

# ASTM B649 / ASME SB649

## SPECIFICATION FOR Ni-Fe-Cr-Mo-Cu LOW-CARBON ALLOY (UNS N08904), Ni-Fe-Cr-Mo-Cu-N LOW-CARBON ALLOYS (UNS N08925, UNS N08031, AND UNS N08926), AND Cr-Ni-Fe-N LOW-CARBON ALLOY (UNS R20033) BAR AND WIRE

This specification covers nickel-iron-chromium-molybdenum-copper low-carbon alloys (UNS N08904) and nickel-iron-chromium-molybdenum-copper-nitrogen alloys (UNS N08925, UNS N08031, and UNS N08926), and Cr-Ni-Fe-N low-carbon alloy (UNS R20033) bar and wire.

### A. Heat Treatment :-

1. The material shall be supplied in the solution-treated condition except as noted below in Point A.3.
2. The recommended heat treatment shall consist of heating to a temperature of 1920 to 2100°F (1050 to 1150°C) followed by water quenching for UNS N08904, 2010 to 2100°F (1100-1150°C) followed by water quenching for UNS N08925, UNS N08031, and UNS N08926, or 2010 to 2150°F (1100 to 1180°C) followed by water quenching or fast air cool for UNS R20033.
3. The heat treatment shall be waived for forging quality material.

### B. Chemical Composition :-

1. The material shall conform to the requirements as to chemical composition prescribed in Table 1.
2. If a product analysis is made, the material shall conform to the requirements as to the composition limits with the product analysis variation prescribed in Table 2.

**Table 1**

Element	UNS N08904	UNS N08925	UNS N08031	UNS N08926	UNSR20033
Carbon, max	0.02	0.02	0.015	0.02	0.015
Manganese, max	2.0	1.0	2.0	2.0	2.0
Phosphorus, max	0.045	0.045	0.02	0.03	0.02
Sulfur, max	0.035	0.03	0.01	0.01	0.01
Silicon, max	1.0	0.5	0.3	0.5	0.5
Nickel	23.00–28.00	24.00–26.00	30.0–32.0	24.00–26.00	30.0–33.0
Chromium	19.00–23.00	19.00–21.00	26.0–28.0	19.00–21.00	31.0–35.0
Molybdenum	4.0–5.0	6.0–7.0	6.0–7.0	6.0–7.0	0.50–2.0
Copper	1.0–2.0	0.8–1.5	1.0–1.4	0.5–1.5	0.30–1.20
Nitrogen	...	0.1–0.2	0.15–0.25	0.15–0.25	0.35–0.60
Iron	balance	balance	balance	balance	balance

**Table 2**

Element	Tolerances Over the Max Limit or Under the Min Limit, %			
	UNS N08925, UNS N08904	UNS N08031	UNS N08926	UNS R20033
Carbon	0.005	0.005	0.005	0.005
Manganese	0.04	0.04	0.04	0.04
Phosphorus	0.005	0.005	0.005	0.005
Sulfur	0.005	0.003	0.003	0.003
Silicon	0.05	0.03	0.03	0.03
Chromium	0.20	0.30	0.25	0.30
Nickel	0.20	0.30	0.25	0.30
Molybdenum	0.10	0.15	0.15	0.05
Copper	0.10	0.04	0.04	0.04
Nitrogen	...	0.01	0.01	0.03

**C. Mechanical and Other Requirements :-**

1. Tensile and Hardness Requirements— The material shall conform to the requirements as to the mechanical property prescribed in Table 3.

**Table 3<sup>A</sup>**

Alloy	Cold Finished and Hot Finished Annealed, All Sizes			
	Tensile Strength, min, psi (MPa)	Yield Strength min, psi (MPa)	Elongation in 2 in. (50.8 mm) , min, %	Forging Quality, All Sizes
UNS N08904	71000 (490)	31000 (220)	35	B
UNS N08925	87000 (600)	43000 (300)	40	B
UNS N08031	94000 (650)	40000 (270)	40	B
UNS N08926	94000 (650)	43000 (295)	35	B
UNS R20033	109000 (750)	55000 (380)	40	B

<sup>A</sup> For wire only, tensile strength 90 000 to 120 000 psi (620 to 830 MPa).

<sup>B</sup> No tensile properties are required on forging quality.

**D. Test Methods :-**

The chemical composition and mechanical properties of the material as enumerated in this specification shall, in case of disagreement, be determined in accordance with the following methods:

<u>Test</u>	<u>ASTM Designation</u>
Chemical analysis	Table 18 of B 649 <sup>A</sup>
Tension	E 8
Brinell hardness	E 10
Rockwell hardness	E 18
Hardness conversion	E 140
Rounding procedure	E 29
Method of sampling	E 55
Spring-back	F 155

<sup>A</sup> Iron shall be determined arithmetically by difference.

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