

### Recommended materials for stamping- and moulding tools • The following steels are standard qualities.

Mat. No.	Symbol	Typical analysis in %					As-delivered strength	Hardening/Nitriding	
1.1730	C 45 W	C	Si	Mn			Annealed, strength approx. 650 N/mm <sup>2</sup>	Hardening not common, since there is the risk of stress cracking and excessive distortion on hardening, consequently it should only be used in exceptional cases. Nitriding not common.	
		0.45	0.3	0.7					
1.2080	X 210 Cr 12	C	Si	Mn	Cr		Soft-annealed with max. 800 N/mm <sup>2</sup> (250 HB)	Hardening: 930-960 °C oil or 950-980 °C air. Usual working hardness 50-56 HRC. Nitriding not common, since installation hardness and corrosion resistance are impaired.	
		2.1	0.3	0.3	12.0				
1.2083	X 42 Cr 13	C		Cr			Soft-annealed with max. 760 N/mm <sup>2</sup> (225 HB)	Hardening in hot bath or oil, Usual working hardness 50-56 HRC. Nitriding not common, since the installation hardness and corrosion resistance are impaired.	
		0.42		13.0					
~1.2085	X 33 Cr S 16	C	Si	Mn	Cr	S	Tempered to 950-1100 N/mm <sup>2</sup> (280-320 HB)	Used in the delivered state, i.e. pre-tempered to 280-320 HB.	
		0.3	0.5	1.0	15.5	0.1			
~1.2099		C	Si	Mn	Cr	S	Ni	Pre-tempered to ~1000 N/mm <sup>2</sup> (280-320 HB)	Used in the delivered state, i.e. pre-tempered to 280-320 HB.
		0.05	0.2	0.9	12.8	0.12	0.4		
1.2162	21 Mn Cr 5	C	Mn		Cr		Soft-annealed 600 N/mm <sup>2</sup>	Hardening in oil, usual working hardness 59-61 HRC. Core strength approx. 1080 N/mm <sup>2</sup> . Nitriding possible according to all methods, but usually carried out only in the tempered state.	
		0.21	1.3		1.2				
1.2311	40 Cr Mn Mo 7	C	Mn	Cr	Mo		Pre-tempered to 950-1100 N/mm <sup>2</sup> (280-325 HB)	Hardening is not common. In exceptional cases, consult the heat-treating department. Nitriding for improving the wear resistance possible according to all known nitriding methods.	
		0.40	1.5	2.0	0.2				
1.2312	40 Cr Mn Mo S 8 6	C	Mn	S	Cr	Mo	Pre-tempered to 950-1100 N/mm <sup>2</sup> (300-345 HB)	Hardening not common. In exceptional cases, in air or hot bath. In the oil bath there is a risk due to stress cracks. Nitriding readily possible according to all known methods, slow cooling required on account of the risk of stress cracking.	
		0.4	1.5	0.05-0.1	1.9	0.2			
1.2316	X 36 Cr Mo 17	C	Cr	Mo	Ni		Tempered 950-1100 N/mm <sup>2</sup> (280-320 HB)	Used in the delivered state, i.e. pre-tempered to 280-320 HB. Nitriding reduces the corrosion resistance.	
		0.36	16.0	1.2	≤1				
1.2343	X 38 Cr Mo V 5 1	C	Si	Cr	Mo	V	Soft-annealed with max. 780 N/mm <sup>2</sup> (229 HB)	Hardening in oil, air or hot bath, usual working hardness 30-53 HRC. Nitriding readily possible according to all known methods. Especially advantageous if the wear resistance is to be increased further at maximum core strength.	
		0.39	1.1	5.2	1.5	0.4			

- If desired we deliver steel in all popular steel qualities.

