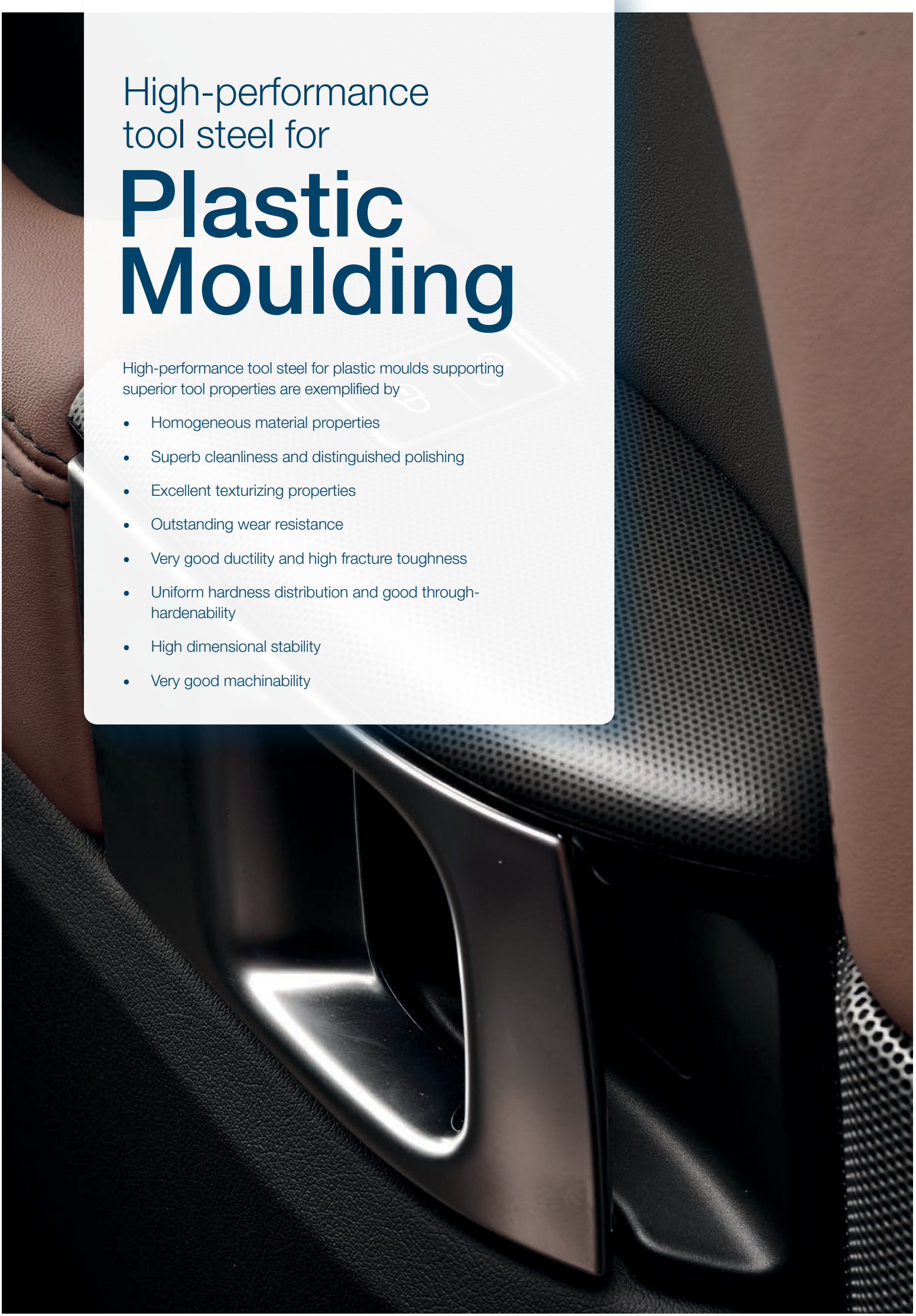
KIND&CO
EDELSTAHLWERK

High-performance tool steel for

Plastic Moulding



High-performance tool steel for Plastic Moulding

High-performance tool steel for plastic moulds supporting superior tool properties are exemplified by

