

The New Premium Grade CS1 – Solution for Die Casting Dies with Highest Surface Requirements

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Wiehl, Germany**

Survey

Brief profile of Kind&Co

Technical developments

Introduction of CS1

Real-live application examples

Conclusion



**Kind&Co: A globally
operating hot-work
tool steel specialist**

BRIEF PROFILE OF KIND&CO

More than 130 years experience in hot-work tool steel solutions



2020

1888

Expertise in every step of the value chain

Melting
ESR-Remelting

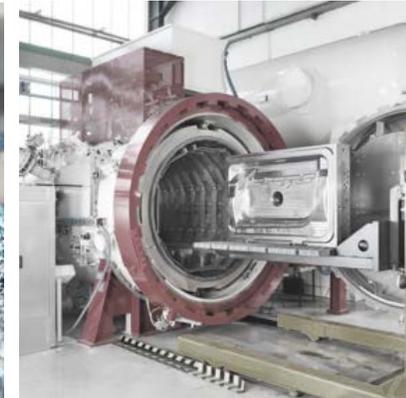
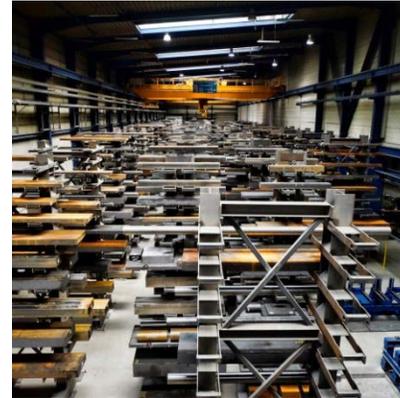
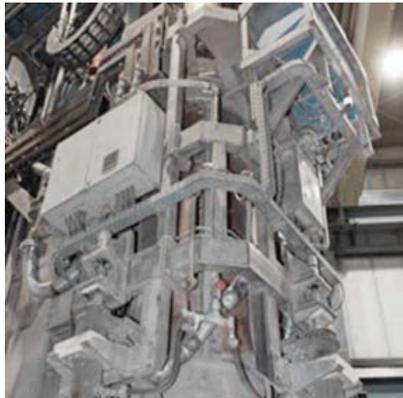
Forging

