# Alleima

# Sanicro® 276

## Tube and pipe, seamless

## Datasheet

Sanicro® 276 (UNS N10276) is a nickel-chromium-molybdenum alloy suitable for service in a broad range of severe environments and is characterized by:

- Superior corrosion resistance in $H_2S$, $CO_2$ and chloride containing environments
- Excellent resistance to pitting corrosion owing to its high PRE* value of 68
- Excellent corrosion resistance in hydrochloric acid

*PRE = %Cr + 3.3 x %Mo + 16 x %N

## Standards

- UNS: N10276
- W.Nr.: 2.4819

**Product standard**

- ASTM B622

## Chemical composition (nominal)

**Chemical composition (nominal) %**

| C | Si | Mn | P | S | Cr | Ni | Mo | W | Fe | Co | V |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ≤0.010 | ≤0.08 | ≤1.0 | ≤0.030 | ≤0.015 | 16 | 57 | 16 | 3.5 | 4.5 | <2.5 | ≤0.35 |

## Applications

The grade is suitable for use in a number of severe industrial environments, such as mixed acid chemical processing, pulp and paper production, industrial and municipal waste treatment and oil and gas.

## Corrosion resistance

Sanicro® 276 has excellent corrosion resistance in a wide range of severe environments. It is resistant to

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general corrosion, localized pitting corrosion and environmental cracking in a wide range of aggressive media.

**Pitting and crevice corrosion**

The relative resistance of alloys to pitting corrosion can be estimated based on the chemical composition using the Pitting Resistance Equivalent number (PRE). Alloys with higher PRE values generally have better corrosion resistance compared to alloys with lower PRE values.

There are several different equations available for calculating the PRE from the chemical composition. In this document the equation specified in NACE MR0175 is used: *PRE = %Cr + 3.3 (%Mo + 0.5W) +16%N

Pitting resistance equivalent numbers (PRE)

| Alloy | UNS | PRE* |
|---|---|---|
| Sanicro® 276 | N10276 | 68 |
| Sanicro® 28 | N08028 | 38 |

**Stress corrosion cracking**

The high levels of nickel, molybdenum and chromium in Sanicro® 276 make the alloy highly resistant to sour environments containing high levels of $H_2S$, $CO_2$ and chlorides. The NACE standard MR 0175 is widely used for selecting material for use in $H_2S$-containing environments in the oil and gas industry. According to NACE MR0175 Sanicro® 276 (UNS N10276) can be used in up to 1000 psi partial pressure $H_2S$ at 232°C (450°F) with no limitation on the chloride concentration. Below 204°C (400°F) there is no limit on the $H_2S$ level or chloride concentration.

## Forms of supply

Sanicro® 276 seamless nickel-chromium-molybdenum alloy is supplied bright annealed in the outside diameter range 6 - 42 mm (0.25" - 1.625") and wall-thickness 0.89 - 5.0 mm (0.035" - 0.197").

Tubing is supplied in:

- Hard condition
- Annealed condition

### Tolerances

**Sanicro® 276, OD 6-42 mm EN 10305-1**

| OD, mm | OD, mm | Wall thickness % |
|---|---|---|
| 6-30 | +/-0.08 | +/-10 |
| 32-40 | +/-0.15 | +/-10 |
| 42 | +/-0.20 | +/-10 |

## Mechanical properties

**At 20°C, metric units**

| Proof strength | Tensile strength | Elongation |
|---|---|---|

| $R_{p0.2}$ [1)] | $R_m$ | $A_{2"}$ |
|---|---|---|
| **MPa** | **MPa** | **%** |
| ≥283 | ≥690 | ≥40 |

### At 68°F, imperial units

| Proof strength | Tensile strength | Elongation |
|---|---|---|
| $R_{p0.2}$ [1)] | $R_m$ | $A_{2"}$ |
| **ksi** | **ksi** | **%** |
| ≥41 | ≥100 | ≥40 |

