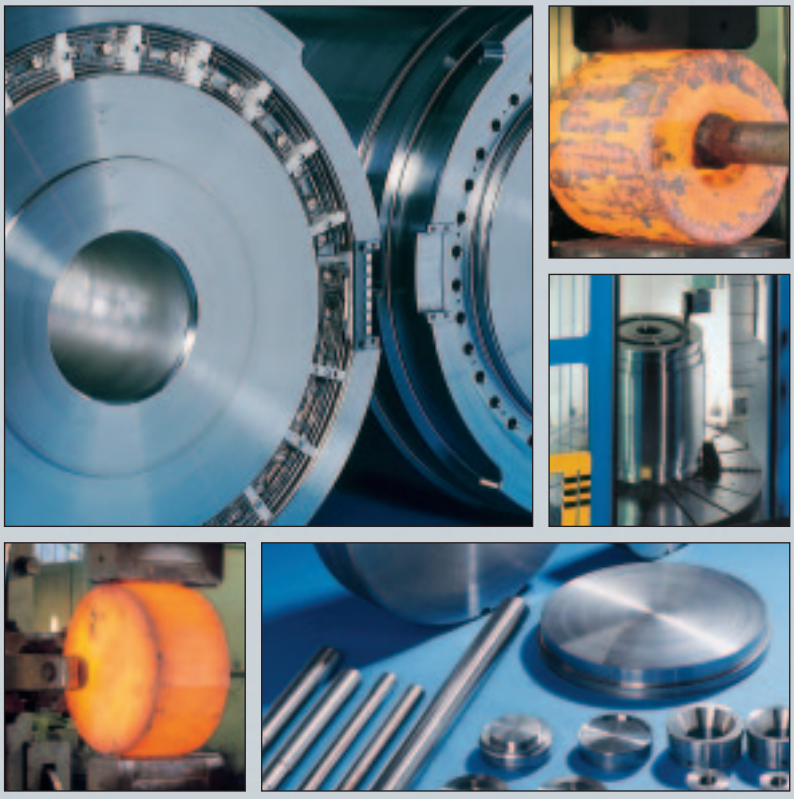


TOOLINGS FOR EXTRUSION PRESSES

KIND&CO
EDELSTAHLWERK

For more than 100 years tool steels and their applications have shaped our company. Experience and the most advanced technological equipment from primary steel melting to the ready-to-use toolings is the basis of the products of KIND & CO which are well excepted all over the world.

SERVICE FROM ONE SINGLE SOURCE

Todays economic importance of the extrusion technology was furthered not only by technical developments on the equipment side but also by constant development on the tooling side. To us, the growing requirements of our customers provide the impetus for our work.

The purpose of this documentation is to serve as a brief guide and to give a summary of recent developments of toolings for extrusions presses.

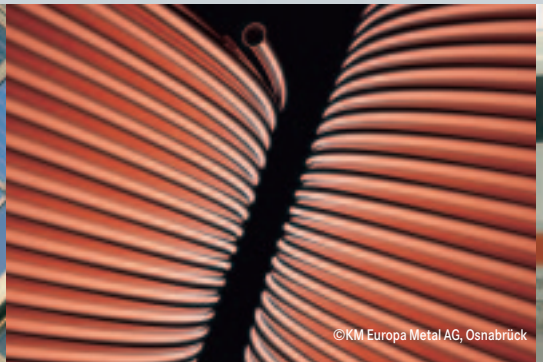
INDIRECT AND DIRECT EXTRUSION

Indirect extrusion

Indirect extrusion has meanwhile found acceptance for producing wire, rods, and sections from brass. Also for extruding high-alloyed aluminium indirect extrusion is often the preferred solution. Compared with direct extrusion, the special material flow of indirect extrusion facilitates higher extrusion rates. No friction between billet and inner liner and therefore no friction heat can occur, results in homogeneous material properties along the entire length of the extruded strand.

Direct extrusion

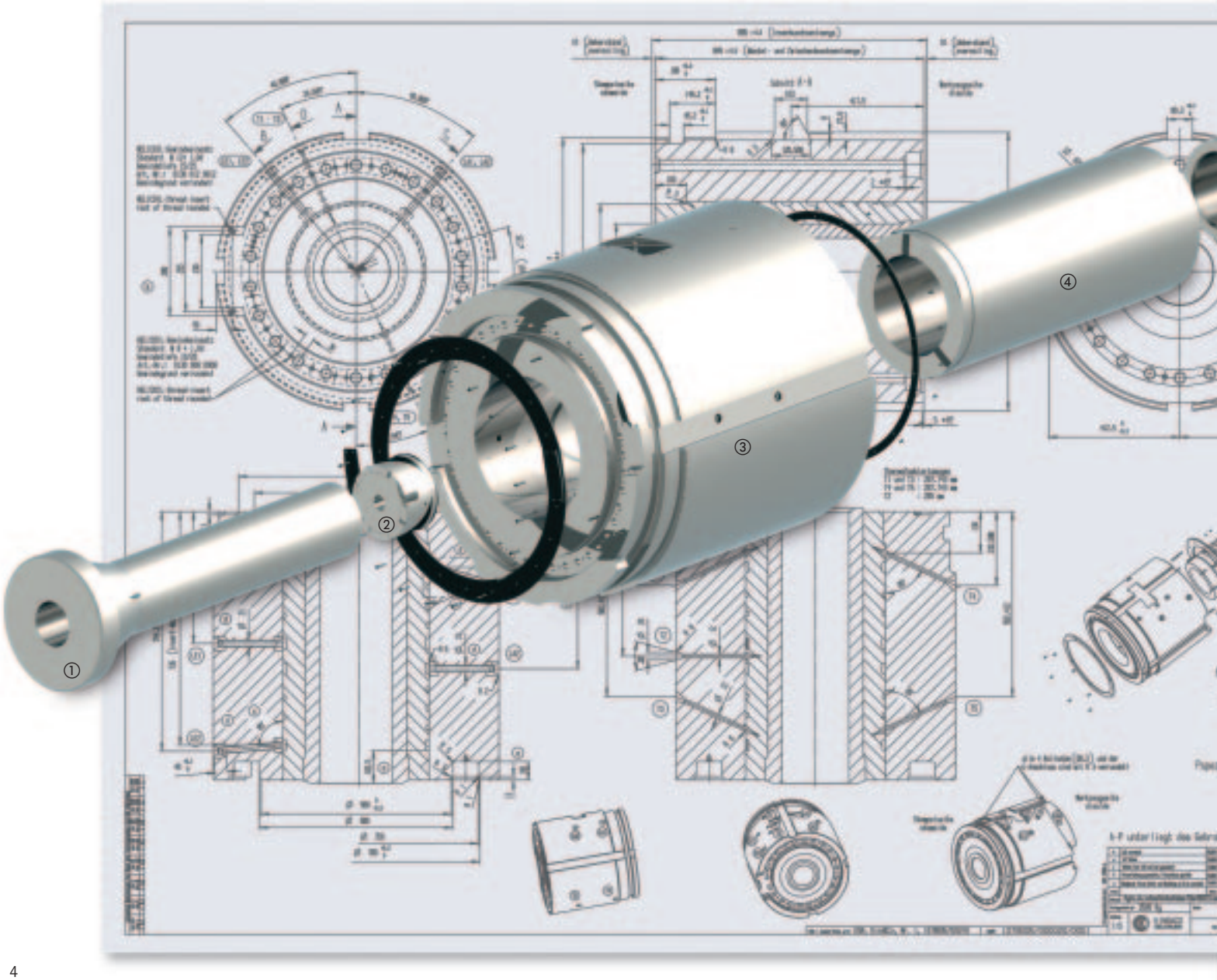
Preferred application for manufacturing copper products using the underwater extrusion method to achieve low-oxide surfaces. Large section circumferences and asymmetrical hollow shapes can be easily direct extrude for the aluminium industry.

