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



Premium Tool Steel Solutions for Efficient Hot-Stamping Applications

实现高效热冲压的高级工具钢解决方案

Content
目 录

- Introduction to Kind & Co. Group
- Actual Demands in the Automotive Industry and Motivation for Light Weight and Hot-Stamping
- Tool Steels for Hot-Stamping Applications
- Tool Steel for Tailored Tempering
- Recommendations for Improved Tool Life
- Conclusion

- Kind & Co. 集团简介
- 汽车工业的客观需求及轻量化和热成形的动机
- 用于热成形应用的模具钢
- 用于定制回火工艺的模具钢
- 提高模具寿命的建议
- 结论

Integrated Production and Full Service Along the Entire Value Chain
全生产链一体化服务

Melting 熔炼 → Forging 锻造 → Heat Treatment 热处理 → Vacuum Treatment 真空热处理 → Stocks 库存 → Mechanical Processing 机加工














SERVICE **服务**

Global Tool Steel Services from Kind & Co. Group
Kind & Co工具钢的全球化服务



- Own enterprise
- Own sales and distribution
- Exclusive distribution partner
- Agent

- 自有的公司
- 自有的销售和配送
- 独家经销合作伙伴
- 代理商

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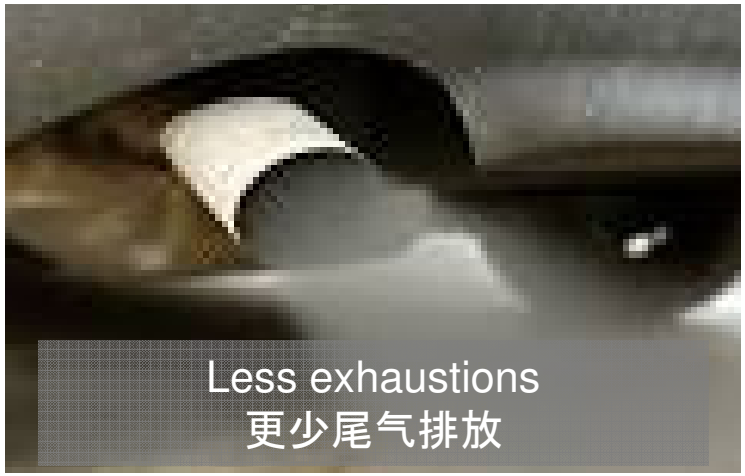
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Actual Demands in the Automotive Industry and Motivation for Light Weight
汽车工业的客观需求和轻量化的动机





Automotive Industry
汽车工业







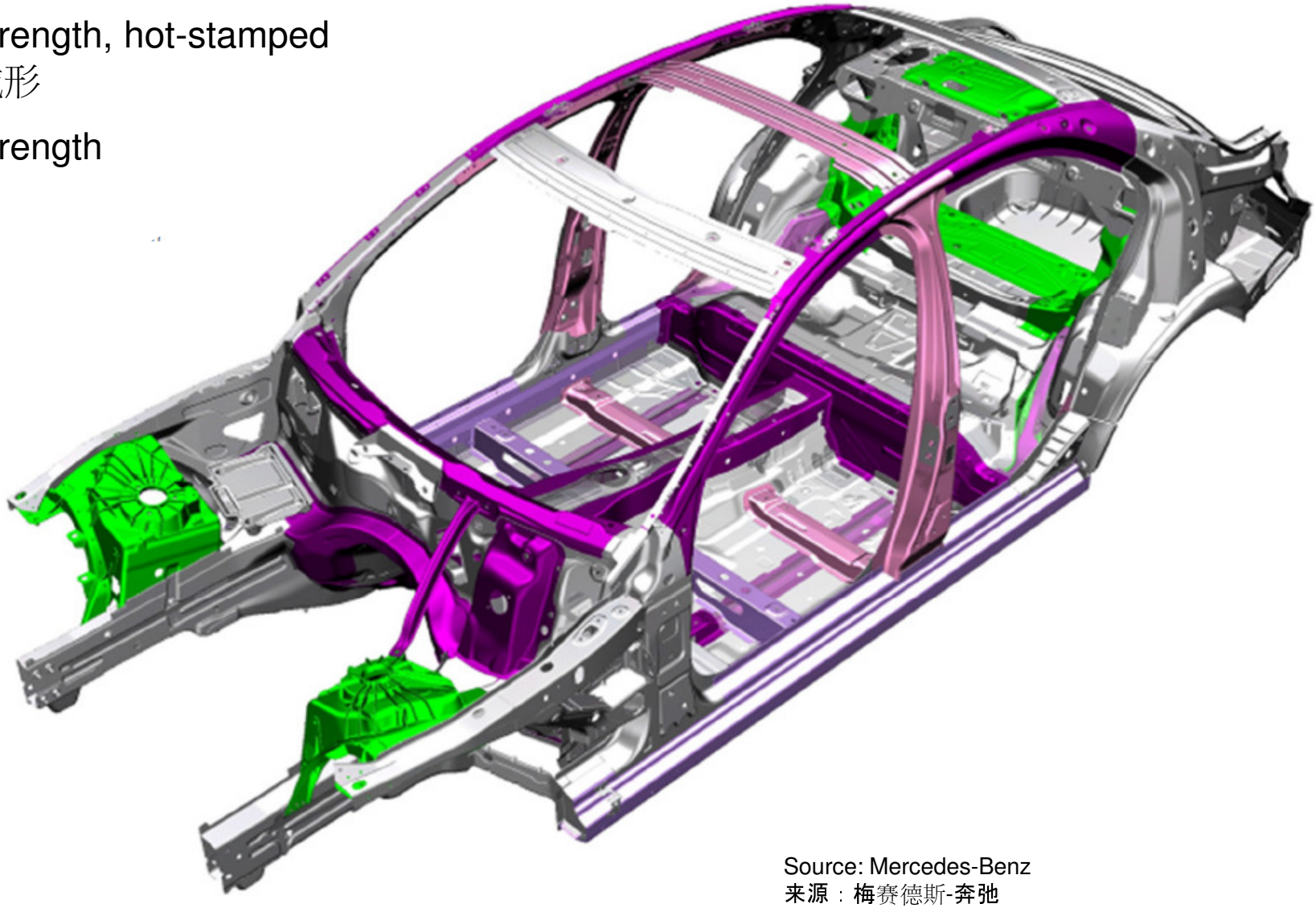
Hot-Stamping – The Leading Technology for Autmotive Light Weight
热成形--汽车轻量化的领先技术

Steel ultra-high-strength, hot-stamped
超高强度钢，热成形

Steel ultra-high-strength
超高强度钢

Steel
钢材

Aluminium
铝合金



Source: Mercedes-Benz
来源：梅赛德斯-奔驰

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Requirements for Successful Hot-Stamping
成功热冲压生产的需求

Hot-stamping tools are extremely expensive and therefore require a reliable performance of some 100.000 pieces.

热冲压模具非常昂贵，**因此需要大**约100,000**件的可靠性能。**

Economic hot-stamping production requires short cycle times and highly effective cooling of the produced components.

