ENGINEERING STEELS + ALLOYS

4140 HIGH TENSILE STEEL

4140 is a 1% chromium - molybdenum medium hardenability general purpose high tensile steel - generally supplied hardened and tempered in the tensile range of 850 - 1000 Mpa (condition T).4140 is now available with improved machinability, which greatly increases feeds and/or speeds, while also extending tool life without adversley affecting mechanical properties.
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 such as:
Adapters, Arbors, Axle Shafts, Bolts, Crankshafts, Connection Rods, Chuck Bodies, Collets, Conveyor Pins & Rolls, Ejector Pins, Forks, Gears, Guide Rods, Hydraulic Shafts & Parts,Lathe Spindles, Logging Parts, Milling Spindles, Motor Shafts, Nuts, Pinch Bars, Pins Various, Pinions, Pump Shafts, Rams, Sockets, Spindles, Sprockets, Studs, Tool Holders, Torsion Bars, Worms etc..

Colour Code	Stocked Sizes	
Dark Blue (Bar End) 	Rounds	8 mm to 690 mm Diameter
	Hexagons	19.05 mm to 65 mm A/F
	Hollow Bar	63 mm to 250 mm OD
	Square	32 mm to 130 mm
	Bar Finish	
	Peeled, Cold Drawn, Turned and Polished, Centreless Ground. or Hot Rolled.	

Related Specifications	
Australia	AS 1444-1996-4140
Germany	DIN 17212 W.Nr 1.7223 Type 41CrMo4 DIN 17200-1654 W.Nr 1.7225 Type 42CrMo4 DIN 17200 W.Nr 1.7227 Type 42CrMoS4
Great Britain	BS970-1955 EN19A BS970 Part 3:1991 709M40
International	ISO 683/II Type 3 ISO 683/IV Type 3a ISO 683/IV Type 3b
Japan	JIS G 4103 SNCM4 JIS G 4105 SCM4 JIS G 4105 SCM440
USA	AISI 4140 ASTM A29/A29M-91 4140 ASTM A322 4140 ASTM A331 4140 (Cold Finish) SAE 4140

Chemical Composition (Base Material)		
	Min. %	**Max %**
Carbon	0.36	0.44
Silicon	0.10	0.40
Manganese	0.65	1.10
Chromium	0.75	1.20
Molybdenum	0.15	0.35

Phosphorous	0	0.04
Sulphur	0	0.04

Mechanical Property Requirements for Steels in the Heat-Treated Condition for Turned, Peeled or Ground Finish to AS1444-1996 4140 and BS970 Part 3-1991 709M40

Mechanical Property Designation		R	S	S	*T	U	V	W
Limited Ruling Section mm		250	250	150	100	63	30	20
Tensile Strength Mpa	Min	700	770	770	850	930	1000	1080
	Max	850	930	930	1000	1080	1150	1230
0.2% Proof Stress Mpa	Min	480	540	570	655	740	835	925
Elongation on $5.65\sqrt{S_0}$ %	Min	15	13	15	13	12	12	12
Izod Impact J	Min	34	27	54	54	47	47	40
Charpy Impact J	Min	28	22	50	50	42	42	35
Hardness Brinell HB	Min	201	233	233	248	269	293	311
	Max	255	277	277	302	331	352	375

*Material stocked generally in condition T
Check test certificate if critical for end use.

Mechanical Property Requirements for Steels Heat-Treated, and then Cold Finished to AS 1444 - 1996, and BS 970 Part 3 - 1991 709 M40

Mechanical Property Designation		R	S	T	U	V
Limited Ruling Section		63	63	63	63	63
Tensile Strength Mpa	Min	700	770	850	930	1000
	Max	850	930	1000	1080	1150
0.20% Proof Stress Mpa	Min	525	585	680	755	850
Elongation on $5.65\sqrt{S_0}$ %	Min	12	11	9	9	9
Hardness Brinell HB	Min	201	223	248	269	293
	Max	255	277	302	331	352

*Material stocked generally in condition T
Check test certificate if critical for end use.

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.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 tempered between 150 C - 200 C to remove quenching stresses in the case. This will have little effect on case hardness and will reduce the risk of grinding cracks.

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 ºC - 530 ºC, 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 ºC - 900 ºC, hold until temperature is uniform throughout the section, soak for 10 - 15 minutes and cool in still air.

Stress Relieving

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

Notes on Heat Treatment

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 satisfactoraly 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 ºC - 620 ºC 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 stress relieved at 15 ºC below the original tempering temperature.

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 +
ºC	370	400	425	455	510

Post Welding

Maximum cooling rate 95 ºC per hour down to 95 ºC, 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..