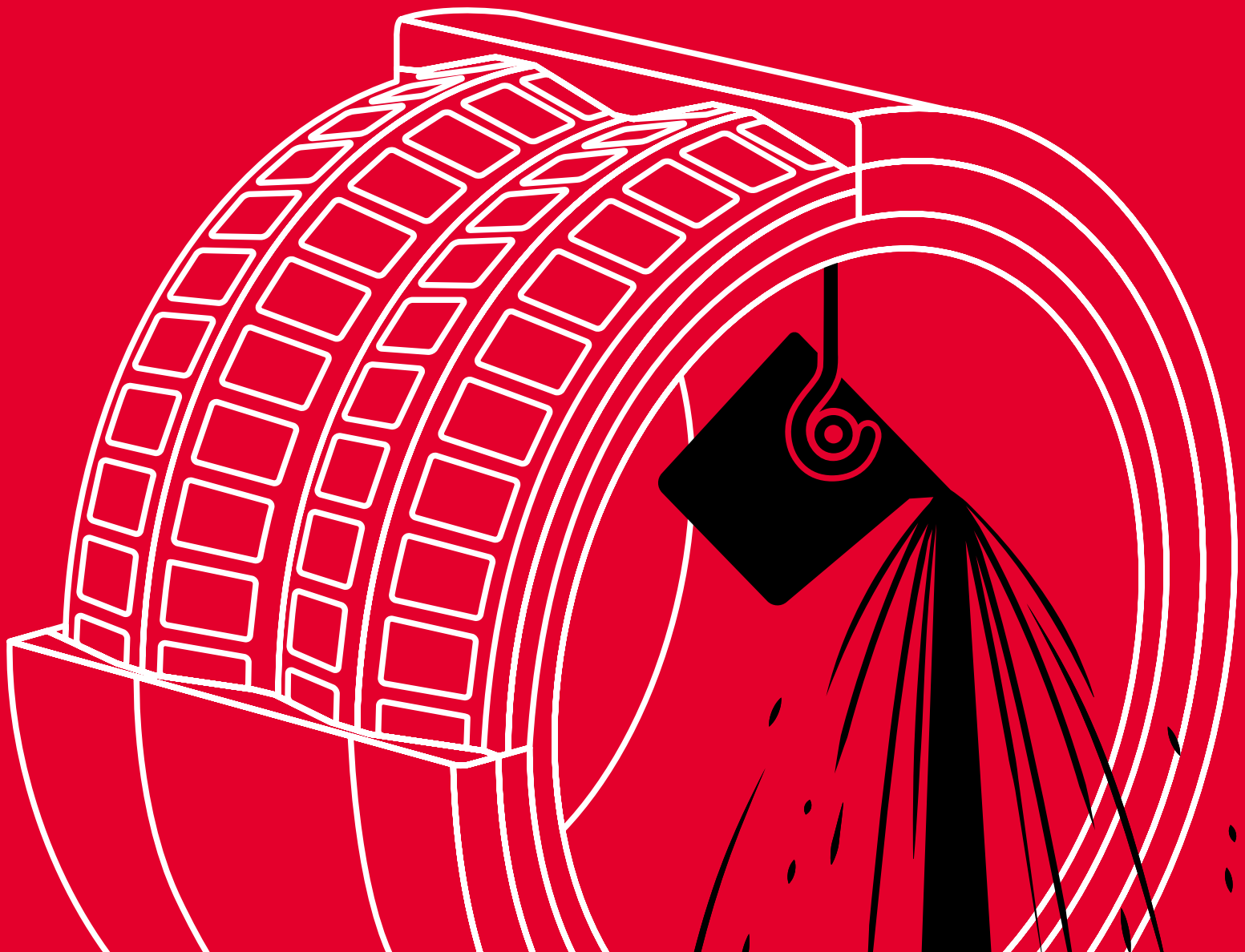
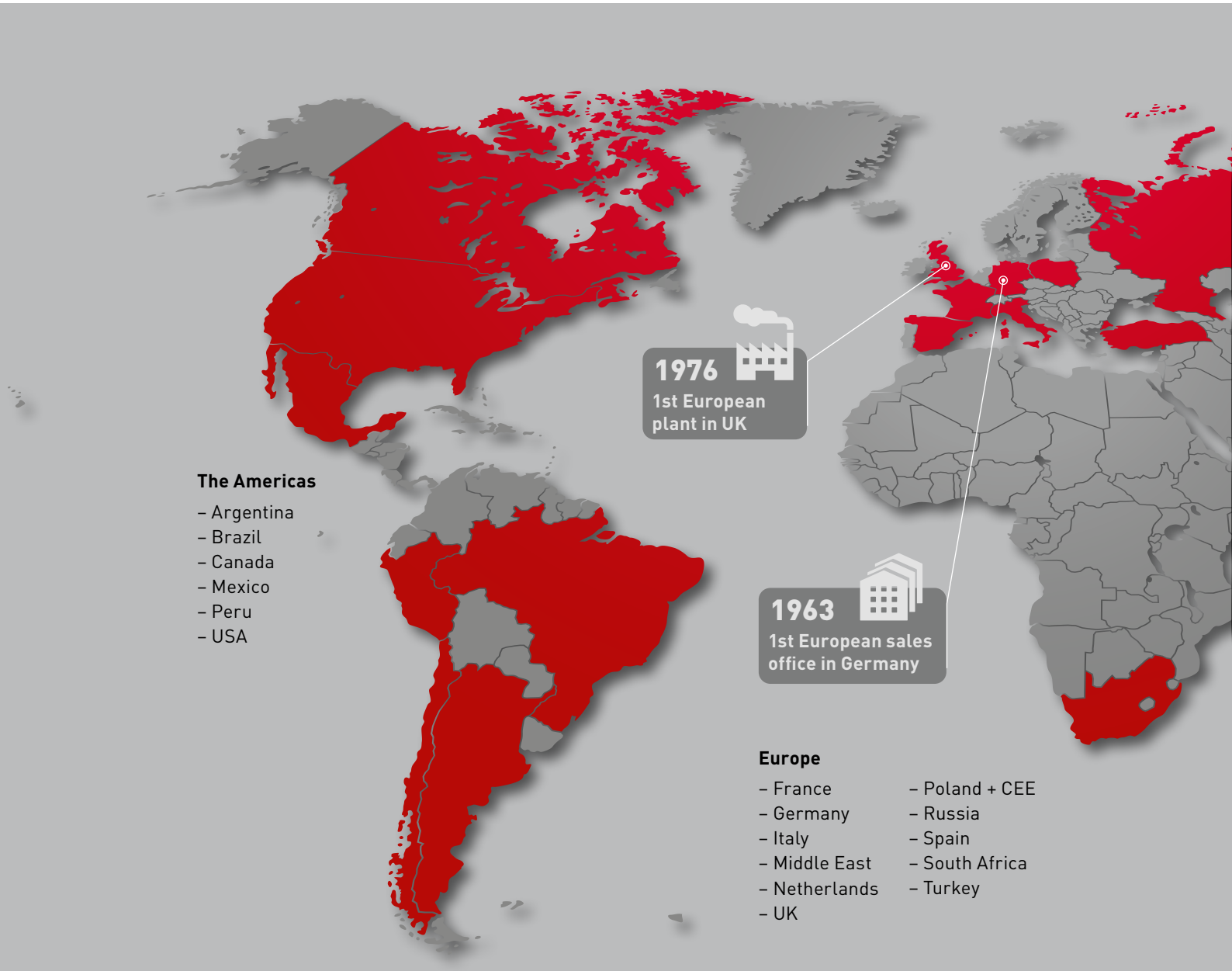
MOTION & CONTROL
NSK

STEEL & METAL



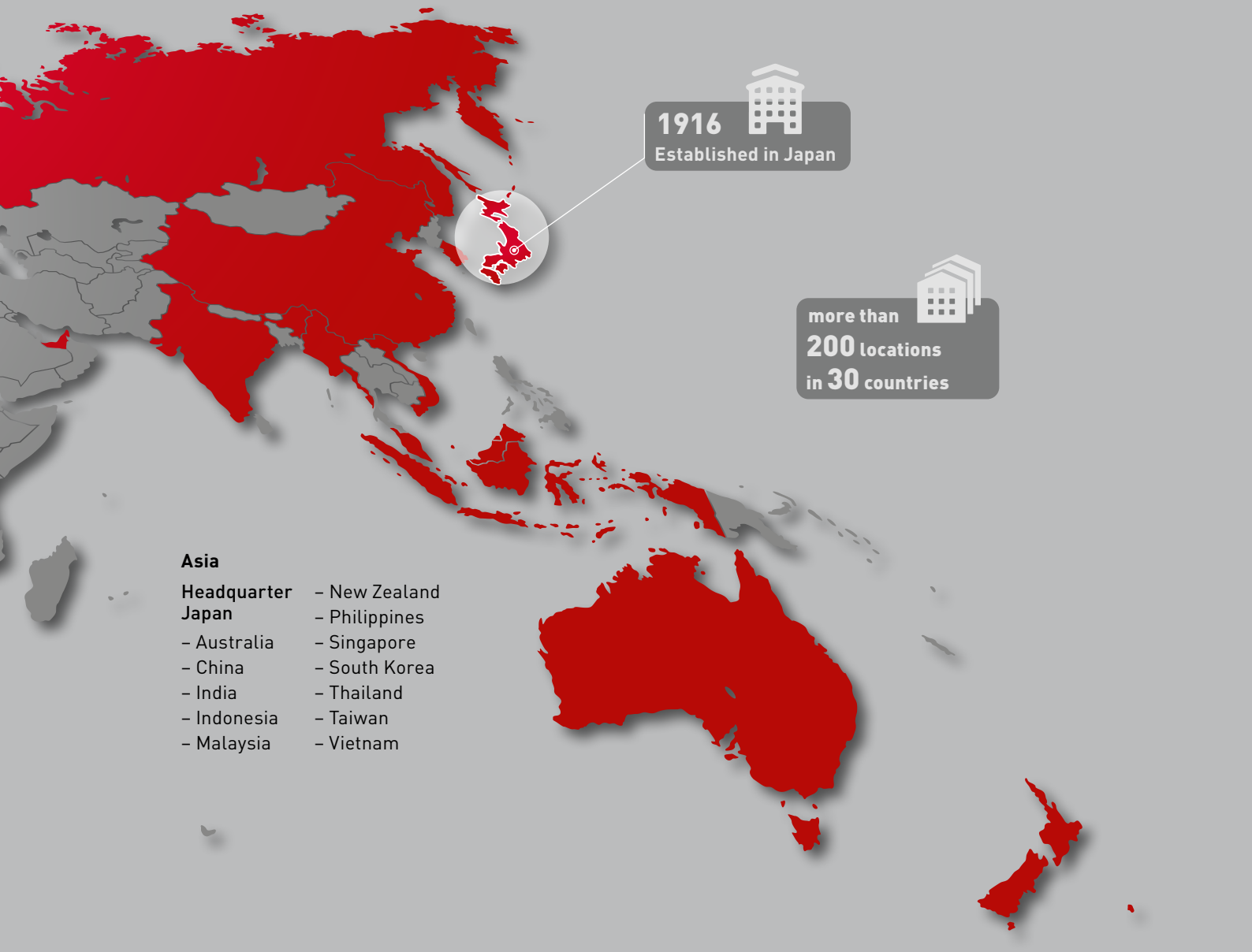
OUR MOST IMPORTANT PRODUCT: OUR CUSTOMERS' SATISFACTION

We are among the leading manufacturers worldwide for rolling bearings, linear technology components and steering systems. One reason for this is that our products are reliable and energy efficient in demanding environments and even under the harshest conditions. To achieve this, we do research in core technology areas such as material engineering and tribology, we are always optimising every process phase in terms of quality and our products undergo continuous development for applications



in a wide variety of industries. One thing motivates us here: we want to help you increase the reliability of your vehicles and equipment, not only with excellent products, but above all with excellent service. Our experienced engineers have a deep understanding of systems – together with you, they work to optimise products and processes and develop solutions for the future. The goal that we are dedicated to every day is ensuring that you remain competitive over the long run.

Dr. Ulrich Nass, CEO of NSK Europe Ltd.



Sector Brochure

"Solutions for the
Steel and Metals Industry"

MOTION & CONTROL™
NSK

SOLUTIONS FOR THE STEEL AND METALS INDUSTRY

OUR MOST IMPORTANT PRODUCT: OUR CUSTOMERS' STATISFACTION

We are among the leading manufacturers for rolling bearings, linear technology components and steering systems worldwide. We can be found on almost every continent – with production facilities, sales offices and technology centres – because our customers appreciate short decision-making channels, prompt deliveries and local service.

The NSK company

NSK commenced operations as the first Japanese manufacturer of rolling bearings back in 1916. Ever since, we have been continuously expanding and improving not only our product portfolio but also our range of services for various industrial sectors. In this context our worlwide research and production facilities are linked together in a global network. Here we concentrate not only on the development of new technologies, but also on the continuous optimisation of quality – at every process stage. Among other things, our research activities include product design, simulation applications using a variety of analytical systems and the development of different steels and lubricants for rolling bearings.

More about NSK under: www.nskeurope.com

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ROBUST, WEAR-RESISTANT AND DURABLE – NSK´S ROLLING BEARINGS FOR THE STEEL AND METAL INDUSTRY

We offer bearings that have been specially developed for all the relevant conditions encountered throughout the entire process. That´s why, for example, we have developed sealed spherical roller bearings for continuous casting plants that prevent the ingress of contamination and offer optimal service life. Our cylindrical roller bearings with optimised profile (NUB series) are also perfectly suited for continuous casting plants.

Then there are our taper roller bearings which are available in various special materials for rolling mills such as Super-TF together with our Sealed-Clean technology. Beyond that, we offer various bearings for sinter machines, LD converters, chain conveyors, levellers and many more.

Sealed-Clean bearings for extreme conditions

Reducing downtime through increased reliability

The variants are many, but all our products have one thing in common: they are reliable, wear-resistant and durable – thereby ensuring profitable production.

Innovation made by NSK – Sealed-Clean

In 1980, NSK was the first company in the world to bring the sealed four row tapered rolling bearing (Sealed Clean) on to the market. Since then, we have continually improved the Sealed-Clean bearing. In this way, we have been able to measurably increase its load-carrying capacity through newly-developed internal construction and a new sealing system. Even grease consumption has been drastically reduced; which not only leads to lower costs but also makes it more environmentally friendly. Sealed-Clean bearings can be supplied in case-hardened and through-hardened steel. NSK's various steel specifications are particularly wear and shock resistant due to our special heat and surface treatment technology.

It´s a tough life in the steel and metal industry: variations in temperature, high levels of contamination, rolling speeds of more than 2000 metres a minute, rocking motions and impacts. NSK rolling bearings take all of this in their stride; from the preparation of the raw material, through the smelting process, right up to the final rolled product.

The best combination for new developments: research and practical experience

NSK rolling bearings for the steel and metal industry are the result of intense research and development, as well as a close working relationship with our clients. As a result of the demands of practical experience, we conduct a continuous improvement programme for our products, with as much regard to construction as materials and lubrication. In order to guarantee the highest standards of quality and reliability under the harshest of conditions, all NSK products undergo the most stringent testing on our test rigs.

Development of rolling bearings for the steel and metal industry

Design and materials
Development of new types of construction and the use of innovative materials for longer operational life under harsh operating conditions

Simulation
Simulation techniques in various operational environments

Analysis and Diagnosis
- Bearing analysis techniques
- Fatigue damage analysis
- Diagnostic techniques

Test rig for the appraisal of performance and durability under realistic operating conditions

Test rig for bearings used in guide rolls of continuous casting machines

Test rig for bearings used in backup rolls of rolling mills

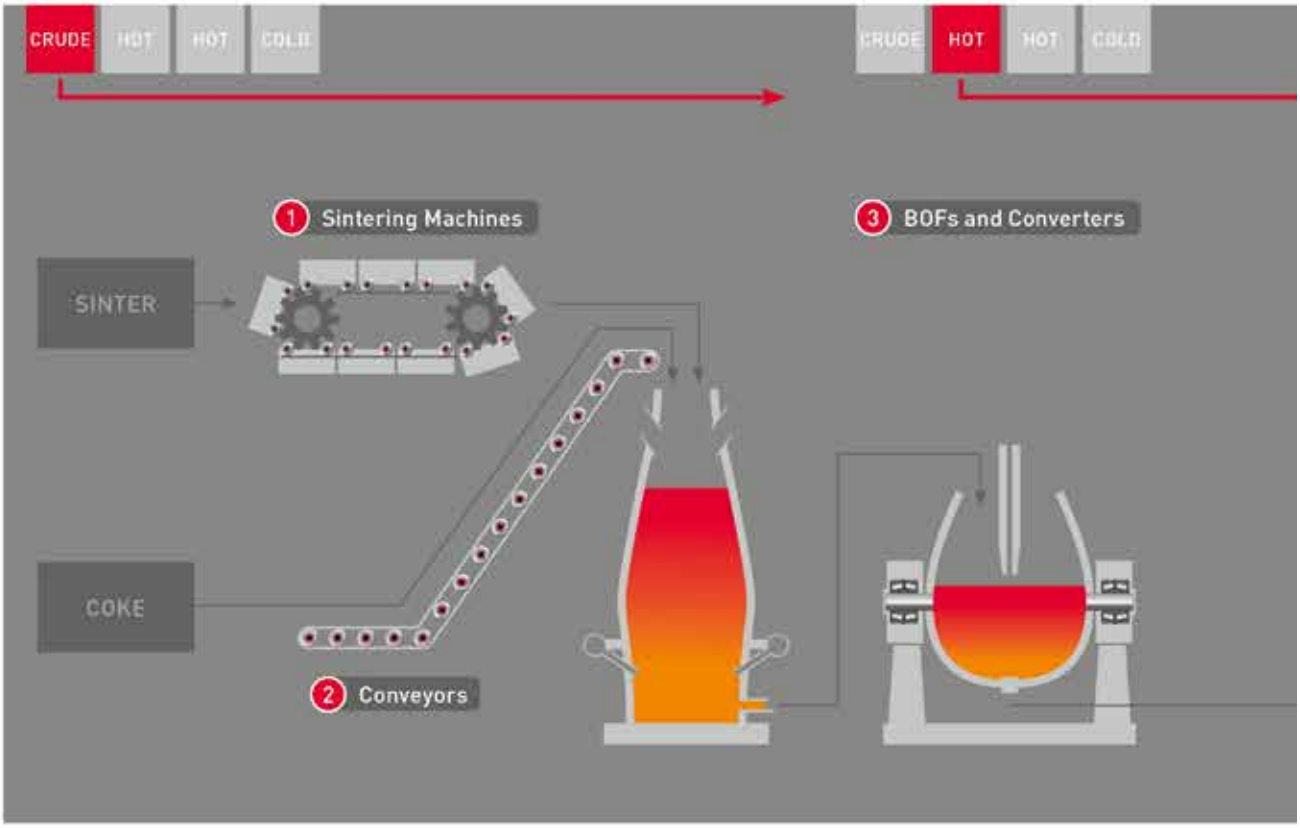
Test rig for bearings used in work rolls of rolling mills

PRODUCTS FOR THE ENTIRE STEEL AND METAL INDUSTRY PROCESS

Rolling bearings for steel and metal mills have to withstand varied and extreme operating conditions, amongst which high temperatures, high or low rotational speeds, as well as environments that are contaminated with water or dirt. We offer a whole range of products for all mill processes; products that deliver reliable and continuous operation under all conditions.

