



Special tool steel solutions for
FORGING DIES



FORGING DIES

Closed-die forging processes are widely spread in metal working industry for discrete part production. The optimal selection of the tool steel and its properties is an important factor for the durability of forging dies.

Premium tool steel with optimized production processes and enhanced chemical composition can improve the properties of the tool with regard to

- High Temperature Strength
- Hot Wear Resistance
- Toughness

Improving these properties reduces maintenance efforts, extends the tool life, improves the quality of the final product and reduces the cost per item.

Kind & Co.

Since 1888 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.

TRENDS

in Die Forging

Die Forging is one of the most important processes in the production of serial parts in all areas of our lives. Basic requirements of forgings in all application areas are high dimensional precision and excellent material properties to allow for a long service life, often in safety-critical components

The forging industry is constantly evolving. Due to:

- increasingly complex component geometries,
- new production materials, and
- increasing series sizes,

the requirements on forging dies are as well increasing constantly.

In addition to conventional hot forging, more modern forming technologies have increased in importance and today are very economical manufacturing process, especially due to cost savings achieved by near-net or precision warm forming. Precision forgings are mainly used in the key components of aircraft, power generation equipment, tubing components and automotive which have the high requirements on surface quality and security. Titanium and titanium alloys are used today extensively in aerospace and medical applications. Because of their highest specific strength, titanium usage results in significant weight reduction. Another advantages include high thermal stability and corrosion resistance.

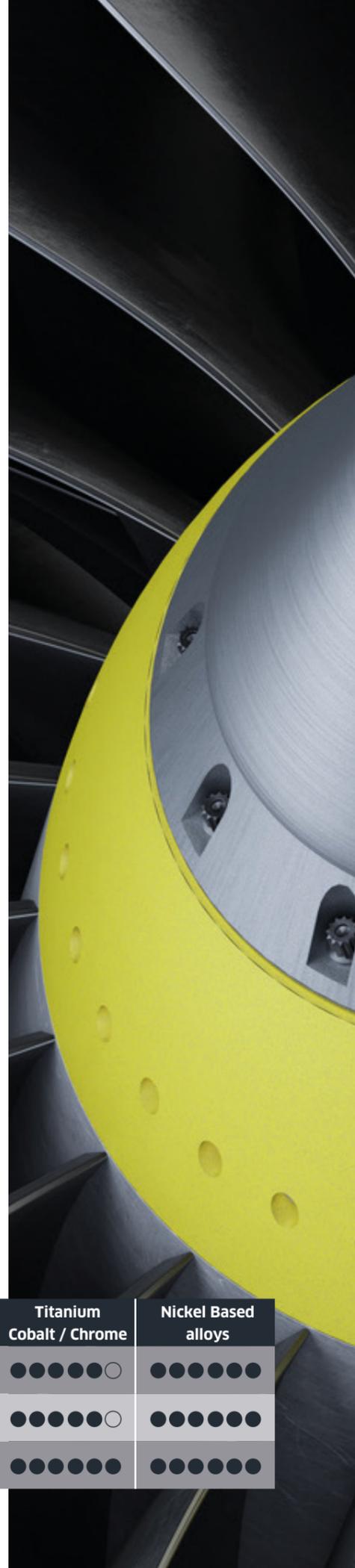
The presence of high temperature gradients during modern precision forging processes increases the risk for tooling defects. Hot wear, radial cracks and tool breakage are often the consequences.

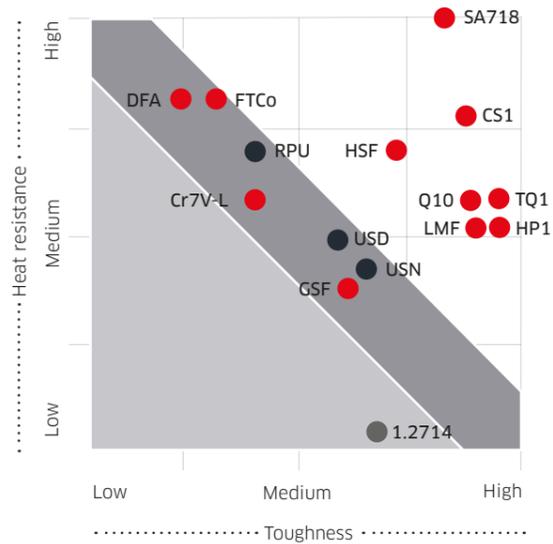
In order to meet these demanding requirements, our company can offer tailor-made hot work steel, which are able to withstand the severe challenges and to maximize die life. With our deep knowledge and vast experience we supply premium solutions. The use and proper selection of special, tailored tool steel grades is the key to meet the challenges of industrial forging today and beyond.



