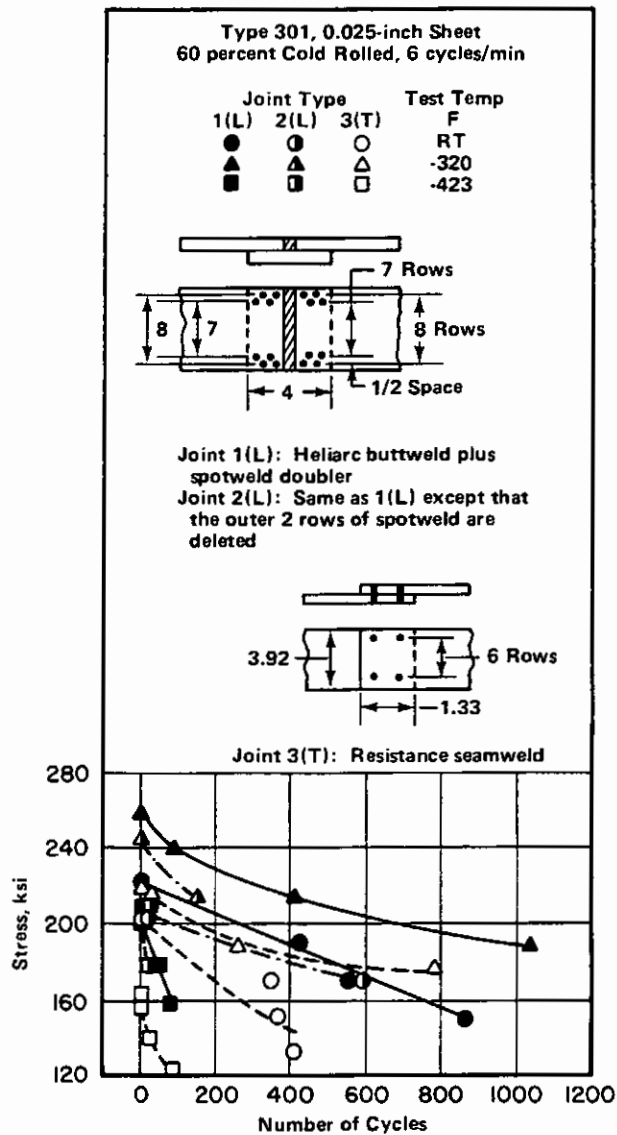


FIGURE 3.059. LOW-CYCLE S-N CURVES FOR COMPLEX WELDED JOINTS OF 60 PERCENT COLD-ROLLED SHEET (36)

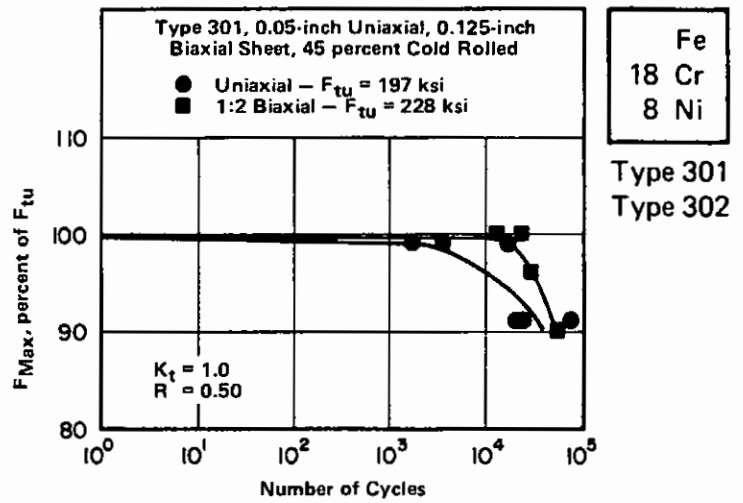


FIGURE 3.0510. S-N CURVES FOR UNIAXIAL AND BIAxIAL SHEET FOR R = 0.50 (46)