3 BOFs and Converters

Ultra-Large Split Bearings for BOFs and Converter Trunnions



1 Sintering Machines

Sealed-Clean Bearings for Sintering Machine Pallets

2 Conveyors

Spherical Roller Bearings NSKHPS Series

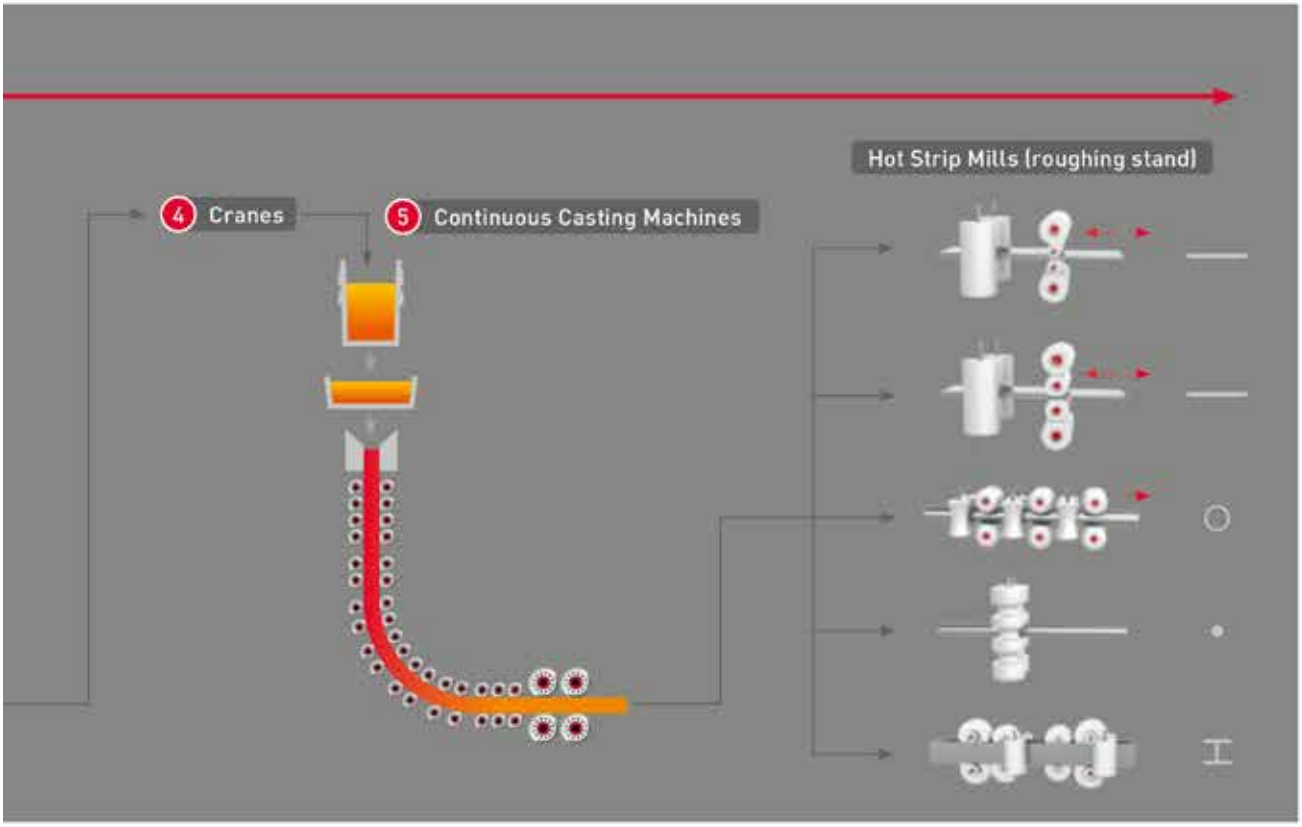
Plummer Blocks

4 Cranes

Full-Complement Cylindrical Roller Bearings for Crane Sheaves

6 Plate Mills

Cylindrical Roller Bearings, 4-Rows for backup rolls, Stud Type cage for super heavy loads



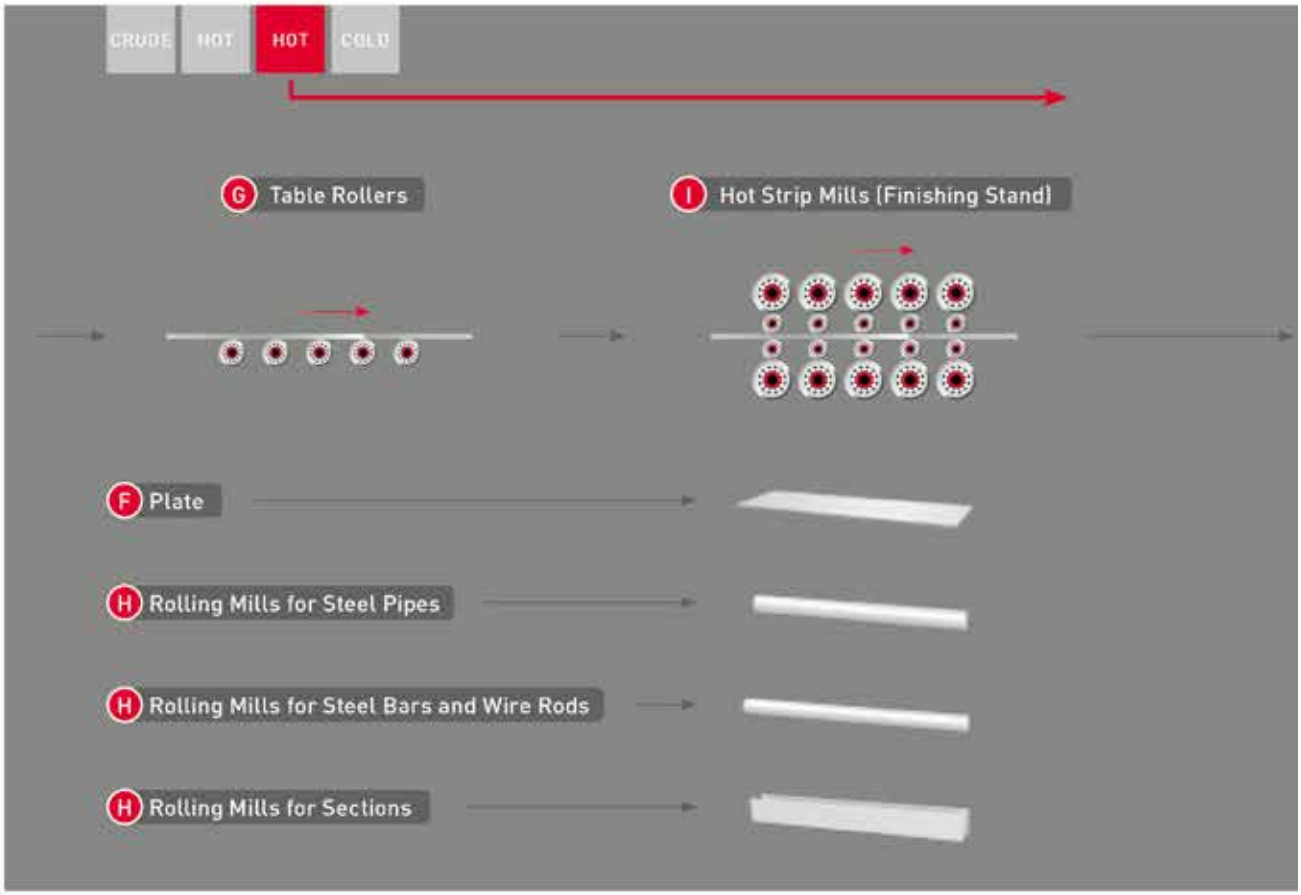
5 Continuous Casting Machines

Cylindrical Roller Bearings – NUB Series

Split Roller Bearing Units for segmented rolls

Cylindrical Roller Bearings with Aligning Rings

SWR Bearings



G Table Rollers

Ball bearings for High-Temperature Environments

Sealed-Clean Spherical Roller Bearings

Plummer Blocks

Cylindrical Roller Bearings EW + EM Series

H Rolling Mills for Steel Pipes, Steel Bars, Wire Rods and Sections

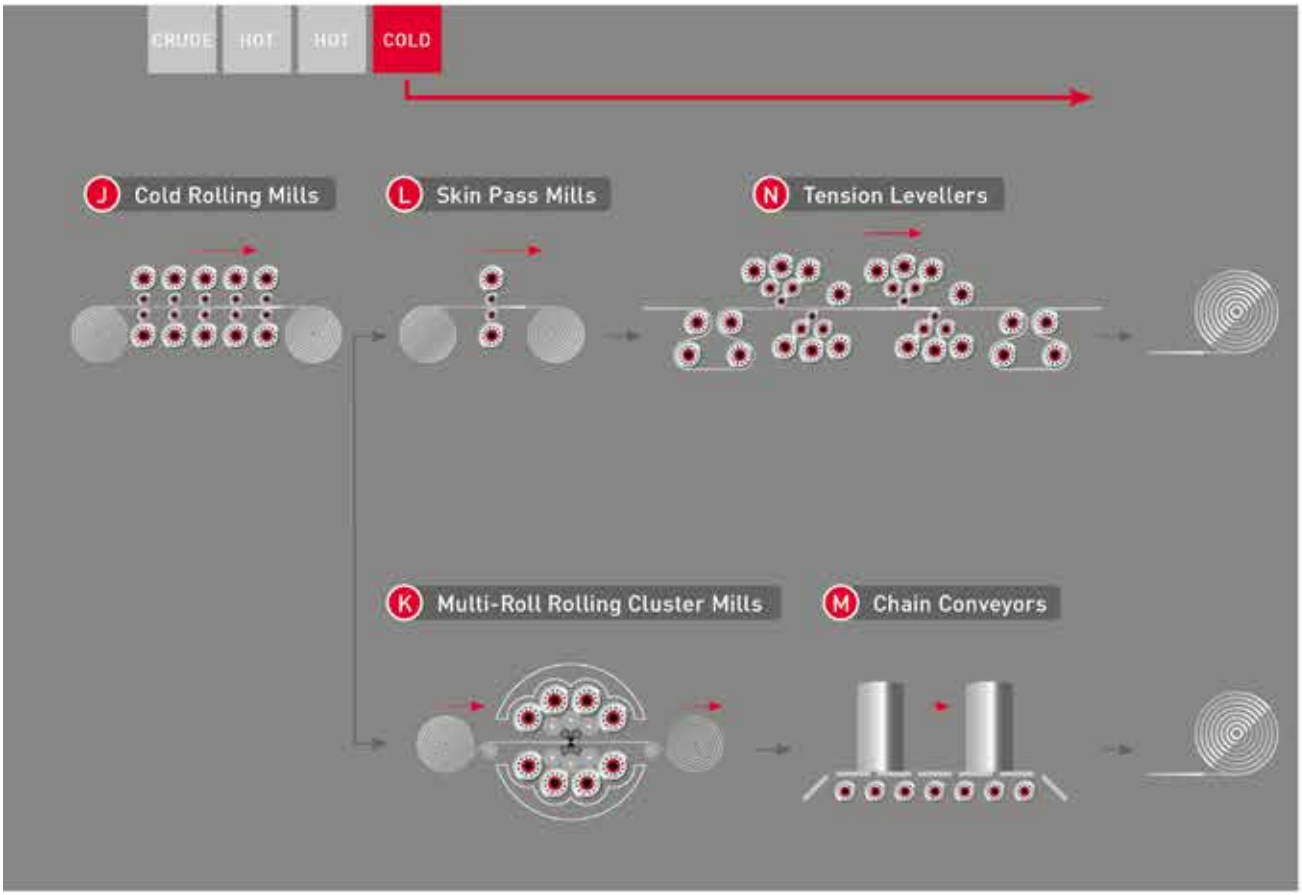
Cylindrical Roller Bearing and Tapered Roller Bearings, 4-Rows for horizontal rolls

Tapered Roller Bearings, 4-Rows for vertical rolls

I Hot Strip Mills (Finishing Stand)

Cylindrical Roller Bearing and Tapered Roller Bearings, 4-Rows for Roll Necks

Tapered Roller Bearings for axial loads



J Cold Rolling Mills

Cylindrical Roller Bearing and Tapered Roller Bearings, 4-Rows for Roll Necks

Tapered Roller Bearings, 4-Rows, Sealed Clean, Extra Capacity

Water-resistant Grease for sealed Roll Neck Bearings

Tapered Roller Bearings, Double-Row for axial loads

K Multi-Roll Rolling Cluster Mills

Backing Bearings for Backup Rolls

L Skin Pass Mills

Tapered Roller Bearings, 4-Rows, Sealed Clean, Extra Capacity

Cylindrical Roller Bearings, 4-Rows for Backup Rolls

M Chain Conveyors

S-Type Sealed-Clean Bearings for Chain Conveyors

N Tension Levellers

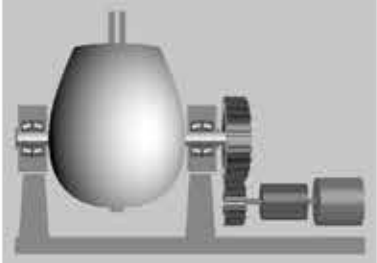
Bearing Units for Tension Levellers

Bearings for BOF's and Converters

ULTRA-LARGE SPLIT BEARINGS FOR BOF'S AND CONVERTER TRUNNIONS

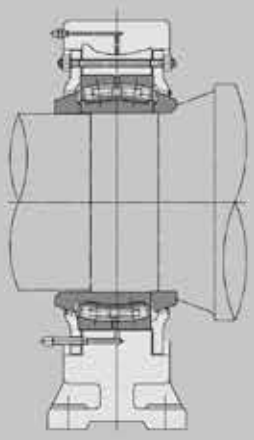
1. Operating conditions

- High temperature
- Heavy loads
- Ultra-low speed and oscillating



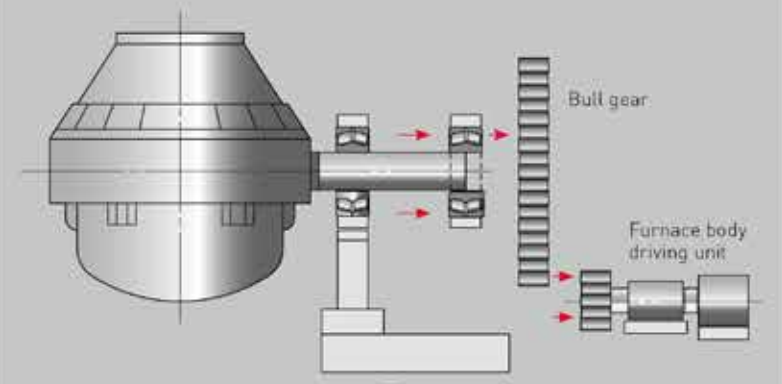
BOFs and converters

Conventional structure



2. Typical problems

Inboard bearings cannot be replaced without removing the bull gear



Bearing replacement work is time-consuming, requiring high maintenance costs

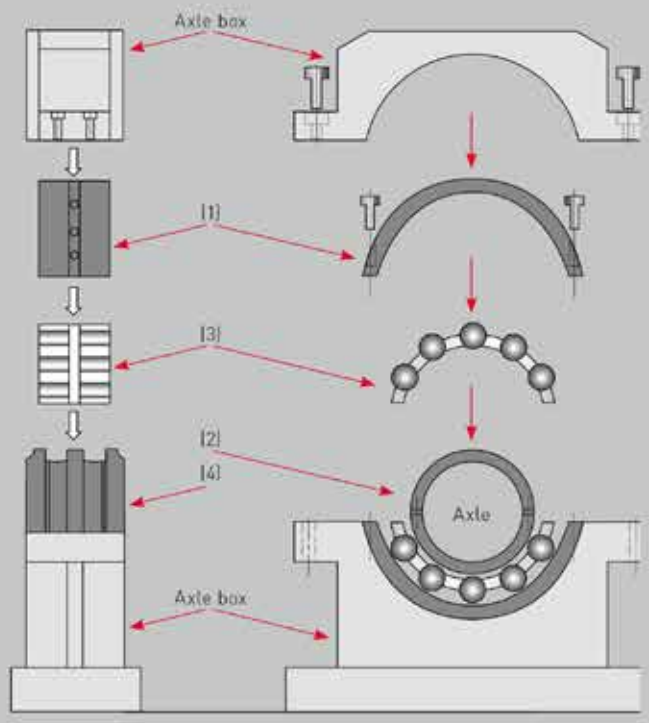
In addition, sudden bearing replacement due to an unexpected failure causes large production loss in the subsequent processes

3. Countermeasures

Ultra-Large Split Bearings for BOFs and Converter Trunnions

- A split design of ultra-large spherical roller bearings:
  (1) outer ring
  (2) inner ring
  (3) roller and cage assembly and
  (4) fastening ring
- Seal sliding surface integrated by a fastening ring

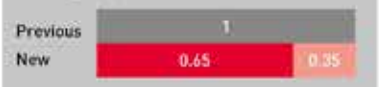
Design measures



4. Benefits

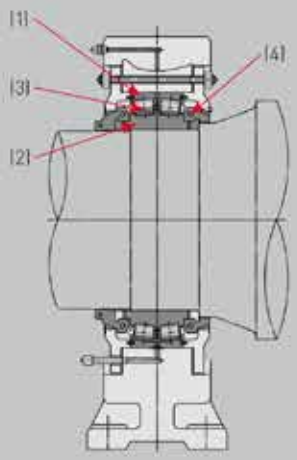
- Bearings can be replaced without removing the bull gear, thus reducing maintenance costs
- Reduction of maintenance costs by shortening length of time for bearing replacement work
- Reduction of production loss, which would affect subsequent processes

Comparison of time required for bearing replacement work in field test



The bearing replacement period represents the actual result for bearings with bore diameter of 1200 mm to 1400 mm. In the case above, the bearing with the newly developed structure reduced the time needed for bearing replacement work by approximately 35 %, and thereby significantly reduced maintenance cost.

