
304 / 304L Stainless Steel – Technical Material Specification

1.0 Material Overview & Common Uses

304 and 304L are the most widely used austenitic stainless steels, offering excellent corrosion resistance, high toughness, and good formability. Grade 304L has a lower carbon content (max 0.03%) to minimize carbide precipitation during welding, making it preferred for heavy-gauge welded components. Common applications include food processing equipment, chemical containers, heat exchangers, architectural trim, kitchen sinks, and pharmaceutical piping.

2.0 Core Technical Properties & Sizing

- Density: 7.93 g/cm³ (0.286 lb/in³)
- Melting range: 1400–1450°C (2550–2640°F)
- Tensile strength (304): 515 MPa min (75 ksi min)
- Yield strength (304): 205 MPa min (30 ksi min)
- Tensile strength (304L): 485 MPa min (70 ksi min)
- Yield strength (304L): 170 MPa min (25 ksi min)
- Elongation in 50 mm: 40% min (both grades)
- Hardness (Rockwell B): 92 max (304), 88 max (304L)
- Modulus of elasticity: 193 GPa (28,000 ksi)
- Standard sheet/plate thickness: 0.5 mm to 50 mm (0.020 to 2.000 in)
- Standard sheet/plate width: 48 in, 60 in (1220 mm, 1524 mm)
- Length tolerance (sheared): ±1/8 in per 8 ft (3.2 mm per 2.4 m)
- Flatness tolerance (annealed): 1/4 in per 4 ft (6.4 mm per 1.2 m) for thickness < 3/16 in
- Surface finish options: 2B (mill finish), No. 4 (brushed), BA (bright annealed), #8 (mirror polish)

3.0 Processing, Machinability & Application

304/304L is considered moderately difficult to machine due to its high work-hardening rate and low thermal conductivity. Use sharp, positive-rake carbide tooling with generous chip clearance. Flood coolant is essential to control heat and prevent work hardening. For welding, 304L is preferred for sections over 6 mm (1/4 in) to avoid sensitization and intergranular corrosion. ER308L filler metal is standard for TIG/MIG welding. Post-weld annealing is not required for 304L but may be specified for 304 in corrosive environments.

- Cutting speed (carbide): 100–150 SFM (30–45 m/min) for turning; 80–120 SFM (24–37 m/min) for milling.
- Feed rate (turning): 0.005–0.015 in/rev (0.13–0.38 mm/rev).
- Depth of cut: 0.020–0.100 in (0.5–2.5 mm) for roughing; 0.005–0.020 in (0.13–0.5 mm) for finishing.
- Use a 30–45 degree helix end mill for slotting and profiling to reduce chatter.
- Drilling: Use 135-degree split-point carbide drills; peck cycle recommended for holes deeper than 3x diameter.

- Welding: Preheating not required; interpass temperature max 150°C (300°F) to avoid carbide precipitation.
- Filler metal: ER308L for TIG/GTAW; E308L-16 for SMAW (stick); ER308LSi for faster wetting in MIG.
- Shielding gas: 98% Ar / 2% O₂ for MIG; 100% Ar for TIG (with optional 5% H₂ for faster travel speeds).
- Forming: Can be deep drawn, bent, and roll formed; use generous bend radii (2x thickness min) to avoid cracking.
- Heat treatment: Anneal at 1010–1120°C (1850–2050°F) followed by rapid quench; do not stress relieve between 425–870°C (800–1600°F).

4.0 Common Defects & Quality Control

- Reject if surface pits, scratches, or die marks exceed 0.005 in (0.13 mm) depth on visible surfaces.
- Reject if any longitudinal or transverse cracks are visible under 5x magnification.
- Reject if out-of-flatness exceeds 1/4 in per 4 ft (6.4 mm per 1.2 m) for sheet/plate under 3/16 in (4.8 mm) thickness.
- Reject if out-of-square exceeds 1/16 in per 12 in (1.6 mm per 305 mm) on sheared edges.
- Reject if thickness variation exceeds ±0.005 in (0.13 mm) for nominal thickness up to 0.125 in (3.2 mm); ±0.010 in (0.25 mm) for thicker material.
- Reject if any evidence of intergranular corrosion (sensitization) is found via ASTM A262 Practice E (Strauss test) for welded components.
- Reject if hardness exceeds 92 HRB (304) or 88 HRB (304L) per ASTM A240.
- Reject if chemical composition deviates from ASTM A240 limits: Cr 18.0–20.0%, Ni 8.0–10.5%, C ≤0.08% (304) / ≤0.03% (304L).
- Reject if surface contamination (oil, grease, carbon steel particles) is present; passivation test (ASTM A967) must show no free iron.

5.0 Storage, Handling & WHMIS Guidelines

- Store indoors in a dry, climate-controlled environment below 60% relative humidity to prevent surface staining.
- Do not store in direct contact with carbon steel or other metals to avoid galvanic corrosion and cross-contamination.
- Use plastic or wooden dunnage between stacked sheets; avoid rubber mats that may contain chlorides.
- Shelf life: Indefinite if stored properly; FIFO recommended to maintain surface finish quality.
- WHMIS 2015: Solid stainless steel is not classified as a hazardous product under GHS. However, dust, fume, and swarf generated during machining/welding are hazardous.
- Welding fume: Contains chromium (VI) and nickel compounds; classified as carcinogenic (GHS08). Use local exhaust ventilation and respiratory protection (N95 or P100).
- Grinding dust: Avoid inhalation; use wet grinding methods or HEPA vacuum. Do not dry sweep.
- Mandatory PPE: Safety glasses with side shields, cut-resistant gloves (ANSI A4 or higher), and steel-toed boots during handling.
- For welding: Wear auto-darkening welding helmet (shade 10–12), leather gauntlet gloves, and flame-resistant clothing.
- First aid: For fume inhalation, move to fresh air; for skin contact with dust, wash with mild soap and water; for eye contact, flush with water for 15 minutes.
- Spill procedure: Sweep up solid dust with non-sparking tools; place in sealed metal container. Do not flush to drains.

Regulatory Disclaimer: This document is a generic technical material specification provided for educational purposes. The end-user assumes all liability for reviewing, adapting, and validating all tolerances, properties, and safety protocols against specific OEM data sheets and local regulations before deployment.