经济的热冲压生产需要较短的循环时间和对**所生**产部件的高效冷却。

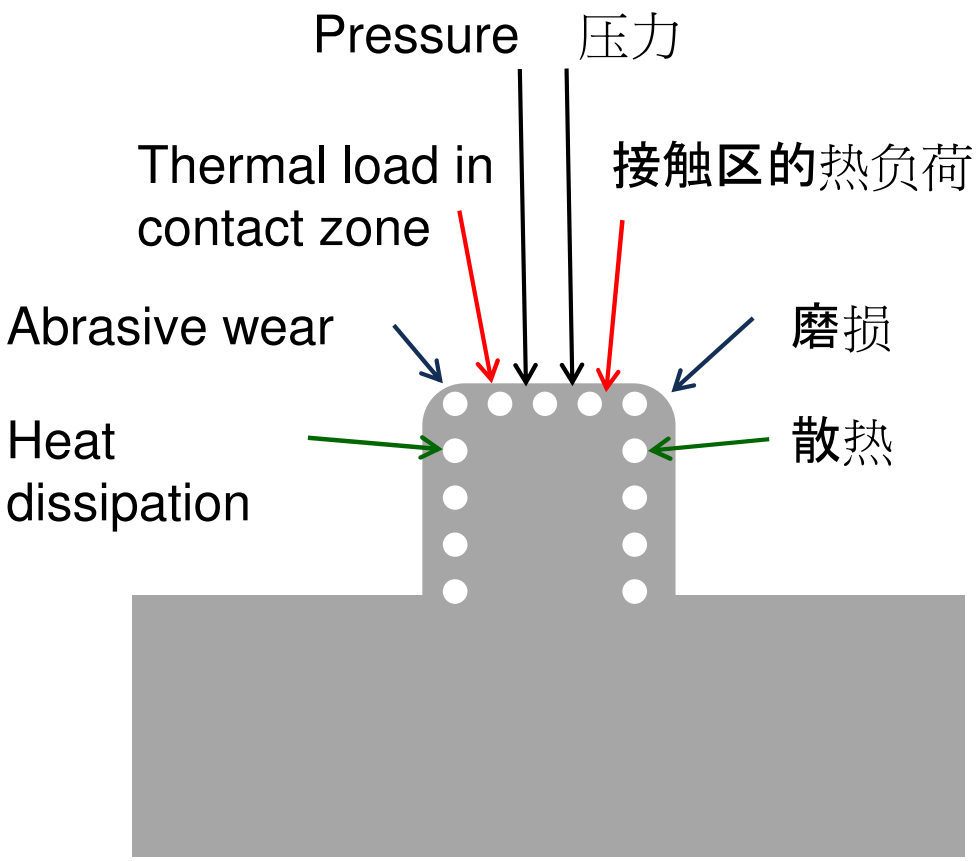
Premature tool failures or unexpected repair work due to excessive wear need to be avoided.

需要避免由于过度磨损导致的过早的模具故**障或意外的修理工作。**

The performance of hot-stamping tools depends to a high degree on an analysis of the loads of the tools, an appropriate tool steel selection and proper heat treatment.

热冲压模具的性能在很大程度上取决于对模**具**载荷的分析，**适当的模具**钢选择和适当的热处理。

Loads on Hot-Stamping Tools and Required Tool Steel Properties
热冲压模具的负载和所需的模具钢性能



Load Situation 负载情况	Requirement 要求	Importance 重要性
Abrasive wear 磨损	Hardness, Carbide content 硬度，碳化物含量	
Thermal load 热载荷	Tempering resistance 回火抗力	
Pressure 压力	Compression strength 抗压强度	
Thermal and mechanical loads 热负荷和机械负荷	Toughness 韧性	
Heat dissipation 散热	Thermal conductivity 热传导性能	

Recommended Tool-Steels for Water-Cooled Hot-Stamping Tools
推荐用于水冷热冲压模具的工具钢

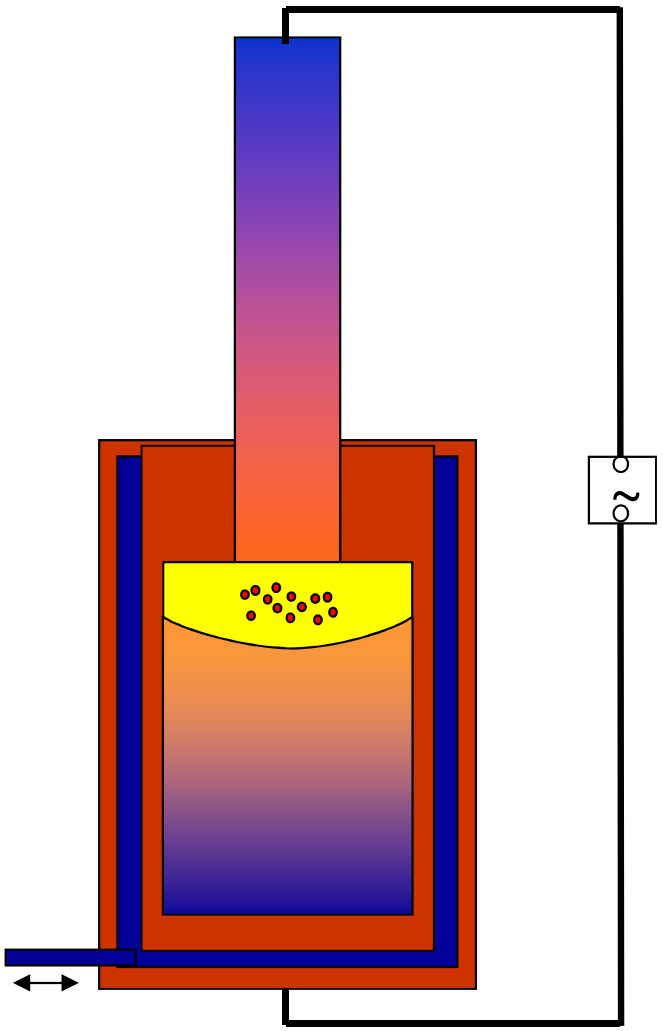
钢材牌号　　化学成份　　推荐硬度

Steel designation	Alloy content in mass-%						Recommended Hardness in HRC
	C	Si	Mn	Cr	Mo	V	
1.2344 (H13)	0,40	1,00	0,40	5,20	1,30	1,00	---
CR7V-L	0,42	0,50	0,40	6,50	1,30	0,80	54 - 58

For high toughness requirements CR7V-L is available as an Electro-Slag-Remelted (ESR) special steel providing significantly improved purity and homogeneity.