Newly developed structure

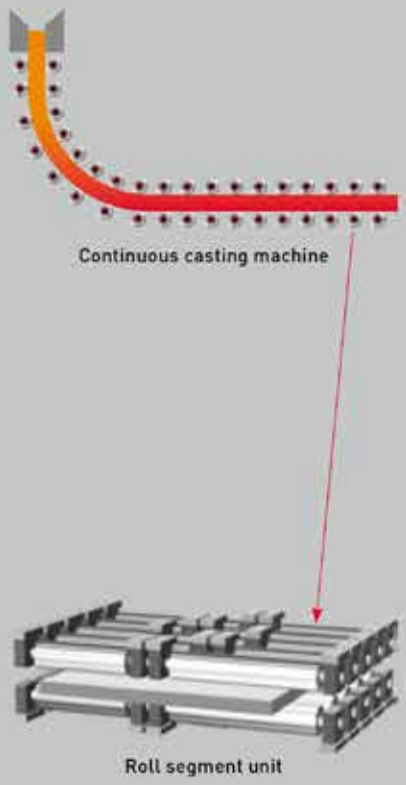


Bearings for Continuous Casting Machines

BEARINGS FOR GUIDE ROLLS

1. Operating conditions

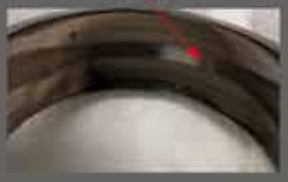
- Heat
- Heavy loads
- Water vapor (water)
- Ultra-low speed
- Scale
- Deflection of a roll



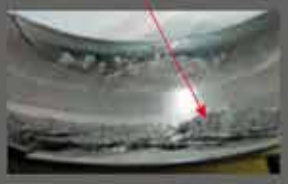
2. Typical problems

Differential sliding specific to spherical roller bearings

- Uneven wear



- Flaking
- Crack



- Expansion of roll gaps (failure of rolls)
- Defective-quality products
- Unexpected production line failure
- High bearing usage cost

3. Countermeasures

Material measures

Spherical Roller Bearings – SWR series*

- Improved wear resistance – three times compared to AISI 52100 bearing steel
- Improved flaking life property – five times compared to AISI 52100 bearing steel
- Improved toughness of material core (prevention of crack damage) – five times compared to AISI 52100 bearing steel

Design measures

Cylindrical Roller Bearings with optimised profile – NUB series*

- High capacity, full complement design
- Prevention of wear due to no differential sliding of spherical roller bearing combined with self-aligning capability due to optimised internal geometry
- Smooth floating capability between inner ring and rollers

Cylindrical Roller Bearings with Aligning Rings (for free end) – RUB Series*

- Prevention of wear due to no differential sliding of spherical roller bearing and additional function of self-aligning (see page 17 for further explantion)
- Smooth floating capability between inner ring and rollers
- Type: Easy handling cage type Full-complement type with higher load capacity

Split Cylindrical Roller Bearings (for segmented rolls) – RCPH/PHR Series*

- Prevention of wear due to no differential sliding of spherical roller bearing (see page 17 for further explantion)
- Full-complement, higher load capacity design
- Multi-functional seal and high rigidity plummer block unit

4. Benefits

- Improved bearing durability prevents unexpected accidents
- Roll segment is replaced less frequently, thus reducing maintenance costs

NSK Total Quality Solutions

SWR

NUB

RUB

RCPH/PHR

Recommended bearing arrangements see next page

* Bearing tables see page 32 (SWR Series), page 34 (RUB Series), page 35 (NUB Series), page 36 (RCPH/PHR).

Bearings for Continuous Casting Machines

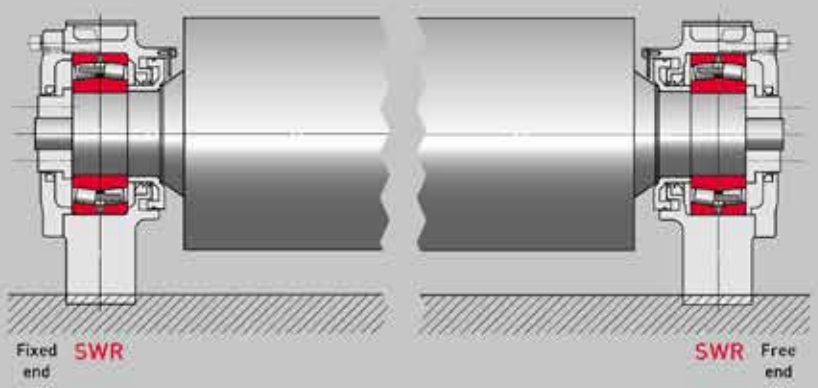
RECOMMENDED BEARING ARRANGEMENTS

NSK has prepared the following arrangements for bearings used in guide rolls of continuous casting machines including the recently developed NUB cylindrical roller bearings and SWR Bearings.

Bearing arrangement for single rolls

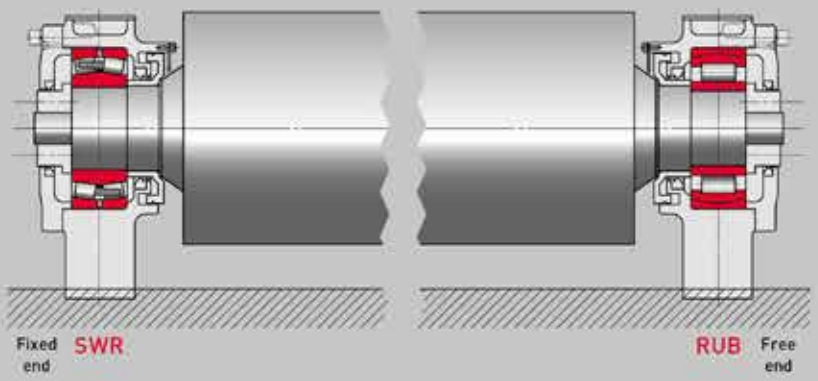
Case 1

Spherical roller bearings currently used can be replaced with SWR Bearings without modifying the axle boxes, thus easily enhancing performance.



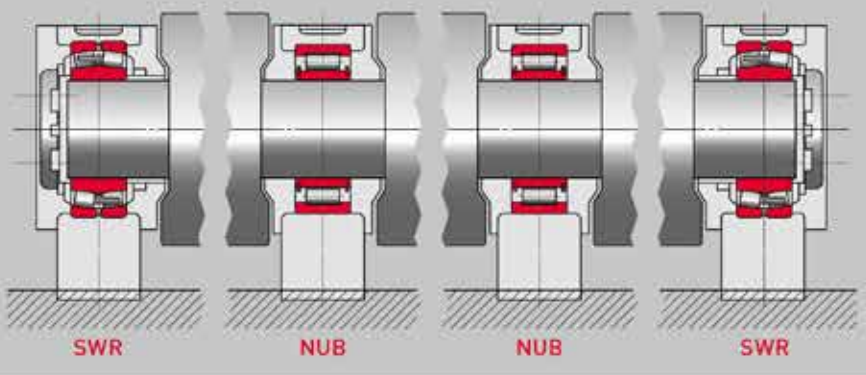
Case 2

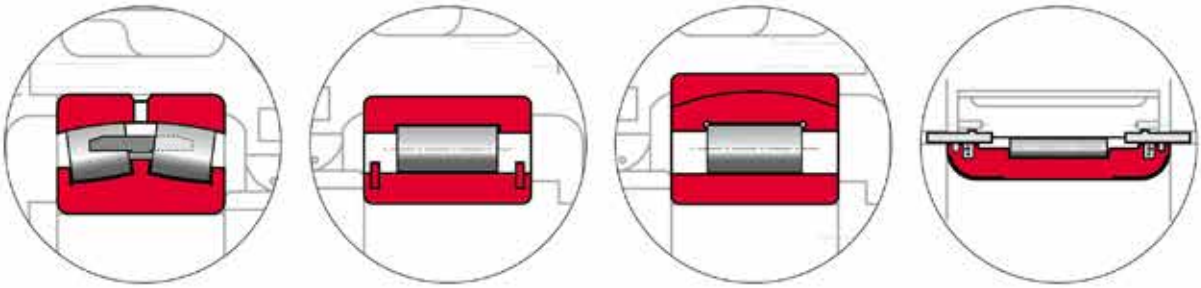
Optimal bearing arrangement to relieve roll expansion. Depending on machine design, minor modifications to axle boxes might be necessary to adopt RUB bearings in free end positions.



Bearing arrangement for sleeve type rolls

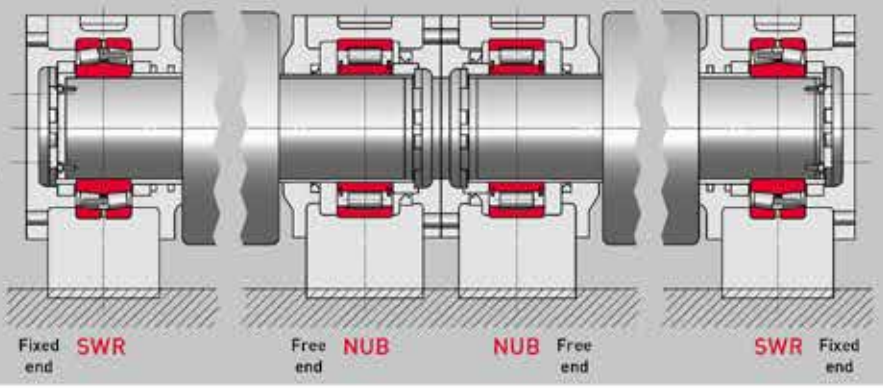
Toroidal bearings used on modern generation machines can be succesfully upgraded with NUB bearings, whilst spherical roller bearings can benefit from SWR technology, all being done without modifications to any of the axle boxes.





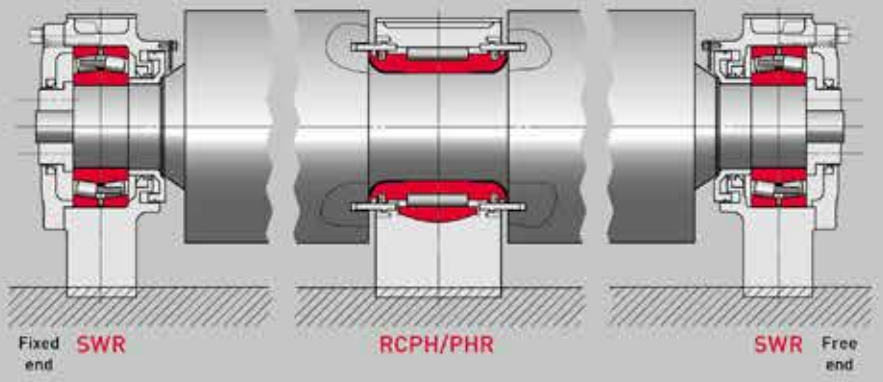
Bearing arrangement for combination type rolls

High load carrying capability through usage of NUB bearings in free-end positions for combination type rolls.
Depending on machine design, minor modifications to axle boxes might be necessary to adopt NUB bearing in free end positions.

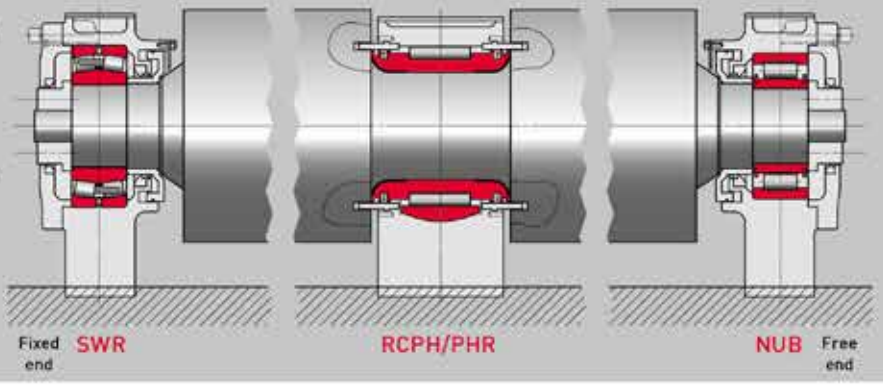


Bearing arrangement for segmented drive rolls

Case 1
Spherical roller bearings currently used can be replaced with SWR Bearings without modifying the axle boxes, thus easily enhancing performance.



Case 2
Optimal bearing arrangement to relieve roll expansion and increase load carrying capability.
Depending on machine design, minor modifications to axle boxes might be necessary to adopt NUB bearings in free end positions.

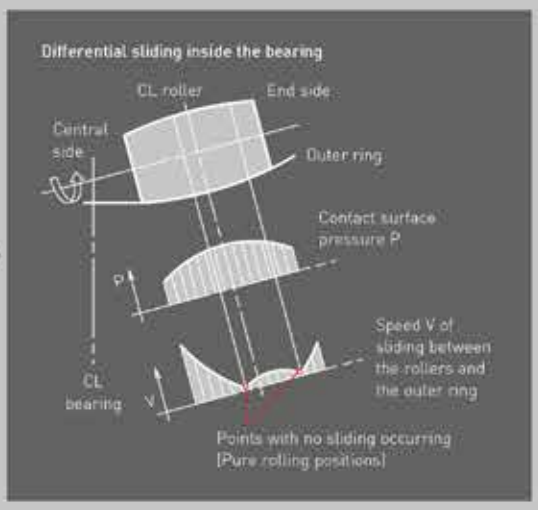


Bearings for Continuous Casting Machines

IDENTIFICATION OF THE FAILURE MECHANISM OF SPHERICAL ROLLER BEARINGS

Bearing

Spherical Roller Bearings

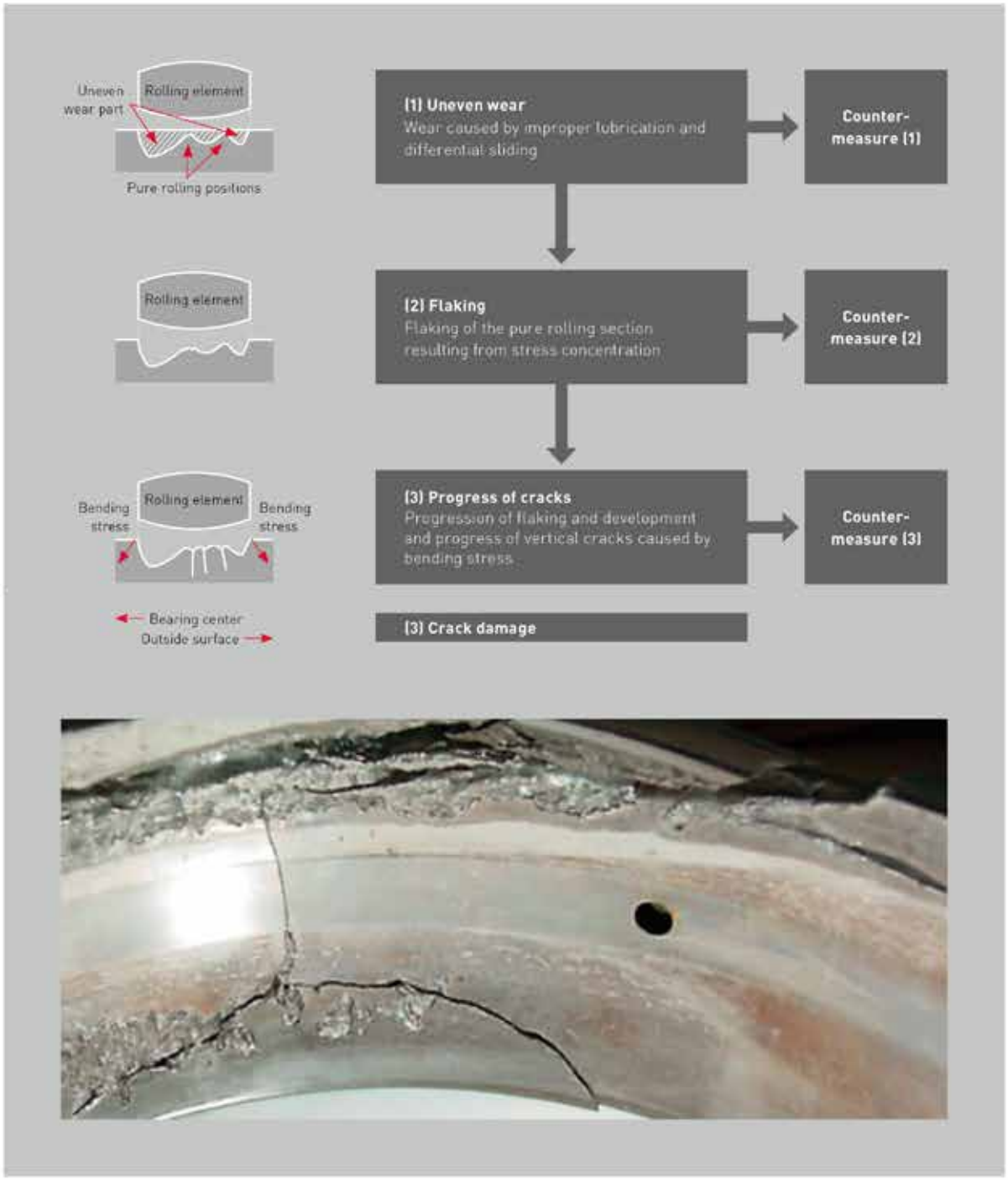


Operating conditions

Entry of debris and water → Insufficient lubrication

Ultra low speed and heavy loads → Insufficient oil film formation

→ Oil film rupture (metallic contact)

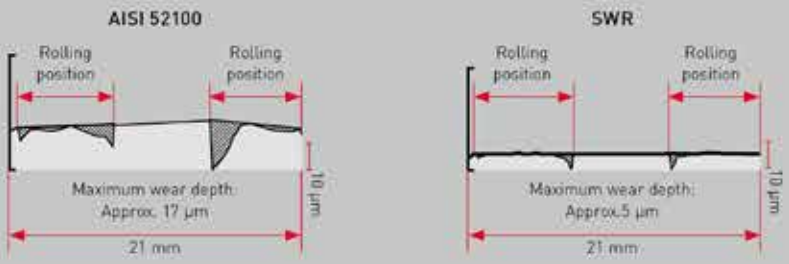

Uneven wear part
Rolling element
Pure rolling positions
(1) Uneven wear
Wear caused by improper lubrication and differential sliding
Counter-measure (1)
Rolling element
(2) Flaking
Flaking of the pure rolling section resulting from stress concentration
Counter-measure (2)
Bending stress
Rolling element
Bending stress
(3) Progress of cracks
Progression of flaking and development and progress of vertical cracks caused by bending stress
Counter-measure (3)
Bearing center
Outside surface
(3) Crack damage

DEVELOPMENT OF SWR BEARINGS

Basic performance

Profile of wear on the outer ring raceway surface of Spherical Roller Bearings

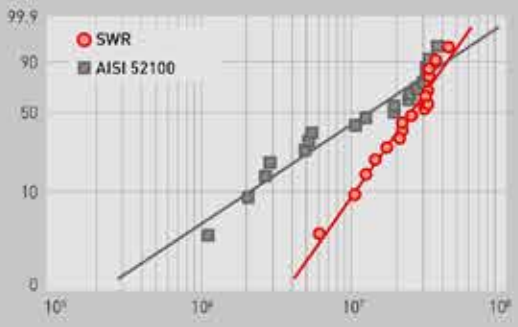
Countermeasure (1): Wear resistance



Wear resistance approx. 3 times

Evaluation of an endurance test using 22210CD bearings

Countermeasure (2): Improved flaking life (inhibition of flaking)



Evaluation of operating life by thrust-type life test

Bearing life approx. 5 times

Countermeasure (3): Improved outer ring strength

Evaluation of outer ring strength

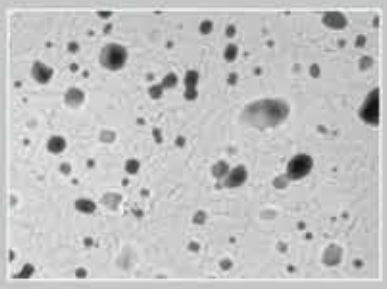
Core toughness approx. 5 times

Development of wear-resistant materials

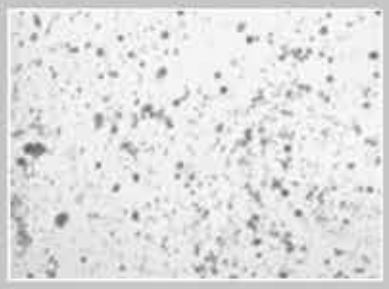
- Selection of steel chemical composition
- Applied special heat treatment technology
- Controlled optimum level for retained austenite

Microstructure:
Result P-extraction replica work using transmission electron microscopy (TEM)

AISI 52100



SWR



Field endurance evaluation

Longer bearing life results in extended segment replacement cycles
SWR Bearings allow users, who have been forced to replace segments at frequent cycles due to the bearing life of standard spherical roller bearings, to attain maximum effect in reducing maintenance, by decreasing unexpected accidents and using rolls to the full extent of their operating life.