The processed material influences the requirement for tool steel and process

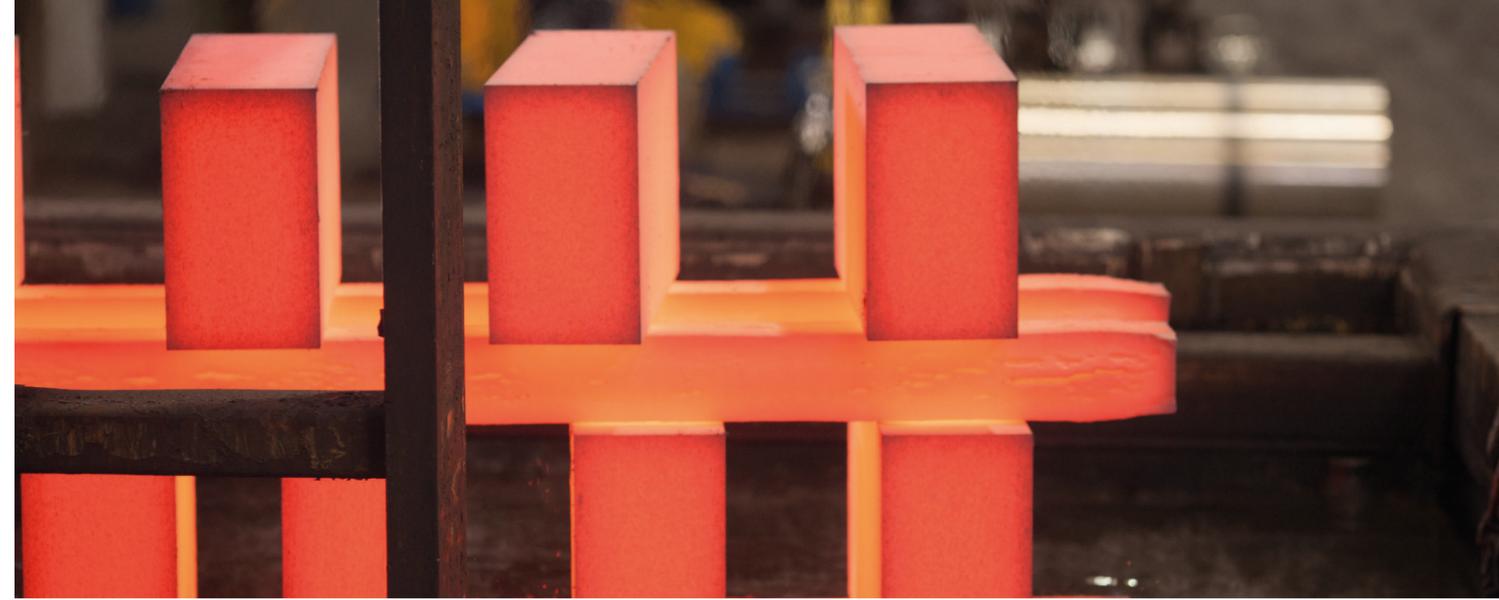
	Steel	Stainless	Aluminium	Brass	Titanium Cobalt / Chrome	Nickel Based alloys
Hot wear resistance	●●●●○○	●●●●●○	●●●○○○	●●●○○○	●●●●●○	●●●●●●
Tempering resistance	●●●●○○	●●●●○○	●●●○○○	●●●●●○	●●●●●○	●●●●●●
Toughness	●●●●○○	●●●○○○	●●●●●●	●●●○○○	●●●●●●	●●●●●●





PREMIUM HOT WORK STEEL

with property combinations tailored to meet the necessary intended use



LMF A tool steel for advanced mechanical loads in finisher dies

Cr7V-L The premium tool steel to manage die wear. For long product series and for high demanding tolerances, for pre-rolling tools

Q10 Superior economics for press forging dies facing thermal fatigue

HSF Outstanding resistance to plastic deformation in warm forging and hot forging

DFA Economics for medium round tools facing high temperature strain

HP1 Excellent toughness. For dies with the tendency facing radial cracks. ESR remelted. For forging aluminium alloys

TQ1 A well balanced excellent ESR remelted steel to manage advanced challenges hot forging

