

SOUTHERLY ALLOY

Incoloy 825 | UNS N08825 | Werkstoff Nr. 2.4858 | NiCr21Mo

ASTM B423 / B424 / B425 / B163 / B564 — Nickel-Iron-Chromium Alloy, All Product Forms

Product Description

Incoloy 825 is a titanium-stabilised nickel-iron-chromium alloy with molybdenum and copper additions, and one grade covers every product form. Copper and molybdenum carry the reducing-acid duty, titanium fixes carbon as carbide so welded joints resist intergranular attack, and a nickel content of 38–46% holds off chloride stress-corrosion cracking. ASTM B424 governs plate, sheet, and strip, B425 governs rod and bar, B423 governs seamless pipe and tube, B163 covers exchanger tube, and B704 with B705 covers welded product. Continuous service holds to about 540 °C.

Chemical Composition

Element	Content (UNS N08825)
Nickel (Ni)	38.0–46.0%
Chromium (Cr)	19.5–23.5%
Iron (Fe)	22.0% min. (balance)
Molybdenum (Mo)	2.5–3.5%
Copper (Cu)	1.5–3.0%
Titanium (Ti)	0.6–1.2%
Carbon (C)	0.05% max.
Manganese (Mn)	1.00% max.
Silicon (Si)	0.50% max.
Aluminium (Al)	0.20% max.
Sulfur (S)	0.03% max.

One composition row serves ASTM B423, B424, B425, B163, B704, and B705, because the grade has a single analysis window across every product form.

Minimum Room-Temperature Mechanical Properties by Product Form

Standard / Form and Condition	Tensile Strength, min.	Yield Strength (0.2%), min.	Elongation, min.
B423 seamless pipe and tube – hot-finished, annealed	≥ 75 ksi (517 MPa)	≥ 25 ksi (172 MPa)	30%
B423 seamless pipe and tube – cold-worked, annealed	≥ 85 ksi (586 MPa)	≥ 35 ksi (241 MPa)	30%
B163 condenser and exchanger tube – annealed	≥ 85 ksi (586 MPa)	≥ 35 ksi (241 MPa)	30%
B704 / B705 welded pipe and tube – annealed	≥ 85 ksi (586 MPa)	≥ 35 ksi (240 MPa)	30%
B424 plate, sheet, and strip – annealed	≥ 85 ksi (586 MPa)	≥ 35 ksi (241 MPa)	30%
B425 rod and bar – annealed	≥ 85 ksi (586 MPa)	≥ 35 ksi (241 MPa)	30%
B564 forgings – solution annealed	≥ 85 ksi (586 MPa)	≥ 35 ksi (241 MPa)	30%
B423 Table X1.1 converter-size tube – annealed	85–115 ksi (586–793 MPa)	≥ 35 ksi (241 MPa)	30%
B423 Table X1.1 converter-size tube – half-hard (No. 2 temper)	105 ksi (724 MPa) min.	≥ 75 ksi (517 MPa)	15%
B423 Table X1.1 converter-size tube – full-hard (No. 3 temper)	125 ksi (862 MPa) min.	≥ 100 ksi (689 MPa)	5%

Each standard prints its own MPa conversion, so the welded routes show 35 ksi (240 MPa) where the seamless and flat routes show 35 ksi (241 MPa). Converter sizes apply below 1¼ in.

(31.8 mm) outside diameter, and hot-forming quality is furnished to chemical and surface requirements alone.

Physical Properties (typical values)

Property	Value
Density	Approx. 8.14 g/cm ³
Melting range	Approx. 1370–1400 °C
Specific heat at 20 °C	Approx. 440 J/kg·K
Modulus of elasticity at 20 °C	Approx. 196 GPa
Shear modulus at 20 °C	Approx. 76 GPa
Poisson's ratio	Approx. 0.29
Thermal conductivity at 25 °C	Approx. 11.1 W/m·K
Thermal expansion, 20–100 °C	Approx. 14.1 µm/m·°C
Electrical resistivity at 25 °C	Approx. 1.13 µΩ·m
Curie temperature	Below –196 °C
Relative permeability at 200 oersted	1.005
Magnetic behaviour	Non-magnetic at ambient temperature

Typical room-temperature values from the Special Metals bulletin for the grade. They support design work rather than acceptance testing.

Applicable Standards

Standard / Designation	Scope
ASTM B424 / ASME SB424	Rolled plate, sheet, and strip – UNS N08825
ASTM B906 / ASME SB906	General requirements and product-form definitions for flat-rolled nickel alloys
ASTM B425 / ASME SB425	Rod and bar
ASTM B423 / ASME SB423 (with B829)	Seamless pipe and tube for general corrosive service
ASTM B163 / ASME SB163	Seamless condenser and heat-exchanger tube, 3 in. (76.2 mm) outside dia. and under
ASTM B704 / B705 (with B751 / B775)	Welded tube, and welded pipe
ASTM B564 / B366	Forgings, including flanges and tube sheets, and wrought pipe fittings
ASME Code Cases N-572 / 1936	Nuclear construction – rod, bar, and forging stock; pipe and tube
NACE MR0175 / ISO 15156	Sour service, 35 HRC maximum in the annealed condition
BS 3072 / 3073 / 3074 / 3076 (NA 16)	British flat, tubular, and bar product standards for the NA 16 series
DIN 17744 / 17750 / 17751 / 17752 / 17753 / 17754	German wrought nickel-alloy standards by product form
ISO 6207 / 6208 / 9723 / 9724 / 9725	ISO tube, flat product, bar, wire, and forging stock
VdTÜV 432 · JIS NCF 825	German pressure-vessel data sheet; Japanese designation
UNS N08825 / W.Nr. 2.4858 / NiCr21Mo	Material designations

No aerospace material specification reaches this grade. The designations below are cross-reference labels rather than separate approvals.

Typical Supply Dimensions

Product Form	Typical Supply Range	Length
Hot-rolled plate	4.76–100 mm thick × up to 2000 mm wide	Up to 6000 mm, or cut to size
Cold-rolled sheet	0.5–4.76 mm thick × up to 1500 mm wide	Up to 6000 mm, or cut to size
Cold-rolled strip	0.1–4.76 mm thick × 10–600 mm wide	Coil, or cut to length
Seamless pipe	6–219 mm outside dia.	Random, or cut to length
Seamless exchanger tube	6–76 mm outside dia. × 0.5–3.76 mm wall	Random, U-bent, or cut to length
Welded pipe and tube	1.6–762 mm outside dia.	Random, coil, or cut to length
Round, hex, square, and forged bar	6–500 mm	Cut to length, or to drawing

Service ceiling: about 540 °C (1000 °F) in continuous service, above which phase formation lowers ductility and impact strength, so designers avoid the grade where creep-rupture

governs. ASME Section VIII allowables stop at 800 °F (427 °C), and NACE MR0175 / ISO 15156 lists the grade in the solution-annealed condition at 35 HRC maximum. Toughness holds

down to –196 °C and beyond.

Southerly Alloy — nickel alloy bar, rod, pipe, tube, plate and fittings · www.southerly-alloy.com · Values are for reference; the mill test certificate prevails for final acceptance.

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