

ORAL PRESENTATION

HTDC_11

AIM ASSOCIAZIONE ITALIANA DI METALLURGIA

AMAFOND

ASSOFOND ASSOCIAZIONE ITALIANA FONDERIE

ASSOMET Associazione Nazionale Industrie Metalli non Ferrosi

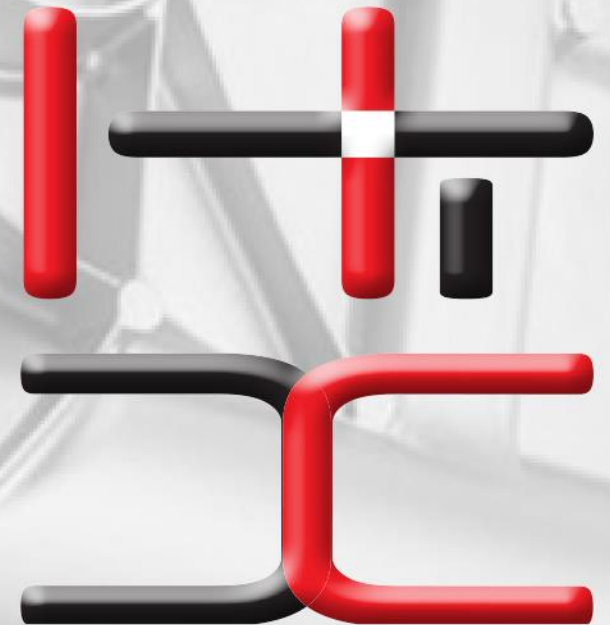
metef

SINFONET SMART & INNOVATIVE FOUNDRY NETWORK



CS1 – The new hot-work tool steel for die casting dies with the highest surface requirements

Dr. Emeline Meurisse, Ingolf Schruff – Kind & Co.,
Edelstahlwerk, GmbH & Co., KG, Wiehl, Germany



High Tech
Die Casting

INTERNATIONAL
CONFERENCE

23-25 JUNE 2021



DISCLAIMER

The viewing is strictly reserved to
HTDC registered attendees

These contents, or any part thereof,
must not be copied, saved, recorded,
shared or posted in any form



High Tech
Die Casting

INTERNATIONAL
CONFERENCE

23-25 JUNE 2021

Content

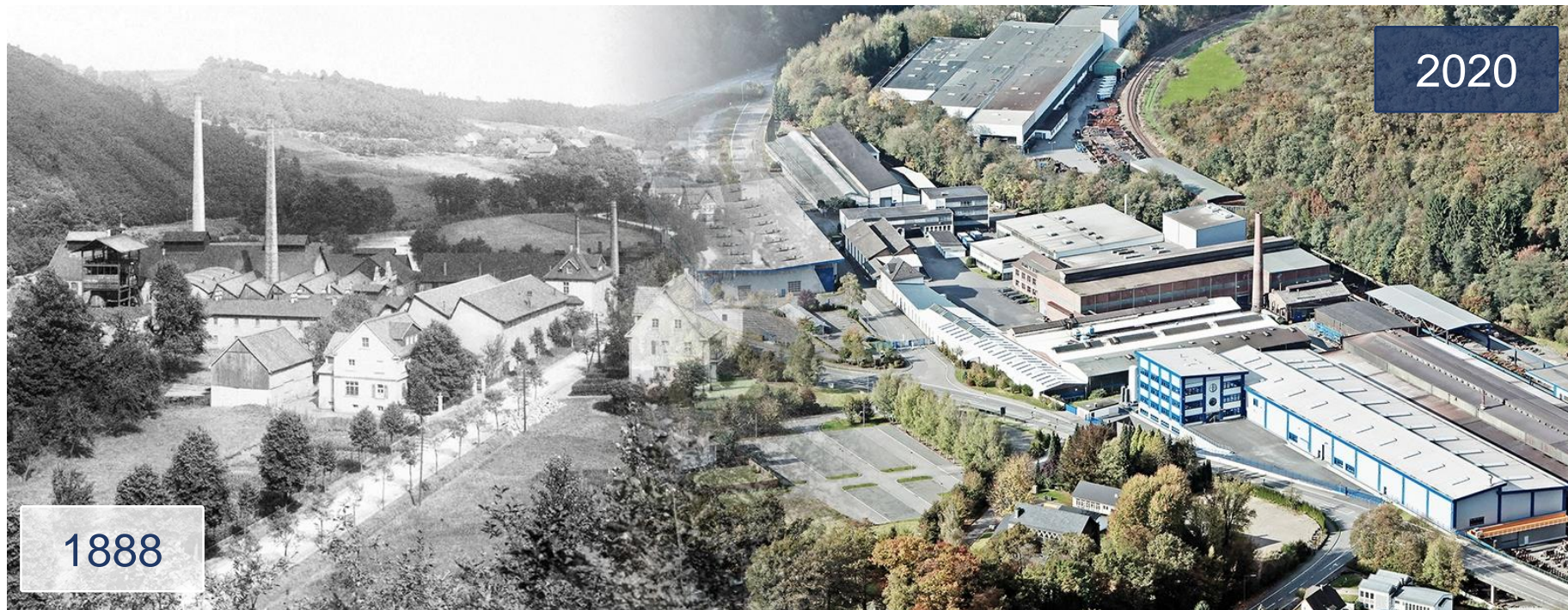
- Brief profile Kind&Co
- Technical development in die casting market
- Introduction of CS1
- Application results
- Conclusion



