

ASTM B167 / ASME SB167

SPECIFICATION FOR NICKEL-CHROMIUM-IRON ALLOYS (UNS N06600, N06601, N06603, N06690, N06693, N06025, and N06045) AND NICKEL-CHROMIUMCOBALT- MOLYBDENUM ALLOY (UNS N06617) SEAMLESS PIPE AND TUBE

This specification covers nickel-chromium- iron alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, and N06045) and nickel-chromium-cobalt-molybdenum alloy (UNS N06617) in cold-worked annealed, hot-worked annealed, and hot-finished seamless pipe and tube intended for general corrosion resistant and heat resistant applications.

A. Chemical Composition :-

The material shall conform to the composition limits specified in Table 1.

Table 1

Element	Alloy N06600	Alloy N06601	Alloy N06617	Alloy N06690	Alloy N06693	Alloy N06025	Alloy N06045	Alloy N06603
Nickel	72.0 min	58.0–63.0	44.5 min	58.0 min	remainder ^A	remainder ^A	45.0 min	remainder ^A
Chromium	14.0–17.0	21.0–25.0	20.0–24.0	27.0–31.0	27.0–31.0	24.0–26.0	26.0–29.0	24.0–26.0
Iron	6.0–10.0	remainder ^A	3.0 max	7.0–11.0	2.5–6.0	8.0–11.0	21.0–25.0	8.0–11.0
Manganese	1.0 max	1.5 max	1.0 max	0.5 max	1.0 max	0.15 max	1.0 max	0.15 max
Molybdenum	...	...	8.0–10.0	...	...	...	...	...
Cobalt	...	...	10.0–15.0	...	...	...	...	...
Aluminum	...	1.0–1.7	0.8–1.5	...	2.5–4.0	1.8–2.4	...	2.4–3.0
Carbon	0.15 max	0.10 max	0.05–0.15	0.05 max	0.15 max	0.15–0.25	0.05–0.12	0.20–0.40
Copper	0.5 max	1.0 max	0.5 max	0.5 max	0.5 max	0.1 max	0.3 max	0.50 max
Boron	...	...	0.006 max	...	...	...	...	...
Silicon	0.5 max	0.5 max	1.0 max	0.5 max	0.5 max	0.5 max	2.5–3.0	0.50 max
Sulfur	0.015 max	0.015 max	0.015 max	0.015 max	0.01 max	0.010 max	0.010 max	0.010 max
Titanium	...	...	0.6 max	...	1.0 max	0.1–0.2	...	0.1–0.25
Niobium	...	...	...	...	0.5–2.5	...	...	...
Phosphorus	...	...	...	...	...	0.020 max	0.020 max	0.020 max
Zirconium	...	...	...	...	...	0.01–0.10	...	0.01–0.10
Yttrium	...	...	...	...	...	0.05–0.12	...	0.01–0.15
Cerium	...	...	...	...	...	...	0.03–0.09	...

^A Element shall be determined arithmetically by difference.

B. Mechanical Properties and Other Requirements :-

1. Tensile Test — The material shall conform to the tensile properties specified in Table 2.
2. Hydrostatic or Non-destructive Electric Test— The type of test to be used shall be at the option of the manufacturer, unless otherwise specified in the purchase order.

Table 2

Condition and Size	Tensile Strength, Min. psi (MPa)	Yield Strength (0.2% Offset), Min., psi (MPa)	Elongation in 2 in. or 50 mm or 4D, Min., %
UNS N06600:			
Hot-worked or hot-worked annealed:			
5 in. (127 mm) in outside diameter and under	80000(550)	30000(205)	35
Over 5 in. (127 mm) in outside diameter	75000(515)	25000(170)	35
cold-worked annealed:			
5 in. (127 mm) in outside diameter and under	80000(550)	35000(240)	30
Over 5 in. (127 mm) in outside diameter	80000(550)	30000(205)	35
UNS N06601:			
cold-worked annealed or hot-worked annealed:(all sizes)	80000(550)	30000(205)	30
UNS N06617:			
cold-worked annealed ^A or hot-worked annealed ^A : (all sizes)	95000(665)	35000(240)	35
UNS N06690:			
Hot-worked or hot-worked annealed:			
5 in. (127 mm) in outside diameter and under	85000(586)	30000(205)	35
Over 5 in. (127 mm) in outside diameter	75000(515)	25000(170)	35
cold-worked annealed:			
5 in. (127 mm) in outside diameter and under	85000(586)	35000(240)	30
Over 5 in. (127 mm) in outside diameter	85000(586)	30000(205)	35
UNS N06693:			
cold-worked annealed or hot-worked annealed:			
5 in. (127 mm) in outside diameter and under	100000(690)	50000(345)	30
UNS N06603:			
Hot-worked annealed or cold-worked annealed (all sizes)	94000(650)	43000(300)	25
UNS N06025:			
Hot-worked annealed or cold-worked annealed (all sizes)	98000(680)	39000(270)	30
UNS N06045:			
Hot-worked annealed or cold-worked annealed (all sizes)	90000(620)	35000(240)	35

^A Solution anneal is done at 2,100°F–2,250°F and quenched in water or rapidly cooled by other means.

C. Test Methods :-

1. Chemical Composition—
 - i. In case of disagreement, the chemical composition shall be determined in accordance with Test Methods E 1473 or Methods E 38.
 - ii. Methods E 38 is to be used only for elements not covered by Test Methods E 1473.
2. Tension Test—
 - i. Tension testing shall be conducted in accordance with Test Methods E 8.
3. Hydrostatic Test —

- i. Each pipe or tube with an outside diameter 1/8 in. (3 mm) and larger and with wall thickness of 0.015 in. (0.38 mm) and over shall be tested by the manufacturer to an internal hydrostatic pressure of 1000 psi (6.9 MPa) provided that the fiber stress calculated in accordance with the following equation does not exceed the allowable fiber stress, S, indicated as follows:

$$P = 2St/D \quad \dots\dots (1)$$

where: P = hydrostatic test pressure, psi (or MPa)

S = allowable fiber stress, for material in the condition (temper) furnished as follows:

Hot-worked or hot-worked annealed:

UNS N06600	20 000 (140 MPa)
UNS N06601	20 000 (140 MPa)
UNS N06603	24 000 (165 MPa)
UNS N06617	23 700 (163 MPa)
UNS N06690	21 200 (146 MPa)
UNS N06693	25 000 (172 MPa)
UNS N06025	24 000 (165 MPa)
UNS N06045	22 500 (155 MPa)

Over 5 in. outside diameter:

UNS N06600	16 700 (115 MPa)
UNS N06690	16 700 (115 MPa)

Cold-worked annealed — All sizes:

UNS N06600	20 000 (140 MPa)
UNS N06601	20 000 (140 MPa)
UNS N06690	21 200 (146 MPa)
UNS N06693	21 200 (146 MPa)
UNS N06025	24 500 (169 MPa)
UNS N06045	22 500 (155 MPa)

t = minimum wall thickness, in. (or mm), equal to the specified nominal wall minus the permissible minus wall tolerance, or the specified minimum wall thickness, and,

D = outside diameter of the pipe or tube, in. (or mm).

4. Non-destructive Electric Test —

- i. Each pipe or tube shall be examined with a non-destructive electric test in accordance with Specification B 829.

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