Material properties/Application	Mat. No.
Non-alloyed tool steel, casehardened steel, hard surface, tough core, readily machinable. For unhardened components and plates subjected to low stress for injection-moulding, diecasting, blanking, metal-forming tools and jigs and fixtures. Polishing not common. Etching, embossing, structure eroding not common. Eroding readily possible.	1.1730
High-chromium-alloy tool steel with great dimensional stability and maximum wear resistance. For punches and die plates for high-speed cuts, pressure strips, guide strips, hobs and slides under high surface loading. Polishing possible but no mirror finish. Structure eroding not possible, coarse carbides are washed out.	1.2080
High corrosion resistance in the hardened and annealed state (250 °C) with polished surface. Still readily machinable. Low-distortion through-hardening steel with high hardenability and great wear resistance. Used in mould plates and mould inserts for processing plastics having a corroding action and cooling media having a corroding action. Can be readily polished in the hardened state. Good properties when etching, embossing, structure eroding. Eroding possible.	1.2083
Uniform strength over the cross section. High compressive loading. Low maintenance costs on account of corrosion resistance and resistance to aggressive plastics, condensation water, vapours, cooling ducts, etc. Good toughness properties. Less suitable for eroding, since striation occurs on the surface. This steel is advisable if machinability with good corrosion resistance is an important factor. Ideal for mould frames and tool top parts with high strength requirements without additional heat treatment.	~ 1.2085
Uniform strength over the cross section. High compressive loading. Low maintenance costs on account of corrosion resistance and resistance to aggressive plastics, condensation water, vapours, cooling ducts, etc. Good toughness properties. Less suitable for eroding, since striation occurs on the surface. This steel is advisable if machinability with good corrosion resistance is an important factor. Ideal for mould frames and tool top parts with high strength requirements without additional heat treatment.	~ 1.2099
Standard case hardening steel, easily machinable. Tools for plastics processing, e.g. mould inserts, mould plates. Used when high requirements are imposed on the wear resistance of the surface hardness at high core strength. Good polishing capacity. Etching, embossing, structure eroding for normal requirements. Eroding readily possible. Hard chromium plating readily possible for increasing the wear resistance, excellent surface protection against corrosion in PVC processing.	1.2162
Resistant to pitting, structure eroding possible, good toughness. Very uniform hardness distribution up to large cross sections of about $\square$ 500 mm. For injection-moulding tools with high requirements as regards strength and surface. No subsequent heat treatment and no hardness risk associated therewith (e.g. distortion on hardening). Can be polished very effectively, also capable of taking a mirror finish; but for the most stringent requirements we recommend our case-hardening and through-hardening steels. Outstandingly suitable for etching, embossing, structure eroding. Intensive rinsing must be ensured for structure eroding.	1.2311
Good toughness and good machining due to sulphur addition. For all injection-moulding and diecasting tools in which machining is prominent. Ideal for mould frames and tool top parts with high strength requirements without additional heat treatment. Stress-free annealing recommended after considerable machining. Suitable for technical polishing to a limited extent. For high-grade polishing, we recommend case-hardening and through-hardening steels. Etching, embossing, structure eroding are not to be recommended. Eroding readily possible, but striation may occur on the surface due to increased sulphur content.	1.2312
Good corrosion resistance especially with polished surface. For tools where corrosive effects occur (e.g. plastics, etc.). Good polishing capacity. Good properties for etching and structure eroding. If embossing is carried out, we recommend the EST quality (please specify when ordering).	1.2316
High hot strength, maximum toughness with high installation hardness. Very good thermal conductivity, readily machinable. Use: Mould plates and for diecasting, injection-moulding and extrusion tools. Can also be supplied in the electroslag remelted form. The polishing capacity, toughness and dimensional stability after the hardening as well as the mechanical properties are thereby improved. Very suitable for mirror finishes on account of the homogeneity. Best properties during etching, embossing, structure eroding. Eroding readily possible. Hard chromium plating not common, possible application must be agreed with the chrome-plating plant.	1.2343

### Recommended materials for stamping- and moulding tools • The following steels are standard qualities.

Mat. No.	Symbol	Typical analysis in %	As-delivered strength	Hardening/Nitriding
1.2363	X 100 Cr Mo V 5-1	C   Si   Mn   Cr   S   V	Soft-annealed with max. 800 N/mm <sup>2</sup> (240 HB)	Hardening in oil, air or hot bath, usual working hardness 63-65 HRC. Nitriding not common.
		0.98   0.3   0.5   5.1   1.0   0.15		
1.2379	X 155 Cr V Mo 12 1	C   Cr   Mo   V	Soft-annealed with max. 860 N/mm <sup>2</sup> (255 HB)	Hardening in oil, air or hot bath, usual working hardness 56-62 HRC. Nitriding very readily possible according to all known methods, although the material must be subjected to secondary hardening.
		1.55   12.0   0.7   1.0		
1.2436	X 210 Cr W 12	C   Cr   W	Soft-annealed with max. 860 N/mm <sup>2</sup> (255 HB)	Hardening in oil, air or hot bath, usual working hardness 58-65 HRC. Nitriding suitable to a limited extent, we recommend the material 1.2379.
		2.10   12.0   0.7		
1.2767	X 45 Ni Cr Mo 4	C   Cr   Mo   Ni	Soft-annealed with max. 880 N/mm <sup>2</sup> (262 HB)	Hardening in oil, air or hot bath, usual working hardness ~52 HRC. Nitriding possible, but not common on account of the drop in strength at the nitriding temperature.
		0.45   1.4   0.3   4.1		
1.2842	90 Mn Cr V 8	C   Mn   Cr   V	Soft-annealed with max. 770 N/mm <sup>2</sup> (229 HB)	Hardening in oil or hot bath, usual working hardness 56-62 HRC. Normally this material is not nitrided. In this case we recommend the material 1.2379.
		0.90   2.0   0.4   0.1		
3.4365.7	Al Zn Mg Cu 1.5	Si   Fe   Cu   Mn   Mg	Rolled, artificially aged, stretched for stress relief. Tensile strength 480- 530 N/mm <sup>2</sup>	
		0.40   0.50   1.2-2.0   0.30   2.1-2.9		
		Cr   Zn   Ti   Ti + Zr		
		0.18-0.28   5.1-6.1   0.20   0.25		

- If desired we deliver steel in all popular steel qualities.

