

## Through-Hardening Low Alloy Steel Bar 4140 Grade Data Sheet

### Grade 4140

Grade 4140 is a Chromium-Molybdenum through-hardening steel of medium hardenability. It is a general-purpose high-tensile steel with medium strength level and good impact properties.

### Related Specifications

Material stocked by Atlas complies with grade AS1444, Grade 4140 and/or ASTM A434(A29) Grade 4140 and/or Euronorm EN 10083 grade 42CrMo4 (Material Number 1.7225/17227).

### Chemical Composition (%)

C	Si	Mn	P	S	Cr	Mo	Ni
0.37 - 0.44	0.10 - 0.35	0.65 - 1.10	≤ 0.040	≤ 0.040	0.75 - 1.20	0.15 - 0.30	-

### Conditions of Supply – Mechanical Properties

Grade 4140 is supplied in the hardened and tempered condition. The level of hardness is selected to give useful strength while still maintaining the ability to machine the material into finished components.

Diameter (mm)	Heat Treated Condition	Tensile Strength (MPa)	0.2% Proof Stress (MPa)	Elongation (% in 50mm)	Impact Izod or Charpy		Hardness (HB)
					(J)	(J)	
Up to 180 incl.	AS1444 Condition U	930 - 1080	740 min	12 min	47 min	42 min	269 - 331
>180 to 250 incl.	AS1444 Condition T	850 - 1000	665 min	13 min	54 min	50 min	248 - 302
>250 to 450 incl.	AS1444 Condition T	850 - 1000	665 min	13 min	Not Guaranteed		248 - 302

Grade 4140 can be re-heat-treated to higher strength or tempered back to lower strength levels than those supplied as standard. Assistance with heat treatment should be sought from reputable heat treatment companies.

### Conditions of Supply – Surface Finish and Machining Allowance

Grade 4140 Black is supplied with +/- tolerance according to DIN 1013 or better. Grade 4140 Bright is supplied cold drawn with h10 tolerance for bar diameter up to 25mm; bars with diameter 25 to 75mm are supplied as cold drawn with h10 tolerance or peeled with k12 tolerance, diameters 75 to 220 mm are supplied peeled to k12, sizes 220mm are supplied peeled to -0/+2mm.

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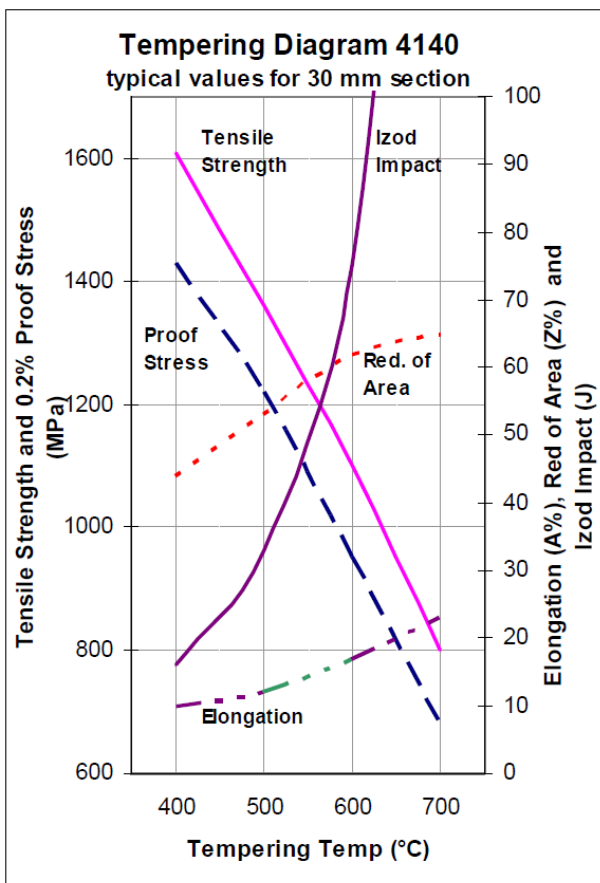
### Machining Allowances for 4140 Round Bar (mm on diameter)

Bar Diameter (mm)	Black (Hot Rolled or Forged)		Bright (Drawn or Peeled Bar)	
	Part Length <120mm	Part Length >120mm	Part Length <120mm	Part Length >120mm
0 - 50	1.5mm	1.5 + 6mm/m	1.0mm	1.0 + 4mm/m
50 - 100	2.3mm	2.3 + 6mm/m	1.0mm	1.0 + 4mm/m
100 - 150	4.5mm	4.5 + 6mm/m	1.0mm	1.0 + 4mm/m
150 - 210	6.5mm	6.5 + 6mm/m	1.5mm	1.5 + 4mm/m
210 - 450	-	-	1.5mm	1.5 + 6mm/m

Hot-rolling surface defects are retained in cold drawing. For bright bar in the range of cold drawing (up to 50mm) it is essential to take machining allowance into account. Peeled bar is generally free of surface defects. A certain allowance for surface defects is recommended however, as minor defects are permitted by the various national standards (AS, EN, etc.).

