DANOIL
DANIELI OIL FILM BEARINGS

Latest generation for rolling mill equipment thanks to Danieli's expertise in design and manufacturing processes for the metal industry

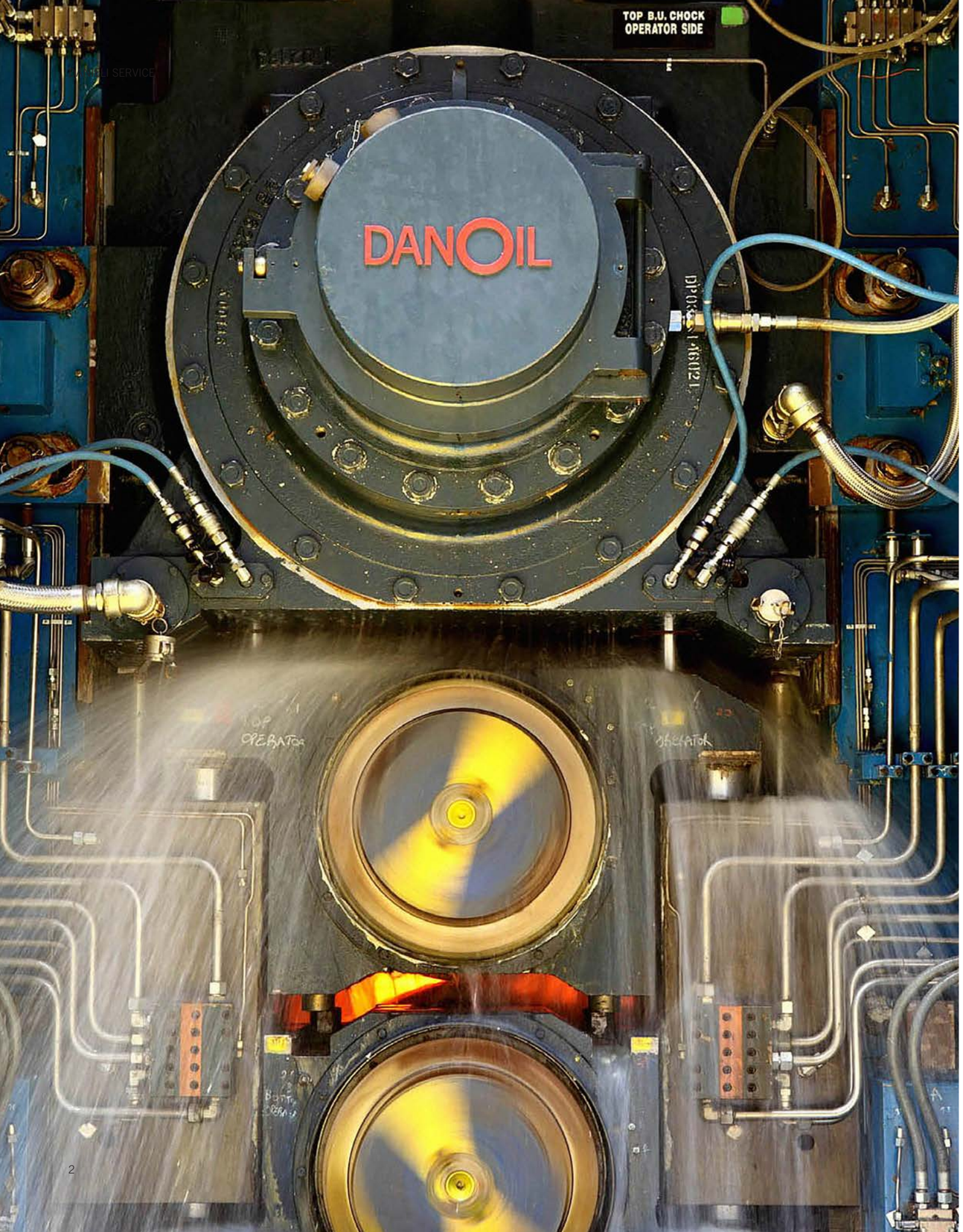
DANIELI SERVICE

INTEGRACTION
SMART SERVICES
FOR INTEGRATED
SUPPORT

DANOIL
LATEST GENERATION FOR ROLLING MILL EQUIPMENT THANKS TO DANIELI'S EXPERTISE IN DESIGN AND MANUFACTURING PROCESSES FOR THE METAL INDUSTRY

DANOIL

DANIELI SERVICE
SINCE 1962



WHY CHOOSE DANOIL BEARINGS

Rolling mill back-up rolls are designed to withstand the forces generated by the rolling process and therefore require bearings capable of carrying very high loads. To ensure the mill stand is as stiff, as possible the bearings also must be stiff and compact.
DanOil bearings satisfy this requirement-which is one of the reasons they are a well-proven design in this field. DanOil bearings are located in the backup roll chocks and are connected to a re-circulating oil lubrication system, usually located in the mill cellar.

— **Know-how**
Being an integral part of Danieli, world leaders in rolling mill innovation, ensures DanOil bearings are at the forefront of developments in all aspects of rolling technology.

— **Engineering Experience**
Our engineers have extensive knowledge and "hands on" experience of the design, manufacture, installation and operation of all back-up roll oil-film bearings and rolling mill technology.

— **Reseach and Development**
Through our knowledge and experience in the design and operation of oil-film bearings, we have identified and are committed to further improvement of the bearing and associated equipment.

— **100% Interchangeable**
Our standard range of bearings is fully compatible with other manufacturers' bearings, for which we offer a full range of spares.

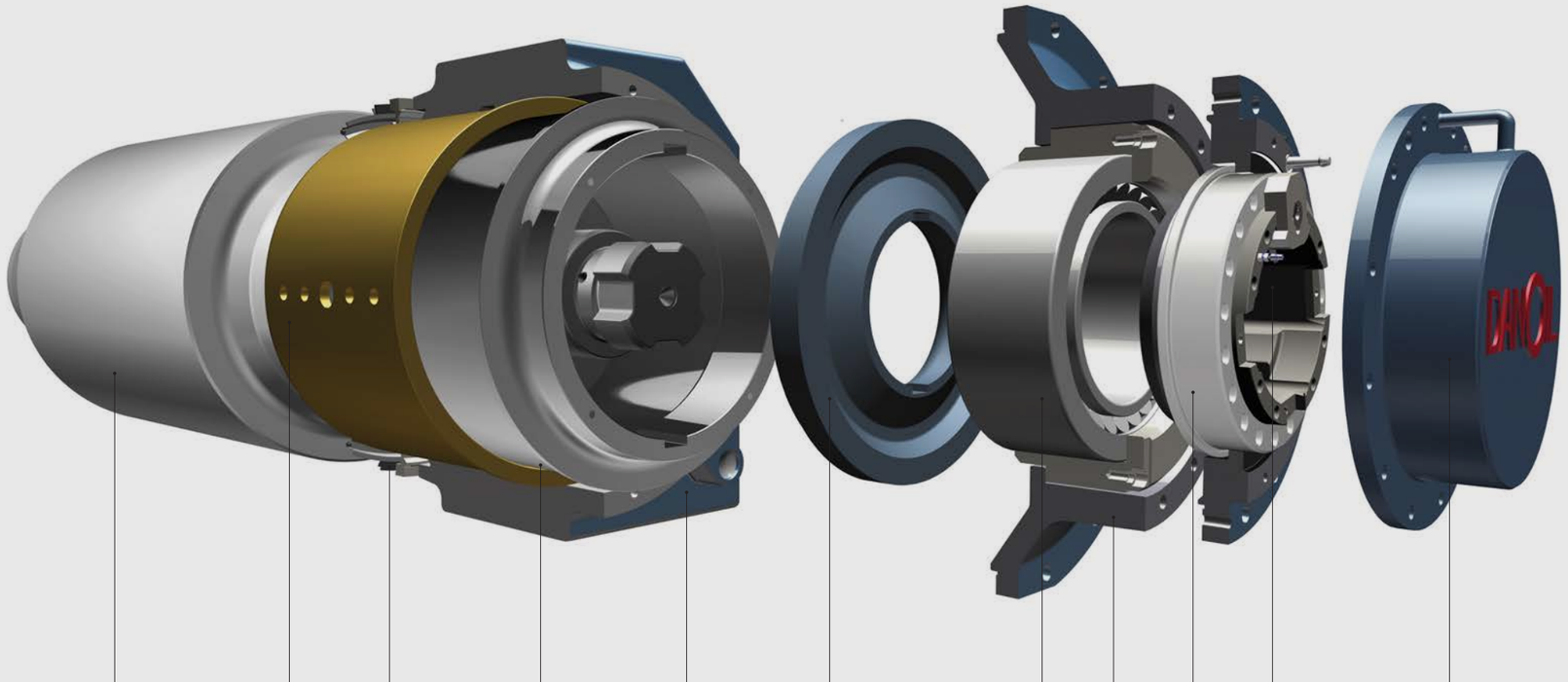
— **Forefront Manufacturing Cells**
Investment in state-of-the-art, purpose-built machines will ensure that all the components of DanOil bearings are manufactured to the highest possible standards and tolerances. The Danieli Headquarters manufacturing facility in Buttrio (Italy) is the most modern in the industry, together with DanOil manufacturing workshops in Changshu (China), in Chennai (India), and coming soon in Ashland (USA).

— **On-site Customer Assistance**
The Danieli philosophy of strong customer support is at the heart of DanOil bearing's operating approach. We offer comprehensive, worldwide technical support service for oil-film bearing users in all aspects of design, operation, maintenance and spare parts.

