High-performance materials, premium service and heat treatment for 

Die Casting
An economical die casting process requires reliably working dies. Tool-related interruptions in the casting process or disproportionately high reworking costs for the products have a direct effect on the production costs of the cast parts.

Our tool steels, manufactured under optimized production processes, offer special and high-quality properties with regard to

- Thermal shock resistance
- High-temperature strength
- Toughness
- Wear resistance

Choosing the right hot-work tool steel extends the life of the tool and improves the quality of the final product.
Kind&Co

For over 130 years, we have been producing high-quality tool steel exclusively at our site in Bielstein. Kind&Co is still a family owned business today. We stand for sophisticated material solutions, highest quality, reliable service and competent advice - tailored to the respective application. We have particularly strong application expertise in the areas of die casting, extrusion and drop forging. As a qualified partner, we offer you interesting solutions in the field of die casting and low-pressure die casting.

Die casting (HPDC/LPDC)

Modern applications in the die casting industry reduce the weight and increase the efficiency of many industrial products.

- Automotive engine and transmission construction  
- Structural components in automotive lightweight construction  
- Solutions in e-mobility  
- Electrical motor and housing construction  
- Telecommunications  
- Industrial applications  
- Consumer goods industry

The increasing demands in the die casting industry require modern and high-quality tooling solutions. Complex geometries, large-format casting products, reduced cycle times and alloys are difficult to cast. These conditions require tool steel that is capable of avoiding premature tool failures even under the toughest production conditions and of achieving the best economic efficiency with the tools.

Trends

Electromobility is bringing about a far-reaching change in the cast parts range. The already very diverse range of die-cast structural components is constantly increasing and contributes to the weight reduction of vehicles. The complexity of such components places particularly high demands on die casters, die makers and steel manufacturers. The high mechanical and thermal stresses occurring in the die inserts must be compensated by the die insert with the highest possible toughness of the steel in order to prevent premature cracking in the heavily-loaded areas of the die inserts.

Visible and painted areas of the die-cast components place the highest demands on the thermal shock resistance of the steels used in order to avoid costly reworking of the cast parts. Higher die reliability can be achieved by using steels with improved toughness and thermal shock resistance.

With state-of-the-art technology and the many years of experience of our materials engineers, we supply first-class solutions and tailor-made hot-work tool steels that meet the high demands of the die casting industry.
Our range covers the entire spectrum from die steel to hardened die inserts.

<table>
<thead>
<tr>
<th>Die casting (HPDC)</th>
<th>Rod, black</th>
<th>3D piece</th>
<th>Rod, bright</th>
<th>Machined part (drawing)</th>
<th>Hardening</th>
<th>Service/repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Die insert, slider, Sprue bush</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>(x)</td>
</tr>
<tr>
<td>Accessories</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>(x)</td>
</tr>
<tr>
<td>• Shot sleeve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Casting piston</td>
<td></td>
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<tr>
<td>• ...</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Low-pressure die casting (LPDC)</th>
<th>Rod, black</th>
<th>3D piece</th>
<th>Rod, bright</th>
<th>Machined part (drawing)</th>
<th>Hardening</th>
<th>Service/repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Die insert</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>(x)</td>
</tr>
</tbody>
</table>
Die casting (HPDC)

Tool steel selection for die casting (HPDC)

The die casting process requires a differentiated tool steel selection for different challenges.

The selection of a suitable tool steel for a die casting die requires a fundamental analysis of the part to be cast. The following aspects in particular must be taken into account:

- Series depth
- Size of insert/Segmentation
- Surface quality of cast part
- Part size
- Casting material
- Cooling method
- Part geometry
- ...
Our high-quality tool steels for high-pressure die casting applications (HPDC)

Die casting (HPDC)

- **TQ1** - The best quality for tool steel in die casting. For tools exposed to extreme conditions - large tools for structural vehicle components, tools for components in electric motor vehicles (e.g. battery housings) and dies exposed to very high flow rates. Recommended for minimal quantity spraying.

- **HP1** - The premium steel for die casting that combines tailor-made properties with cost-effectiveness. For dies for highest loads and narrow tolerances (cooling fins, sealing surfaces) up to medium insert sizes. Recommended for minimal quantity spraying.

- **CS1** - The solution for die casting of parts with increased demands on surface quality. A hardness of up to 54 HRC is possible. For visible parts in die casting for motorcycles, high-quality consumer products such as laptops, mobile phones and electronic components with the highest demands on surface quality. Recommended for minimal quantity spraying.

