Crucible Data Sheet

Issue #5

CRUCIBLE 410 STAINLESS STEEL*

Carbon	**0.15% max.**
Silicon	**1.00% max.**
Sulfur	**0.03% max.**
Manganese	**1.00% max.**
Phosphorus	**0.04% max.**
Chromium	**11.50/13.50**

Crucible 410 is a hardenable chromium steel which is adaptable for general purpose corrosion resisting and heat resisting applications. This grade is magnetic at all times.

Typical Applications:

Machine Parts
Meat Hooks
Oil Refinery Equipment
Pump Shafts and Parts
Sucker Rods
Copper Sheet Rolls

Note: The above are some *typical* applications. Your *specific* application should not be undertaken without independent study and evaluation for suitability.

Forging:

CRUCIBLE 410 should be forged at 2050 to 2150 F and finished not lower than 1400 F. Reheating should be used if necessary. When CRUCIBLE 410 is to be upset, temperatures should be such that the work is finished between 1450 and 1600 F.

Annealing:

CRUCIBLE 410 should be annealed for maximum softness at 1550 F followed by a furnace cool. This grade may be semi-annealed for better machinability by air cooling from 1450 F.

Hardening and Tempering:

CRUCIBLE 410 can be hardened by either air cooling or oil quenching from 1750 to 1850 F. When air hardening is applied, a temperature in the upper part of this range should be used. The tempering should be at the proper temperature to give the desired properties as indicated in Figure 1. It is desirable to avoid tempering between 800 and 1100 F as there is a drop in impact strength within this range, coincidental with which there is a drop in resistance to corrosion. This condition disappears when the tempering temperature is 1100 F or higher.

Note: Temperatures shown throughout this data sheet are metal temperatures.

Attainable Hardness:

The attainable hardness of CRUCIBLE 410 can be varied within the limits of analysis to suit the requirements of particular applications. Attainable hardness is defined as the hardness obtained on quenching a sample approximately ½" in thickness in oil from 1800 F. This hardness gives some idea of the mechanical properties of the material which might be expected after hardening and tempering. The attainable hardness of CRUCIBLE 410 is in general, between 352 and 444 Brinell.

*Data also applicable to Crucible 403. For additional data contact Customer Technical Services at Syracuse, New York.

It is recommended, therefore, when a specific hardness is required after a specified heat treatment, that special attention be given in ordering, so that material of suitable attainable hardness can be supplied.

Welding:

CRUCIBLE 410 should be welded using Type 410 filler weld metal. CRUCIBLE 410 is susceptible to air hardening and cracking unless the material is preheated to a minimum temperature of 300 F prior to welding, and is postheated directly after welding by annealing at 1300 F, furnace cooling at a rate of 50 to 100 degrees per hour to 1100 F followed by an air cool.

Resistance to Scaling:

CRUCIBLE 410 scales at approximately 1250 F. This temperature will vary with the type of atmosphere, type of construction and cycle or operation.

General Corrosion Resistance:

CRUCIBLE 410 is adaptable to applications where maximum resistance to corrosion is not required. It is resistant to the corrosive action of the atmosphere, fresh water, and a variety of the milder acids and alkalies. Detailed results of corrosion tests are given in the CRUCIBLE Corrosion Resistance Data Sheet.

Specifications

CRUCIBLE 410 has found wide industry acceptance and meets the following specifications:

QQ-S-763	MIL-W-17481	AMS 5613	ASTM A-276	ASTM A-580

Machining data

Operation	Tool Width or Depth of Cut (in)	CRUCIBLE 410* High Speed Tooling		Carbide Tooling	
		Speed (fpm)	Feed (in/rev)	Speed (fpm)	Feed (in/rev)
Turning single point	0.050	90	0.0055	200	0.010
	0.250	85	0.0050	200	0.020
	0.500	80	0.0045	175	0.025
Forming	1/2 wide	95	0.0015	180	0.0022
	1 wide	90	0.0012	170	0.0022
	1½ wide	90	0.0012	170	0.0020
	2 wide	85	0.0010	160	0.0015
Cutoff	1/16 wide	85	0.0015	160	0.0020
	1/8 wide	90	0.0015	160	0.0020
	3/16 wide	90	0.0015	170	0.0022
	1/4 wide	95	0.0020	170	0.0030
Drilling	1/16 dia.	60	0.0015		
	1/8 dia.	60	0.0020		
	1/4 dia.	60	0.0030		
	1/2 dia.	60	0.0035		
	3/4 dia.	65	0.0040		
	1 dia.	65	0.0050		
Threading†		10—25	—		
Tapping†		10—20	—		

†Use the higher speeds for the finer threads.