Hardening
Annealing

Stocking and
sawing

Machining

Vacuum
hardening
Nitriding



Global network with uniformly high service standards

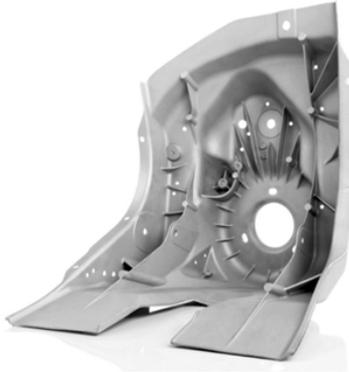




**Kind&Co accompanies
changes in the die
casting industry**

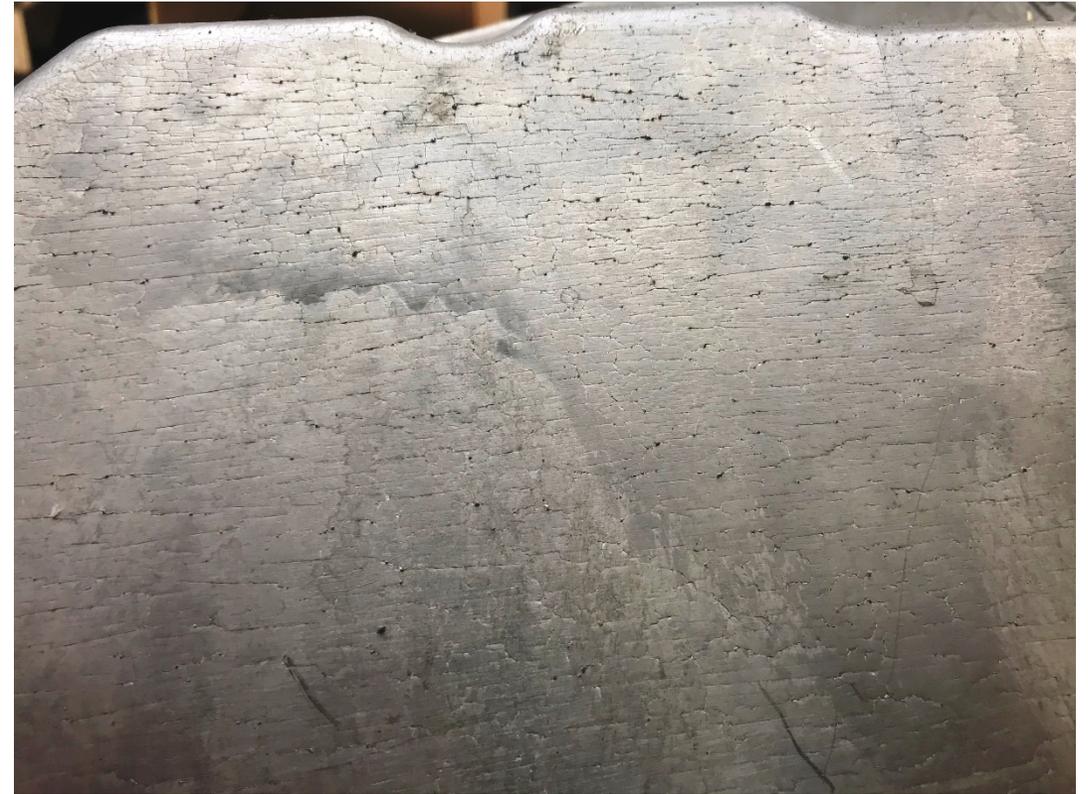
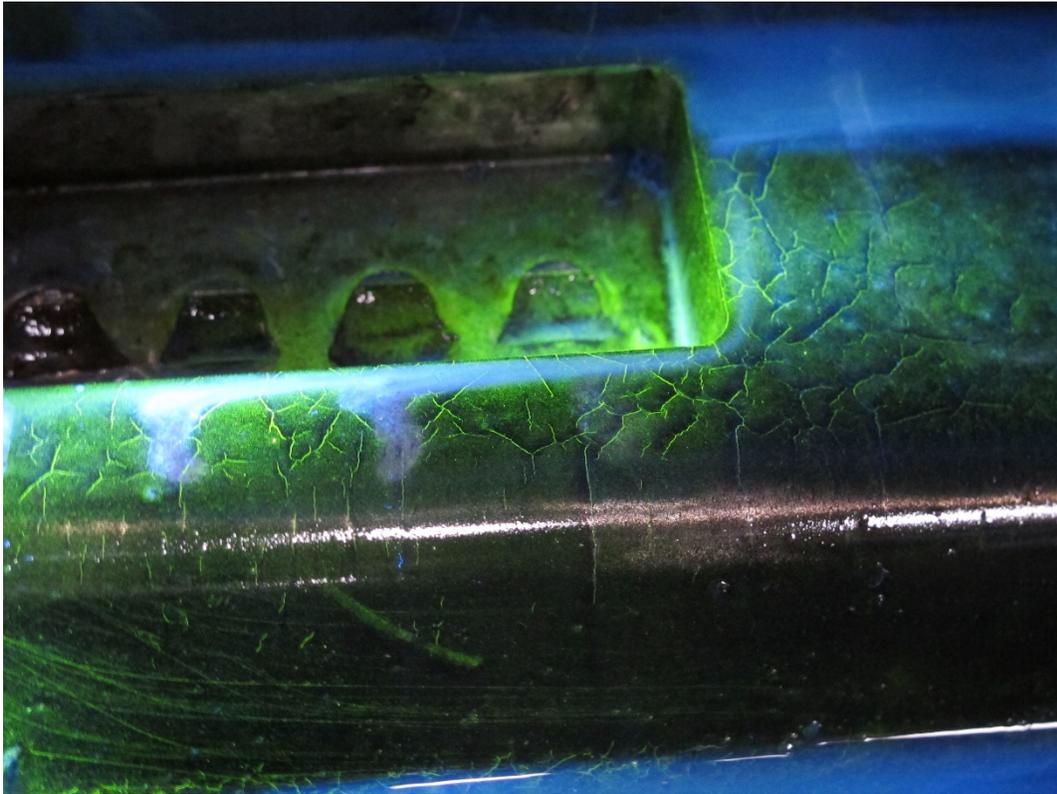
TECHNICAL DEVELOPMENTS