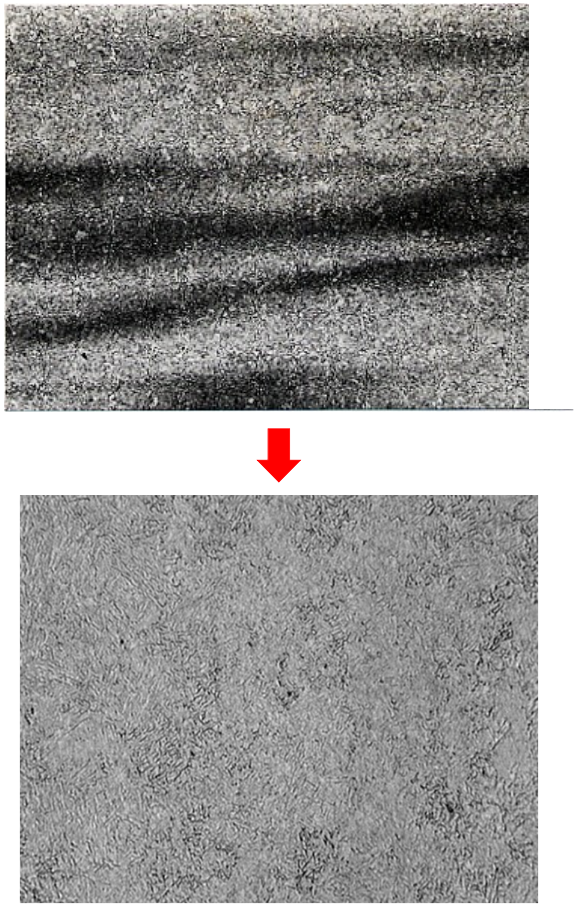
对于高韧性需求，我们提供电渣 - 重熔（ESR） 级别的CR7V-L材料，可显着提高钢材的纯净度和组织均匀性。

Influence of Electro-Slag-Remelting (ESR) on Properties of CR7V-L
电渣重熔（ESR）对CR7V-L性能的影响



Improvement of homogeneity by ESR

通过ESR改善同质性



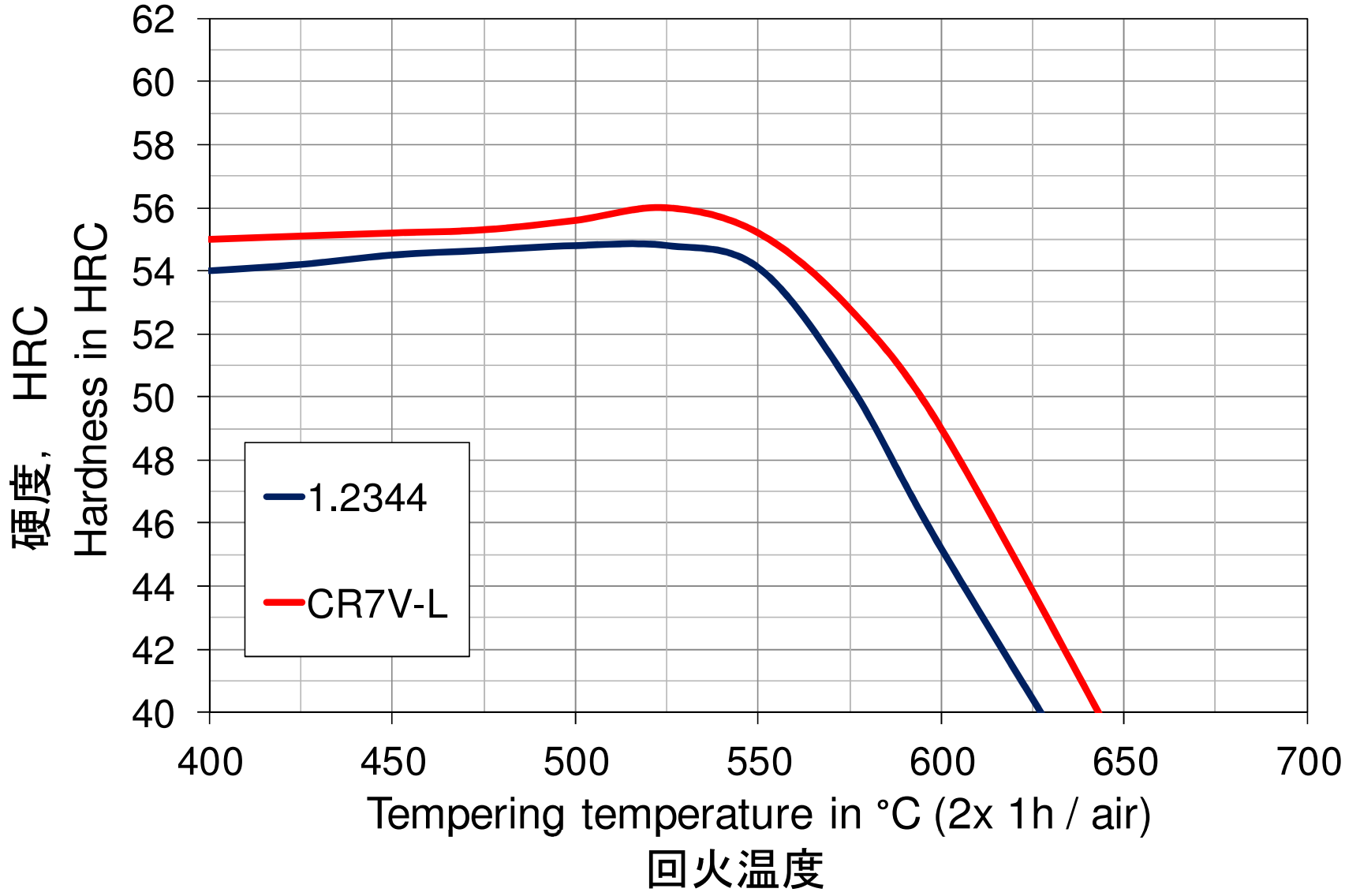
The ESR Process:

- Purifies the steel,
- Improves the steel's homogeneity macroscopically and microscopically,
- Improves toughness considerably,
- Allows for higher hardness values and wear resistance.