- **HTR** - A remelted ESR tool steel combining very good thermal shock resistance, excellent High-temperature strengths and high thermal conductivity. For local areas and small applications that are exposed to high thermal loads, e.g. cooling blocks.
USN ESR - A high-quality re-melted ESR hot-work tool steel with high toughness and good high-temperature strengths. A world-wide standard for HPDC parts in many applications where tooling economy and tooling safety must be combined. Used for inserts and die plates in many areas of die casting of Al, Al-Mg and Zn-Sn-Pb.

USD ESR - A high-quality, re-melted ESR tool steel for aluminium, magnesium and zinc die casting moulds. Slightly lower toughness compared to USN ESR. The standard in many non-European markets.

RPU ESR - A tool steel with increased thermal shock resistance and high high-temperature strengths. For small and medium-sized moulds and long production units in HPDC, e.g. die casting of electric motor housings, consumer goods and casting of brass at elevated temperatures. Also the standard for ejector pins, casting pistons and shot sleeves in die casting.

RM10Co - A tool steel with extremely high high-temperature strengths, suitable for special requirements regarding wear at high temperatures and resistance to molten metal: die plates for die casting of brass, casting systems for hot-chamber die casting machines, casting pistons, piston rings and local inserts in shot sleeves.

HMoD - Hot-work tool steel with excellent wear resistance and excellent high-temperature strengths. For local areas in the gate area or distribution system, small die inserts and die casting tools for casting brass or other heavy metals, especially for thin-walled castings.
3D-forging

Kind&Co offers a special forging process for the forming of die-cast die steels: individual 3D forging of the die block. Selected starting material in the form of ingots and billets is forged to the customer’s desired dimensions. The isotropic properties of the component are achieved by the precisely fitting deformation on our forging presses.

The fibre in the longitudinal direction is avoided and a much more homogeneous microstructure is achieved. Three-dimensional forging improves the toughness level of the steel and is, therefore, particularly recommended for larger die inserts with complex design and the highest toughness requirements.

3D pieces have better quenching conditions for geometric reasons

3D forging improves toughness and isotropy

![Toughness (qualitative) chart]

- Conventional bar
- ESR bar
- 3D
High-quality heat treatment service from a single source

For more than 40 years, Kind&Co has been known as a specialist supplier of heat treatment processes for die casting dies. With 5 vacuum furnaces and up to 6.5 tons charging weight, we are able to meet even the highest customer requirements. Due to the very high quenching performance and high cooling pressures of up to 15 bar, we can ensure excellent material properties even with large cross-sections and unit weights. Comprehensive documentation for our customers guarantees reliable and reproducible results.

Our equipment exceeds the requirements of the current NADCA, as well as Ford and GM specifications. We are known internationally by die casters and die makers as one of the leading service providers in heat treatment, even for the largest die casting dies for the production of structural parts in automotive engineering.

Premium steels such as TQ1 and CS1 are characterized by a special transformation behaviour during cooling and are therefore ideally suited for large-format die inserts.

Our specialists in application technology and heat treatment will be pleased to advise you on questions concerning the determination of machining allowances and the preparation of dies for hardening and stand ready with their recommendations.

As a long-standing partner of the die casting industry, we also offer nitriding without compound layer in our Program 99. The process reduces the adhesion tendency of the melt and increases the wear resistance of the die without the usual negative influence on the formation of thermal shock cracks.

### Hardness parameters

<table>
<thead>
<tr>
<th>Brand label</th>
<th>Hardening temperature in °C</th>
<th>Soaking time in minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TQ1</td>
<td>1010</td>
<td>60</td>
</tr>
<tr>
<td>HP1</td>
<td>1020</td>
<td>60</td>
</tr>
<tr>
<td>CS1</td>
<td>1030</td>
<td>60</td>
</tr>
<tr>
<td>HTR</td>
<td>1060</td>
<td>60</td>
</tr>
<tr>
<td>USN ESR</td>
<td>1000</td>
<td>45</td>
</tr>
<tr>
<td>USD ESR</td>
<td>1020</td>
<td>45</td>
</tr>
<tr>
<td>RPU ESR</td>
<td>1030</td>
<td>45</td>
</tr>
<tr>
<td>RM10Co</td>
<td>1130</td>
<td>45</td>
</tr>
<tr>
<td>HMoD</td>
<td>1130</td>
<td>45</td>
</tr>
</tbody>
</table>

We recommend 3 tempering cycles to ensure maximum toughness properties.
Steel, pre-machining of the die contour and hardening from a single source

Due to the fully-integrated service of KC GS Tooling GmbH at the Wiehl location, we can offer extensive machining possibilities with a focus on deep hole drilling and 3D processes for die casting die inserts.