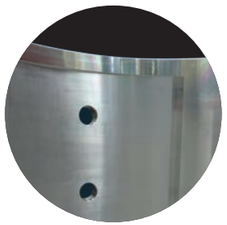
— **Safety and Application**
We are able to offer new mechanical and hydraulic locking designs to increase operator safety and to simplify the assembly and installation procedure, with every unit specifically designed for each customer's actual requirements, ensuring there are no disruptions to rolling schedules.

— **Competitive Pricing**
Our aim is to reduce mill operating costs by providing the highest quality bearings and spares at low prices. Danieli's highly efficient production techniques and strong buying power results in very competitively priced bearings and spare parts, without compromising the high finished quality to which Danieli's customers have become accustomed.

— **DanOil Worldwide References**
In addition to a comprehensive list of DanOil bearing customers, we also supply spare parts such as new oil-film bearing sets for many hot-and cold-rolling mills supplied by both Danieli and others.

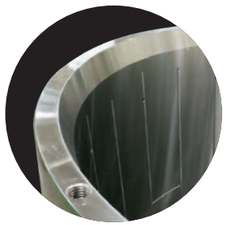


1. Back-up roll
2. Bushing
3. Sealing system
4. Sleeve
5. Back-up roll chock
6. Sleeve ring
7. Thrust bearing
8. Chock end plate
9. Hydraulic locking unit
10. Outer end plate
11. End cover



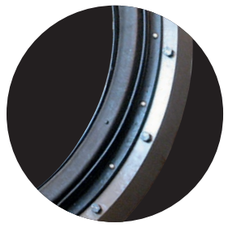
— Bushing

The bushing is the static part of the bearing assembly and is located in the bore of the back-up roll chock. The steel shell of the bushing is lined with a special white metal (also known as Babbitt). DanOil Babbitt was carefully selected for its ability to reduce start-up friction and to withstand rolling forces, as well as to capture small particles that otherwise would damage the bearing.



— Sleeve

The sleeve is the journal part of the bearing assembly; it is located on the taper neck of the back-up roll.
The sleeve is made from high-quality forged alloy steel and is precision ground to ensure roll eccentricity is minimized (the bearing surface is round and concentric to 3 micron or better).



— Sealing system

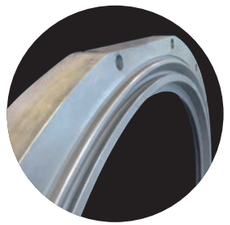
To keep the roll coolant and the bearing lubricant separate, specially developed seals are located at the inboard end of the bearing. Danieli can supply the innovative solutions for the coolant seal (stationary), the aluminum seal inner ring and neck seal (rotates).
Moreover Danieli has developed a innovative solution for the Seal End Plate (with nitreg heat-treatment process), solving the difficult working conditions to which these components are exposed.

— Locking device

Various types of locking devices are used to ensure that the sleeve and the other components mounted on the roll are located in the right position.
Danieli can offer two efficient solutions as an alternative to the traditional mechanical and hydraulic locking systems.

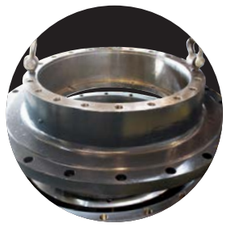
— Sleeve ring

The sleeve ring located in the outboard end bore of the sleeve is used to transmit the axial force from the locking unit to the sleeve during mounting and also to transmit any axial forces to the thrust bearing.



— Chock End Plate, Outer End Plate and other rings

Thanks to the skill and experience of our engineers, Danieli can offer its customers innovative, high-tech solutions for the other main components of the oil-film bearing.



— Bearing End covers

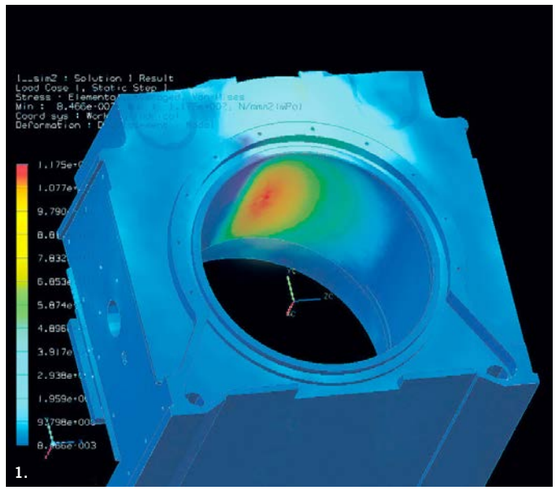
These items secure the components to the back-up roll chocks and form an oil-tight enclosure at the outboard end of the bearing assembly.

— Thrust bearing

A conventional double-row, taper roller bearing withstands the axial loads imposed on the back-up roll and bearing by the rolling process. Traditionally this bearing is mounted on the operator side of the mill.
For optimal control of the axial movement of the bearing and chocks, thrust bearings may be fitted to both ends of the roll. Chock-spreader bars, their locating pods, and the associated maintenance of these items are eliminated.

ENGINEERING, RESEARCH AND DEVELOPMENT

The DanOil system is a fundamental part of the technological equipment fitted to hot- and cold-rolling stands, and Danieli has a group of specialists who are fully dedicated to its design and development for continuous improvement of quality and service life, thus ensuring it maintains its top-level status.
The Danieli Engineering Department backed by the Danieli Research and Development Center and based on feedback from its on-field technicians, focuses on conceptual design, customized solutions and standardization of oil-film bearing components, so as to develop first-class, reliable and innovative products at competitive prices.



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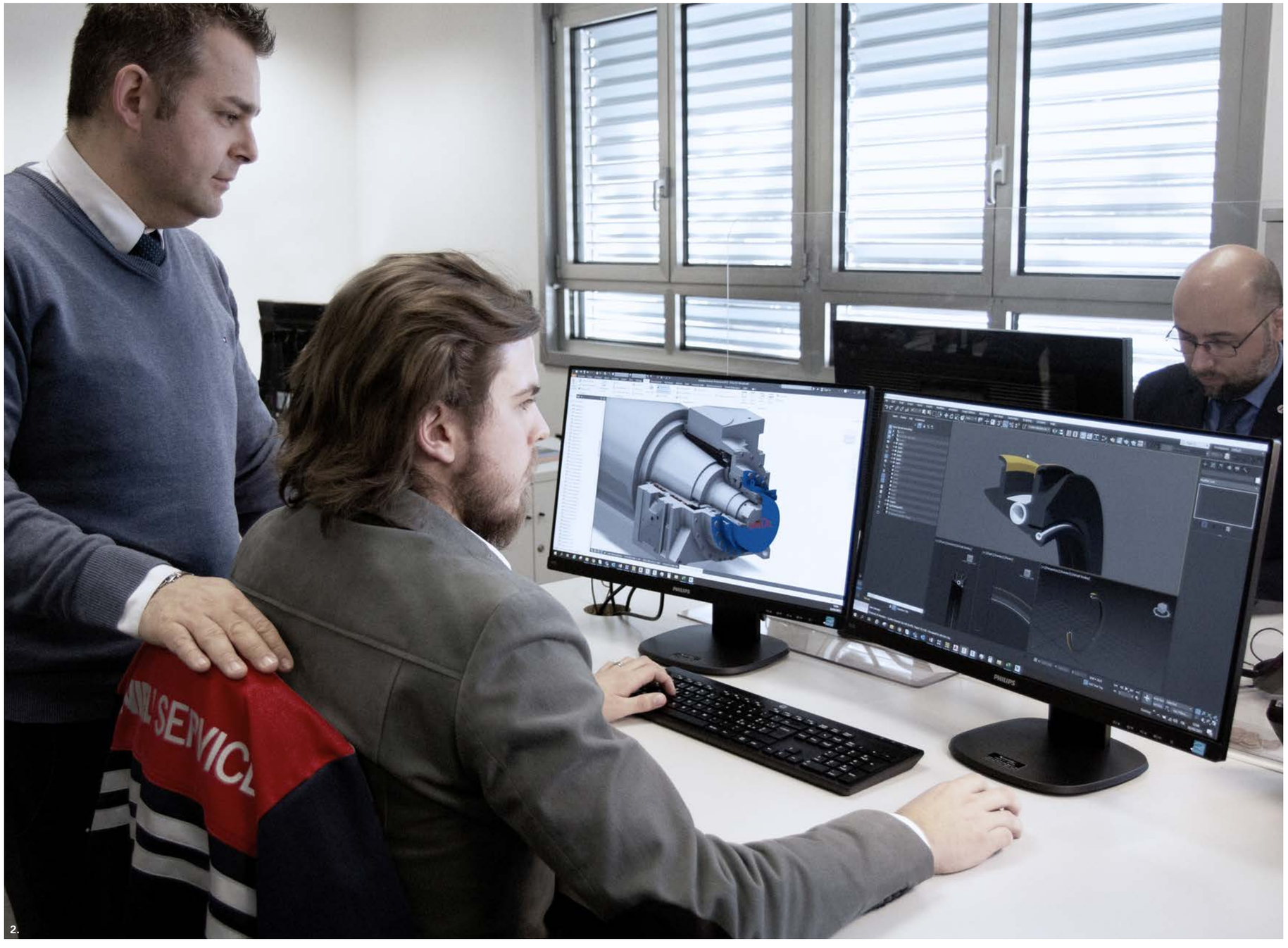

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1. **FEM allows us to simulate working conditions and to analyze the behavior of the sleeve and bushing in various loaded conditions. This ensures that we optimize the performance of each bearing component.**
2. **Danieli's expertise in design, manufacturing and experience of rolling processes for long and flat mills, has ensured that the DanOil bearing technology has reached the same levels of excellence for all types of rolling applications.**

WHITE METAL WELDING OF BUSHINGS

White metal welding facilities have been installed in our shops in Italy, China and India to ensure that DanOil bushings are manufactured to the highest standards. This investment is proof of our commitment to control the production of key components. This new center is specifically dedicated to spinning the white metal linings onto the bushing shells of DanOil bearings. The maximum capacity is ø 2,000 x 1,500, with a maximum casting weight of 5,000 kg. In an air-controlled, covered area of more than 500 square meters, all the following operations for this production process are performed:

— heating and tinning to activate the bushing surface and facilitate the bonding of the white metal;
— welding casting facility to distribute the white metal onto the bushing surface evenly;
— accelerated cooling to obtain 100% bonding and achieve the specified bond strength;
— every bushing is ultrasonically tested in order to confirm no cracks on longitudinal welding and Chalmers test is performed to ensure bond strength value.

