

AISI 440C Stainless Steel

Technical Datasheet — Forged Bars, Rings, Shafts & Components

UNS S44004 | SUS 440C | X105CrMo17 / DIN 1.4125 | GB 9Cr18Mo

Jiangsu Liangyi Co., Limited · ISO 9001:2015 Certified · Est. 1997 · 80,000 sqm Facility

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Density 7.80 g/cm ³	Melting Pt 1483°C	Max Hardness 58–60 HRC	Tensile Strength ≥1965 MPa	Forging Range 925–1150°C	Elastic Modulus 200 GPa
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1. Definition & Overview

AISI 440C (also designated UNS S44004, JIS SUS 440C, DIN X105CrMo17 / 1.4125, GB 9Cr18Mo) is a **high-carbon (1.0–1.2% C), high-chromium (16–18% Cr) martensitic stainless steel**. It achieves the **highest hardness (58–60 HRC) of any commercial stainless steel** after quenching and tempering, with a density of 7.80 g/cm³, melting point of 1483°C, elastic modulus of 200 GPa, and tensile strength ≥1965 MPa. AISI 440C is the preferred material for bearings, valves, cutting tools, gage blocks, and high-wear industrial parts.

Key Designations: AISI 440C / SAE 51440C | UNS S44004 | SUS 440C (JIS) | X105CrMo17 / 1.4125 (EN/DIN) | 9Cr18Mo / 9Cr18 (GB) | 95Kh18 (GOST)

2. International Equivalent Grades & Standards

Standard	Designation	Specification / Norm
AISI/SAE (USA)	AISI 440C / SAE 51440C	ASTM A276, A473, A580
UNS (USA)	UNS S44004	ASTM A276, A473
AMS (Aerospace)	AMS 5618, 5630, 5880	SAE AMS
EN / DIN	X105CrMo17 / 1.4125	EN 10088-3, DIN 17440
JIS (Japan)	SUS 440C	JIS G4303, G4304
GB (China)	9Cr18Mo / 9Cr18	GB/T 1220, GB/T 3280
GOST (Russia)	95Kh18	GOST 5632
BS (UK)	BS 440C	BS 970

Source: ASTM Steel, AZoM

Key Takeaway: Always verify the exact standard (ASTM A276 for bars, A473 for forgings, AMS 5630 for aerospace) and required test certificates for your specific project.

3. Chemical Composition — ASTM A276 / A473

The high carbon (1.0–1.2%) combined with high chromium (16–18%) forms a large volume of Cr₂₃C₆ carbides, ensuring exceptional hardness and wear resistance.

Element	Wt% Range	Function
Iron (Fe)	Balance (78–83)	Base matrix element

Chromium (Cr)	16.0 – 18.0	Passive oxide layer for corrosion resistance; forms carbides for hardness
Carbon (C)	1.0 – 1.2	Primary hardening element; enables 60 HRC and maximum wear resistance
Manganese (Mn)	0 – 1.0	Improves hardenability and hot workability
Silicon (Si)	0 – 1.0	Deoxidizer; enhances strength
Molybdenum (Mo)	0 – 0.75	Improves temper resistance and pitting corrosion resistance
Phosphorus (P)	0 – 0.040	Controlled to minimize brittleness
Sulfur (S)	0 – 0.015	Controlled for optimal toughness

Source: ASTM A276

4. Physical & Thermal Properties

Property	Metric	Imperial
Density	7.80 g/cm ³	0.282 lb/in ³
Melting Point	1483°C	2700°F
Elastic Modulus	200 GPa	29,000 ksi
Shear Modulus	83.9 GPa	12,200 ksi
Bulk Modulus	166 GPa	24,100 ksi
Poisson's Ratio	0.27 – 0.30	—
Thermal Conductivity	24.2 W/m·K	168 BTU·in/hr·ft ² ·°F
Thermal Expansion (CTE)	10.2 μm/m·°C	5.67 μin/in·°F
Specific Heat	0.460 J/g·°C	0.110 BTU/lb·°F
Magnetic	Ferromagnetic (all conditions)	—

Sources: MatWeb, AZoM

Important: AISI 440C has relatively low thermal conductivity (24.2 W/m·K vs ~50 for carbon steels). Temperature must be controlled carefully during forging and machining to prevent thermal cracking.