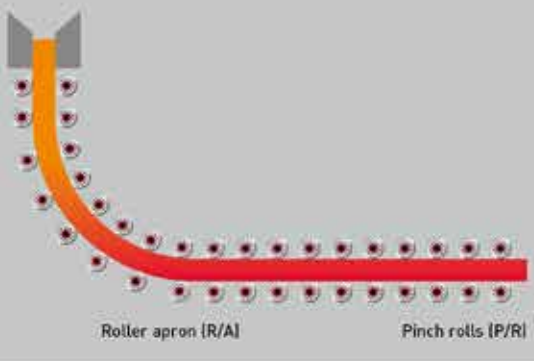
Standard Spherical Roller Bearings

Ø Average segment replacement cycles: 1

SWR Bearings

Ø Average segment replacement cycles: 1.6

Maximum: 2



Bearings for Continuous Casting Machines

CYLINDRICAL ROLLER BEARINGS WITH OPTIMISED PROFILE AND ALIGNING RINGS

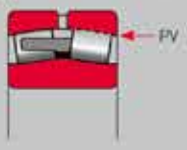
Development of new type bearings

Comparison of PV value properties affecting the wear within the bearing

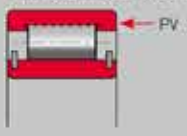
Surface pressure (P), Sliding (V), Wear property parameter: PV (PxV)

PV value between the outer ring raceway surface and roller raceway surface

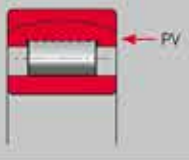
(1) Spherical Roller Bearing



(2) Cylindrical Roller Bearing with optimised profile

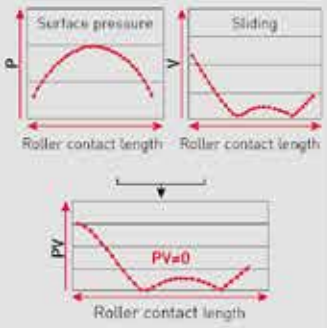


(3) Cylindrical Roller Bearing with aligning ring

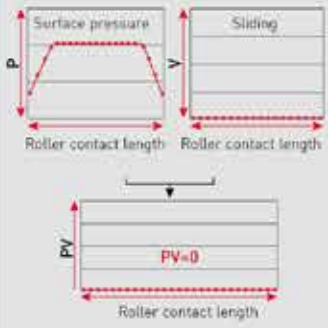


PV value properties of

Spherical Roller Bearing (1)



Cylindrical Roller Bearing (2) (3)



Field endurance evaluation

Wear evaluation

Example of inspection of an abrasion level on the outer ring raceway surface

Standard Spherical Roller Bearing

Amount of wear:
14 µm

Service period: 12 months

Outer ring raceway surface abrasion was significant: large uneven wear

Cylindrical Roller Bearing

Amount of wear:
2 µm

Service period: 21 months

Wear on the outer ring raceway surface was infinitesimal

USER BENEFIT

Estimated effect of maintenance cost reduction

Maintenance cost includes expenses for repairing of rolls, replacement of bearings, seal and fittings, as well as labor cost required on every segment replacement.

Standard bearings

Example: 24 months

Frequency of segment maintenance	First	Second	Third
Maintenance cost	Maintenance cost	Maintenance cost	Maintenance cost
Segment replacement cycles	1 (8 months)	1 (8 months)	1 (8 months)

SWR Bearings

Example: 26 months

Frequency of segment maintenance	First		Second	
Maintenance cost	Maintenance cost	Reduced cost	Maintenance cost	Reduced cost
Segment replacement cycles	1.6 (13 months)		1.6 (13 months)	

If SWR Bearings are used on 1-8 segments out of 15 segments of a 2-strand continuous casting machine, then segment life is extended on average 1.6 times. The estimated reduction effect is 20 %-30 % of total maintenance cost.

Success Story

Find out how NSK can help you to save costs by improving the productivity of your machinery and reducing costs caused by any failures during the production process.

https://www.nskeurope.com/en/industries/industrial/steel-and-metals/continuous-casting-machine---production-of-shaped-sections.html

Bearings for Rolling Mills

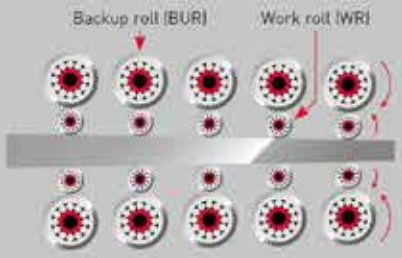
TAPERED ROLLER BEARINGS (4-ROWS) FOR WORK ROLLS

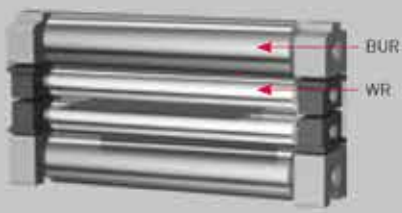
1. Operating conditions

- High speed/low speed
- Heavy loads
- Vibration and impact
- High temperature
- Scale
- Water infiltration

Major target mills:

- Hot strip mills
- Skin pass mills
- Cold rolling mills
- Temper rolling mills





Tandem cold rolling mill

2. Typical problems

3. Countermeasures

Optimum construction

Tapered Roller Bearings (4-Rows) Extra capacity, Sealed-Clean Concept, KVS Series*

- Higher load capacity: increased by 15 %-35 % compared to conventional sealed bearings
- Super-TF steel: resistant to foreign contamination, used as standard
- Controlled negative pressure during rolling to prevent water infiltration
- Improved sealing through usage of heat- and water-resistant sealing materials
- Easier handling of seals

Water-resistant grease for sealed roll neck bearings – AQGRD R1

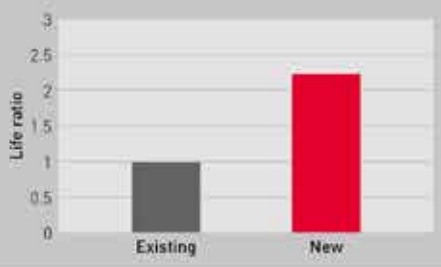
- Inhibits water entry to rolling surface
- Minimises premature flaking and rust
- More than doubled life with new grease

Flaking life test – AQGRD R1

Scenario of cold rolling work roll at following conditions

- Bearing: HR32017XJ (open single-row tapered roller bearing)
- Room temperature while bearing temperature at 60-70 °C
- Radial force: 35.8kN
  Axial force: 15.7kN, P/C: 0.25
- Speed: 1500 r/min

Test Result



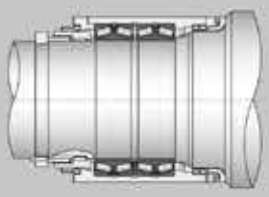
4. Benefits

- Higher reliability and longer operating life prevent unexpected accidents
- Bearing seal requires less cleaning of work environment and reduces grease consumption
- Reduced maintenance costs

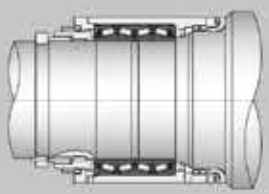
User Benefit page 31

Conventional structure

(1) Open type four-row tapered roller bearing



(2) Sealed four-row tapered roller bearing



*Bearing tables see page 38.

Bearings for Rolling Mills

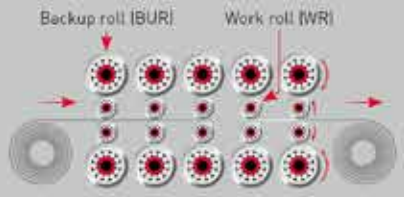
CYLINDRICAL ROLLER BEARINGS (4-ROWS) FOR BACKUP ROLLS

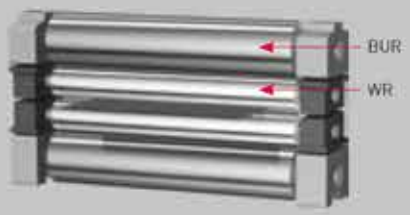
1. Operating conditions

- Vibration and impact
- Heavy loads
- High temperature
- High speed/low speed

Major target mills:

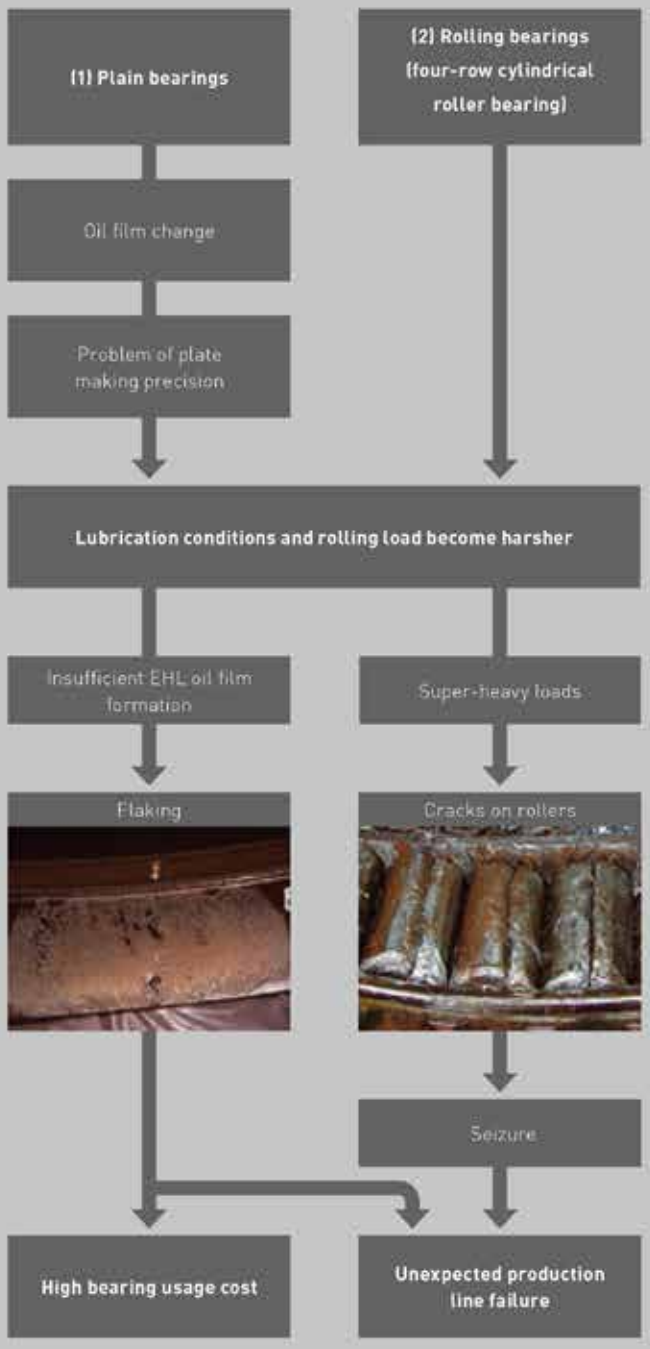
- Plate mills
- Skin pass mills
- Hot strip mills
- Temper rolling mills
- Cold rolling mills





Tandem cold rolling mill

2. Typical problems



3. Countermeasures

Design

Cylindrical Roller Bearings (4-Rows) STF-RV Series, Pin Type Cage*

- Long life Super-TF steel, resulting in longer durability, even under boundary-lubrication with insufficient EHL oil film formation
- Higher load capacity by using pin type cage
- Higher rotational accuracy

Bearing usage cost reduced by 50 %

Cylindrical Roller Bearings (4-Rows), STF-RV Series, Stud Type Cage*

- Adoption of solid type rollers associated with the development of a stud-type cage
- Higher load capacity
- Adoption of long life Super-TF steel
- Higher rotational accuracy

Elimination of unexpected accidents caused by cracks on rollers

4. Benefits

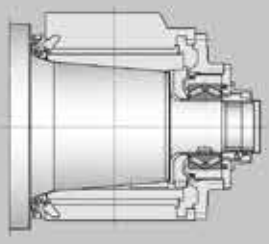
- Higher reliability and longer operating life prevent unexpected accidents
- Reduced maintenance costs
- Smoother rolling of bearings for backup rolls improves plate making precision

Comparison of actual life extension in field test

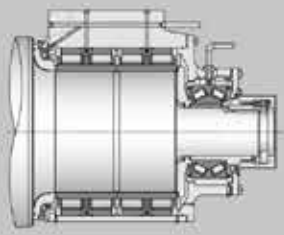
- Conventional steel = 1
- Super TF steel = 2

Conventional structure

(1) Plain bearing



(2) Rolling bearing



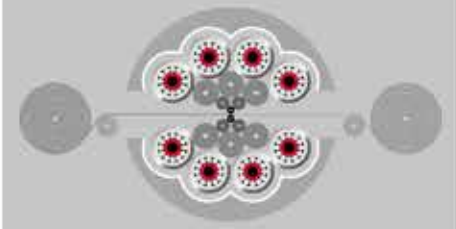
* Bearing tables see page 40.

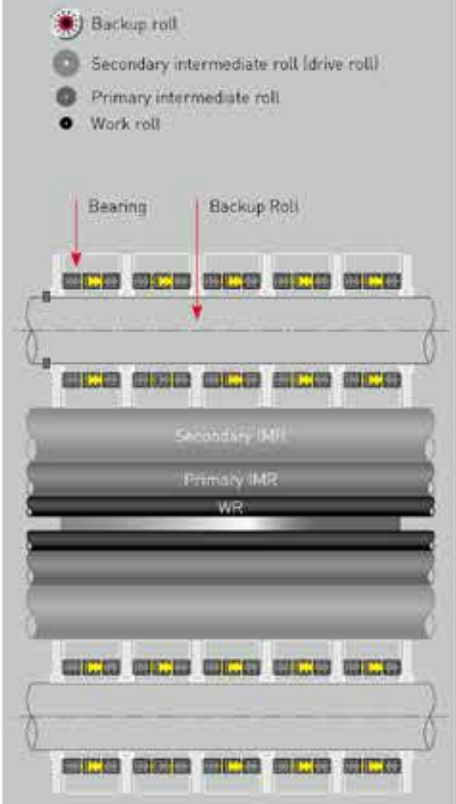
Bearings for Rolling Mills

SENDZIMIR BACKUP ROLL BEARINGS

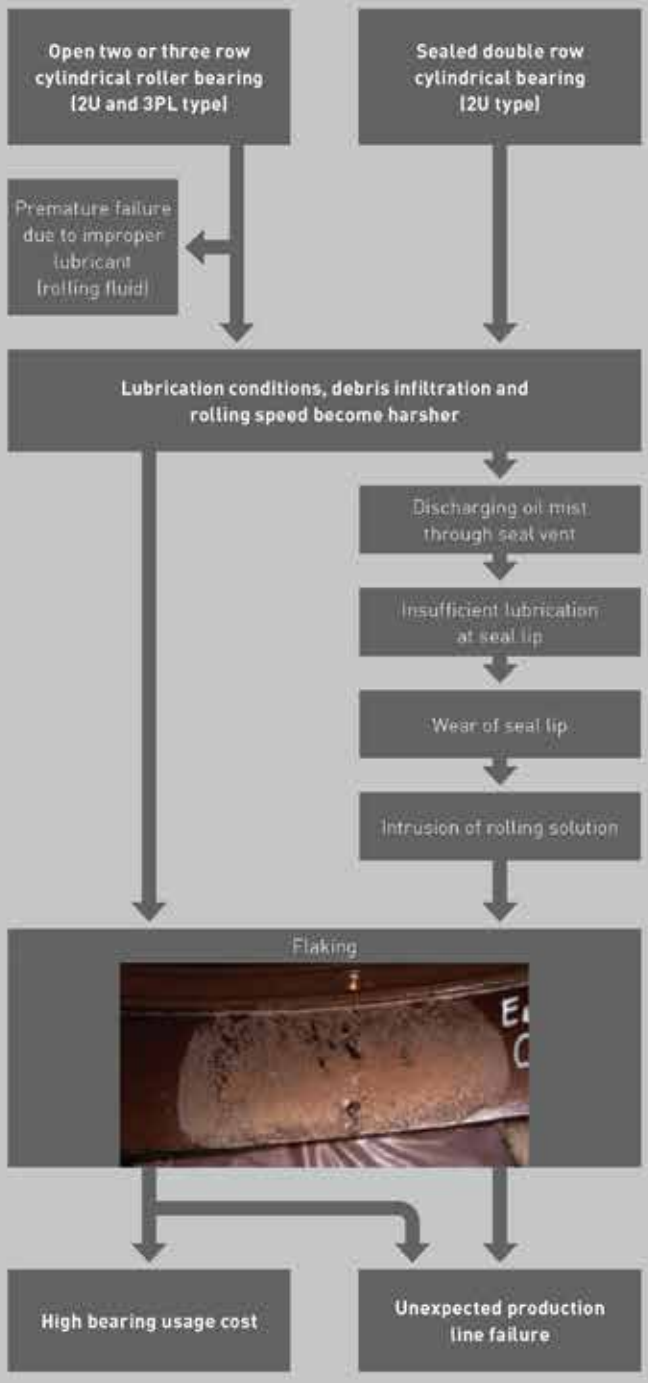
1. Operating conditions

- High speed
- Heavy loads
- Vibration and impact
- Entry of rolling solution





2. Typical problems



3. Countermeasures

Material

Super-TF Sendzimir Backup Roll Bearings

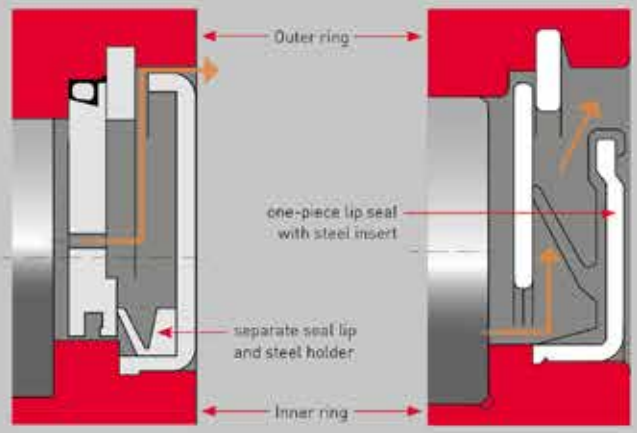
- Improved inner ring durability under heavy loads and severe lubrication conditions
- Almost twice the fatigue life time under contaminated environment when compared to conventional bearing steel
- Optionally available with EP (extra-pure) steel for up to 5 times longer life time than conventional bearing steel