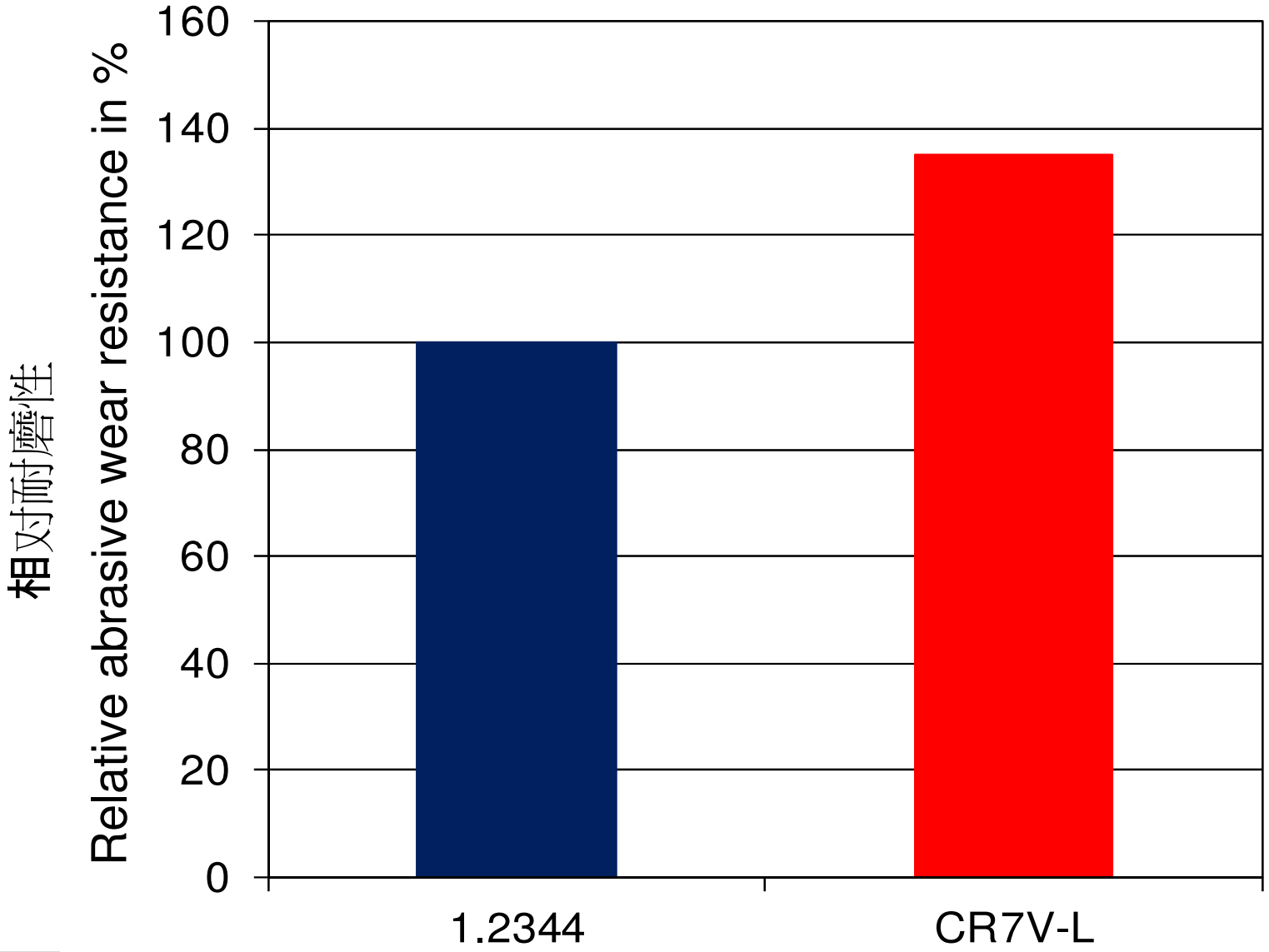
ESR工艺:

- 钢材更纯净
- **从宏**观和微观上改善钢的均匀性
- 显著提高韧性
- **允**许更高的硬度值和耐磨性。

Recommended Tool Steels – Tempering Behaviour
推荐的工具钢 - 回火表现



Recommended Tool Steels – Abrasve Wear Resistance
推荐的工具钢 - 耐磨性



Recommended Tool Steels – Thermal Conductivity
推荐的工具钢 - 导热系数

Thermal Conductivity in W/(m*K)
热传导系数

Steel grade 钢种	Test temperature in °C / 测试温度		
	20 ° C	200 ° C	400 ° C
1.2344 (H 13)	25,5	27,1	21,7
CR7V-L	26,7	29,8	30,8

Recommended Tool Steel CR7V-L
推荐工具钢CR7V-L

The special steel CR7V-L provides all necessary material properties for a successful application in the hot-stamping technology:

- High abrasive wear resistance,
- High hardness,
- Excellent tempering resistance,
- Thermal conductivity exceeding the standardized hot-work tool steel 1.2344 (H 13).

CR7V-L is available as an Electro-Slag-Remelted steel for highest toughness requirements. CR7V-L has been approved and used worldwide by all leading hot-stamping companies.

特殊钢CR7V-L为热冲压技术的成功应用提供了所有必要的材料特性:

- 高耐磨性,
- 高硬度,
- 优异的抗回火性能,
- 导热系数超过标准热作工具钢1.2344（H 13）。

CR7V-L提供电渣重熔版本，以满足更高的韧性要求.
CR7V-L已获得所有领先的热冲压公司的认可和使用。

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Tailored Tempering Process
定制回火工艺