5. AISI 440C vs 440A vs 440B vs 420 — Grade Comparison

Property	440C	440B	440A	420
Carbon (%)	1.0–1.2	0.75–0.95	0.60–0.75	0.15–0.40
Chromium (%)	16–18	16–18	16–18	12–14
Max HRC	58–60	56–58	54–56	50–52
Tensile (MPa)	≥1965	≥1860	≥1750	≥1550
Corrosion Res.	Moderate	Moderate	Good	Good
Toughness	Low	Low–Med	Medium	Med–High
Wear Resistance	Excellent	Very Good	Good	Moderate
Forging °C	925–1150	925–1175	925–1200	900–1200
Applications	Bearings, valve seats, dies	Cutting tools, instruments	Surgical, knives, cutlery	Plastic molds, knives

Sources: AZoM, Forged Product

Selection Guide: Choose 440C for maximum hardness and wear (bearings, valve seats, dies). Choose 440A for better corrosion resistance and toughness (surgical instruments, cutlery). Choose 440B as a balanced compromise.

6. Mechanical Properties — Guaranteed Delivery Values (Q&T;)

All parts supplied quenched and tempered (Q&T;), meeting or exceeding ASTM A276 and ASTM A473:

Property	Guaranteed Value	Test Standard
Tensile Strength	≥ 1965 MPa (285 ksi)	ASTM E8
Yield Strength (0.2%)	≥ 1896 MPa (275 ksi)	ASTM E8
Elongation	≥ 2%	ASTM E8
Reduction of Area	≥ 5%	ASTM E8
Hardness (Q&T;)	58 – 60 HRC	ASTM E18
Impact (Charpy V)	≥ 10 J (RT)	ASTM E23

7. Manufacturing Process & Forging Parameters

7.1 Ultra-High Purity Melting

Jiangsu Liangyi employs an advanced triple-melting method. Oxygen content is ≤8 ppm with minimal non-metallic inclusions per ASTM E45:

Step	Process	Purpose
1	VIM — Vacuum Induction Melting	Primary melting under high vacuum (≤1 Pa); controls composition to ±0.01%
2	ESR — Electro-Slag Remelting	Reduces sulfur, minimizes segregation, improves uniformity
3	VAR — Vacuum Arc Remelting	Tertiary refining for aerospace / bearing applications per AMS 5630

7.2 Forging Temperature & Process Control

Stage	Temperature / Parameter	Notes
Preheat	760–820°C (1400–1500°F)	Heat slowly until uniformly heated through
Forge Temperature	1050–1150°C (1900–2100°F)	Raise uniformly; begin forging immediately
Minimum Forge Temp	≥ 900°C	Do NOT forge below 900°C — risks carbide cracking
Post-Forge Cooling	Slow cool	In furnace, dry lime, or ashes to prevent thermal shock
Immediate Anneal	843–871°C (1550–1600°F)	Slow furnace cool; perform immediately after forging

CRITICAL: Do NOT overheat above 1200°C — causes grain boundary melting and permanent toughness loss that cannot be recovered by subsequent heat treatment.

7.3 Heat Treatment — Hardening & Tempering

Step	Parameter	Result / Notes
Preheat	760°C	Equalize temperature before austenitizing
Austenitize	1010–1065°C	Hold uniformly before quench
Quench	Warm oil or air cool	Avoid water quench — high cracking risk
Sub-Zero (optional)	–73°C to –196°C	Converts retained austenite; improves hardness uniformity

Temper	148–177°C (≥1 hr/inch)	Final hardness: 58–60 HRC
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Avoid tempering at 427–593°C (800–1100°F) — this temperature range significantly degrades both corrosion resistance and toughness.

