Detailed Overview of 303 and 416 Stainless Steel

This document provides an in-depth analysis of 303 and 416 stainless steel, detailing their chemical composition, mechanical properties, corrosion resistance, machinability, weldability, and common applications. These grades are known for their specific strengths in machinability and performance.

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303 Stainless Steel

Chemical Composition

- **Chromium (Cr):** 17–19%
- **Nickel (Ni):** 8–10%
- **Carbon (C):** ≤ 0.15%
- **Manganese (Mn):** ≤ 2%
- **Silicon (Si):** ≤ 1%
- **Phosphorus (P):** ≤ 0.2%
- **Sulfur (S):** 0.15–0.35%
- **Iron (Fe):** Balance

Mechanical Properties

- **Tensile Strength:** 500–700 MPa
- **Yield Strength:** 190 MPa (minimum)
- **Elongation:** 35% (minimum in 2-inch gauge length)
- **Hardness:** ≤ 190 HB

Corrosion Resistance

303 offers good corrosion resistance in mild environments, such as atmospheric exposure and mild acids. The inclusion of sulfur for improved machinability slightly reduces its resistance to highly corrosive environments compared to other austenitic grades like 304.

Machinability

303 is one of the easiest stainless steels to machine. The added sulfur improves chip-breaking during machining, but it can reduce weldability and toughness.

Weldability

303 is not ideal for welding due to its sulfur content, which can cause hot cracking. Weldability may be improved by using a low-carbon filler material, but it's generally not recommended for applications requiring extensive welding.

Common Applications

- Fasteners (bolts, screws)
- Automotive and marine fittings
- Electrical equipment components
- Gears and shafts
- Valve bodies

Additional Notes

- If welding and higher corrosion resistance are required, consider other grades like 304 or 316.
- Best suited for machining-intensive applications where corrosion resistance is secondary.

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416 Stainless Steel

Chemical Composition

- **Chromium (Cr):** 12–14%
- **Nickel (Ni):** None (trace amounts only)
- **Carbon (C):** ≤ 0.15%
- **Manganese (Mn):** ≤ 1.25%
- **Silicon (Si):** ≤ 1%
- **Phosphorus (P):** ≤ 0.06%
- **Sulfur (S):** 0.15–0.35%
- **Iron (Fe):** Balance

Mechanical Properties

- **Tensile Strength:** 540–770 MPa
- **Yield Strength:** 290 MPa (minimum)
- **Elongation:** Approximately 30%
- **Hardness:** ≤ 220 HB

Corrosion Resistance

416 offers moderate corrosion resistance, lower than that of austenitic stainless steels. It performs well in mildly corrosive environments and industrial settings but is not suitable for high-chloride or marine environments.

Machinability

416 is one of the most machinable stainless steels, making it highly popular in production involving high-speed machining. This property is achieved due to its high sulfur content.

Weldability

Similar to 303, 416 has poor weldability due to its sulfur content, which can lead to hot cracking. Pre- and post-weld thermal treatments may help, but 416 is generally not preferred for welded assemblies.

Common Applications

- Gears and pinions
- Bearings
- Pump shafts
- Valves and spindles
- Cutting tools

Additional Notes

- Heat treatments can enhance hardness and strength in 416.
- 416 is ideal for applications needing a combination of high machinability and moderate corrosion resistance.

Key Comparison at a Glance

Feature	303 Stainless Steel	416 Stainless Steel
Chromium Content	17 – 19%	12 – 14%
Sulfur Content	0.15 – 0.35%	0.15 – 0.35%
Machinability	Excellent	Superior
Corrosion Resistance	Moderate (better than 416)	Moderate
Primary Use Case	Machined components (e.g., fasteners)	Machined components (e.g., shafts, gears)

Choosing Between 303 and 416

- Opt for **303** when high corrosion resistance and excellent machinability are needed, especially in environments not demanding extensive welding.
- Choose **416** when extreme machinability and hardness are critical, provided corrosion resistance is not the primary concern.

Contact Us

For further questions or help selecting the right stainless steel grade for your project, don’t hesitate to contact our team. Download this PDF using the "View More" button for easy access to the information.