



## 4140 HIGH TENSILE STEEL HOLLOW BAR

4140 is a 1% chromium - molybdenum medium hardenability general purpose high tensile steel - generally supplied hardened and tempered in the tensile range of 860 - 1130 Mpa. Brinell hardness range 265 - 330 (Rc 28 - 36). Characterised by high strength and good impact properties with good machinability, but low weldability. Pre hardened and tempered 4140 can be further surface hardened by flame or induction hardening and by nitriding.

4140 is used extensively in most industry sectors for a wide range of applications utilising its considerable savings on weight and machining time over solid bar.

Typical applications are: Bearings, Bushes, Cylinders (Various), Gears, Conveyor Rolls, Hydraulic Shafts, Hollow Shafts, Hollow Parts (Various), Nuts and Rings.

Colour Code	Stocked Sizes	
ISO Hollow Bar Dark Blue (Bar end) 	ISO Stocked Sizes Chart (pdf)	56 mm to 250 mm OD
	EN Stocked Sizes Chart (pdf)	65 mm to 230 OD
EN Hollow Bar Light Blue (Bar end) 	<b>Bar Finish</b>	
	Cold Rolled and Hot Rolled	

### Related Specifications

Germany	DIN 17212 W.Nr 1.7223 Type 41CrMo4 DIN 17200-1654 W.Nr 1.7225 Type 42CrMo4
Japan	JIS G 3441 SCM 440 TK
USA	AISI 4140 ASTM A519-96 4140 SAE 4140 UNS G 41400

### Chemical Composition (Base Material)

	Min. %	Max %
Carbon	0.38	0.43
Silicon	0.15	0.04
Manganese	0.75	1.00
Chromium	0.80	1.10
Molybdenum	0.15	0.25
Phosphorous	0	0.04
Sulphur	0	0.015

**Mechanical Property Requirements for 4140 Hollow Bar As Supplied, Black Hot Rolled Finish - Hardened and Tempered Condition**

Tensile Strength Mpa (Min)	862	
Yield Strength Mpa Min	758	
Elongation on % Min.	14	
Hardness RC	Min	28
	Max	36

**Typical Mechanical Properties for 4140 Hollow Bar As Supplied, Black Hot Rolled Finish - Hardened and Tempered Condition**

Tensile Strength Mpa (Min)	1000	
Yield Strength Mpa Min	900	
Elongation on % Min	16	
Hardness	HB	300
	Rc	33

**Forging**

Heat to 1150 °C - 1200 °C maximum, hold until temperature is uniform throughout the section. Do not forge below 850 °C. Following forging operation the work piece should be cooled as slowly as possible.

**Heat Treatment**

**Annealing**

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

**Flame or Induction Hardening**

4140 hardened and tempered bar can be further surface hardened by either the flame or induction hardening methods resulting in a case hardness in excess of Rc 50. The black hot rolled surface will first require to be machined sufficiently to remove any decarburised layer otherwise less than satisfactory results will be obtained. Parts should be heated as quickly as possible to the austenitic temperature range (840 °C - 870 °C) and required case depth followed by an immediate oil or water quench, depending upon hardness required, workpiece size/shape and quenching arrangements.

Following quenching to hand warm, most components should be stress relieved to remove quenching stresses in the case.

**Hardening**

Heat to 840 °C - 875 °C, hold until temperature is uniform throughout the section, soak for 10 - 15 minutes per 25 mm section, and quench in oil, water, or polymer as required. \*Temper immediately while still hand warm.

**Nitriding**

4140 hardened and tempered bar can also be successfully nitrided, giving a surface hardness of up to Rc 60. Nitriding is carried out at 490 °C - 530 °C, followed by slow cooling (no quench) reducing the problem of distortion. Parts can therefore be machined to near final size, leaving a grinding allowance only. The tensile strength of the core is usually not affected since the nitriding temperature range is generally below the original tempering temperature employed.

**Normalizing**

Heat to 870 °C - 900 °C, hold until temperature is uniform throughout the section, soak for 10 - 15 minutes and cool in still air.

**Stress Relieving**

Heat to 680 °C - 700 °C, hold until temperature is uniform throughout the section, soak for 1 hour per 25 mm section, and cool in still air.

**Tempering**

Re-heat to 550 °C - 700 °C as required, hold until temperature is uniform throughout the section, soak for 1 hour per 25 mm of section, and cool in still air.

**Note**

Heating temperatures, rate of heating 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**

4140 in the hardened and tempered as supplied condition has good to very good machinability and operations such as sawing, turning, drilling, broaching, hobbing, milling and tapping can be carried out satisfactorily using machine manufacturers recommendations for suitable tool type - feeds and speeds.

## Welding

Welding of 4140 in the hardened and tempered condition (as normally supplied), is not recommended and should be avoided if at all possible, as the mechanical properties will be altered within the weld heat affected zone. It is preferred that welding be carried out on 4140 while in the annealed condition, and that the work piece, immediately on cooling to hand warm, is then stress relieved at 595 °C - 620 °C prior to hardening and tempering. If welding in the hardened and tempered condition is really necessary, then the work piece, immediately on cooling to hand warm, should be if possible stress relieved at 15 °C below the original tempering temperature (if known).

## Welding Procedure

Welding of 4140 in whatever condition should always be carried out using low hydrogen electrodes - please consult your welding consumables supplier.

## Suggested pre-heat temperature

Section	25mm	40mm	50mm	75mm	150mm+
°C	370	400	425	455	510

## Post Welding

Maximum cooling rate 95 °C per hour down to 95 °C, follow by cooling in still air. N.B. No draught. It is recommended that the work piece if possible is wrapped in an heat resistant blanket or buried in sand etc..

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