

Crucible Data Sheet

Issue #7

CRUCIBLE 440A is a hardenable chromium steel which is the toughest of the high chromium cutlery grades. This grade is magnetic at all times.

Typical Applications:

- Bearings
- Cutlery
- Seaming rolls
- Surgical and dental tools
- Valve parts

Forging:

CRUCIBLE 440A should be forged at 2000 to 2100 F and finished not lower than 1750 F. Reheating should be used if necessary. This grade should be allowed to cool slowly after forging.

Annealing:

CRUCIBLE 440A 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.

*Cycle (isothermal) annealing is most practical for applications in which full advantage may be taken of the rapid cooling to the transformation temperature, and from this temperature down to room temperature. Thus for small parts which can be conveniently handled in salt or lead baths, this isothermal annealing makes possible large time savings as compared with the conventional slow furnace cooling. The method offers no particular advantage for applications

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

CRUCIBLE 440A STAINLESS STEEL

Carbon	0.60/0.75%
Phosphorus	0.04% max.
Chromium	16.00/18.00%
Manganese	1.00% max.
Silicon	1.00% max.
Sulfur	0.03% max.
Molybdenum	0.75% max.



Hardening and Tempering:

For maximum hardness, Crucible 440A can be oil quenched from 1850 to 1900 F. Large sections or complex parts should be preheated to 1425 F, equalized, and then raised to the austenitizing temperature. If the finished part is not to be ground and polished, the surface may be improved by packing in a neutral material during heating. Tempering should be at the proper temperature to give the desired approximate hardness as indicated below.

such as batch annealing of large furnace loads in which the rate of cooling to the center of load may be so slow as to preclude any rapid cooling to the transformation temperatures. For such applications, the conventional full annealing method usually offers a better assurance of obtaining the desired microstructure and properties.

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.

Hardening and Tempering (Cont'd)

Tempering Temperature (°F)	Hardness Rockwell C
As quenched	57
212	57
400	54
600	52
800	51
1000	44

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 also a reduction in resistance to corrosion.

Welding:

Crucible 440A should be welded with Type 440A 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 the tempering temperature, weld, and post-heat at the appropriate tempering temperature for 2 hours.

Resistance to Scaling:

Crucible 440A scales at approximately 1400 F. This temperature will vary with the type of atmosphere, type of construction, and cycle of operation.

General Corrosion Resistance:

Crucible 440A is resistant to corrosion in atmosphere environments, fresh water,

mild acids and alkalies, and fruit and vegetable juices. The better the finish of the hardened and tempered part, the better will be its corrosion resistance.

Cutlery Applications:

Crucible 440A is particularly designed for cutlery applications requiring a high hardness and an excellent retention of the cutting edge. 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 as the resistance to staining will be lowered. In general, Crucible 440A resembles tool steels in that it requires great care in fabrication and hardening.

Specifications

CRUCIBLE 440A has found wide industry acceptance and meets the following specifications:

QQ-S-763d	AMS 5631	ASTM A-276-67	ASTM A-580-67
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Machining data

Operation	Tool Width or (in) Depth of Cut	CRUCIBLE 440A High Speed Tooling		Carbide Tooling	
		Speed (fpm)	Feed (in/rev)	Speed (fpm)	Feed (in/rev)
Turning single point	0.050	75	0.0045	200	0.010
	0.250	75	0.0040	175	0.020
	0.500	70	0.0030	175	0.025
Forming	½ wide	75	0.0012	150	0.0022
	1 wide	75	0.0010	150	0.0022
	1½ wide	75	0.0010	150	0.0020
	2 wide	70	0.0008	150	0.0015
Cutoff	⅙ wide	75	0.0010	150	0.0020
	⅛ wide	75	0.0010	150	0.0020
	⅜ wide	80	0.0010	150	0.0022
	¼ wide	80	0.0015	150	0.0030
Drilling	⅙ dia.	45	0.0012		
	⅛ dia.	50	0.0020		
	¼ dia.	50	0.0025		
	½ dia.	50	0.0030		
	¾ dia.	50	0.0035		
	1 dia.	50	0.0040		

†Use the higher speeds for the finer threads.

