

High-performance tool steel for
hot stamping tools

UH1

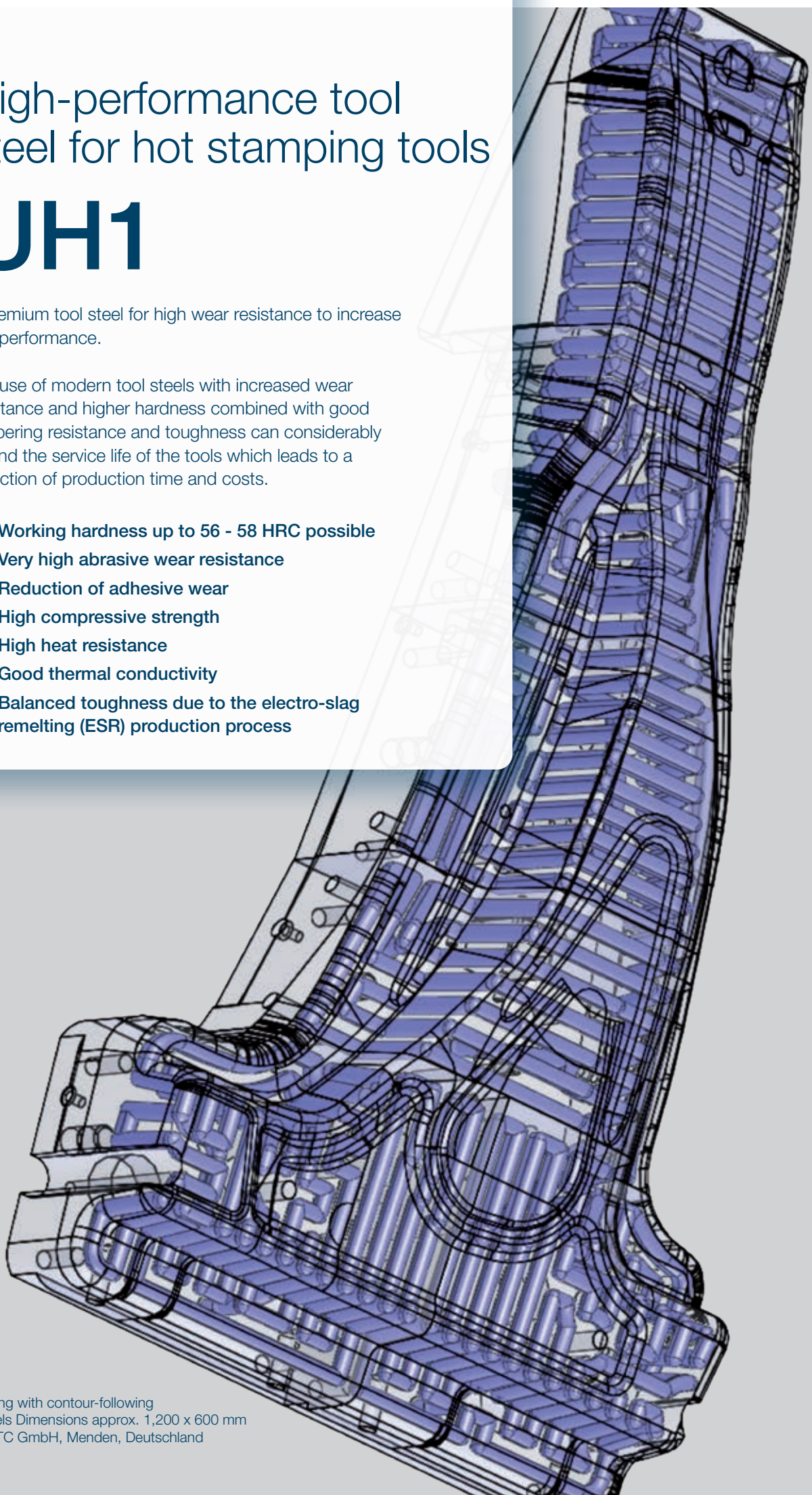
High-performance tool steel for hot stamping tools

UH1

A premium tool steel for high wear resistance to increase tool performance.

