
Carrs
toolsteel technologies
Special High Performance Tool Steels and Aluminium Alloys for tools
Tel 0121 522 6789
www. carrs-tool.co.uk

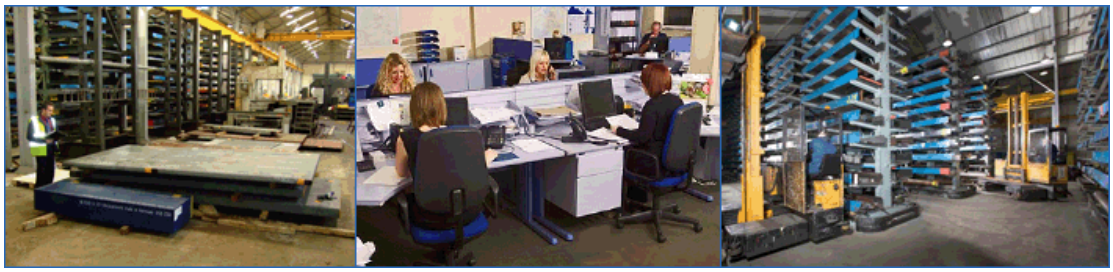
Carrs Tool Steel.

Contact Information.

Carrs Tool Steels Limited

Steelbright Works, Coneygree Road,
Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770

Contact us : Sales@carrs-tool.co.uk



Contents.

DC53

Typical Analysis

C	0.95	Cr	8.00
Mo	2.00	V	0.30
Si	1.00	Mn	0.40

Colour Code

Characteristics

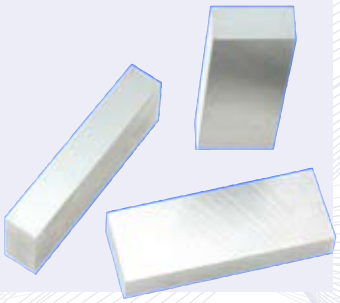
- Higher hardness (62-63HRc) than D2 after heat treatment
- Twice the toughness of D2 with a superior wear resistance
- 20% higher fatigue strength than D2
- Smaller primary carbides than D2 protect the die from chipping and cracking
- Secondary refining process (DLF) reduces Impurities
- Machines and grinds up to 40% faster than D2
- Less risidual stress after wire EDMing
- The chart top right shows where DC53 properties lie compared with conventional tool steels and powder metallurgy tool steels

Stock

CARRS DC53 is stocked in a range of diameters and plate and cut to customers requirements

READYMILLED.COM

Rectangular sections from 25mm³ up to 430 X 430 X 150mm can be delivered fine milled on all six faces to - 0+0.1mm and with squareness guaranteed to 0.1mm/m.



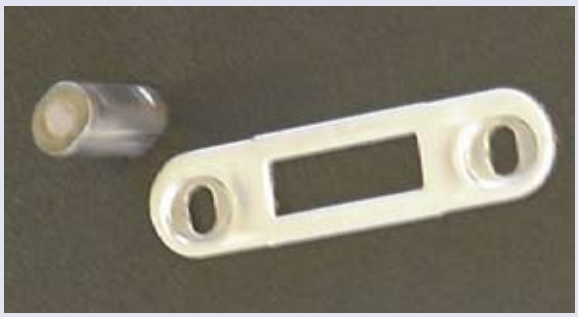
Typical Applications

- Plastic Moulds
- Stepped punch and press-punching dies
- Concrete sprayer parts, rotor plates
- Swaging dies and backers
- Dies for cold forging
- Thread-rolling dies for heat-treated bolts
- Forming dies
- Stripper plates for lead fame blanking
- Gauges
- Screws for injection moulding machines

Case Studies

(More available on request)

Shearing mild steel rolled sections. The 12,000 operations before tool failure using D2 material increased to 30,000 using DC53



Punching operations.
This D2 compression punch was achieving only 2,000 operations before regrinding or failure. Changing to DC53 resulted in more than 25,000 operations before regrinding.

Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

HEAT TREATMENT

Welding

Lower minimum pre-and post - heating temperature than D2 reduces the incidence of weld cracking and simplifies welding. Low hardness decline in heat affected zone minimises any deterioration in performance.

Hardening Vacuum Furnace

Pre-heat to 300-400°C and then to 800-850°C allowing sufficient time to equalise. Raise to 1,020-1,040°C and allow soaking time according to the chart below:

Maximum Section (mm)	Soaking Time (mins)
100 and below	20-30 mins per25mm
Above 100	10-20 mins per 25mm

Quenching Vacuum Furnace

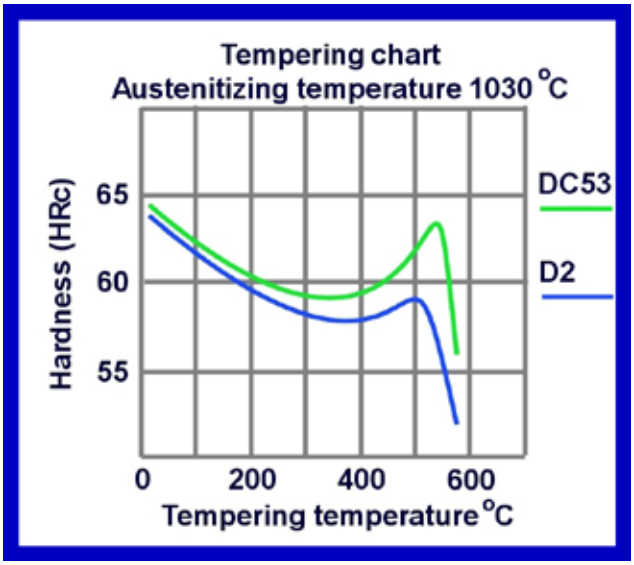
The high hardenability of this steele enables it to be satisfactorally quenched in a vacuum furnace.