CS1 A top performance ESR remelted tool steel to manage even highest impacts in forging, e.g. high temperature resistant alloys

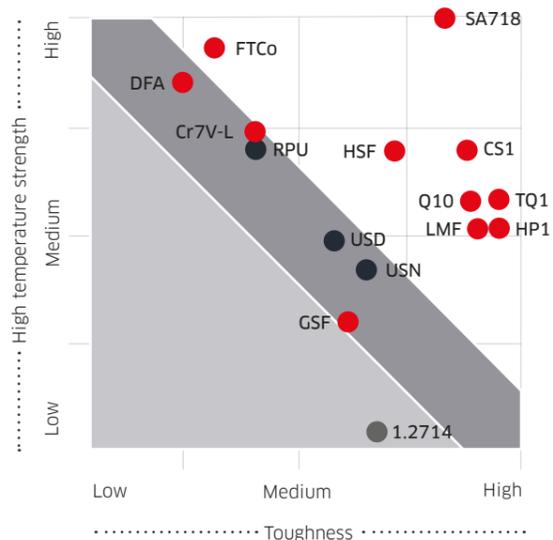
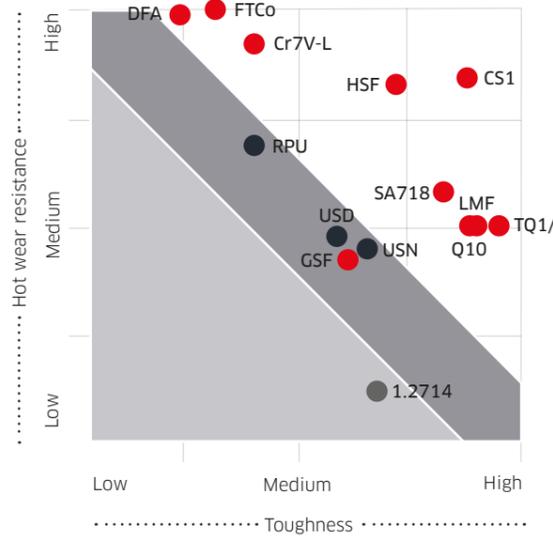
FTCo A ESR remelted matrix steel of singular high temperature strength and high tempering resistance. For high demanding forging mandrels and die forging stems, subjected to high compression, also for forging of Cu and brass alloys

GSF High toughness at improved level of tensile, hardened ex-mill. For impressions subjected to cracks, especially for dies in hammer forging; also perfect for rams of hammers

SA718 Outstanding high temperature resistance and ductility. A Ni-base alloy for special applications in drop stamping like isothermal presses and forming devices of Ti- alloys

We provide premium tool steel as well as machined tooling - ready for impression

Tools		Bar	Single block / or ring	Pre-machined	Pre-machined supplied at working hardness	Manufactured in accordance with drawings, without impression	Processed in accordance with 3D data / drawings
Dies	Round dies	X	X	X	X	X	
	Flat dies	X	X	X	X	X	
Rolling tools	Tapered rolls		X	X	X	X	X
	Main rolls		X	X	X	X	X
	Expanding mandrels		X	X	X	X	X
	Mandrel sleeves		X	X	X	X	X
	Stems		X	X	X	X	X
	Forging rolls		X	X	X	X	
	Cross wedge rolls		X	X	X	X	



