4340 High Tensile Steel

4340 is a 1.8% nickel - chromium - molybdenum high hardenability high tensile steel - generally supplied hardened and tempered in the tensile range of 930 - 1080 Mpa (condition U) - (Rc 28 - 36)..

Characterised by high strength and toughness in relatively large sections.

Pre hardened and tempered 4340 can be further surface hardened by flame or induction hardening and by nitriding.

4340 is used in most industry sectors for applications requiring higher tensile/yield strength than 4140 can provide.

Typical applications are: Heavy Duty Shafts, Gears, Axles, Spindles, Couplings, Pins etc.

Colour Code	Stocked Sizes	Rounds	90mm to 360 mm Diameter
 Green & Yellow (Bar end)	Bar Finish	Peeled, Turned, or Hot Rolled.	

Related Specifications

Australia	AS 1444-1996-4340
Germany	W.Nr 1.6565 40NiCrMo6
Great Britain	BS970-1955 EN24 BS970 Part 3:1991 - 817M40
Japan	JISG 4103 SNCM439 JISG 4103 SNCM8
USA	AISI 4340 ASTM A29/A29M-1991 4340 ASTM A322 4340 ASTM A331 4340 Cold Finished SAE 4340 UNS G43400

Chemical Composition	Min. %	Max. %
Carbon	0.37	0.44
Silicon	0.10	0.35
Manganese	0.55	0.90
Nickel	1.55	2.00
Chromium	0.65	0.95
Molybdenum	0.20	0.35
Phosphorous	0	0.04
Sulphur	0	0.04

Mechanical Property Requirements for Steels in the Heat-Treated Condition for Black,Turned, Peeled or Ground Finish to AS1444-1996 4340.

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
T	250	850	1000	635	13	40	35	248	302
T	150	850	1000	665	13	54	50	248	302
*U	100	930	1080	740	12	47	42	269	331
V	63	1000	1150	835	12	47	42	293	352
W	30	1080	1230	925	11	41	35	311	375
X	30	1150	1300	1005	10	34	28	341	401

Y	30	1230	1380	1080	10	24	20	363	429
Z	30	1550		1125	5	10	9	444	

*Material stocked generally in condition U.
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 in sand or dry lime etc.

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

4340 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 (830 °C - 860 °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.

Hardening

Heat to 830 °C - 860 °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

4340 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.

N.B. Nickel is inert to the action of nitrogen and in general resists its diffusion into steel. This can result in lower case hardness or longer nitriding cycle times for steels containing nickel such as 4340.

Stress Relieving

Heat to 600 °C - 650 °C, hold until temperature is uniform throughout the section, soak for 1 hour per 25 mm of section, and cool in still air.

Tempering

Re-heat to 450 °C - 660 °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.

N.B. Tempering should be avoided if possible within the range 250 °C - 450 °C due to temper brittleness.

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

4340 in the hardened and tempered as supplied condition is still regarded as being readily machinable and operations such as turning and drilling etc. can be carried out satisfactorily using machine manufacturers, recommendations for suitable tool type - feeds and speeds.

Welding

Welding of 4340 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 4340 while in the annealed condition, and that the work piece, immediately on cooling to hand warm, is then stress relieved at 640 °C - 660 °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 4340 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
200 mm +	550

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..