

ASTM SAE AISI 1045 Carbon Steel Heat Treatment, Chemical Composition, Properties

SAE AISI 1045 Steel

ASTM SAE AISI 1045 steel is a commonly used medium carbon steel with an average carbon content of 0.45%, which exhibits moderate tensile strength, good strength, toughness and wear resistance. It can be treated by annealing, flame treatment or induction hardening. The cold-worked 1045 is also known as C1045, and the hot-rolled 1045 is known as 1045 HR.

■ Applications

AISI SAE 1045 material is widely used in industrial applications that require higher wear resistance and strength. Typical applications include light gears, shafts, axles, spindles, pins, guide rods, connecting rods, bolts, worms, crankshafts, and machine components, etc.

■ Datasheet & Specification

The following table provides the AISI SAE ASTM 1045 steel data sheet, including chemical composition, physical properties, mechanical properties, etc.

■ Chemical Composition

AISI ASTM 1045 Chemical Composition (%)				
Steel Grade (UNS)	C	Mn	P (≤)	S (≤)
1045 (G10450)	0.43-0.50	0.60-0.90	0.04	0.05

■ Physical Properties

AISI SAE 1045 coefficients of linear thermal expansion		
Value (10 ⁻⁶ /K)	Temperature (°C)	Treatment or condition
11.6	0-100	Annealed
12.3	0-200	
13.1	0-300	
13.7	0-400	
14.2	0-500	
14.7	0-600	
15.1	0-700	

Material 1045 thermal conductivity		
Value (W/m·K)	Temperature (°C)	Treatment or condition
50.8	100	Annealed

Electrical Resistivity of AISI SAE 1045 Carbon Steel		
Value (μΩ·m)	Temperature (°C)	Treatment or condition
0.162	20	Annealed
0.223	100	

Electrical Resistivity of AISI SAE 1045 Carbon Steel

Value ($\mu\Omega\cdot\text{m}$)	Temperature ($^{\circ}\text{C}$)	Treatment or condition
0.162	20	Annealed
0.223	100	

■ Mechanical Properties

The following is a table of mechanical properties for 1045 material, including tensile strength, yield strength, elongation, reduction, and hardness, etc.

1045 carbon steel mechanical properties (sizes ranging: 19-32 mm)						
Steel (UNS)	Tensile strength (Mpa) \geq	Yield strength (Mpa) \geq	Elongation in 50 mm, % \geq	Reduction in area, % \geq	Hardness (HB)	Processing, condition or treatment
AISI SAE 1045 (G10450)	565	310	16	40	163	Hot rolled
	625	530	12	35	179	Cold drawn
	585	505	12	45	170	Annealed, cold drawn

1045 Steel Heat Treatment

■ Normalizing

The normalizing temperature range for 1045 steel is 830-900 $^{\circ}\text{C}$, and the typical normalizing temperature is 860 $^{\circ}\text{C}$.

■ Austenitizing

The austenitizing temperature for SAE 1045 induction hardening carbon steel is 800-845 $^{\circ}\text{C}$.

■ Full Annealing

The annealing temperature for AISI 1045 carbon steel is from 790-870 $^{\circ}\text{C}$. The cooling cycle is from 790 to 650 $^{\circ}\text{C}$ at a rate of 28 $^{\circ}\text{C}/\text{h}$ in the furnace, and this can result in a HBW hardness range from 156 to 217. (This is suitable for forgings with a section thickness of up to 75 mm. For sections up to 25 mm thick, the temperature should be held for at least 1 hour; for each additional 25 mm of thickness, an additional 0.5-hour hold time is needed.)

■ Hardening

For the austenitizing treatment of AISI 1045 steel, the heating temperature is 845 $^{\circ}\text{C}$, the quenching medium is water or brine, and for workpieces with wall thickness ≤ 6.35 mm, oil quenching should be used, and the hardness should not be less than 55 HRC.

■ Welding

For weldments with a thickness of ≤ 13 mm, the preheating and interpass temperature should be at least 150 $^{\circ}\text{C}$ under low hydrogen conditions, or at least 177 $^{\circ}\text{C}$ under other conditions. Post-weld heat treatment is required, with a temperature range of 590-675 $^{\circ}\text{C}$.

For weldments with a thickness of > 13 mm, the preheating and interpass temperature before welding should be $\geq 205^{\circ}\text{C}$ (under low hydrogen conditions) or $\geq 230^{\circ}\text{C}$ (under non-low hydrogen conditions). The post-weld heat treatment temperature is 590-675 $^{\circ}\text{C}$.

1045 steel grade comparison

The equivalent comparisons of ASTM AISI SAE 1045 carbon steel to European standards (Germany DIN EN, British BSI, French NF...), Chinese GB and Japanese JIS standards are as follows:

AISI 1045 equivalent									
US		Germany		China		Japan		ISO	
Standard	Grade (UNS)	Standard	Steel name (Steel number)	Standard	Grade	Standard	Grade	Standard	Grade
AISI SAE; ASTM A29/A29M	1045 (G10450)	EN 10083-2	C45 (1.0503)	GB/T 699	45 Steel	JIS G 4051	S45C		