In addition, our services range from melting and forging to pre-machining of the cavity to hardening allowance - with simultaneous hardening service in our modern vacuum hardening shop. You get all these processes from one source and at one location, saving you time.

The machine park of KC GS Tooling comprises five machining centres with a maximum piece weight of 8t, various boring mills, a vertical milling machine and four deep-hole boring machines with traverse paths of up to 1250x1100x1600 mm for machining pieces weighing up to 7 tonnes.

Effective programming and work preparation support the fast and efficient processing of your production orders. All common file formats for the following CAD/CAM programs can be read and processed:
- IGS
- CATIA
- VDA
- PRT
- CAD
- other formats on request

The four deep hole drilling machines include a SAMAG TFZ2L-1000 with a travel of 1250x1100x1600mm.

Contact our sales department and book this service at no extra effort.
Our high-quality tool steels for low pressure die casting (LPDC) applications

Applications in low-pressure casting are subject to mechanical, thermal and chemical stresses during operational use. With the growing size, but also the complexity of cast components in automotive engineering - in particular a large number of structural components - the demands on dies and tool steels are increasing. The automotive market is characterized by increasingly larger light alloy wheels on vehicles. But the rims are also becoming more and more filigree in design.

At the same time, the wheels must meet the highest safety requirements. The industrial production in casting is a special challenge for the foundryman and the die maker. The use of steels which combine maximum toughness with very high high-temperature strength offers foundrymen new opportunities to manufacture more complex products cost-effectively. TQ1 has proved itself in this field especially for the visible side of the wheels, but also for thick-walled structural parts, e.g. in the wheel suspension.

Modern tool steel solutions for low pressure die casting (LPDC)
Alloy Application Tooling characteristics

Aluminium
combustion engine power train
• medium-sized parts
• complex geometry
light-alloy rims
top cores
• large-sized discs
• simple geometry
bottom cores
• large-sized discs
• complex design
• visible part: highest surface requirements
• tight radii
structural parts in automobiles
• large-sized castings
• complex design
• different cross-sections
• high surface requirements
Magnesium
exhaust systems
• high thermal stress
• high mechanical stresses
• abrasion by blasting material
• erosion
• tempering effects
• distortion
USN
32-38 HRC
USD ESR
34-40 HRC
RPU ESR
34-40 HRC

light-alloy rims
• high thermal stress
• erosion
• tempering effects
• distortion
USN
32-38 HRC
USD
32-38 HRC
RPU
32-38 HRC

structural parts in automobiles
• high thermal stress
• high mechanical stresses
• long contact times
• intensive cooling, partly by water
• abrasion by blasting material
• erosion
• tempering effects
• distortion
• risk of crack formation at cross section transitions
USN ESR
34-40 HRC
USD ESR
34-40 HRC
RPU ESR
34-40 HRC
TQ 1
36-42 HRC
33-40 HRC
### Alloy Application Tooling characteristics

<table>
<thead>
<tr>
<th>Specific stress</th>
<th>Typical failure pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>• high thermal stress</td>
<td>• abrasion by blasting material</td>
</tr>
<tr>
<td>• high mechanical stresses</td>
<td>• erosion</td>
</tr>
<tr>
<td>• large-sized parts</td>
<td>• tempering effects</td>
</tr>
<tr>
<td>• complex geometry</td>
<td>• distortion</td>
</tr>
<tr>
<td>• high thermal stress</td>
<td>• surface roughness</td>
</tr>
<tr>
<td>• high mechanical stresses</td>
<td>• crack formation from radii and screw holes</td>
</tr>
<tr>
<td>• long contact times</td>
<td>• intensive cooling</td>
</tr>
<tr>
<td>• intensive cooling, partly by water</td>
<td>• risk of crack formation at cross section transitions</td>
</tr>
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<td>• high thermal stress</td>
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<td>• tight radii</td>
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<td>• surface roughness</td>
</tr>
<tr>
<td>• intensive cooling, partly by water</td>
<td>• crack formation from radii and screw holes</td>
</tr>
</tbody>
</table>

### Requirements

- **Standard**
- **High**
- **Very High**

- **Good Standard**
- **Premium**

- **Requirements**

- **Standard high very high**
High-quality heat treatment service from a single source

Modern bogie hearth furnaces permit economical and high-quality hardening and tempering of bars and individual pieces for low-pressure casting applications. Water or polymer solutions are used for quenching to ensure rapid martensite transformation and a uniform, homogeneous hardening structure for our customers. A fully-automatic modern hardness testing technology ensures the high quality requirements of our customers and documents the process results.

