SOUTHERLY ALLOY

Alloy 59 | UNS N06059 | Werkstoff Nr. 2.4605 | NiCr23Mo16Al | NS3311

ASTM B574 / B575 / B622 / B619 / B626 / B564 / B366 — Nickel-Chromium-Molybdenum Alloy, All Product Forms

Product Description

Alloy 59 is a nickel-chromium-molybdenum alloy carrying the UNS N06059 grade, and iron holds at 1.5% maximum, roughly a quarter of the ceiling in C-276. That restraint keeps the matrix close to a pure solid solution, so the passive film recovers faster after a process upset. Chromium at 22.0–24.0% and molybdenum at 15.0–16.5% cover oxidising and reducing media in one heat, and the pitting resistance equivalent sits near 75. Carbon at 0.010% maximum and silicon at 0.10% maximum support welded service, and every lot leaves the furnace into a water quench.

Chemical Composition

Element	Content (UNS N06059)	Element	Content (UNS N06059)
Nickel (Ni)	Balance	Chromium (Cr)	22.0–24.0%
Molybdenum (Mo)	15.0–16.5%	Iron (Fe)	1.5% max.
Aluminum (Al)	0.10–0.40%	Copper (Cu)	0.50% max.
Manganese (Mn)	0.50% max.	Cobalt (Co)	0.30% max.
Silicon (Si)	0.10% max.	Carbon (C)	0.010% max.
Phosphorus (P)	0.015% max.	Sulfur (S)	0.010% max.

Iron at 1.5% maximum and silicon at 0.10% maximum are the deliberate restraints behind the grade, and aluminium is the small deliberate addition. ASTM B574, B575, and B564 share this one composition table, so a single window governs every product form. The mill certificate governs final acceptance.

Minimum Room-Temperature Mechanical Properties

Standard / Form and Condition	Tensile Strength, min.	Yield Strength (0.2%), min.	Elongation, min.
Bar, rod, and wire, ASTM B574 – solution annealed	≥ 100 ksi (690 MPa)	≥ 45 ksi (310 MPa)	45%
Plate, sheet, and strip, ASTM B575 – solution annealed	≥ 100 ksi (690 MPa)	≥ 45 ksi (310 MPa)	45%
Seamless pipe and tube, ASTM B622 – solution annealed	≥ 100 ksi (690 MPa)	≥ 45 ksi (310 MPa)	45%
Welded pipe, ASTM B619 – solution annealed	≥ 100 ksi (690 MPa)	≥ 45 ksi (310 MPa)	45%
Welded tube, ASTM B626 – solution annealed	≥ 100 ksi (690 MPa)	≥ 45 ksi (310 MPa)	45%

ASTM B574, B575, B619, B622, and B626 print one row set for UNS N06059, so no form carries a lower floor than another. Each of those documents carries three columns and prints no hardness requirement against this grade, so release rests on chemistry and on tensile results. A separate European data sheet applies a higher yield floor of 340 MPa, and that regime is not the ASTM one.

Physical Properties (typical values)

Property	Value
Density	Approx. 8.6 g/cm³
Melting range	Approx. 1310–1360 °C
Modulus of elasticity	Approx. 210 GPa
Thermal conductivity at 20 °C	Approx. 10.4 W/m·K
Electrical resistivity at 20 °C	Approx. 1.26 µΩ·m
Specific heat at 20 °C	Approx. 414 J/kg·K
Thermal expansion, 20–100 °C	Approx. 11.9 µm/m·°C
Relative magnetic permeability at 20 °C	1.001 max.
Strengthening route	Cold work only

Typical values published for the grade, intended for design work rather than acceptance testing. The alloy stays essentially non-magnetic, which suits instrument assemblies in acid duty. Cold work is the only route above the annealed floor.

Applicable Standards

Standard / Designation	Scope
ASTM B574 / ASME SB574	Bar, rod, and wire
ASTM B575 / ASME SB575	Plate, sheet, and strip
ASTM B622 / ASME SB622	Seamless pipe and tube
ASTM B619 / ASME SB619	Welded pipe
ASTM B626 / ASME SB626	Welded tube and heat-exchanger tube
ASTM B564 / B366 / B462 / B472	Forgings and forging stock; wrought fittings; forged flanges; forging billets
VdTÜV 505	German pressure-equipment approval
DIN 17750 / 17752 / 17744 / 17754	Flat product, bar, strip and wire, forgings
NACE MR0175 / ISO 15156-3	Sour service qualification for oil and gas
API 5LD	Welded strip for line pipe
UNS N06059 · W.Nr. 2.4605 · NiCr23Mo16Al · GB/T 15007 NS3311	Material designations
SAE AMS	No aerospace specification covers this grade

Alloy 59 has no aging response, so cold work sets every figure above the annealed floor, and welded joints usually enter service as welded. Solution annealing sits at 1100–1180 °C followed by a water quench, because the low silicon content makes secondary phases form quickly on a slow cool. Filler metal: ERNiCrMo-13 to AWS A5.14, or ENiCrMo-13 to AWS A5.11.

Typical Supply Dimensions

Product Form	Typical Supply Range	Length
Bar and rod	6–300 mm diameter to ASTM B574	Cut to length or random
Forged bar	200–1000 mm diameter to ASTM B564	Cut to length
Seamless tube	Outside diameter 6–219 mm	Random, or cut to length
Welded pipe	Schedule 5S to XXS, heavy wall by agreement	Random, or cut to length
Welded tube	Outside diameter 3.2–88.9 mm	Random, or cut to length
Plate	4.76–63.5 mm thick to ASTM B575	Cut to length and width
Sheet and strip	Under 4.76 mm thick; sheet from 600 mm wide, strip narrower	Coil, or cut to length

Bar sizes follow ASTM B574, and tubular sizes follow the scope each of B622, B619, and B626 defines. ASME pressure-vessel rules cover service from about −196 to +450 °C.

Surface Finishes

Surface Condition	Typical Use
Solution annealed and pickled	Standard delivery for acid and chloride service
Hot-worked	As-rolled or as-forged surface for parts that will be machined
Cold drawn	Close diameter control with a brighter surface
Peeled	Uniform diameter with a machined skin for further turning
Centerless ground	Tight diameter and straightness for shafting
Polished	Reduced roughness for product-contact and visible parts
Bright annealed	Scale-free surface for instrument and clean circuits