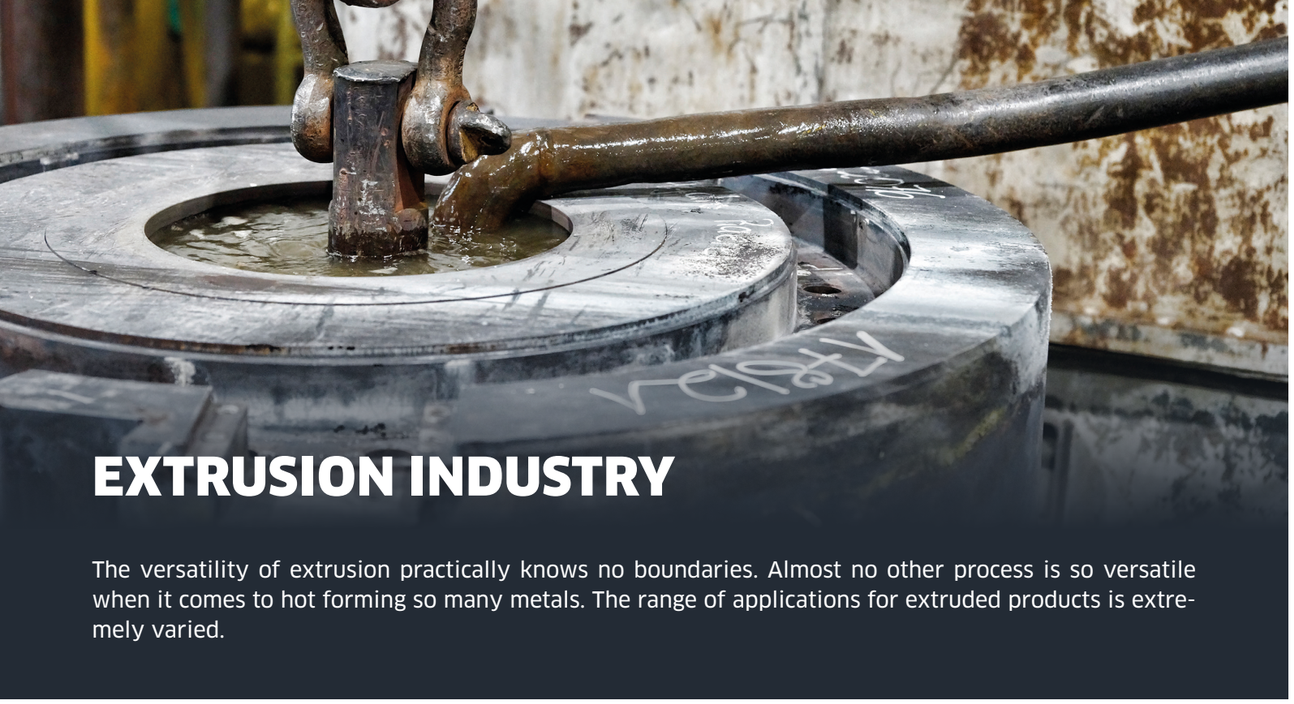
EXTRUSION INDUSTRY

High quality tool steel, premium service and engineering

Edelstahlwerk Kind & Co.
GMH GRUPPE



EXTRUSION INDUSTRY

The versatility of extrusion practically knows no boundaries. Almost no other process is so versatile when it comes to hot forming so many metals. The range of applications for extruded products is extremely varied.

For example, aluminium alloys that are relatively simple to extrude are used in aircraft, automotive and railway industry. New applications such as e-mobility and the continued need for lightweight automotive construction demands new material concepts to satisfy such requirements.

We offer new solutions for these applications with our current, in-house developments such as TQ1, Q10, HP1 or HTR. Since 2016 we have introduced our premium hotwork tool steel CS1 for the extrusion industry.

Technical advice
Our team of specialist application engineers provides service in selecting of correct tool steel. The objective is to specify the correct tool steel along with the ideal features for your specific application together with you.

Service
We also use FEM-Analysis to optimize tool design with the objective of continuously improving performance and life time across the entire process. We provide recommendations for you based on the results of our investigations on damaged or worn out tools.
We provide innovated tool steel solutions for the extrusion industry with the aid of our relining centre, the database system, the database which has existed for more than 20 years.

