



NESSteel Inc.

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1045 Carbon Steel

1045 is a medium tensile low hardenability carbon steel generally supplied in the black hot rolled or occasionally in the normalized condition, with a typical tensile strength range 570 - 700 Mpa and Brinell hardness range 170 - 210 in either condition. Characterized by fairly good strength and impact properties, plus good machinability and reasonable weldability in the hot rolled or normalized condition.

1045 has a low through hardening capability with sections up to around 60mm only generally recommended as suitable for through hardening and tempering. It can however be successfully flame or induction hardened in the as rolled or normalized condition resulting in surface hardnesses of up to Rc 54 - 60 depending upon the quenching medium employed, type of setup, section size etc. Core strengths will remain as supplied.

It does not however respond satisfactorily to nitriding due to the lack of suitable alloying elements.

1045 is used extensively by all industry sectors for applications requiring more strength and wear resistance than the low carbon mild steels can provide and the higher strength of the low alloy high tensile steels is not necessary, plus those applications requiring flame or induction hardening.

Typical applications are: Axles various, bolts, connecting rods, hydraulic clamps and rams, various pins and rolls, studs, shafts, spindles etc.

Chemical Composition

Carbon	Silicon	Manganese
0.43 - .050	0.10 - 0.35	0.60 - 0.90

Typical Mechanical Properties - Hot Rolled Condition

Tensile Strength Mpa	570 - 700
Yield Strength Mpa	300 - 450
Elongation in 50mm %	14 - 30
Hardness Brinell HB	170 - 210

Typical Mechanical Properties - Normalized Condition

Tensile Strength Mpa	640
Yield Strength Mpa	410
Elongation in 50mm %	22
Impact Izod	54
Hardness HB	187
Hardness Rc	10

*Material stocked generally in the hot rolled condition but can occasionally be in the normalized condition. Check the mill certificate if critical for end use.

Typical Mechanical Properties - Hardened by Water Quench at 820° - 850° Oil Quench at 830° - 860°, tempered between 540° - 680°C

Section size mm	up to 16mm	17 - 44 mm	41 - 100 mm
Tensile strength Mpa	700 - 850	650 - 800	630 - 780
Yield strength Mpa	500	430	370
Elongation in 50mm %	14	16	17
Impact Charpy	30	30	30
Hardness HB	210 - 245	195 - 235	185 - 230

Forging

Pre heat to 750° - 800°C, then continue heat to 1100° - 1200°C maximum, hold until temperature is uniform throughout the section and commence forging immediately. Do not forge below 850°C. Finished forgings may be air cooled.

Heat Treatment

Annealing

Heat to 800° - 850°C hold until temperature is uniform throughout the section, and cool in furnace.

Flame or Induction Hardening

Heat as quickly as possible to the austenitic temperature range (820 - 860°C) and required case depth followed by an immediate water or oil quench, depending upon hardness required, workpiece size/shape and quenching arrangements. The black hot rolled/normalized surface will first require to be machined sufficiently to remove any decarburized quenching to hand warm, most components should be tempered at 150° - 200°C to remove quenching stresses in the case. This will have little effect on case hardness.

Hardening

Heat to 820° - 850°C hold until temperature is uniform throughout the section, soak for 10 - 15 minutes per 25mm of section, and quench in water or brine. Or heat to 830° - 860°C soak as above and quench in oil. Temper immediately while still hand warm.

Normalizing

Heat to 870° - 920°C hold until temperature is uniform throughout section, soak for 10 - 15 minutes. Cool in still air.

Stress Reliving

Heat to 550° - 660°C hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air.

Tempering

Re heat to 400° - 650°C as required, hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air.

Notes on Heat Treatment

Heating temperatures, rate of heating, cooling and soaking times will vary due to factors such as work piece size/shape, also furnace type employed, quenching medium and work piece transfer facilities etc. Please consult your heat treater for best results.

Machining

1045 in the hot rolled and normalized condition has very good machinability and all operations such as sawing, turning, drilling, broaching, milling and tapping etc. can be carried out satisfactorily using machine manufacturers recommendations for suitable tool type, feeds and speeds.

Welding

1045 is readily weldable in the as rolled and normalized condition providing the correct procedure is employed. Following welding the work piece immediately upon cooling to hand warm should be stress relieved at 550° - 660°C if possible. Welding in the hardened and tempered, flame or induction hardened condition is not recommended.

Welding Procedure

Welding of 1045 should always be carried out using low hydrogen electrodes. Please consult your welding consumables supplier.

Suggested Pre-heat Temperature

Section	25 mm	50 mm	75 mm	150 mm+
°C	100	140	200	300

Post Welding

Cool as slowly as possible in dry lime, sand, etc.