8. Corrosion Resistance Guide

AISI 440C has **moderate corrosion resistance** — better than carbon tool steels but lower than austenitic 304/316. The 16–18% Cr forms a passive oxide layer; however, high carbon consumes some chromium for carbide formation.

Environment	Performance	Notes
Mild Atmosphere	Good	Suitable for indoor and mild outdoor use
Fresh Water	Good	Best in hardened and polished condition
Mild Chemicals	Moderate	Suitable for short-term exposure only
Seawater / Marine	Poor	Use duplex or super austenitic grades instead
Strong Acids (HCl, H ₂ SO ₄)	Poor	Not suitable
H ₂ S / Sour Service	Conditional	NACE MR0175 compliant when hardness ≤22 HRC (annealed)

Best corrosion resistance is achieved in the hardened and highly polished condition (Ra ≤ 0.4 μm). Passivation per ASTM A967 further improves performance.

9. Machinability & Welding Advisory

9.1 Machinability

In the **annealed condition** (~269 HB), AISI 440C has ~40% machinability rating relative to AISI 1212. Based on production experience and industry references (Carpenter Technology):

Parameter	Recommendation
Tooling	Carbide (C2/C3) or ceramic inserts; HSS wears rapidly
Cutting Speed	30–60 m/min (100–200 SFM) with carbide
Feed Rate	0.10–0.30 mm/rev roughing; 0.05–0.15 mm/rev finishing
Coolant	Flood coolant (sulfurized/chlorinated oils) strongly recommended
Chip Breakers	Required for tough, stringy martensitic chips
Post-HT Grinding	CBN and diamond wheels only at 58–60 HRC

9.2 Welding Advisory

AISI 440C is generally not recommended for welding due to its high carbon content, which causes rapid air hardening and high risk of HAZ cracking. If welding is unavoidable (per AZoM):

1. Preheat to 260°C (500°F) minimum
2. Use matching or AWS ER309/ER310 filler wire
3. Minimize heat input; narrow stringer beads only
4. PWHT: 732–760°C for 6 hours with slow furnace cool
5. Re-anneal and re-harden if full mechanical properties are required

Recommendation: For AISI 440C components, mechanical joining (bolting, press fitting, brazing) is strongly preferred over welding.

10. Full Range of AISI 440C Forged Products

Product Type	Shapes / Configurations	Max Size / Weight
Forged Bars & Rods	Round, square, flat, rectangular, hollow	Max Ø 2,000 mm / Up to 30 tons
Seamless Rolled Rings	Gear rings, slewing bearing rings, contoured rings	Max OD 6,000 mm / Up to 30 tons
Forged Shafts	Step shafts, gear shafts, crankshafts, turbine shafts	Max Ø 1,800 mm / Length up to 15 m
Structural Components	Hubs, housings, sleeves, bushes, discs, flanges, pump bodies, valve parts	Per drawing
Forged Blanks & Custom Shapes	Near-net-shape forgings and rough-machined blanks per client drawings	Reduces material waste & machining costs up to 30%

All AISI 440C forged products are supplied with complete heat treatment (Q&T; to 58–60 HRC), EN 10204 3.1/3.2 mill test certificates, and 100% NDE (UT + MT) as standard.