*Details on tool life test techniques and Crucible High Speed and Tool Bit recommendations are described in the booklet, "Machining Crucible Stainless Steels."

Physical Properties:

Modulus of Elasticity in Tension — psi	29,000,000
Modulus of Elasticity in Torsion — psi	11,000,000
Specific Electrical Resistance	
Room Temperature — microhms/cm	56.90
Specific Heat — Btu./lb./° F (32-212 F)	0.11
Specific Gravity	7.70
Weight — lb./cu. in.	0.278
Thermal Conductivity—Btu./hr./sq. ft./°F/ft.	
At 200 F	14.4
1000 F	16.5
Mean Coefficient of Thermal Expansion — in/in/° F x 10^{-6} (See Fig. 2)	
32- 212 F	5.5
32- 600 F	5.6
32-1000 F	6.4
32-1200 F	6.5
Melting Point Range — F	2700/2790

Mechanical Properties:

(All values are representative properties in the annealed condition):

Room Temperature:	**Bar 1 in. Rd.**
Tensile Strength, psi	75,000
Yield Strength (0.2% Offset), psi	45,000
Elongation in 2 in., per cent	30
Reduction of Area, per cent	75
Izod Impact Resistance, ft. lbs.	90
Hardness	155 BHN
Endurance Limit (Fatigue) psi	40,000

Mechanical Properties as Heat Treated:

Chemical Analysis: C — 0.12%, Mn — 0.44%, Si — 0.27%, Cr — 12.74%.
Heat Treatment: 1800 F. Oil Quench, Temper — 3 Hrs.
Size: 1 in. Rd., Tensile 0.505 in. Dia., Izod Notched 0.394 in. sq.

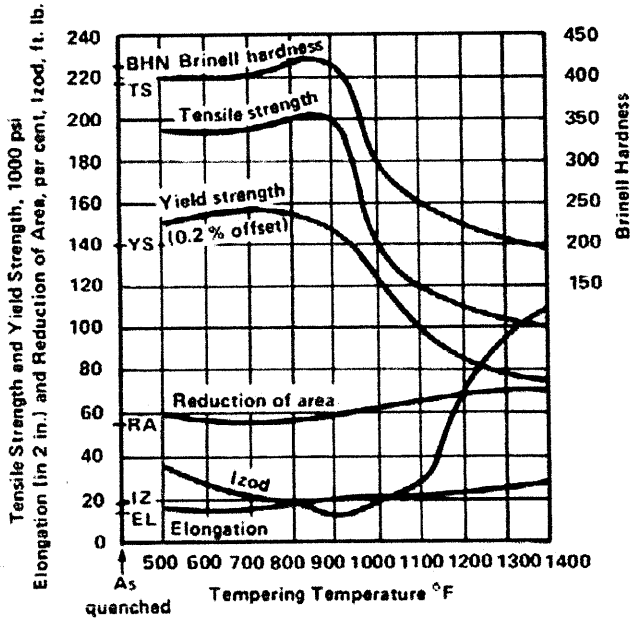


Figure 1

Thermal Expansion:

Hardened 1850 F — ½ Hr. Oil.
Tempered 1150 F — 2 Hr.
Figure 1
Figure 2

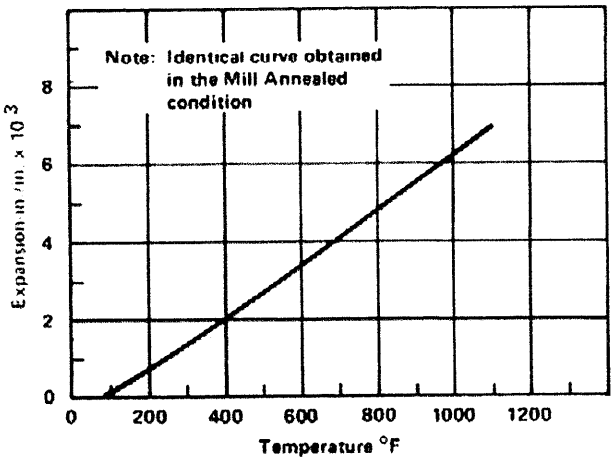
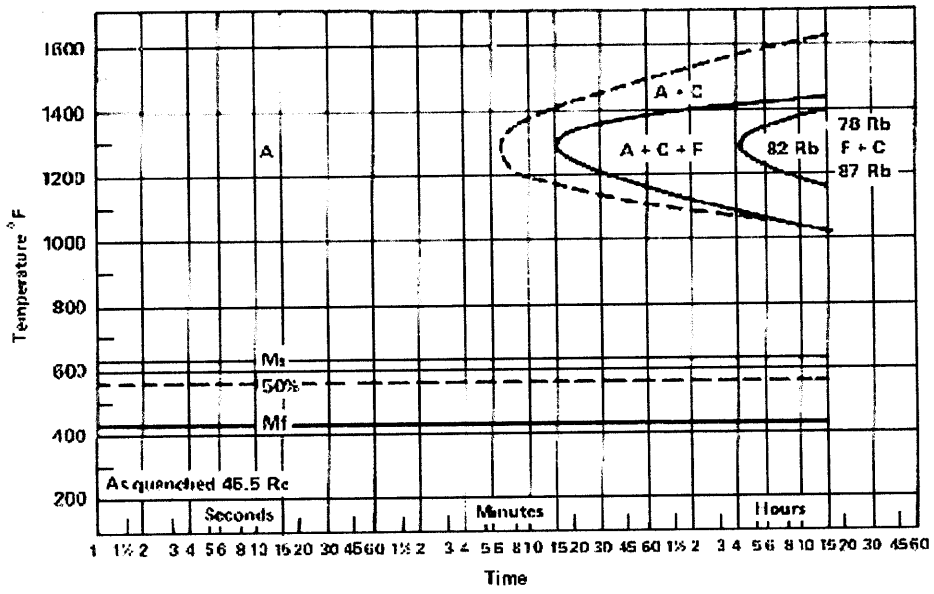


Figure 2

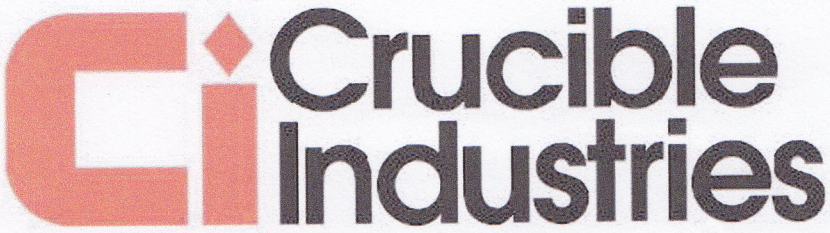
TTT Curve:

Grade — CRUCIBLE 410 Critical Temperature (Ac_1) — 1485 F.
Austenitizing Temperature 1800 F. Prior Condition — Annealed.



The TTT curve shows the times required for the austenite of the steel to start and to complete transformation at each temperature as well as the Rockwell "C" hardness values of the resulting transformation products. It summarizes the reactions which may take place when the steel cools from above its Ae1, critical temperature. It is useful in predicting the approximate structures and hardnesses to be obtained when the steel is cooled at different rates. It indicates holding temperatures and times, and suitable cooling rates for annealing; necessary quenching speeds for hardening; and correct hot quenching procedures for austempering and martempering.

Note: Properties shown throughout this data sheet are typical values. Normal variation in chemistry, size, and conditions of heat treatment may cause deviations from these values.



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