- Homogeneous material properties
- Superb cleanliness and distinguished polishing
- Excellent texturizing properties
- Outstanding wear resistance
- Very good ductility and high fracture toughness
- Uniform hardness distribution and good through-hardenability
- High dimensional stability
- Very good machinability

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 advise - tailored to the respective application. We have particularly strong application expertise in the most demanding areas of mould and die processing e.g. die casting, extrusion and drop forging. As a qualified partner, we offer you interesting solutions in the field of plastic processing.

Trends in Plastic Processing

We encounter plastics almost in every area of our life. Increasing demands on the quality of end products lead to ever higher surface requirements for plastic parts in mobility, consumer goods, electronics, telecommunication, medical products, and cosmetics.

The increasing demands on material and processing quality put new challenges to the industry. New high-performance plastics, complex geometries, higher processing temperatures and increasing closing pressures in injection moulding go hand in hand with shorter cycle times. High durability of the processing mould is a key element of cost efficiency.

Improved surface condition is one of the most important demands of surface recent product design. Larger surfaces with high aesthetic requirements call for tool steels of improved homogeneity and cleanliness. Often, the mould has to ensure mirror finishes without any irregularities.

Light weight construction and the increase in efficiency of many industrial products require more complicated geometries, in particular thin wall thickness. High mould durability is of major importance for the die maker and plastic processing company.

Filled plastics, once considered suited only for aerospace applications, are becoming more widely specified for thermal insulators, high-performance bearings and electrical connectors. Increasing functional integration of the product often requires increased design complexity. Intensive wear due to increased use of abrasive plastic in the automotive and electronics industries or household goods requires moulds and tool steels of marked wear resistance.

Dimensional accuracy, a high class surface gloss, and reproducibility as the basis for fully automatic further processing of injection moulded parts are the focus of the selection of suitable tool steels. To meet the high expectations of the industry with regard to shape, product quality and long mould life, a tool steel of improved wear resistance and excellent toughness needs to be selected, as this is prime for a reduced total cost of ownership of the product.

Kind&Co products are used to produce high-end moulds for precise plastic parts of singular quality in moulding processes. Reliability and cleanliness are the hallmarks of our products. Our tool steels ensure long service life of the mould and high economic efficiency.

◀ Electro-slag remelting process (ESR)

Mould steel selection for improved economics

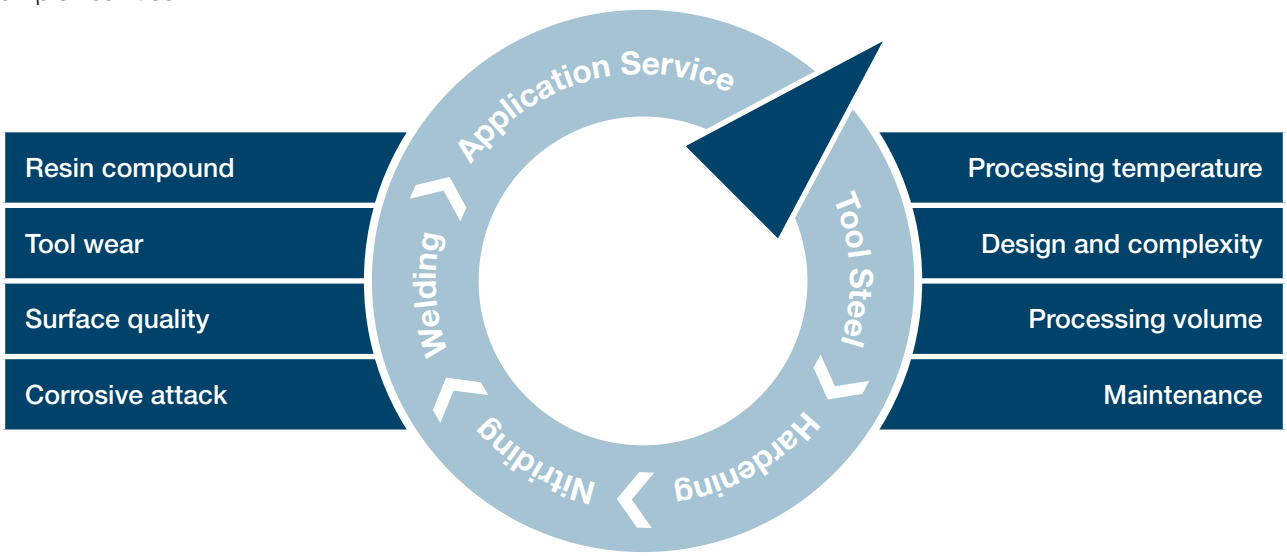
The international industry uses a wide range of injection moulding plastic resins, including commodity, engineering and high-performance grades. Every application has unique material requirements for temperature, strength, chemical resistance, resistance to hot steam or water, electrical resistance, potential stiffness and more.

