POLMAX

Stainless mould steel

COLD WORK | PLASTIC MOULDING | HOT WORK | HIGH PERFORMANCE STEEL

UDDEHOLM

General

The rapid development in the hightech area is putting higher and higher demands on the tool steel. Surface finishes, which have not been possible to achieve with ordinary tool steel, are required. For these extreme requirements Polmax is the right choice.

New processes have been developed to meet the increased demands on surface finish. For Polmax methods like ESR (Electro Slag Remelting) and VAR (Vacuum Arc Remelting) are used in order to reduce inclusion levels to minimum amounts.

Characteristics found in Polmax:

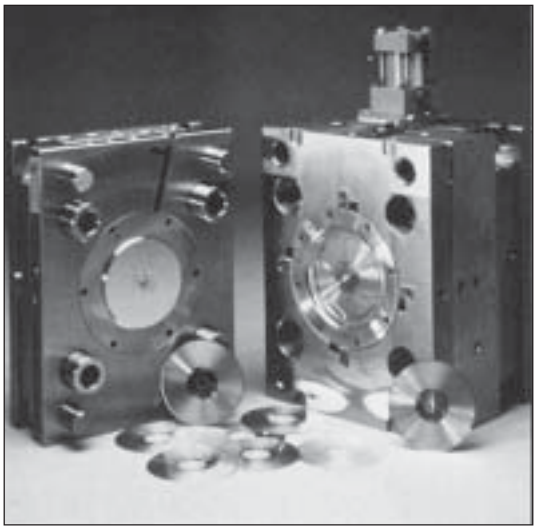
- Excellent polishability
- Good corrosion resistance
- Good wear resistance
- Good machinability
- Good stability in hardening

Typical analysis %	C 0,38	Si 0,9	Mn 0,5	Cr 13,6	V 0,3
Delivery condition	Soft annealed to approx. 200 HB				
Colour code	Green/black				

Applications

Examples on applications where extreme surface finishes are required:

- Lens moulds
- Moulds for compact discs and memory discs
- Moulds for medical applications.



Properties

PHYSICAL DATA

Hardened and tempered to 52 HRC. Data at room and elevated temperatures.

Temperature	20°C (68°F)	200°C (390°F)	400°C (750°F)
Density, kg/m^3 lbs/in^3	7 800 0,282	7 750 0,280	7 700 0,277
Coefficient of thermal expansion per °C from 20° per °F from 68°F	 – –	 11,0 x 10^{-6} 6,1 x 10^{-6}	 11,4 x 10^{-6} 6,4 x 10^{-6}
Thermal conductivity W/m °C Btu in/ft^2 h °F	 16 110	 20 138	 24 166
Modulus of elasticity N/mm^2 psi	 200 000 29,0 x 10^6	 190 000 27,6 x 10^6	 180 000 26,1 x 10^{-6}
Specific heat J/kg °C Btu/lb°F	 460 0,110	 – –	 – –

Strength of material

The strength values are to be considered as approximate. The test samples have been hardened in oil from 1025°C (1875°F) and tempered twice to 52 HRC.

Tensile strength, R_m	2050 N/mm^2 300 000 psi
Yield point, $R_{p0,2}$	1610 N/mm^2 234 000 psi

Corrosion resistance

Polmax is resistant to corrosive attack by water, water vapour, weak organic acids, dilute solutions of nitrates, carbonates and other salts.

A tool made from Polmax will have good resistance to rusting and staining dure to humid working and storage conditions and when moulding corro-sive plastics under normal production conditions.

Polmax shows the best corrosion resistance when tempered at about 250°C (480°F) and polished to a mirror finish.

Heat treatment

SOFT ANNEALING

Protect the steel and heat through to 890°C (1630°F). Then cool in the furnace at 20°C (40°F) per hour to 850°C (1560°F), then at 10°C (20°F) per hour to 700°C (1200°F), then freely in air.

STRESS-RELIEVING

After rough machining the tool should be heated through to 650°C (1200°F), holding time 2 hours. Cool slowly to 500°C (930°F), then freely in air.

HARDENING

Preheating temperature: 600–850°C (1110–1560°F)
Austenitizing temperature: 1000–1050°C (1830–1920°F) but usually 1020–1030°C (1870–1885°F)

Temperature °C	Soaking time* minutes	Hardness before tempering
1020	30	56±2 HRC
1050	30	57±2 HRC

** Soaking time = time at hardening temperature after the tool is fully heated through.*

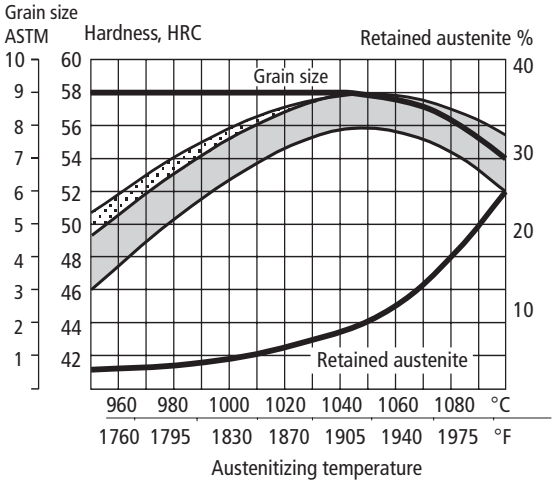
Protect the part against decarburization and oxidation during hardening.