Globally operating hot-work
tool steel specialist

Brief profile Kind&Co

Tradition and modernity: The best of both worlds!



Tradition

Experience and know-how
Sustainability
Commitment and respect in cooperation
Linked with our home region



Modernity

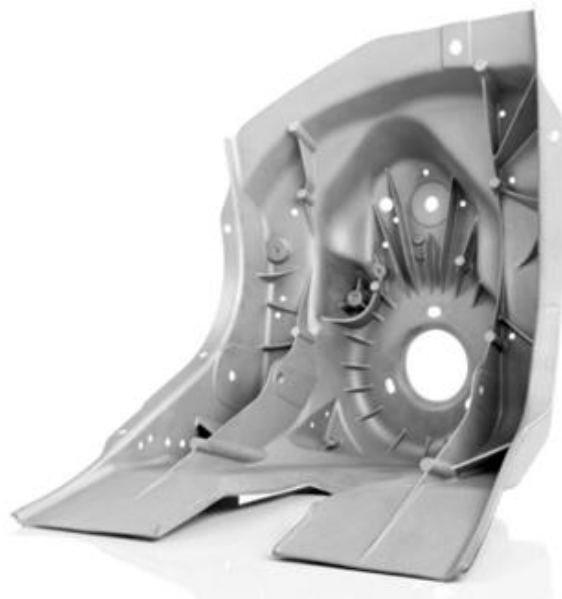
Up to date production technology
Professionalism in service
Quick decision processes
Internationality



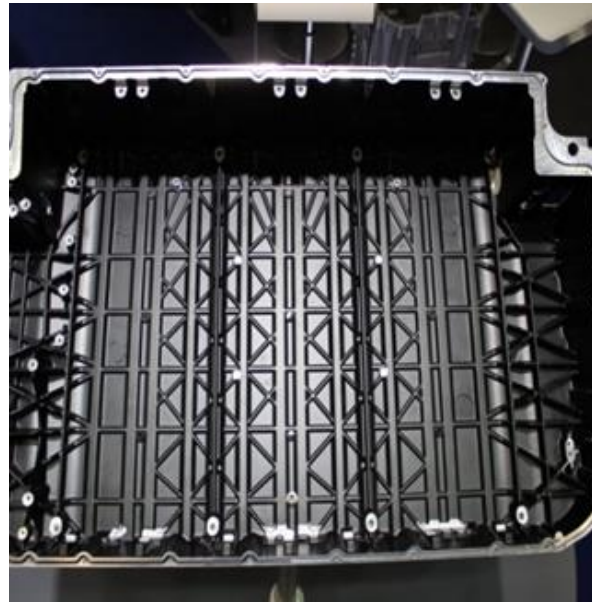
Kind&Co accompanies technological changes in the die casting industry

Technical developments

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.



- Battery boxes of electrically driven vehicles must provide highest accuracy within the sealing areas.



- Triggered by the boom in 5G technology, cost effective die cast components with a high quality are required.
- E.g. cast heat sinks are often used without additional finishing, although they include a lot of functionalities. The highest demands are placed on the surface quality and geometrical accuracy

Thermal shock cracks reduce the quality of the cast products



- 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.