The product is only as good as the mould in which the product is formed. Examples for particularly demanding products are, e.g.,

- thin-wall products processed in fast moving injection machines with very short cycles
- filigree micro-parts
- tight installation conditions
- complex cavities

Many products in the automotive industry as well as many personal care products require high-quality surfaces and resilient functional areas. Pharmceutical devices, medical disposables, and medical consumables have to match hygienic standards.

There are many factors to consider when selecting the steel for a mould. The final plastic part requirements are the most important factors to consider when selecting the proper mould material. Surface requirements, resin type, and filler content are the main considerations along with the expected tool life.



Alloyed Tool Steels

Our tool steels are specially designed for the production of precise injection moulded parts in large quantities requiring hardness, wear resistance and good thermal conductivity. Flawless quality, low maintenance costs, and a long service life as the basis for fully automatic production of injection moulded parts are the focus of the selection of alloyed tool steels.

High performance hot-work tool steels for moulds in plastic processing

Good Standard Premium

Brand name	Recommended hardness	Wear restistance	Toughness	Polishabiltiy	Compression strength	Weldability
TQ1	48-54 HRc					
CSP	52-58 HRc					
GSF ESR	41-45 HRc					
USN ESR	46-50 HRc					
USD ESR	48-52 HRc					

TQ1 - A premium steel of outstanding toughness, advanced high tempering strength and superb cleanliness. This premium tool steel provides safety against cracking or overstressing due to excellent toughness at working hardness and allows more progressive cooling with cooling bores closer to the mould surface. For moulds with complex cavities, e.g. processing thin walled parts and fast acting, facing more intense pressure and temperature impact. Suitable for mirror polishing and moulds requiring optical finish.

CSP - The premium steel with a unique combination of wear resistance and a potential working hardness up to 58 HRC with simultaneously very high toughness. Superb cleanliness and higher attainable hardness allow for excellent polishing results.

Outstanding moulding performance with high repeat accuracy and dimensional stability and prevention of premature wash out in plastic processing due a unique combination of high wear resistance, compression strength and outstanding toughness at elevated working hardness. With its high compressive strength at high hardness, CSP increases the stability of parting edges in injection molds at high closing pressure without compromising on toughess.

The high hardness of CSP offers excellent durability of mould inserts when processing fibre reinforced plastics with a high fibre content or in thermoset moulds and compression moulding. CSP is also an excellent choice for moving parts and slide cores in the plastic processing mould.