A heat treatment to working hardness ex works leads to cost and time savings in your company

Highest efficiency for your application

- Save time
- Save costs
- Good machinability
- Reliable hardness
- No distortion during heat treatment
- All services from a single source

All tool steels can be supplied in the as-delivered condition in typical application hardnesses. Additional heat treatment by die maker is not necessary.
- Typical working hardness 32-42 HRC
- Other working hardness values on request
- Heat treatment with short lengths of only 1000-1300 mm ensures high homogeneity and uniform hardness of the sawn piece
Machining recommendations

<table>
<thead>
<tr>
<th>LATHE Cemented Carbide</th>
<th>Condition</th>
<th>Cutting speed Vc in m/min</th>
<th>Feed Fz in mm</th>
<th>Cutting depth ap in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>annealed</td>
<td>140-200</td>
<td>0,40-0,90</td>
<td>3-10</td>
</tr>
<tr>
<td></td>
<td>quenched and tempered</td>
<td>50-90</td>
<td>0,25-0,70</td>
<td>2-6</td>
</tr>
<tr>
<td>Premium</td>
<td>annealed</td>
<td>100-160</td>
<td>0,40-0,90</td>
<td>3-8</td>
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<tr>
<td></td>
<td>quenched and tempered</td>
<td>30-70</td>
<td>0,25-0,70</td>
<td>2-5</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>FACE MILLING rounded cutter plate</th>
<th>Condition</th>
<th>Cutting speed Vc in m/min</th>
<th>Feed Fz in mm</th>
<th>Cutting depth ap in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>annealed</td>
<td>120-180</td>
<td>0,25-0,50</td>
<td>2-5</td>
</tr>
<tr>
<td></td>
<td>quenched and tempered</td>
<td>50-90</td>
<td>0,20-0,30</td>
<td>2-5</td>
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<tr>
<td>Premium</td>
<td>annealed</td>
<td>150-200</td>
<td>0,20-0,50</td>
<td>2-4</td>
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<tr>
<td></td>
<td>quenched and tempered</td>
<td>30-70</td>
<td>0,20-0,30</td>
<td>2-4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DRILLING Solid carbide</th>
<th>Condition</th>
<th>Cutting speed Vc in m/min</th>
<th>Feed Fn in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>annealed</td>
<td>60-100</td>
<td>0,15-0,30</td>
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<tr>
<td></td>
<td>quenched and tempered</td>
<td>40-60</td>
<td>0,10-0,25</td>
</tr>
<tr>
<td>Premium</td>
<td>annealed</td>
<td>50-90</td>
<td>0,10-0,25</td>
</tr>
<tr>
<td></td>
<td>quenched and tempered</td>
<td>40-60</td>
<td>0,10-0,25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DRILLING Indexable insert</th>
<th>Condition</th>
<th>Cutting speed Vc in m/min</th>
<th>Feed Fn in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>annealed</td>
<td>180-220</td>
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<tr>
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<td>quenched and tempered</td>
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<td>0,05-0,25</td>
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<tr>
<td>Premium</td>
<td>annealed</td>
<td>120-180</td>
<td>0,10-0,20</td>
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<tr>
<td></td>
<td>quenched and tempered</td>
<td>40-60</td>
<td>0,05-0,25</td>
</tr>
</tbody>
</table>

**Standard:** USN, USD, RPU  
**Premium:** TQ1, HP1, CS1

The cutting parameters are guide values. Local conditions must always be taken into account in order to choose the right values.
Processes
Melting
Forging
Heat treatment
Machining
Surface treatment

Products
Hot-work steels
Cold-work steels
Drop steels
Plastic dies

Industries
Pressure die casting
Drop forging
Extrusion
Pipe production
Plastics processing
Press hardening