CS1 proves itself even at
highest requirements

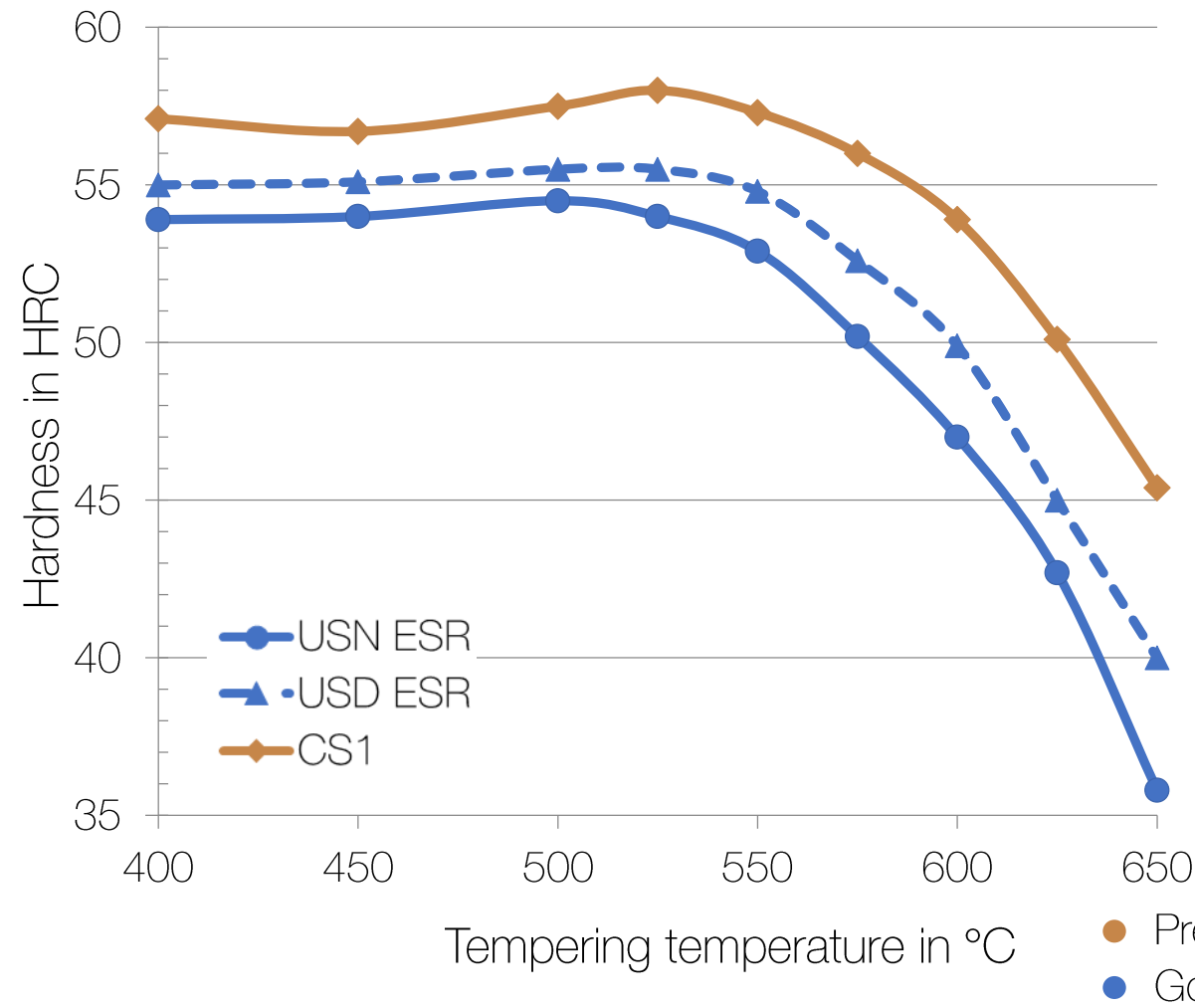
Introduction of CS1

Premium hot-work tool steel CS1 - Characteristics

- The material CS1 is a chrome-molybdenum-vanadium hot-work steel, which was specially designed for 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.
- 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