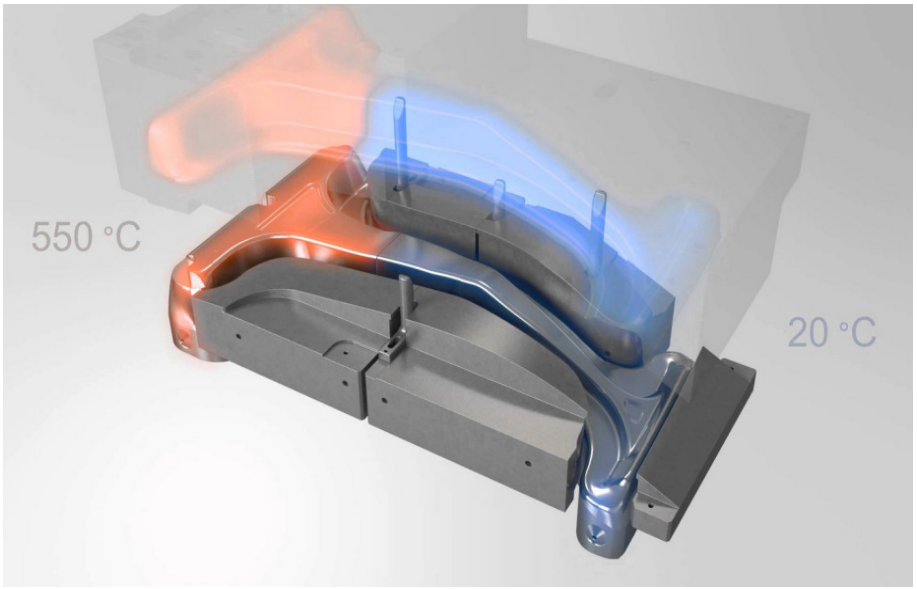


Heated segment for slow cooling
- High toughness

加热部分，冷却慢，韧性高

Cooled segments for rapid cooling
- High strength

快速冷却部分，强度高



ThyssenKrupp

different component properties by different cooling rates

不同冷却速率使得同一零件的不同部分具有不同的机械性能

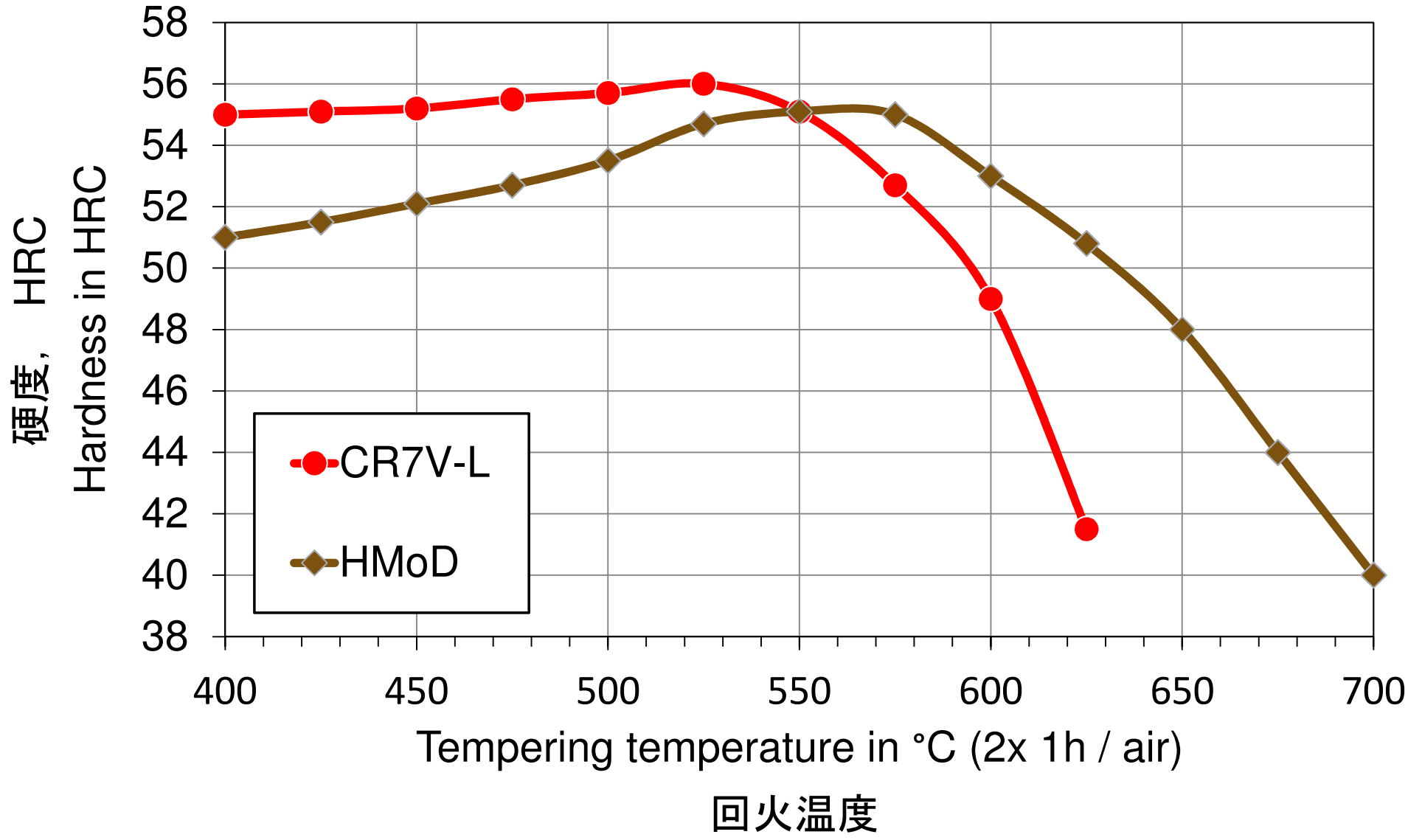
Tailored Tempering Process – Recommended Tool Steel
定制的回火工艺 - 推荐的工具钢

Steel	Alloy content in mass-% 合金成分							Recommended hardness in HRC
牌号	C	Si	Mn	Cr	Mo	V	Co	推荐硬度
HMoD	0,45	0,30	0,40	4,50	3,00	2,00	4,50	50 - 52

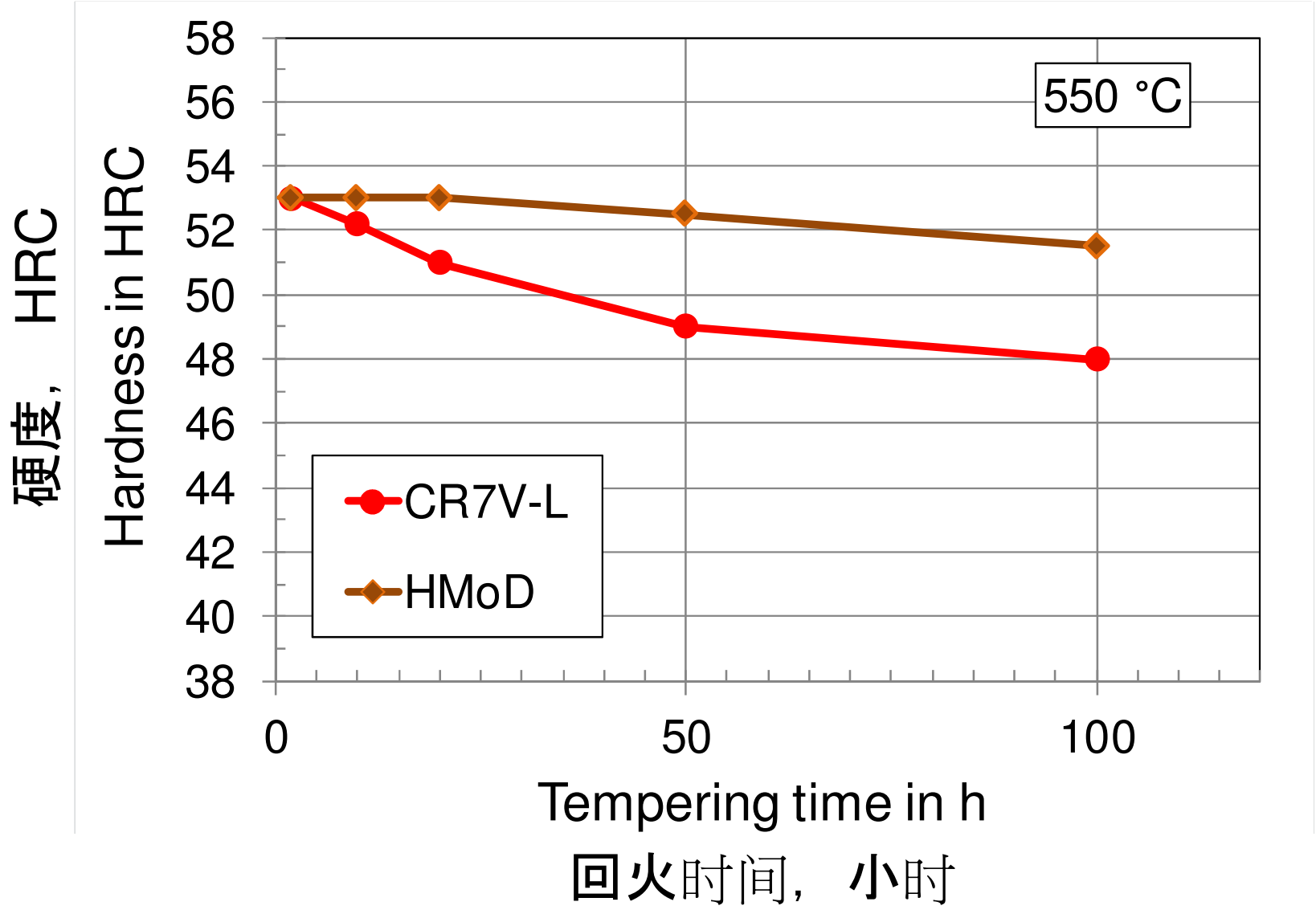
For best homogeneity, cleanliness, and toughness HMoD is exclusively produced by Electro-Slag-Remelting (ESR).
The high concentrations of Molybdenum and Cobalt provide highest high-temperature strength and tempering / long-time tempering resistance.