Kind & Co.

Since 1888 we have been producing high-quality tool steel exclusively at our site in Bielstein. We stand for sophisticated material solutions, highest quality, reliable service and competent advice - tailored to the respective application. We have particularly strong application expertise in the areas of die casting, extrusion and die forging.

Premium material solutions
Kind&Co. provides state-of-the-art materials solutions, technical services and ready to use tools for the following applications:

- E-mobility
- Lightweight automotive construction
- Construction industry
- Aircraft construction
- Railway industry

OUR PRODUCTS

Globally-recognized quality for every extrusion application

In extrusion, we are the market leader as a complete supplier of ready-to-use tooling.

	Individual forged (liner, 3d)	Pre-machined	Finished products (drawing)	Heat treatment	Relining service, repairs
Mantle	■	■	■	■	■
Intermediate liner	■	■	■	■	■
Inner liner	■	■	■	■	■
Stem	■	■	■	■	■
Mandrel	■	■	■	■	■
Die		■	■	■	
Bolster	■	■	■	■	
Die holder	■	■	■	■	
Dummy block, cleaning disc		■	■	■	

Technical advice and service
Our experienced team of engineers, application experts and production specialists offers you the following services:

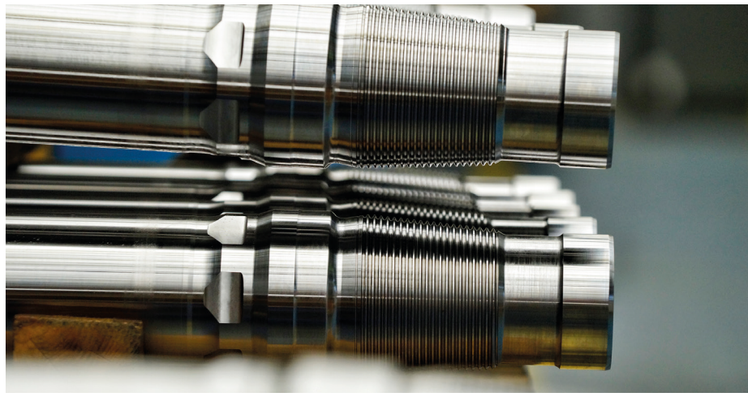
1. Construction / design
• FEM-Analysis and process simulations
• Changing the billet lengths and diameters on the containers

2. Material selection
• Technical advice
• Application-specific premium steels

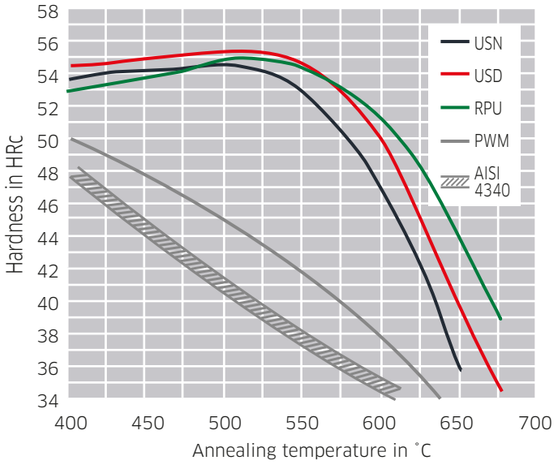
3. Inspection
• Hardness test
• Crack test
• Dimensions test
• Ultrasonic test
• Magnetic powder test
• Analysis

4. Service
• Repair work / welding
• Welding sealing surfaces
• Honing

5. Damage analysis
• Usage evaluation
• Comprehensive damage diagnostics

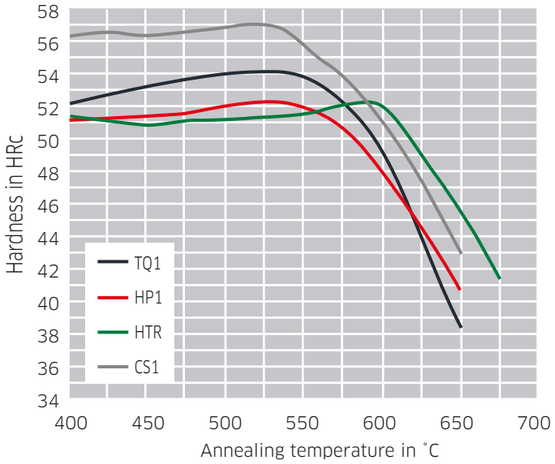


USN, USD, RPU, PWM, AISI 4340



- The classic USN and USD hot-work steels are characterised by high-temperature strength and excellent toughness.
- Hot-work tool steel RPU is recommended if there are more
- stringent requirements regarding high-temperature strength and temper resistance.
- Due to higher process related requirements, the lower-all-oyed tool steels PWM and AISI 4340 are not recommended for this application.