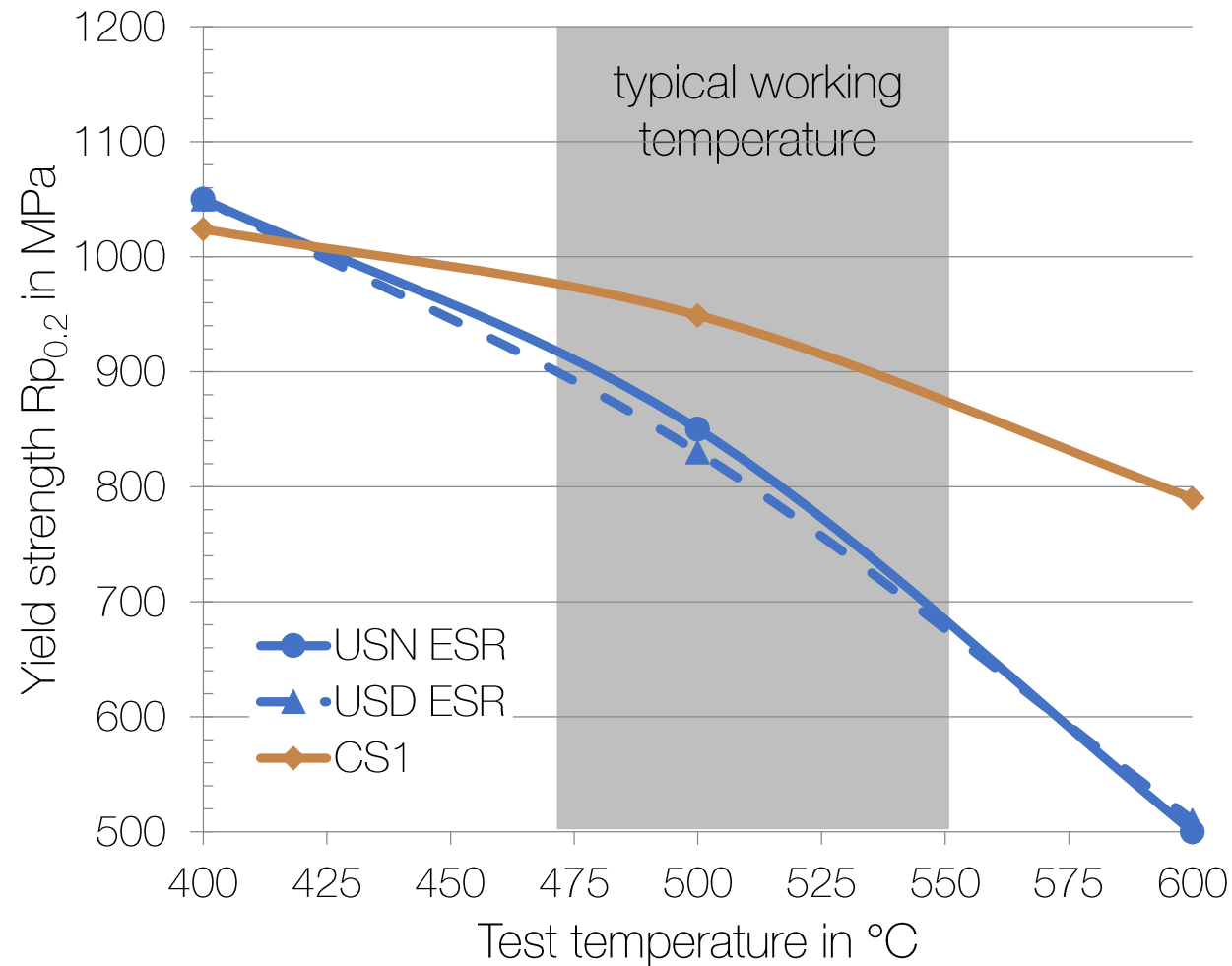
Steel		Alloy content in mass%						
Brand	M.- No.	C	Si	Mn	Cr	Mo	V	Nb
USN	1.2343	0,37	1,00	0,40	5,20	1,20	0,40	-
USD	1.2344	0,40	1,00	0,40	5,20	1,30	1,00	-
CS 1	---	0,50	0,30	0,40	5,00	1,90	0,55	+