The use of modern tool steels with increased wear resistance and higher hardness combined with good tempering resistance and toughness can considerably extend the service life of the tools which leads to a reduction of production time and costs.

- Working hardness up to 56 - 58 HRC possible
- Very high abrasive wear resistance
- Reduction of adhesive wear
- High compressive strength
- High heat resistance
- Good thermal conductivity
- Balanced toughness due to the electro-slag remelting (ESR) production process



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 die forging.

Current trends in automotive manufacturing

The importance of environmentally friendly mobility and climate protection increases constantly and will increase considerably over the coming years. In order to decrease the fuel consumption and CO₂-emissions the automotive industry uses more high-strength steels and ultra high-strength steels. The high strength up to 1900 MPa of these steels permits a reduction of sheet thicknesses and mass. Therefore the steel amount in vehicle is decreasing, thus the weight, fuel consumption along the CO₂-emissions are reduced. At the same time, hot stamped steels increase the crash safety of the vehicle.

The hot stamping of high-strength steels has established internationally as manufacturing process. During this process, sheets are heated to a temperature higher than the austenitizing temperature and simultaneously formed and quenched in the hot stamping tools. In addition to A- or B-pillars, front or rear bumper beams; side-rail parts; tunnels and crash relevant parts are manufactured by hot stamping.



Forging of ESR blocks on the 30MN press ▲

Due to increasing demands, industry expects sophisticated material solutions. The higher production amount requires a long lifetime of the tool with a short cycle time and non-productive time.

The tools used for hot stamping are subjected to intensive abrasive wear and high pressure. The high mechanical stresses consequently lead to insufficient dimensional accuracy of the production engraving. The tool surface is also exposed to high thermal loads due to the high temperature of the sheet with more than 900 °C.

Depending on the design and coating of the sheet, adhesive wear is another reason for failure. Users expect higher wear resistance of the tools in use.

At the same time, the tools are exposed to the highest mechanical and thermal loads due to the required intensive cooling. Successful quenching of the sheet requires intensive cooling close to the working surface, which induces a cyclic thermal load into the tool. Stress corrosion cracking is a frequent failure cause. Corrosion appears in the cooling system due to the contact with cooling water. Cracks are formed under the high stresses and propagate up to the surface. Insufficient toughness of the tool steel can lead to premature tool failure.



◀ Electro-slag remelting process (ESR)

UH1 minimizes tool wear and extends tool performance.

Alloying concept

UH1 is a Cr-Mo-V alloyed premium steel with a special manufacturing process to ensure excellent wear resistance combined with high toughness. With the development of the steel UH1, we are meeting market demands for higher wear resistance of tools in modern hot stamping processes. UH1 minimizes tool wear and extends tool performance. UH1 is a premium steel for tools with the highest performance potential.



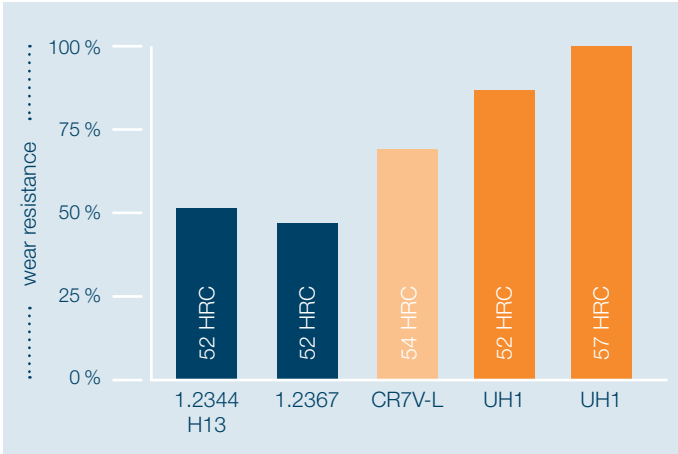
▲ Photo: KIND UH1 in use at modern PCH Flex applications in a hot forming line of the Ford company