Design

Sealed Sendzimir Backup Roll Bearings

- Optimised sealed design allowing oil-air mist to be discharged through the seal lip
- Lower seal contact force allows for higher speed operation, increasing productivity
- Simplified seal construction with reduced number of components for easier and quicker maintenance

Oil-air flow – Conventional vs NSK seal design



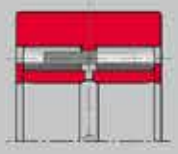
4. Benefits

- Reduced seal wear translates into lower maintenance costs and higher bearing reliability
- Higher reliability and longer operating life prevent unexpected line stops and production losses
- Reduced total bearing usage cost through longer life time

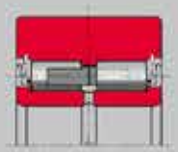
Conventional Structure

3PL type

2U type

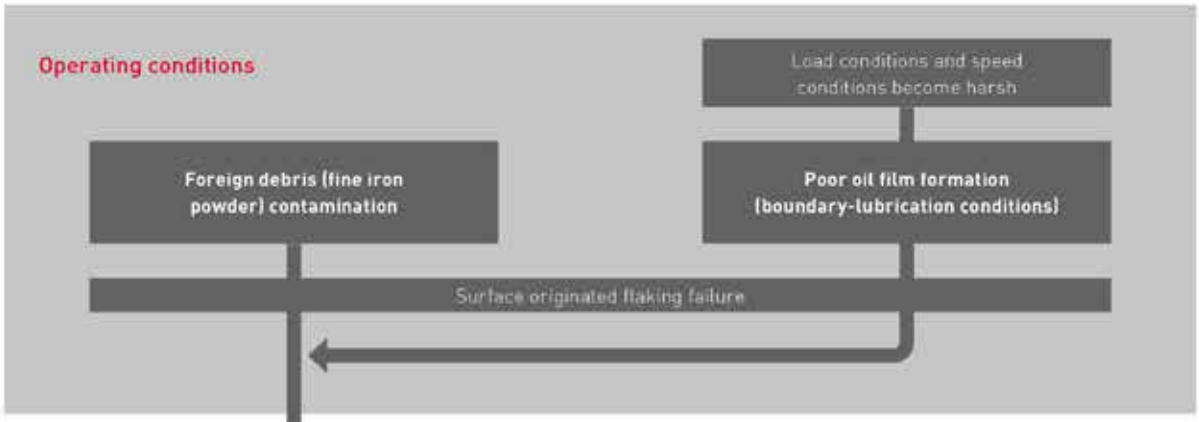


Sealed 2U type



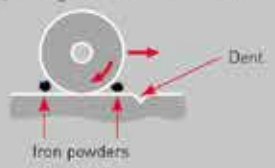
Bearings for Rolling Mills

IDENTIFICATION OF THE FAILURE MECHANISM OF BEARINGS FOR ROLLING MILLS

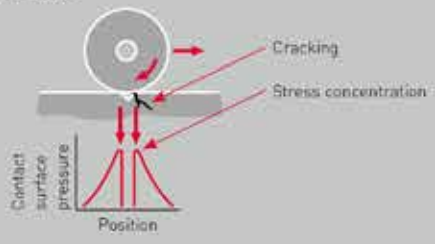


Failure mechanism

Step 1: Dents by foreign debris contamination



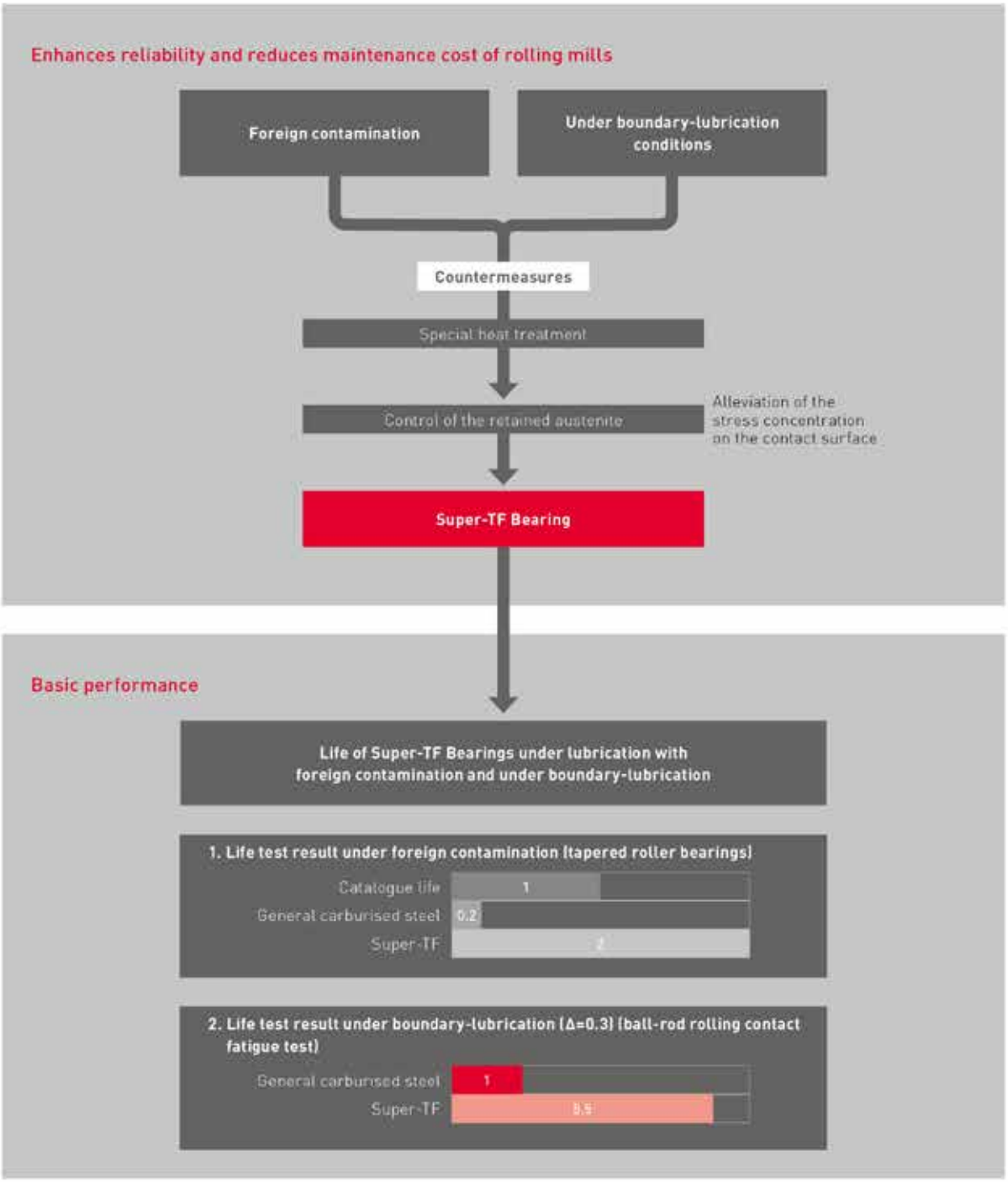
Step 2: Stress concentration around debris dents develop into cracks



Step 3: Cracks propagate under the load of each passing roller and develop into flaking

Example of early stage of flaking generated by foreign debris contamination

DEVELOPMENT OF SUPER-TF BEARING



Bearings for Rolling Mills

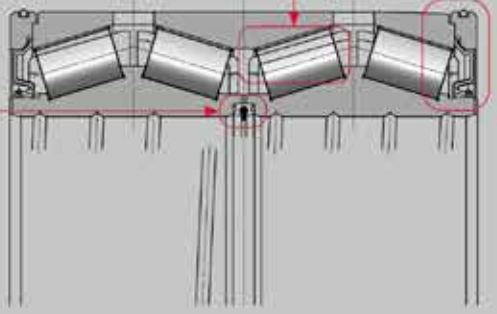
TAPERED ROLLER BEARINGS (4-ROWS) EXTRA-CAPACITY, SEALED CLEAN, KVS SERIES

Design measures

High-load capacity design
New internal structure specifications, combined with a new type of seal, increase bearing capacity

New seal and holder
The new seal and its holder make handling easier and minimise seal damage

New bore seal
The new bore seal prevents negative pressure that causes water entry and provides for easier mounting and dismounting

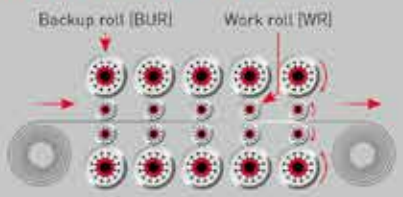


KVS Series

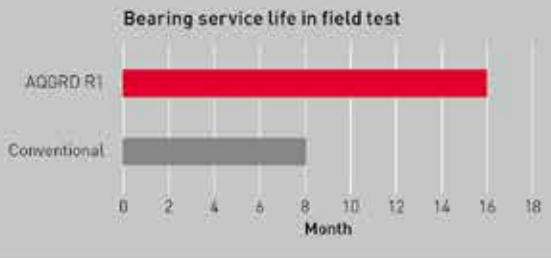
- **Basic load rating (C_r):**
  15-35 % increase
- **Estimated life (L_{10}):**
  1.6 to 2.7 times of estimated life extension
- **Performance of the bearing seal (Control of negative pressure inside the bearing):**
  Negative pressure and water infiltration were reduced to less than 1/3

Field performance results of KVS sealed roll neck bearings lubricated with AQGRD grease

- Type of mill: tandem cold rolling mill (4 high)
- Position: work roll bearings
- Bearing type: sealed roll neck bearings KVS
- Bearing reference: STF360KVS4801



NSK bearings lubricated with AQGRD grease demonstrated at least two times the life span of conventional sealed roll neck bearings facing water infiltration issues, which resulted in over 1 Million ton of reliable steel output.



USER BENEFIT

Estimated effect of maintenance cost reduction

Bearing specifications	Grease	Bearing usage cost and seal repair cost	Maintenance work cost for bearings
Open type bearings (without seal) Maintenance cycle: 3 months			
Conventional sealed bearings Maintenance cycle: 6 months	90 % reduction		50 % reduction
KVS series lubricated with AQGRD grease Maintenance cycle: 6 months	90 % reduction	50 % reduction	50 % reduction

Success Story

Find out how NSK can help you to save costs by improving the productivity of your machinery and reducing costs caused by any failures during the production process.

https://www.nskeurope.com/en/industries/industrial/steel-and-metals/tandem-cold-mill.html

Dimensions of Bearings for Continuous Casting Machines

SPHERICAL ROLLER BEARINGS – SWR SERIES

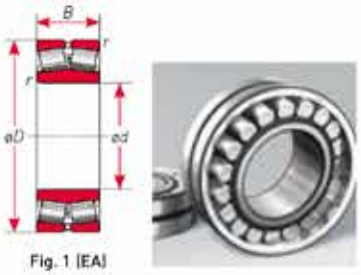


Fig. 1 (EA)

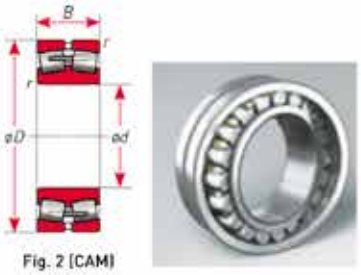


Fig. 2 (CAM)

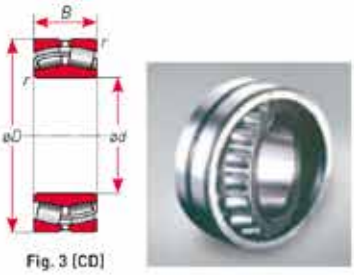


Fig. 3 (CD)

Bearing Numbers	Boundary Dimensions (mm)				Basic Load Ratings (kN)		Fig.
	d	*D*	*B*	*r* (min)	C_r	C_{0r}	
22208SWREAg2E4	40	80	23	1.1	113	99.5	1
22210SWREAg2E4	50	90	23	1.1	124	119	1
23012SWRCgE4	60	95	26	1.1	98.5	141	3
22212SWREAg2E4	60	110	28	1.5	178	174	1
22214SWREAg2E4	70	125	31	1.5	225	232	1
22216SWREAg2E4	80	140	33	2.0	264	275	1
22218SWREAg2E4	90	160	40	2.0	360	395	1
23020SWRCDg2E4	100	150	37	1.5	212	335	3
24020SWRCg2E4	100	150	50	1.5	276	470	3
24120SWRCAg2ME4	100	165	65	2.0	345	535	2
22220SWREAg2E4	100	180	46	2.1	455	490	1
23022SWRCDg2E4	110	170	45	2.0	293	465	3
24022SWRCg2E4	110	170	60	2.0	380	645	3
24122SWRCg2E4	110	180	69	2.0	460	750	3
22222SWREAg2E4	110	200	53	2.1	605	645	1
23024SWRCDg2E4	120	180	46	2.0	315	525	3
24024SWRCg2E4	120	180	60	2.0	395	705	3
24124SWRCg2E4	120	200	80	2.0	575	950	3
22224SWREAg2E4	120	215	58	2.1	685	765	1
23026SWRCDg2E4	130	200	52	2.0	400	655	3
24026SWRCg2E4	130	200	69	2.0	495	865	3
24126SWRCgE4	130	210	80	2.0	590	1 010	3
22226SWREAg2E4	130	230	64	3.0	820	940	1
23028SWRCDg2E4	140	210	53	2.0	420	715	3
24028SWRCg2E4	140	210	69	2.0	525	945	3
24128SWRCg2E4	140	225	85	2.1	670	1 160	3
22228SWRCDg2E4	140	250	68	3.0	645	930	3

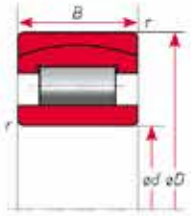
Bearing Nomenclature

Bearing Numbers	Boundary Dimensions (mm)				Basic Load Ratings (kN)		Fig.
	d	*D*	*B*	*r* (min)	C_r	C_{0r}	
23030SWRCDg2E4	150	225	56	2.1	470	815	3
24030SWRCg2E4	150	225	75	2.1	590	1 090	3
24130SWRCgwE4	150	250	100	2.1	890	1 530	3
22230SWRCg2E4	150	270	73	3.0	765	1 120	3
23032SWRCDg2E4	160	240	60	2.1	540	955	3
24032SWRCg2E4	160	240	80	2.1	680	1 260	3
24132SWRCg2E4	160	270	109	2.1	1 040	1 760	3
22232SWRCDg2E4	160	290	80	3.0	910	1 320	3
23034SWRCDg2E4	170	260	67	2.1	640	1 090	3
24034SWRCg2E4	170	260	90	2.1	825	1 520	3
24134SWRCg2E4	170	280	109	2.1	1 080	1 860	3
22234SWRCDg2E4	170	310	86	4.0	990	1 500	3
23036SWRCDg2E4	180	280	74	2.1	750	1 270	3
24036SWRCg2E4	180	280	100	2.1	965	1 750	3
24136SWRCg2E4	180	300	118	3.0	1 190	2 040	3
22236SWRCDg2E4	180	320	86	4.0	1 020	1 540	3
23038SWRCAg2ME4	190	290	75	2.1	775	1 350	2
24038SWRCg2E4	190	290	100	2.1	975	1 840	3
24138SWRCg2E4	190	320	128	3.0	1 370	2 330	3
22238SWRCAg2ME4	190	340	92	4.0	1 140	1 730	2
23040SWRCAg2Me4	200	310	82	2.1	940	1 700	2
24040SWRCg2E4	200	310	109	2.1	1 140	2 120	3
24140SWRCg2E4	200	340	140	3.0	1 570	2 670	3
22240SWRCAg2ME4	200	360	98	4.0	1 300	2 010	2
23044SWRCAg2ME4	220	340	90	3.0	1 090	1 980	2
24044SWRCgE4	220	340	118	3.0	1 360	2 600	3
24144SWRCg2E4	220	370	150	4.0	1 800	3 200	3
22244SWRCAg2ME4	220	400	108	4.0	1 570	2 430	2

Remarks: Other bearings are available. Please contact NSK for additional information.

Dimensions of Bearings for Continuous Casting Machines

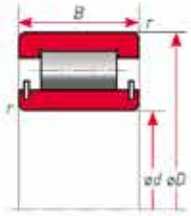
CYLINDRICAL ROLLER BEARINGS – RUB-SERIES



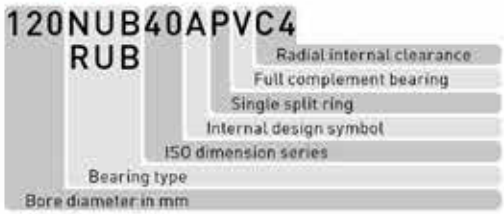
Bearing Numbers	Boundary Dimensions (mm)				Basic Load Ratings (kN)	
	d	D	B	r (min)	C_r	C_{0r}
110RUB41APV	110	180	69	2.0	375	805
120RUB40APV	120	180	60	2.0	305	715
120RUB41APV	120	200	80	2.0	450	958
120RUB32APV	120	215	76	2.1	510	990
130RUB40APV	130	200	69	2.0	405	935
130RUB41APV	130	210	80	2.0	480	1 050
130RUB32APV	130	230	80	3.0	585	1 090
140RUB40APV	140	210	69	2.0	420	990
140RUB41APV	140	225	85	2.1	545	1 230
140RUB32APV	140	250	88	3.0	715	1 390
150RUB40APV	150	225	75	2.1	435	1 070
150RUB41APV	150	250	100	2.1	710	1 620
15R0UB32APV	150	270	96	3.0	815	1 640
160RUB40APV	160	240	80	2.1	490	1 200
160RUB41APV	160	270	109	2.1	855	1 830
160RUB32APV	160	290	104	3.0	960	1 890
170RUB40APV	170	260	90	2.1	640	1 520
170RUB41APV	170	280	109	2.1	875	1 900
170RUB32APV	170	310	110	4.0	1 060	2 090
180RUB40APV	180	280	100	2.1	785	1 870
180RUB41APV	180	300	118	3.0	940	2 120
180RUB32APV	180	320	112	4.0	1 090	2 190
190RUB40APV	190	290	100	2.1	810	1 980
190RUB41APV	190	320	128	3.0	1 120	2 480
190RUB32APV	190	340	120	4.0	1 210	2 430
200RUB40APV	200	310	109	2.4	960	2 250
200RUB41APV	200	340	140	3.0	1 300	2 930

Remarks: Other bearings are available. Please contact NSK for additional information.