Surface quality and geometrical accuracy increases in cast products

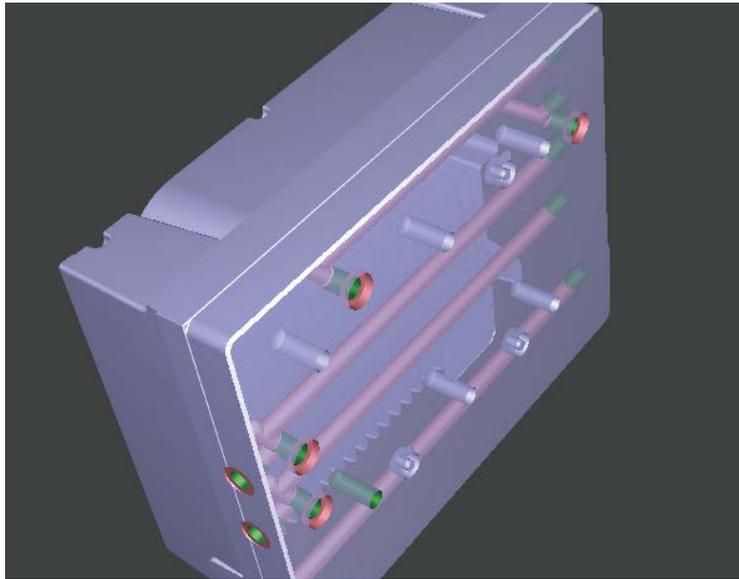


- Due to new power systems the volume of traditional die cast products (gear boxes etc.) will decrease.
- Die cast structural components contribute to automotive light weight and require very high surface quality.
- Cases for electronic components must provide highest surface quality.
- Battery boxes of e-vehicles must provide highest accuracy in sealing areas.

Thermal shock cracks reduce the quality of the cast products

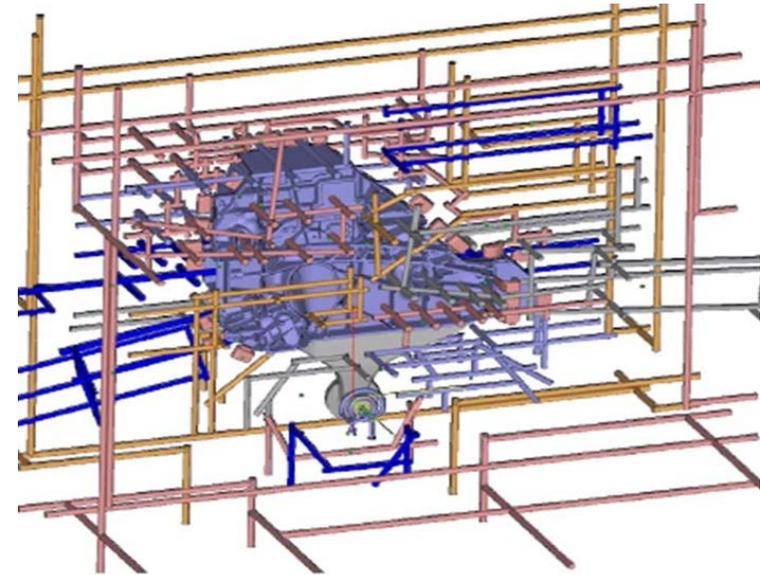


New cooling concepts modify the requirements on die steels



Conventional die cooling

Minimum spray cooling requires improved high-temperature strength and toughness



Minimum spray cooling



**CS1 proves itself even
at highest
requirements**

INTRODUCTION OF CS1

CS1 for high surface requirements and working hardness



- Thermal shock resistance depends on high-temperature strength and toughness.
- Significantly higher working hardness improves hot yield strength and thermal shock resistance.
- Good long-term tempering resistance delays softening.