▼ Sheet forming during hot stamping

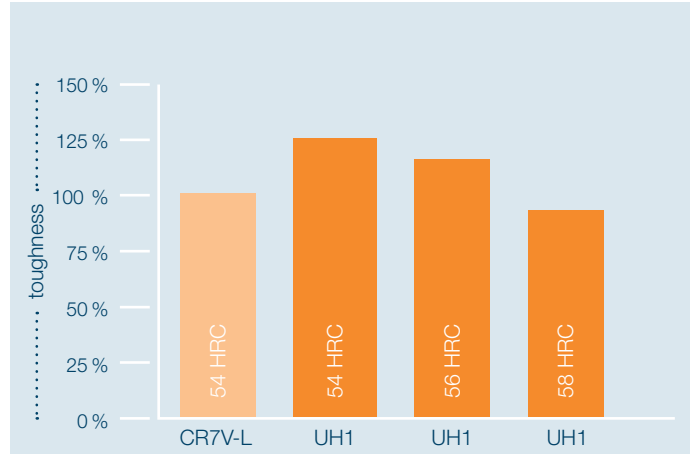


Property levels of typically used tool steels

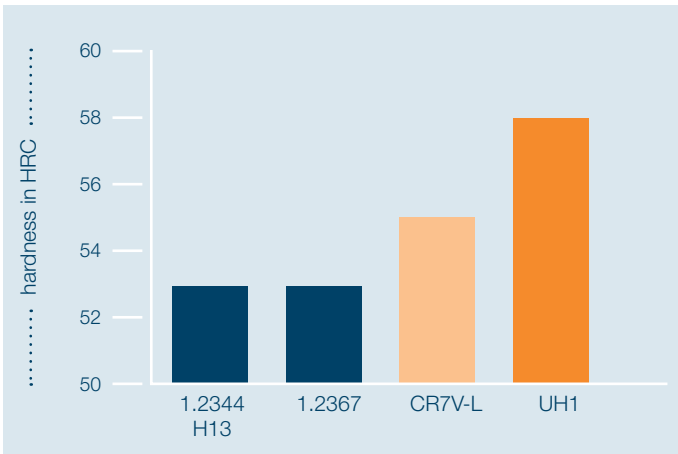
Comparison of wear resistance



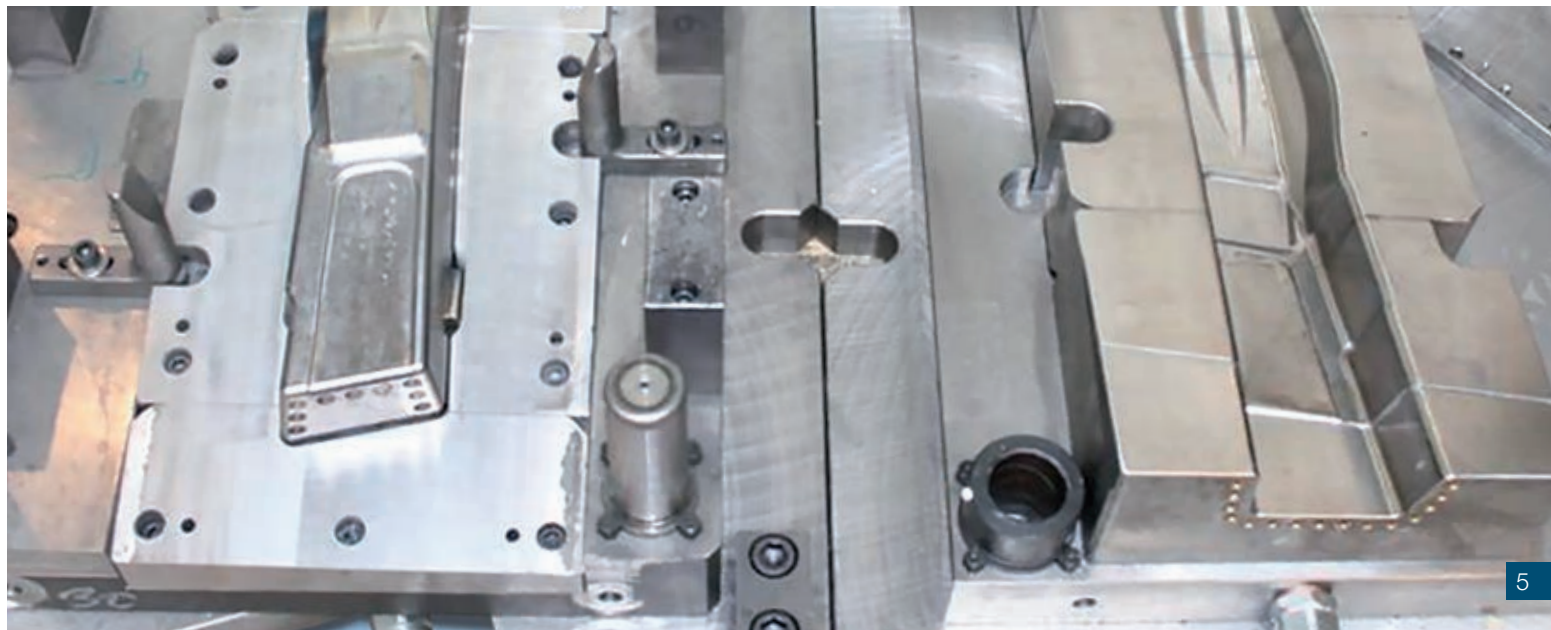
Comparison of toughness



Maximum recommended hardness

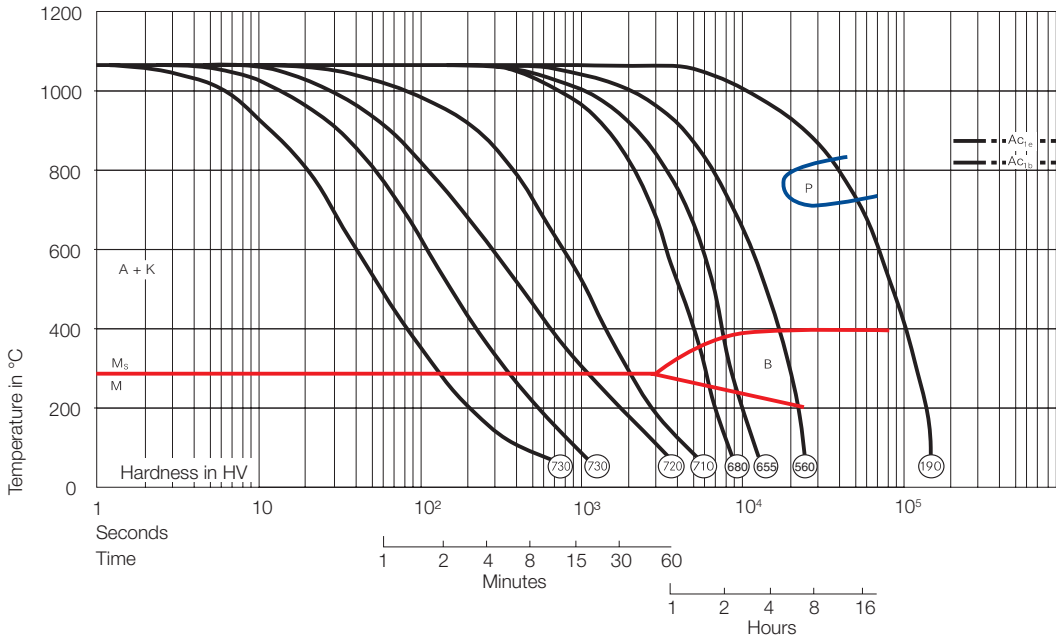


▼ Photo: Institute Tools and Forming Graz, Austria, University of Technology



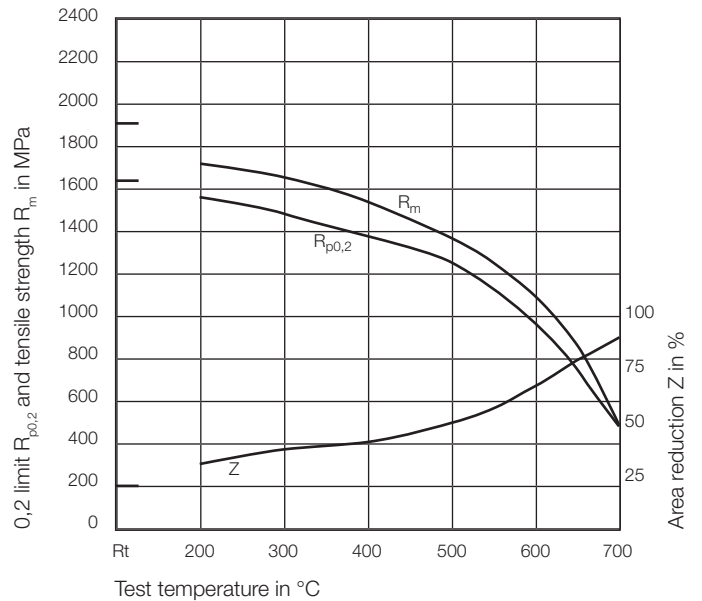
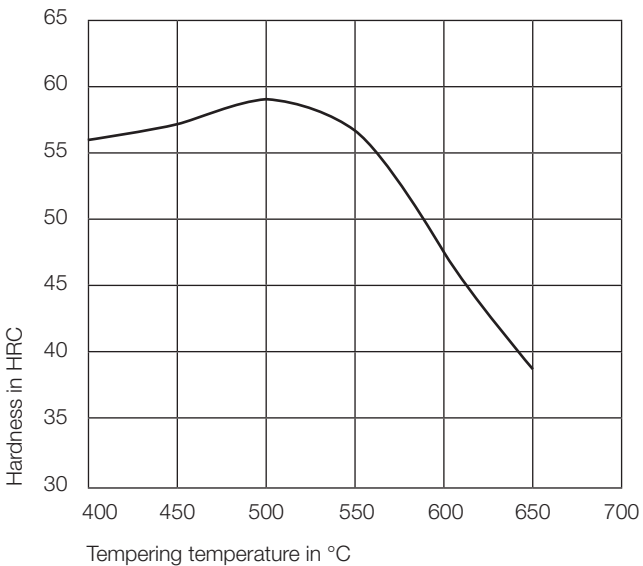
Continuous time-temperature-transformation graph

Austenitizing temperature 1050 °C



Tempering graph

High-temperature strength graph



Physical properties