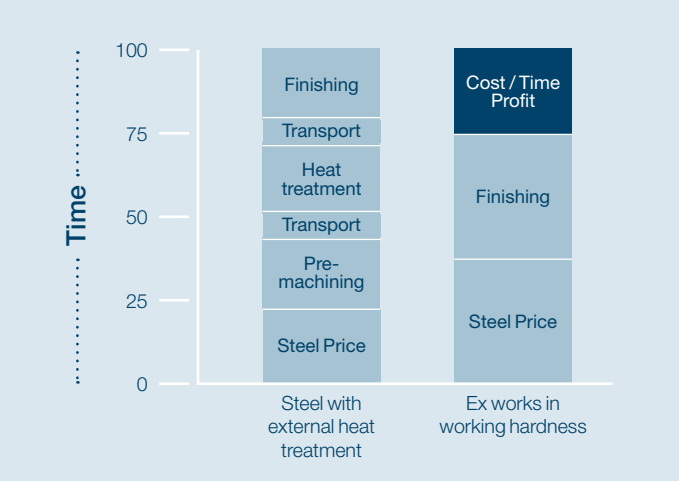
GSF ESR - The hardened and tempered premium steel which comes with increased working hardness ex mill. Thus, it does not require any intermediate third-party heat treatment, and can be used directly in delivery condition. The economic tool steel choice providing excellent cleanliness and outstanding homogeneity for superior polishing results.

With a hardness up to 44-46 HRC and a very good through-hardenability for larger blocks up to ~400 mm thickness, GSF ESR supports advanced requirements on wear resistance. In this context, the steel provides enhanced mechanical strength, dimensional stability and allows easy machining for mould making and processing of superior productivity. The steel can be easily welded.

GSF ESR is specifically suitable for mid sized to bigger injection moulds with high demands on surface finish. Typical applications are high gloss polished moulds for use within automotive, as well as packaging and white goods.

GSF ESR is perfectly suitable for high-quality etching processes. The well selected alloying concept, a uniform microstructure, a high purity, a low segregation level and a uniform hardness distribution result in an excellent surface gloss and a uniform etching depth.

External Heat Treatment versus Ex Works - in Working Hardness



Highest Efficiency for your Applications

- Time saving
- Cost saving
- Good machinability
- Reliable hardness
- No distortion during hardening
- All services from one provider

USN ESR - A hot-work tool steel with a standard alloying concept (1.2343 ESR/H11 ESR) in excellent quality standard to fulfill high surface requirements on polishing and texturing or coating in long-life serial processing moulds. A safe bet for most plastic moulding processes in high demanding injection moulding and compression moulding with very good wear resistance.

USD ESR - The tool steel according to 1.2344 ESR/H13 ESR standards with slightly more wear resistance than USN ESR for mould components processing plastics for high volume parts in many countries outside Europe. Reliability for moulds of all sizes of precision plastic parts.

Welding of dies and moulds

Repairs by welding are necessary to modify the shape of existing tools due to design changes. Welding is also performed to solve minor machining errors. Moreover welding plays an important part in mould shops for necessary maintenance processes, e.g. to rebuild worn out surface areas or to remove surface wear.

Easy and safe welding is of particular importance to allow the mould maker to carry out cost effective repairs avoiding production downtime. Polished surfaces require smooth transition zones to assure repeatable moulding processes with a constant and high quality finish of the plastic product.

Welding repair technology is an extremely demanding process with regards to know-how and skills. To make sure reliable results, the welder must care for mould preparation, pre-heating, a proper temperature flow during welding, a controlled cooling of the mould, as well as tempering after the total process.

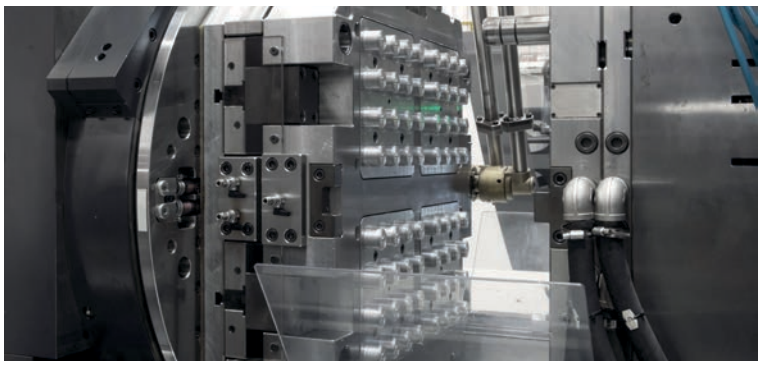
GSF ESR is produced in a way to support outstanding welding properties. As a result of the low carbon contents and the specific material properties, the welding process is significantly improved. The risk of cracks and outbreaks in the heat affected zone is decreased. This supports the die maker in his demands to provide a shiny surface and high quality of the plastic part.