Premium hot-work tool steel CS1 - Characterization

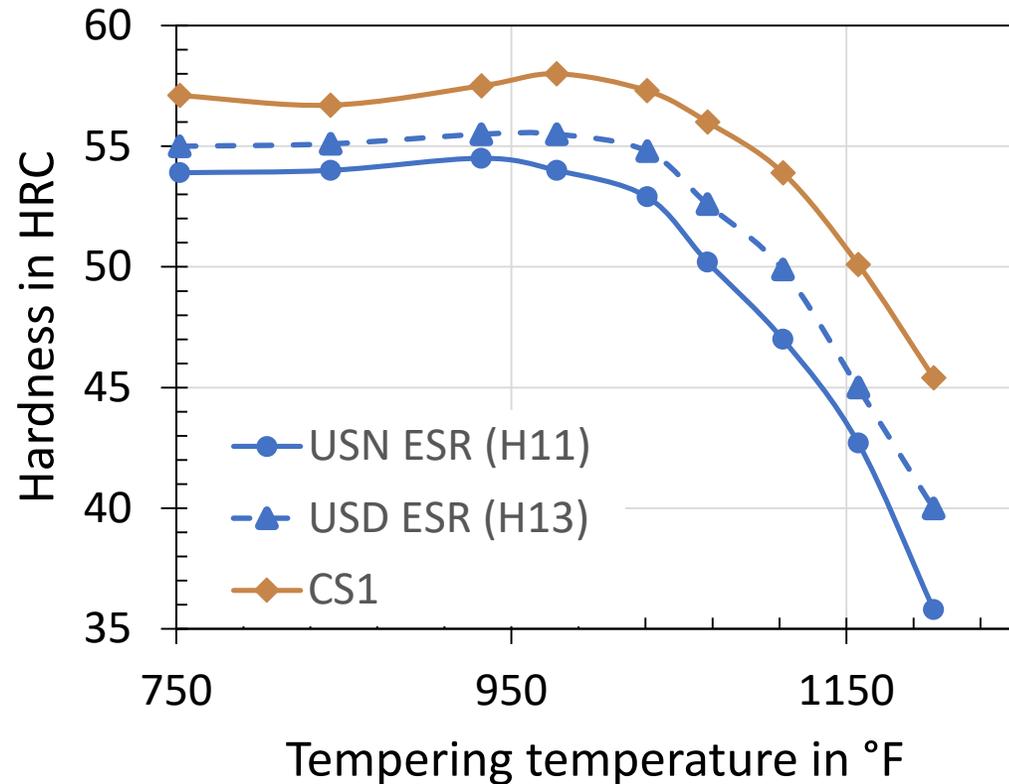
- CS1 is a chromium-molybdenum-vanadium alloyed premium hot-work tool steel which was specially designed for highly mechanically stressed tools.
- By combining a tailor-made alloy concept, manufacturing processes with the highest level of purity and optimum heat treatment, CS1 offers the possibility 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.

Alloy concept of CS1 optimized for toughness at elevated hardness

Steel designation			Alloy content in mass-%						
Brand	AISI	Mat.-no.	C	Si	Mn	Cr	Mo	V	Nb
USN ESR	H11	1.2343	0,37	1,00	0,40	5,20	1,20	0,40	-
USD ESR	H13	1.2344	0,40	1,00	0,40	5,20	1,30	1,00	-
CS1	-	-	0,50	0,30	0,40	5,00	1,90	0,55	+