QUENCHING MEDIA

- Oil
- Martempering bath at 250–550°C (480–1020°F) then cool in air
- Vacuum furnace with sufficient overpressure
- Circulating air or atmosphere.

Note: Temper the tool as soon as its temperature reaches 50–70°C (120–160°F).

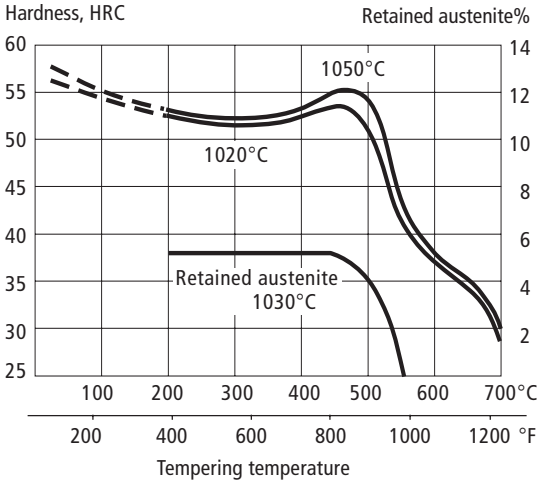
Hardness, grain size and retained austenite as a function of the austenitizing temperature



TEMPERING

Choose the tempering temperature according to the hardness required by reference to the temper-ing graph. Temper twice with intermediate cool-ing to room temperature. Lowest tempering tem-perature 180°C (360°F). Holding time at tempera-ture minimum 2 hours.

Tempering graph

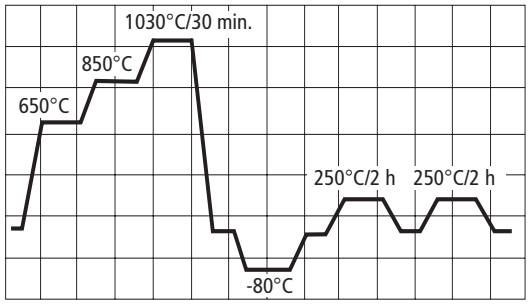


Note 1: Tempering at 250°C (480°F) is recom-mended for the best combination of toughness, hardness and corrosion resistance.

Note 2: Above curves are valid for small samples. Achieved hardness depends on mould size.

Note 3: A combination of high austenitizing tem-perature and low tempering temperature <250°C (480°F) gives a high stress level in the mould and should be avoided.

For maximum hardness and best combination of toughness, corrosion resistance and dimension stability during use, following heat treatment cycle is recommended



Subzero cooling is only required when demands on dimen-sion stability during use are very high. Received hardness: 52–54 HRC.

Polishing

Polmax has extremely good polishability in the hardened and tempered condition.
A slightly different technique is needed when polishing corrosion resistant tool steel compared with conventional tool steel. The main principle is to use smaller steps at the fine-grinding/polishing stages and try to grind to as fine surface as possible before starting the polishing operation. It is also important to stop the polishing operation immediately the last scratch from the former grain size has been removed.

PRACTICAL HINTS

- Polishing should be carried out in dust- and draught-free places. Hard dust particles can easily contaminate the abrasive and ruin an almost finished surface.
- Each polishing tool should be used for **only one** paste grade and kept in dust-proof container.
- The polishing tools gradually become "impregnated" and improve with use.
- Hands and workpiece should be cleaned carefully between each change of paste grade, the workpiece with a grease solvent and the hands with soap.
- Paste should be applied to the polishing tool in manual polishing, while in machine polishing, the paste should be applied to the workpiece.
- The finer the grain size, the less thinning liquid.
- Polishing pressure should be adjusted to the hardness of the polishing tool and the grade of the paste. For the finest grain sizes, the pressure should only be the weight of the polishing tool.
- Heavy material removal requires hard polishing tools and coarse paste.
- Finish polishing of plastic moulds should be carried out in the release direction.
- Polishing should start in the corners, edges and fillets or the difficult parts of the mould.
- Be careful with sharp corners and edges, so they are not rounded off. Preferably use hard polishing tools.

Cleanliness in every step of the polishing operation is of such great importance that it can not be overemphasized.

Certificate

To be sure Polmax fulfil the high demands on cleanliness, which is required to obtain good polishability, each bar is individually tested and delivered with certificate.
Chemical composition, soft annealed hardness and microcleanliness are given in the certificate.
Microcleanliness is rated according to ASTM E45 Method A, a well established standard method taking into consideration the amount of sulphides, oxides, silicates and globular inclusions.

Maximum inclusion level approved, according to ASTM E–45 Method A, Plate I–r

A		B		C		D	
T	H	T	H	T	H	T	H
0	0	1,0	0	0	0	1,0	0,5

Further information

Please contact your local Uddeholm office for further in formation on the selection, heat treatment, application and availability of Uddeholm tool steels.

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