The homogenous hardness course after welding results in a smooth and shiny transition in the subsequent surface polish, supporting the plant in his efforts of high quality and efficiency.

For details on welding please contact our technical application experts.

Corrosion Resistant Steels

The processing of plastics containing chemically aggressive additives demands moulds made of corrosion- resistant steels. With durability, transparency, and cleanliness as primary concerns, the industry demands for grades with a combination of excellent polishability, wear resistance and constant tool quality. With moulds made of our steels, high-quality plastic parts are produced by injection moulding. Reliability, low mold maintenance effort, and high cost-effectiveness are hallmarks of our products.



High quality corrosion resistant steels for moulds in plastic processing

Good Standard Premium

Brand name	Recommended hardness	Wear restistance	Toughness	Polishabiltiy	Compression strength	Corrosion resistance
PCV-ESR	48-52 HRc					
RF ESR	46-50 HRc					
CMR ESR	40-44 HRc					

PCV ESR - A premium corrosion resistant optimized AISI 420 type tool steel with excellent homogeneity and cleanliness to achieve superior surface polish for long lasting production runs at low service cost.

PCV ESR is corrosion-resistant option for moulds requiring high dimensional stability, tight shape tolerances, and edge stability. An answer to advanced requirements of aesthetics and enhanced product quality in the medical industry, parts for electronics and for plastics with additives or fire retardant. Recommended hardness 48 -52 HRC.

RF ESR - The remelted solution of a corrosion resistant tool steel according to 1.2083 ESR standard analysis with very good wear resistance and high cleanliness. For mould components in processing chemically aggressive plastics or for moulds with high surface finish in corrosive working conditions in injection moulding, blow moulding, compression moulding or extrusion. Good dimensional stability in hardening.

Recommended hardness 46 - 50 HRC, but can be also supplied in working hardness of 32-42 HRC to improve corrosion resistance.

CMR ESR - A mould steel according to standardized analysis 1.2316 with outstanding corrosion resistance providing superior wear resistance than most standards. With this most suitable for the processing of chemically aggressive thermoplastics. A steel with advanced working hardness of 40-44 HRC ex mill that does not require intermediate heat treatment. Due to the ESR process the steel has a high degree of cleanliness and has a very good polishability to achieve a high surface finish.