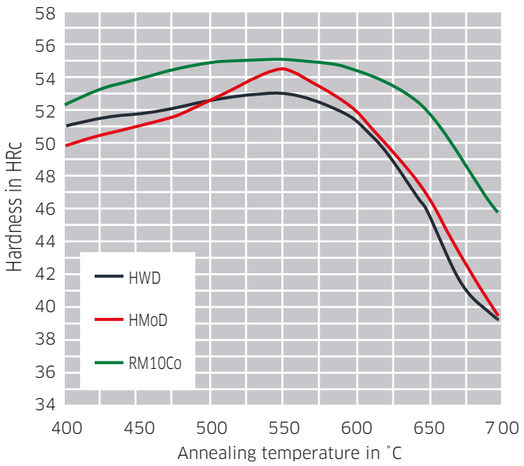
USN, USD, RPU, PWM, AISI 4340



The premium tool steels from our own development are based on the principle of greatest cleanliness.

- TQ1 and HP1 are characterised by the combination of high temperature strength combined with high toughness.
- HTR was developed for requirements that demand extremely great high-temperature strength and/or thermal conductivity.
- For more demanding special applications in the 55-57 HRc hardness range, we've developed the new CS1 highperformance steel.

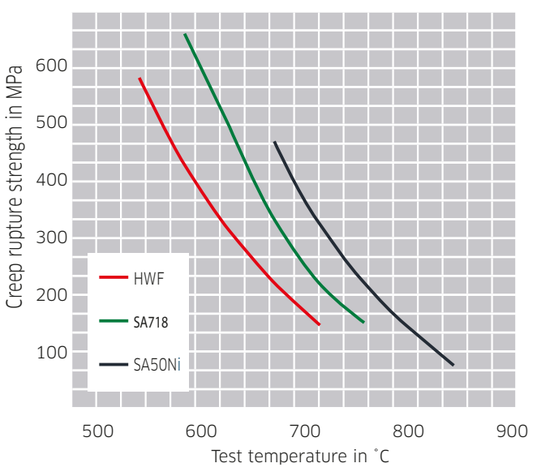
HWD, HMoD, RM10Co



The premium steels from our own development are based on the principle of greatest purity.

- TQ1 and HP1 are characterised by the combination of high temperature strength combined with high toughness.
- HTR was developed for applications that require extremely high levels of temperature strength and thermal conductivity.
- Thanks to its superior tenacity behaviour, HMoD is preferred for water-cooled tools.

SA718, SA50Ni, HWF



- HWF is an austenitic, curable steel for inner liner, dies, or die holders that face particularly high temperatures.
- With the SA 718 for inner liner in the container during extrusion of brass, copper, and copper-nickel alloys, it is possible to achieve considerable improvements in durability.
- The material SA 50Ni has an extremely high temperature strength and is preferred in use for dies, mandrel tips, and pressure discs.

Extrusion is a hot metal forming process used to produce solid or hollow profiles, wires or tubes. The most commonly processed materials are aluminum, copper, brass, and steel or stainless steel. However, special materials such as titanium, zirconium or silver brazing alloys are also used.

