
1045 Hot Rolled Medium Carbon Steel – Technical Material Specification

1.0 Material Overview & Common Uses

1045 hot rolled medium carbon steel is a high-strength, low-cost carbon steel with a nominal carbon content of 0.45%. It offers a balance of strength, toughness, and wear resistance, making it suitable for parts requiring moderate hardness and good machinability. The hot rolled finish results in a scaled surface and slightly oversized dimensions, which are typically removed during machining.

- Common applications include shafts, gears, bolts, studs, axles, spindles, and structural components in automotive, agricultural, and general manufacturing industries.
- Often used in as-rolled condition or after normalizing, annealing, or quenching and tempering to achieve desired mechanical properties.

2.0 Core Technical Properties & Sizing

- Density: 7.85 g/cm³ (0.284 lb/in³)
- Melting point: approximately 1420-1460°C (2588-2660°F)
- Tensile strength (as-rolled): 570-700 MPa (82,000-101,500 psi)
- Yield strength (as-rolled): 310-450 MPa (45,000-65,000 psi)
- Elongation in 50 mm: 12-20% (as-rolled)
- Hardness (as-rolled): 170-210 HB (Brinell)
- Standard forms: round bar, flat bar, square bar, plate, and sheet
- Common diameter tolerances for hot rolled round bar (per ASTM A29): ±0.005 inch for sizes up to 1 inch, ±0.006 inch for 1-2 inch, ±0.008 inch for 2-4 inch
- Standard lengths: 12 ft (3.66 m) or 20 ft (6.1 m), random lengths available
- Surface condition: mill scale (dark oxide layer) present, may have slight surface irregularities

3.0 Processing, Machinability & Application

1045 steel has good machinability (approximately 55-60% of 1212 free-machining steel). It produces continuous chips and requires proper chip control. Carbide tooling is recommended for high-production runs, while high-speed steel (HSS) tools can be used for lower volumes. Flood coolant is essential to manage heat and extend tool life.

- Turning: Use carbide inserts with a feed rate of 0.008-0.020 in/rev and cutting speed of 300-500 SFM (surface feet per minute) for carbide; reduce by 40% for HSS.
- Milling: Use 4-flute carbide end mills at 0.003-0.008 in/tooth feed, cutting speed 250-400 SFM. Climb milling recommended for better surface finish.
- Drilling: High-speed steel twist drills at 80-120 SFM with pecking cycle for holes deeper than 3x diameter. Use cutting oil or water-soluble coolant.
- Welding: Preheating to 150-300°C (300-570°F) required for sections over 1 inch to prevent hydrogen cracking. Use low-hydrogen electrodes (E7018) or MIG wire (ER70S-6). Post-weld stress relief at 600-650°C (1110-1200°F) recommended.

- Heat treatment: Can be normalized at 845-900°C (1550-1650°F), annealed at 790-870°C (1450-1600°F), or hardened by quenching in water or oil from 800-845°C (1475-1550°F). Tempering at 200-650°C (400-1200°F) to adjust hardness.
- Forming: Good formability in annealed condition. Avoid cold forming in as-rolled condition due to higher strength and lower ductility.

4.0 Common Defects & Quality Control

- Reject if surface cracks, seams, or laps are visible to the naked eye or under 5x magnification.
- Reject if surface pitting exceeds 0.010 inch (0.25 mm) depth on critical surfaces.
- Reject if out-of-round exceeds 0.005 inch for diameters under 2 inches, or 0.008 inch for larger diameters.
- Reject if straightness deviation exceeds 1/8 inch over 10 feet (3.2 mm over 3 m).
- Reject if decarburization depth exceeds 0.010 inch (0.25 mm) on surfaces that will not be machined.
- Reject if hardness varies more than 20 HB across a single bar or plate.
- Reject if mill scale is flaking or has deep rust pitting indicating poor storage.
- Acceptable surface roughness (as-rolled): up to 250-500 microinches Ra (6.3-12.5 µm).

5.0 Storage, Handling & WHMIS Guidelines

- Store indoors in a dry, well-ventilated area. Relative humidity below 60% recommended to minimize rust formation.
- Do not store directly on concrete floors; use wooden dunnage or steel racks to prevent moisture wicking.
- Shelf life: indefinite if stored properly, but surface rust may develop over time. Apply light oil or rust inhibitor for long-term storage.
- FIFO (First In, First Out) protocol: Rotate stock to use older material first, especially if rust inhibitor has degraded.
- WHMIS Classification: Not classified as a hazardous material under WHMIS 2015 in solid form. However, dust and fumes from machining are hazardous.
- Hazards during processing: Inhalation of metal dust or fumes (from welding, grinding) may cause respiratory irritation. Prolonged skin contact with cutting fluids may cause dermatitis.
- Mandatory PPE: Safety glasses with side shields, cut-resistant gloves (e.g., Kevlar or leather) when handling sharp edges, steel-toed boots. During welding: welding helmet with appropriate shade, flame-resistant clothing, and hearing protection.
- First aid: For dust inhalation, move to fresh air. For skin contact with cutting fluids, wash with soap and water. For eye contact, flush with water for 15 minutes and seek medical attention.
- Disposal: Scrap metal is recyclable. Dispose of cutting fluids and contaminated rags per local environmental regulations.

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.