11. Quality Control, NDE & Compliance Standards

11.1 Applicable Standards by Region

Region	Standards
North America	ASTM A276, A473, AMS 5630, API 6A, NACE MR0175
Europe	EN 10088-3, DIN 17440, EN 10204 3.1/3.2
Japan	JIS G4303, JIS G4304
China	GB/T 1220
Australia	AS standards
Middle East	NACE MR0175, API 6A

11.2 NDE & Inspection Capabilities

Test	Scope / Standard
100% Ultrasonic Testing (UT)	Per ASTM A388; calibrated to ASTM E428; full volume coverage; FBH Ø2.0 mm reference
Magnetic Particle (MT)	Surface/near-surface per ASTM E709; wet fluorescent MT available
Dimensional (CMM)	Coordinate Measuring Machine verification with detailed reports
Chemical (OES)	Full spectrographic analysis per heat including tramp elements
Mechanical Testing	Tensile, yield, elongation, hardness, impact per ASTM E8/E23
Microstructure	ASTM E45 inclusion rating when required; carbide distribution per ASTM E1245

11.3 Mill Test Certificate (EN 10204)

- Heat Number, melting process (VIM/ESR/VAR) and full material traceability
- Full dimensional inspection with CMM data
- Heat treatment records (temperature, time, cooling rate, furnace ID)
- Full chemical analysis including tramp elements
- Complete mechanical results with all individual test values
- UT/MT examination results
- Visual inspection confirmation
- Third-party witness (TUV/SGS/BV/Lloyd's) for EN 10204 3.2 — available on request

12. Common Processing Mistakes to Avoid

#	Mistake	Consequence / Correct Practice
1	Forging Below 900°C	Causes carbide network cracking — always maintain above 900°C
2	Overheating Above 1200°C	Grain boundary melting; permanent toughness loss — unrecoverable
3	Rapid Cooling After Forging	Creates untempered martensite with extreme brittleness — always slow-cool
4	Skipping Immediate Annealing	As-forged 440C is extremely hard and brittle — anneal at 843–871°C immediately
5	Tempering at 427–593°C	Severely degrades corrosion resistance and toughness — temper only at 148–177°C
6	Machining After Hardening	Rapidly destroys tooling at 58–60 HRC — always machine before final hardening
7	Welding Without PWHT	High carbon causes severe HAZ cracking — avoid welding when possible
8	Skipping Post-HT UT	Internal cracks from heat treatment may be invisible — always 100% UT per ASTM A388

13. Typical Industrial Applications

Industry	Typical Components	Key Requirement Met
Oil & Gas	Valve balls, seat rings, stems, wellhead components	NACE MR0175 / H ₂ S service; wear resistance
Aerospace	Bearing rings, races, instrument components	AMS 5630 / VIM+VAR; dimensional stability
Mining	Work rolls, roll sleeves, screen deck rolls	Wear resistance + fracture toughness
Automotive	Cold forming die inserts, punches, gauges	60 HRC; long regrind interval
Power Generation	Turbine blade forgings, stationary blades	Erosion resistance; fatigue strength ≥650 MPa
Desalination / Pumps	Impellers, wear rings, pump shafts	Cavitation erosion resistance; passivation
General Industrial	Gage blocks, cutting tools, knife blades, bearings	Highest hardness of any stainless steel

14. About Jiangsu Liangyi Co., Limited

Est. 1997 25+ Years Experience	ISO 9001:2015 Quality Certified	80,000 sqm Production Facility	6,300-Ton Hydraulic Press	30 Tons Max Single Piece	50+ Countries Export Markets
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Established in 1997, **Jiangsu Liangyi Co., Limited** is a professional ISO 9001:2015 certified open die forging manufacturer located in Jiangyin City, Jiangsu Province, China. Our factory covers 80,000 sqm and operates advanced forging and inspection equipment including a 6300-ton hydraulic press, ring rolling mills, and CNC machining centers. We provide a full range of services from steel melting, forging, and heat treatment to fine machining, with complete NDE and mill test certificates. Products are exported to more than 50 countries via Shanghai Port and Ningbo-Zhoushan Port.

Contact Jiangsu Liangyi Co., Limited for Custom AISI 440C Forged Parts

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Lead Time: Raw forgings: 3–4 weeks | Machined + heat treated: 4–6 weeks | Expedited: 2–3 weeks