1) Corresponds to 0.2% offset yield strength

## Physical properties

Density: 8.89 g/m$^3$ (0.321 lb/in$^3$)

### Thermal conductivity

| Temperature, °C | W/(m °C) | Temperature, °F | Btu/(ft h°F) |
|---|---|---|---|
| **-168** | **7.2** | **-270** | **4.2** |
| **-73** | **8.7** | **-99** | **5** |
| 20 | 9.8 | 68 | 5.7 |
| 100 | 11.2 | 200 | 6.5 |
| 200 | 12.8 | 400 | 7.4 |
| 300 | 14.7 | 600 | 8.5 |
| 400 | 16.4 | 800 | 9.5 |
| 500 | 18.2 | 1000 | 10.5 |
| 600 | 20.0 | 1200 | 11.6 |
| 700 | 21.9 | 1400 | 12.7 |
| 800 | 23.7 | 1600 | 13.7 |
| 900 | 25.4 | 1800 | 14.7 |

### Specific heat capacity

| Temperature, °C | J/(kg °C) | Temperature, °F | Btu/(lb °F) |
|---|---|---|---|
| 20 | 427 | 68 | 0.10 |

### Thermal expansion, mean values in temperature ranges (x10$^{-6}$)

| Temperature, °C | Per °C | Temperature, °F | Per °F |
|---|---|---|---|
| 25-100 | 12.2 | 77-200 | 6.8 |
| 25-200 | 12.4 | 77-400 | 7 |
| 25-300 | 12.9 | 77-600 | 7.2 |
| 25-400 | 13.2 | 77-800 | 7.4 |
| 25-500 | 13.5 | 77-1000 | 7.5 |
| 25-600 | 13.6 | 77-1200 | 7.7 |
| 25-700 | 14.1 | 77-1400 | 8.1 |
| 25-800 | 14.8 | 77-1600 | 8.5 |

### Resistivity

| Temperature, °C | µΩm | Temperature, °F | µΩin. |
|---|---|---|---|
| 20 | 1.30 | 68 | 51.2 |
| 100 | 1.32 | 200 | 52.0 |
| 200 | 1.34 | 400 | 52.8 |
| 300 | 1.35 | 600 | 53.2 |
| 400 | 1.36 | 800 | 53.5 |
| 500 | 1.37 | 1000 | 54.3 |
| 600 | 1.38 | 1200 | 54.3 |
| 700 | 1.38 | 1400 | 53.9 |
| 800 | 1.38 | 1600 | 54.7 |
| 900 | 1.38 | 1800 | 53.1 |

### Modulus of elasticity (x10$^3$) (annealed condition)

| Temperature, °C | MPa | Temperature, °F | ksi |
|---|---|---|---|
| 25 | 205 | 77 | 29.7 |
| 100 | 203 | 200 | 29.4 |
| 200 | 198 | 400 | 28.7 |
| 300 | 192 | 600 | 27.8 |
| 400 | 186 | 800 | 27 |
| 500 | 180 | 1000 | 26.1 |
| 600 | 178 | 1200 | 25.8 |
| 700 | 167 | 1400 | 24.2 |
| 800 | 159 | 1600 | 23 |

## Welding

The weldability of Sanicro® 276 is good. Suitable methods of fusion welding are manual metal-arc welding (MMA/SMAW) and gas-shielded arc welding, with the TIG/GTAW method as first choice.

For Sanicro® 276, heat-input of <1.2 kJ/mm and interpass temperature of <100°C (210°F) are recommended. A string bead welding technique should be used.

### Recommended filler metals

TIG/GTAW or MIG/GMAW welding

ISO 18274 S Ni 6276/AWS A5.14 ERNiCrMo-4 (e.g. Exaton Ni56)

MMA/SMAW welding

ISO 14172 E Ni 6276/AWS A5.11 ENiCrMo-4



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