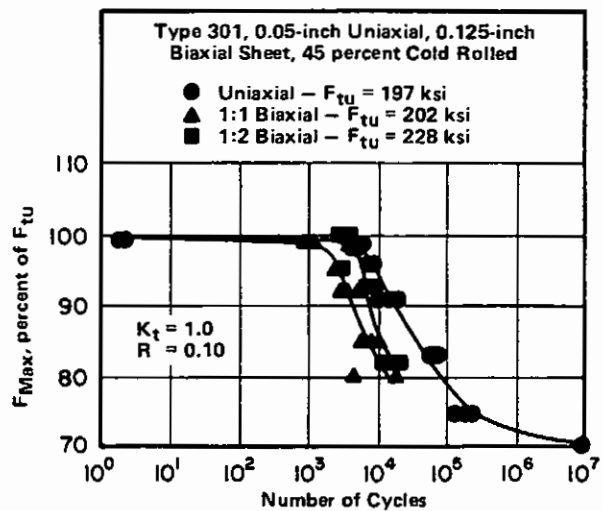


FIGURE 3.0511. S-N CURVES FOR UNIAXIAL AND BIAxIAL SHEET FOR R = 0.10 (46)

Fe
 18 Cr
 8 Ni

Type 301
Type 302

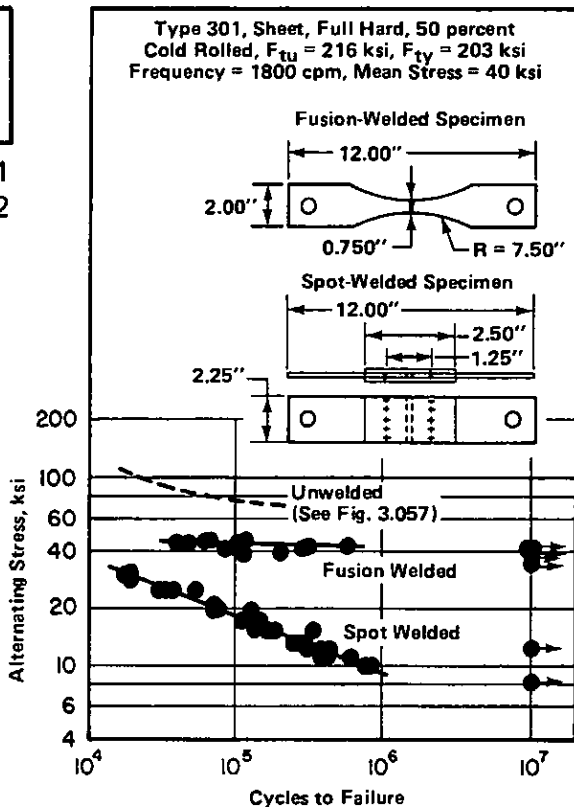


FIGURE 3.0512. EFFECTS OF FUSION AND SPOT WELDING ON FATIGUE BEHAVIOR OF SHEET (89)

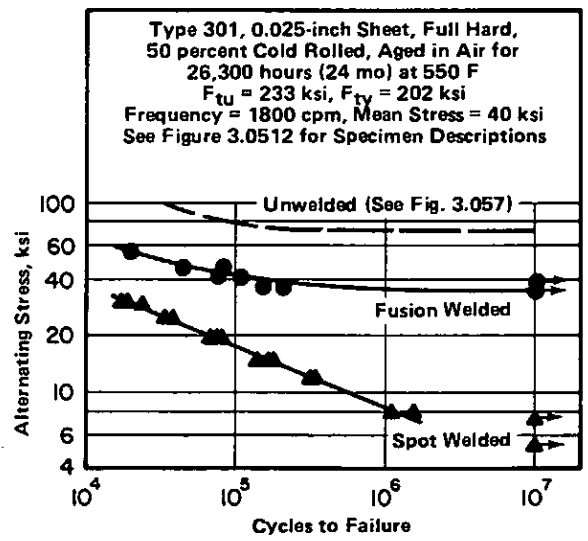


FIGURE 3.0513. FATIGUE BEHAVIOR OF WELDED SHEET AT ROOM TEMPERATURE AFTER AGING FOR 26,300 HOURS AT 550 F (88)