CYLINDRICAL ROLLER BEARINGS – NUB-SERIES



Bearing Nomenclature



Bearing Numbers	Boundary Dimensions (mm)				Basic Load Ratings (kN)	
	d	*D*	*B*	*r* (min)	C_r	C_{or}
120NUB40V	120	180	60	2	450	740
130NUB40V	130	200	69	2	570	950
140NUB40V	140	210	69	2	560	960
150NUB40V	150	225	75	2.1	665	1 160
160NUB40V	160	240	80	2.1	765	1 360

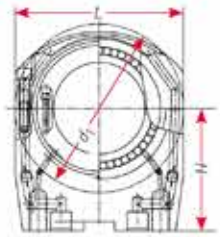
Success Story

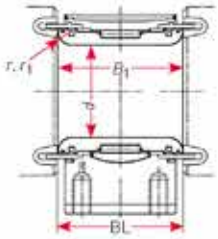
Find out how NSK can help you to save costs by improving the productivity of your machinery and reducing costs caused by any failures during the production process.

https://www.nskeurope.com/en/industries/industrial/steel-and-metals/continuous-casting-machine.html

Dimensions of Bearings for Continuous Casting Machines

SPLIT CYLINDRICAL ROLLER BEARINGS (FOR SEGMENTED ROLLS) – RCPH/PHR SERIES





Bearing Numbers		Boundary Dimensions (mm)					Roll diameter d_1	Basic Load Ratings (kN)		Guide Roll		perm. ax. movem. (mm)
Bearing	Housing	d	B_1	r	L	H		C_r	C_{0r}	roll length BL	Radius r_1	
100RCPH171	100PHR211	100	154	18	200	145	210	405	950	155	18	± 10.0
100RCPH201	100PHR231	100	169	15	235	132	225	605	1 390	170	15	± 8.0
110RCPH181	110PHR221	110	139	15	220	225	220	450	1 090	140	15	± 9.0
110RCPH191	110PHR231	110	137	15	230	160	230	480	1 120	138	15	± 8.0
110RCPH192	110PHR232	110	154	20	230	150	230	525	1 280	155	20	± 8.0
110RCPH193	110PHR233	110	154	20	230	180	225	500	1 200	155	20	± 10.0
110RCPH201	110PHR234	110	154	20	230	180	230	540	1 270	155	20	± 10.0
115RCPH201	115PHR241	115	173	20	240	220	240	600	1 400	174	15	± 6.0
120RCPH181	120PHR221	120	163	20	220	145	220	360	965	164	20	± 10.5
120RCPH182	120PHR222	120	164	20	220	160	220	360	965	165	20	± 10.5
120RCPH201	120PHR231	120	157	15	234	165	235	540	1 340	158	20	± 8.0
120RCPH211	120PHR251	120	151	20	250	180	250	610	1 430	152	20	± 6.0
120RCPH212	120PHR252	120	151	20	250	190	250	525	1 310	152	20	± 10.0
120RCPH213	120PHR253	120	153	20	250	145	250	560	1 340	154	20	± 9.0
120RCPH214	120PHR254	120	154	20	250	180	250	565	1 380	155	20	± 8.0
120RCPH215	120PHR255	120	154	20	250	190	250	570	1 400	155	20	± 10.0
120RCPH216	120PHR256	120	179	20	255	230	255	630	1 580	180	20	± 8.0
130RCPH201	130PHR241	130	184	20	240	175	240	455	1 320	185	20	± 10.5
130RCPH221	130PHR261	130	157	20	270	180	260	615	1 520	158	20	± 6.0
130RCPH221	130PHR271	130	154	20	270	190	270	545	1 420	155	20	± 10.0
130RCPH222	130PHR272	130	154	20	270	190	270	585	1 480	155	20	± 9.0
130RCPH223	130PHR262	130	145	18	265	145	250	545	1 270	146	18	± 7.5
130RCPH224	130PHR263	130	157	20	265	180	265	625	1 530	158	20	± 6.0
130RCPH231	130PHR273	130	143	20	270	197	250	555	1 270	144	20	± 6.0
130RCPH232	130PHR281	130	174	20	280	160	280	760	1 890	175	20	± 9.0

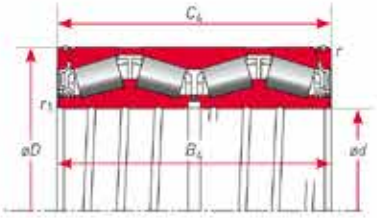
Bearing Nomenclature

Bearing Numbers		Boundary Dimensions (mm)					Roll diameter d_1	Basic Load Ratings (kN)		Guide Roll		perm. ax. movem. (mm)
Bearing	Housing	d	B_1	r	L	H		C_r	C_{0r}	roll length BL	Radius r_1	
135RCPH211	135PHR251	135	183	20	250	160	250	515	1 350	184	20	± 10.0
140RCPH221	140PHR261	140	184	20	260	185	260	565	1 410	185	20	± 10.5
140RCPH222	140PHR262	140	174	20	265	242.5	265	620	1 590	175	20	± 9.0
140RCPH223	140PHR263	140	191	20	265	250	265	615	1 570	192	20	± 6.0
140RCPH231	140PHR271	140	179	20	270	245	270	665	1 750	180	20	± 6.0
140RCPH232	130PHR281	140	159	25	270	180	280	615	1 590	160	25	± 8.0
140RCPH233	140PHR282	140	163	20	280	180	280	665	1 610	164	20	± 6.0
140RCPH261	140PHR311	140	184	20	310	175	310	840	1 970	185	20	± 9.0
145RCPH231	145PHR281	145	179	20	280	250	280	680	1 860	180	20	± 8.0
145RCPH232	145PHR282	145	196	20	280	260	280	675	1 800	197	20	± 6.0
145RCPH233	145PHR283	145	196	20	280	250	280	675	1 800	197	20	± 10.0
145RCPH251	145PHR291	145	208	20	295	270	295	880	2 230	209	20	± 6.0
150RCPH251	150PHR291	150	208	20	295	310	295	754	1 870	209	20	± 6.0
150RCPH252	150PHR301	150	169	20	295	180	300	715	1 880	170	20	± 9.0
150RCPH271	150PHR321	150	187	20	320	220	320	955	2 320	188	20	± 9.0
155RCPH251	155PHR301	155	199	20	300	260	300	770	1 970	200	20	± 8.0
160RCPH261	160PHR311	160	199	20	310	270	320	845	2 270	200	20	± 9.0
160RCPH281	160PHR331	160	200	20	330	225	320	1 070	2 650	201	20	± 7.0
160RCPH271	160PHR321	165	228	25	320	280	320	925	2 440	229	25	± 6.0
170RCPH271	170PHR321	170	214	20	320	255	330	855	2 330	215	20	± 10.0
170RCPH281	170PHR331	170	235	25	330	280	330	1 100	2 870	236	25	± 6.0
180RCPH281	180PHR341	180	235	25	340	280	340	980	2 490	236	25	± 6.0
180RCPH291	180PHR331	180	169	20	335	217.5	335	780	1 800	170	20	± 8.0
190RCPH331	190PHR391	190	233	20	390	280	370	1 510	3 850	234	20	± 6.0

Remarks: Other bearings are available. Please contact NSK for additional information.

Dimensions of Bearings for Rolling Mills

TAPERED ROLLER BEARINGS – EXTRA CAPACITY SEALED-CLEAN 4-ROWS – KVS-SERIES



Dynamic Equivalent Load
$P = XF_r + YF_a$

Static Equivalent Load
$P_0 = F_r + Y_0F_a$
Where $Y_0 = Y_3$
The values of e, Y_2 and Y_3 are given in the table below.

$F_a / F_r \leq e$		$F_a / F_r > e$	
X	Y	X	Y
1	Y3	0.67	Y2

Bearing Numbers	Boundary Dimensions (mm)						Basic Load Ratings (kN)		Constant	Axial Load Factors	
	d	*D*	B_4	C_4	*r* (min)	r_1 (min)	C_r	C_{0r}	e	Y_2	Y_3
STF170KVS2401Eg	170	240	175	175	2.5	2.5	1 020	2 010	0.32	3.2	2.1
*STF215KVS2851Eg	215.900	288.925	177.800	177.800	3.3	0.8	1 070	2 350	0.49	2.1	1.4
*STF216KVS3351Eg	216.103	330.200	263.525	269.875	3.3	1.5	2 290	4 550	0.46	2.2	1.5
STF220KVS3301Eg	220	330	260	260	3.0	4.0	2 330	4 800	0.40	2.5	1.7
*STF220KVS3151Eg	220.662	314.325	239.712	239.712	3.3	1.5	1 960	4 350	0.33	3.0	2.0
*STF228KVS3151Eg	228.600	311.150	200.025	200.025	3.3	1.5	1 560	3 500	0.33	3.0	2.0
*STF234KVS3251Eg	234.950	327.025	196.850	196.850	3.3	1.5	1 550	3 200	0.46	2.2	1.5
*STF241KVS3451Eg	241.478	349.148	228.600	228.600	3.3	1.5	2 020	4 150	0.35	2.9	1.9
*STF244KVS3251Eg	244.475	327.025	193.680	193.680	3.0	1.5	1 370	3 050	0.40	2.5	1.7
STF245KVS3402Eg	245	345	310	310	3.0	2.0	2 700	6 650	0.40	2.5	1.7
*STF254KVS3552Eg	254	358.775	269.875	269.875	3.3	1.5	2 420	5 500	0.40	2.5	1.7
STF260KVS3601Eg	260	365	340	340	4.0	2.7	2 960	7 350	0.40	2.5	1.7
*STF260KVS3651Eg	260	365	340	340	4.0	2.5	2 960	7 350	0.40	2.5	1.7
*STF260KVS4251Eg	260.350	422.275	314.325	317.500	3.3	6.4	3 600	7 050	0.33	3.0	2.0
*STF266KVS3551Eg	266.700	355.600	230.188	228.600	3.3	1.5	1 960	4 600	0.35	2.9	1.9
STF275KVS3801Eg	275	380	340	340	3	3	3 100	7 750	0.32	3.2	2.1
*STF276KVS3952Eg	276.225	393.700	269.875	269.875	3.3	1.5	2 720	6 100	0.45	2.2	1.5
*STF279KVS3952Eg	279.400	393.700	269.875	269.875	6.4	1.5	2 720	6 100	0.45	2.2	1.5
*STF279KVS3954Eg	279.400	393.700	320	320	6.4	1.5	3 100	7 350	0.40	2.5	1.7
STF280KVS3801Eg	280	380	290	290	3	3	2 690	6 500	0.33	3.0	2.0
STF280KVS3804Eg	280	380	340	340	4	1.5	2 870	7 650	0.33	3.0	2.0
STF280KVS4301Eg	280	430	350	350	3.5	2	4 100	8 558	0.40	2.5	1.7
STF290KVS4001Eg	290	400	346	346	4.0	3.0	3 250	8 400	0.40	2.5	1.7
*STF304KVS4351Eg	304.648	438.048	280.990	279.400	3.3	3.3	3 100	6 750	0.45	2.2	1.5
*STF304KVS4155Eg	304.800	419.100	269.875	269.875	6.4	1.5	2 850	6 550	0.33	3.0	2.0

Bearing Nomenclature

Success Story

Find out how NSK can help you to save costs by improving the productivity of your machinery and reducing costs caused by any failures during the production process.

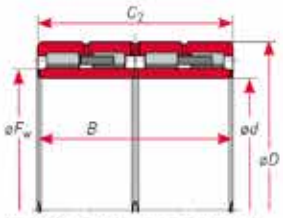
https://www.nskeurope.com/en/industries/industrial/steel-and-metals/plate-rolling-mill.html

Bearing Numbers	Boundary Dimensions (mm)						Basic Load Ratings (kN)		Constant	Axial Load Factors	
	d	D	B_4	C_4	r (min)	r_1 (min)	C_r	C_{0r}	e	Y_2	Y_3
*STF304KVS4152Eg	304.902	412.648	266.700	266.700	3.3	1.5	2 760	6 500	0.33	3.0	2.0
STF310KVS4301Eg	310	430	310	310	3.0	3.0	3 350	8 200	0.46	2.2	1.5
STF310KVS4302Eg	310	430	350	350	3.0	2.7	3 700	9 550	0.46	2.2	1.5
*STF317KVS4251Eg	317.500	422.275	269.875	269.875	3.3	1.5	2 740	6 750	0.34	3.0	2.0
*STF317KVS4451Eg	317.500	447.675	367	367	3	3.6	3 850	9 500	0.33	3.0	2.0
*STF343KVS4551Eg	340.052	457.098	254	254	3.3	1.5	2 830	6 700	0.45	2.2	1.5
*STF355KVS4551Eg	355.600	457.200	252.412	252.412	3.3	1.5	2 650	6 750	0.32	3.2	2.1
*STF355KVS4851Eg	355.600	482.600	265.112	269.875	3.3	1.5	3 100	7 200	0.47	2.1	1.4
*STF374KVS5051Eg	374.650	501.650	250.825	260.350	3.3	1	2 970	7 150	0.47	2.1	1.4
*STF384KVS5451Eg	384.175	546.100	400.050	400.050	6.4	3.3	5 250	12 400	0.33	3.1	2.1
*STF385KVS5151Eg	385.762	514.350	317.500	317.500	3.3	3.3	4 150	10 400	0.33	3.0	2.0
STF390KVS5101Eg	390	510	350	350	3	1.5	3 900	10 800	0.35	2.9	1.9
*STF406KVS5451Eg	406.400	546.100	288.925	288.925	6.4	1.5	3 950	9 450	0.48	2.1	1.4
*STF406KVS5452Eg	406.400	546.100	330	330	6.4	1	4 350	11 000	0.48	2.1	1.4
*STF406KVS5651Eg	406.400	562	381	381	6.4	3.3	4 950	11 900	0.33	3.0	2.0
*STF409KVS5451Eg	409.575	546.100	334.962	334.962	6.4	1.5	4 500	11 700	0.40	2.5	1.7
STF450KVS5901Eg	450	595	368	368	5.0	4.0	5 550	15 000	0.33	3.0	2.0
*STF457KVS5951Eg	457.200	596.900	276.225	279.400	3.3	1.5	4 000	9 850	0.47	2.2	1.4
*STF482KVS6151Eg	482.600	615.950	330.200	330.200	6.4	4.3	4 900	13 500	0.33	3.1	2.1
*STF489KVS6351Eg	489.026	634.873	320.675	320.675	3.3	3.3	4 850	12 500	0.38	2.7	1.8
STF490KVS6201Eg	490	625	385	385	3	3	5 650	16 600	0.32	3.2	2.1
*STF558KVS7353Eg	558.800	736.600	455.600	457.200	6.4	3.3	8 300	23 000	0.35	2.9	2.0
*STF585KVS7751Eg	585.788	711.525	479.425	479.425	6.4	3	8 250	22 700	0.33	3.0	2.0
*STF660KVS8151Eg	660.400	812.800	365.125	365.125	6.4	3.3	6 050	17 700	0.33	3.0	2.0
*STF708KVS9351Eg	708.025	930.275	565.150	565.150	6.4	3.3	12 000	34 000	0.33	3.0	2.0

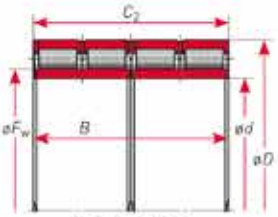
Remarks: 1. Extra-Capacity Sealed-Clean Four-Row Tapered Roller Bearings are made of NSK Super-TF material as the standard specification.
2. Bearings marked * are inch design.
3. Other bearings are available. Please contact NSK for additional information.

Dimensions of Bearings for Rolling Mills

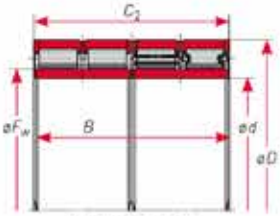
CYLINDRICAL ROLLER BEARINGS (4-ROWS) – STF-RV SERIES



Machined brass or steel cage



Pin type cage



Stud type cage

Bearing Numbers	Boundary Dimensions (mm)					Basic Load Ratings (kN)	
	d	*D*	*B*	C_2	F_w	C_r	C_{0r}
STF127RV1722g	127	174.625	150.812	150.812	139.500	735	1 580
STF145RV2101g	145	210	155	155	165.930	770	1 850
STF145RV2201g	145	225	156	156	169	975	1 820
STF160RV2302g	160	230	168	168	180	895	2 200
STF160RV2306g	160	230	130	130	180	785	1 460
STF160RV2403g	160	240	145	145	180.073	920	1 600
STF165RV2221g	165.100	225.450	168.300	168.300	180.975	1 010	2 220
STF170RV2321g	170	230	160	160	185.500	1 150	2 060
STF170RV2405g	170	240	130	130	190	895	1 760
STF180RV2601g	180	260	168	168	202	1 150	2 300
STF180RV2802g	180	280	180	180	205.085	1 410	2 490
STF190RV2701g	190	270	200	200	212	1 470	3 100
STF190RV2801g	190	280	200	200	214	1 480	2 920
STF200RV2702g	200	270	170	170	222	1 120	2 590
STF200RV2804g	200	280	170	170	222	1 370	2 960
STF200RV2802g	200	280	200	200	222	1 410	3 200
STF200RV2901g	200	290	192	192	226	1 420	3 000
STF210RV2901g	210	290	192	192	236	1 400	3 350
STF220RV3101g	220	310	192	192	247	1 540	3 450
STF230RV3301g	230	330	206	206	260	1 760	3 900
STF240RV3603g	240	360	218	218	270.085	2 110	4 000
STF260RV3701g	260	370	220	220	292	2 050	4 450
STF280RV3901g	280	390	220	220	312	2 120	4 800
STF280RV3907g	280	390	220	220	312	2 280	5 100
STF320RV4621g	320	460	240	240	364	2 820	6 100
STF400RV5611g	400	560	410	410	445	6 550	16 500
STF440RV6215g	440	620	450	450	487	8 100	19 700

Bearing Nomenclature

STF600RV8711gS8CR370P5A

- Special tolerance class
- Radial internal clearance (370 µm)
- Special surface treatment – specific areas only
- Case carburised material
- Sequence number: 1 – 9
- Tolerances: 0 – 4 metric, 5 – 9 inch
- Bearing OD (870 – 879.999 mm)
- 4-Row cylindrical roller bearing
- Bore diameter (600 mm)
- Super-TF material designation

Success Story

Find out how NSK can help you to save costs by improving the productivity of your machinery and reducing costs caused by any failures during the production process.