CS1 provides elevated hardness and improved tempering behaviour



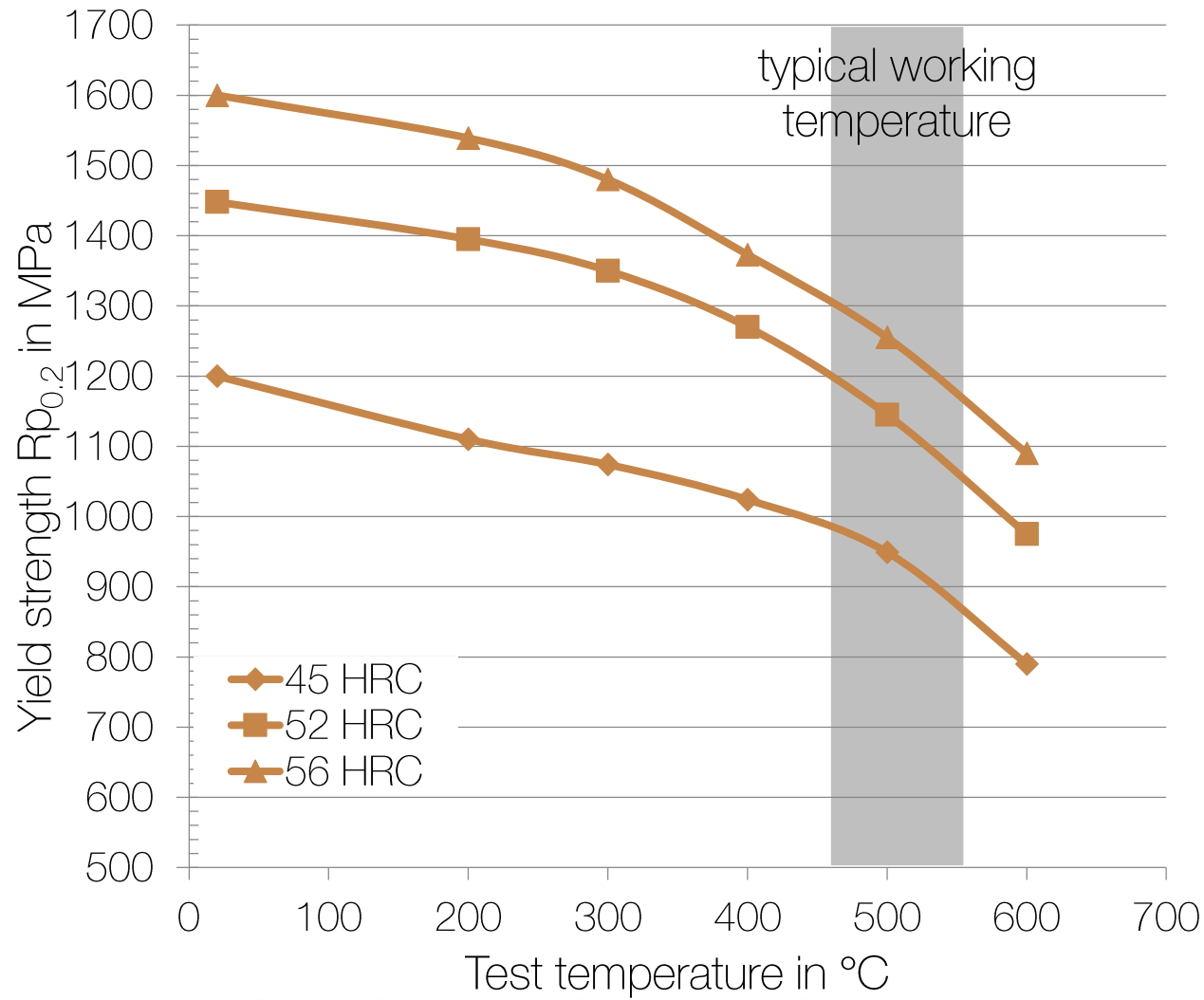
- Higher secondary hardness maximum compared to USN and USD.
- Improved tempering resistance compared to USN and USD.

CS1 has significantly higher strength at typical working temperatures



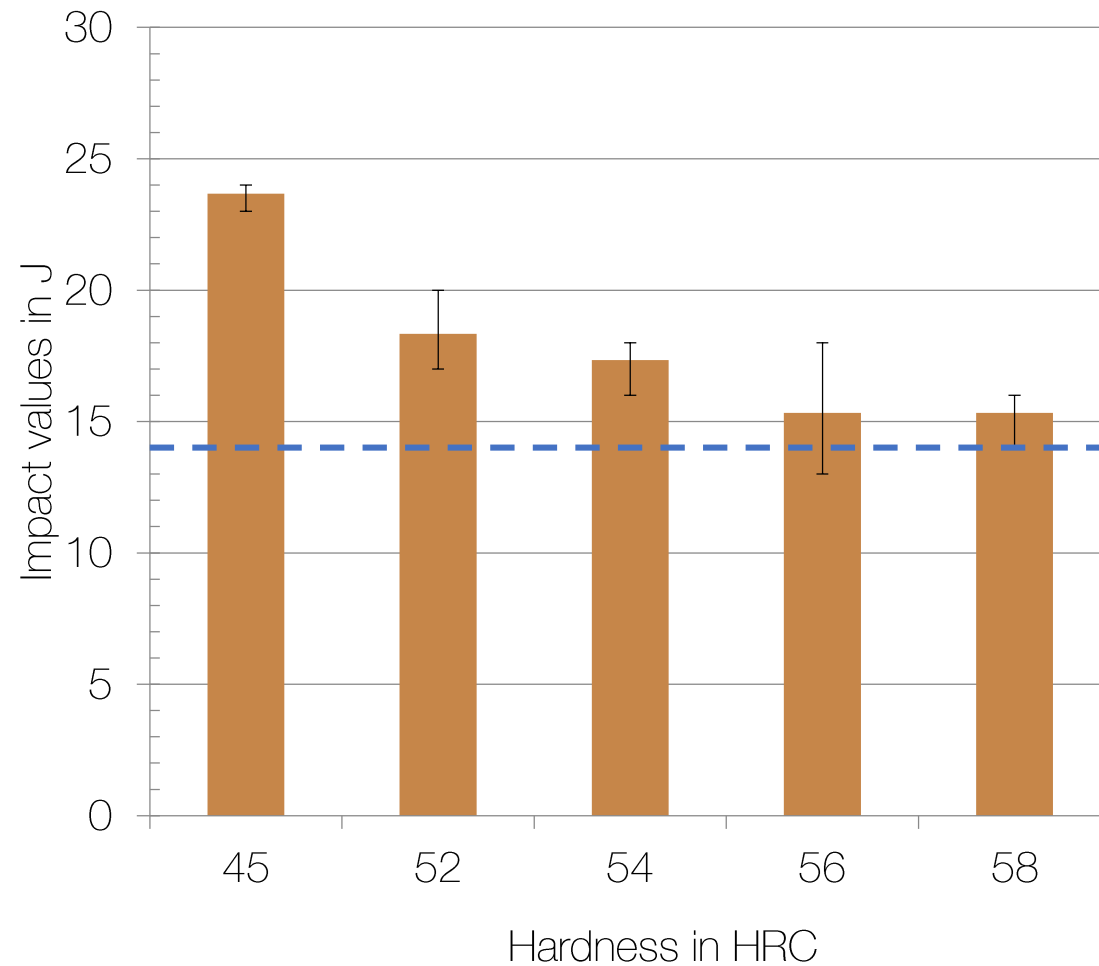
- The premium hot-work tool steel CS1 has a higher strength even with increasing test temperatures in the range of typical working temperatures.
- As a result, an even higher high-temperature strength can be achieved.
- In addition, CS1 has excellent resistance to the formation of thermal fatigue cracks (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