Temperature in °C	20 - 100	20 - 200	20 - 400	20 - 600
Coefficient of thermal expansion in $10^{-6}m/m \times K$	11,0	11,6	12,2	12,7
Temperature in °C	20	200	400	
Thermal conductivity in W/m x K	25,0	28,2	29,0	
Temperature in °C	20			
Density in g/cm ³	7,79			

Recommendation for heat treatment of UH1

Hardening in vacuum furnace

Preheating:

The preheating stages are used for temperature equalization in the tool to be hardened. The temperature is measured by means of a thermocouple which is placed in the area of the thickest cross-section or in the core area of the reference piece.

1. First preheat stage:
Heating to a temperature of 640 °C, equalizing until the temperature difference between furnace and core temperature is less than 50 K.
2. Second preheat stage:
Heating to a temperature of 850 °C, equalizing until the temperature difference between furnace and core temperature is less than 50 K.
3. Third preheat stage:
Heating to the austenitizing temperature, equalizing until the temperature difference between furnace and core temperature is less than 10 K. Then begin of the soaking time.

Hardening:

The recommended austenitizing temperature is 1050 °C for a soaking time of 45 min.

Depending on cross-section and required hardness, quenching is carried out by blowing in nitrogen at an overpressure between 4.5 and 10 bar.

