

17-4 PH Precipitation Hardening Stainless Steel: Technical Material Specification

1.0 Material Overview & Common Uses

17-4 PH (UNS S17400) is a martensitic precipitation-hardening stainless steel that combines high strength, good corrosion resistance, and excellent toughness up to 600°F (316°C). It is supplied in the solution-annealed Condition A and then aged to achieve desired mechanical properties. Common applications include aerospace components, chemical processing equipment, nuclear reactor parts, oil and gas valves, pump shafts, and high-strength fasteners.

2.0 Core Technical Properties & Sizing

- Density: 7.80 g/cm³ (0.282 lb/in³)
- Melting Range: 2560–2625°F (1404–1440°C)
- Tensile Strength (Condition H900): 190 ksi (1310 MPa) minimum
- Yield Strength (Condition H900): 170 ksi (1170 MPa) minimum
- Elongation (Condition H900): 10% minimum in 2 inches
- Hardness (Condition H900): 40–47 HRC
- Hardness (Condition A, annealed): 30–33 HRC maximum
- Modulus of Elasticity: 29.0×10^6 psi (200 GPa)
- Thermal Conductivity: 10.6 BTU-in/hr-ft²-°F (1.53 W/m·K) at 212°F (100°C)
- Coefficient of Thermal Expansion: 6.0×10^{-6} in/in/°F (10.8×10^{-6} m/m/°C) from 70–600°F (21–316°C)
- Electrical Resistivity: 44.0 μΩ·cm at 70°F (21°C)
- Standard Forms: Round bar (1/8 to 12 inch diameter), flat bar, plate, sheet, and forging billet
- Diameter Tolerance (cold-finished round bar): ±0.002 inch for diameters up to 1 inch; ±0.003 inch for 1–2 inch; ±0.005 inch for 2–4 inch
- Length Tolerance: +1/8 inch, -0 inch for random mill lengths; custom lengths per order
- Straightness Tolerance: 1/16 inch in any 4 feet (0.0013 inch per inch)

3.0 Processing, Machinability & Application

17-4 PH is machinable in the solution-annealed Condition A (hardness <33 HRC) and becomes more difficult to machine after aging (H900–H1150). Use carbide tooling with positive rake angles and flood coolant for all operations. For turning, use coated carbide inserts with a feed rate of 0.005–0.015 inch/rev and cutting speed of 150–250 SFM in Condition A, reducing to 100–150 SFM in H900. For milling, use 4-flute carbide end mills at 0.002–0.006 inch/tooth feed and 200–300 SFM in Condition A. Drilling requires high-speed cobalt or carbide drills with a 118–135° point angle and peck cycles to break chips. Tapping is difficult; use roll-form taps in Condition A or thread milling after aging. Welding is possible with AWS E630 or ER630 filler metal; preheat to 300–400°F (149–204°C) and post-weld solution anneal at 1900°F (1038°C) for 30 minutes, then age per required condition. Heat treatment: solution anneal at 1900°F (1038°C) for 30 minutes, air cool to below 90°F (32°C); age at 900°F (482°C) for 1 hour (H900), 925°F (496°C) for 4 hours (H925), 1025°F (552°C) for 4 hours (H1025), 1075°F

(579°C) for 4 hours (H1075), or 1150°F (621°C) for 4 hours (H1150). All aging is followed by air cooling. Stress relieving is not recommended due to risk of over-aging.

- Use coated carbide inserts (C2–C5 grade) for turning and facing.
- Maintain flood coolant concentration at 8–12% soluble oil for optimal heat dissipation.
- Avoid work hardening by using consistent feed rates and sharp tooling.
- For grinding, use aluminum oxide or CBN wheels with a soft bond and open structure.
- EDM (sinker or wire) is suitable; use deionized water dielectric and low power settings to minimize recast layer.
- Chemical milling or etching is possible with ferric chloride or nitric-hydrofluoric acid solutions.

4.0 Common Defects & Quality Control

- Reject if surface cracks or seams are visible under 10x magnification after etching with 10% oxalic acid.
- Reject if surface pitting exceeds 0.005 inch (0.13 mm) depth or 0.030 inch (0.76 mm) diameter.
- Reject if decarburization depth exceeds 0.010 inch (0.25 mm) per side on bar stock.
- Reject if out-of-roundness exceeds 50% of diameter tolerance.
- Reject if straightness exceeds 1/8 inch in any 4 feet (0.0026 inch per inch).
- Reject if hardness after aging deviates more than ± 2 HRC from specified condition.
- Reject if tensile strength or yield strength is below minimum for specified condition per ASTM A564.
- Reject if elongation is below 10% in Condition H900 or below 14% in Condition H1150.
- Reject if non-metallic inclusions exceed ASTM E45 Plate A rating of 2.0 for thin/heavy series.
- Reject if grain size is coarser than ASTM No. 5 per ASTM E112.
- Reject if delta ferrite content exceeds 5% per magnetic measurement or metallographic examination.
- Reject if intergranular corrosion is detected per ASTM A262 Practice E (if specified).

5.0 Storage, Handling & WHMIS Guidelines

- Store in a dry, indoor environment with relative humidity below 60% to prevent surface oxidation.
- Maintain temperature between 10–30°C (50–86°F) to avoid condensation on cold metal.
- Shelf life is indefinite under proper storage; use FIFO to avoid prolonged exposure to contaminants.
- Separate from carbon steel and other non-stainless materials to prevent cross-contamination and galvanic corrosion.
- Use protective paper or plastic interleaving between stacked sheets or bars.
- WHMIS Classification: Not classified as hazardous under WHMIS 2015 for solid form. Dust or fines from machining may be classified as a nuisance particulate.
- Hazard Statements: H315 (Causes skin irritation) for prolonged contact with cutting fluids; H319 (Causes serious eye irritation) for coolant splash.
- Precautionary Statements: P264 (Wash hands thoroughly after handling); P280 (Wear protective gloves, safety glasses, and protective clothing); P302+P352 (IF ON SKIN: Wash with plenty of soap and water); P305+P351+P338 (IF IN EYES: Rinse cautiously with water for several minutes; remove contact lenses if present and easy to do; continue rinsing).
- Mandatory PPE: Cut-resistant gloves (ANSI A4 or higher) when handling sharp edges; safety glasses with side shields; steel-toed boots for heavy sections.
- During machining: Use local exhaust ventilation to control airborne dust; wear hearing protection if noise exceeds 85 dBA.
- First Aid: For skin contact with coolant, wash with mild soap and water. For eye contact, flush with water for 15 minutes. Seek medical attention if irritation persists.
- Spill Procedure: Sweep up solid material and place in labeled container for recycling. For coolant spills, contain with absorbent pads and dispose per local regulations.

- Disposal: Scrap metal can be recycled. Coolant and cutting fluids must be disposed as hazardous waste per provincial regulations.

Regulatory Disclaimer: This document is a generic technical material specification provided for educational purposes. The end-user assumes all liability for reviewing, adapting, and validating all tolerances, properties, and safety protocols against specific OEM data sheets and local regulations before deployment.