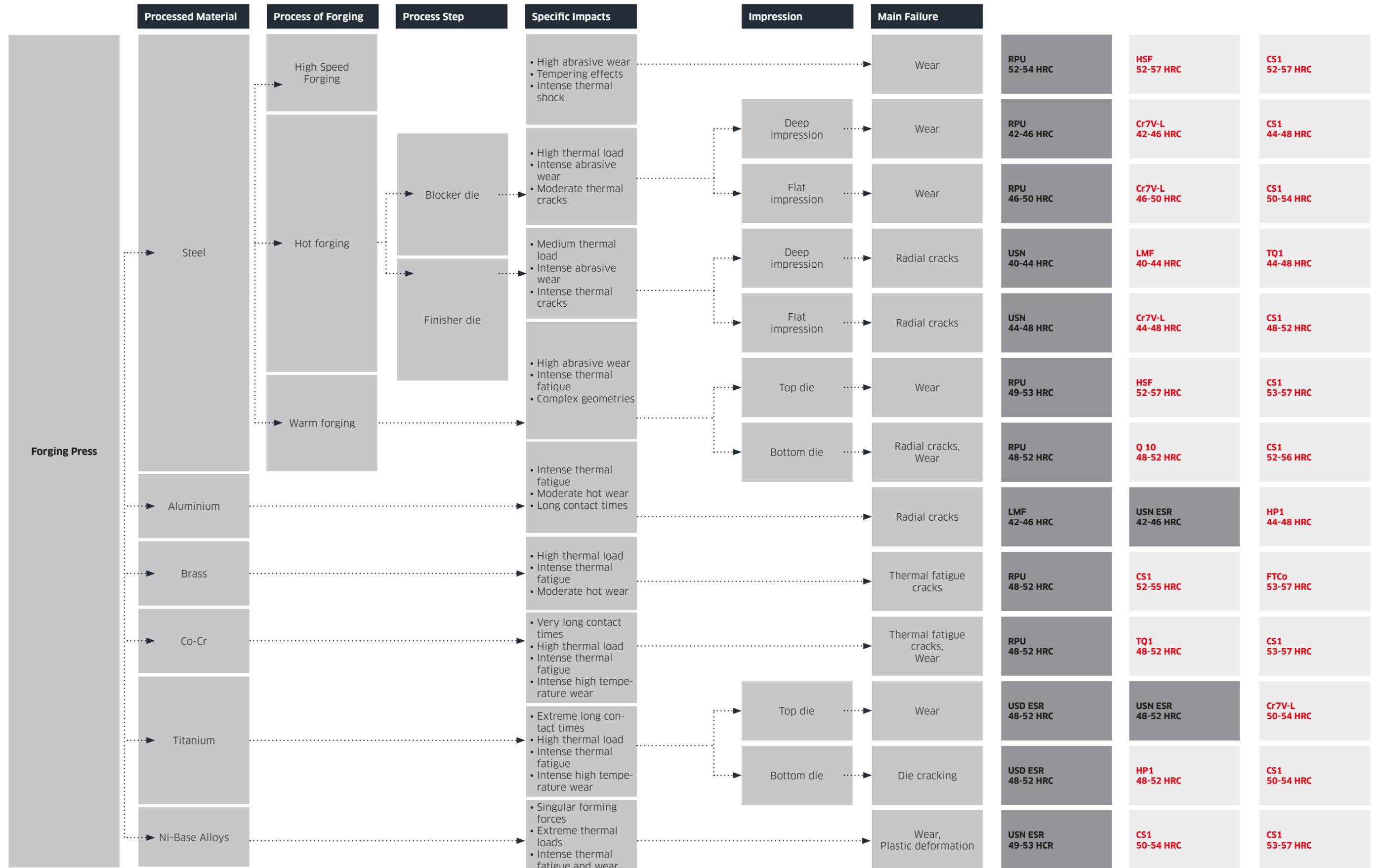
● Premium ● Good Standard ● Standard



TOOL STEEL SELECTION

We provide premium tool steel as well as machined tooling – ready for impression

● Premium
● Good Standard



EXPERIENCES FROM THE FORGING INDUSTRY

Product	Machine Type	Grade in Comparison	Reason for Failure	Kind Premium Tool Steel	Improved Lifetime Forged Against Standard Used before
Crankshaft for passenger car (4 cylinder)	Hydraulic press 4000 tons Hot forging	AISI H13 43-46 HRC	Wear	Cr7V-L 43-46 HRC in blocker and finisher die	~60%
Dies for forging of connecting rods for passenger cars	Hydraulic Press 2000 tons Hot forging	AISI H13 47-50 HRC	Wear	Cr7V-L 43-46 HRC in blocker and finisher die	~53%
Steering and suspension parts for passenger cars like steering arms, control arms, cross members	Hydraulic Press 3200 tons Hot Forging	AISI H11 45-47 HRC	Wear	Cr7V-L 47 HRC in blocker and finisher die	up to 65%
Round dies for truck spider parts approx. ø 275mm finish size	Hydraulic Press Hot Forging	AISI H11 45-47 HRC	Wear/Cracks in the transition area to the base of impression	-	Completely switched over to Cr7V-L
Truck parts die sizes 400 x 240 x 600mm	Hydraulic Press Hot Forging	1.2343	Wear	Cr7V-L 50 HRC in blocker and finisher die	~50%
Heavy duty shackles and chain slings	Hydraulic Press 1600 tons Hot Forging	AISI H13 steel 45-50 HRC	Wear/Cracks after ~2000 forgings	Cr7V-L 52-54 HRC	Cr7V-L raised die life more than 2 times
Crankshafts 2,7, 3.0 and 3,5 L V6 motors	Hot forging on 6300 tons press Hot Forging	Die Steel 1.2714mod with ~5000 pushes	Cracking/Wear	Blocker dies made of Cr7V-L (42-45 HRC) Finisher dies made of LMF (42-45 HRC)	1. run + 34% blocker / finisher 2. run + 72% blocker / finisher 3.+4. run plus 20% >40%
Forging cup, wheel cup for passenger car on Transfer press	Connected forging line Hot Forging	1.2343, 47-49 HRC	Thermal fatigue/Wear	Q10 with 50 HRC in blocker and finisher die	>200%
