



## Casting Material: Precipitation-Hardening Stainless Steel 17-4PH

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. 17-4 is a common named used by two or more producers, not a trademark. And it's not official material grade name too. In every country, it has different standard and grade.

**Cast UNS:** J92180, ASTM A747 Grade CB7CU-1.

**European standard EN10088-3:** W.Nr 1.4542;  
X5CrNiCuNb16-4

**Japan:** JIS G4303; SUS630.

**USA:** AISI 630; ASTM A564/A693/A705-Type630;  
AMS5604; AMS 5622; AMS 5643; AS  
7474;A564/SA693/SA705-Type630; UNS S17400

**China:** 0Cr17Ni4Cu4Nb; 05Cr17Ni4Cu4Nb



### Casting Methods in Casting Quality Industrial:

- n Sand Casting
- n Investment Casting (Lost Wax Casting, Precision Casting)

### Reference Casting Standards and others

ASTM A747 / A747M - 16a Standard Specification for Steel Castings, Stainless, Precipitation Hardening

ASTM A705 / A705M - 13 Standard Specifications for Age-Hardening Stainless Steel Forgings

ASTM A693 - 16 Standard Specifications for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

ASTM A564 / A564M - 13 Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes

### CB7CU-1 (17-4PH) Chemical Requirements:

Standard	ASTM 747 CASTING	ASTM A705 FORING	ASTM A693 Plate/Sheet/Strip	ASTM A564 Bars/Shapes
Grade	CB7Cu-1 (UNS J92180)	Type 630 (UNS S17400)	Type 630 (UNS S17400)	Type 630 (UNS S17400)
Carbon	0.07	0.07	0.07	0.07
Manganese	0.70	1.00	1.00	1.00
Phosphorus	0.035	0.040	0.040	0.040
Sulfur	0.03	0.030	0.030	0.030
Silicon	1.00	1.00	1.00	1.00
Chromium	15.50-17.70	15.00-17.50	15.0-17.5	15.0-17.5
Nickel	3.60-4.60	3.00-5.00	3.0-5.0	3.0-5.0
Copper	2.50-3.20	3.00-5.00	3.0-5.0	3.0-5.0
Columbium	0.15-0.35	0.15-0.45	0.15-0.45	0.15-0.45
Tantalum	-			
Nitrogen	0.05	-	-	-



**0Cr17Ni4Cu4Nb; 05Cr17Ni4Cu4Nb chemistry in Chinese Standard:**

C:≤0.07  
 Si: ≤1.00  
 Mn:≤1.00  
 P:≤0.035  
 S:≤0.030  
 Ni:3.00-5.00  
 Cr:15.0-17.5  
 Mo:-  
 Cu:3.00-5.00  
 Nb:0.15-0.45

**CB7CU-1 (17-4PH) Heat treatment process:** All castings, whether homogenized or not, should be given a solution treatment: heating the castings and material to 1925°F (1050°C) 50F [30°C], holding the 30 min/in. [1.2 min/mm] of section but not less than 30min, and cooling to below 90°F [30°C]

Condition	PH Temperature, °F [°C]	Time, h and min	Cooling Treatment
SA	No Precipitation hardened, solution annealing treatment.		
H900	900 [480]	1.5	Air cool
H925	925 [495]	1.5	Air cool
H1025	1025 [550]	4.0	Air cool
H1075	1075 [580]	4.0	Air cool
H1100	1100 [595]	4.0	Air cool
H1150	1150 [620]	4.0	Air cool
H1150M	1400 [760]	2.0	Air cool
	1150 [620]	4.0	Air cool
H1150 DBL	1150 [620]	4.0	Air cool
	1150 [620]	4.0	Air cool

