

Crucible Data Sheet

Issue No. 3

CRUCIBLE 17Cr-4Ni is a precipitation-hardening stainless steel which is capable of high strength and hardness levels after a relatively simple heat-treatment procedure. This grade is martensitic and magnetic in both the solution-treated and precipitation-hardened conditions. It has high resistance to crack propagation, good transverse properties, and corrosion resistance is normally superior to the regular martensitic chromium-type of stainless steel. Because of the single low-temperature (900 to 1150°F) precipitation-hardening heat treatment of this grade, scaling and distortion are virtually eliminated. This enables material to be finish machined to close tolerances prior to heat treatment.

Typical Applications

Valves	Turbine blades
Motor shafts	Bolts
Propeller shafts	Fasteners
Pump parts	Instrument Parts
Ball bearings	Forgings
Gears	Aircraft Parts
Storage tanks	

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

Forging

Forging stock is normally supplied in the overaged condition to eliminate the possibility of strain cracking in large sections. CRUCIBLE 17Cr-4Ni should be forged at 2150 to 2200°F. Heating practices are similar to those of the other hardenable stainless steels except that it is recommended to heat fairly rapidly through the 1750 to

Note: Temperature throughout data sheet are steel temperatures.

CRUCIBLE 17Cr-4Ni

Carbon	0.07% maximum
Chromium	15.50/17.50%
Nickel	3.00/5.00%
Silicon	1.00% maximum
Copper	3.00/5.00%
Manganese	1.00% maximum
Phosphorus	0.04% maximum
Columbium plus Tantalum	0.15/0.45%
Sulfur	0.03% maximum



1850°F temperature range. It is also not good practice to hot work the steel in this temperature range. After forging, sections should be cooled to room temperature. Material that is hot worked or forged must be solution treated prior to hardening.

Heat Treatment

As shipped from the mill, CRUCIBLE 17Cr-4Ni is usually in the solution-treated condition (Condition A) ready for fabrication and subsequent precipitation hardening by the user. However, it can also be supplied hardened or in overaged conditions for cold heading or forging if desired.

The heat treatment of CRUCIBLE 17Cr-4Ni consists of a solution treatment (1900°F, 30 minutes, air cool or oil quench) and a precipitation-hardening or aging treatment (900 to 1150°F, 1 to 4 hours, air cool).

Material supplied in the solution-treated (Condition A) condition can be heat treated at different temperatures to develop a wide

range of properties. A number of standard heat treatments have been developed as outlined below:

Heat Treatments for 17Cr-4Ni in Solution-Treated Condition

Condition	Precipitation Hardening Temperature (°F)	Hardening Time (hr)	Typical Hardness	
			Cooling	(Rc)
H 900	900	1	Air	44
H 925	925	4	Air	42
H1025	1025	4	Air	38
H1075	1075	4	Air	36
H1100	1100	4	Air	34
H1150	1150	4	Air	33
H1150-M	1400	2	Air	—
	1150	4	Air	27

Welding

CRUCIBLE 17Cr-4Ni is readily welded by conventional practices. No preheating treatment is required with this grade. Any of the arc and resistance welding processes used on the regular grades of stainless steel are applicable to CRUCIBLE 17Cr-4Ni. Properties comparable to those of the parent metal can be secured in the weld by applicable postweld heat treatment. Weld metal of a 17Cr-4Ni composition is utilized when it is desired to obtain properties comparable to those of the base metal. Austenitic stainless steel weld metal may be used when high strength at the weld is not important.

Resistance to Scaling

When CRUCIBLE 17Cr-4Ni is purchased in the solution-treated condition and fabricated by machining, a simple low-temperature (900 to 1175°F) precipitation-hardening heat treatment is required. Parts are lightly discolored or heat tinted when subjected to the final hardening treatment. The light discoloration may be removed by dipping in a 10% nitric—2% hydrofluoric acid (by volume) solution at 110 to 140°F. It can also be removed by electropolishing.

Corrosion Resistance

CRUCIBLE 17Cr-4Ni exhibits excellent corrosion resistance when exposed to a wide variety of corrosive media. It has the best corrosion resistance of the martensitic stainless steels and compares favorably to Type 304.

CRUCIBLE 17Cr-4Ni is highly resistant to stress-corrosion cracking when hardened at temperatures of 1000°F and higher. This is important for applications where parts have a high level of internal tension stress due to cold deformation after hardening or to welding without subsequent stress relieving. Environments that contain hydrogen sulfide or high concentrations of chlorides can also cause stress-corrosion cracking.

Machining

CRUCIBLE 17Cr-4Ni stainless can be readily machined in both solution-treated (Condition A) and the precipitation hardened conditions. One of the advantages of this grade is that it can be machined to close tolerances in Condition A prior to the precipitation hardening treatment. The low-hardening temperatures of CRUCIBLE 17Cr-

4Ni cause only a thin discoloration film and a dimensional contraction of 0.0004 to 0.0006" per inch.

In Condition A (solution treated), CRUCIBLE 17Cr-4Ni is machined at approximately the same speed as Type 304 stainless.

Machining Data

Operation	Tool Width or (in) Depth of Cut	CRUCIBLE 17Cr-4Ni 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	90	0.0015	180	0.0022
	1 wide	85	0.0012	170	0.0022
	1½ wide	85	0.0012	170	0.0020
	2 wide	80	0.0010	160	0.0015
Cutoff	1/16 wide	80	0.0015	160	0.0020
	1/8 wide	80	0.0015	160	0.0020
	3/16 wide	85	0.0015	170	0.0022
	1/4 wide	85	0.0020	170	0.0030
Drilling	1/16 dia.	50	0.0015		
	1/8 dia.	50	0.0020		
	1/4 dia.	50	0.0030		
	1/2 dia.	50	0.0035		
	3/4 dia. 1 dia.	55 55	0.0040 0.0050		
Threading †		5-15			
Tapping †		5-15			

† Use the higher speeds for the finer threads.

Stress-Rupture Strength—Condition H 900

Temperature °F	Time to rupture (hrs)	Strength (p.s.i.)	Elongation at rupture (% in 2")	Reduction of area (%)
600°F	100	164,000	3	7
	1000	158,000	2	6
700°F	100	156,000	3	7
	1000	150,000	2	6
800°F	100	140,000	4	8
	1000	128,000	4	6
900°F	100	95,000	5	9
	1000	60,000	12	25



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