

# 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 / Hardness, min. |
|--------------------------------------------------------|------------------------|-----------------------------|-----------------------------|
| Bar, rod, and wire, ASTM B574 – solution annealed      | ≥ 100 ksi (690 MPa)    | ≥ 45 ksi (310 MPa)          | 45%, 100 HRB max.           |
| Plate, sheet, and strip, ASTM B575 – solution annealed | ≥ 100 ksi (690 MPa)    | ≥ 45 ksi (310 MPa)          | 45%, 100 HRB max.           |
| Seamless pipe and tube, ASTM B622 – solution annealed  | ≥ 100 ksi (690 MPa)    | ≥ 45 ksi (310 MPa)          | 45%, 100 HRB max.           |
| Welded pipe, ASTM B619 – solution annealed             | ≥ 100 ksi (690 MPa)    | ≥ 45 ksi (310 MPa)          | 45%, 100 HRB max.           |
| Welded tube, ASTM B626 – solution annealed             | ≥ 100 ksi (690 MPa)    | ≥ 45 ksi (310 MPa)          | 45%, 100 HRB max.           |

ASTM B574, B575, B619, B622, and B626 print one row set for UNS N06059, so no form carries a lower floor than another. A separate European data sheet applies a higher yield floor of 340 MPa, and that regime is not the ASTM one. Hardness figures are informative only and do not serve as a basis for rejection.

## Physical Properties (typical values)

| Property                                | Value                         |
|-----------------------------------------|-------------------------------|
| Density                                 | Approx. 8.6 g/cm <sup>3</sup> |
| 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           |

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