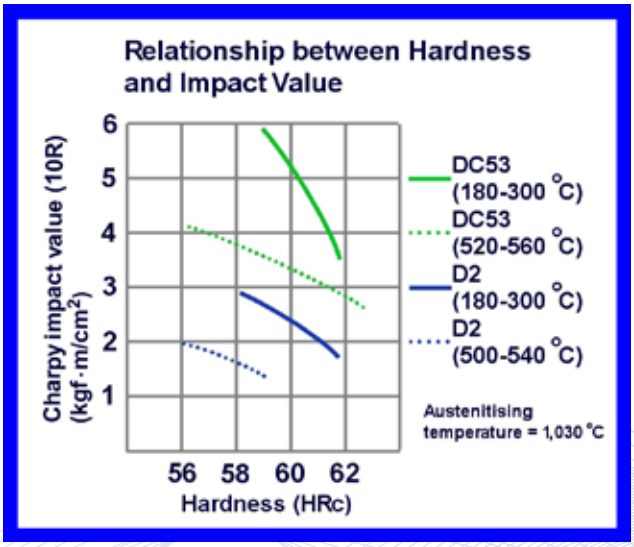
Surface Treatments

Surface treatments such as CVD, PVD, TD and Nitriding require the use of relatively high processing temperatures. While this can be a problem with standard D2, the higher through hardness of DC53 at elevated temperatures will allow these surface treatments to be used successfully.

Tempering

Double temper according to the hardness and toughness charts below. As with D2, a third temper at 400°C should be carried out to avoid any chance of any delayed grain growth and distortion. This is the preferred heat treatment for most applications as high hardness will be the primary consideration. Where maximum toughness is required, double temper between 200 and 300°C (depending on application). Note the material tempered at the lower temperature should not be subjected to subsequent high temperature processes such as PVD. For the fullest details of application related heat treatments, please ask for our detailed publication on the subject





Further information

Detailed information covering physical properties, welding and surface treatments are available, please ask.

Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

DRM1

Colour Code

Black

Characteristics

DRM1 is an entirely new Matrix type high speed tool steel specifically designed for hot and warm forging operations.
High toughness compared with conventional hot work grades.

- Good hardness at 58 HRc.
- Excellent resistance to heat checking.
- High softening resistance and hot hardness.
- Double melting ensures great cleanliness and very low inclusion levels.

DAIDO STEEL

Typical Applications

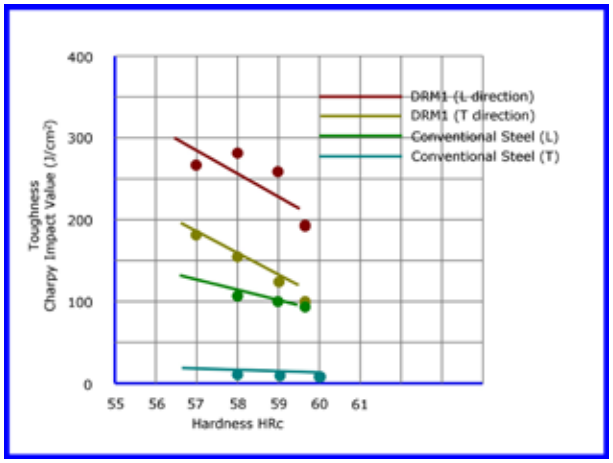
- Hot forging dies and punches.
- Warm forging dies and punches.

Stock

CARRS DRM1 is stocked in a range of diameters and plate and cut to customers requirements

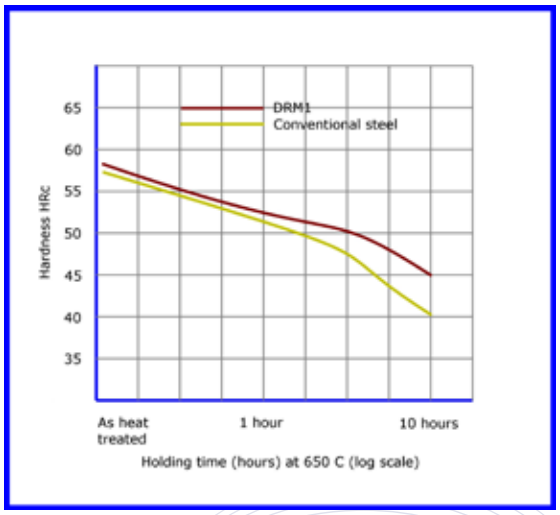
Toughness

DRM1 is significantly tougher in both the longitudinal and transverse directions



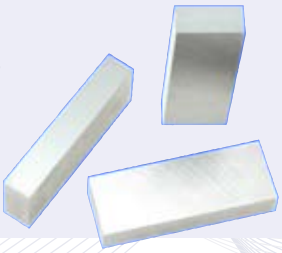
Resistance to Softening

All tool steels temper back to a greater or lesser extent as they are exposed to high temperatures but DRM1 has a considerably greater resistance to softening than other hot work tool steels.