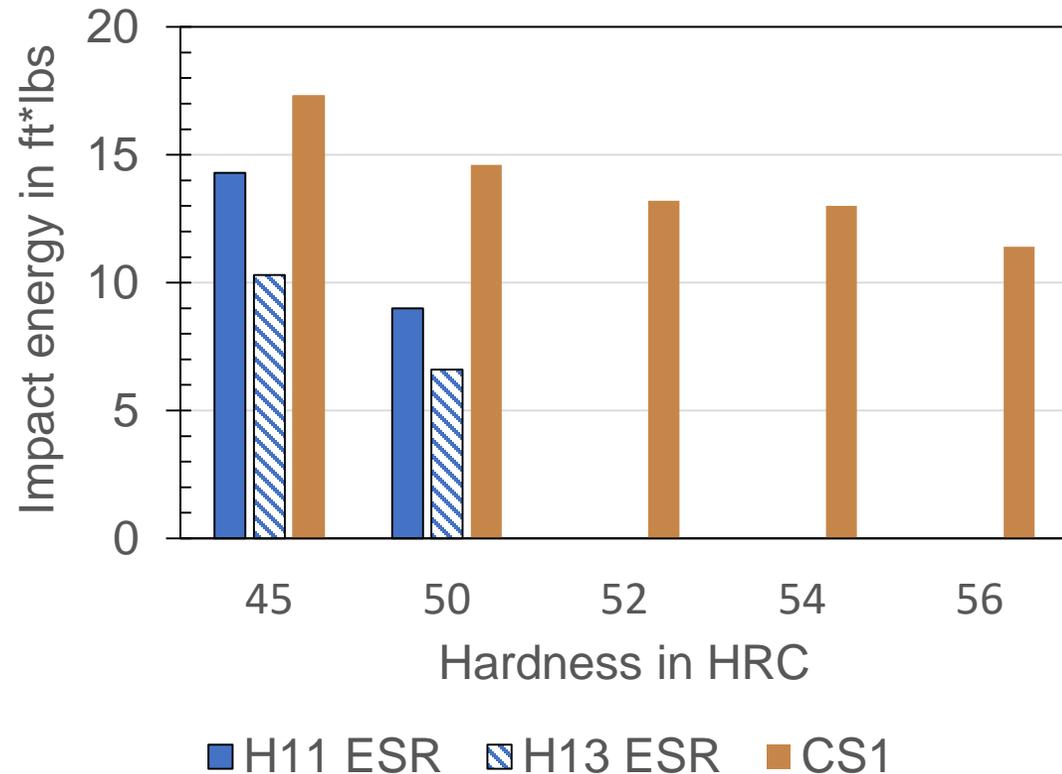
- Higher carbon for hardness and wear resistance (carbides)
- Mo for improved hardenability and high-temperature strength
- Nb dose to support grain refinement thus toughness
- Lowest levels of undesired trace elements

CS1 provides elevated hardness and improved tempering behavior



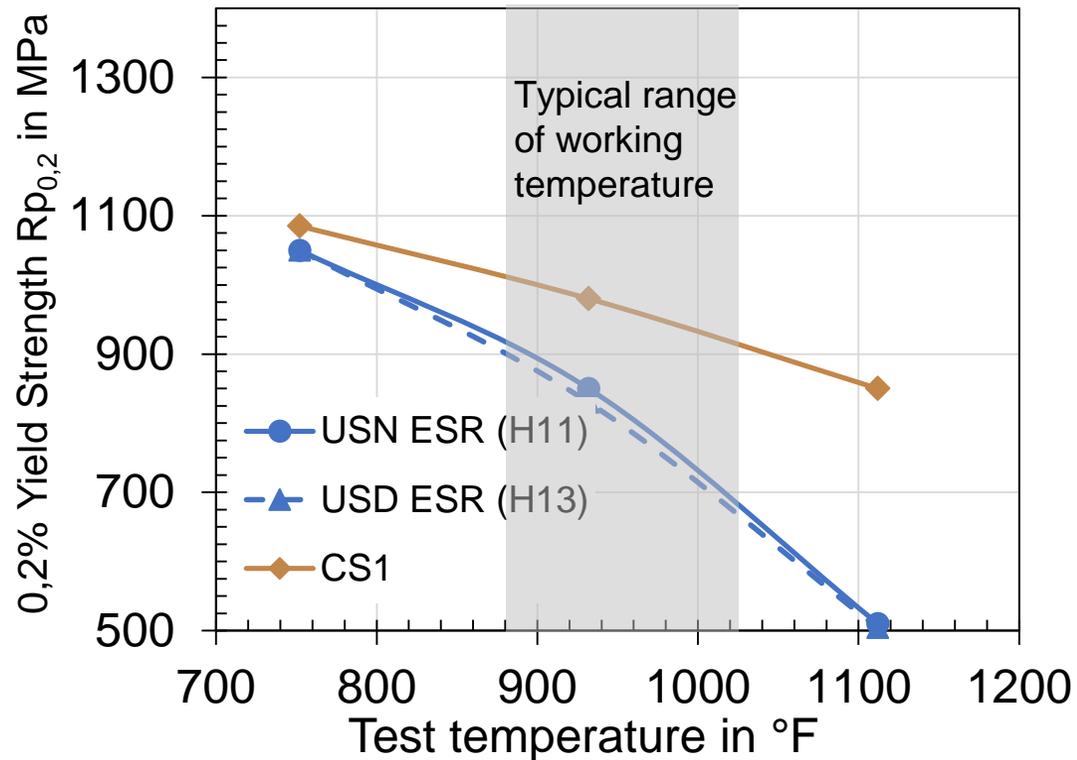
- Higher secondary hardness maximum compared to H11 and H13.
- Improved tempering resistance compared to H11 and H13.