### Heat Treatment

Annealing	Normalising	Hardening	Quenching Medium	Tempering
850°C	850 - 920°C	850 - 860°C	Oil	500 - 680°C



### Hardening

Components should be heated slowly to 850 to 860°C, held until uniform, then quenched vigorously in oil (or polymer with an equivalent quench rate to between 80 to 110°C). Polymer quenchants have similar cooling capacities to oil, while having the advantage of being less likely to ignite.

### Tempering

While still warm, re-heat to tempering temperature, hold one hour per 25mm of section (2 hours minimum) and cool in air. Select tempering temperature according to the required mechanical properties (refer to tempering curve). Holding in the temperature range 230 to 370°C should be avoided due to possible temper embrittlement ("Blue Brittleness"). For yield strengths above 1380MPa: temper ½ to 2 hours at between 175 and 230°C, while for yield strength below 1380MPa temper in the temperature range 500 to 680°C, then air cool or water quench.

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### Surface Hardening

#### Nitriding

Nitride at approximately 510°C for 10 to 60 hours, depending upon required case depth. Surface hardness achievable is 600 to 650HV.

#### Induction or Flame Hardening

Grade 4140 can be surface hardened to 58HRC (typical value).

### Welding

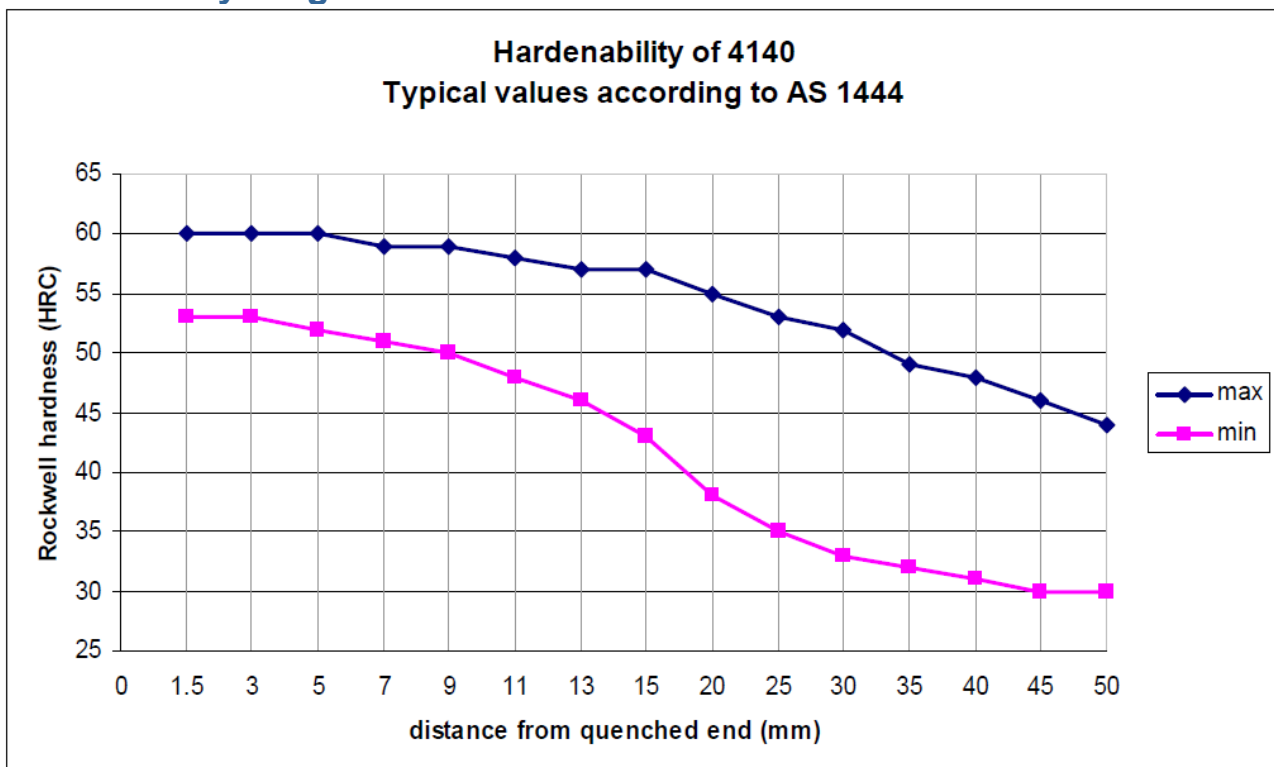
Welding is not recommended because of the likelihood of quench cracking occurring. If welding must be carried out, pre-heat to 200 to 300°C and maintain this while welding. Immediately after welding stress relieve at 500 to 600°C.

### Applications of Grade 4140

Medium-high stressed shafts and components where the use of carbon steel 1045 would not be appropriate. Reasons for using 4140 are the higher yield and fatigue strength, better through hardening of the material and superior impact properties compared to plain carbon steels like 1045.

These advantages are only achieved when 4140 is used in the heat-treated condition. Typical components include transmission shafts, spindles and small gears, threaded fasteners such as bolts, nuts and studs.

### Hardenability Diagram



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### Possible Alternative Grades

Grade	Why it might be chosen instead of 4140
6582 or 4340	Higher core strength required, especially in sections larger than 100mm. These grades also have better impact properties and ductility (in all sections).

#### **Limitation of Liability**

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