Cardan parts for truck and agriculture market	Mechanical press Hot Forging	1.2714:38-42 HRC Total lifetime 12.116 strokes	Strong wear attack, intense re-machining required	Q10: 42-46 HRC performs with 6 total lifetime 35.036 strokes	3x
Forged Pistons	Hydraulic press 1600 tons Hot Forging	1.2367	Inferior die life, cracking/wear	HSF with 51-53 HRC	>28%
Forged motorcycle crankshaft	Hydraulic press 2000 tons Hot Forging	AISI H13 (52 HRC) 3000 pieces; 1.2367 (53 HRC) 6000 pieces	Wear with H13/ cracking and wear with 1.2367	HSF with 56-57 HRC	>60%, more than 10000 pc
Sleeves, bottom die	Hydraulic press 2000 tons Hot Forging	SKD 61 (1.2344) 52-53 HRC + nitriding 5000-8000 pc RPU (1.2367) 53 HRC 10000 pushes	Wear	HSF with 56-58 HRC	15000- 20000 pushes stable/HSF increased die life by up to 100 %
Drive shaft special-shaped, upper punch	Hydraulic press 1000 tons Warm Forging	RPU (1.2367) 53-55 HRC + nitriding 1500 pcs	Wear, plastic deformation and local wear	HSF with 56-58 HRC + nitriding 2000 pieces	>33%
Hot Forging of stainless 316 Elbow pipe/ T-pipe	Hydraulic press	SKD 61 (1.2344) 52-53 HRC + nitriding	-	HSF with 56-58 HRC no nitriding	>40%
Bearing	High Speed Forging AMP 50	RPU (1.2367): 50 HRC	-	HSF with 54-57 HRC	>52%
Stainless steel fittings, hot forged	Hydraulic press	RPU (1.2367): 50 HRC	-	CS1 with 54-56 HRC	>65%
Precision gears, warm forged	Hydraulic press	1.2367, 50-52 HRC	Wear/tear Maximum service life 1000-1500 parts	FTCo with 53-56 HRC	>80-100%, Gears show much higher precision
Pliers, wrenches and manual spanner tooling in CRV steel	31,5 MN Drop Hammer	1.2714 +laser hardening = 5.000 Forging strokes	-	GSF 38-42 HRC	>8000 Forgings
Spanners in CRV steel	Drop Hammer	L6 / 1. 2714, T2 (38-42 HRC)	-	GSF 38-42 HRC	>55%
Wrenches in CRV steel	Drop Hammer	L6 / 1. 2714, T2 (38-42 HRC)	-	GSF 38-42 HRC	GSF performs very satisfactory in these applications and has become standard

