Interlloy™

ENGINEERING STEELS + ALLOYS
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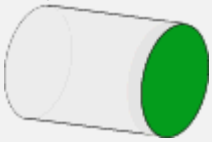
# EN25 HIGH TENSILE STEEL

EN25 is a 2.5% nickel - chromium - molybdenum high hardenability, high tensile steel, generally supplied hardened and tempered in the tensile range 930 - 1080 Mpa (Condition U) Rc 28 - 36.
Characterised by high strength and toughness in very large sections - similar to EN26 but with lower carbon content.
Pre hardened and tempered EN25 can be further surface hardened by flame or induction hardening, and by nitriding.
EN25 is used extensively in most industry sectors for applications requiring higher tensile and yield strength than 4140 can provide
Typical uses are: Adapters, Axles, Connecting Rods, Die Holders, Drill Shanks, Ejector Rods, Hydraulic Clamps, Jack Shafts, Line Shafts, Motor Shafts, Nuts, Pins, Piston Rods, Pump Shafts, Rams, Spindles, Torsion Bars Winch Gears etc.

| Colour Code | Stocked Sizes |
|---|---|
| Dark Green (Bar End)  | Available subject to enquiry |

| **Related Specifications** | |
|---|---|
| Australia | AS 1444-1996-X9931 |
| Germany | W.Nr 1.6743 32 NiCrMo10 4 |
| Great Britain | BS970: Part 3: 1991 826M31<br>BS970: 1955 - EN25 |

| **Chemical Composition (Base Material)** | | |
|---|---|---|
| | **Min. %** | **Max %** |
| Carbon | 0.27 | 0.35 |
| Silicon | 0.10 | 0.40 |
| Manganese | 0.45 | 0.70 |
| Nickel | 2.30 | 2.80 |
| Chromium | 0.50 | 0.80 |
| Molybdenum | 0.45 | 0.65 |
| Phosphorous | 0 | 0.04 |
| Sulphur | 0 | 0.04 |

**Mechanical Property Requirements for Steels in the Heat-Treated Condition for Black, Peeled, Turned or Ground Finish to AS1444-1996 X9931 and BS970 Part 3-1991 826M31**

| Mechanical Property Designation | | T | T | U | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|
| Limited Ruling Section mm | | 250 | 150 | 250 | 150 | 150 | 100 | 63 | 63 | 63 |
| Tensile Strength Mpa | Min | 850 | 850 | 930 | 930 | 1000 | 1080 | 1150 | 1230 | 1550 |
| | Max | 1000 | 1000 | 1080 | 1080 | 1150 | 1230 | 1300 | 1380 | |
| 0.2% Proof Stress Mpa | Min | 635 | 665 | 725 | 740 | 835 | 925 | 1005 | 1080 | 1125 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Elongation on $5.65\sqrt{S_0}$ % | Min | 13 | 13 | 12 | 12 | 12 | 11 | 10 | 10 | 5 |
| Izod Impact J | Min | 40 | 54 | 34 | 47 | 47 | 40 | 34 | 34 | 10 |
| Charpy Impact J | Min | 35 | 50 | 28 | 42 | 42 | 35 | 28 | 28 | 9 |
| Hardness Brinell HB | Min | 248 | 248 | 269 | 269 | 293 | 311 | 341 | 363 | 444 |
| | Max | 302 | 302 | 331 | 331 | 352 | 375 | 401 | 429 | |

**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**

EN25 hardened and tempered bar can be further surface hardened by either the flame or induction hardening methods resulting in a case hardness of Rc 50 approx. Parts should be heated as quickly as possible to the austenitic temperature range (830 °C - 850 °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 - 850 °C, hold until temperature is uniform throughout the section, soak for 10 - 15 minutes per 25 mm of section, and quench in oil, water, or polymer as required.
*Temper immediately while still hand warm.

**Nitriding**

EN25 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, and this can result in a lower case hardness or longer nitriding cycle times for steels containing nickel such as EN25.

**Stress Relieving**

Heat to 640 °C - 660 °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**

EN25 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 EN25 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 EN25 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 stress relieved at 15 C below the original tempering temperature.

**Welding Procedure**

Welding of EN25 in whatever condition should always be carried out using low hydrogen electrodes - please consult your welding consumables supplier.

| **Suggested pre-heat temperature** | | | | | | |
|---|---|---|---|---|---|---|
| **Section** | 25 mm | 40 mm | 50 mm | 75 mm | 150 mm | 200 mm + |
| **°C** | 370 | 400 | 425 | 455 | 510 | 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..

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