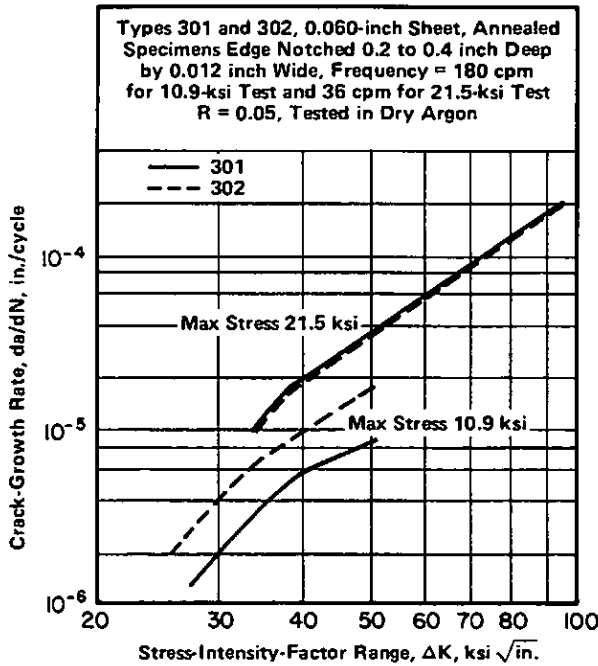


FIGURE 3.0515. FATIGUE CRACK-GROWTH BEHAVIOR AT ROOM TEMPERATURE FOR TYPES 301 AND 302 ANNEALED SHEET TESTED AT TWO DIFFERENT STRESS LEVELS (59)

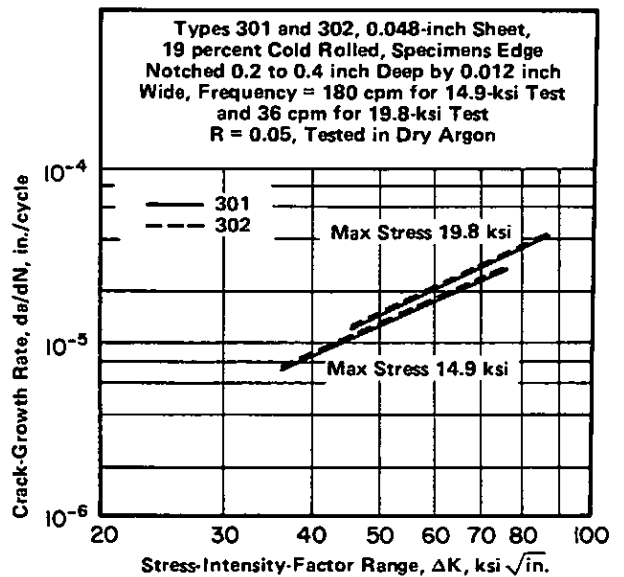


FIGURE 3.0516. FATIGUE CRACK-GROWTH BEHAVIOR AT ROOM TEMPERATURE FOR TYPES 301 AND 302 COLD-ROLLED SHEET TESTED AT TWO DIFFERENT STRESS LEVELS (59)

