Crucible Data Sheet

Issue #7

CRUCIBLE 420 STAINLESS STEEL

Carbon	over 0.15%
Manganese	1.00% max.
Phosphorus	0.04% max.
Sulfur	0.03% max.
Silicon	1.00% max.
Chromium	12.00/14.00%

CRUCIBLE 420 is a hardenable chromium steel which is the general purpose cutlery grade. This grade is magnetic at all times.

Typical Applications

Bushings
Cutlery
Plastic molds
Glass molds
Valve trim
Screw drivers
Dental and surgical instruments

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

Forging

CRUCIBLE 420 should be forged at 1950 to 2050 F and finished not lower than 1750 F. Reheating should be used if necessary.

Annealing

CRUCIBLE 420 should be annealed for maximum softness by a thorough soaking at 1600 F for six hours, followed by a furnace cool. This grade can be cycle annealed by heating to 1600 F, holding two hours, cooling to 1300 F, and holding four hours. The steel may then be cooled in air if desired.

For certain operations improved machinability can be obtained by a sub-critical anneal at 1400 F.

The recommendation for cycle annealing is based on the principles explained in P. Payson's "The Annealing of Steel" which appeared in Iron Age, June and July issues, 1943.

Note: Temperatures throughout data sheet are steel temperatures.

Hardening and Tempering

CRUCIBLE 420 can be hardened for maximum hardness by oil quenching from 1800 to 1900 F. Large sections should be preheated at about 1250 F. 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 and a drop in resistance to corrosion. This condition disappears when the tempering temperature is 1100 F or higher.

Attainable Hardness

The attainable hardness of CRUCIBLE 420 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 1850 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 420 is, in general, between 495 and 555 Brinell.

Welding

CRUCIBLE 420 should be welded with Type 420 filler weld metal if the mechanical properties of the weld metal must be similar to those of the parent metal. In welding annealed material, the steel should be preheated to 600 F and annealed following welding by heating uniformly and thoroughly at 1300 F followed by air cooling. When welding hardened and tempered material, preheat to 600 F, weld, and post-heat at the appropriate tempering temperature for 2 hours.

Resistance to Scaling

CRUCIBLE 420 scales at approximately 1200 F. This temperature will vary with the type of atmosphere, type of construction and cycle of operation.

General Corrosion Resistance

CRUCIBLE 420 is resistant to the corrosive action of the atmosphere, fresh water, mild acids and alkalies, and fruits and vegatable juices, its corrosion resistance being almost as good as that of CRUCIBLE 410. It is necessary to harden and polish this material in order to develop maximum resistance.

Cutlery Applications

CRUCIBLE 420 is particularly designed for cutlery applications. When this grade is ordered specifically for mirror finish cutlery applications, material will be supplied which has been processed in such a manner as to insure the obtaining of a polished surface of "mirror finish" quality. Care should be taken in grinding and polishing this grade so that excessive heat is not produced by this operation. In general, CRUCIBLE 420 resembles tool steels in that it requires great care in fabrication and hardening.

Physical Properties

Modulus of elasticity in tension—psi	29,000,000
Modulus of elasticity in torsion—psi	11,700,000
Electrical Resistivity	
room temperature—microhm—centimeters	54.8
Specific heat—Btu/lb./°F (32-212F)	0.11
Specific gravity	7.75
Weight—lb./cu.in.	0.276
Thermal conductivity—Btu/hr./sq.ft./°F/ft.	
At 200	14.4
Mean coefficient of thermal expansion—in/in/°F x 10^{-6} (See Fig. 2)	
32- 212	5.7
32- 600	6.0
32-1000	6.5
32-1200	6.8
Melting point range °F	2650/2750

Mechanical Properties

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

	Bar-1 in. Rd.
Tensile strength, psi	95,000
Yield strength (0.2% offset), psi	50,000
Elongation in 2 in., %	25
Reduction of area, %	55
Hardness	180 BHN

Specifications:

CRUCIBLE 420 meets the following specifications:

QQ-S-763	AMS 5621	ASTM A-276	ASTM A-580

Machining Data

Operation	Tool Width or Depth of Cut (in)	High Speed Tooling		Carbide Tooling	
		Speed (fpm)	Feed (in/rev)	Speed (fpm)	Feed (in/rev)
Turning single point	0.050	80	0.0060	225	0.015
	0.250	80	0.0055	200	0.030
	0.500	75	0.0045	175	0.045
Forming	1/2 wide	85	0.0020	200	0.003
	1 wide	85	0.0017	200	0.002
	1½ wide	80	0.0015	175	0.002
	2 wide	80	0.0013	175	0.002
Cutoff	1/16 wide	85	0.0017	175	0.002
	1/8 wide	90	0.0020	200	0.003
	3/16 wide	90	0.0020	200	0.003
	1/4 wide	90	0.0025	200	0.003
Drilling	1/16 dia.	50	0.0020		
	1/8 dia.	55	0.0030		
	1/4 dia.	55	0.0040		
	1/2 dia.	60	0.0045		
	3/4 dia.	60	0.0055		
	1 dia.	60	0.0065		
Threading†		15-25	—		
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."