READYMILLED.COM

Rectangular sections from 25mm³ up to 430 X 430 X 150mm can be delivered fine milled on all six faces to - 0+0.1mm and with squareness guaranteed to 0.1mm/m.



Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

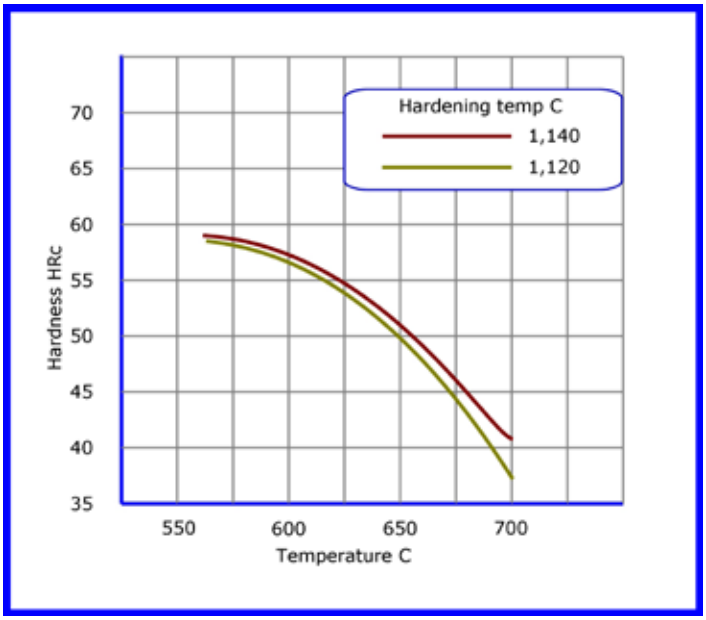
HEAT TREATMENT

Hardening Vacuum Furnace

Raise temperature to 950C and hold for 30 minutes then raise to 1,120 – 1,140C and hold for 30 to 90 minutes depending on the maximum section. Gas quench with a minimum of 6 bar. It is important to maintain a high quench rate below 500C to ensure high toughness to suppress lower Bainitic transformation.

Tempering

Double tempering is essential for optimum properties. The final tempering temperature should be selected with the following characteristics in mind.



Tempering Temperature (c)	Hardness HRc	Characteristics
600	56	Maximum toughness
580	57	Good toughness and wear resistance
550	58	Maximum wear resistance

Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

PORCERAX II

Self Venting Mould Steel

Unique Characteristics

- Porcerax II is a sintered, porous steel with porosity in the range of 20-30% by volume. A system of interconnecting pores with average diameters of 7 or 20µm are dispersed through the material.
- Pre hardened to 35-38 HRc
- Suitable for polishing and texturing

Key Benefits

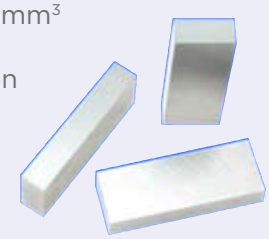
- Eliminates gas entrapment
- Minimises flow/knit lines
- Eliminates material burning
- Lowers scrap/reject rate
- Eliminates short shots
- Lowers gloss levels and improves product appearance
- Reduces clamping pressure and cycle time by reducing back-pressure

Stock

Stock is held in a comprehensive range of sizes including machined bar and vent plugs. Please enquire.

READYMILLED.COM

Rectangular sections from 25mm^3 up to 430 X 430 X 150mm can be delivered fine milled on all six faces to -0+0.1mm and with squareness guaranteed to 0.1mm/m.



Applications

- Suitable for most polymers with a hardness greater than 60 Shore A
- Use as a self-venting insert or for the production of whole mould cores

Important Note

Porcerax II represents an important advance in materials available to the moulder. However, machining, polishing, texturising and heat treatment (not reccomended) all require different techniques to those employed on standard tool steels. Failure to take these factors into account will almost certainly result in failure. Please always request additional information covering the intended machining and post machining treatment.

Machining

Porcerax may be machined by cutting, grinding, milling and EDM but it is important to avoid crushing and blocking the pore structure. Grinding will close the pores as will milling to a lesser extent. The best permeability is achieved using EDM which will also open the crushed pores as will correctly applied stoning.

Heat Treatment

Porcerax II is pre-hardened and further heat treatment is not recommended due to its propensity to in-process distortion. However it is possible to achieve a hardness of 50-52 HRc in a vacuum furnace. In the event that this is required, it is essential that the heat treater obtains guidelines from Carrs Toolsteel Technologies. Rockwell and Brinell hardness testers will crush the porous material giving false readings. For this reason, use of a Vickers micro hardness tester with a 30 or 50g load is reccomended.

Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

PORCERAX II

Self Venting Mould Steel

Texturing

In order to prevent the destruction of the pore structure, it is vital that the chosen texturing company is aware that it is working with Porcerax. The pores of the material must be thoroughly cleaned and then sealed prior to texturing. The perfect venting achieved by Porcerax will result in greater resolutionof any texture (or polish) in the moulding and therefore Porcerax should not be used as an insert in areas requiring consistent appearance.

Water Cooling

Although not reccomended, water cooling can be achieved by treating water lines with an appropriate sealant.

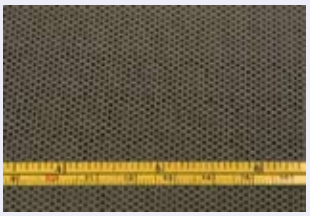
Cleaning

Adequate cleaning before and during use is essential and cleaning methods should be designed into the tooling concept from the outset

CASE STUDIES (Further examples on request)

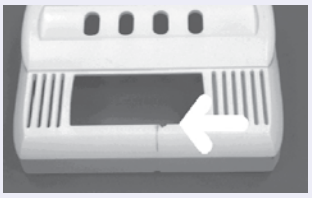
Loud Speaker Grille

This is a good example of what can be achieved using a Porcerax core. The efficient venting allows the reproduction of the very fine detail even though the cavity is fed by only a single gate. The illustrations show the grille (left) the detail (middle) and the single gate feed point at the core pin (right).


Thermostat Housing

This example shows how burn problems can be cured using a Porcerax insert in the core side of the cavity at the point where the problems are occurring. The illustrations show the defect (left arrowed), the problem cured (middle) and the insert position (right).

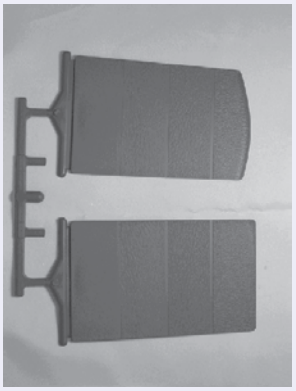


Gloss Reduction

The shot to the right shows how the use of Porcerax can reduce gloss and provide a greatly improved finish with more accurate rendering of texture. Standard mould steel at the top, Porcerax at the bottom

Short Shot

The illustration to the right (top) shows how high pressure and air entrapment can result in a partially filled cavity. The lower illustration shows what can be achieved using Porcerax.



Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

Carrs toolsteel technologies

TOOLOX 33

Typical Analysis

C	0.25	Si	0.60
Mn	0.90	Cr	1.20
V	0.13	Mo	0.40

Colour Codes

Characteristics

TOOLOX 33 is a pre-hardened, free machining steel with very high impact toughness and exceptional cleanliness. This steel may be polished and etched with excellent results. Because of the very low levels of internal stress, large sections may be machined without movement and stress relieving is neither necessary nor recommended.

Typical Applications

TOOLOX 33 is especially suited for plastic moulds having excellent polishing and photo-etching ability which are guaranteed to NADC207-97. Other applications include rubber moulds, bending tools and general engineering where high toughness, high impact strength and great stability are important. This material can substitute and will give better results than qualities such as 1.2311, 1.2738 and 1.2312.
See over for case studies.

Please see overleaf for case studies

Machining

For best results, it is important to select the appropriate high quality cutting tools and the correct speeds and feed rates. A considerable amount of information is available on request.

For milling it is important to use inserts with a positive cutting angle. Expect 25% faster cutting compared with 1.2312 and much more compared with 1.2311. At cutting speeds of 300m/min and a feed rate of 0.15mm using a Sandvik Coromill 200 with GC1025 inserts, we quarantee a maximum edge wear of 0.3mm in 10 minutes.

When drilling short holes, cemented carbide drills have proved to be best. For deep holes, straight flute, cemented carbide drills have been effective. Cooling channels should be drilled with HSS drills such as HS6-5-2-5 (M35) where the Cobalt content has proved beneficial. A drill tip angle of 118° rather than the conventional 130° has been found to provide a two to three times better service life.

Physical Properties (Guaranteed and Typical)

Hardness		HBW	280-330	300
		HRC	-	29
Impact Values (longitudinal)	=<130mm thick	J	27min	60
	>130mm thick	J	14min	27
Tensile Stregnth	at 20°C	R_m[Mpa]	-	1,080
	at 200°C	R_m[Mpa]	-	1,010
Yield Strength	at 20°C	R_{p02}[Mpa]	-	955
	at 200°C	R_{p02}[Mpa]	-	860
Coefficient of thermal expansion at:	+20°C to 200°C	10^{-6}/K	-	13.1

Carrs toolsteel technologies

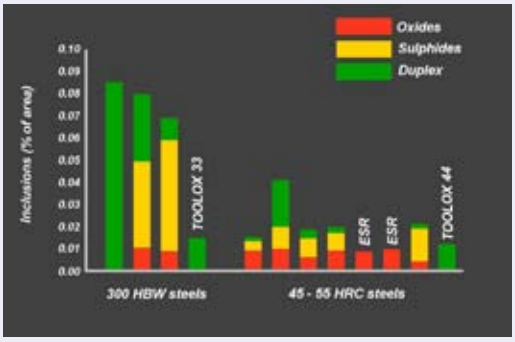
TOOLOX 33

CASE STUDIES

Theka Formverktyg AB produced this plastic mould tool for vehicle number plates using Toolox 33 for the core and Toolox 44 for the cavity. The high stability and ease of machining was particularly noted.