Advantages of plasma welding
— Very fine microstructure for high compressive strength;
— Uniform quality due to high reproducibility of the process parameters;
— Environmental friendliness due to save resources;
— Consistently thin layer even after repeated repairs.

This installation, which complies with the UNI EN ISO 9001 standard, is environmentally friendly: particular attention has been given to the fume treatment plant to ensure a safe working environment.


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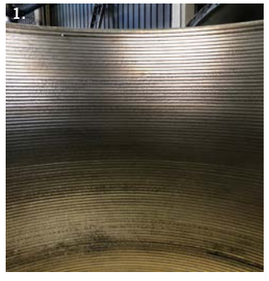
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1. Bushing welding booth with controlled atmosphere and temperature.
2. Bushing machine at the end of the white metal welding process.
3. Ultrasonic testing to determine bushing bond strength.

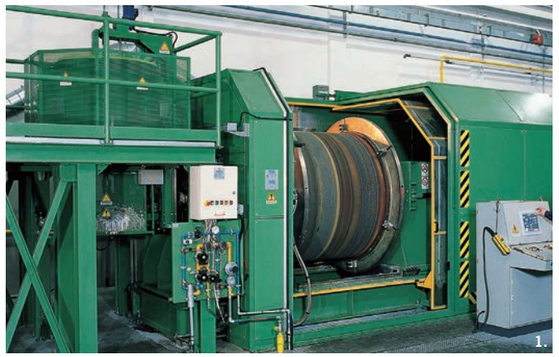
QUALITY DANOIL COMPONENTS: TRACEABILITY OF THE ENTIRE PRODUCTION CYCLE.

WHITE METAL CENTRIFUGAL CASTING PROCESS OF BUSHING

A centrifugal casting facility was installed in Changshu (China) to manufacture DanOil white metal, high-thickness bushings to the highest standards.
This center is specifically dedicated to spinning the white metal linings onto the bushing shells of DanOil bearings. The maximum capacity is ø 2,000 x 1,400, with a maximum weight of 6,000 kg. In an air-controlled, covered area of more than 600 square meters, all the following operations for this production process are performed:

— chemical cleaning, pickling and fluxing;
— heating and tinning to activate the bushing surface and facilitate the bonding of the white metal;
— heat pot capable of holding 1,000 kg of molten white metal;
— centrifugal facility to distribute the white metal onto the bushing surface evenly;
— accelerated cooling to obtain 100% bonding and achieve the specified bond strength;
— every bushing is ultrasonically tested to ensure 100% bonding. Bond strength is verified by Chalmers tests.

This installation, which complies with the UNI EN ISO 9001 standard, is environmentally friendly: particular attention has been given to the fume treatment plant, maintaining a safe working environment.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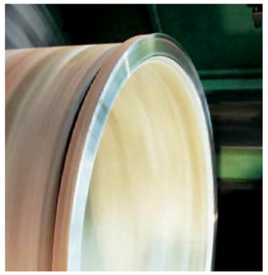

1. Bushing casting machine installed in Danieli Changshu, China
2. Working in synergy towards a common goal
3. Bushing exiting the centrifugal machine at the end of the white metal casting process.
4. Every bushing is ultrasonically tested to ensure 100% bonding.

DANOIL SLEEVES

To ensure the machine is capable of achieving the highest standards, Danieli's oil-film bearing manufacturing experts played an extensive role in the design of the grinding machines installed in Danieli's three, state-of-the-art manufacturing facilities.
These CNC machines ensure the highest accuracy and repeatability during the sleeve grinding and polishing process. The taper bore and the bearing journal diameter of the sleeve are ground simultaneously to ensure concentricity values consistent with modern, rolling mill Automatic Gauge Control requirements.
Sleeves are ground to roundness and concentricity values of ≤ 3µm. Every sleeve is checked to ensure it meets the rigorous standards for roundness, wall variation and hardness prior to dispatch.
The grinding machine table features a hydrostatic oil-film bearing to ensure a mirror like surface of the bearing journal, with a surface finish Ra value of 0.02 µm. The mirror finish enables the bearing to operate at high loads by reducing the risk of metal-to-metal contact between the sleeve and the bushing during operation.


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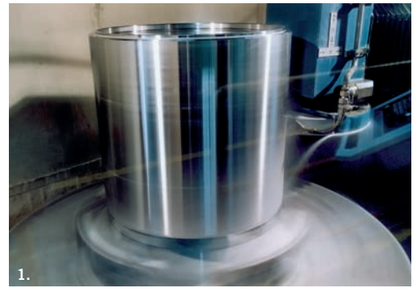
1- 3. The high-tech CNC grinding machine performs simultaneous internal and external grinding in order to achieve a wall thickness concentricity lower than 3 µm. The external surface is ground to a mirror finish (surface roughness lower than 0.025 µm).
2. Finished sleeve ready for final inspection.

RECONDITIONING REFURBISHMENT AND REPAIR

One of the attributes of oil-film bearings is that in the event of mill wrecks or other accidental damage, the sleeves and bushings can be reconditioned to first-class condition by regrinding and re-spinning processes, respectively.
As part of our customer service, our engineers can be available to visit the site and assess the condition of your bushings and sleeves in your roll shop.
After careful evaluation we will confirm if they are suitable or not to send to Danieli for reconditioning. Doing this will reduce the risk of unnecessary transportation costs.
Bushings, sleeves and hydraulic locking units can be repaired in Danieli's worldwide workshops, giving longer life to repaired items and considerable economic benefits.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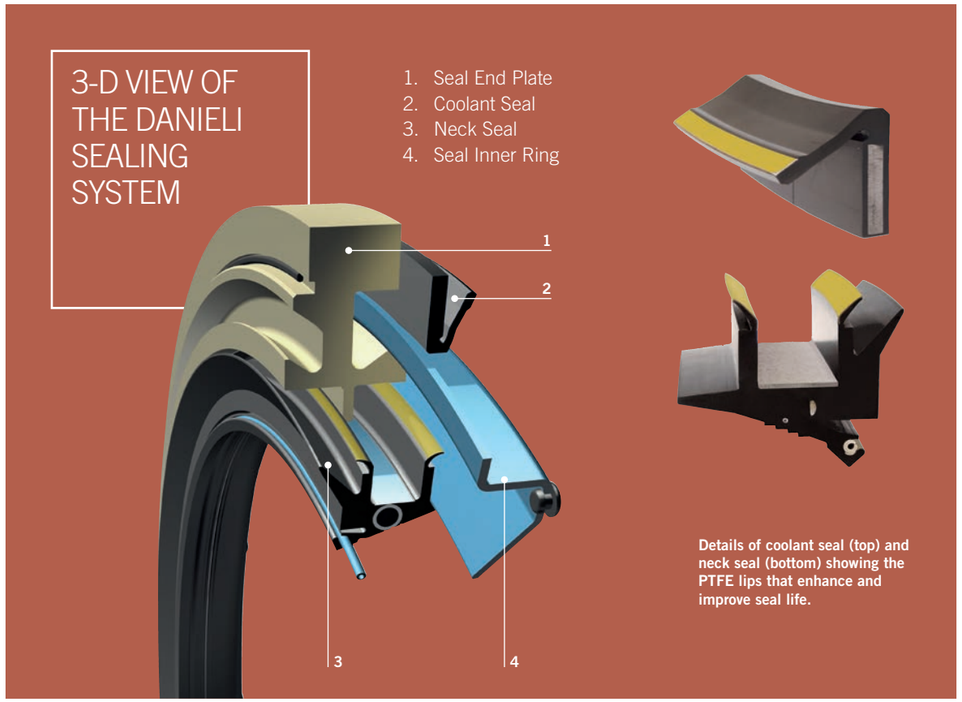
1. Reconditioning external diameter of bushing during the grinding process.
2. Internal, preliminary visual inspection of bushings.
3. New, high-tech 3-D CMM machine at Danieli HQ, Italy; works in temperature control; measures all pieces within a tolerance of 1 micron.

SEALING SYSTEM

Although DanOil bearings are tolerant of lubricating oil contamination, it is nevertheless important to ensure that the lubricating oil is maintained in first-rate condition by preventing infiltration of mill coolant and contaminants.