Hot-work tool steels

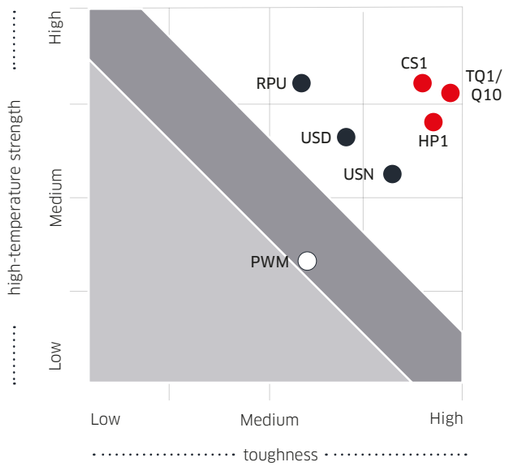
Brand name	Mat.-Nr.	AISI	Application	Toughness	High-temperature strength	Hot wear resistance
CS1*	**Premium**	-	Extrusion dies with specific compressive stress > 1000 MPa, very highly stressed stems, dummy blocks and inner liners			
HP1*	**Premium**	-	Highly stressed extrusion stems and dies with high toughness requirements			
TQ1*	**Premium**	-	Highly stressed intermediate and inner liners and stems, mandrels and extrusion dies			
Q10	**Premium**	-	Tools for extrusion with very long tool life for highly stressed inner liners and smaller stems			
HTR*	**Premium**	-	Air-cooled intermediate liners in copper/ brass alloys extrusion, extrusion dies and mandrels			
GSF	**Premium**	-	Tie rods, press columns, mandrel holders and piston rods			
HMoD**	1.2889	H19A	Extrusion dies and die holders for the processing of copper/brass alloys			
HWD	1.2678	H19	Extrusion dies and die holders for the processing of copper/brass alloys			
RM10Co**	1.2888	-	Extrusion dies, die holders and inner liners for processing copper/brass alloys			
RPCo	1.2885	H10A	Tool head for indirect stems for copper/ brass alloys			
RPU**	1.2367	-	Intermediate and inner liners for high loads, extrusion stems, mandrels, dies, dummy blocks and die holders			
USD**	1.2344	H13	Containers, intermediate and inner liners, press stems, mandrels and dies			
USN**	1.2343	H11	Highly stressed container mantles, intermediate and inner liners, mandrels and dies			

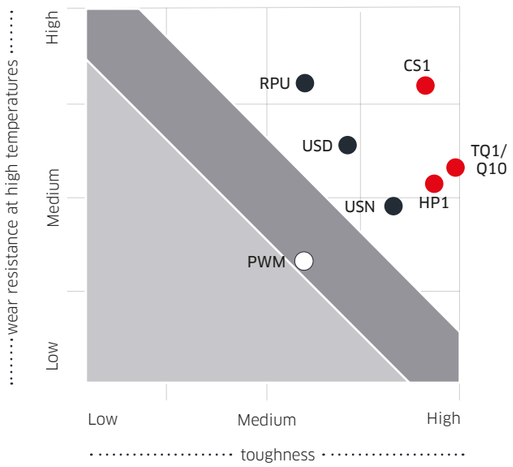
High temperature austenitic steels & Nickel-base alloys

Brand name	Mat.-Nr.	AISI	Characteristics	Application
AWS	1.2731	-	Austenitic hot-work tool steel	Extrusion dies for processing copper alloys
HWF	1.2779	A286	Austenitic precipitation hardenable steel	Thermally highly stressed inner liners for the processing of copper/brass alloys
MA-Rekord	1.2758	-	Austenitic hot-work tool steel	Extrusion dies for processing of copper/brass alloys
SA50Ni	2.4973	R41	Precipitation-hardenable nickel-base alloy with very high high-temperature strength	Dies, die holders and mandrel tips for processing of copper/brass alloys
SA718	2.4668	UNS 7718	Precipitation-hardenable nickel-base alloy with high high-temperature strength	Inner liners, dies, die holders and mandrel tips for processing of copper/brass alloys

MATERIAL RECOMMENDATIONS

for light metal extrusion





Premium High Standard Standard

- High standard: standardised alloy concept, but excellent finish at Kind&Co.
- Q10 for inner sleeves with exceptional durability, particularly with problems such as deformations on sealing surfaces
- TQ1 or HP1 are suitable for sophisticated extrusion tools and long durability (TCO reduction)
- TQ1 for thin-walled profile geometries - without nitration
- CS1 is of particular interest for frequently used tools, e.g. extrusion punches and dies