Material properties/Application	Mat. No.
<p>Cold working steel with low dimension modification which can be air-hardened with excellent toughness, high wear resistance and good cutting property. Utilisation for cutting- and stamping tools and for shear blades.</p>	<p><b>1.2363</b></p>
<p>Lederburitic chromium steel, maximum wear hardness, good toughness, best edge-holding property and retention of hardness. High-speed cutting steel, fracture-sensitive cutting dies, shear blades, pressing, drawing and bending tools.</p>	<p><b>1.2379</b></p>
<p>Lederburitic chromium steel, highly wear-resistant, good toughness, best edge-holding property, high retention of hardness, improved hardenability compared with 1.2080. Used for cutting, punching, drawing, pressing, shearing and bending tools as well as guide strips. Readily polished in the hardened state. Etching, embossing, structure eroding not common. Not suitable for eroding for larger wire cuts. In this case, we recommend 1.2379. Hard chromium plating not common.</p>	<p><b>1.2436</b></p>
<p>Air and oil hardening steel, maximum toughness, dimensionally stable, uniformly through-hardening. Mould plates and mould inserts for injection-moulding tools, especially for mirror finishes. Embossing and bending tools as well as all components which call for high compressive and bending strength. Polishing for mirror finishes is very highly suitable on account of its chemical composition and homogeneity. Ideally suitable for etching, embossing, structure eroding on account of metallurgical properties. Hard chromium plating readily possible, the wear resistance is increased, consequently excellent surface protection against corrosion in PVC processing.</p>	<p><b>1.2767</b></p>
<p>Oil hardening steel with simple heat treatment, especially easy machining, high hardenability, good dimensional stability. Used for punching, cutting, deep-drawing tools, punches, blades, measuring tools, guide strips. Polishing not common. Etching, embossing, structure eroding not common. Eroding not suitable for larger wire cuts. In this case we recommend the material 1.2379. Hard chromium plating not common.</p>	<p><b>1.2842</b></p>
<p>Highest-strength aluminium material, optimum thermal conductivity, good workability (machining, eroding, polishing), weight saving. Plates for press and forming tools and for the construction of jigs and fixtures.</p>	<p><b>3.4365.7</b></p>

## Corrosion resistant standard steels for injection moulds

Mat. No.	Symbol	Typical analysis in %	As-delivered strength	Hardening/Nitriding
<b>1.2083</b>	X 42 Cr 13	C   Cr	Soft-annealed with max. 760 N/mm <sup>2</sup> (225 HB)	Hardening in hot bath or oil, Usual working hardness 50-56 HRC. Nitriding not common, since the installation hardness and corrosion resistance are impaired.
		0.42   13.0		
~ <b>1.2085</b>	X 33 Cr S 16	C   Si   Mn   Cr   S	Tempered 950-1100 N/mm <sup>2</sup> (280-320 HB)	Used in the delivered state, i.e. pre-tempered to 280-320 HB.
		0.3   0.5   1.0   15.5   0.1		
<b>1.2316</b>	X 36 Cr Mo 17	C   Cr   Mo   Ni	Tempered 950-1100 N/mm <sup>2</sup> (280-320 HB)	Used in the delivered state, i.e. pre-tempered to 280-320 HB. Nitriding reduces the corrosion resistance.
		0.36   16   1.2   ≤1		