Thanks to our engineering experience we have developed new neck seal (Danieli Patent) and a coolant seal (Danieli Patent) to retain the oil within the bearing and exclude coolant.
The standard Neck seal rotates with the roll and has garter springs and internal stiffening to prevent it from being deformed by centrifugal forces when rotating at high speeds.
To enhance seal performance further, the seal lips are made from PTFE.
This reduces friction and heat build-up to prolong seal life.

Seal developments
— No oil leakage, no coolant ingress and no scale ingress;
— PTFE lips provide higher durability thanks to anti-friction properties and lower working temperature;
— easy to install and remove;
— seal life is three times higher than NBR standard requirements;
— reduced spare parts costs.



Details of coolant seal (top) and neck seal (bottom) showing the PTFE lips that enhance and improve seal life.

Hardness tests being carried out on the seal end plate after the Nitreg process.

SEAL END PLATE (NITREG PROCESS)

Due to the difficult working conditions to which the seal end plate is exposed, we have optimized the design by analyzing critical aspects such as stress concentration and heat transfer that severely affect the other sealing components of the assembly.
These issues have been addressed in our manufacturing process by using a high-quality forged steel, and a Nitreg heat-treatment procedure.
This Nitreg treatment is a Danieli-patented process that gives an optimal seal running surface, with the additional benefit of corrosion protection.
This reduces wear and corrosion, and improves lubricity of the sealing surface and heat transmission, resulting in a low working temperature of the seal.

1. Assembly of sealing elements on the back-up roll chocks at customer's site.
2. Machining of the seal end plate on the grinding machine.

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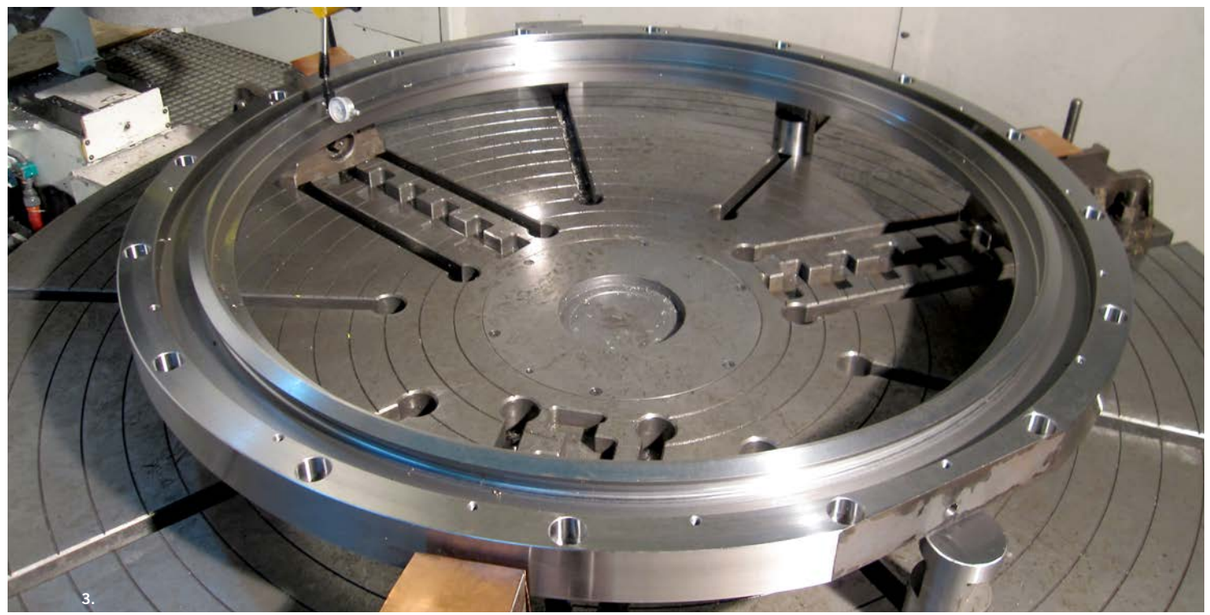

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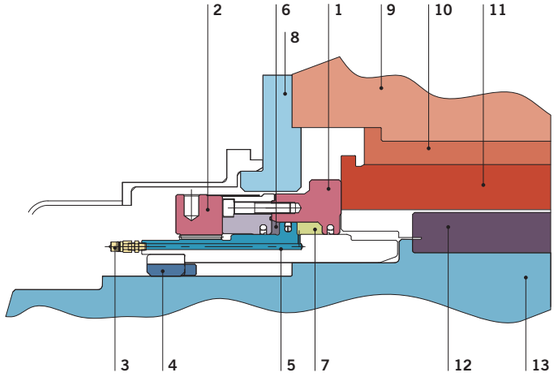
LOCKING DEVICE

To ensure the bearing is secure on the roll, various methods of locking are used:
— Traditional solution, with locknuts and threaded rings;
— T-Lock mechanical locking unit;
— HLU hydraulic locking unit.

— Traditional solutions
There are still many mills in the world that use locknuts and threaded half rings to secure the bearing on to the roll. Probably just as many use quick-change locknuts and threaded rings. Once a locknut has been tightened, it keeps the bearing components in position without axial movement. However, these two methods rely on using an overhead crane and a wire rope to tighten and loosen the locknut. In response to our customers' concerns over potential safety issues of this operation we have developed a hydraulic locking unit that ensures the mounting/dismounting force is controlled and consistent each time.

— T-LOCK Mechanical locking
To solve the problems of operator safety and damage to the threaded ring and ring nut, Danieli engineers developed a new solution called T-Lock. This mechanical locking system provides the same results as the hydraulic lock but is less invasive and costly. The calibrated screws push the pressure ring against the thrust bearing and lock the system. The mounting and dismounting of the oil-film bearing is easier and faster with the torque wrench; the locking force is always controlled and the load is perfectly calibrated.

HLU Hydraulic locking unit
Modern rolling mills built in the past decade have been equipped with a hydraulic bayonet locking device to ensure operator safety and to engage and disengage the bearings in a controlled and repeatable manner.



Hydraulic locking nuts section view
1. Cylinder
2. Threaded Jam Nut
3. Port Fittings
4. Splined Snap Ring
5. Piston
6. Pressure to Dismount
7. Pressure to Mount
8. End Plate
9. Chock
10. Bushing
11. Sleeve
12. Key
13. Roll

Conversion of existing locking systems to the DanOil technology provides a safe and controlled operational procedure
DanOil engineers provide technical evaluations to confirm that locking conversions on existing hot and cold mills can be implemented. The customer is supported in ensuring that the final design selection achieves the criteria and objectives required, and in addition to this we provide plant operators training consisting of classroom and on-site sessions.

Benefits of converting to DanOil Technology
— quicker assembly and disassembly process;
— precise locking force and resultant position of assembled bearing components on roll body;
— reduction of crane-dependent tasks in the roll shop;
— productivity and quality improvements by proper bearing mounting.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1. **SSAB Tandem Mill workshop team and Danieli Service DanOil technical team at the completion of the HLU installation**
2. **Recent advisory services/ training on oil-film bearing maintenance practices in Egypt.**
3. **T-Lock mechanical locking unit installation at Metinvest Valsider in Italy.**
4-5. **Pressure testing of hydraulic locking unit before delivery.**


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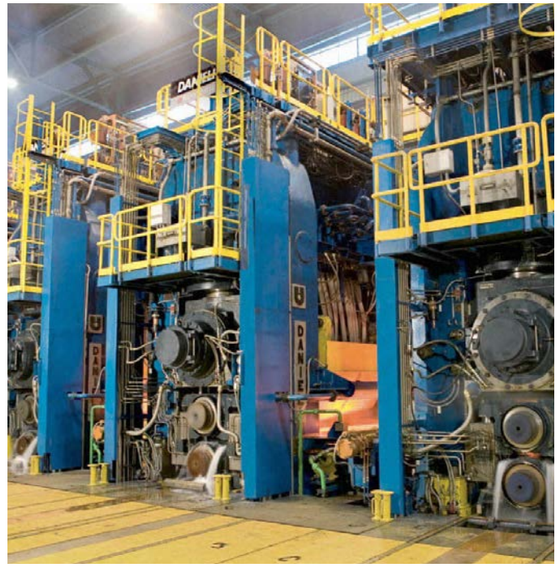
BEARING LUBRICATION SYSTEMS