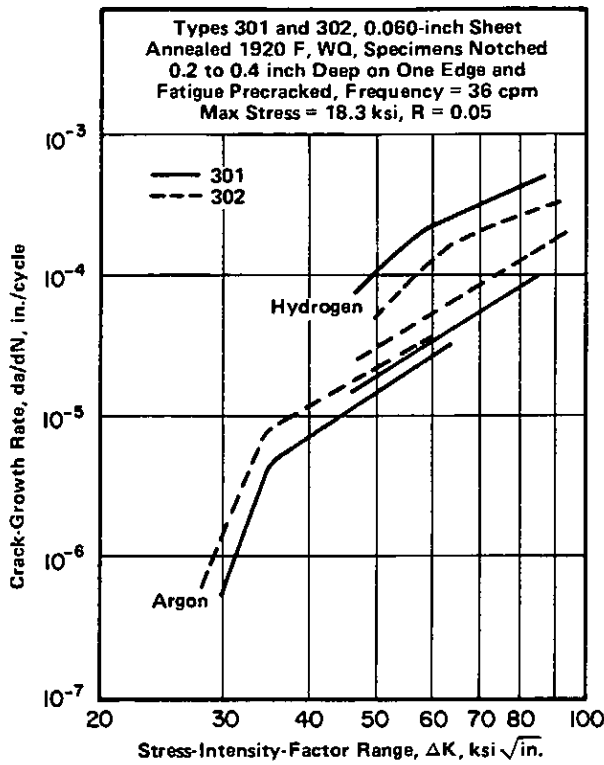


FIGURE 3.0518. FATIGUE CRACK-GROWTH BEHAVIOR AT ROOM TEMPERATURE FOR TYPES 301 AND 302 ANNEALED SHEET TESTED IN DRY HYDROGEN, DRY ARGON, AND AIR (90)

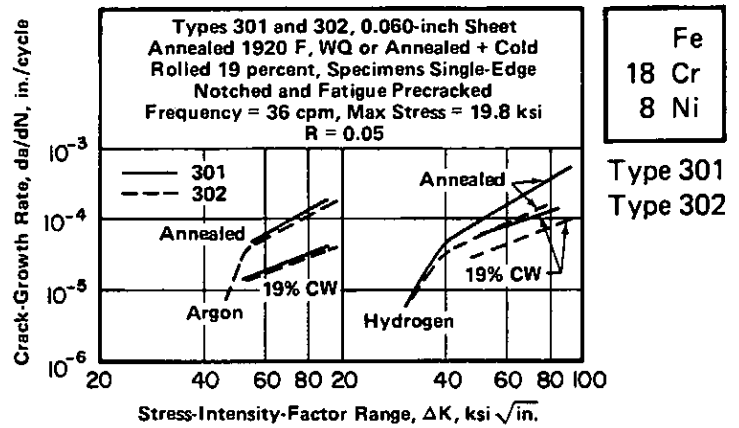


FIGURE 3.0519. FATIGUE CRACK-GROWTH BEHAVIOR AT ROOM TEMPERATURE FOR ANNEALED AND COLD-WORKED SHEET TESTED IN ARGON AND HYDROGEN (90)

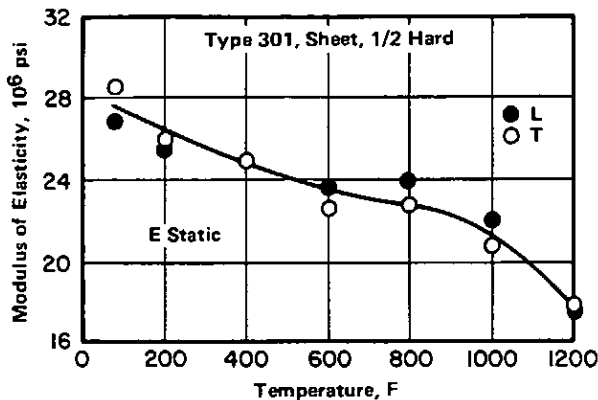


FIGURE 3.0621. MODULUS OF ELASTICITY FOR TYPE 301 1/2-HARD SHEET AT ROOM AND ELEVATED TEMPERATURES (11)