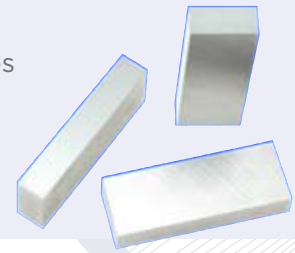
Ursviken Pullmax produced this 3 metre long press-brake blade in Toolox 33 and measured only 0,7mm maximum deflection from end to end. Milling speed was also 25% faster than with the previous material 1.2312 (P20 with Sulphur).
This demonstrates both the superb stability of Toolox 33 and its free-cutting qualities.

The exceptional cleanliness of Toolox (see chart below) provides high quality polished finishes and etch-grain effects with very low risk.



READYMILLED.COM

Rectangular sections from 25mm³ up to 430 X 430 X 150mm can be delivered fine milled on all six faces to - 0+0.1mm and with squareness guaranteed to 0.1mm/m.



Stock

TOOLOX 33 is stocked in plate and cut to individual customers requirements.

SSAB OXELÖSUND

Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

Carrs toolsteel technologies

Carrs toolsteel technologies

TOOLOX 44

Typical Analysis

C	0.32	Si	0.60-1.10
Mn	0.80	Cr	1.35
Mo	0.80	V	0.14

Colour Codes

Characteristics

TOOLOX 44 is a pre-hardened, relitively free machining steel with very high impact toughness and exceptional cleanliness. Because of the very low levels of internal stress, large sections may be machined without movement and stress relieving is neither necessary nor recommended. This steel may be polished and etch grained with excellent results.

Typical Applications

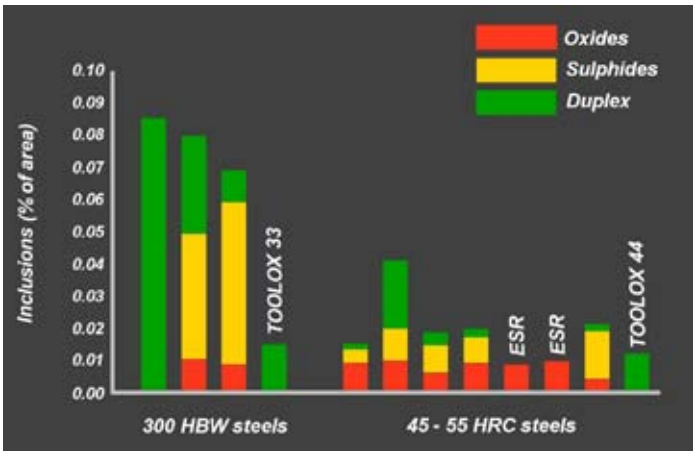
TOOLOX 44 is especially suited for plastic moulds having excellent polishing and photo-etching properties which are guarenteed to NADCA207-97. Other applications include press tools and general engineering where high toughness, high imact stregnth and great stability are important.

Please see overleaf for case studies

Machining

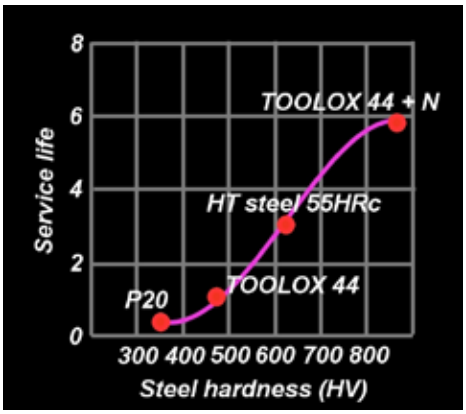
For best results, it is important to select the appropriate high quality cutting tools and the correct speeds and feed rates. A considerable amount of information is available on request.

The exceptional cleanliness of Toolox (see chart below) provides high quality polished finishes and etch-grain effects with very low risk.



Surface Treatment

Due to its high hardness and excellent toughness. TOOLOX 44 provides an ideal substrate for surface treatments such as nitriding and PVD. Treated in this way TOOLOX 44 may be employed in an additional range of applications where high surface pressures are involved and where high wear strength is needed.



Physical Properties (Guaranteed and Typical)

Hardness		HBW	410-475	450
		HRC	-	45
Impact Values (longitudinal)	=<130mm thick	J	18min	30
Tensile Stregnth	at 20°C	R_m[Mpa]	-	1,450
	at 200°C	R_m[Mpa]	-	1,380
Yield Strength	at 20°C	R_{p02}[Mpa]	-	1,300
	at 200°C	R_{p02}[Mpa]	-	1,200
Coefficient of thermal expansion at:	20°C to 200°C	10^6/K		13.5

Carrs toolsteel technologies

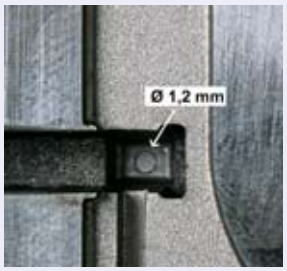
TOOLOX 44

CASE STUDIES

Plastic Mould Tools

Thorsman Lexel produced this plastic mould tool in Toolox 44.