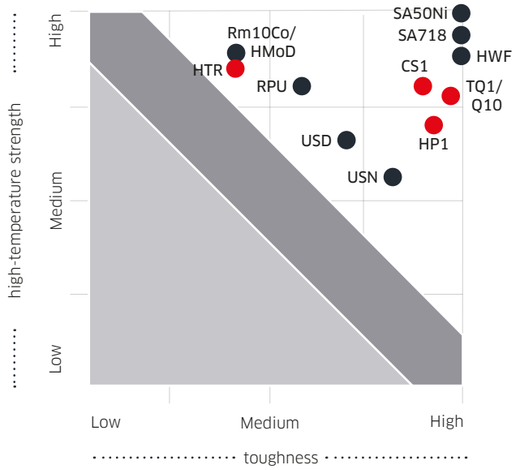
Steel grades per product group on light metal including typical hardness (HRc)

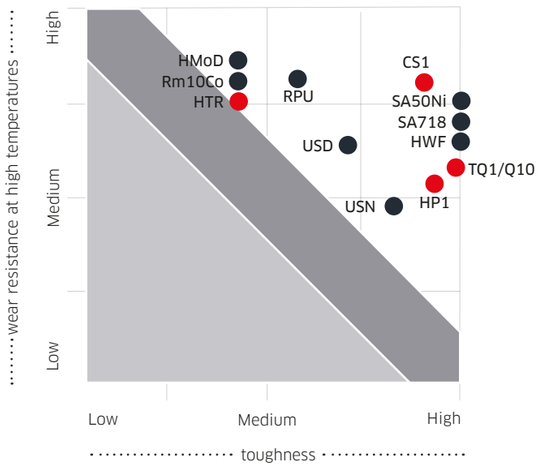
HRc	Mantle	Interme-diate liner	Inner liner	Stem	Die	Bolster	Die holder	Dummy block	Tie rod	Press column
PWM						41-45	41-45		32-38	32-38
GSF							41-45		32-36	32-36
USN*	33-38	40-44	47-50	48-50	47-50	42-45	45-47	48-50	42-45	
RPU*		40-44	47-50	48-51	47-50			47-50		
USD*	33-38	40-44	47-50	48-51	47-51		45-47	48-50		
TQ1/Q10		40-44	51-53	51-53	48-53			51-53		
HP1		40-44	47-51	50-52	47-51			47-51		
CS1			55-57	55-57	50-57			50-57		

* The alloy concept is standardised for our “High Standard” grades.

MATERIAL RECOMMENDATIONS

for heavy metal extrusion





Premium High Standard

- High Standard: standardised alloy concept, but excellent finish at Kind&Co.
- SA 718 inner liner for extrusion of Cu alloys with improved durability compared to HWF
- HTR interim sleeves with excellent temper resistance and enhanced thermal conductivity, successfully combined with SA 718 inner liner

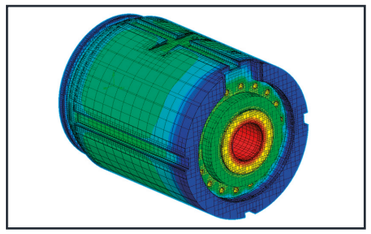
Steel grades per product group on light metal including typical hardness (HRc)

HRc	Mantle	Interme-diate liner	Inner liner	Stem	Mandrel/ Tip	Bolster	Die	Die holder	Dummy block	Cleaning discs
USN*	33-38			48-50		41-45				45-48
USD*	33-38			48-51	46-50					45-48
RPU*		39-44		48-50	46-50				46-50	45-48
TQ1/Q10				51-53						
CS1				55-57					50-57	
RPCo							45-48	45-48		
RM10Co		44-46	48-50	48-50	45-50		48-50	45-48	48-50	
HWD					45-48		45-48			
HMOD					45-48		45-48			
HTR		39-44					45-48			
AWS							29-34	29-34		
HWF			31-39				31-39	31-39	31-39	
SA718			40-44		40-44			40-44	40-44	
SA50Ni					38-41		38-41			

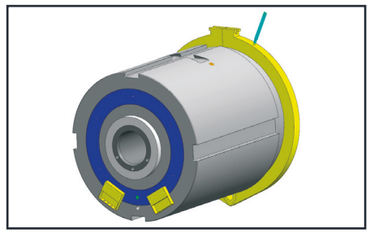
TECHNICAL ADVICE AND SERVICE

We can stimulate various material features, as well as simulate thermal and mechanical loads. This method identifies critical areas on tools, with the potential of optimization in design and material selection. Experience from many relining orders supported by FEM-simulations lead to optimised tool solutions.