## Selection of corrosion resistant steels for injection moulds, which we deliver if desired by you.

<b>M315 EXTRA</b>		C   Si   Mn   Cr   S   Ni	Tempered 950-1100 N/mm <sup>2</sup> (280-320 HB)	Hardening (if a higher strength is desired): Temperature 1050°, holding time approximately 0.5 h, quenching medium oil.
		0.05   0.20   0.90   ~13   0.12   +		
<b>Ramax® S</b>	~ <b>1.2085</b>	X 33 Cr S 16	Tempered ca. 1150 N/mm <sup>2</sup> (ca. 340 HB)	Hardening: UDDEHOLM RAMAX® S is not normally provided for a new hardening. A new hardening can only be carried out if the material has been annealed before at 750 °C/4 h.
<b>ES Antikor S</b>	~ <b>1.2085 mod.</b>	X 33 Cr S 16	Tempered 950-1100 N/mm <sup>2</sup> (280-320 HB)	Generally the material ES Antikor S is used in the delivered state. A restarted heat treatment is inadvisable.
<b>ES Antikor SL</b>			Tempered ca. 950-1100 N/mm <sup>2</sup> (280-325 HB)	Is delivered in the tempered condition of approximately 320 HB.
<b>M340 ISOPLAST</b>			Soft-annealed with max. 880 N/mm <sup>2</sup> (260 HB)	Assembly hardness: 53-58 HRC
<b>Plast 1</b>			Tempered ca. 1100 N/mm <sup>2</sup> (ca. 320 HB)	Is delivered in the tempered condition of approximately 320 BH.
<b>M333 ISOPLAST</b>			Soft-annealed with max. 730 N/mm <sup>2</sup> (ca. 220 HB)	Assembly hardness: max. 52 HRC.

Material properties/Application	Mat. No.
<p>High corrosion resistance in the hardened and annealed state (250 °C) with polished surface. Still readily machinable. Low-distortion through-hardening steel with high hardenability and great wear resistance. Used in mould plates and mould inserts for processing plastics having a corroding action and cooling media having a corroding action. Can be readily polished in the hardened state. Good properties when etching, embossing, structure eroding. Eroding possible.</p>	<p><b>1.2083</b></p>
<p>Uniform strength over the cross section. High compressive loading. Low maintenance costs on account of corrosion resistance and resistance to aggressive plastics, condensation water, vapours, cooling ducts, etc. Good toughness properties. Less suitable for eroding, since striation occurs on the surface. This steel is advisable if machinability with good corrosion resistance is an important factor. Ideal for mould frames and tool top parts with high strength requirements without additional heat treatment.</p>	<p>~1.2085</p>
<p>Good corrosion resistance especially with polished surface. For tools where corrosive effects occur (e.g. plastics, etc.). Good polishing capacity. Good properties for etching and structure eroding. If embossing is carried out, we recommend the EST quality (please specify when ordering).</p>	<p><b>1.2316</b></p>
<p><b>Please inquire desired steel qualities, which are not mentioned.</b></p>	
<p>BÖHLER M 315 EXTRA is a corrosion resistant plastic mould steel <i>with a machinability which has considerably been improved compared with all 1.2085 types</i>. The BÖHLER M 315 EXTRA is used at all cavity retainers, mould built-ups, moulds with a high removal volume and at the production of corrosion resistant moulds as well as at the production of simple components. The corrosion resistance can be compared with all 1.2085 types.</p>	
<p>UDDEHOLM RAMAX® S is an against water corrosion resistant holder steel. We have already tempered it for you. It can directly be used and is applicable for simple plastic moulds with little requirements to the surface. Good machinability (for a Cr-steel). Corrosion resistant against water. Constant hardness in all cross sections.</p>	<p>~1.2085</p>
<p>Corrosion resistant steel with machinability which has considerably been improved compared with the material 1.2316. Cavity retainers, moulds for the machining of plastics which have a corrosive effect. This steel is recommended if the machinability at good corrosion resistance comes to the fore. Generally the material ES Antikor S in the delivered state is used. A new heat treatment is inadvisable. ES Antikor is only suited for technical polishes. Otherwise we recommend ES Antikor in EST-quality.</p>	<p>~1.2085 mod.</p>
<p>Excellent machinability properties. Good corrosion resistance. Constant and unchanging hardness in all dimensions. Good impression resistance (resistance to pressure). Excellent extensibility. Excellent evenness. Deformation resistance. Smoothness like at rolled surfaces. Excellent weldability. Good thermal conductivity. Applications: plastic injection-moulding built-ups, plastic and rubber injection moulds with little requirements to the polishing capacity, construction parts, plastic extrusion.</p>	
<p>Special steel in ESU-execution with excellent corrosion properties, for example in salt-water, good temperable, permanent to dimension at the hardening, highly wear-resistant and with a good edge-holding property, good machinability and polishing ability. For machine knives in the fish- and food industry, valves, pumps, roller bearings, moulds in the plastics processing.</p>	
<p>Martensitic plastic mould steel with good corrosion resistance thanks of the high content of chrome. Delivery in tempered condition with a strength of about 1100 N/mm<sup>2</sup>, therefore omission of the extensive heat treatment and improved form stability at great removal volume. Constant hardness also at great cross-sections. Very good machinability. The high heat conductance allows short production cycles. Very good weldability because of the very low carbon content (omission of the preheating of the mould).</p>	
<p>Particularly suited for mould inserts where corrosion resistance and hardness is required. Very good corrosion resistance. Optimal mirror finish buffability. Very good toughness and hardness. Improved heat conductance - shorter cycle times. Because of the high cleanliness good eroding possible.</p>	