CS1 for Die Casting with Highest Surface Requirements

Nuremberg, January 15, 2020
Content

- Brief profile Kind&Co
- Technical developments
- Introduction CS1 and examples of application
- Conclusion
Globally operating hot-work tool steel specialist

Brief profile Kind&Co

- Global network
- Continuous production process
Kind&Co Group in a Nutshell: Global Network with Uniformly High Service Standards

- Own stock/production
- Own sales team
- Exclusive distribution partner
- Agent/Trader
Continuous production process: Expertise in every step of the value chain

Melting | Forging | Hardening and Annealing | Finishing | Stocking and Sawing | Machining | Vacuum hardening

Acquisition

Electro-slag-re-melting

Induction furnace VID

Forging furnaces, forging presses

Hardening and annealing furnaces

Sand-blasting, lathing, steel control

Autom., storage with integrated saws

Milling, lathing, drilling etc.

Vacuum furnaces, nitriding, oxidising

Customer
Kind&Co accompanies technological changes in the die casting industry

Technical developments

- Development of cast products
- Development of die casting technologies
Developments of cast products intensify the requirements on surface quality

- Die cast structural components of light metal contribute to weight reduction of modern passenger cars.
- Technical and optical reasons require very high surface quality.
- Due to technical reasons bodies of numerous electronic components must provide highest surface quality.
- The volume of classical die cast products like gear boxes and clutch housings will decrease due to modified power concepts.
- Battery boxes of electrically driven vehicles must provide highest accuracy within the sealing areas.
Thermal shock cracks limit the lifetime of dies and reduce the quality of castings.

- Thermal shock cracks result from the cyclic heating and quenching of the die surface due to the contact with the liquid cast alloy followed by spray cooling.
- Thermal shock cracks limit lifetime of the dies and reduce quality of the castings. They are responsible for 80% die casting die failures.
- The demands on surface quality, especially visible or mounting surfaces, are already high and will continue to increase.
- Modified cooling technologies such as minimum spray cooling contribute to improved surface quality but require modified cooling concepts.
CS1 proves itself even at highest requirements

Introduction CS1

- CS1 for highest surface requirements and high working hardness
- CS1 – Characterization
- Higher working hardness
- Transformation behaviour
- Examples of application
Developments of the die casting technology modify the requirements on die steels

Die for conventional spray cooling:
- Relatively simple cooling concept
- Few cooling channels and intersections
- Comparably large distances between cooling and die contour.

Die for minimum spray cooling:
- Complex cooling concept
- Complex orientation of cooling channels, numerous circuits, many intersections
- Short distances between cooling channels and working surface.

Source: BMW Group
Premium hot-work steel CS1 for high surface requirements and high working hardness

- Resistance against thermal shock cracks depends on high-temperature strength and toughness of the hot-work tool steel.
- With a significantly higher working hardness, as can be achieved with CS1, the hot yield strength and thermal shock resistance are significantly improved. Likewise, the high attainable hardness can make any possible nitriding of the die redundant.
- In addition, a very good long-term tempering resistance significantly reduces a hardening decrease in the applied areas.
Premium hot-work steel CS1 - Characterization

• CS1 is a chromium-molybdenum-vanadium alloyed premium hot-work tool steel which was specially designed for highly mechanically stressed tools.

• By combining a tailor-made alloy concept, manufacturing processes with the highest level of purity and optimum heat treatment, CS1 offers the possibility of high hardness combined with a very high level of toughness.

• CS1 has excellent wear resistance and excellent polishability and thus meets the highest demands on surface quality.

• The hot-work tool steel CS1 has a good dimensional stability during heat treatment and in use.
CS1 has significantly higher strength at typical working temperatures

- The premium hot-work tool steel CS1 has higher strength even with increasing test temperatures in the range of typical working temperatures.

- As a result, an even higher hot-strength limit can be achieved.

- In addition, the CS1 has excellent resistance to the formation of thermal fatigue cracks (heat cracking).

- CS1 is therefore very well suited for tools with the highest surface requirements.
The alloy concept of CS1 allows a working hardness of up to 56 HRC.

- The alloy of CS1 allows hardness values up to 56 HRC.
- In addition to the improved heat crack resistance, a higher working hardness also allows the flexible adjustment of the material with regard to wear resistance.
- The CS1 hardness window available for optimization is well above the hardness window of standard materials.
The delayed bainitic transformation of CS1 enables the hardening of large parts with greater safety.

Time-temperature-transformation diagram USN
- Occurrence of the unwanted bainitic phase after approx. 10 minutes.
- Despite high quench pressure and strong gas circulation, it is difficult to reliably hit this narrow process window with large pieces.

Time-temperature-transformation diagram CS1
- Manifestation of the unwelcome bainite phase only after about 60 minutes.
- This means that die inserts can also be hardened martensitically with greater safety in the core.
- With 1030 °C and 60 minutes hold time, CS1 has usual hardness parameters.
Significant improvements by CS1 with high surface requirements and solid components

Motorcycle brake liquid container
- Large visible surface, which led to the rejection of the die after about 3,500 shots.
- In a recent attempt, the CS1 die reached up to 13,000 produced pieces at 53 HRC.

Throttle body
- High surface finish requirements demanded frequent reworking of the 1.2343 ESR die, resulting in a maximum life of 90,000 shots.
- A current attempt with a CS1 die with 52 HRC is without significant reworking at 80,000 shots. The result is still pending.
Significant improvements by CS1 with high surface requirements and solid components

Cast cover of a memory unit

- Very high sealing requirements of the component led to first defects of the inserts from 1.2343 ESR after about 5,000 shots.
- In a recent experiment, the CS1 die with 53 HRC has so far achieved 7,100 shots without any abnormalities.
- The trial is still ongoing.
CS1 for die casting with highest surface requirements

Conclusion
Conclusion

- The variety of die cast components is subject to permanent changes. The demands for surface quality are permanently intensified for technical and optical reasons.
- Advanced development of the spray cooling technology modifies the loads on the dies.
- With CS1 a new premium hot-work tool steel is available for the die casting industry, providing a hardness of up to 56 HRC with a high toughness simultaneously.
- Within the range of typical working temperatures CS1 achieves significantly higher high-temperature strength resulting in an improved resistance against thermal shock cracks.
- With high safety the specific transformation behaviour of CS1 allows a martensitic transformation when hardening large dies.
- Application tests of our customers prove that dies of CS1 achieve due to their clearly increased hardness great improvements of their performance, especially with products of highest surface requirements.
Thank you very much for your attention!

Kind & Co., Edelstahlwerk, GmbH & Co. KG
Bielsteiner Str. 124-130 • 51674 Wiehl, Germany
Telephone: +49 (0)2262/84-0 • Telefax: +49 (0)2262/84-175
Web: www.kind-co.de • Email: info@kind-co.de