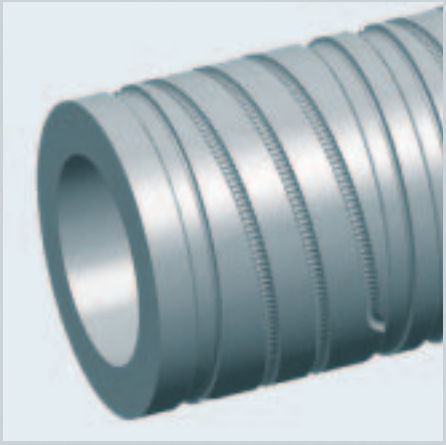


FROM DESIGN TO PROJECT INTEGRATION

Based on a set of requirements defined by the plant operator or manufacturer, we conceive ultra modern tool packages such as containers, stems, mandrels and dummy blocks.

The new designs are not only based on theoretical considerations but, due to years of maintenance and repair of containers, also on hands-on experience. Together with our customers' production expertise, a high-performance and modern 3D-CAD design is achieved. That‘s why Kind + Co. is also a reliable partner for the total modernisation of tooling systems.





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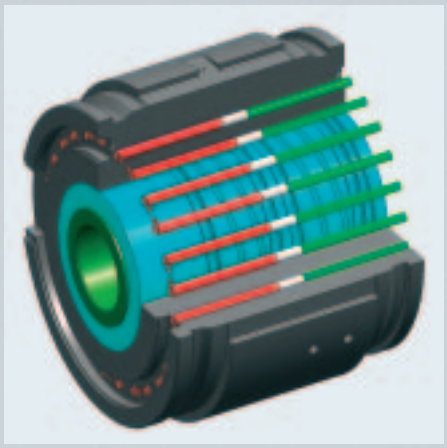

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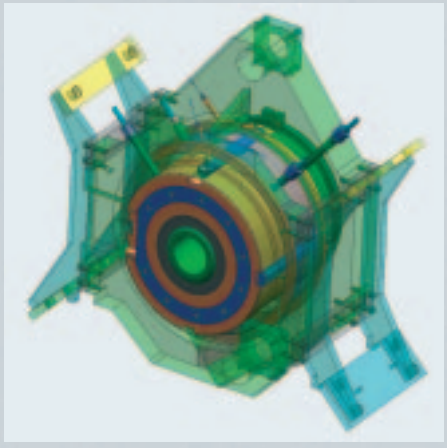

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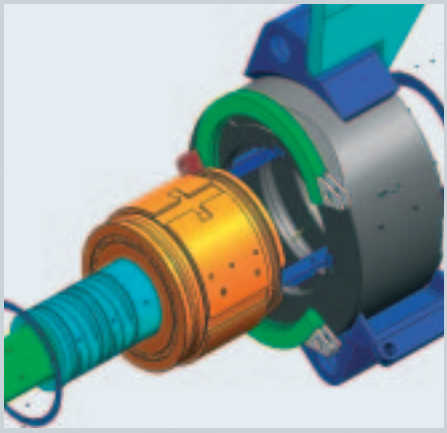

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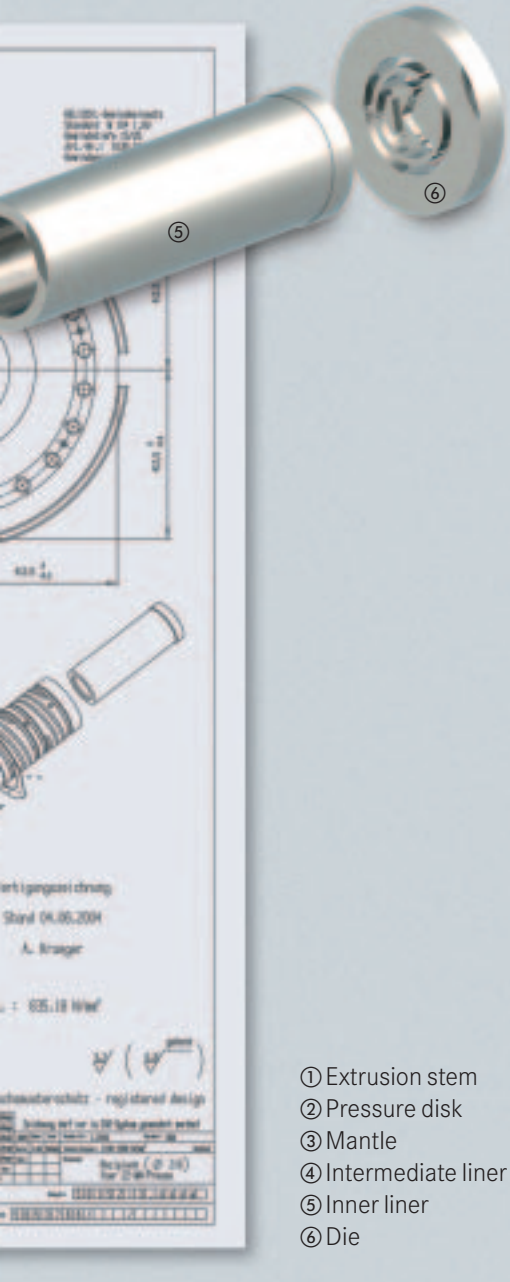