为了获得最佳的均匀性，清洁度和韧性，HMoD采用电渣重熔工艺（ESR）生产。
高浓度的钼和钴提供最高的高温强度和回火/抗长时间回火性能。
HMoD使用钼钴合金而不是钨钴合金来保持其长时间的抗回火能力，从而比含钨的同类钢材具有更好的韧性。

Special Steel Grade HMoD - Tempering Behaviour
特殊钢种HMOD - 回火表现



Special Steel Grade HMoD - Long Time Tempering Behaviour
特殊钢种HMOD - 长时间的回火表现

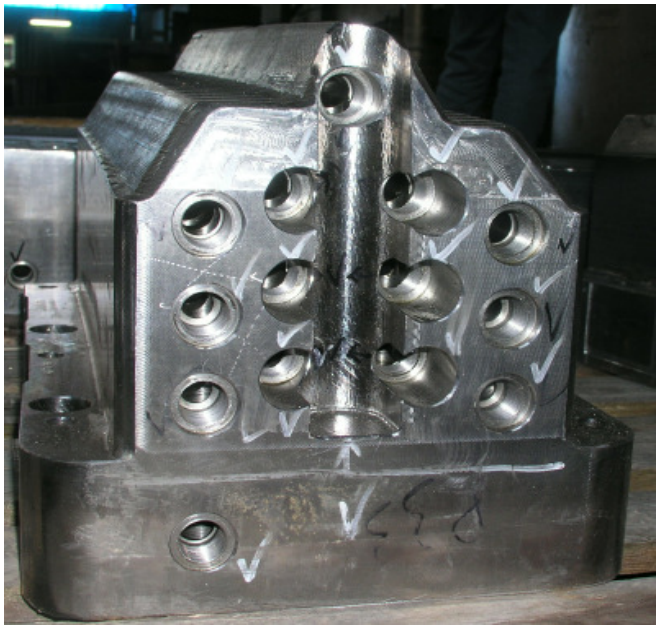


Content
目 录

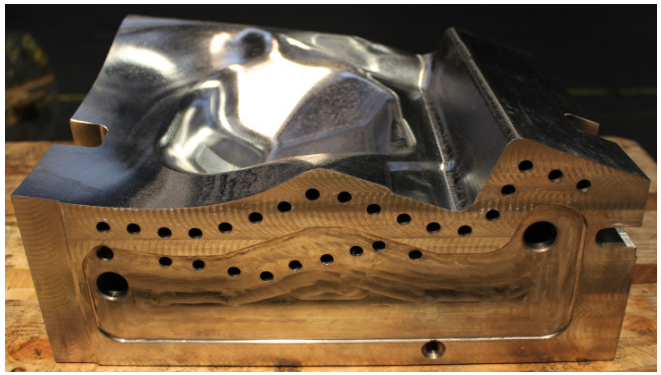
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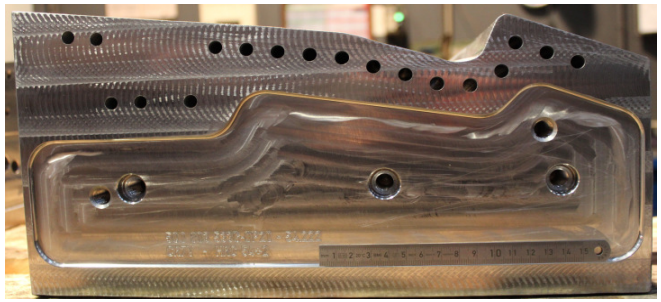
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Development of Size, Shape, And Cooling of Hot-Stamping Tools
热冲压模具的尺寸，形状和冷却的发展









2007

2017

Modifications within 10 years:

- Tool sizes increased
- Shapes modified from simple to complex,
- Number of cooling channels increased,
- Distance between cooling channel and working surface reduced to few millimeters.

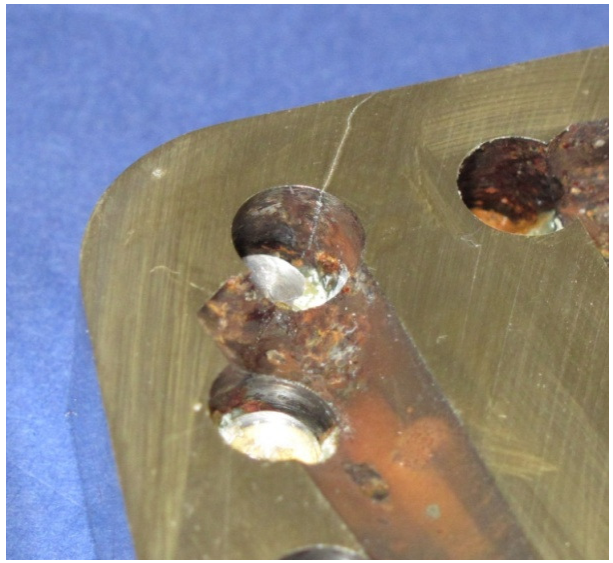
10年间的模具变化：

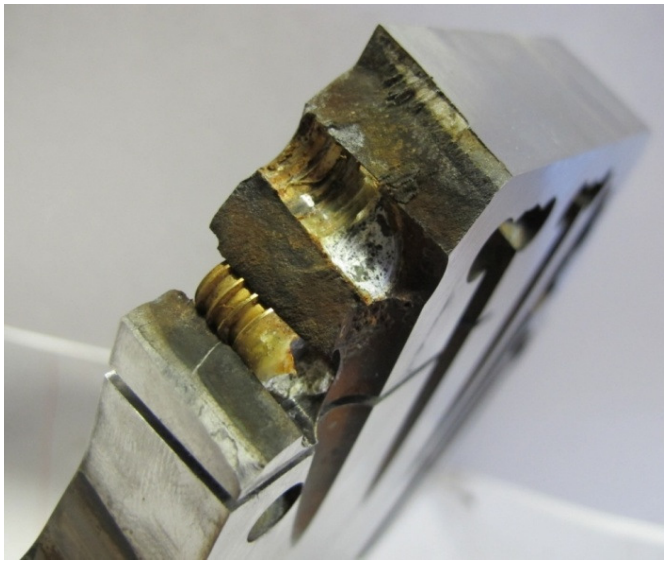
- **模具尺寸增加**
- **形状从**简单变到更复杂
- **冷却水道数量增加,**
- **冷却水道和工作表面之**间的距离减小到几毫米.