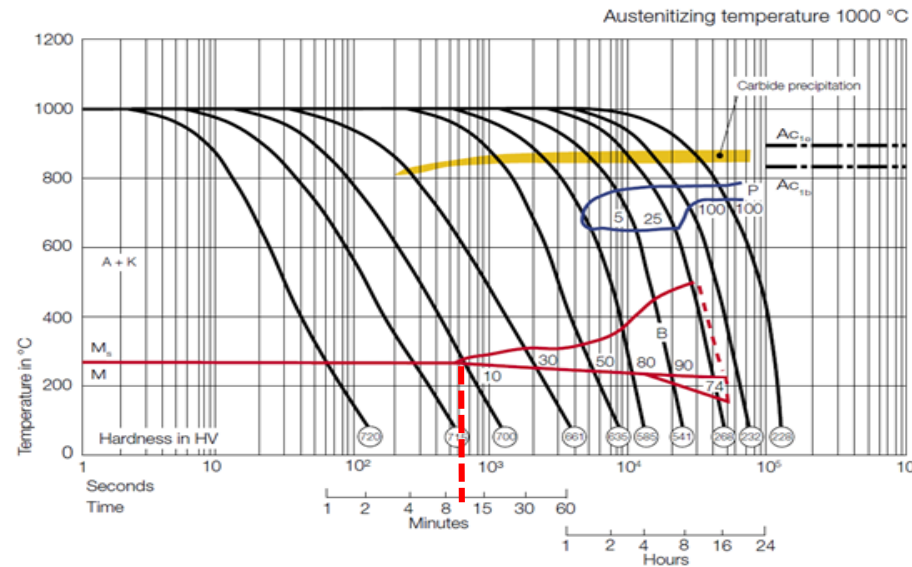
- The alloy of CS1 allows hardness values up to 56 HRC.
- In addition to the improved heat crack resistance, a higher working hardness also allows the flexible adjustment of the material with regard to wear resistance.
- The CS1 hardness range available for optimization is well above the hardness range of standard materials.