1 Special surface topography (WT cooling*) for highly efficient cooling of air-cooled intermediate liners.

2 Air protection (AP system**) to prevent cracks on air-cooled containers.

3 Modern 3D-CAD design of a container with integral zone heating/cooling system.

4/5 Development and modernization of customized holders and containers.

* Registered design no. 201 17 589.4 (Germany)
** Registered design no. 203 18 917.5 (Germany)
** Registered design no. GM 874 2003 (Austria)

① Extrusion stem
② Pressure disk
③ Mantle
④ Intermediate liner
⑤ Inner liner
⑥ Die

MATERIALS: ANALYSIS & PROPERTIES

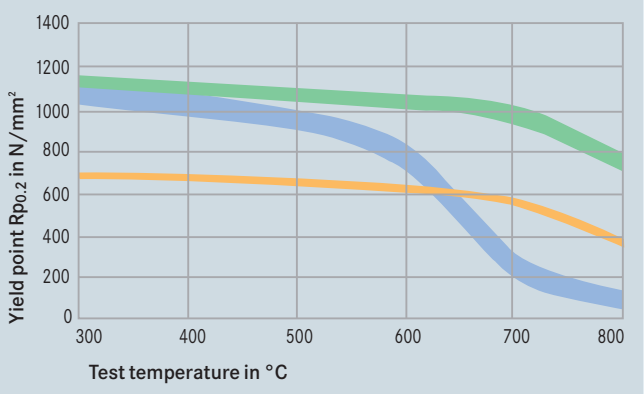
Overview of the most important materials for extrusion toolings

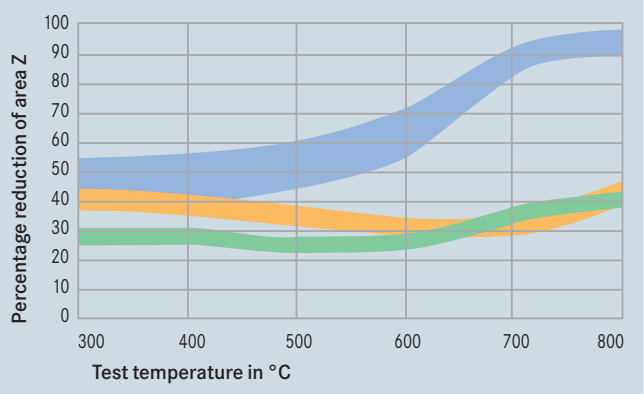
Dominial	Grade	DIN Standard	AISI	AFNOR	Reference analysis %							
					C	Cr	Mo	Ni	V	W	Co	Other
KTW	1.2311	40CrMnMo7	~P 20	40CMD8	0,42	2,00	0,20	–	–	–	–	Mn 1,50
CM 167	1.2323	48CrMoV6-7	–	45CDV6	0,45	1,50	0,75	–	0,30	–	–	
USN	1.2343	X37CrMoV5-1	H 11	Z38CDV5	0,38	5,20	1,30	–	0,40	–	–	
USD	1.2344	X40CrMoV5-1	H 13	Z40CDV5	0,40	5,20	1,30	–	1,00	–	–	
RP	1.2365	32CrMoV12-28	H 10	32DCV12-28	0,32	3,00	2,80	–	0,60	–	–	
RPU	1.2367	X38CrMoV5-3	–	Z38VDV5-3	0,38	5,00	2,80	–	0,60	–	–	
Q10/TQ1*	–	–	–	–	0,36	5,20	1,90	–	0,55	–	–	
HWD**	1.2678	X45CoCrWV5-5-5	H 19	Z40KCWV05-05-05	0,40	4,50	0,50	–	2,10	4,50	4,50	
PWM	1.2714	55NiCrMoV7	~L 6	~55NCDV7	0,55	1,10	0,45	1,70	0,10	–	–	
AWS**	1.2731	X50NiCrWV13-13	–	–	0,50	13,00	–	13,00	0,60	2,40	–	
MA-Rekord**	1.2758	X50WNiCrVCo12-12	–	–	0,55	4,00	0,60	11,50	1,10	12,00	1,50	
RPCo**	1.2885	X32CrMoCoV3-3-3	H 10A	–	0,32	3,00	2,80	–	0,60	–	3,00	
RM 10 Co**	1.2888	X20CoCrWMo10-9	–	–	0,20	9,50	2,00	–	–	5,50	10,00	
HMoD**	1.2889	X45CoCrMoV5-5-3	H 19A	–	0,45	4,50	3,00	–	2,00	–	4,50	
HWF**	1.2779	X6NiCrTi26-15	A286	Z6NCTDV25 15B	< 0,08	15,00	1,50	26,00	–	–	–	Ti 2,40
SA 718**	2.4668	NiCr19Fe19Nb5Mo3	UNS No 7718	NC19FeNb	0,05	19,00	3,00	53,00	–	–	– Al 0,5	Nb 5,0 Ti 0,9
SA 50 Ni**	2.4973	NiCr19CoMo	R41	–	< 0,12	19,00	9,50	Rest Balance	–	–	11,00	Ti 3,0 Al 1,6

* produced using electroslag remelting (ESR)