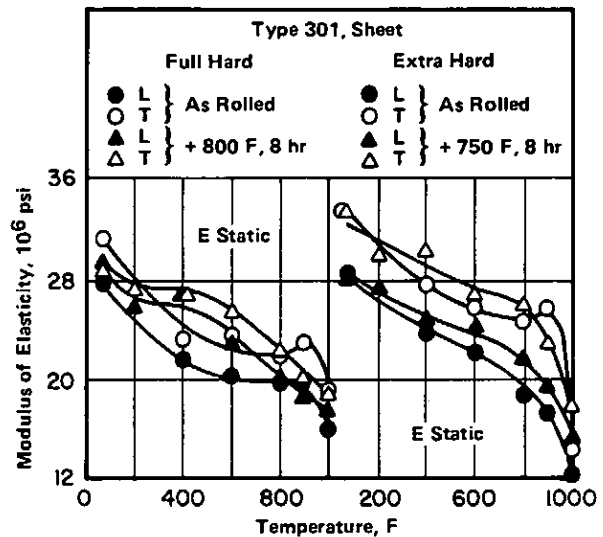


FIGURE 3.0622. MODULUS OF ELASTICITY IN TENSION FOR TYPE 301 FULL-HARD AND EXTRA-HARD SHEET (11)

Fe
18 Cr
8 Ni

Type 301
Type 302

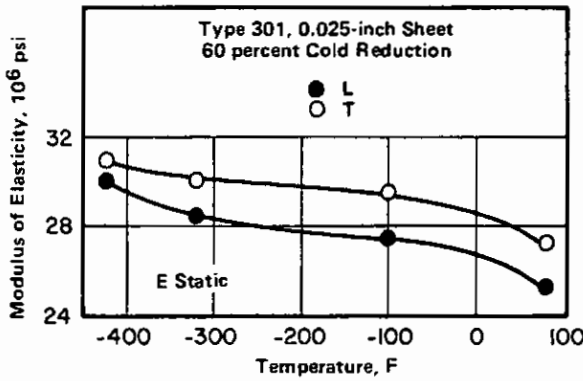


FIGURE 3.0623. EFFECT OF LOW TEST TEMPERATURE ON MODULUS OF ELASTICITY FOR 60 PERCENT REDUCED SHEET (36)