Corrosion Induced Crack from a Cooling Channel
冷却水道腐蚀引起的裂纹





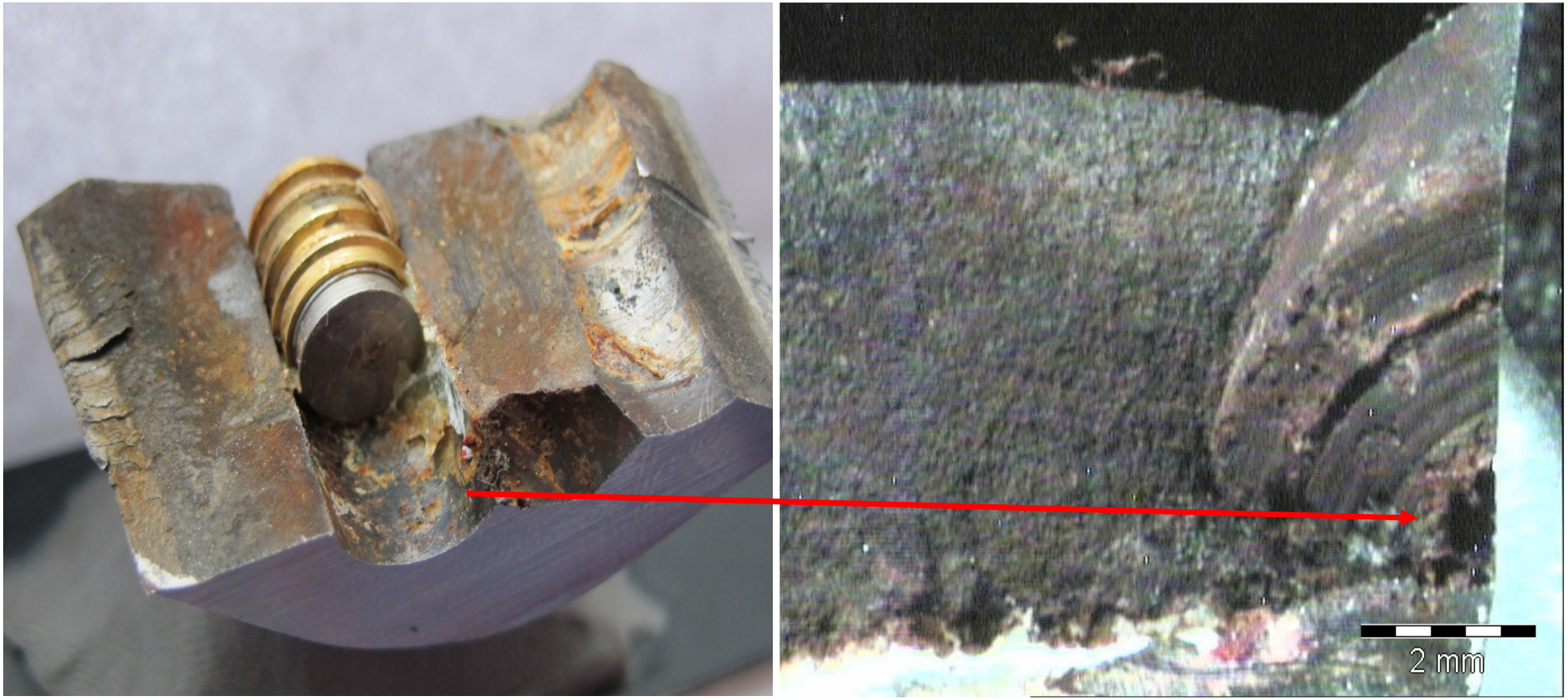




Corrosion induced crack from a cooling channel to working surface of a hot-stamping tool.

从冷却水道到热冲压模具的工作表面的腐蚀引起的裂缝

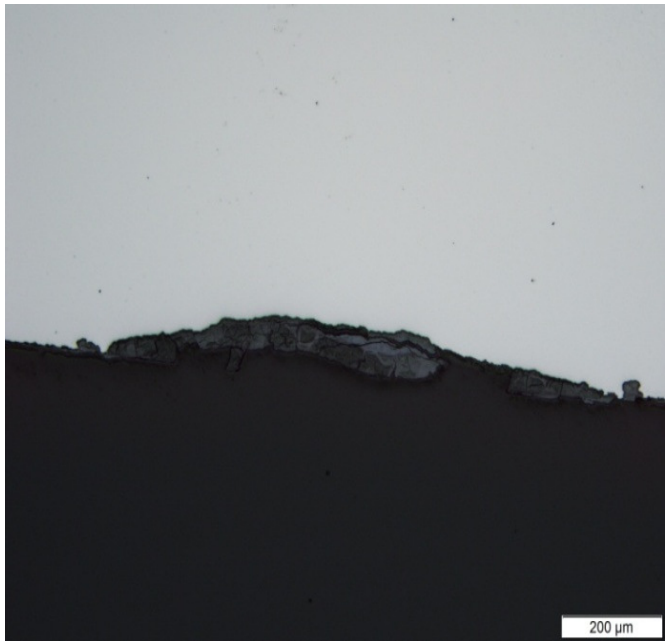
Water Leakage from a Cooling Channel
冷却水道漏水



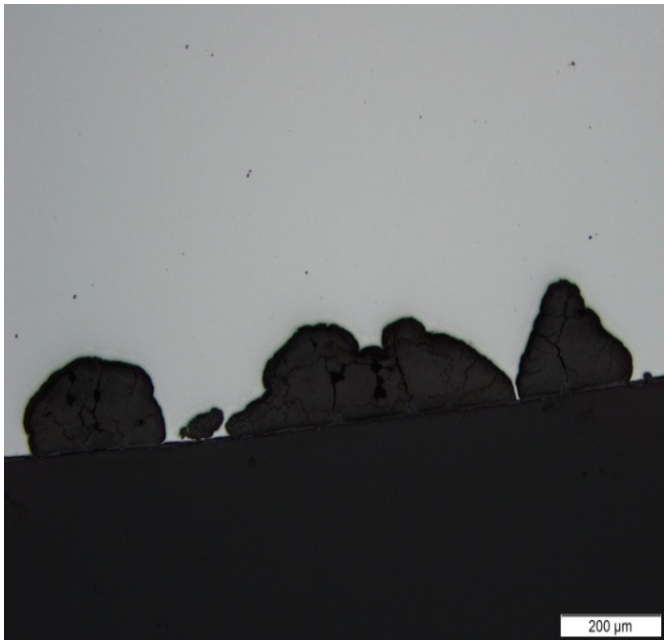
Corrosion crack as starting point of a dynamically growing crack