** exclusively for heavy metal extrusion

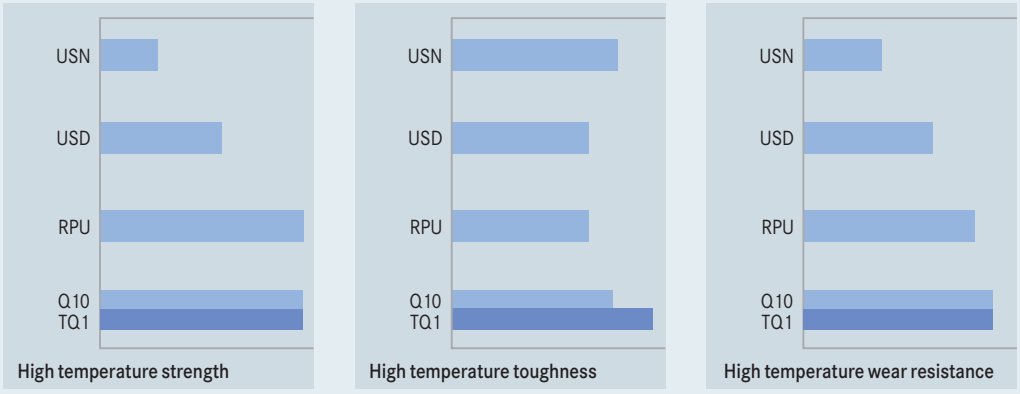
M = martensitic **A = austenitic** **Ni = nickel based alloy**



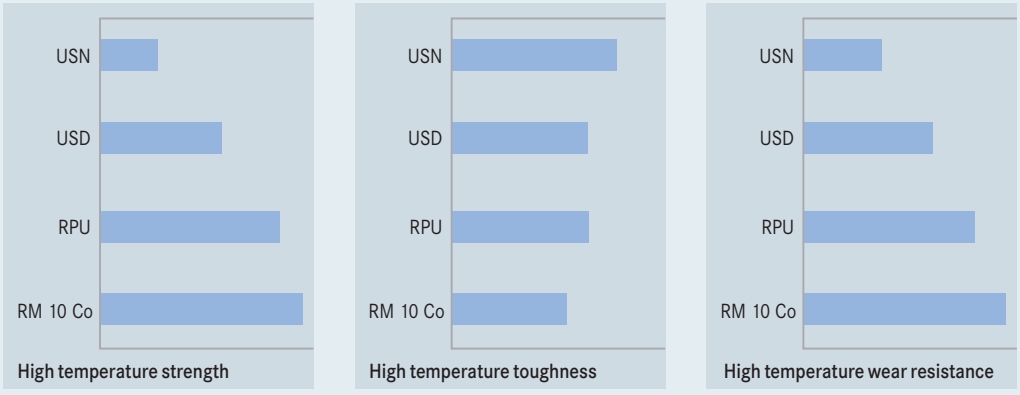


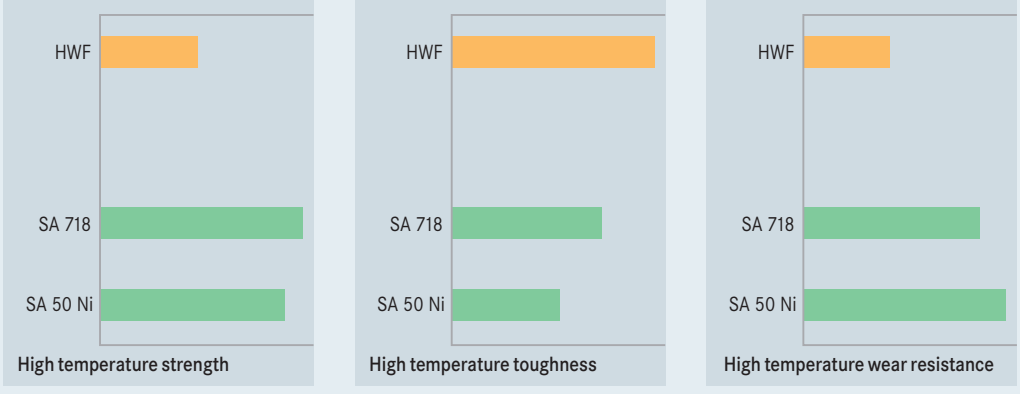
Comparison of properties of major materials

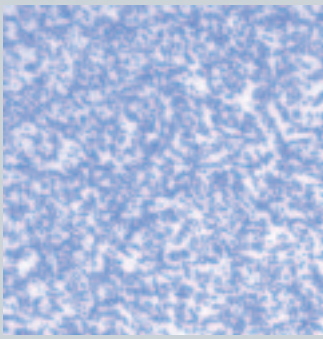
Light metal processing



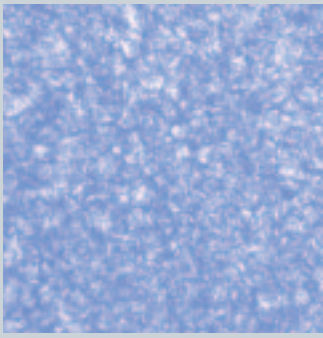
Heavy metal processing



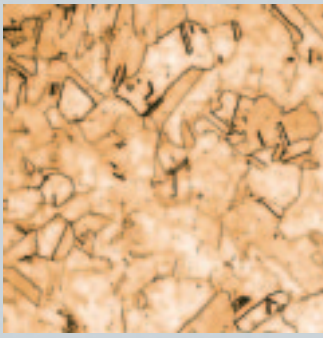




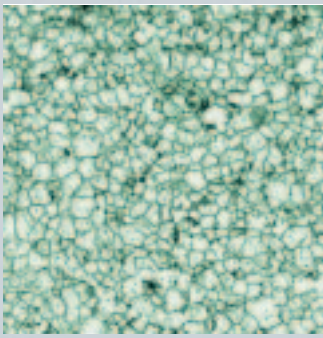
Typical annealing structure
of a hot-work steel