Despite higher hardness, CS1 offers improved toughness



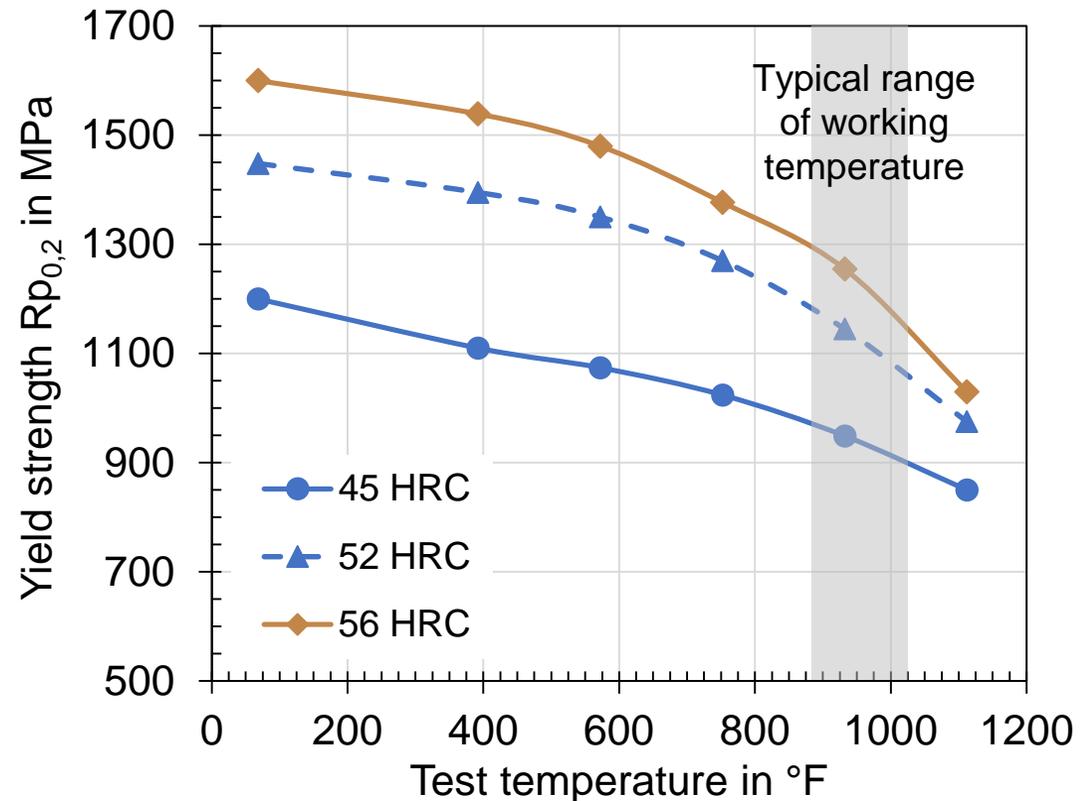
- CS1 offers an improvement of impact toughness by more than 20 % compared to H11 and H13.
- ISO-V-notch samples taken from the center of forged bars (short transverse).

CS1: Significantly higher strength at typical working hardness



- CS1 has higher strength even with increasing test temperature in the range of typical working temperature.
- This provides CS1 an excellent resistance to the formation of thermal fatigue cracks.
- All samples treated to $R_m = 1450$ MPa

