Specification Sheet: Alloy 17-4PH

(UNS S17400) W. Nr. 1.4542 Type 630

A Precipitation-Hardening Martensitic Stainless with High Strength and Hardness and Good Corrosion Resistance

Alloy 17-4PH (UNS S17400), Type 630, is a chromium-nickel-copper precipitation-hardening martensitic stainless steel with an addition of niobium. 17-4PH combines high strength and hardness with good corrosion resistance.

The alloy is furnished in the solution annealed condition (Condition A). It should not be used at temperatures above 572°F (300°C) or for cryogenic service. Optimal mechanical properties can be obtained by subjecting the alloy to age hardening heat treatments. Heat treatment in the 900°F (482°C) range produces the highest strength.

The corrosion resistance of Alloy 17-4PH is comparable to 304 stainless steel in most environments, and is generally superior to the 400 series stainless steels. It is used in applications where the combination of moderate corrosion resistance and unusually high strength are required.

Alloy 17-4PH can be easily welded and processed by standard shop fabrication practices. It is magnetic.

Applications

- Aerospace — structural and parts
- Biomedical — hand tools
- Chemical Processing
- Food Process Equipment
- Gate Valves
- Mechanical Components
- Nuclear Waste Processing and Storage
- Oil and Gas Production — foils, helicopter deck platforms, etc.
- Pulp and Paper — paper mill equipment

Standards

ASTM ..... A 693

ASME ..... SA 693

AMS..... 5604

Chemical Analysis

Weight % (all values are maximum unless a range is otherwise indicated)

Chromium	15.0 min.–17.5 max.	**Phosphorus**	0.04
Nickel	3.0 min.–5.0 max.	**Sulfur**	0.03
Copper	3.0 min.–5.0 max.	**Silicon**	1.0
Carbon	0.07	**Niobium plus Tantalum**	0.15 min.–0.45 max.
Manganese	1.0	**Iron**	Balance

Physical Properties (Condition A)

Density
0.280 lbs/in^3
7.75 g/cm^3

Specific Heat
0.11 BTU/lb-°F @ 70°F
460 J/kg-°C @ 20°C

Electrical Resistivity
29.5 Microhm-in at 75°F
75 Microhm-cm at 24°C

Modulus of Elasticity
28.5 x 10^6 psi
196 GPa

Melting Range
2560–2625°F
1404–1440°C

Thermal Conductivity 212°F (100°C)
10.6 BTU-in/ft^2-hr-°F
18.3 W/m-°C

Mean Coefficient of Thermal Expansion

Temperature Range °F	Temperature Range °C	in/in °F	cm/cm °C
70–800	21–427	6.3 x 10^{-6}	11.3 x 10^{-6}

Mechanical Properties

Room temperature properties (longitudinal direction)
Guaranteed values (ASTM A693 hot rolled plates).

Table 1

HEAT TREATMENT		Y.S. 0.2% MPa	Y.S. 0.2% ksi	UTS MPa	UTS ksi	Elongation %
Hardening 496 °C (925 °F) 4 hours — air cooling	Min.	1070	155	1170	170	8
	Typ.	1207	175	1310	190	14
Hardening 593 °C (1100 °F) 4 hours — air cooling	Min.	790	115	965	140	10
	Typ.	931	135	1034	150	17

SANDMEYER STEEL COMPANY
ONE SANDMEYER LANE • PHILADELPHIA, PA 19116-3598
800-523-3663 • +1-215-464-7100 • FAX +1-215-677-1430
www.SandmeyerSteel.com

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Corrosion Resistance

The corrosion resistance of Alloy 17-4PH is comparable to 304 stainless steel in most environments, and is generally superior to the 400 series stainless steels. It is used in applications where the combination of moderate corrosion resistance and unusually high strength are required. Alloy 17-4PH has corrosion resistance comparable to 304L in some chemical, dairy, food, paper and petroleum applications.

Alloy 17-4PH in the solution-annealed condition (Condition A) should not generally be put in service. The alloy is subject to brittle fractures and more sensitive to chloride stress corrosion cracking than the aged material.

If risks of chloride stress corrosion cracking are present the higher aging temperatures should be selected over 1022°F (550°C), preferably 1094°F (590°C). 1022°F (550°C) is the recommended tempering temperature in chloride service. 1094°F (590°C) is preferred in H_2S media.

Alloy 17-4PH is subject to crevice corrosion and pitting attack when exposed to stagnant seawater for a duration of time.

Fabrication Data

Alloy 17-4PH can be easily welded and processed by standard shop fabrication practices. It is magnetic.

Heat Treatment

Alloy 17-4PH is provided in the solution-annealed condition (Condition A). Mechanical properties may be altered by subsequent age hardening treatments. These aging treatments are referred to as Conditions H900, H1025, H1075, H1150, H1150M and H1150D. The processes are outlined in Table 2 below. The resultant mechanical properties appear above in Table 1.

Table 2

CONDITION	Temperature °F	Time, h	Quench
H900	900	4	Air Cool
H1025	1025	4	Air Cool
H1075	1075	4	Air Cool
H1150	1150	4	Air Cool
H1150M	1400 for 2 h, air cool plus 1150 for 4 h, air cool		
H1150D	1400 for 2 h, air cool plus 1150 for 4 h, air cool		

Hot Forming

Heat uniformly at 1742–2192°F (950–1200°C). A full solution anneal, cooling lower than 76°F (25°C) and aging at the required temperature must occur after hot forming. The post forming heat treatment should be a function of the desired mechanical properties.

Cold Forming

Alloy 17-4PH has limited cold forming properties. Cold forming can only be undertaken on plates in the fully annealed condition. Stress corrosion resistance is enhanced by re-aging at the precipitation hardening temperature after cold working.

Cutting

Thermal cutting operations such as plasma cutting should be avoided. Mechanical cutting operations such as bandsaw, abrasive waterjet, shearing and machining are preferred.

Welding

Alloy 17-4PH can be readily welded by most standard processes including SMAW, GTAW, PAW and GMAW.

Machining

Alloy 17-4PH can be machined in both the solution treated and precipitation hardened conditions. Machining characteristics may vary according to the hardness of the metal. High speed tools are acceptable, but carbide tools are preferred. Standard lubrication should be used. Dimensional changes as a result heat treatment should be taken into account if very stringent tolerances are required.

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