Typical tempering structure
of a hot-work steel



Typical structure of
age hardened austenite



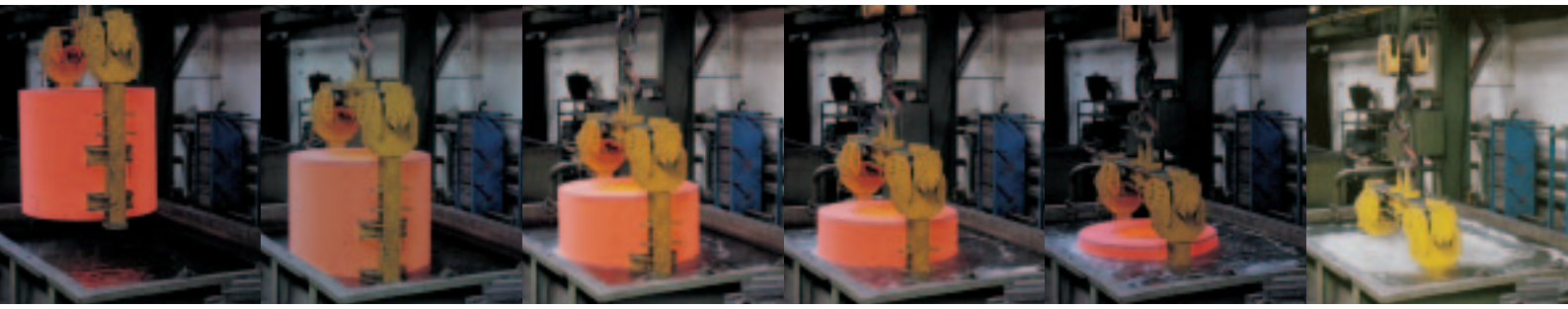
Typical structure
of a nickel base alloy

MATERIALS FOR EXTRUSION TOOLINGS

Container technology		Light metal		Heavy metal	
	Load Pspec.	KIND + CO brand	Grade	KIND + CO brand	Grade
Mantle	low	PWM KTW	1.2714 1.2311	PWM USN	1.2714 1.2343
	high	USN USD	1.2343 1.2344	USN RPU	1.2343 1.2367
Intermediate liner	low	USN USD	1.2343 1.2344	USN USD Q10	1.2343 1.2344 –
	high (air cooling)	USN RPU Q10	1.2343 1.2367 –	RPU Q10	1.2367 –
Inner liner	low (‹600 N/mm²)	USN USD RP RPU Q10	1.2343 1.2344 1.2365 1.2367 –	RP RPU HWF	1.2365 1.2367 1.2779
	high (›600 N/mm²)	USN RPU TQ1 Q10	1.2343 1.2367 – –	RM 10 Co HWF SA 718	1.2888 1.2779 1.4668

Extrusion stem		Light metal		Heavy metal	
	Load Pspec.	KIND + CO brand	Grade	KIND + CO brand	Grade
	low (‹600 N/mm²)	USN USD	1.2343 1.2344	USN RP RPU	1.2343 1.2365 1.2367
	high (›600 N/mm²)	USN RPU TQ1 Q10	1.2343 1.2367 – –	USN RPU TQ1 Q10	1.2343 1.2367 – –

Tooling	Light metal		Heavy metal	
	KIND + CO brand	Grade	KIND + CO brand	Grade
Sealing plate	USN USD RPU	1.2343 1.2344 1.2367	RP RPU SA 718	1.2365 1.2367 2.4668
Die holder	USN RPU	1.2343 1.2367	RPU RM 10 Co SA 718	1.2367 1.2888 2.4668
Mandrel	USN USD RPU Q10	1.2343 1.2344 1.2367 –	USN USD RP RPU	1.2343 1.2344 1.2365 1.2367
Mandrel tip			SA 718 SA 50 Ni	2.4668 2.4973
Dies	USN USD RPU TQ1 Q10	1.2343 1.2344 1.2367 – –	HWD AWS MA-Record HWF RM 10 Co HMoD Stellit6 / Stellit4 / MHC	1.2678 1.2731 1.2758 1.2779 1.2888 1.2889



HEAT TREATMENT – THE WAY TO PROVIDE THE REQUIRED TOOL PROPERTIES

Achieving the best material properties is the key for dependability and maximum life time.

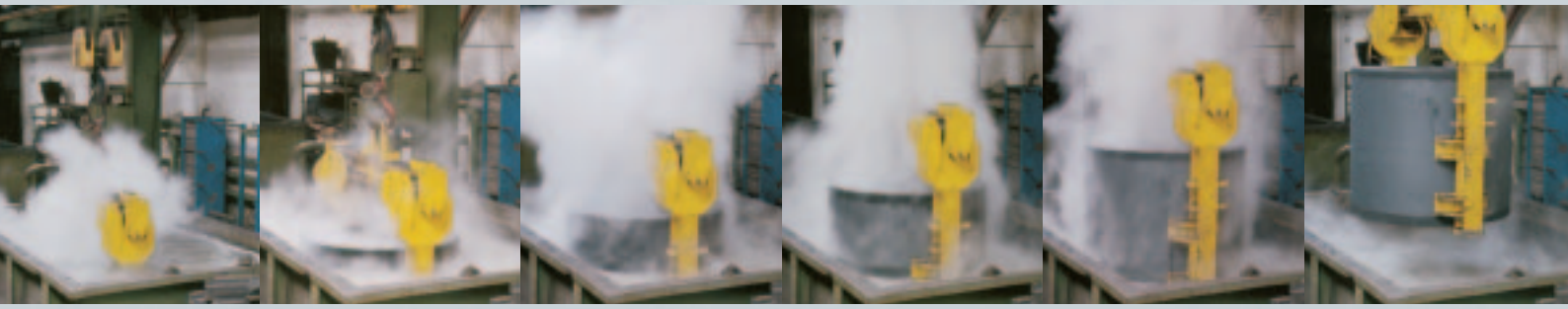
The most advanced vacuum hardening and nitriding furnaces, an integrated quality assurance system as well as experience and know-how ensure the repeat accuracy heat treatment.

Defined material properties are certificated by sampling in our own testing laboratory. Processing only takes place once the required features have been confirmed.