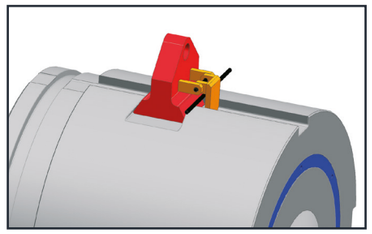
Examples of several design improvements with the aid of FEM-simulations and empirical development steps



FEM-analysis of mechanical pressure



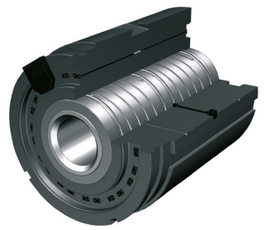
KCPC – **K**ind&Co. **P**ower **C**onnector



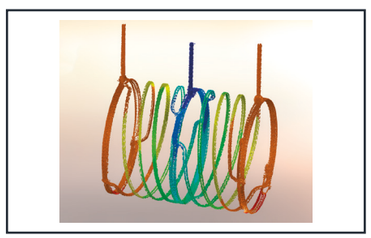
Optimised container lifting device

A modern container consists of

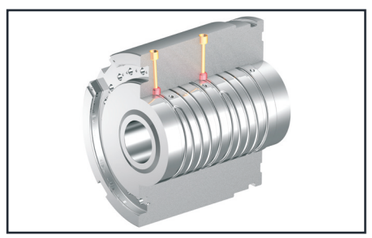
- Multi-part design
- 1 to 8-zone heating system
- 1 to 4-zone air system
- AP-system (Air Protection system)
- KCPC (Kind&Co. Power Connector)
- Individual shrinkage technology



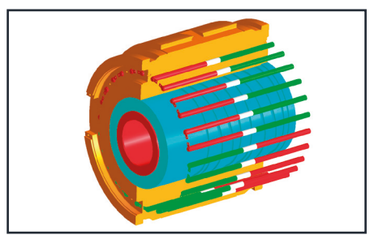
Examples for optimising temperature management in container



FEM-simulation of temperature distribution in containers



AP-System, Air Protection system



Optimised resistance heating system with various heating zones

Example of a modern AP-System (AirProtection)

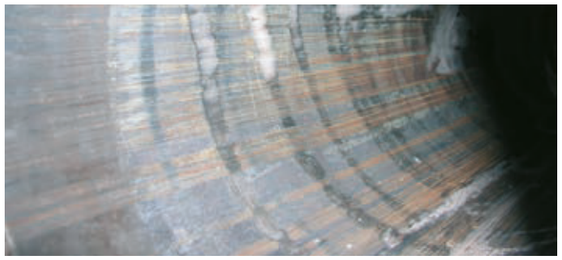
- Multi-part design
- 1 to 8-zone heating system
- 1 to 4-zone air system
- AP-system (Air Protection system)
- KCPC (Kind&Co. Power Connector)
- Individual shrinkage technology

Necessary information for the FEM-simulation

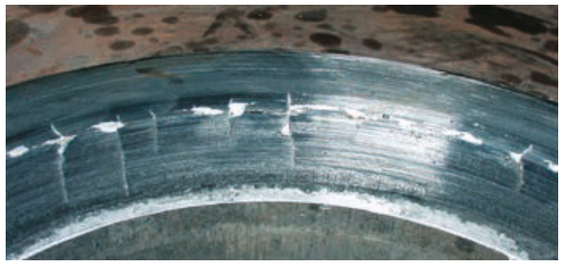
	Container	Stem	Die holder	Mandrel
Pressing force [MN]	■	■	■	■
Specific load [MPa]	■	■	■	■
Temperature of billets [°C]	■	■	■	■
Extrusion cycle time [round billets/h]	■			■
Extrusion time [sec.]	■			■
Temperature of container [°C]	■			■
Ambient Temperature [°C]	■	■	■	

TYPICAL WEAR

on containers on light metal extrusion and possible solutions



Abrasion or damage to the inner liner bore:
Repair by readjustment of the motion axis of extrusion stem/pressure disc and container; setting and gap dimension of dummy block



Deformation and cracks on sealing surfaces:
Checking installation position of dies and die holder; use of premium material Q10 with higher hardness and the same level of ductility