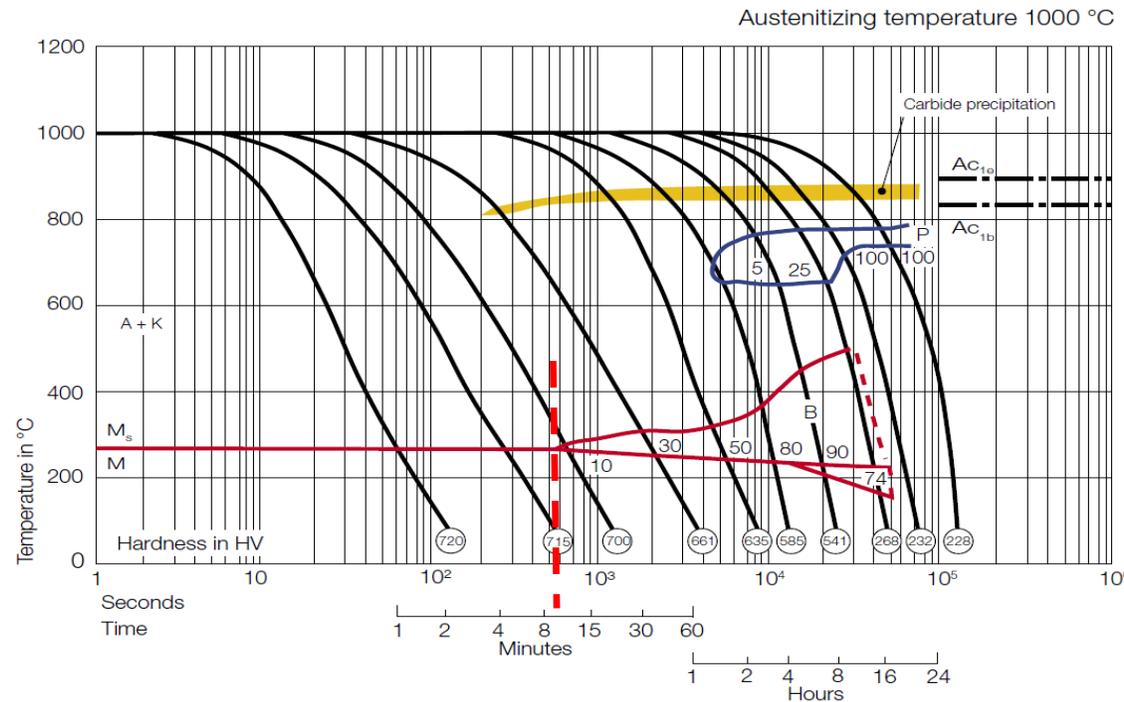
CS1: Alloy concept allows working hardness up to 56 HRC



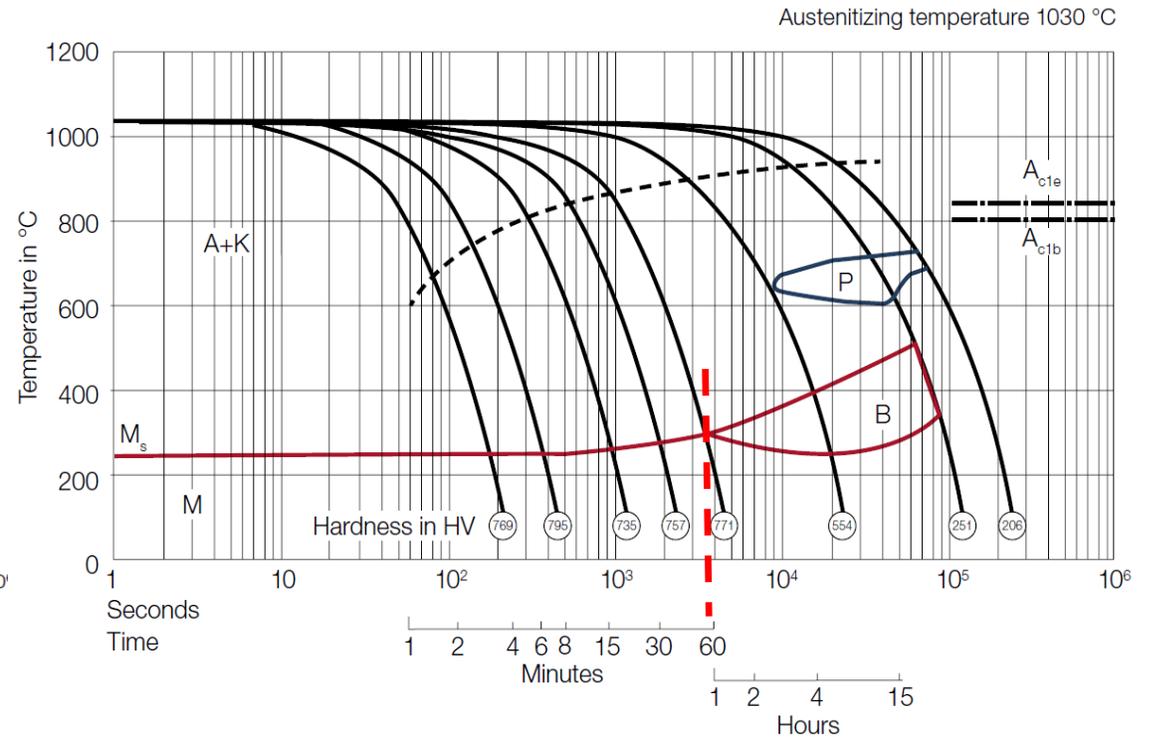
- The alloy composition of CS1 allows hardness values up to 56 HRC.
- Higher working hardness allows flexible adjustment of the die material with respect to heat checking and wear resistance.