— Hydrodynamic lubrication

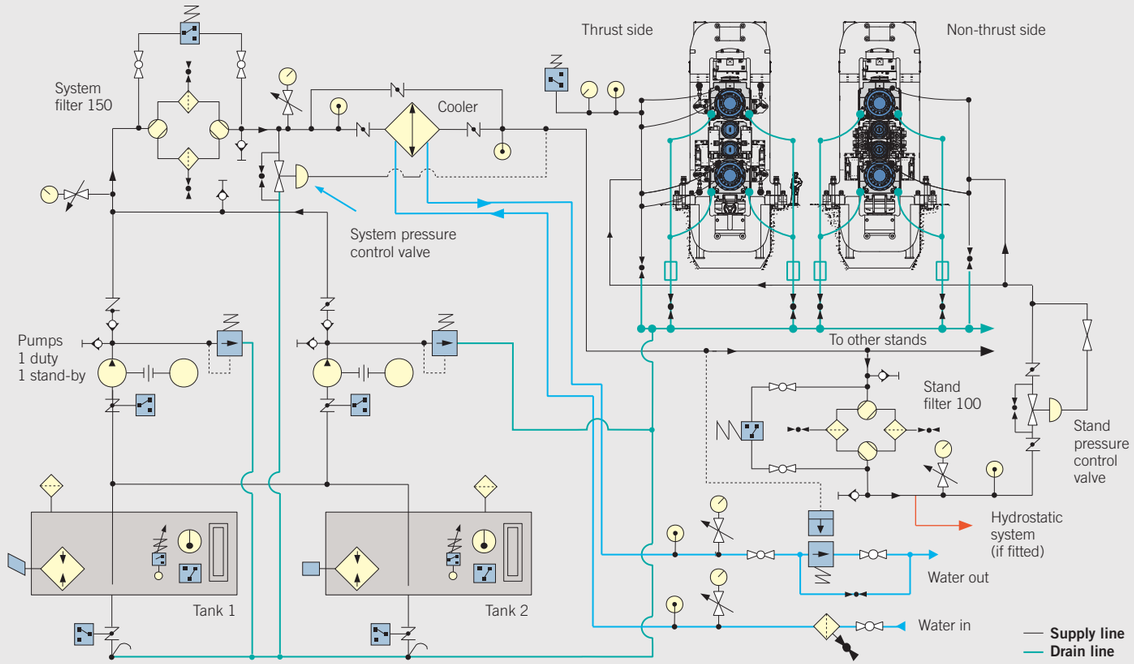
The traditional two-tank system shown below enables oil conditioning to be performed with one tank offline.
Some of our recent installations have adopted the single-tank system to reduce space and costs. In these cases the oil conditioning is performed online by use of a vacuum separator.
In the traditional system shown below, fixed delivery pumps circulate oil around the circuit and the stand pressure valve controls the oil demanded by the bearings. The excess oil is diverted back to the tank. In certain applications it is beneficial to use variable speed pumps to supply the oil flow rate required by the bearings, thus reducing the oil circulation.
Further reductions in tank sizes (and hence tank heating/cooling requirements and cellar space) can be achieved by using super demulsifying oils to reduce settling time to a minimum.

— Hydrostatic lubrication

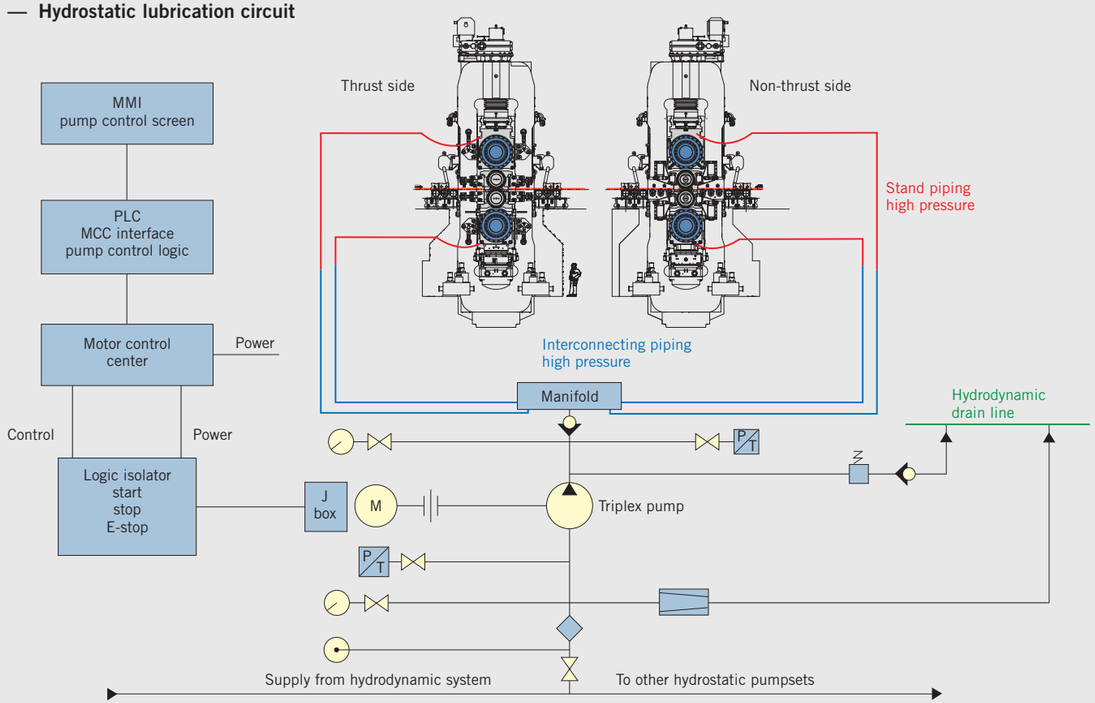
Mills that frequently operate at low speeds (plate mills and reversing roughing stands) and those that stop under load (cold reversing and temper mills) are often equipped with hydrostatic systems to prevent damage to the bushings until the hydrodynamic film is established. Continuous cold mills and new, thin-slab hot-strip mills can require hydrostatic lubrication as well. Recently, there has been a trend by tandem cold-mill operators to retrofit hydrostatic lubrication systems to improve mill performance at low speeds.
Endless rolling mills that stop to shear coils while the mill is under load can restart without risk of bearing damage or tension variations due to boundary lubrication. New, high-strength steels impose severe power constraints on mills and often necessitate rolling at high loads and low speeds. This may cause extreme lubrication conditions in the bearings, resulting in bearing damage. Conversion to hydrostatic operation will alleviate this damage.
To minimize loss of production, installation of the pump and interconnecting piping can be conducted during normal rolling. The mill stand piping and connection to the hydrodynamic system may be installed during normal scheduled stops.



— Hydrodynamic lubrication circuit

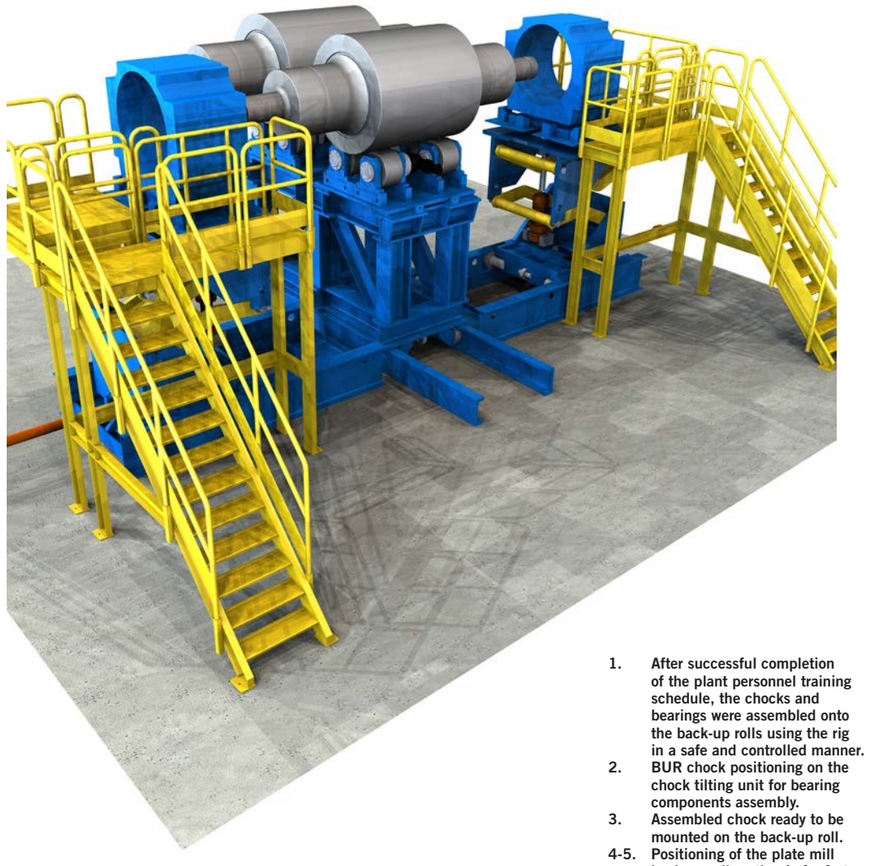


— Hydrostatic lubrication circuit



DE-CHOCKER AND TILTER MACHINES

During the mounting and dismounting of the chock assemblies on the rolls, it is difficult to control these movements using the overhead crane.
We have designed a back-up roll chock changing device in response to customers' requests to improve safety and reduce damage to components (especially seals).
The movements on and off the roll are performed by hydraulic actuators thus ensuring the operator is controlling the procedure safely, accurately and predictably.
The Danieli De-Chocker and Tilter machine are designed to accommodate a range of chock sizes that are found in the shop.
This ensures minimal cost outlay and that customers' requirements are met in full.
In the De-Chocker both the drive-side and roll change-side chocks are positioned on a seat location, which can be moved horizontally to mount and dismount the bearing assembly onto the roll.
The roll is supported by four motorized rolls, which allows the roll to be turned to align the keyways in the roll with the keys in the bearing sleeve.
By using the Danieli De-Chocker, tilter and hydraulic locking unit described above, the overhead crane can be used for other duties.



— 3D image of the new Daniel chock-changing rig that optimizes roll shop efficiency.