Despite higher hardness, CS1 offers improved toughness



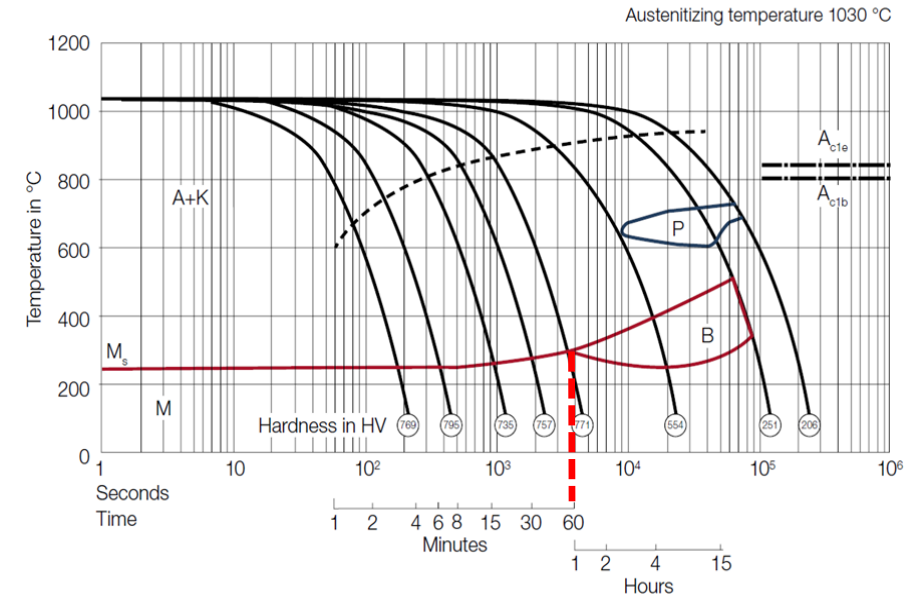
- The toughness was tested after a heat treatment in the laboratory according to the NADCA-rules and at different hardness values (230 Ø mm).
- With 23 J, CS1 surpasses significantly the NADCA-requirements for the grades 1.2344 and 1.2343 (at 45 HRC).
- Although higher hardness generally reduces toughness, CS1 is even able to achieve impact energy values of 15 J up to a hardness of 58 HRC.

The delayed bainitic transformation of CS1 enables the hardening of large parts with greater safety



Time-temperature-transformation diagram USN

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



Time-temperature-transformation diagram CS1

- Manifestation of the undesirable bainite phase only after about 60 minutes.
- This means that die inserts can also be martensitic hardened with greater safety in the core.
- The hardening parameters of CS1 (1030°C/60 min) match with usual industrial standards



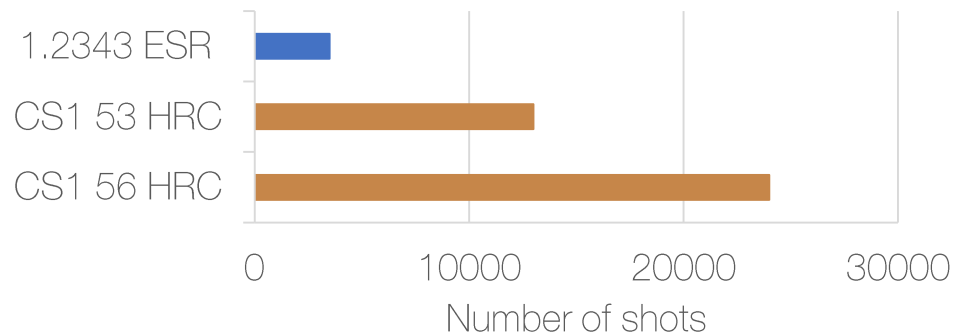
The first applications of CS1 are promising

Application results

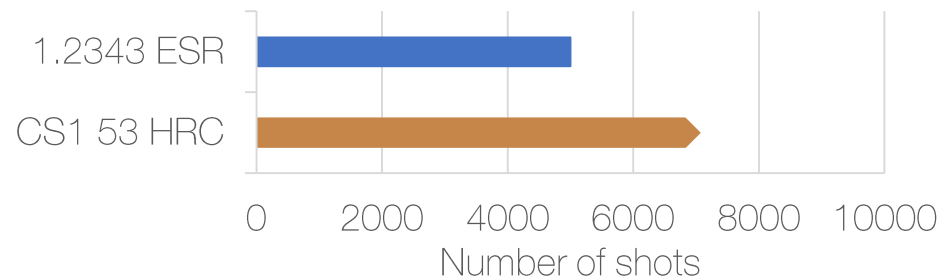
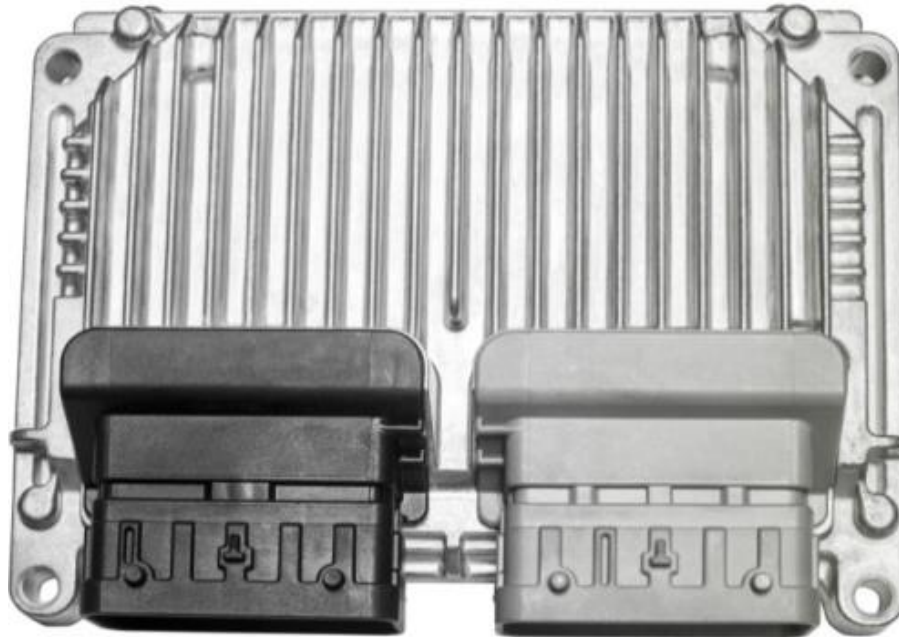
Case example 1: CS1 extends lifetime of the dies