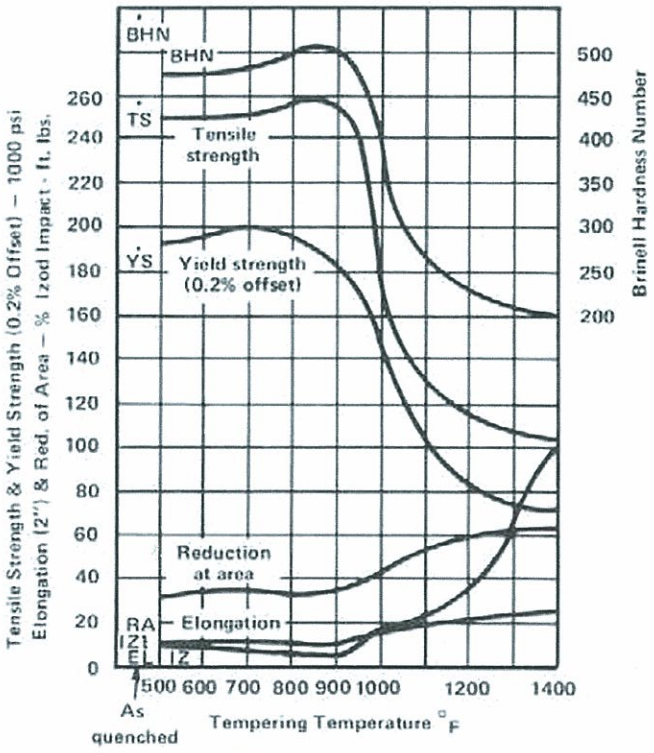


Figure 1

Mechanical Properties as Heat Treated

Chemical Analysis	C	Mn	Cr
	0.35	0.47	13.25

Heat treatment—1850 F—oil quench—temper—5 hrs.

Size—1" rd.—tensile—.505" dia.—izod—.394" sq.

Thermal Expansion

Hardened 1850 F, ½ hr., oil.
Tempered 1150 F, 2 hr.

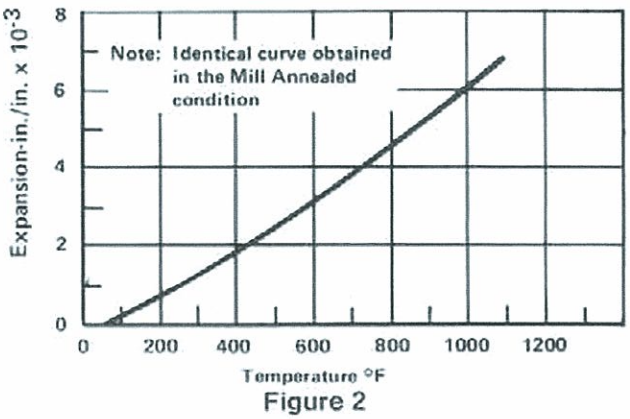
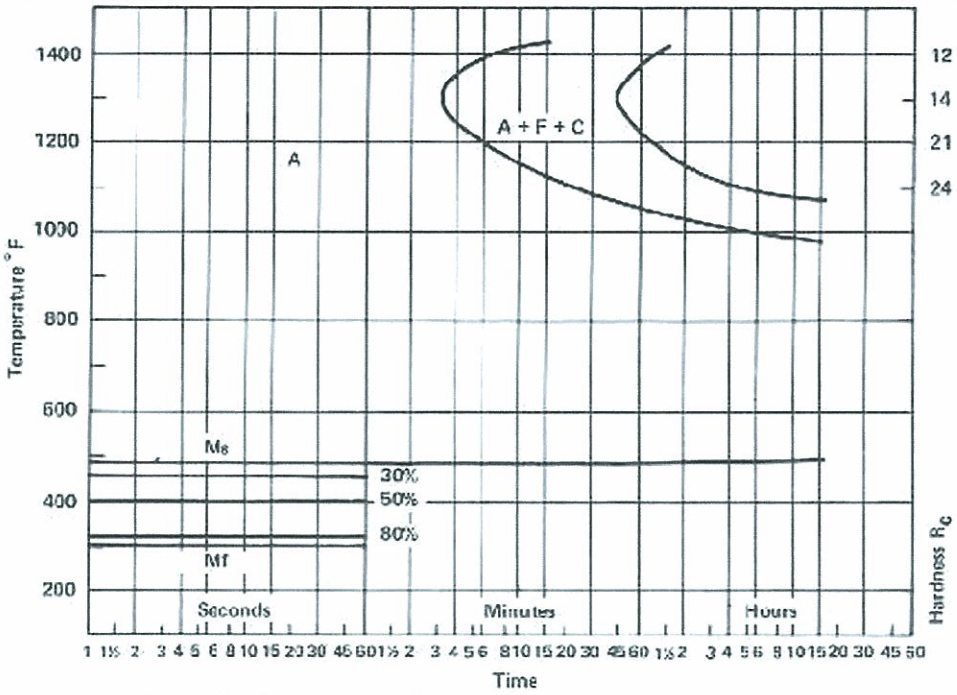


Figure 2

TTT Curve

Grade—CRUCIBLE 420
Austenitizing Temperature—1800°F
Critical Temperature (Ac1)—1490°F
Prior Condition—Tempered at 1300-1400°F

A—Austenite
F—Ferrite
C—Carbide
M—Martensite



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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