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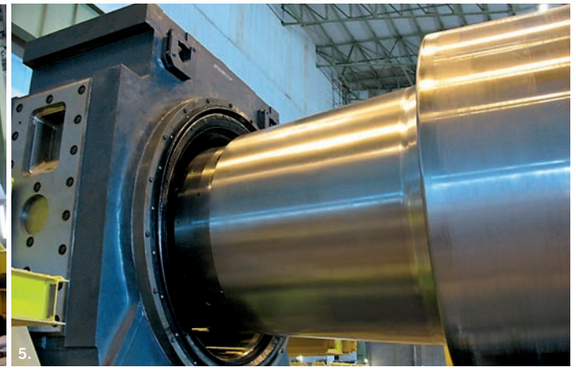

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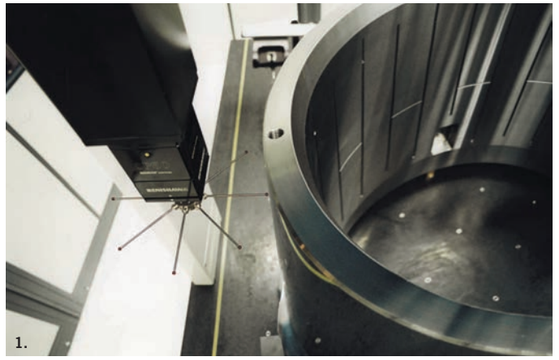
1. After successful completion of the plant personnel training schedule, the chocks and bearings were assembled onto the back-up rolls using the rig in a safe and controlled manner.
2. BUR chock positioning on the chock tilting unit for bearing components assembly.
3. Assembled chock ready to be mounted on the back-up roll.
4-5. Positioning of the plate mill back-up roll on the rig for fast, effective and safe mounting of chock on the roll neck.

TRACEABILITY / QUALITY CERTIFICATE

Every production step, from materials arrival to dispatch, is recorded to issue the final DanOil product certificate and ensure full traceability.

Every bushing and sleeve has its own unique identification number stamped on the flange. This is an essential requirement for the complete control of all aspects of our manufacturing quality procedures.
The identification numbers are very important for the customer's future reference, particularly in the event of a mill wreck resulting in bearing damage.
We always recommend that customers record the bushing and sleeve number, along with the roll and chock number and where they are installed in the mill.
This historical data can be used to determine the amount of time in service, and the amount that has been rolled.

Further evaluation of the data will assist in identifying the cause of the problem.
At the end of the manufacturing process and before shipment, the DanOil quality department issues for each bushing/sleeve the dimensional and quality certificate, which guarantees the components are in compliance with EN10204.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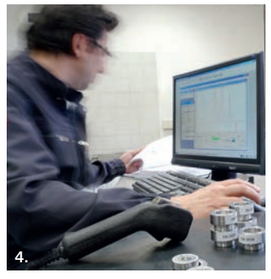
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1. Non-destructive dye-penetrant testing of bushing after welding.
2. DanOil bearing ready to be shipped.
3. The strength of the bond interface between the white metal and the shell is verified by a Chalmers test.
4. Checking the dimensional roundness and concentricity of a sleeve.
5. Measuring white metal thickness.

INSTALLATION, ADVISORY SERVICE AND TRAINING

The Danieli philosophy of strong customer support is at the heart of the operating approach of DanOil bearings.

We offer a comprehensive, worldwide technical support service for oil-film bearing users in all aspects of design, operation, maintenance and spare parts, as well as:

— Help during planning of new mills and revamps
We will determine the required size of bearings and oil requirements.
We will provide information for the interface with mating components, such as chocks and rolls.
We will supply technical support during the installation and commissioning periods.
Operational assistance is available throughout the life of the mill, with advice on troubleshooting and reconditioning procedures.

— Installation and commissioning
Towards the end of the installation period our engineers visit the client to demonstrate the correct assembly of the bearings and to monitor the hydrodynamic (and hydrostatic, where applicable) fluid systems to ensure a smooth start-up.

— Rolling Mill and Rollshop Audit
Throughout the life of the mill we are able to help our clients with advice on operational, maintenance troubleshooting and reconditioning procedures of the bearing components.

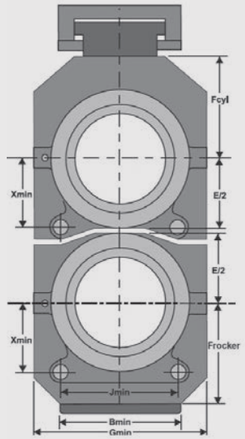
— Reconditioning service
One of the attributes of oil-film bearings is that in the event of mill wrecks or other accidental damage, the sleeves and bushings can be reconditioned to first-class condition by re-grinding and re-spinning processes, respectively.
As part of our customer service, our engineers are available to visit the site and assess the condition of your bushings and sleeves in your roll shop. After careful evaluation, we will determine if they need to be sent to Danieli for reconditioning. Doing this will reduce the risk of unnecessary transportation costs.

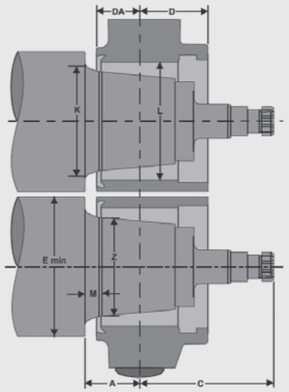
— Training on-site and in classroom
We take great care to ensure the client's operating personnel receive first-class training in the assembly and maintenance of DanOil bearings.

— Manuals
Service/operating manuals are supplied as teaching materials during the training courses.

DANOIL BEARING DATA TABLE

Standard keyless range
— All dimensions shown are standard but can be changed to suit special project requirements.
— All data in the table is given only as a guide for the mill designer - all applications of a chosen bearing designation must be checked and approved by Danieli's DanOil division.
— Comprehensive specifications, accurate arrangement drawings, parts list and lubrication requirements are supplied.
— We offer a complete technical service - our knowledge and experience will ensure that your bearing selection is optimized for your mill application.
— Comprehensive spare parts service for all existing bearing types and ranges - i.e. Morgoil, Morgan, KLX, Davy, SMS, MDS, Mesta, IHI, Innse.





KL		Rating	Roll							Chock								Drains		Typical Applications
			Unfactored Neck Stress		HB[3]							F[2]								
Size	**Series**	**kN**	**Mpa**	**A**	**C**	**K**	**Z**	**Emin**	**M**	**DA**	**D**	**hyd cyl**	**rocker**	**L**	**E/2**	**Gmin**	**Bmin**	**Xmin**	**Jmin**	
30	67	5.750	89,7	295	855	597	520	750	120	225	380	450	485	635	375	815	560	380	600	Cold Strip and Temper Mills Hot Bar and Section Mills Hot Strip Mills (Narrow/Light Duty) Hot Steckel Mills (Narrow/Light Duty)
	75	6.430	108,9	320	875					250	400	475	505							
	84	7.200	131,3	345	900					275	425	495	530							
32	67	6.530	30,2	310	870	631	555	790	120	240	400	480	515	675	395	865	585	405	650	
	75	7.320	109,1	335	890					265	420	505	540							
	84	8.190	131,2	360	910					290	440	530	560							
34	67	7.370	90,2	325	885	666	590	840	120	255	410	510	550	715	420	915	635	430	700	
	75	8.260	110,4	355	910					285	435	535	570							
	84	9.250	134,1	385	940					315	465	560	595							
36	67	8.270	89,5	345	1.060	707	630	890	125	270	470	540	580	760	445	965	660	455	700	
	75	9.260	107,4	370	1.080					295	490	565	605							
	84	10.370	131,6	405	1.110					330	520	595	630							
38	67	9.220	88,4	355	1.065	742	665	950	125	280	475	575	615	805	475	1.015	685	480	750	
	75	10.320	107,3	385	1.090					310	500	600	640							
	84	11.550	131,1	420	1.120					345	530	630	670							
40	67	11.795	93,8	370	1.090	780	705	1.000	125	290	500	600	645	845	500	1.065	735	510	800	
	75	13.205	114,2	400	1.120					320	525	630	670							
	84	14.790	128,7	435	1.145					355	555	660	700							
42	67	13.010	91,6	390	1.100	827	740	1.050	140	305	510	630	675	885	525	1.120	760	535	800	
	75	14.560	111,9	425	1.130					340	540	660	705							
	84	16.307	126,8	460	1.160					375	570	690	735							
44	67	14.280	91,6	400	1.115	860	775	1.090	135	315	525	660	710	930	545	1.170	815	560	850	
	75	15.975	111,5	435	1.145					350	555	690	740							
	84	17.892	127,2	475	1.180					390	590	725	770							
46	67	13.500	86,2	425	1.140	902	810	1.150	145	340	545	690	740	970	575	1.220	840	585	900	
	75	15.110	104,4	460	1.165					375	575	720	770							
	84	16.930	127,1	500	1.200					415	610	760	805							
48	67	16.985	91,1	435	1.155	939	850	1.180	145	335	565	720	775	1.015	590	1.270	890	610	950	
	75	19.015	110,3	470	1.185					370	595	755	805							
	84	21.297	125,6	515	1.220					415	630	790	840							
50	67	18.435	91,1	450	1.165	976	885	1.230	150	350	575	755	810	1.060	615	1.320	915	635	1.000	Cold Strip Mills (Wide/Heavy Duty) Hot Strip Mills Hot Steckel Mills Hot Plate Mills Hot Roughing Mills
	75	20.635	111,1	490	1.200					390	610	790	840							
	84	23.111	126,0	535	1.240					435	650	825	880							
52	67	19.930	93,1	470	1.340	1.009	920	1.260	145	368	625	780	835	1.095	630	1.370	965	660	1.050	
	75	22.310	113,5	510	1.380					408	665	815	870							
	84	24.987	127,4	555	1.420					453	705	855	910							
54	67	21.495	93,3	485	1.360	1.047	955	1.290	150	390	645	810	870	1.140	645	1.420	990	685	1.100	
	75	24.065	114,1	530	1.400					435	685	850	905							
	84	26.953	127,4	575	1.440					480	725	890	945							
56	67	23.605	89,7	505	1.380	1.108	1.015	1.350	150	415	665	850	910	1.195	675	1.475	1.015	710	1.150	
	75	26.410	109,4	550	1.420					460	705	890	950							
	84	29.579	122,7	600	1.465					510	750	930	990							
60	67	27.095	87,5	525	1.580	1.184	1.095	1.440	145	425	690	910	975	1.275	720	1.575	1.095	760	1.200	Hot Steckel Mills (Wide/Heavy Duty) Hot Roughing Mills (Wide/Heavy Duty) Hot Plate Mills (Wide/Heavy Duty)
	75	30.325	106,3	570	1.620					470	730	950	1.015							
	84	33.964	119,6	625	1.665					525	775	995	1.060							
64	67	30.820	87,5	555	1.615	1.259	1.170	1.520	145	455	725	990	1.065	1.360	760	1.675	1.170	810	1.350	
	75	34.505	106,8	605	1.655					505	765	1.035	1.110							
	84	38.646	119,0	660	1.695					560	815	1.090	1.160							
68	67	34.320	84,9	575	1.765	1.335	1.245	1.640	144	450	820	1.045	1.125	1.440	820	1.780	1.250	865	1.450	
	75	38.425	104,1	630	1.815					505	870	1.095	1.175							
	84	43.036	116,0	690	1.865					565	920	1.155	1.225							
70	67	32.840	78,6	600	1.795	1.390	1.300	1.690	144	475	850	1.095	1.180	1.510	845	1.860	1.285	890	1.500	
	75	36.640	95,7	655	1.845					530	900	1.150	1.230							
	84	40.780	116,3	715	1.895					595	950	1.210	1.285							
72	67	34.530	77	610	1.815	1.430	1.340	1.730	144	485	880	1.125	1.210	1.550	865	1.910	1.320	915	1.550	
	75	38.660	94,8	670	1.865					545	920	1.180	1.265							
	84	43.300	116,4	735	1.920					610	975	1.240	1.325							
74	67	37.140	77	630	1.830	1.480	1.390	1.780	144	505	885	1.165	1.255	1.600	890	1.980	1.360	940	1.600	
	75	41.550	94,4	690	1.880					565	935	1.220	1.305							
	84	46.320	115,2	755	1.940					630	995	1.280	1.365							
76	67	46.185	85,7	650	1.855	1.529	1.440	1.860	144	525	910	1.210	1.305	1.670	930	2.040	1.395	965	1.650	
	75	51.690	104,8	710	1.910					585	940	1.270	1.360							
	84	57.893	116,8	780	1.970					655	1.025	1.335	1.425							
80	67	45.810	77,2	685	2.123	1.628	1.540	2.000	144	560	935	1.305	1.405	1.800	1.000	2.180	1.470	1.015	1.750	
	75	51.290	95,3	755	2.208					625	1.020	1.365	1.465							
	84	57.430	117,4	830	2.273					700	1.080	1.435	1.530							
82	67	56.030	84,6	700	2.218	1.679	1.590	2.050	144	575	960	1.340	1.445	1.850	1.025	2.230	1.505	1.040	1.800	
	75	62.850	104,4	770	2.278					645	1.020	1.405	1.505							
	84	70.392	116,6	850	2.338					720	1.085	1.480	1.575							