Delayed bainitic transformation of CS1 allows safe heat treatment

USN ESR (H11)



CS1





**CS1 allows for longer
die life, reduced
maintenance cost, and
higher quality of cast
parts**

REAL-LIVE APPLICATION EXAMPLES

Case example 1: CS1 extends lifetime of the dies



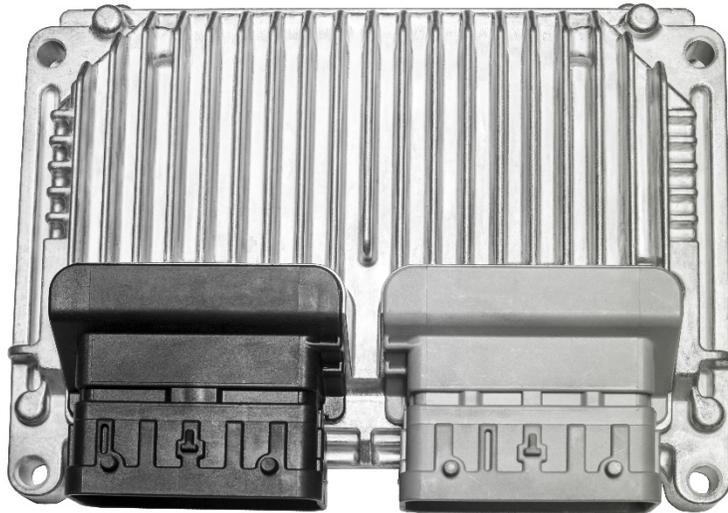
- Die cast tank for brake fluid of a motorcycle.
- Visible painted or chromium plated surfaces.
- Dies rejected after only 3.500 shots.
- Dies of CS1, 53 HRC, achieved 13.000 shots.

Case example 2: CS1 reduces maintenance costs



- Throttle bodies require highest surface conditions for technical reasons.
- Dies of H11 ESR: 90.000 shots, frequently reworked.
- Dies of CS1, 52 HRC: 90.000 shots, no reworking.
- Average maintenance per die reduced by 62 %

Case example 3: CS1 improves die performance



- Cast covers of memory units have high surface requirements in the sealing area.
- Dies of H11 developed first defects after 5.000 shots.
- CS1 (53 HRC) has actually done more than 7.100 shots without any repair.



**CS1 allows for longer
die life, reduced
maintenance cost, and
higher quality of cast
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CONCLUSION

Conclusion

- The variety of die cast components is subject to permanent changes:
 - Surface quality
 - Geometrical accuracy
 - ...
- Advanced development of the spray cooling technology modifies the loads on the dies.
- With CS1 a new premium hot-work tool steel solution is available for the die casting industry
 - Working hardness of up to 56 HRC
 - Elevated toughness
- Within the range of typical working temperatures, CS1 achieves significantly higher high-temperature strength
 - Improved resistance against thermal shock cracks.
- Real-live application examples prove that dies of CS1 achieve significant performance improvements
 - Longer die life
 - Less rework
 - Higher cast part quality

Thank you very much for your attention!

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