The product is an electrical box moulded in Nylon 6 with no filler material. The toolmaker commented particularly on the time saved by avoiding heat treatment and the relative ease of machining for a hardened steel.

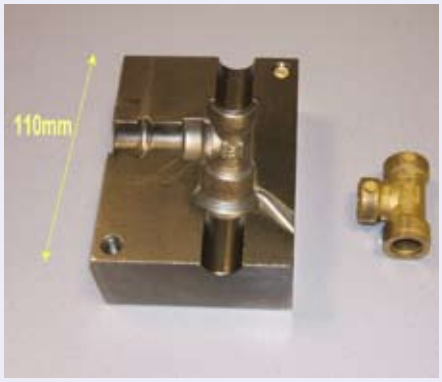


Press Tools

Toolmaker Flextronics customers include Electrolux who use press tools in Toolox 44 to form the base plates in all their refrigerators.
The very high stability of Toolox 44 means that the tool does not warp or move and no remedial finishing is required. In use the tool showing no sign of adhesive wear.

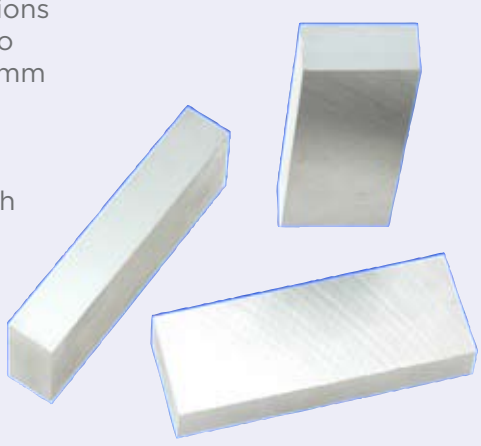
Hot Work

Toolox 44 has shown good results in hot work applications including diecasting. It is now in routine use for hot steel forging in the nitrided condition where its strength and the avoidance of heat treatment are important considerations.



READYMILLED.COM

Rectangular sections from 25mm³ up to 430 X 430 X 150mm can be delivered fine milled on all six faces to -0+0.1mm and with squareness guaranteed to 0.1mm/m.



Stock

TOOLOX 44 is stocked in plate and cut to individual customers requirements.

SSAB OXELÖSUND

Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

Carrs toolsteel technologies

TQ1

Typical Analysis

C	0.36	Si	0.30
Mn	0.40	Cr	5.20
Mo	1.90	V	0.55

Lowest possible levels of trace elements

Colour Code

Characteristics

TQ1 embodies an entirely new technology that has resulted in a hot work steel with properties far in advance of the best premium hot work steels such as those meeting the NADCA specification. The key properties of this new steel are its ability to combine toughness with hardness, low sensitivity to thermal shock and resistance to heat-checking.

KIND & CO EDELSTAHLWERK

Stock

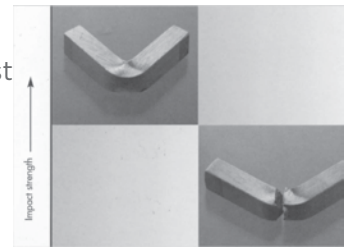
TQ1 is stocked in various thickness' as forged plate and is cut to customers specifications.

Typical Applications

- Diecasting tools for longer runs, arduous applications and difficult designs such as small sections.
- Extrusion tools.
- Die forging tools.

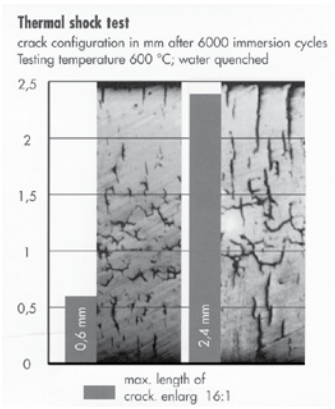
Impact Strength

The pictures on the right contrast the results of an impact test on samples of TQ1 (left) and H13 (right). The H13 material is Electro Slag Refined steel and complies with the Diecasting Quality Standard NADCA 207-97.



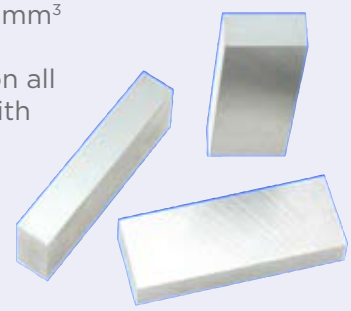
Resistance To Thermal Shock

The pictures on the right show the difference in resistance to thermal shock between TQ1 and H13 of a similar standard to that used in the impact test above.



READYMILLED.COM

Rectangular sections from 25mm³ up to 430 X 430 X 150mm can be delivered fine milled on all six faces to - 0+0.1mm and with squareness guaranteed to 0.1mm/m.



Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

Carrs toolsteel technologies

TQ1

HEAT TREATMENT

Stress Relieving

a) Inert gas atmosphere (preferred)
Raise temperature to the last tempering temperature minus 30°C. Hold for a minimum of 6 hours. Cool slowly in still air without the use of forced draught or grids.
b) Conventional furnace
Raise temperature to 480°C max. hold for a minimum of 6 hours. Cool slowly in still air without the use of forced draught or grids.

Hardening

Preheat in two stages to 650°C and 850°C allowing sufficient time for equalisation at each stage (minimum 30 minutes). Raise to the hardening temperature of 1,010/1,020°C, allow to equalise then hold for 45 minutes.

Quenching

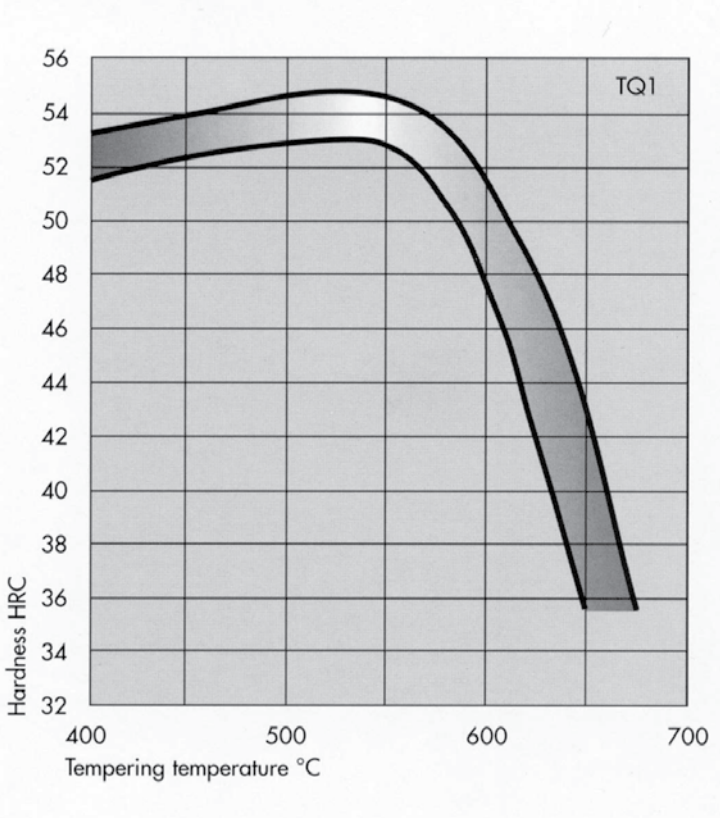
Quench in a vacuum furnace in Nitrogen to 100°C. To reduce stress, interrupt quench at 440°C for 30 mins. Temper immediately while tools are still warm.

Always Preheat Before Use

For optimum performance, it is vitally important that tools be preheated to between 100 and 350°C depending on use, and allowed to equalise.

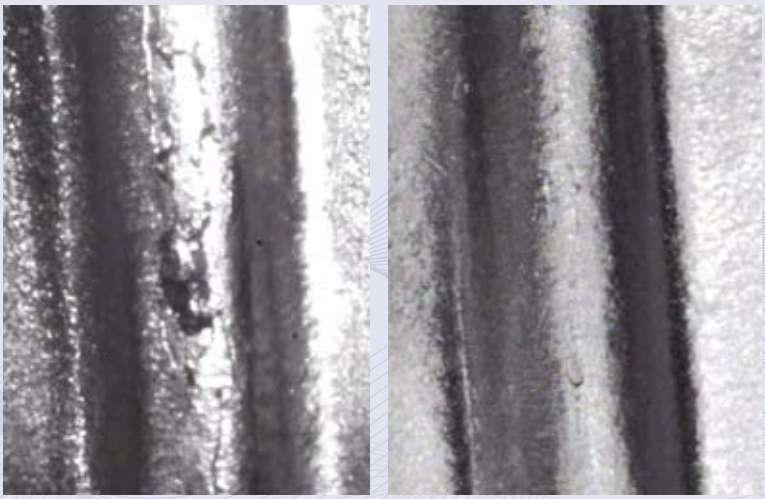
Tempering

Double tempering is essential and triple tempering beneficial.



CASE STUDY

The picture on the left shows part of the 80,000th component from a diecasting tool in H11 material produced to a standard in excess of NADCA 207-97 (the diecasting industry benchmark specification). Considerable break-up is evident and the tool would not be expected to continue long in production. The picture on the right is of the same part of the 80,000th component from a tool in TQ1. Note that there is no evidence of significant wear or break-up and there is clearly much life left in the tool.



Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

Carrs toolsteel technologies

ALUMOLD 500

Colour Code

Salmon

Characteristics

Alumold 500 is a heat treated and stress relieved Aluminium alloy specifically developed for tooling applications. It has high strength, very high thermal conductivity and is very easy to machine. These characteristics are especially relevant where time compression in tool production and product output are important. Depending on the polymer involved, extended production runs are possible

Manufacturing

There are two manufacturing routes depending on thickness, rolled plate and forged block. The two routes result in slightly different properties and these are set out in the table on the back page.

