Technical Whitepaper: Hastelloy C-276 (UNS N10276) – The Definitive Guide to Universal Corrosion Resistance

Executive Summary

Hastelloy C-276 (UNS N10276 / W.Nr. 2.4819) is a nickel-molybdenum-chromium-tungsten alloy that serves as the global benchmark for corrosion resistance in the chemical processing and marine industries. Recognized for its ability to handle both oxidizing and reducing media, C-276 is often the "material of last resort" when standard stainless steels fail. In 2026, its role is pivotal in green hydrogen production and advanced pharmaceutical synthesis. This whitepaper provides a comprehensive metallurgical audit of C-276, including strict ASTM composition limits, melting protocols, and real-world failure prevention.

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1. Global Standard Compliance

Shanghai Hangbo Alloy Group supplies Hastelloy C-276 in compliance with the most stringent global engineering codes.

Standard Body	Specification	Form / Product Type
ASTM (International)	**ASTM B575**	Plate, Sheet, and Strip
ASTM (Piping)	**ASTM B622 / B619**	Seamless and Welded Pipe
ASME (Pressure)	**ASME SB-575**	Identical to ASTM B575 for Pressure Vessels
NACE (Corrosion)	**NACE MR0175 / ISO 15156**	Sour Service (Oil & Gas) Compliance
DIN (German)	**DIN 17750**	Nickel and Nickel Alloy Sheet/Strip

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2. Melting & Purity Control: VIM-ESR Synergy

For Hastelloy C-276, the primary challenge is maintaining ultra-low Carbon (0.01% max) and Silicon (0.08% max) levels while ensuring uniform distribution of Molybdenum and Tungsten.

2.1 The Need for Low Carbon

Carbon is the enemy of corrosion resistance in C-276. If Carbon levels exceed 0.015%, chromium-carbide precipitates form at the grain boundaries during welding. This leads to intergranular corrosion in the heat-affected zone (HAZ). We utilize **Vacuum Induction Melting (VIM)** to achieve this extreme precision.

2.2 Electroslag Remelting (ESR)

ESR is used to refine the ingot structure. Tungsten (W) is a heavy element and prone to segregation. ESR remelting through a specialized slag bath ensures that the Tungsten and Molybdenum are distributed

uniformly across the entire section, preventing "soft spots" in corrosion resistance.

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3. Strict Chemical Composition (ASTM B575)

The precise "cocktail" of elements makes C-276 the universal choice.

Element	Symbol	Min (%)	Max (%)	Critical Role in C-276
Nickel	**Ni**	**Balance**	**Balance**	Austenitic matrix; provides resistance to SCC.
Molybdenum	**Mo**	**15.00**	**17.00**	Resistance to **Reducing** acids (HCl, H■SO■) and Pitting.
Chromium	**Cr**	**14.50**	**16.50**	Resistance to **Oxidizing** media (Nitric, Wet Chlorine).
Iron	**Fe**	**4.00**	**7.00**	Controls cost and stabilizes the matrix.
Tungsten	**W**	**3.00**	**4.50**	Synergistic pitting resistance in chloride environments.
Cobalt	**Co**	-	**2.50**	Improves stability at elevated temperatures.
Carbon	**C**	-	**0.01**	**Critical:** Prevents HAZ sensitization and corrosion.
Silicon	**Si**	-	**0.08**	**Critical:** Prevents deleterious Mu-phase formation.
Manganese	**Mn**	-	**1.00**	Deoxidizer; improves weld fluidity.
Phosphorus	**P**	-	**0.04**	Trace impurity; strictly restricted.
Sulfur	**S**	-	**0.03**	Trace impurity; strictly restricted.
Vanadium	**V**	-	**0.35**	Aids in grain refinement.

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4. Mechanical & Physical Properties

Despite its primary role as a corrosion-resistant alloy, C-276 possesses high tensile strength.

4.1 Mechanical Properties (Annealed)

Property	Metric Value	Imperial Value	Requirement (ASTM B575)
Tensile Strength (UTS)	790 MPa	115 ksi	Min 690 MPa
Yield Strength (0.2% Offset)	355 MPa	52 ksi	Min 283 MPa
Elongation (%)	60%	60%	Min 40%
Hardness	90 HRB	90 HRB	Max 100 HRB

4.2 Physical Properties

- **Density**: 8.89 g/cm³
- **Melting Range**: 1325°C – 1370°C
- **Thermal Conductivity**: 10.2 W/m·K (at 100°C)
- **Pitting Resistance Equivalent (PREN)**: **68 - 72** (Universal Grade)

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5. Fabrication, Machining & Welding Masterclass

5.1 The "Over-Alloyed" Welding Rule

When welding C-276, the weld metal solidifies with a different microstructure than the parent plate. To compensate for Molybdenum segregation, we mandate the use of **ERNiCrMo-4** filler.

- **Interpass Temperature**: Must be kept below **100°C** to prevent the formation of brittle Mu-phase precipitates.
- **Gas Shielding**: High-purity Argon is required for both the face and root to prevent oxidation.

5.2 Machining Strategy

C-276 work-hardens significantly faster than stainless steel.

- **Strategy**: Rigid setup, heavy-duty machines, and slow cutting speeds.
- **Tools**: Sub-micron tungsten carbide. The tool must never dwell on the surface; continuous positive feed is mandatory to stay below the work-hardened layer.

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6. Industrial Applications & Case Studies

6.1 Pollution Control: Flue Gas Desulfurization (FGD)

Scenario: Scrubber linings handling hot SO■ gases and acidic slurries.

Case Study: A coal-fired power plant switched from 317L to C-276 wallpaper lining in the scrubber inlet. The 317L failed due to "pitting-to-perforation" in 14 months. The C-276 section showed <0.02 mm/y corrosion after 10 years of identical service.

6.2 Chemical Synthesis: Boiling Hydrochloric Acid (HCl)

Scenario: Reactors handling 10% HCl at 100°C.

Case Study: A pharmaceutical plant reactor suffered a catastrophic leak. Failure analysis found that the material was sold as "C-276" but had a Carbon content of 0.05%. This led to intergranular attack. Replacement with **Hangbo Certified 0.01% Carbon C-276** solved the issue.

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7. Technical FAQ

Q: Can C-276 be used in Nitric acid?
A: It is resistant, but for purely oxidizing nitric service, Alloy C-22 or Inconel 690 are technically superior.

Q: Is C-276 magnetic?
A: No, it is a fully austenitic, non-magnetic alloy.

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