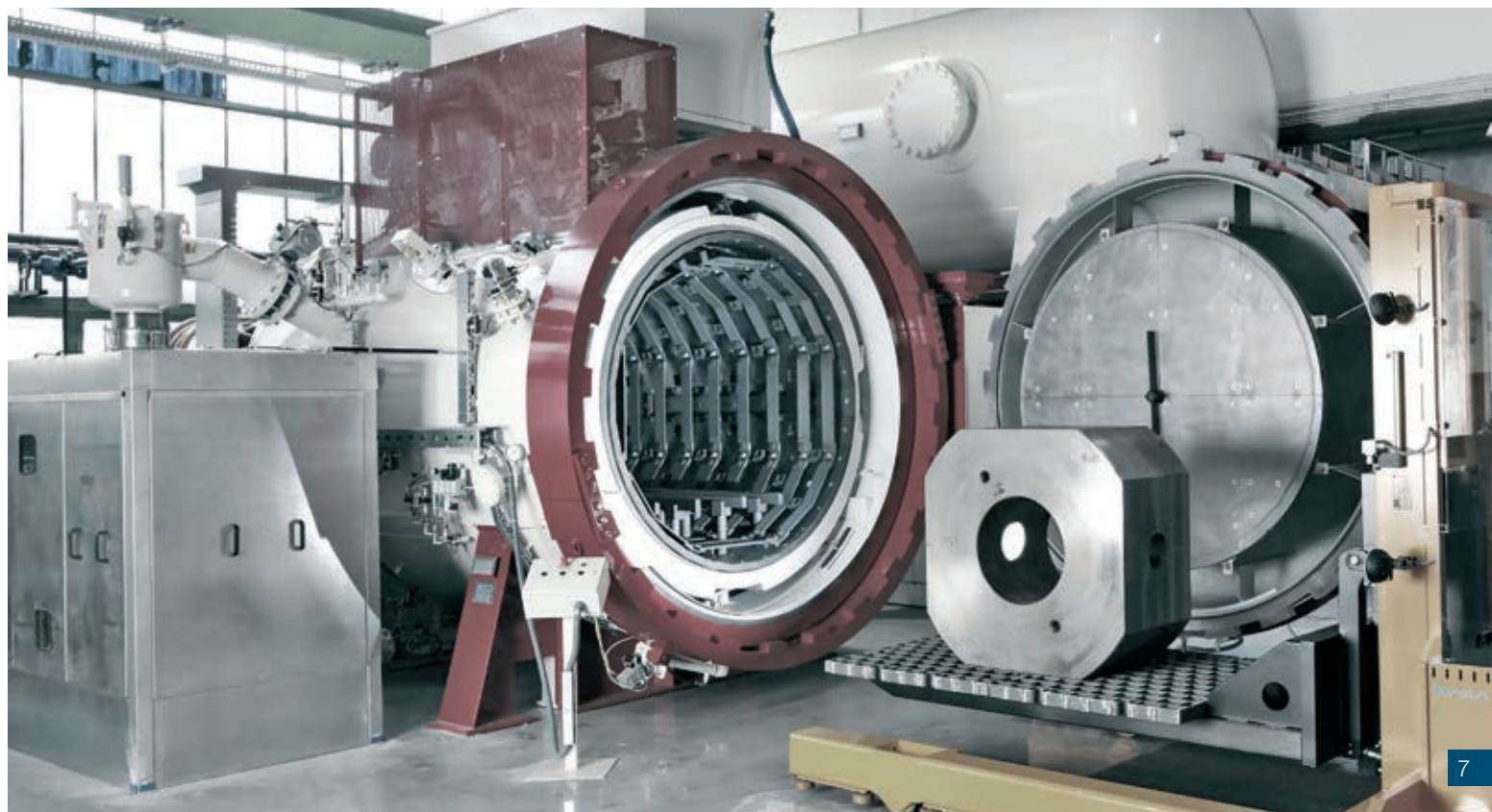
For large cross-sections, a warm bath quenching simulation is also possible.

Tempering:

The first tempering should be carried out immediately after quenching. Tempering is preferably performed in a vacuum furnace or in an inert gas furnace.

The first tempering temperature depends on the required hardness (see tempering diagram). The selection of the second tempering temperature depends on the hardness achieved after the first tempering.

6.5t vacuum furnace ▼



Production processes

Melting

Forging

Heat treatment

Mechanical processing

Vacuum hardening

Surface treatment

Products

Hot-work tool steels

Cold-work tool steels

Die forging steels

Plastic mould steels

Industries

Die casting

Extrusion

Die forging

Pipe technology

Plastics technology

Hot-stamping

Special applications

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