Physical Properties:

Modules of elasticity in tension—1000 psi	29,000
Specific electrical resistance	
Room temperature—microhms/cm.	59.94
Specific heat—Btu/lb./°F	0.11
Specific gravity	7.75
Weight—lb./cu. in.	0.276
Thermal conductivity—Btu/hr./sq. ft./° ft.	
200° F	14.0
Mean coefficient of thermal expansion—in./in./° F x 10 ⁻⁶	
0—200° F	5.7
0—600° F	6.0
Melting point range—° F	2500/2750

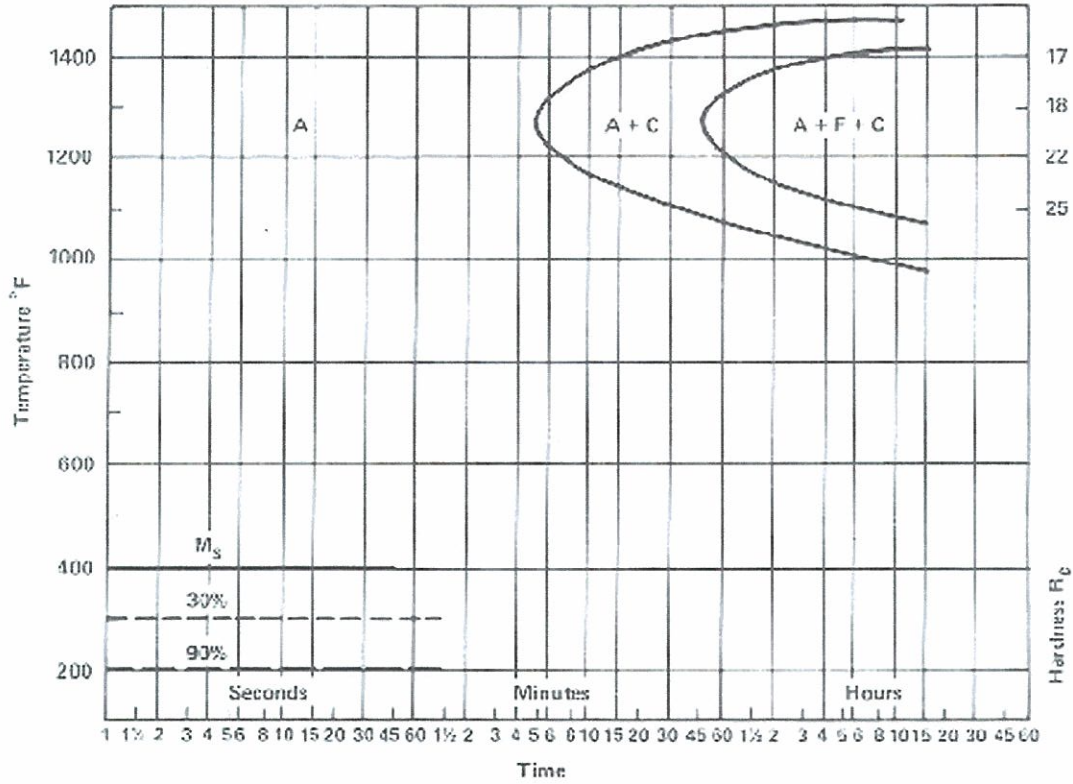
Mechanical Properties: (All values are representative properties in the annealed condition):

	Bar-1 in. Rd.
Tensile strength, 1000 psi	105
Yield strength (0.2% offset), 1000 psi	60
Elongation in 2 in., %	20
Reduction of area, %	45
Hardness	215 BHN

TTT Curve :

Grade-CRUCIBLE 440A
 Austenitizing temperature -1900° F
 Critical temperature (AC1)-1490° F
 Prior condition-annealed

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



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



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