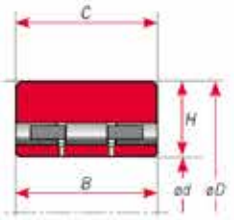
https://www.nskeurope.com/en/industries/industrial/steel-and-metals/hot-strip-mill.html

Bearing Numbers	Boundary Dimensions (mm)					Basic Load Ratings (kN)	
	d	*D*	*B*	C_2	F_w	C_r	C_{0r}
STF460RV6513g	460	650	470	470	509	8 600	21 200
STF480RV6815g	480	680	500	500	532	9 400	23 500
STF500RV6713g	500	670	450	450	540	7 750	20 000
STF500RV7011g	500	700	500	500	554	9 650	24 600
STF530RV7811g	530	780	570	570	601	11 800	29 200
STF550RV7413g	550	740	510	510	600	10 100	27 600
STF560RV8211g	560	820	600	600	625	14 100	34 000
STF570RV8113g	570	815	594	594	628	13 200	32 000
STF600RV8212g	600	820	575	575	660	12 900	35 500
STF650RV9212g	650	920	670	670	723	16 200	44 000
STF660RV9311g	660	930	660	660	728	17 000	44 000
STF690RV9813g	690	980	750	750	766	19 200	53 000
STF730RV1011g	730	1 030	750	750	809	20 700	56 500
STF761RV1012g	761.425	1 079.6	787.4	787.4	846	23 900	65 500
STF770RV1011g	770	1 075	770	770	847	23 100	63 500
STF800RV1013g	800	1 080	700	700	878	19 100	56 000
STF800RV1014g	800	1 080	700	700	878	19 200	55 000
STF800RV1012g	800	1 080	750	750	880	19 300	57 000
STF820RV1119g	820	1 100	745	720	892	20 100	59 000
STF820RV11112g	820	1 130	650	650	891	20 300	53 000
STF820RV11110g	820	1 130	800	800	903	22 900	66 500
STF840RV1111g	840	1 160	840	840	920	24 900	71 500
STF850RV1115g	850	1 150	840	840	928	25 600	77 500
STF850RV1111g	850	1 180	850	850	940	24 700	72 500
STF900RV1216g	900	1 220	810	800	981	25 900	74 500
STF900RV1212g	900	1 220	840	840	989	26 800	80 000
STF950RV1314g	950	1 330	950	950	1 053	33 500	97 000

Remarks: The specification of oil mist fitting and O-rings on outer rings are available when requested.
Other bearings are available. Please contact NSK for additional information.

Dimensions of Bearings for Rolling Mills

SENDZIMIR BACKUP ROLL BEARINGS

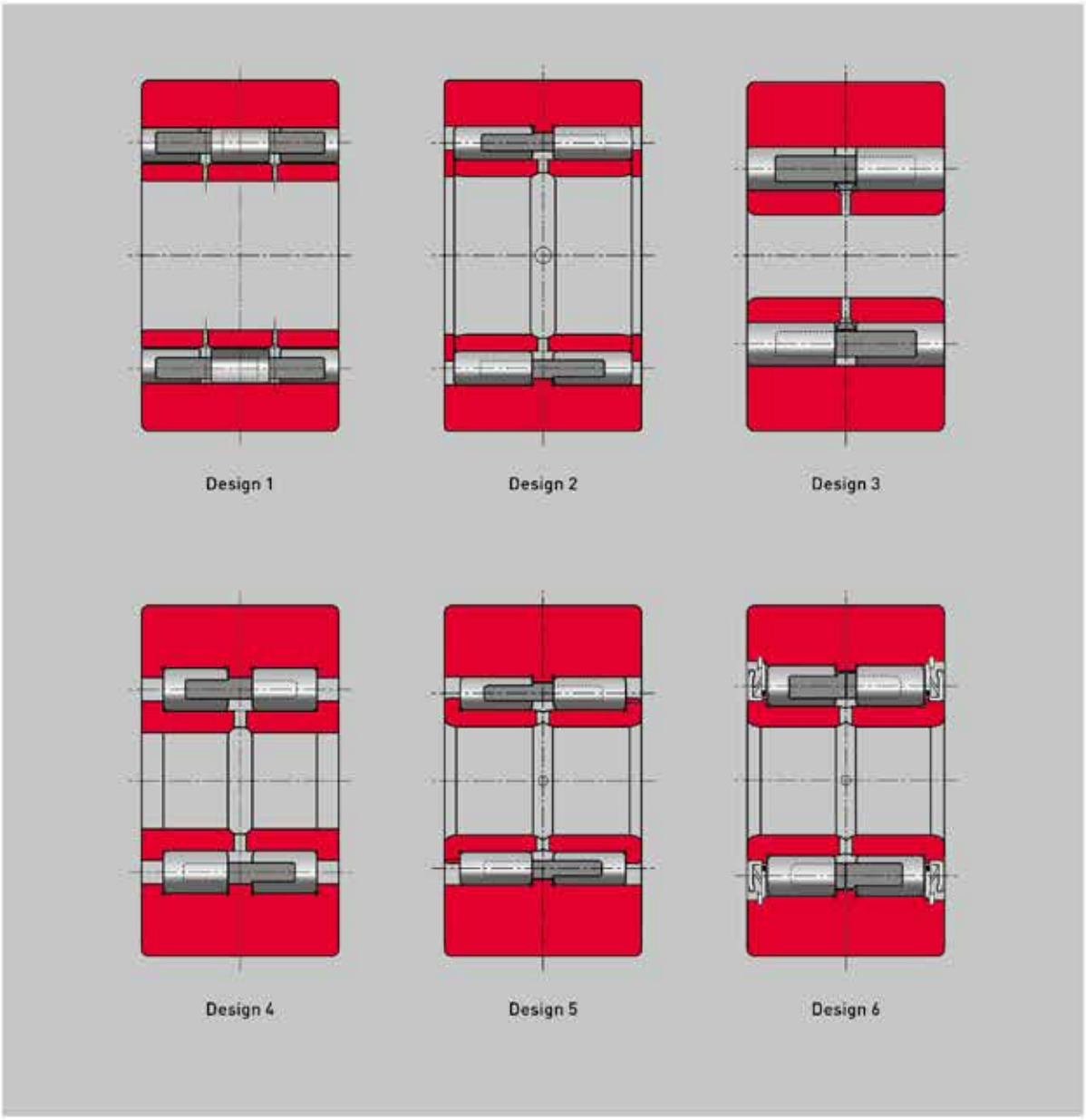


Bearing Numbers	Boundary Dimensions (mm)					Design	Basic Load Ratings (kN)
	d	D	B	C	H		C_r
2U55-1	55.004	120.016	64	63.200	-	4	182
2U55-3	55	119.100	52.200	52	32.050	2	151
3PL70-1	70	160	90	90	45	1	410
2U80-5	80	220	130	120	69.968	6	625
2U90-14	90	220	94	94	65	3	630
2U90-11	90	220	120	119	65	4	680
2U90-13	90	220.020	96	94	65	4	520
2PL100-3	100	225	80	80	62.470	3	535
2U100-16	100	225	100	100	62.480	5	575
2U100-17	100	225	120	119	62.500	2	550
3PL100-1	100	225	120	120	62.470	1	715
2U110-12	110	260	98	98	75	4	625
2U130-32	130	300	132	129	85	4	1 000
3PL130-2	130	300	160	159.500	84.950	1	1 470
3PL130-7	130	300	172.640	172.640	84.950	1	1 540
2U130-37	130	300	172.750	169	85	4	1 170
2U130-34	130	300.020	150	149	85.010	2	1 100
2U130-23	130	300.020	160	158	85.010	4	1 290
2U130-17	130	300.020	172.650	171.600	85.010	4	1 370
2U180-2	180	406.420	171.040	170	113.200	2	1 850
2U180-5	180	406.420	171.040	170	113.200	4	1 650
3PL180-3	180	406.420	171.040	171.040	113.155	1	2 000
2U180-7	180	406.420	171.040	171.040	113.155	6	1 520
3PL180-2	180	406.420	224	224	113.155	1	2 610
2U180-4	180	406.420	224	224	113.160	2	2 360
2U190-5	190	380	112	110	94.950	6	875
2U190-4	190	380	142	140	94.950	6	1 210

Bearing Nomenclature

EP3-3PL180-2AgCCG93UPBDR7

- Bearing supplied in matched sets of 7 bearings
- Special accuracy class
- Matched radial internal clearance (93µm)
- Case carburised material
- Design number and modification
- Bore diameter in mm
- Bearing type
- Special (Extra Pure) Material



Success Stories

Air Recirculation Fan

Plate Rolling Mill

Continuous Casting Machine

Gas Turbine Blade Casting

Wire Forming Production

Continuous Annealing Process Line

Quench Conveyor

Rotary Valve

Dust Extraction Fan

Wire guides

Coiler Gearbox

Hot Strip Mill

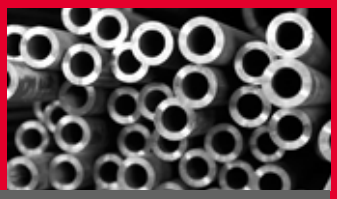
Pilger Mill

Tandem Cold Mill

Cold Rolling Mill

Cold Rolling Mill

Continuous Casting Machine



Steel Tube Making Machine

Success Story

Industry: Steel and Metals

Application: Air Recirculation Fan

Cost Savings: 393,706 euros

Introduction

A customer experienced bearing failure on an Air Recirculation Fan application within a ore preparation plant. This had been a regular problem and compressed air cooling was applied to try and reduce high bearing running temperature. NSK Engineers carried out an Application Review including a temperature survey of the fan and bearings, revealing major issues with incorrect fitting of the bearings, over lubrication and inadequate sealing arrangement. NSK recommended using NSKHPS Spherical Roller Bearings within NSK SNN Plummer Blocks and NSK Labyrinth seals, along with recommendations for correct fitting and correct lubrication intervals and quantities. A trial was conducted resulting in no bearing failure for more then 12 months and the removal of the compressed air cooling generating a significant cost saving for the customer.

Key Facts

- Air Recirculation Fan
- Overheating of bearings
- Incorrect fitting
- Incorrect lubrication amounts and frequencies
- NSK Solution: NSKHPS Spherical Roller Bearings within NSK SNN Plummer blocks and Labyrinth seals
- Significant cost saving generated by removing the need for compressed air cooling

↑ Air Recirculation Fan

Value Proposals

- NSK engineering conducted an Application Review including a Temperature Survey and a Bearing Condition Report
- NSK engineers recommended NSKHPS Spherical Roller Bearings in combination with SNN Plummer Blocks and Labyrinth seals and suggested changes in the lubrication amount and intervals
- Trial conducted, with NSK Engineering overseeing the installation and implementation of NSK recommendations
- The customer benefited from increased productivity, reduced maintenance costs and the removal of compressed air resulting in a significant cost saving

Product Features

- Highest load rating SRB's
- Optimum raceway design & surface finishing
- Brass cage design (CAM) or strengthened steel cage (EA)
- High cleanliness Z-steel
- Temperature stability: up to 200° C
- 40 mm to 260 mm bore size
- Up to twice the operating life
- Up to 20% higher limiting speed
- Dynamic load rating: 25% higher
- Lower maintenance cost and improved productivity
- High load rating enables downsizing

NSK HPS SRB and NSK SNN Plummer Block

Cost Saving Breakdown

Before		Cost p.a.	NSK Solution	Cost p.a.
	€8.400/hour x 36hours shift due to bearing failure	€ 302.400	No downtime	€ 0
	€42/hr x 36hours x 2 persons due to bearing failure	€ 3.024	Manpower, fitting of NSK bearing €42/hr x 8hours x 2 persons	€ 672
	Cost of compressed air per year	€ 88.954	No compressed air used	€ 0
	Bearing cost	€ 750	Bearing cost	€ 750
Total Costs		**€ 395.128**		**€ 1.422**

Success Story

Industry: Steel and Metals

Application: Plate Rolling Mill

Cost Savings: 46,904 euros

Introduction

A major steel manufacturer was using open roll work bearings for their plate rolling mill. The maintenance team was investigating alternatives to the grease being used in this application. NSK was asked to provide a potential alternative for the bearing application with associated cost savings. By using an NSK Sealed Clean 4 row tapered roller bearing assembly the customer's need for daily re-greasing was removed. This had the added benefits of reduced grease disposal costs, continuous operation and protected the bearing from external contamination.

Key Facts

- Plate Rolling Mill
- Open roll bearings required daily maintenance
- Efficiency improvement
- NSK solution: Sealed Clean technology
- Improved grease retention
- Improved bearing protection
- Large cost savings made by reducing grease consumption and maintenance time

↑ Plate Rolling Mill

Value Proposals

- Analysis of the existing bearings showed that grease retention and maintenance were a major issue
- NSK Engineers were able to select Sealed Clean bearing options together with improved material technology
- Consideration of the existing bearing set up allowed NSK to make recommendations on best fit and appropriate bearing design
- Technical support was then provided to trial the proposed bearing arrangement
- Results showed a significant reduction in grease usage

Product Features

- Super-TF or WTF steel material
- Newly designed bearing internal geometry - wider cage diameter, increased number of rollers & larger rollers
- Higher load capacity due to newly designed bearing internal geometry and special seal
- Seals: New type of lateral seal, new bore seal
- Main seal and seal holder are of a more compact design
- Special helical groove to prevent creeping on the roll neck shaft
- New type of bore seal prevents the build-up of negative pressure that can cause the entry of water through the main seals
- Super-TF steel provides significantly longer service life under heavily contaminated operating conditions
- WTF steel provides significantly longer service life under water and metallic contamination
- Sealed-clean solution significantly reduces grease consumption

↑ Extra-Capacity Sealed-Clean Four Row TRB Bearings

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
Cost of greasing current open bearings: 1.2 times per day bearings greased × 4kg of grease × €4/kg cost of grease × No. of bearings × 350 days a year	€26.987	Cost of NSK Sealed Clean design: bearings × 6kg of grease during re-grease × €13,36 cost of grease recommended by NSK	€642
Cost of used grease disposal (per mill staff)	€ 20.625	Cost of grease disposal (per re-grease)	€66
Total Costs	**€47.612**		**€708**

Success Story

Industry: Steel and Metals

Application: Continuous Casting Machine

Cost Savings: 140,000 euros

Introduction

An international steel manufacturer experienced regular failures on bearings in a continuous casting machine. This machine is used in the production of shaped sections and due to that, the bearings have to handle heavy loads. The problem was a short bearing life of the standard bearings due to wear and fatigue. The average bearing life was 124 weeks and they had experienced 3 failures to date. After an investigation, NSK suggested to apply a durability test with NSK's SWR Spherical Roller Bearings. These bearings are made of specially developed bearing steel, which has a much better wear resistance and resistance against fatigue. With the NSK solution, the customer could achieve a significant cost saving.

Key Facts

- Steel & Metals
- Continuous Casting Machine
- Short bearing life because of wear and fatigue
- Heavy operation conditions
- Longer bearing lifetime & reduced maintenance costs requested
- Special Spherical Roller Bearings (SWR Steel)
- Bearing reached 60% longer life time

↑ SWR Roller Bearing and Housing

Value Proposals

- NSK engineers conducted an Application Review including a Bearing Condition Report
- This resulted in SWR Spherical Roller Bearing recommendation.
- Recommemded test with SWR Spherical Roller Bearing
- Bearing reached 60% longer life time

Product Features

- Improved material strength of outer ring
- Ability to use with or without seals
- Improved wear resistance - three times compared to AISI 52100 bearing steel
- Minimized outer-ring friction to extend bearing life
- Improved flaking life property - five times compared to AISI 52100 bearing steel
- Material strength improved to prevent breakage of the outer ring after the occurrence of flaking - five times compared to AISI 52100 bearing steel
- SWR can replace standard SRB without modifying the axle boxes

↑ SWR Spherical Roller Bearings

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
Production loss due to bearing failures	€ 100.000	No production loss	€ 0
Manpower costs for replacing the bearings	€ 40.000	No manpower costs	€ 0
Total Costs	**€ 140.000**		**€ 0**

Success Story

Industry: Steel and Metals

Application: Gas Turbine Blade Casting

Cost Savings: 100,095 euros

Introduction

A company was experiencing a short service lifetime from the bearings used in the casting of gas turbine blades. NSK undertook an Application Review of the existing design which included an inspection of the failed bearings. An extremely caustic solution combined with high loads and misalignment was causing lubrication and seizure problems. An alternative wheel design was proposed using a cylindrical roller bearing, with improvements in sealing and lubrication. This resulted in significantly improved performance and doubled lifetime.

Key Facts

- Gas Turbine casting
- Bearing replacement every 6 weeks
- Caustic solution: 50% Sodium hydroxide at 180°C
- NSK solution: Application design change of wheel used on carousel, with bearing substition to NSK sealed cylindrical roller bearing
- Reduced downtime and maintenance
- Doubled bearing life
- Significant reduction in bearing and maintenance costs

↑ Gas turbine blade casting

Value Proposals

- The customer was experiencing poor performance on bearings within a carousel application. A Failed Bearing Analysis erformed by NSK Engineers showed that this was caused by ingress of extremly agressive caustic solution, combined with high loads and misalignment
- An Application Review highlighted inadequate sealing as the cause and NSK Engineers designed an alternative wheel design, incorporating improved sealing, easier assembly and an NSK sealed cylindrical roller bearing
- A trial was conducted using the new design and the results were reviewed. The redesign was succesful with the remaining lines modified

Product Features

- High load rating
- Highly corrosion resistant phosphate coating
- Contact seals prevent ingress of foreign particles or water
- Increased radial and axial capability
- Bearings pre-greased with Lithium grease
- Re-lubrication holes for easy maintenance & grease replenishment
- Snap ring (DIN 471) can be applied to the outer ring

Sealed cylindrical roller bearing

Cost Saving Breakdown

Before		Cost p.a.	NSK Solution	Cost p.a.
	Cost of 1 set of assemblies = € 4.462	€ 133.860	Cost of 1 set of assemblies = €7.089Cost of 1 bearing / seal kit = €1.487	€ 39.111
	Cost of labour to renew 1 set of assemblies = € 297	€ 8.910	Cost of labour to renew 1 set of assemblies = € 297	€ 3.564
	Bearing life 6 weeks		Bearing life 12 - 14 weeks	
	Total costs per year à 10 changes (x 3 rotators) = € 142.770		Total cost per year for 1 change (x 3 rotators) = € 42.675	
Total Costs		**€ 142.770**		**€ 42.675**

Success Story

Industry: Steel and Metals

Application: Wire Forming Production

Cost Savings: 1,202,455 euros

Introduction

A customer was experiencing repeated failures on bearings fitted to roller assemblies on his wire drawing machinery. This resulted in excessive downtime and high maintenance costs. This was a serious concern to the management and a solution was needed urgently. NSK was called in to investigate and found that there was a lubrication and sealing problem. A new bearing and lubrication package was tested. Results showed that this solution significantly improved the bearing performance resulting in large improvements in productivity and a reduced maintenance cost.

