



Improving the performance of forging dies with premium tool steel solutions

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Globally operating hot-work tool steel specialist

Brief profile of the Kind&Co Group

- Expertise in every step of the value chain
- Global network with uniformly high service standards
- Partners for the Indian tool steel market

Kind&Co operates and provides expertise in every step of the value chain





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Kind&Co Group in a nutshell: Global network with uniformly high service standards





Two strong partners for India









Two strong partners for the Indian tool steel market since 2008

The demands of forging dies are permanently increasing

Forging – General remarks

- High demands in die forging
- Factors influencing die life
- Loads on forging dies
- Failure types of forging dies

High demands in die forging require reliable and powerful tools





India's forging industry faces a rapidly growing demand in forged products and many challenges:

- High demand of forged products for two-wheelers, passenger cars, and commercial vehicles,
- Changes in transportation technology influence the product portfolio of the forging industry and intensify the economic pressure.
- Forging new special materials require high-performance tool steels.
- Continuous improvement of performance of the production tools is a promissing approach to cost optimization.

Several factors influence the performance of forging dies





Wear and cracking are the main reasons for failure of forging dies



Picture: Heinemeyer 1976	Upper die Wear Therm. Cracking Mech. Cracking Plast. Deformation Lower die	70% 25% 2% 3%	 Wear Mechanical Cracking Thermal Cracking Plastic deformation 	
Wear	Mechanical Cracking	Thermal Cracking	Plastic Deformation	
Adhesive: Tear off of micro weldings	Locally high tensions	Alternating thermal stresses	Exceeding of the yield-strength	
Abrasive: Relative movement of tinder particles	Mechanical overloading	Different temperature surface - core		

Mainly wear and cracking are causing early die failure





Abrasive wear



Mechanically induced cracking



Abrasive wear



Mechanically induced cracking



Plastic deformation, chipping



Thermal cracking

Improving die performance in press forging with premium hot-work tool steels



Hot-work tool steel selection

- Important properties for forging dies
- Tool steel for blocker dies
- Tool steel for finisher dies
- Carbides contribute to wear resistance
- Successful selection and combination of tool steels

Hot-work tool steels for forging dies require a property profile adapted to the purpose





Blocker dies place high demands on tool steels



Process parameters	Stresses on the die	Requirements
Long contact timesHigh forging temperature	High thermal load	High tempering resistanceHigh high-temperature strength
High forming forces	High mechanical load	Good toughnessHigh high-temperature strength
High forming degreesHigh relative movement	Abrasive wear	High wear resistance

• The high temperature gradients in modern precision forging processes increase the risk of tool defects. Hot wear, radial cracks and tool breakage are often the result.

• To meet these high demands, the correct selection of a hot work tool steel with improved properties to withstand the high demands and maximize tool life is essential.

Hot-work tool steels for blocker dies take into account the requirement for high wear resistance





- The alloy composition of the grades USD and RPU complies with ISO 4957, but due to the excellent production methods (metallurgy, forging strategy, heat treatment) at Kind&Co these "standard" grades have an above-average performance ("good standard").
- Cr7V-L, Q10, HSF and CS1 have been specially developed by Kind&Co and offer a tailor-made combination of properties ("Premium").
- The premium hot work steel grade CS1 is produced exclusively by the electro-slag-remelting (ESR) process.

The correct size and distribution of carbides contributes to the necessary wear resistance





• Very fine, homogeneously

dispersed carbides





- Coarse carbides in network distribution
- Little influence





- Coarse carbides in homogeneous distribution
- Strong influence

No influence



Process parameters		Stresses on the die		Requirements	
•	Long contact times	•	High thermal load	•	High tempering resistance High high-temperature strength
•	Complex contours and small radii	•	High tension on the surface of the die	•	Excellent toughness
•	Friction between the forging product and the die surface	•	Abrasive wear	•	High wear resistance

- The high temperature gradients in modern precision forging processes increase the risk of tool defects. Hot wear, radial cracks and tool breakage are often the result.
- Since fine and sometimes complex contours have to be filled in during die forging, which leads to high mechanical stresses on the die surface, a tool steel with high toughness is required.

Hot-work tool steels for finisher dies take into account the requirement for high toughness





- The alloy composition of the USN, USD and RPU grades complies with ISO 4957, but due to the excellent production methods (metallurgy, forging strategy, heat treatment) at Kind&Co, these "standard" grades have an above-average performance ("good standard").
- LMF, Q10, HSF and CS1 have been specially developed by Kind&Co and offer a tailor-made combination of properties ("Premium").
- The premium hot work steel grade CS1 is produced exclusively by the electro-slag-remelting (ESR) process.

Individual tool steel selection for blocker dies and finisher dies can further improve tool life





- Blocker dies require a hot-work tool steel with high wear resistance: Cr7V-L
- Finisher dies often require a die steel with higher toughness: LMF
 - LMF is a 5 % chromium hot-work tool steel with reduced silicon content and a dose of niobium for improved toughness and grain size stability
- The combination of Cr7V-L for blocker dies and LMF for finisher dies improved the lifetime of forging dies at an American car producer by 73 % compared to traditional hot-work tool steels (product: crankshafts).

Conclusion



- India's forging industry is under constant pressure to reduce production costs.
- Extending tool life and improving the general performance of the dies is a proven approach.
- Detailed studies of the forged products and of the die design helps to select the best suitable hotwork tool steel
- Kind&Co produces not only internationally standardized hot-work tool steels but also a wide range of premium hot-work tool steels with properties (high-temperature strength, wear resistance, and toughness) tailored to customer's results.
- The correct application of these grades as well as their combination within a forging tool provides extended die life and help to compensate economic pressure.
- While this presentation concentrated mainly on press forging of steel products, we can also provide solutions for aluminium and non-ferrous products.

Thank you for your attention!







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