A modern process control system ensures continuous monitoring and documentation of the complete manufacturing process.

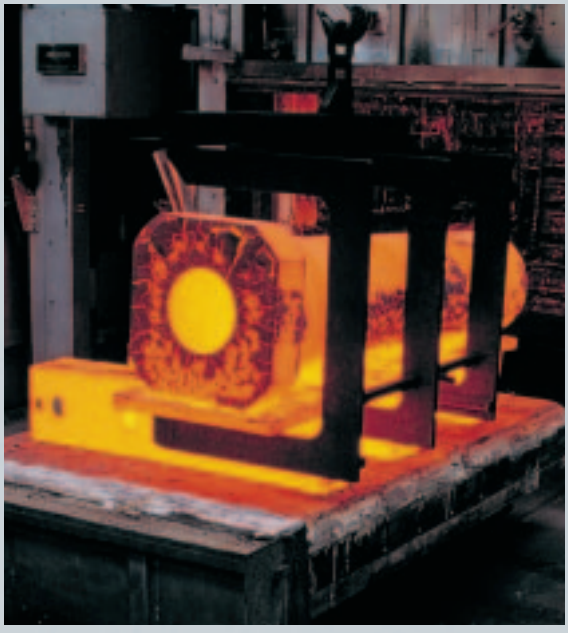
Special heat treatment such as partial annealing of tools (stem base/thread on the mandrel) or special surface treatments (nitriding/oxidising) complete our range of services in the field of heat treatment.

Power unit	Max. loading dimensions L x W x H mm	Max. heat weight	Max. quenching pressure
Vacuum hardening furnace	1,500 x 1,000 x 1,000 1,500 x 1,000 x 1,000 Ø 1,000 x 1,800 900 x 610 x 610	2,500 kg 2,000 kg 2,000 kg 600 kg	13 bar 6 bar 6 bar 10 bar
Nitriding furnaces	1,500 x 1,000 x 1,000 1,200 x 900 x 800 910 x 610 x 610	3,500 kg 1,500 kg 600 kg	

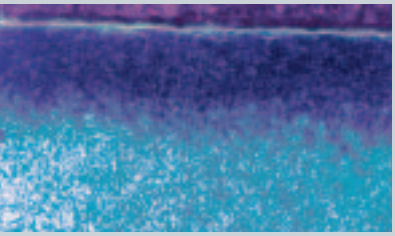


Quenching of a mantle in a polymer bath

Nitriding furnace, index controlled



Hardening of extrusion stem



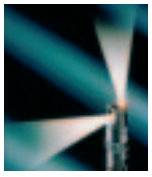
Nitriding of aluminium dies
with white layer (6 – 10 µm) and
diffusion layer (0.10 – 0.15 mm)

Index controlled oxidising
(metal oxidising / MO) of mandrels
from heavy metal (4 – 6 µm)

Vertical loading for low-distortion vacuum hardening

Supercooled shrinking of inner liner with double shoulders

SERVICE CHECK ON CONTAINERS



The single components of each container such as the mantle, intermediate liner or inner liner are subject to a load situation which requires – sooner or later – replacing the liners. When carrying out this work, each container is completely inspected in order to decide on its further use or the need for any additional activities.

Our service team includes qualified experts who are competent in the field of metallography, quality control, machining and sales.

In addition to general tests, a detailed inspection of the sensitive holes for temperature sensors and air supply using a boroscope has become an important preventive activity.

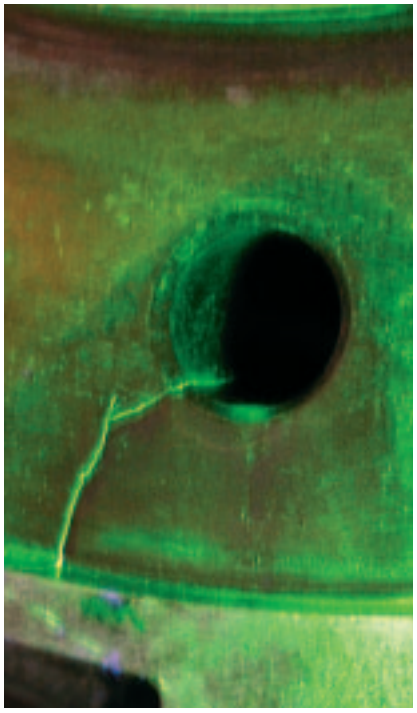
All test results and actions taken are stored in a database so that a comprehensive history of the containers can be provided and further technical developments can be worked out together with the customers. These practical experiences are the bench mark for the design of new containers and lead into enhanced tool life using detailed modifications, e.g., WT cooling or AIR protection.

RELINING/ SHRINKING

During operation, the container is subjected to strongly fluctuating mechanical and thermal loads.

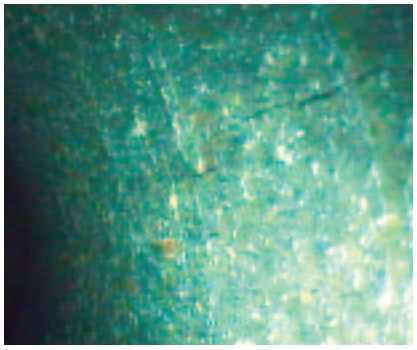
Application-specific load calculations take into account the press power, the container and billet temperatures as well as shrinkage strain. It is important that the various expansion coefficients of the materials are taken into account.

Shrinking requires profound experience and extensive process technology to achieve the required parameters as well as the engineering solutions.