腐蚀裂纹成为动态扩展裂纹的起点

Types of Corrosion in Cooling Channels in Hot-Stamping Tools
热冲压模具冷却水道中的腐蚀类型



General corrosion
一般腐蚀



Pitting corrosion
点腐蚀

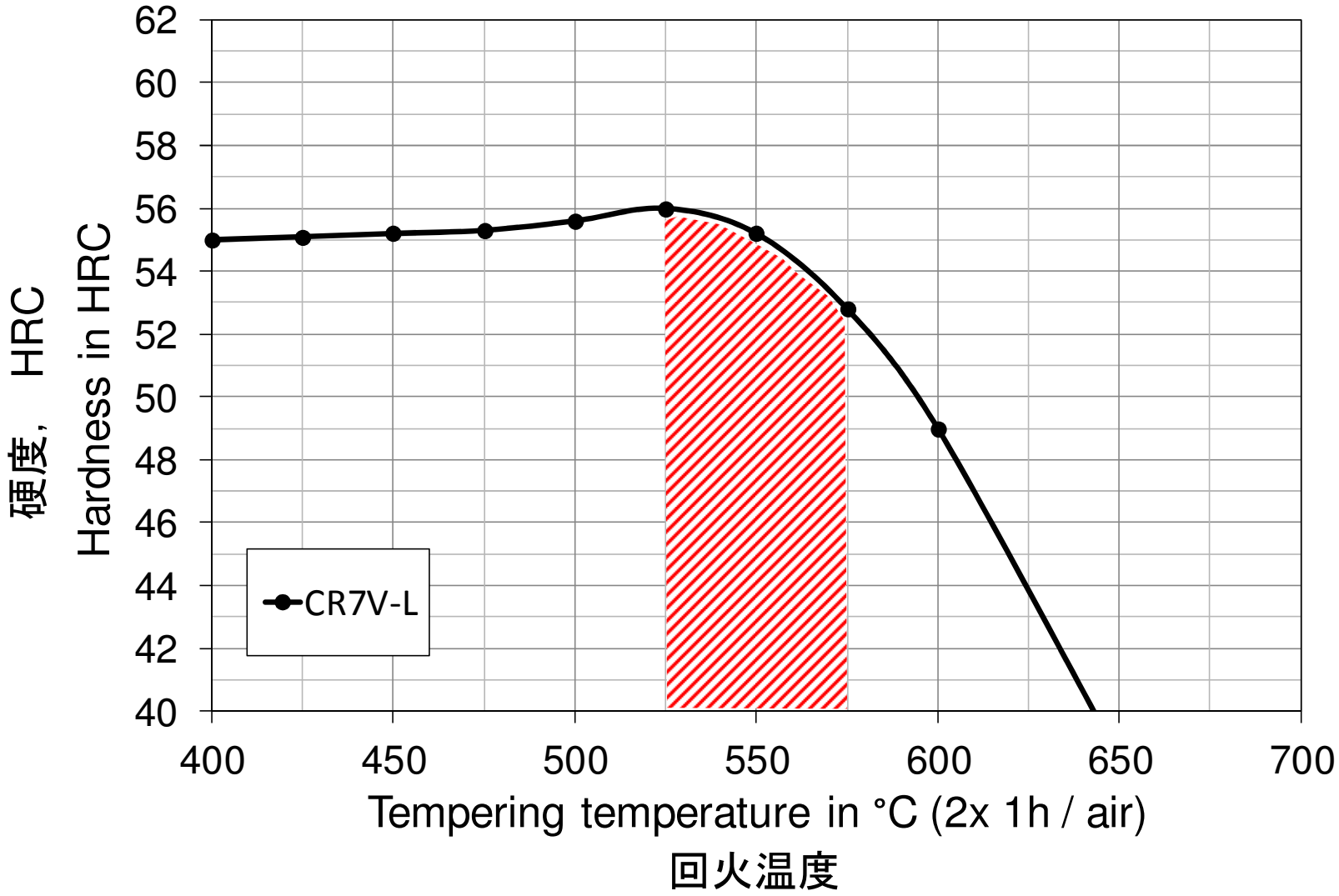


Corrosion induced crack
腐蚀引起的裂纹

Mainly two factors are responsible for corrosion induced cracks:
- Poor water quality, especially high chlorine concentrations,
- High hardness of the tools

主要有两个因素导致腐蚀引起的裂纹：
水质较差，特别是水中含有高浓度的氯，
模具硬度过高

Critical Hardness Range of Hot-Stamping Tools Concerning Corrosion
有关腐蚀的热冲压模具的临界硬度范围



In order to avoid severe corrosion induced defects use hardness ranges below the critical range.

为了避免严重的腐蚀引起的缺陷，使用低于临界范围的材料硬度。

Precautions To Avoid Corrosion of Hot-Stamping Tools
防止热冲压模具腐蚀的注意事项

- Use closed cooling water circuits.
- Check cooling water regularly. High concentrations of chlorine favour the formation of corrosion pits.
- Consider the addition of corrosion inhibitors to cooling water.
- Only best and sharp drill tools should be used during tool making.
- Use of Electro-Slag-Remelted (ESR) is highly recommended.
- Avoid hardness within secondary hardness maximum of the tool steel.

- **使用封**闭的冷却水回路
- **定期**检查冷却水，**高**浓度的氯会加速形**成腐**蚀坑
- **考**虑在冷却水中添加腐蚀抑制剂。
- **加工冷却水道**时最好使用锋利的钻头。
- 强烈建议使用电渣重熔（ESR）钢材
- **避**开工具钢的二次硬化峰值硬度。

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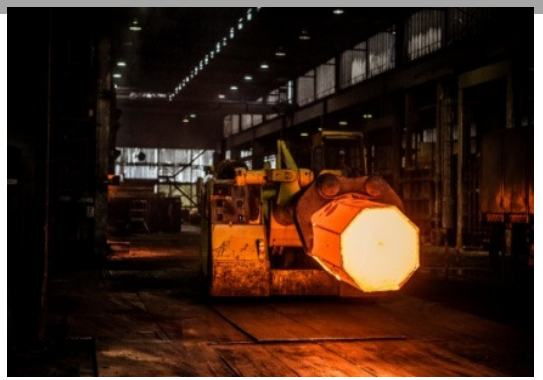
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结论

- Efficient hot-stamping production requires highly developed tool steel solutions.
- Kind & Co.‘s special steel grade CR7V-L successfully balances the required mechanical properties.
  CR7V-L has proved its superior suitability worldwide not only for hot-stamping of steel sheet components, but also aluminium and nickel-base alloys.
- Corrosion and corrosion induced cracks are among the most frequently observed failure reasons, Kind & Co. recommends to balance the tool steels properties towards sufficient toughness and protection against corrosion.

- **高效的**热冲压生产需要高度发达的工具钢解决方案。
- Kind＆Co**的特殊**钢种CR7V-L**成功地平衡了所需的机械性能。** CR7V-L**在全球范**围**内**证明了其卓越的适用性，**不**仅适用于钢板部件的热冲压，还适用于铝和镍基**合金**。
- **腐**蚀和腐蚀引起的裂纹是最常见的失效**原因之一**，Kind＆Co**建**议选择具有平衡**性能的模具**钢，**使其具有同**时具有足够**的**韧性和防腐蚀性。

Thank You for Attention!
谢谢关注！



Kind Special Alloys (Beijing) Trading Ltd.

凯德特钢（北京）贸易有限公司

David Wang 王旭军

MP: 13911 808 202

David.Wang@Kind-special-alloys.hk

Web: www.kind-special-alloys.hk