- Product: Motorcycle brake lever holder
- Requirements: very high surface demand because cast parts are painted or chromium plated, no cracks allowed
- Results: improvement of the lifetime of 600%

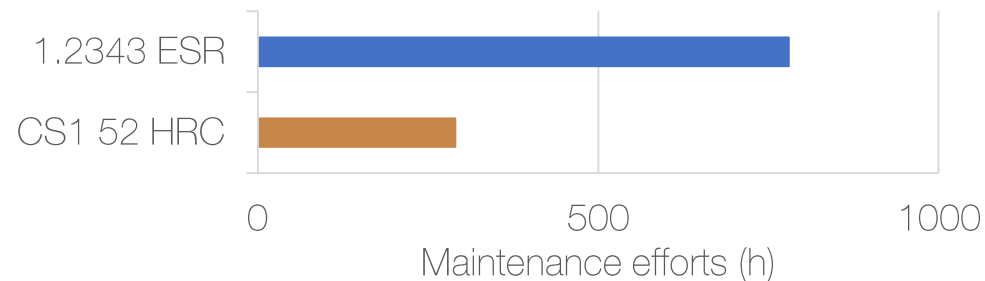


Case example 2: CS1 improves die performance



- Product: Memory unit housing
- Requirements: high dimensional stability, high surface requirements in the sealing area, resistance against crack formation at the grooves
- Results: after 7100 shoots no defect appeared. Trial is going on.

Case example 3: CS1 reduces maintenance costs



- Product: Throttle bodies
- Requirements: high surface demand in the sealing area (any mark of thermal shock cracks not tolerated, excessive remachining of the die)
- Results: 90 000 shots for 1.2343 and CS1, average maintenance per die reduced by 62 % by using CS1.

Based on the successful uses of CS1, the approval procedure in NADCA-specification is well in progress

- Casting of automotive center consoles:
 - Insert in a slide, 49 HRC, after 100 000 shots no surface damage visible whereas the rest of the die (1.2343 ESR) shows washout.
- Casting of electric vehicle motor controller housings:
 - Complete die, 51 HRC, sampling process completed, production has started.
- Casting of automotive structural parts (equipment carrier for the rear wing):
 - Insert, 49 HRC, after 30000 shots no defect visible, trial on going.
- Casting of door handles:
 - Fixed und mobile inserts, 53 HRC, sampling process finished, production has started.
- Casting of instrument housings:
 - Fixed und mobile inserts, 49 HRC, after 22000 shots no defect visible, production on going.
- Approval procedure in NADCA-specification:
 - Material for testing sent to the NADCA-organization
 - Material tested according to NADCA in an external laboratory
 - Dunker test will be performed in June
 - Acceptance expected in autumn 2021



CS1 for die casting with highest
surface requirements

Conclusion

Conclusion

- The variety of die-cast components is subject to constant changes. The demands on the surface quality and geometrical accuracy of the cast products are becoming much more stringent for technical and optical reasons.
- With the tool steel CS1, the die casting industry has a new premium hot-work tool steel at its disposal that enables hardness values of up to 56 HRC combined with very high toughness.
- In the range of typical working temperatures, CS1 achieves a significantly higher high-temperature strength and thus greater resistance to thermal shock cracking.
- The special transformation behaviour of CS1 enables martensitic transformation with great certainty when hardening large dies.
- Practical tests carried out by our customers show that dies made of CS1, thanks to its significantly higher hardness, show a noticeable improvement in performance, especially for castings with the highest surface requirements.

Contact details

**Thank you very much
for your attention**

Kind & Co., Edelstahlwerk, GmbH & Co. KG

Bielsteiner Str. 124-130 • 51674 Wiehl

Telefon: 02262/84-0 • Telefax: 02262/84-175

Web: www.kind-co.de • Email: info@kind-co.de

