17-4 PH

17-4 PH, also known as Type 630, is a **precipitation-hardening martensitic stainless steel** offering an exceptional combination of **high strength, hardness, and moderate to good corrosion resistance**. The alloy is supplied in the solution-annealed condition (Condition A) and achieves its properties through low-temperature aging, forming copper-rich precipitates that dramatically increase strength. 17-4 PH maintains high mechanical performance up to **600°F (316°C)** and is widely used where high strength and corrosion resistance must coexist with reliable fabrication characteristics.

Standards & Designations

- **UNS**: S17400
- **AMS** 5604 (plate), 5643 (bars)
- **EN / W. Nr.**: 1.4542
- **ASTM/ASME**: A564/A564M (bars), A693 (plate)

Corrosion Resistance: 17-4 PH provides corrosion resistance **comparable to Type 304 stainless steel** in many environments and significantly superior to the hardenable 400-series grades. Its resistance is excellent in atmospheric and mild chemical service, though susceptibility to chloride stress-corrosion cracking increases at peak strength conditions. For chloride-bearing environments, the alloy should be aged to the highest temperature compatible with the required strength to reduce hardness and improve SCC resistance.

Heat Treatment: 17-4 PH uses a simple precipitation-hardening heat-treatment sequence, beginning with solution annealing at about 1900°F (Condition A) followed by aging between 900°F and 1150°F to achieve the desired strength and toughness. Lower aging temperatures like 900°F, produce the highest strength, while higher temperatures such as 1100–1150°F improve toughness and stress-corrosion-cracking resistance. The alloy should not be used long-term above about 572°F, as elevated exposure reduces mechanical performance.

Welding:

- **Machining**: excellent in the **solution-annealed condition**, permitting complex cutting operations.
- **Forming**: Being a martensitic precipitation-hardening stainless steel, 17-4 PH has **lower ductility than austenitic grades**, making forming operations more limited.
- **Welding**: Can be welded using standard stainless-steel processes, typically in the solution-annealed Condition A, and requires re-solution annealing followed by aging to fully restore strength and corrosion resistance.

The list of applications for this general-purpose grade is very extensive and includes:

- aerospace components
- mechanical components
- power generation components
- oil & gas processing equipment
- chemical processing vessels
- food & beverage process equipment
- nuclear waste
- pulp & paper mill

A.I.S.I. Analysis	Grade	C	Mn	Si	P	S	Cr	Ni	Cu	Nb + Ta
	17-4 PH	.04 max	.40 max	.50 max	.020 max	.005 max	15.5	4.5	3.50	0.30

Typical Mechanical Properties - Annealed	Yield Strength .2% Offset psi	Ultimate Strength psi	Elongation % in 2″	Impact Charpy (ft. – lbs)	Elastic modulus (psi)
	175,000	190,000	14	15	28.5×10^6 psi

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Other Properties	Density (lb/in^3)	Melting Range	Electrical Resistivity at 68^0F ($\mu\Omega$-cm)	Thermal Expansion 70^0 – 800^0F ($In/In/^0F \times 10^{-6}$)	Thermal Expansion 32^0 – 212^0F ($In/In/^0F \times 10^{-6}$)
	0.280	2560–2625°F	0.75	6.3	7.2-7.8