**CB7CU-1 (17-4PH) Mechanical Properties and Hardness**

Alloy Type	PH Heat Treatment	Hardness, HB	Yield Strength 0.2% offset, min, Ksi [MPa]	Tensile Strength, min, Ksi [MPa]	Elongation in 2 in.[51mm], min, %
CB7CU-1	H900	375 min	145 [1000]	170 [1170]	5
CB7CU-1	H925	375 min	150 [1035]	175 [1205]	5
CB7CU-1	H1025	311 min	140 [965]	150 [1035]	9
CB7CU-1	H1075	277 min	115 [795]	145 [1000]	9
CB7CU-1	H1100	269 min	110 [760]	135 [930]	9
CB7CU-1	H1150	269 min	97 [670]	125 [860]	10
CB7CU-1	H1150M	310 max	-	-	-
CB7CU-1	H1150 DBL	310 max	-	-	-



## CB7CU-1 (17-4PH) Casting Application:

Propeller shafts pump shafts, pins, and valve spindles. Corrosion resistance is similar to type 304.

- Used where high strength and good corrosion resistance are required.
- Applications requiring high fatigue strength, good resistance to galling, seizing and stress corrosion.
- Suitable for intricate parts requiring machining and welding.
- 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

## Heat Treatments for 17-4PH and Their Designation

Designation	Processing
Condition A* SA	Heated at 1900°F ± 25°F for 1/2 hour, air (Solution treated) cooled or oil quenched to below 90°F. Normally performed at mill.
H 1075, H 1150	Condition A material heated at 1075 or 1150°F ± 15°F for 4 hours and air cooled.
H 900	Condition A material heated at 900°F ± 15°F for 1 hour and air cooled. Maximum hardness but low toughness. Sensitive to stress corrosion cracking.
H 925, H 1025, H 1100	Condition A material heated at specified temperature for 4 hours and air cooled.
H 1150-M	Condition A material heated at 1400 ± 25°F for 2 hours, air cooled, then heated at 1150 ± 15°F for 4 hours and air cooled. This heat treatment used for maximum toughness, and for cryogenic applications to -320°F.

## 17-4PH WELDABILITY:

17-4PH has been welded by GTAW, GMAW, SMAW, PAW, Electron-beam (EB) and resistance welding. For GMAW a shielding gas of 75% argon and 25% helium is suggested.

Sections up to 1" thick are normally welded in the annealed (A) condition. Highly restrained joints or heavier sections are best welded in conditions H1100 or H1150. Welding of 17-4PH in conditions H900 through H1075 is not recommended.

No preheat is usually necessary for sections up to 4" thick. For restrained welds a 200-300°F (100-150°C) pre-heat is beneficial.

Matching composition ER630 wire or E630 covered electrodes (AMS 5803, 5825 or 5827) are normally used. Joints to carbon or low alloy steel may be made with ERNiCr-3 wire (alloy 82) or ENiCrFe-3 covered electrodes (alloy 182).

Post-weld heat treatment (PWHT) is required. For single pass welds on condition A base metal, simply aging to condition H 900 through H 1150 usually suffices (H 900 condition has very low notch toughness). For multipass welds the structure should be solution annealed after welding, followed by an aging treatment 900-1150°F.



Notches must be avoided, and partial penetration welds with their built-in notches are quite undesirable. If design considerations force the use of partial penetration welds consider making the root pass only with ERNiCr-3 (alloy 82) wire to minimize notch sensitivity.

## Machining:

Typical machining speeds for 17-4PH, using high speed steel tools are:

Operation	Speed	Feed
	SFPM	IPR
Turning, Single Point	80-95	0.015-0.007
Drilling 1/4" dia	50	0.004
3/4" dia	50	0.008
Reaming		
under 1/2"	60	0.003
over 1/2"	60	0.008
Die Threading		
3--7 1/2 TPI	5-12	--
8--15 TPI	8-15	--
over 16 TPI	10-20	--
Tapping	12-25	--
Milling, End and Peripheral	85	0.001-0.004
Broaching	10	



When using carbide tools, surface speed feet/minute (SFPM) may be increased 2 to 3 times over high speed suggestions. Feeds can be increased 50 to 100%.

## 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 band saw, abrasive water jet, shearing and machining are preferred.

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