HIGH-TECHNOLOGY PRODUCTS

Technical support, training, spare parts, assistance, plant upgrading and refurbishment.

— Q-ROLL

Caster rolls to increase productivity and reduce plant OpEx.

— DANCHOCK

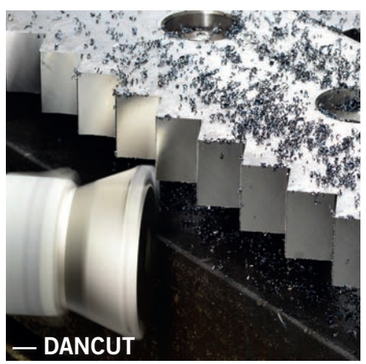
High-quality forged or cast bearing chocks, for rolling mill back-up, work, and intermediate rolls.

— HAGC

Automatic cylinders to provide consistent service life in the worst mill conditions.

— BENDING BLOCKS

An effective mechanism to control strip shape is work-roll bending.

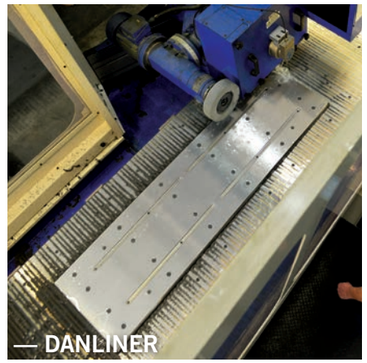


— DANCUT

Customized shear blades for the ferrous and non-ferrous metal industry, designed to enhance plant performance and improve reliability.

— DANMANDRELS

Hot and cold coilers fitted with the latest technological innovations, and refurbishment and overhaul programs to extend mandrel life.



— DANLINER

Rolling mill stand liners to improve performance and protect the stand from imprint damage.

— CLADDED ROLLS

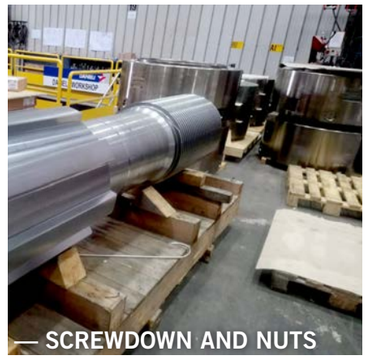
Hot-mill rolls reconditioned multiple times for unlimited roll body lifetime, using performance-driven custom-made coatings.

— LEVELER ROLLS

Hot and cold leveler rolls, flattener and straightener rolls, and tension and multi-roll leveler rolls for both the ferrous and non-ferrous metals industry.

— SINK-ROLLS

Zinc Pot rolls and auxiliary equipment to improve coated product quality and reduce operational costs.



— SCREWDOWN AND NUTS

The mechanical and hydraulic screwdown system allows the roll gap to be opened extremely quickly during the rolling of ingots.

— DAN'JOINT

High-torque cardan shafts to provide customers with a quality product capable of withstanding the tough working conditions typical of a steelmaking complex.

— GEARBOXES

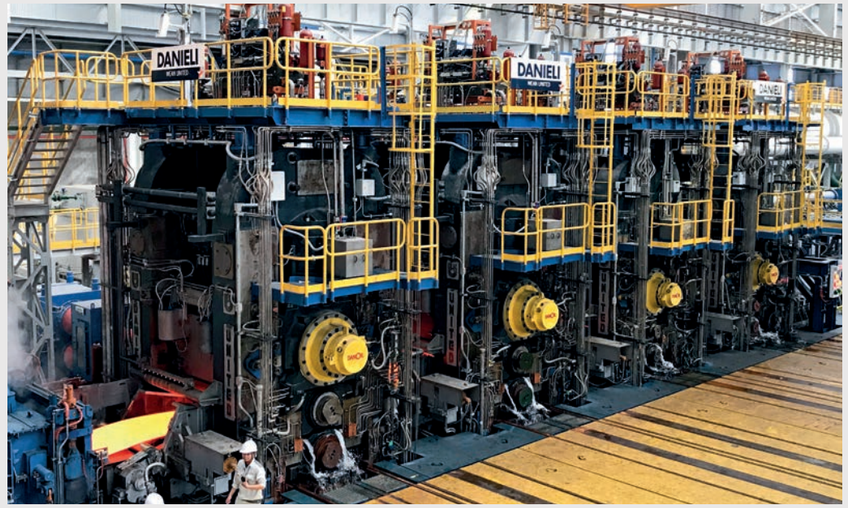
Top-notch efficient solutions for minimal friction, best lubrication characteristics and high-quality precision machining.

DANOIL BEARING REFERENCE LIST

In the past 20 years, the Danieli Group has supplied more than 5,000 high-precision oil-film bearings for the steel and non-ferrous industry to more than 150 customers worldwide. Today you can recognize our modern and cost-effective oil-film bearings by the DanOil trademark.