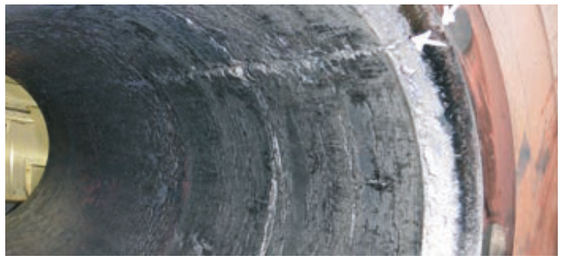
Air inclusions between billets and inner liner:
Dimension and hardness testing of liner, intermediate liner in the container and dummy block: Check burp cycle on the press; Switch to Q10 inner liner

“The 10 golden rules” from Kind&Co. for container design

1. Start extrusion from a container if the temperature > 380°C.
2. Homogeneous temperature distribution in the longitudinal direction (aluminium +-25°C).
3. Multi-part design of the container if Pspez > 600 MPa.
4. Positive shoulder to inner liners from austenitic steel HWF and to inner liners from SA718 nickel-based alloy.
5. Negative shoulder with martensitic steels (USN, USD, Q10, RPU).
6. Projection on the inner liner on the die side for the sealing face (conical/flat) of at least 10 mm.
7. Heating elements in the centre of the container mantle minimum distance of 80 mm.
8. Power connector for heating system on stem side (KCPC).
9. Container is as large as possible d > 2; container starts with inner liner > 50 mm wall thickness.
10. Air cooling on the intermediate liner due to product and customer requirements or to reduce temper effects and plastic deformation on the container.

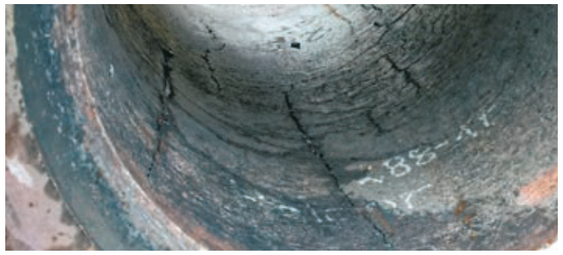
TYPICAL WEAR

on containers on heavy metal extrusion and possible solutions



- Thermal shock cracks in inner liner bores:
  Reduction of cracks by using SA718 inner liners.
- Deformation of conical sealing face:
  Check cleaning intervals in press operations;
  Use of SA718 inner liners.
- Abrasion of inner liner bore during the extrusion process:
  Use of SA718 inner liners with > 300 MPa higher strength compared to a standard HWF inner liner.

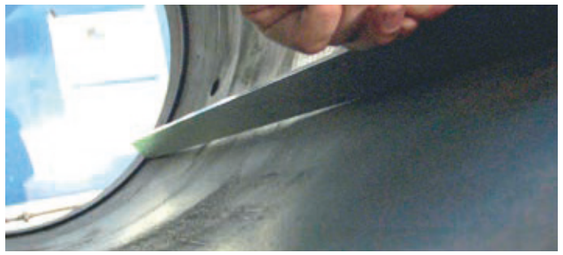
Comparison of lifetime for HWF- and SA718-inner liners during extrusion



HWF (1000 – 1150 MPa) after 30,000 Cu billets, coarse network of cracks with eruptions

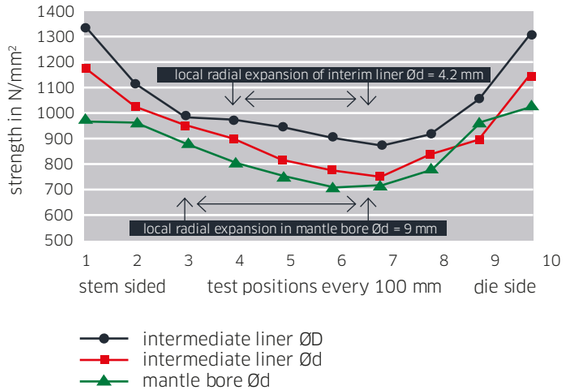
SA718 (1250 – 1400 MPa) after 150,000 Cu billets, fine network of cracks

Temper effect and its plastic deformation across the container length



Changeover of containers to air cooling; use of high temperature strength materials and HTR intermediate liners in combination with SA718 inner liners

Temper effect and its plastic deformation across the container length



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