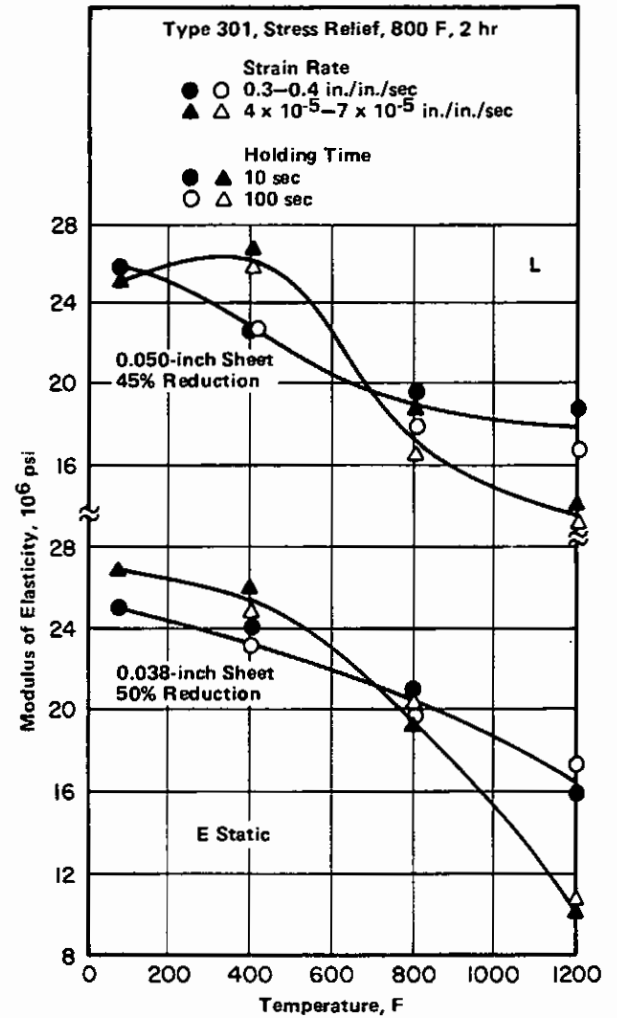


FIGURE 3.0624. EFFECT OF TEST TEMPERATURE, STRAIN RATE, AND HOLDING TIME ON MODULUS OF ELASTICITY IN TENSION OF 45 AND 60 PERCENT REDUCED SHEET (28)

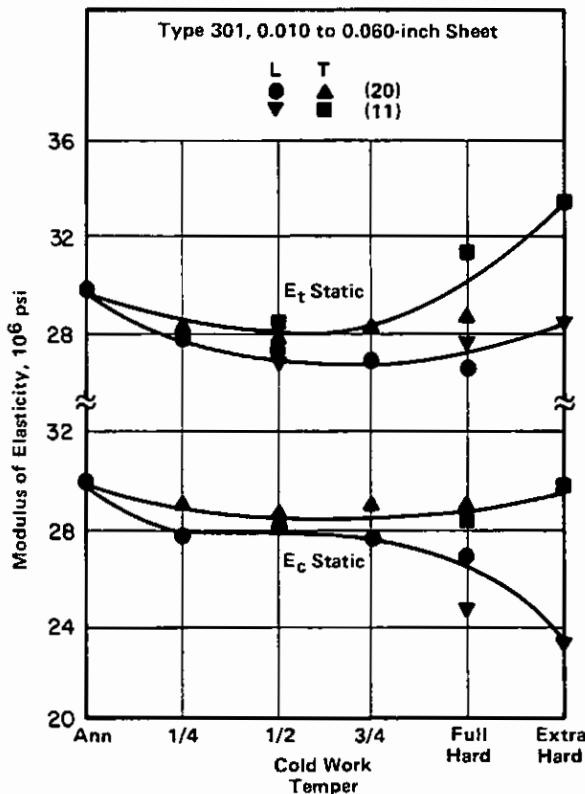


FIGURE 3.0625. EFFECT OF TEMPER ON STATIC MODULUS OF ELASTICITY IN TENSION AND COMPRESSION FOR TYPE 301 SHEET (11,20)

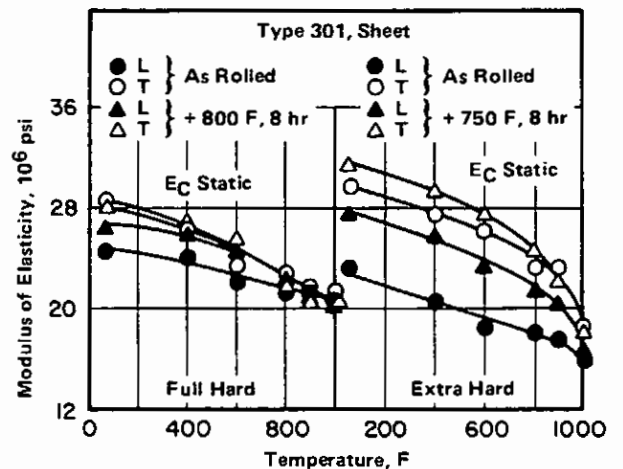


FIGURE 3.0626. MODULUS OF ELASTICITY IN COMPRESSION FOR TYPE 301 FULL-HARD AND EXTRA-HARD SHEET (11)