— AMERICAN AREA			
Jsw Steel Inc	USA	Plate	Danieli
North Star Bluescope	USA	Hot Strip	Danieli
Nucor Steel Gallatin	USA	Hot Strip	Danieli
Altos Hornos	Mexico	Hot Strip	Danieli
Ternium	Argentina	Hot Strip	SMS Siemag
Arcelormittal Tubarao	Brasil	Hot Strip	SMS Siemag
Usiminas Ipatinga	Brasil	Hot Strip	Primetals
— EUROPEAN AREA			
Arcelormittal Gent	Belgium	Hot Strip	Danieli
Outukumpu	Finland	Hot Strip	SMS Siemag
Ssab Europe	Finland	Hot Strip, Tandem	Danieli
Arcelormittal Dunkerque	France	Hot Strip	Primetals
Arcelormittal Florange	France	Hot Strip, Tandem	Danieli, Primetals
Arcelormittal Fos-Sur-Mer	France	Hot Strip	Danieli
Arcelormittal Bremen	Germany	Hot Strip	SMS Siemag
Salzgitter Flachstahl	Germany	Hot Strip	SMS Siemag
Thyssenkrupp	Germany	Hot Strip, Plate, Tandem	SMS Siemag
Acciai Speciali Terni	Italy	Hot Strip	-
Arcelormittal Italy	Italy	Hot Strip, Plate, Tandem	SMS Siemag, Danieli
Liberty Magona	Italy	Tandem	-
Marcegaglia Palini & Bertoli	Italy	Plate	Danieli
Metinvest Ferriera Valsider	Italy	Steckel	Danieli
Liberty Skopje	Macedonia	Tandem	SMS Siemag
Arcelormittal Poland	Poland	Hot Strip	Primetals
Csn Lusosider	Portugal	Cold	-
Liberty Galati	Romania	Hot Strip, Plate, Tandem	NKMZ
Hbis	Serbia	Hot Strip, Tandem	SMS Siemag
Arcelormittal Asturias	Spain	Hot Strip, Plate, Tandem	SMS Siemag
Arcelormittal Etxebarri	Spain	Temper	SMS Siemag
Arcelormittal Sagunto	Spain	Tandem	Danieli
Tata Steel Ijmuiden	The Netherlands	Hot Strip, Tandem	SMS Siemag
Celsa Steel	UK	Rod	Primetals
Tata Steel Llanwern	UK	Tandem	Danieli
Tata Steel Port Talbot	UK	Hot Strip, Tandem	Danieli
Tata Steel Trostre	UK	Tandem	Danieli
— AFRICAN AND TURKISH AREA			
Sider El Hadjar	Algeria	Tandem	SMS Siemag
Al Ezz Flat Steel	Egypt	Hot Strip	Danieli
Arcelormittal	South Africa	Hot Strip, Plate, Tandem	Primetals, SMS Siemag, Danieli
Erdemir	Turkey	Hot Strip, Tandem	Danieli
Habas	Turkey	Hot Strip	SMS Siemag
Isdemir	Turkey	Hot Strip	Primetals
Mmk Metalurji	Turkey	Hot Strip	Danieli
— RUSSIAN AREA			
Am Temirtau	Kazakhstan	Hot Strip, Tandem	Danieli, Uralmash
Novolipetsk Steel (Nlmk)	Russia	Hot Strip, Tandem	NKMZ, Uralmash
Omk Vyksa	Russia	Hot Strip	Danieli
Pjsc Magnitogorsk I.&S.	Russia	Hot Strip, Plate, Tandem	NKMZ, SMS Siemag
Severstal	Russia	Hot Strip	NKMZ
Azovstal (Metinvest)	Ukraine	Plate	ZDAS
Ilyich M.z. (Metinvest)	Ukraine	Hot Strip, Plate	NKMZ, Skoda
Zaporizhstal (Metinvest)	Ukraine	Hot Strip, Tandem	Danieli
Uzbek Metallurgical Plant	Uzbekistan	Hot Strip	Danieli

— CHINESE AREA			
Baoshan I&S Co Ltd	PR China	Hot Strip	SMS Siemag
Jiangyin Xingcheng Steel	PR China	Plate, Steckel	Danieli
Baosteel Meishan	PR China	Hot Strip	Danieli
Hebei Zongheng	PR China	Hot Strip	China First Heavy
Hunan Valin Lianyuan	PR China	Hot Strip, Plate	SMS Siemag
Minmetal Yinkou Medium Plate	PR China	Plate	SMS Siemag
Nanjing I&S Co Ltd	PR China	Hot Strip	-
Shagang Zhangjiagang	PR China	Hot Strip	Danieli
Shougang I&S Qian'an	PR China	Hot Strip	SMS Siemag
Tangshan Guofeng I&S Group	PR China	Hot Strip	Danieli
Tangshan I&S Co	PR China	Hot Strip	Danieli
Tianjin Tiantie Metallurgy Co	PR China	Hot Strip	China First Heavy
Wuhan I&S Co	PR China	Hot Strip	SMS Siemag
Xinyu I&S Co	PR China	Hot Strip	China First Heavy
Zhangjiagang Pohang Stainl.	PR China	Hot Strip	Primetals
— FAR EAST, INDIA, OCEANIA AREA			
Bluescope	Australia	Hot Strip, Plate, Tandem	SMS Siemag, Danieli
Arcelormittal Nippon Steel	India	Hot Strip	SMS Siemag
Bhushan Power & Steel	India	Hot Strip	SMS Siemag
Jindal Stainless Hisar	India	Hot Strip	-
Mishra Dhatu Nigam	India	Plate	Danieli
Nmdc Limited	India	Hot Strip	Danieli
Sail Bokaro	India	Hot Strip	NKMZ
Sail Rourkela	India	Plate	Danieli
Pt Krakatau Steel	Indonesia	Hot Strip	SMS Siemag
Jfe Steel Keihin	Japan	Plate	IHI
Nssmc Nagoya	Japan	Plate	IHI
Nssmc Oita	Japan	Plate	Primetals
China Steel	Taiwan	Hot Strip	Primetals
Sahaviriya Steel	Thailand	Hot Strip	SMS Siemag
Hoa Phat Steel	Vietnam	Hot Strip	Danieli



A recent, complete installation of DanOil Bearing at Hoa Phat, Vietnam (Danieli QSP).

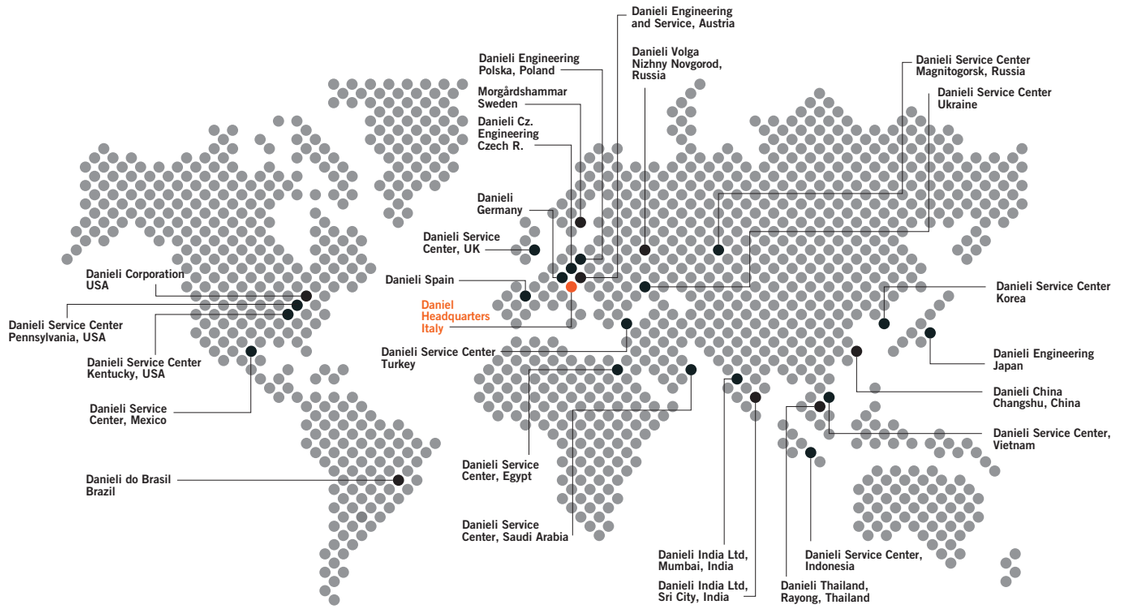
DANIELI SERVICE CENTERS AND DANIELI WORKSHOPS AND FACILITIES

The Danieli Service Centers operate with Danieli's manufacturing know-how to guarantee the same excellent quality we achieve at our headquarters in Italy and in our wholly owned facilities in Thailand, China, India, Austria, Germany, Sweden, Russia, USA, and Brazil, and allow us to claim: "**Danieli workshops: same quality worldwide**".

Eight regional companies plus a global network provide full-quality Danieli services close to the customer and a rapid response to all, maintenance and consultation requests.

All activities and production processes are carried out in accordance with Danieli's own technical standards and with the technical requirements of international standards.

Danieli worldwide production capacity:
— 331,800 sqm dedicated to manufacturing and assembly;
— 185 primary machine tools;
— 45,000 hours per month of machining capacity;
— 9,600 tpy gear cutting and grinding capacity
— 15,000 tpy heat treatment capacity;
— 1,000 sqm thick narrow gap welding
— 400 t hoisting capacity.



> Danieli Headquarters / Italy

Total surface area: 320,000 m²
Workshop area: 92,000 m²
Technical and administrative offices: 28,000 m²
Start of operations: 1962

< Danieli China

Total surface area: 200,000 m²
Workshop area: 90,000 m²
Technical and administrative offices: 12,000 m²
Start of operations: 2007

< Danieli India

Total surface area: 320,000 m²
Workshop area: 41,000 m²
Technical and administrative offices: 2,500 m²
Start of operations: 2013

> Danieli USA / Ashland (KY)

Total surface area: 30,000 m²
Workshop area: 10,500 m²
Technical and administrative offices: 800 m²
Start of operations:2020

At Danieli we don't shop around for noble equipment

Danieli worldwide
Total surface area: 2,032,000 m²
Workshop area: 439,000 m²
Technical and administrative offices: 123,000 m²

DANIELI WORKSHOPS

State-of-the-art Danieli workshops ensure top-level manufacturing, quality control and assembly phases, at the highest levels.


1.


2.


3.

1. A CNC vertical lathe is used for finishing the bushings to drawing dimensions.
2. Danieli workshops house three, state-of-the-art temperature-controlled inspection rooms to check DanOil components.
3. The white metal bond strength is verified by Chalmers test in the materials testing laboratory.

DANOIL
DANIELI OIL FILM BEARINGS

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