Inspection of critical points using the magnaflux method

Internal stability check



Boroscope diagnostics with digital recording

Shrinking of a cooled intermediate bushing in a preheated jacket

SERVICE FROM A TO Z

Basic inspection and assessment of usability:

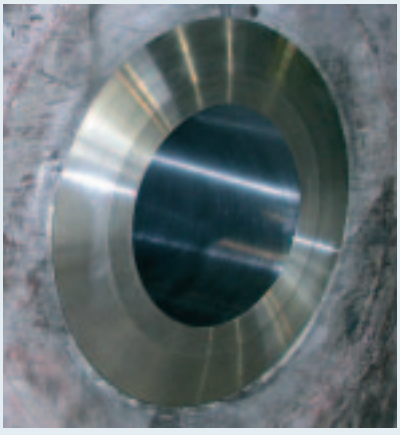
- Component dimensions
- Heating
- Cracks
- Hardeness
- Damages
- Boroscope examination on containers
- Identification
- Design
- Loading in a database

Results of diagnostics and discussion with the customer:

- Replacement of liners
- Repair by welding
- "Air Protection" (AP) retrofit
- Repair of the heating system

Optimized proposal/development:

- Material selection
- Determination of wall thickness
- Cooling
- Heating
- Temperature measurement
- Temperature control system
- AP Air Protection
- WT heat exchanger technology
- Database evaluation
- Preparation of drawings/optimization



Order processing:

- Integration of activities resulting from diagnostics
- Production release by the customer in case of a new design
- Repair/new production of components including assembly

Order completion:

- Final inspection
- Inspection sheet/shrinkage
- Acceptance certificate
- Delivery/despatch

LIST OF DIAGNOSTIC RESULTS

Typical failure reasons on extrusion toolings:

1 Cracks in heating pockets can be eliminated by design changes.

2 Avoidance of threaded holes in the heating pockets (new development).

3 Softening (diagram) and plastic deformation on the container.

4 Excessive surface pressure on flat sealing of the inner liner – flame marks at inner liners.

5 Cracks in air supply holes of cooled containers are today prevented using the AP system*.

6 Damaged mantle due to defective resistance heating element.

7 Compression of extrusion stem is prevented using tough TQ1 material.

8 Critical transitions on stems should be mitigated by design changes and by using superior materials (TQ1 / Q10).

9 Contraction and the presence of scaly surface on mandrels at heavy metal extrusion.

10 Surface softening and lack of lubrication on mandrels during extruding copper tubes.

11 Multiple nitriding treatments lead to excessive nitriding of the die surface (flaking).

12 Plastic deformation and deflection at AL dies can be reduced using tough TQ1 material.

* Registered design no. 203 18 917.5 (Germany)
* Registered design no. GM 874 2003 (Austria)

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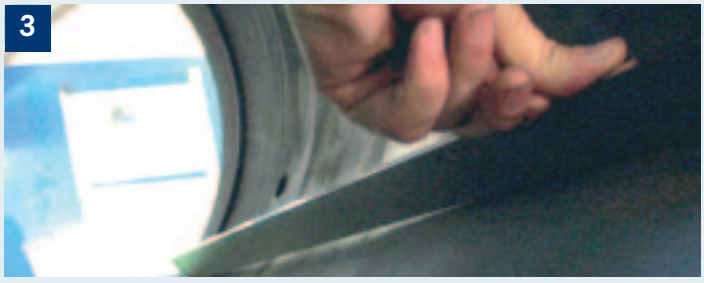

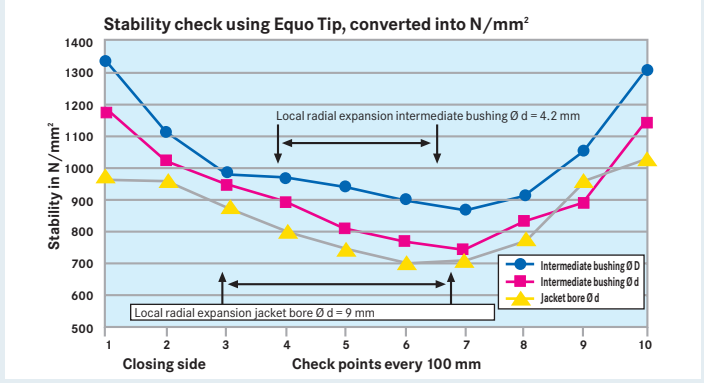

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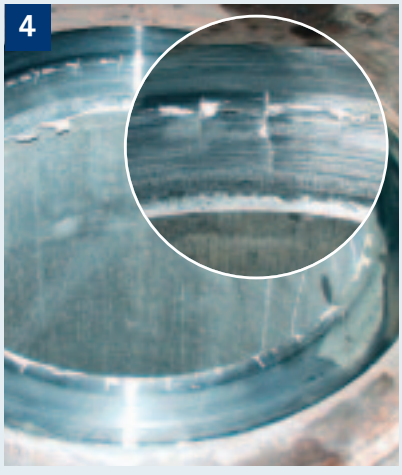

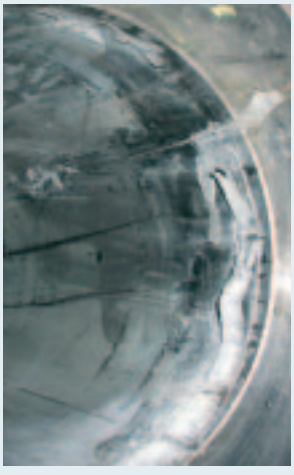

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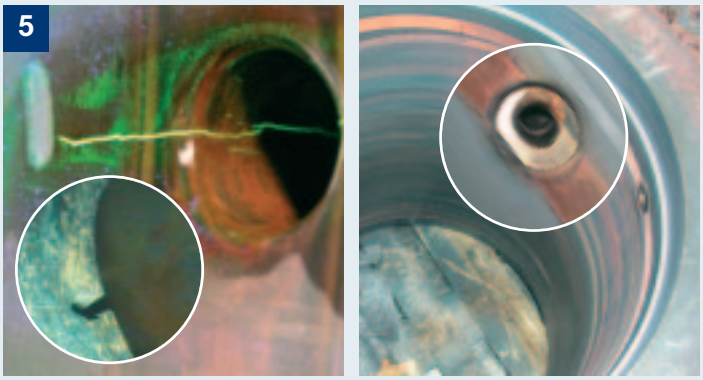