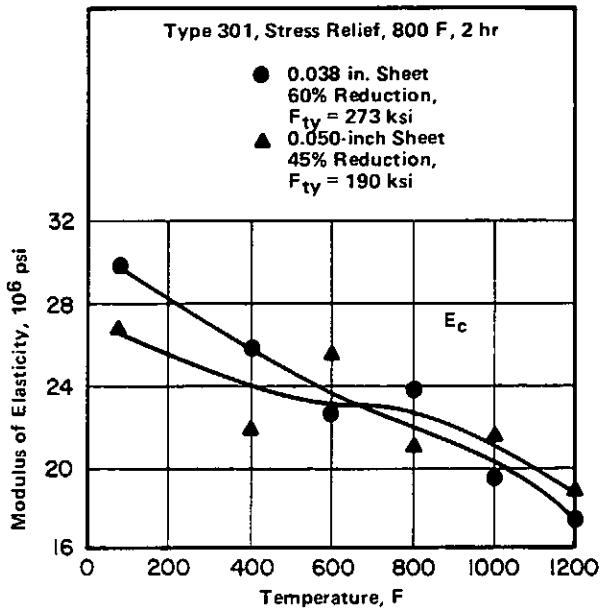


FIGURE 3.0627. EFFECT OF TEST TEMPERATURE ON MODULUS OF ELASTICITY IN COMPRESSION OF 45 AND 60 PERCENT REDUCED SHEET (28)

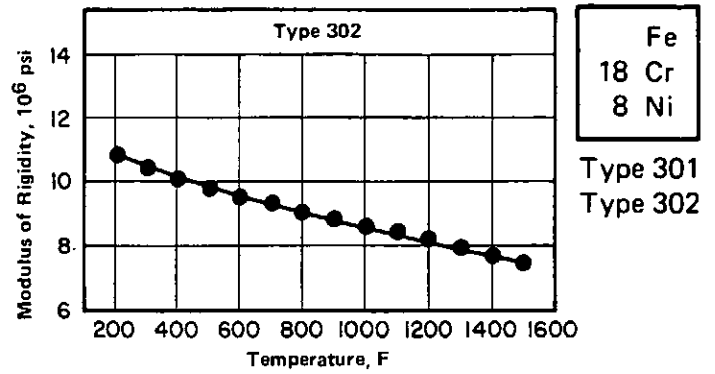


FIGURE 3.0631. MODULUS OF RIGIDITY (62)

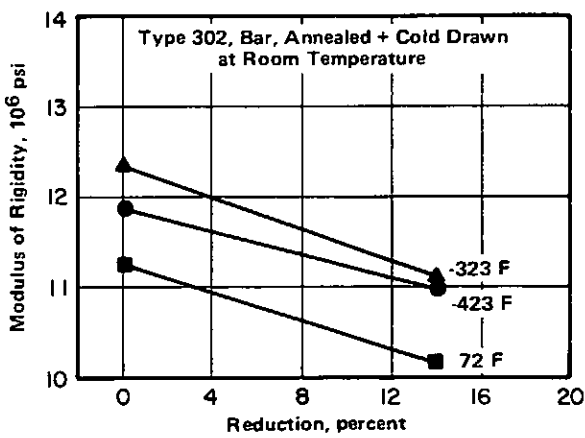


FIGURE 3.0632. EFFECTS OF COLD REDUCTION AND TEMPERATURE ON MODULUS OF RIGIDITY (93)

