S136 Mold Steel Comprehensive Guide (WORD Compatible)

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What Is S136 Mold Steel

S136 is a high-chromium martensitic stainless mold steel, benchmarked against ASSAB (Uddeholm) S-136 from Sweden. Produced using the Electro-Slag Remelting (ESR) process for ultra-high purity, it is preferred for high-end precision molds. It offers SPI A-1 mirror polishing, long-term corrosion resistance, and micron-level dimensional stability. With balanced hardness and toughness, its mold service life is 2–3 times longer than conventional steels.

Main Characteristics of S136

Mirror-Grade Surface: SPI A-1 polishing performance, ideal for optical lenses and high-gloss components.

Corrosion-Resistant & Maintenance-Free: Excellent rust resistance for corrosive plastics, reducing maintenance frequency.

Long-Term High Hardness: HRC 48–54 with good toughness, increasing productivity, and mold lifespan.

High Dimensional Stability: Very low deformation, guaranteeing precise part dimensions.

Excellent Machinability: Superior machining and EDM performance, reducing manufacturing cycles.

S136 Performance Specifications

1. Chemical Composition

Element	Typical %	Range %	Function
C	0.38	0.36–0.42	Determines hardness and wear resistance
Si	0.9	0.60–1.00	Improves polishability and deoxidation
Mn	0.5	0.30–0.80	Enhances hardenability and strength
Cr	13.6	12.50–14.00	Provides corrosion resistance
V	0.3	0.20–0.50	Refines grain structure, improves toughness
P	<0.025	⩽0.030	Harmful impurity (must be controlled)
S	<0.001	⩽0.003	Affects polishing (extremely low in ESR steel)

2. Physical Properties

Property	Metric	Imperial	Condition
Density	7.85 g/cm^3	0.284 lb/in^3	20°C
Elastic Modulus	215,000 N/mm^2	31.2×10^6 psi	20°C
Thermal Conductivity	25.0 W/m・K	173.5 BTU・in/ft^2・h・°F	20°C
Specific Heat	460 J/kg・K	0.11 BTU/lb・°F	20°C
Melting Point	1425°C	2597°F	Approximate
Magnetism	Magnetic	Magnetic	Martensitic stainless steel

3. Mechanical Properties

Property	Value	Remarks
Quenched & Tempered Hardness	50–55 HRC	Recommended: 50–52 HRC
Annealed Hardness	⩽235 HB	Supply condition
Tensile Strength	1750–1900 MPa	Depends on tempering temperature
Yield Strength	1550–1700 MPa	High load capacity
Compressive Strength	≈2200 MPa	High-pressure molding
Impact Toughness	25–35 J/cm^2	Measured at 20°C

Elongation	7–9%	Plastic deformation index
Reduction of Area	≈45%	Uniform microstructure
Elastic Modulus	208–215 GPa	20°C
Poisson’s Ratio	0.28–0.29	-

Typical Applications of S136 Mold Steel

- Optical Components: Lenses and high-gloss housings (SPI A-1).
- Transparent Products: High light transmission and impurity-free parts.
- Medical & Food Packaging: Resistant to sterilization and corrosion.
- Micro-Structured Parts: Accurate micron-level textures.
- Complex EDM Cavities: Improved deep cavity finishing.
- Acid Resistance: Suitable for PVC and flame-retardant plastics.
- Large High-Gloss Parts: Uniform surface brightness.

Applications Not Recommended for S136

- High-Impact Loads: Insufficient toughness, prone to cracking.
- 30%+ Glass-Fiber Plastics: Low wear resistance.
- Long-Term >200°C Environment: Performance degradation.
- High-Chlorine Plastics: Poor corrosion resistance.

- Low-Precision Products: Overperformance and cost waste.
- Small Batch & Urgent Projects: Long machining cycles.
- Frequent Welding: Poor weldability.
- No Professional Heat Treatment: Inconsistent hardness.

S136 CNC Cutting Tool Selection

Stage	Tool Type	Coating Priority	Parameters	Recommended Brands
Roughing	Ultra-fine WC-Co Carbide End Mill	AlCrN > TiAlN > TiN	8–12% Co, 0.5–1 µm grain	Zhuzhou Diamond, Zigong Carbide (China); Sandvik GC1025
Semi-Finishing	Solid Carbide / Ball Nose	TiAlN > AlCrN	Helix 30–45°	Sumitomo, Kennametal, Sandvik
Finishing	CBN / PCD Tools	TiSiN > None	Polished edge, relief 12–15°	Element Six, Sumitomo, Sandvik
Deep Cavity	Long-Neck End Mill	TiAlN	L/D ⩽10:1	Sandvik, OSG
Deep Hole	Internal Cooling Drill	TiCN	⩾70 bar coolant	Guhring, Nachi

Common Problems and Solutions

Why Does S136 Rust?

As a martensitic stainless steel, its passive layer is easily damaged during machining. Chloride coolant or PVC decomposition gas accelerates pitting corrosion.

Solution: Passivation after polishing; avoid chloride exposure.

Why Is There a Thick White Layer After EDM?

High chromium forms a thick, brittle Cr_2O_3 layer, three times as thick as in normal steel.

Solution: Reduce current, increase pulse interval; acid pickling or electro-polishing.

Why Does ESR Grade Achieve Better Polishing?

Ordinary S136 contains inclusions that fall off during polishing. ESR grade has purity below grade 0.5 and inclusions ⩽ 10 μm, enabling a Ra 0.012 μm mirror finish.

Solution: Use ESR grade only; stress relief before polishing.

Why Is Welding Prone to Cracking?

High chromium and carbon content cause strong hardening and high residual stress.

Solution: Preheat at 300°C, low-current segmented welding, post-annealing.

Why Is Tool Wear So Fast?

Thermal conductivity is only one-third of that of 45 steel, concentrating heat on cutting edges.

Solution: Use ultra-fine carbide tools; reduce speed by 20%; ⩾70 bar cooling.

Why Does Quenching Cause Large Deformation?

Poor heat conduction leads to temperature differences over 300°C, plus 3% martensitic expansion.

Solution: Stress relief, step heating, reserve finishing allowance.

Why Does Size Change Over Time?

Trace amounts of vanadium and molybdenum cause aging, hardening, and carbide precipitation.

Solution: 180°C×8h aging; 7-day stabilization at 40°C.

Why Does Thermal Fatigue Occur?

Thermal expansion is 15% higher than that of normal steel, causing repeated stress.

Solution: Optimize cooling; nitriding/TD treatment; tempering at 550°C.

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