Typical Applications

Plastic injection moulding tools, blow moulding, jigs, prototype tools, vacuum forming and low-inertia base and top plates for cold work die sets.

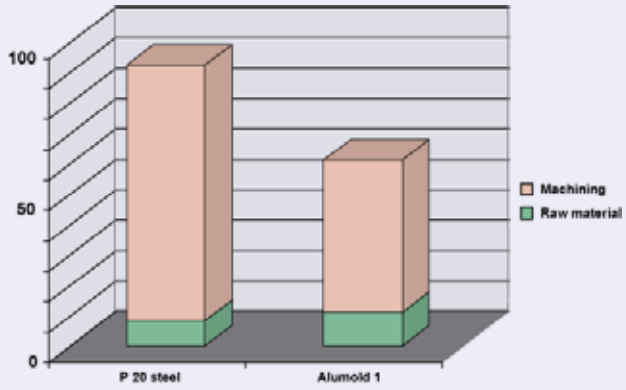
STOCK

Alumold 500 is stocked as plate or block and cut to customer's requirements.

Productivity

The very high thermal conductivity of Alumold 500 results in much higher cooling rates and therefore increased output. Its high diffusivity allows rapid temperature equalisation in the mould and hence reduction in internal stresses and warping in the product.

Indicative Mould Production Cost Compared With Conventional Tool Steel



Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk

ALUMOLD 500

MECHANICAL PROPERTIES

Rolled Material							Forged Material						
Thickness (mm)	Minimum values MPa			Typical values MPa			Thickness (mm)	Minimum values MPa			Typical values MPa		
	Rm	Rp 0.2	% A	Rm	Rp 0.2	% A		Rm	Rp 0.2	% A	Rm	Rp 0.2	% A
25.0 to 76.2	560	504	5	590	540	10	175.0 to 200.0	475	420	4	530	470	10
76.2 to 127.0	550	497	4	580	530	6	200.0 to 300.0	465	400	3.5	520	460	9
127.0 to 152.4	540	476	2.5	570	520	4	300.0 to 400.0	450	370	3	520	460	8
152.4 to 203.2	525	473	1	555	510	2	400.0 to 450.0	430	350	3	520	460	7
203.2 to 254.0	505	455	1	535	490	1.5	450.0 to 700.0	410	340	3	480	420	7
254.0 to 305.0	470	435	0.5	510	470	1.5							

USAGE PROPERTIES

Operation	Performance criteria	Rolled Material	Forged Material
Milling	Swarf breaking Surface brightness	Excellent	Excellent Excellent
Polishing	Aesthetic Optical	Excellent Good	Excellent Good (add surface treatment)
Engraving/etching	Chemical etching Laser Etching	Excellent Excellent	Good Excellent
Surface treatments	Hard anodising	Excellent	Excellent
	Nickel plating	Excellent for cavity: abrasion resistance	Excellent for cavity: abrasion resistance
	PVD / PA CVD	Dedicated for Aluminium: high hardness	Dedicated for Aluminium: high hardness
	Thermal / laser spraying	Thick and hard layer: parting line resistance	Thick and hard layer: parting line resistance
Welding	Refilling (TIG)	Good: DC/Helium rod 5180,5356, 4047,4145	Good: DC/Helium rod 5180,5356, 4047,4145

PHYSICAL PROPERTIES

(both forged and rolled material)

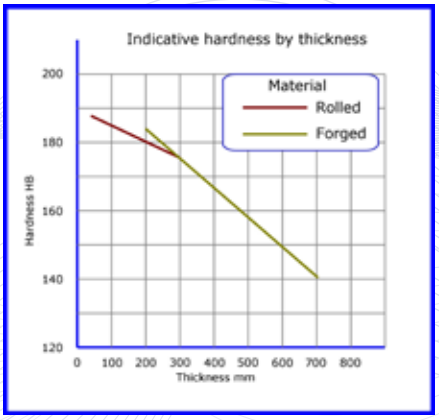
Specific Gravity	2.82 kg/dm³
Coefficient of thermal expansion	23.7 x 10-6/°C
Thermal conductivity	153 W/m.°C
Specific heat	857 J /kg.°C
Thermal diffusivity	63 x 10-6 m² / sec
Tensile modulus	72,000 MPa
Compression modulus	73,000 Mpa
Poisson's coefficient	0.33
Melting range	475 – 630 °C

MOULD DESIGN

Parting line stress should be limited to 50 MPa maximum and, ideally 35 MPa.

HEAT TREATMENT AND INTERNAL STRESS RELIEVING

Plates are delivered after complete thermal treatment and internal stress relieving. No further treatment is recommended.



Steelbright Works, Coneygree Road, Tipton, West Midlands DY4 8XQ, United Kingdom
Tel 0121 522 6789 Fax 0121 522 6770 Email : Sales@carrs-tool.co.uk
www. carrs-tool.co.uk


Carrs
toolsteel technologies
Special High Performance Tool Steels and Aluminium Alloys for tools
Tel 0121 522 6789
www. carrs-tool.co.uk