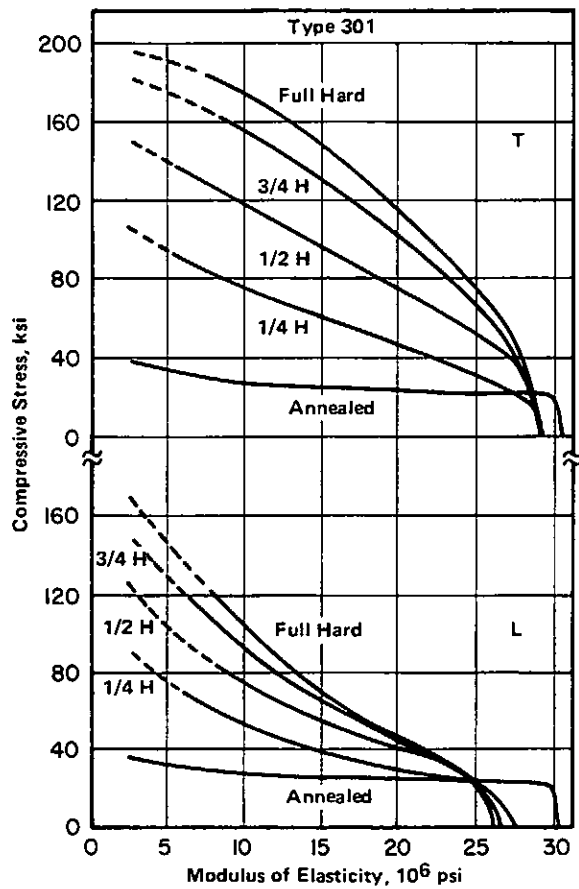
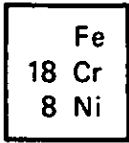


FIGURE 3.0641. COMPRESSIVE TANGENT MODULUS CURVES FOR TYPE 301 SHEET IN VARIOUS CONDITIONS (20)



Type 301
Type 302

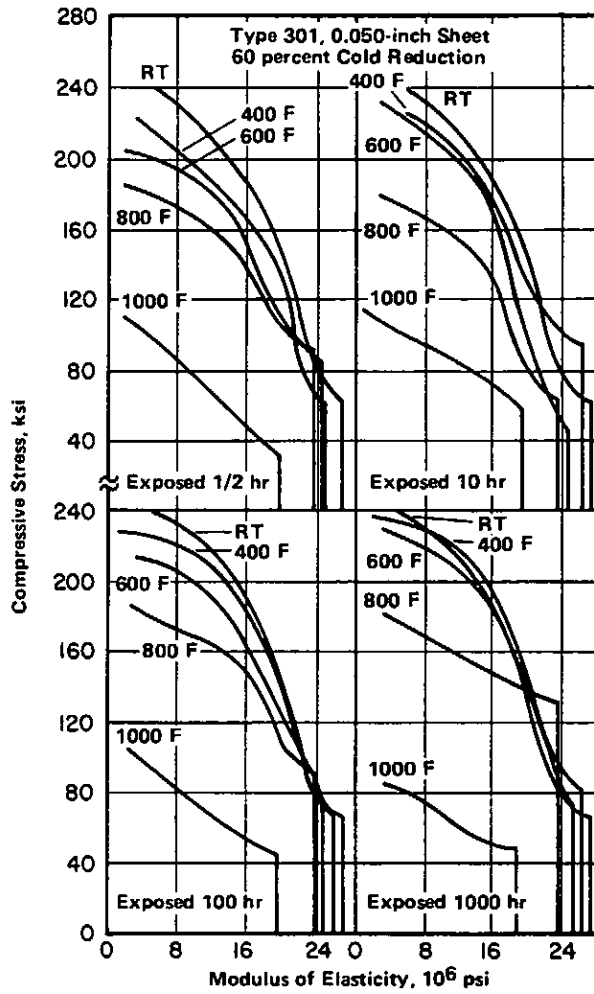


FIGURE 3.0642. COMPRESSIVE TANGENT MODULUS CURVES FOR 60 PERCENT COLD-REDUCED SHEET FOR VARIOUS EXPOSURE TIMES AND TEMPERATURES (38)

Temper	Anneal	1/4 H	1/2 H	3/4 H	Full H
Bend Factor, t	1/2 to 1-1/4	1 to 2-1/4	2-1/2 to 4	3 to 4	4 to 6

TABLE 4.0121. PRACTICAL BEND FACTORS FOR SHEET