Product	Machine Type	Grade in Comparison	Reason for Failure	Kind Premium Tool Steel	Improved Lifetime Forged Against Standard Used before
Complex design of metal braket	Forging hammer	1.2714 - 38-40 HRC	deep cracks in the bottom radius	GSF - 40-42 HRC	2 times less cracks less remachining
Ring gear made of engineering steel	Hydraulic press 1600 tons	1.2367 - 45 HRC	failure due to die breakage	Q10 - 48-52 HRC	~ 3 times
Suspension parts	Hydraulic press 2500 tons Blocker and finisher	AISI H 11 (1.2343)	Wear	Cr7V-L - 50-54 HRC	+ 50%
Larger connecting rods	Hydraulik press 3000 tons Finish forging die	Medium alloyed die steel, improved for toughness	Die crack	Q 10 - 44-46 HRC	+ 75%
Truck parts	Hydraulic press 6500 tons	1.2714	Crack	GSF - 38-42 HRC	+ 38%
Automotive suspension part	Hydraulic press 2500 tons Blocker and finisher	1.2343	Micro surface cracks and wear	Cr7V-L - 50-54 HRC	+ 42%
Connecting rods	Hydraulic press 2500 tons	(1.2367)	Wear	Cr7V-L - 50-52 HRC	+ 27%
Crankshafts	Hydraulic press 4000 tons Blocker die	AISI H 13 (1.2344)	Wear	Cr7V-L - 40-42 HRC	+ 38%
Crankshafts	Hydraulic press 4000 tons Finisher die	AISI H 13 (1.2344)	Micro cracks	Cr7V-L - 40-42 HRC	+ 26%
Crankshafts	Hydraulic press 12000 tons Blocker die	AISI H 13 (1.2344)	Wear	Cr7V-L - 38-41 HRC	+ 43%
Connecting rods	Hydraulic press 2500 tons Blocker die	AISI H 13 (1.2344)	Wear	Cr7V-L - 48-50 HRC	+ 25%
Sector shafts	Mechanical press 2000 tons Hot forging 1st forging stage Bottom die	AISI H 13 (1.2344)	Wear	Cr7V-L - 50-52 HRC	+ 35%
Sector shafts	Mechanical press 2000 tons Hot forging 2nd forging stage Bottom die	AISI H 13 (1.2344)	Cracking	Q10 - 48-50 HRC	+ 52%
Aluminium forging Chassis suspension parts components	Concatenated Forging line	many test series with different tool steel materials	Intensive radial cracks	HP1 - 45 HRC	Best performance of all tested standard and special grades
Orthopedic implant Ti and Co Cr alloys	Precision forging line Near net shape forging	1.2367 50-52 HRC	Radial cracks	CS1 - 53-55 HRC	+ 62%
Turbine blades made of Ti composite	Screw press 4000 tons and 8000 tons	(H 11) 1.2343 46-48 HRC	Cracks in the bottom die	USN ESR 3 d forged	+ 142%
Brass components	650 tons press	1.2367	Wear	FTCo - 52 HRC	~ 5 times
Stem tool for high speed forging	Hatebur P 50	1.2365 50-52 HRC	Wear and intense deformation	FTCo - 54-56 HRC	~ 3 times
Spindels	Warm forging press 1st forging stage Bottom die	Warm forging press 1st forging stage Bottom die	Wear	Cr7V-L - 52-54 HRC	+ 57%



GSF THE RELIABLE SOLUTIONS FOR RAMS OF HAMMER

In drop forging hammers pneumatic or hydraulic energy is converted into kinetic energy of the falling heavy hammer bear or ram to shape the piece. Typical parts produced are relative flat drop forgings, connecting rods, levers, flanges, rings, turbine blades.

The loads on hammer forging dies are extremely sudden. Bears or rams of hammer have to face intense forces and with this very high stresses and sudden and high impacts. Many rams fail early due to fracture in the lower radius or even final gross cracking.

Our premium grade GSF has an excellent toughness. GSF combines a good ductility and yield strengths with necessary wear resistance. Due to its outstanding purity and mechanical properties GSF is well suited in various industries for larger components.

Individual 3-dimensional forging optimizes the formation as well as the homogeneity of the microstructure and its mechanical properties.

With premium grade GSF Kind&Co provides a tool steel grade in machinery items and forging dies for hammers respect the requirements of extreme toughness. By using GSF, the risk of cracks in the radial areas of these components can be minimized. The premium steel GSF absorbs the necessary high strain in the hammer and thus ensures good stability of the machine. GSF is an outstanding choice for dies and tools which have to bear high strains during hammer forging.

REFERENCE CASE GSF

3 D forged blocks treated to 1000-1200 MPa, Customer results: Increasing of the global tool life with from 600.000 to 1 million strokes before repairing. Advantages: Decreasing of the crack problems and the maintenance cost, Excellent weldability.

Mechanical properties at RT	High Toughness	→	High Strength
Tensile strength Rm [N/mm ²]	900 - 1000	1000 - 1250	1250 - 1400
0,2 % yield strength Rp0,2 [N/mm ²]	min. 720	min. 800	1000
Elongation A5 [%]	min. 15	min. 13	min. 10
Impact energy [Joule]	min. 55	min. 40	min. 27



PREMIUM METAL FORMING TOOLS

for Rolling and Preforming Processes

The aim of rolling processes in die forging is to produce preformed products with a mass distribution that approximates the final geometry and to descale the pre-formed product.

For the tools used in the processes

- Forming by reducer rolling processes
- Forming by cross wedge rolling processes

we are your partner providing high-quality tool steels as well as machined and hardened tools for a long service life. Our premium tool steels with enhanced properties can help you to improve performance and profitability.