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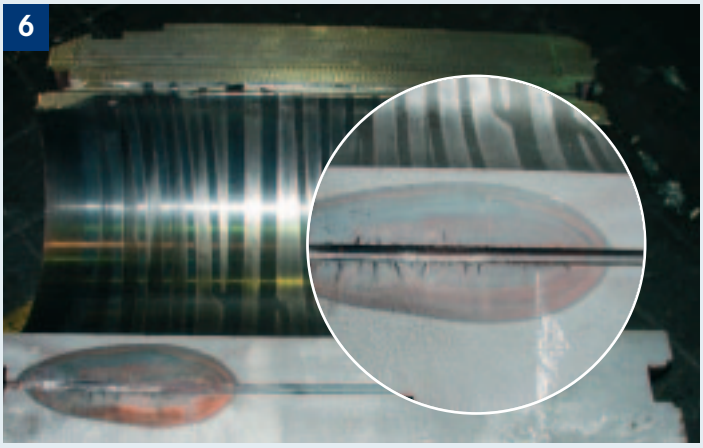

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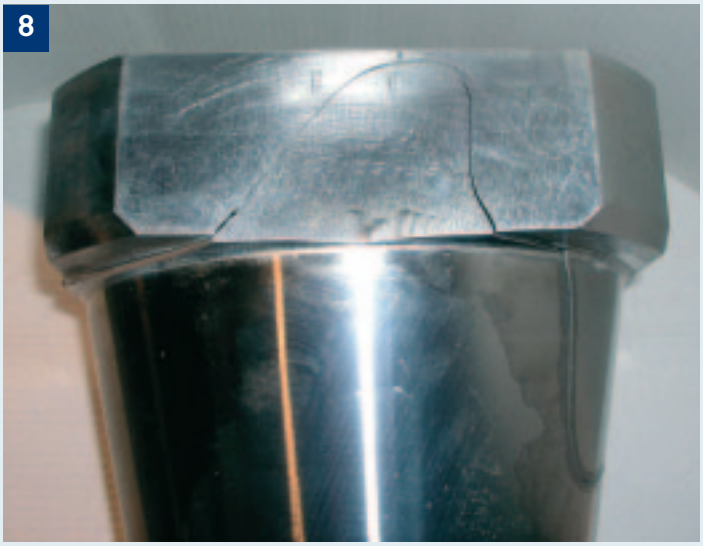

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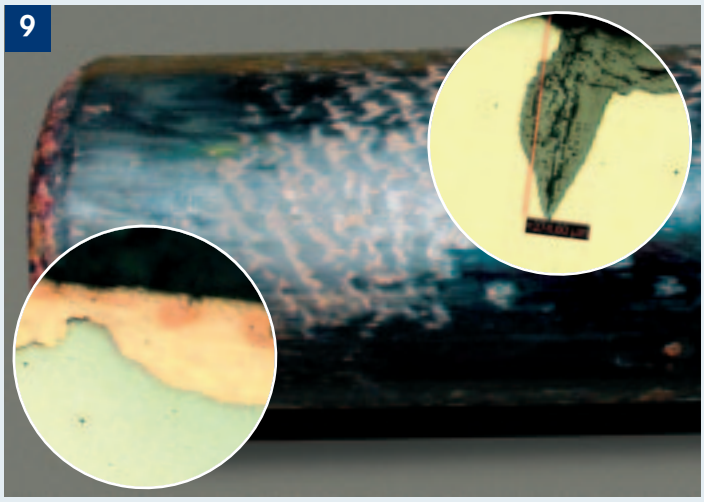

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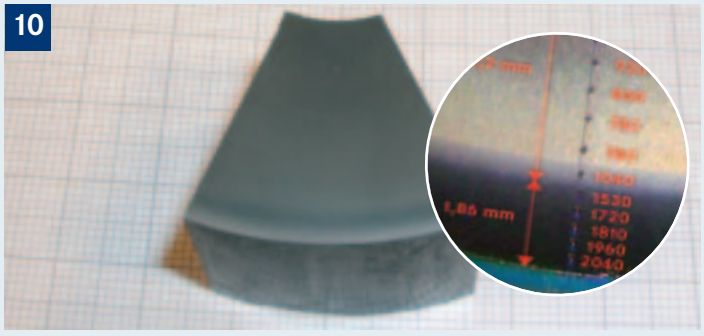

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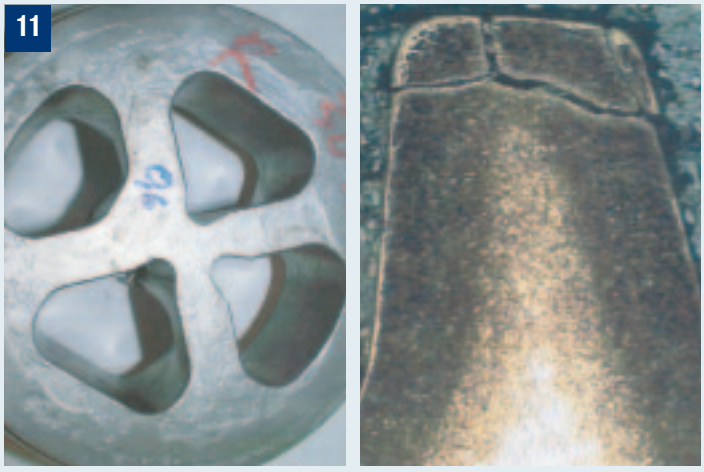

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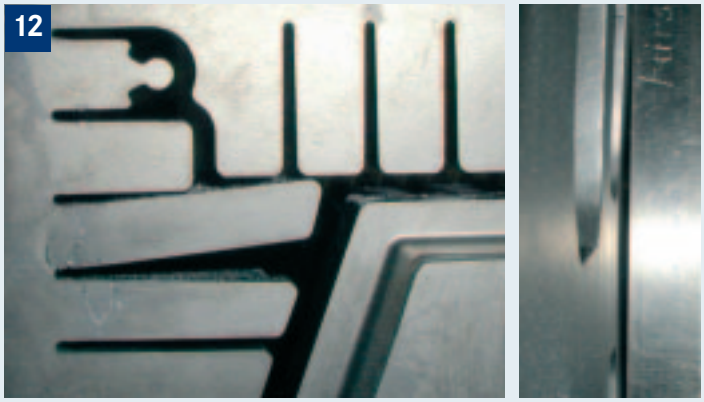

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