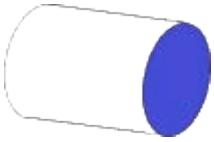
4140 High Tensile Steel

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			
 Dark Blue (Bar end)	Stocked Sizes	Rounds	10mm to 690 mm Diameter
		Hexagons	19 mm to 55 mm A/F
		Hollow Bar	63 mm to 250 mm OD
	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	**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	Limited Ruling Section mm	Tensile Strength Mpa		0.2% Proof Stress Mpa	Elongation on $5.65\sqrt{S_o}$* %	Izod Impact J	Charpy Impact J	Brinell Hardness HB	
		(Min)	(Max)	Min	Min.	Min.	Min.	Min	Max
R	250	700	850	480	15	34	28	201	255

S	250	770	930	540	13	27	22	223	277
S	150	770	930	570	15	54	50	223	277
*T	100	850	1000	665	13	54	50	248	302
U	63	930	1080	740	12	47	42	269	331
V	30	1000	1150	835	12	47	42	293	352
W	20	1080	1230	925	12	40	35	311	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	Limited Ruling Section	Tensile Strength Mpa		0.20% Proof Stress Mpa	Elongation on 5.65 $\sqrt{S_o}$* %	Brinell Hardness HB	
		Min	Max	Min	Min	Min	Max
R	63	700	850	525	12	201	255
S	63	770	930	585	11	223	277
T	63	850	1000	680	9	248	302
U	63	930	1080	755	9	269	331
V	63	1000	1150	850	9	293	352

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

Forging

Heat to 1150 ^{o}C - 1200 ^{o}C maximum, hold until temperature is uniform throughout the section.
Do not forge below 850 ^{o}C.

Following forging operation the work piece should be cooled as slowly as possible.

Heat Treatment

Annealing

Heat to 800 ^{o}C - 850 ^{o}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 ^{o}C - 875 ^{o}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 ^{o}C - 530 ^{o}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 ^{o}C - 900 ^{o}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.

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