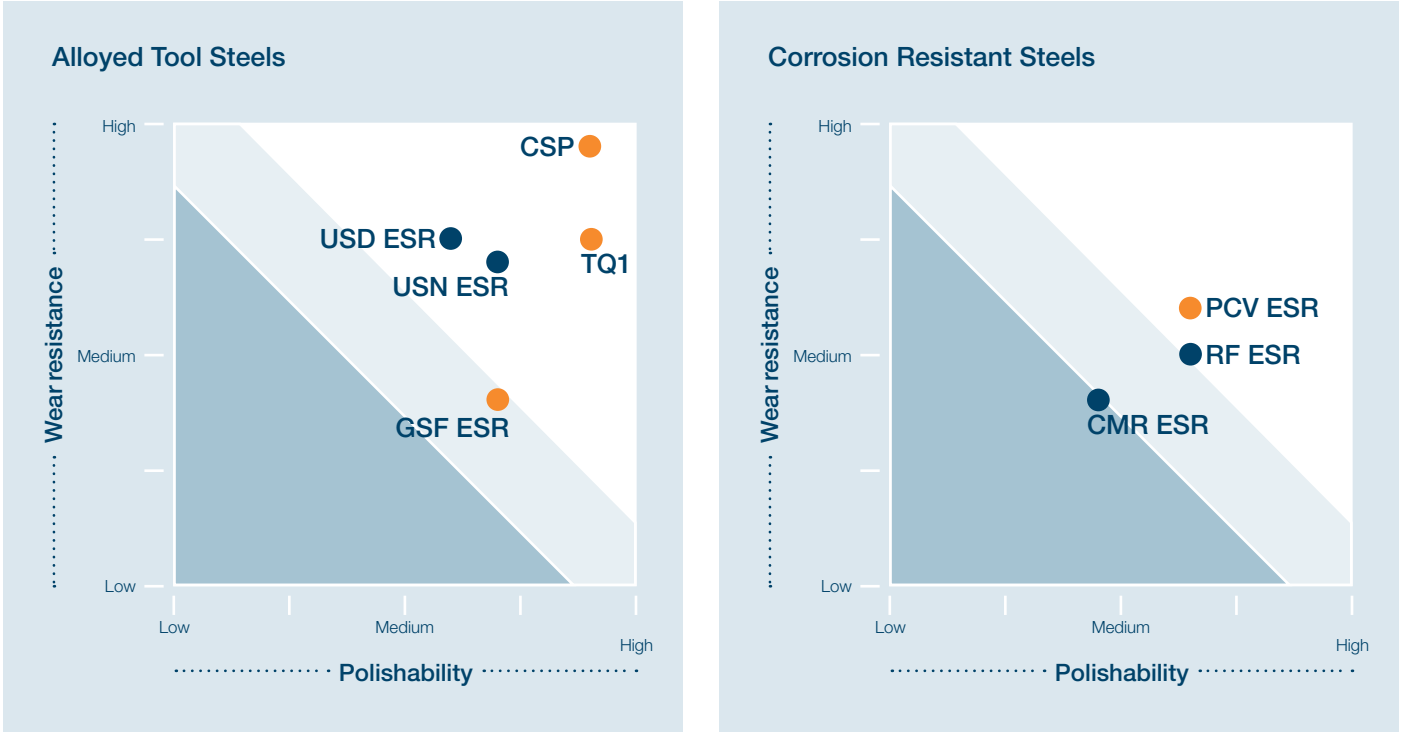
The mould surface polish decides about the aesthetics and look of the product

Product designers around the world would agree that the product's aesthetic appeal relies on the product's look and how it feels in consumers' hands. The mould greatly influences the surface smoothness of the injection moulding.

Not all plastics can achieve the same injection moulding surface finish. Some polymers are better suited to smooth finishes, while others are better suited to roughening up for a more textured surface. Material additives like fibre and pigments might impact the surface finish of a moulded object.

Polishability vers. wear resistance for advanced steels used in plastic moulding

● Premium ● Good Standard



Hardening parameters

Brand label	Hardening temperature in °C	Soaking time in minutes
TQ1	1010	60
CSP	1030	60
USN ESR	1000	45
USD ESR	1020	45
PCV ESR	1030	45
RF ESR	1020	45

DIN EN ISO 18265: Metallic Materials – Conversion of Hardness Values			
Tensile Strength [MPa]	Vickers [HV10]	Brinell [HB]	Rockwell [HRC]
995	310	295	31,0
1030	320	304	32,2
1060	330	314	33,3
1095	340	323	34,4
1125	350	333	35,5
1155	360	342	36,6
1190	370	352	37,7
1220	380	361	38,8
1255	390	371	39,8
1290	400	380	40,8
1320	410	390	41,8
1350	420	399	42,7
1385	430	409	43,6
1420	440	418	44,5
1455	450	428	45,3
1485	460	437	46,1
1520	470	447	46,9
1555	480	456	47,7
1595	490	466	48,4
1630	500	475	49,1
1665	510	485	49,8
1700	520	494	50,5
1740	530	504	51,1
1775	540	513	51,7
1810	550	523	52,3
1845	560	532	53,0
1880	570	542	53,6
1920	580	551	54,1
1955	590	561	54,7
1995	600	570	55,2
2030	610	580	55,7
2070	620	589	56,3
2105	630	599	56,8
2145	640	608	57,3
2180	650	618	57,8

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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