Key Facts

- Continuous wire drawing process with high loads and arduous conditions
- High failure rates of bearings up to 75 stoppages a month
- Excessive downtime and high maintenance costs
- Bearing Failure Analysis which showed a lubrication problem
- NSK proposed Lithium Complex grease together with a sealed Cylindrical Roller Bearing unit which was tested in the machine resulting in improved productivity and reduced maintenance costs
- A significant cost saving could be realised

↑ Wire Drawing Machine

Value Proposals

- A Bearing Failure Analysis showed that the primary cause was poor lubrication performance
- A Lubrication Analysis identified the existing grease as graphite based which was not suitable
- NSK proposed a trial using a specially selected Lithium Complex grease together with a Sealed Double Row Cylindrical
- Roller Bearing Unit
- The trial was successful with a 40% improvement in bearing life
- The customer converted all of their roll assemblies over to the NSK proposed bearing / grease combination
- There was a significant reduction in downtime and maintenance costs and this was documented in a substantial cost saving

Product Features

- Improved contact seals prevent ingress of foreign particles or water
- High load rating
- Increased radial and axial capability
- Highly corrosion resistant phosphate coating
- Easier grease re-lubrication: Inner and outer ring re-lubrication holes
- Bearings pre-greased with Lithium grease
- Can be fitted with DIN 471 snap rings to the outer ring
- Can be used in external environments due to coating

↑ Full compliment Cylindrical Roller Bearing unit with seals

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
Constant failure of bearings / 75 Rolls changed per month		Significant improved reliability / 45 Rolls changed per month	
0.5 hours per change / €6.000 per hour lost production cost / €225.000 per month x 12 months	€ 2.700.000	0.5 hours per change / €6.000 per hour lost production cost / €135.000 per month x 12 months	€ 1.620.000
378 man hours / €13.986 cost per month / €13.986 x 12 months	€ 167.832	108 man hours / €3.996 cost per month / €3.996 x 12 months	€ 47.952
Technical Support & Engineering Time	€ 2.575	No Technical Support needed	€ 0
Total Costs	**€ 2.870.407**		**€ 1.667.952**

Success Story

Industry: Steel and Metals

Application: Continuous Annealing Process Line

Cost Savings: 372,555 euros

Introduction

The continuous annealing process line at a steel works was experiencing unplanned downtime which was, on average, 17 hours per year at a cost of €21.915 per hour. Plant stoppages resulted in the requirement for hiring heavy lifting gear as well as increased maintenance personnel. NSK engineers performed analysis on the failed bearings and identified that both the bearing type and the sealing arrangement were inadequate for the application. The high load and low speed were major factors and the application of the multi row sealed cylindrical roller bearing (Crane Sheave) was ideal to solve this problem.

Key Facts

- Steel strip manufacturing process
- High load and slow speed application
- Inadequate bearing in-situ
- Contamination and lubrication problems
- Bearing collapse resulted in 17 hours per year lost production
- Multiple locations affected
- Original equipment design issue

↑ Continuous Annealing Process Line

Value Proposals

- Failed bearing analysis showed significant fatigue on the existing ball bearing
- Crane Sheave Bearing Unit with integral sealing arrangement proposed
- Machine Design Support resulted in a revised housing design to accommodate bearing
- Bearing Condition Analysis performed mid trial demonstrating no signs of wear
- Post-trial review showed no significant bearing damage and bearing life was extended to over 3 years

Product Features

- Improved contact seals
- High load rating
- Highly corrosion resistant phosphate coating
- Easier grease re-lubrication due to inner and outer ring re-lubrication holes
- Bearings pre-greased with Lithium grease
- Can be fitted with DIN 471 snap rings
- Contact seals prevent ingress of foreign particles or water
- Increased radial and axial capability
- Re-lubrication holes for easy maintenance and grease replenishment
- Can be used in external environments due to coating
- Snap ring (DIN 471) can be applied to the outer ring

↑ Full complement Cylindrical Roller Bearings for Crane Sheaves

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
 Lost production costs: more than 119 hours over 7 years due to accumulator's sheave bearing failure. Annual downtime: 17 hours × € 21.915	€372.555	No lost production: Bearings in full operational condition after 3 years service. Expected life time of the new NSK design: 5 years	€0
Total Costs	**€372.555**		**€0**

Success Story

Industry: Steel and Metals

Application: Quench Conveyor

Cost Savings: 241,802 euros

Introduction

A customer was facing mechanical failures on quench drives due to wear in the Teflon bushes supporting the quench rollers. This led to the rollers dropping and damaging the sprockets and chains, causing the manufactured steel shoe to stick. The result was poor heat treatment of the shoes and subsequent quality issues. NSK recommended replacing the Teflon bushes with stainless steel Molded-Oil bearings. The bearings were on trial for 12 months without problem and subsequently all bushes were converted in the quench area.

Key Facts

- Quench conveyor
- Mechanical failure of rollers causing manufactured heat treated shoes to stick and therefore insufficiently quenched
- Poor quality heat treatment of shoes
- NSK Solution: Molded-Oil
- Improvement to quality of heat treatment
- Significant cost saving on downtime, parts and maintenance labour

↑ Quench Conveyor

Value Proposals

- NSK application review highlighted poor bearing life and costly downtime
- NSK recommended stainless steel Molded-Oil bearings which lasted 12 months operation without failure
- Additional benefit of not having to replace costly conveyor items - chain, sprokets and rollers

Product Features

- Available for high speed applications
- Available in Ball Bearing, Spherical Roller Bearing and Tapered Roller Bearing types
- Rust-proof - Stainless steel for corrosive environments
- Ideal for applications where contact with liquids and chemicals is unavoidable
- Seals made from nitrile rubber
- Contact-seal type available in standard inventory for ball bearings
- Able to minimise oil leakage
- Longer service life
- No need for re-lubrication
- Smooth rotation of rolling elements

↑ Molded-Oil

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
Cost of parts replaced - Chain, Teflon bushes, Sprockets, Rollers	€ 20.614	Cost of Molded-Oil bearings	€ 15.067
55 hours downtime @ € 4.109 / hour	€ 225.995	No downtime	€ 0
Labour for maintenance 380 hrs @ € 27 / hour	€ 10.260	No maintenance	€ 0
Total Costs	**€ 256.869**		**€ 15.067**

Success Story

Industry: Steel and Metals

Application: Rotary Valve

Cost Savings: 144,694 euros

Introduction

An international steel manufacturer was experiencing regular failures on a bearing fitted to a rotary coal valve in an ore preparation plant. This occured twice per year resulting in significant lost production costs and damage to associated components. An Application Review identifying the current bearing design was inadequate for the high temperatures involved, NSK recommended a customised HLT bearing insert within a Self-Lube cast iron FC housing together with a special heat isolating spacer. A trial was conducted with NSK Applications Engineers overseeing the correct fitting of the bearing units within the application. The NSK bearings fitted ran for over 12 months with no bearing failure which resulted in a large overall cost saving for the customer.

Key Facts

- Rotary Coal Valve
- Overheating of bearings
- Incorrect lubrication amounts and frequencies
- NSK Solution: HLT bearing inserts with a Self-Lube cast iron FC housing, with NSK bespoke designed adaptor plate with
- Additional heat resisting material ring
- Significant cost saving generated by prolonged bearing life which eliminated the lost production costs

↑ Rotary Valve

Value Proposals

- NSK engineering conducted an Application Review including a Temperature Survey and a Bearing Condition Report
- NSK engineers recommended HLT bearing inserts with a Self-Lube lube cast iron FC housing, with NSK bespoke designed adaptor plate and additional heat resistant material ring. They also suggested changes in the lubrication amount and intervals
- Trial conducted, with NSK Engineering overseeing the installation and implementation of NSK recommendations
- The customer benefited from reduced maintenance and lost production costs, resulting in significant cost saving

Product Features

- Special internal geometry; C5 internal clearance
- High performance Klueber grease
- Durable silicone rubber seals
- Steel cage material
- Interchangeable with standard Self-Lube® inserts
- High performance grease and effective lubrication at extreme temperatures, with upper and lower limits of –40°C and +180°C
- Efficient sealing and protection at extreme temperatures (–40°C and +180°C)
- Steel cage and special internal features designed to function at temperature extremes Increase radial clearance (C5) between balls and raceways to help prevent radial preload

↑ HLT Self-Lube bearing insert

Cost Saving Breakdown

Before		Cost p.a.	NSK Solution	Cost p.a.
	Cost of bearings x 2 times per year	€ 126	Costs of bearings once per year	€ 63
	€89/hr x 7 hours per breakdown for 2 engineers x 2 times per year	€ 1.246	€89/hr x 7 hours fitting for 2 engineers x 1 times per year	€ 623
	€8.938/hr x 7 hours per breakdown x 2 times per year	€ 125.132	No downtime costs	€ 0
	€2.554 per month for shutdown to relubricate	€ 30.648	€981 per month for shutdown to re-lubricate	€ 11.772
Total Costs		**€ 157.152**		**€ 12.458**

Success Story

Industry: Steel and Metals

Application: Dust Extraction Fan

Cost Savings: 36,000 euros

Introduction

A steel manufacturer was experiencing regular failures within its Ore Preparation Plant (OPP). The plant was fitted with housed bearing units installed on a 60mm shaft and running at approximately 1485 rpm. NSK experts were informed that the bearing used was failing and asked to perform a vibration analysis on the current condition within the application. An ISO14836-2 qualified condition monitoring engineer visited the site to make an assessment. On replacement of the bearings, initial readings were taken by NSK and subsequent, readings were then taken within the following weeks to trend the condition and predict failure.

Key Facts

- Dust Extraction Fan
- Electric motor coupled to a belt drive delivering typical output speed of 1485 rpm
- Housed bearing failures, spherical roller bearings within a housed unit
- NSK Solutions: Condition Monitoring Service (CMS) with vibration analysis at three separate occasions: with the initial bearings, after the bearings were replaced, then again one month later
- After the bearing replacement, the vibration analysis detected an unbalance due to the addition of a metal arm used to detect rotation added to the end of the shaft. The unbalance would have added loads to the system and reduced the bearing and component lifetime. It was to be corrected by the customer and checked by NSK again at a third visit

↑ Ore Preparation Plant

Value Proposals

- NSK Condition Monitoring Service analysed the current condition to assist and reduce the number of unplanned failures. A bearing problem was detected and this bearing replaced.
- After one month, a second visit revealed the bearing condition was acceptable, but some unbalance was present within the application. This was to be corrected by the customer and checked at a third visit a month later.
- At the third visit, NSK Condition Monitoring Service detected the unbalance was greatly reduced, but still present. The analysis detected some structural resonance from the base.
- This was due to the belt tension acting upon the structure revealing a loose bolt on the motor base. The customer adjusted the motor, but did not secure all four bolts correctly.
- The customer corrected the loose bolts and the application ran without any further problems.

Product Features

- Live assessment of a machines condition and health while machine is still in operation
- Predicted life of the critical components inside a machine allowing the customer to plan maintenance more accurately
- Early warning of problems occurring in machinery. Condition Monitoring is the most sensitive and long reaching method of detecting the signs of machine wear
- On-site support from NSK Engineers
- Assurance that NSK as a full range supplier can help with the provision of critical bearing and linear motion spares
- Performance improvements and operational cost savings

↑ Condition Monitoring Service (CMS)

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
Cost of lost productivity from the blast furnaces	€ 36.000	No lost productivity	€ 0
Total Costs	**€ 36.000**		**€ 0**

Success Story

Industry: Steel and Metals

Application: Wire guides

Cost Savings: 10,000 euros

Introduction

A wire manufacturer in France was experiencing frequent damage on final products due to bearing failures within their wire guides where Deep Groove Ball Bearings were mounted. On average, the bearings failed every 6 weeks, incurring maintenance time and loss of production. The bearings were failing due to ingress of contamination behind the seals and NSK recommended to replace the existing bearings with Stainless Steel Deep Groove Ball Bearings with Molded-Oil lubrication and DDU seals.

Key Facts

- Wire manufacturing - Wire guides
- Bearing replacement every 6 weeks
- Contaminated environment
- NSK solution: Stainless Steel Deep Groove Ball Bearings with Molded-Oil and DDU seals
- Bearing replacement reduced to 3 times per year

↑ Wire guides

Value Proposals

- The customer experienced many failures on their wire guides. An Application Review determined that ingress of contaminants from the production process was the main cause of failure
- The existing 2RS sealed Deep Groove Ball Bearings were inadequate
- NSK recommended Stainless Steel Molded-Oil Deep Groove Ball Bearings with DDU seals
- Since the introduction of new bearings, lifetime and machine performance has been significantly improved

Product Features

- Molded-Oil provides continuous supply of lubrication oil
- Stainless steel for corrosive environments
- Grease-free property with no oil refilling keeps operating Environments clean
- Operating life more than twice as long as grease lubrication, in water or dustcontaminated environments
- Contact-seal type available in standard inventory for ball bearings
- Achieves extended maintenance-free performance as Molded-Oil provides a continuous supply of lubricant
- Available for high speed applications
- Available in ball bearing, spherical roller bearing and tapered roller bearings types

↑ Deep Groove Ball Bearings with Molded-Oil

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
 - Long life- Product substitution- Reduced maintenance	€ 10.000		
Total Costs	**Before**		**€ 10.000**

Success Story

Industry: Steel and Metals

Application: Coiler Gearbox

Cost Savings: 17,450 euros

Introduction

A manufacturer of Industrial Gearboxes was commissioning a reducer gearbox in collaboration with NSK for a cold roll steel mill application. The gearbox featured NSK Spherical Roller bearings which gave the advantage of high load carrying capacity for the output shaft. During the agreed running trail, the engineers had to review performance of the bearings. Normally the gearbox would have to be stripped and the components examined. This would have been very costly and caused a significant delay to the project. However as part of the design support process, NSK performed Condition Monitoring on the running gearbox. This demonstrated that all components were in optimum condition with no need for further investigation allowing the gearbox to be released and delivered on time.

Key Facts

- Coiler Gearbox
- Commissioning tests of new bearing set up
- Unexplained noise during testing
- NSK Solution: Condition Monitoring Service (CMS) with detailed analysis to identify bearings and associated components health. NSK performed a full vibration analysis of the running gearbox
- The results showed that the bearings were in optimum condition and no issues were identified
- This allowed the manufacturer to pass the commissioning trials
- Significant costs were saved because further investigation and disassembly of the gearbox were not necessary

↑ Cold Rolling Mill

Value Proposals

- An NSK expert performed an AIP Survey on the gearbox
- The NSK engineer conducted a Condition Monitoring review including all technical data, measurement conditions and explanations of spectrum analysis
- At the fixed trial running speed, the resonance of the machine was reached and some noise appeared
- No issue was detected on the bearings and there was no risk due to the noise on the final application resulting from the variable speed on the coiler gearbox

Product Features

- Live assessment of a machine's condition and health while the machine is still in operation.
- Predicted life of the critical components inside a machine allowing you to plan maintenance more accurately.
- On-site support from NSK Engineers. Not only are our engineering experts fully trained in the use of condition monitoring, they are also experienced bearing experts and can take diagnostics to the ultimate level of root cause. This allows them to also recommend improved bearing and linear motion solutions.
- Assurance that NSK as a full range supplier can help with the provision of critical bearing and linear motion spares.

↑ Condition Monitoring Service (CMS)

Cost Saving Breakdown

Before		Cost p.a.	NSK Solution	Cost p.a.
	Cost of bearings	€ 1.750	No further bearing needed	€ 0
	Remove the bearings from coiler gearbox and install new bearings	€ 2.500	Replacement not necessary	€ 0
	Late delivery costs commissioning	€ 13.200	No late delivery penalty	€ 0
Total Costs		**€ 17.450**		**€ 0**

Success Story

Industry: Steel and Metals

Application: Hot Strip Mill

Cost Savings: 154,000 euros

Introduction

A large manufacturer of steel wanted to increase replacement intervals for 4-row Tapered Roller Bearings used in the hot strip mill. Due to severe operation conditions, standard bearings provided 1.400 hours of operation. The key target was to decrease spend on bearings and costs for bearing replacement and maintenance. NSK checked the bearing units and the operating conditions. As a result new 4-row bearings with modified internal design and contact angle were delivered for testing. New bearing lifetime was increased up to 2.200 hours.

Key Facts

- 4-row Tapered Roller Bearings
- Frequent line stoppage
- NSK Solution: Modified internal design of bearings
- Increased lifetime
- Reduced down-time
- Cost saving for bearings and maintenance works

↑ Finishing Section of Hot Strip Mill

Value Proposals

- NSK engineers inspected the machine and operating conditions
- The analysis showed that the existing bearing solution was not adequate for the application
- NSK recommended additional modification of the bearing internal design for operation under severe conditions and the contact angle was changed
- A training was provided regarding root cause failure and further prevention of similar issues
- The customer benefited from increased bearing lifetime and reduction in maintenance costs

Product Features

- Steel material technology
- Special NSK heat-treatment technology
- Optimum chemical composition design technology
- Bearing life is 3 times longer than that of conventional bearing
- Reduced non-metallic inclusions on raceway surface inhibiting generation of surface cracks

NSK 4-row Tapered Roller Bearing

Cost Saving Breakdown

Before		Cost p.a.	NSK Solution	Cost p.a.
	Bearing replacement costs	€ 432.000	Bearing replacement costs	€ 288.000
	Additional maintenance costs compared to NSK solution	€ 10.000	Reduced maintenance time and no additional costs	€ 0
Total Costs		**€ 442.000**		**€ 288.000**

Success Story

Industry: Steel and Metals

Application: Pilger Mill

Cost Savings: 159,933 euros

Introduction

A Steel Mill customer was experiencing regular failures on bearings in their Pilger Mill. NSK investigated this and found that the main problems were severe operating conditions with high loads and inadequate lubrication. NSK proposed a special Spherical Roller Bearing with optimised internal design and Super Tough (STF) steel. A trial showed that the new bearings gave a 20-30% longer life and a consequential reduction in maintenance costs.

Key Facts

- Pilger Mill application
- Bearings failure due to heavy and severe operating conditions
- NSK solution: Special Spherical Roller Bearings made in STF steel
- Bearings reached 2 times longer life than old bearings
- Reduced maintenance and plant stoppage
- Cost saving generated

↑ Seamless Stainless Steel Pipe and Tubes

Value Proposals

- NSK application technical analysis
- NSK proposed bearings with Super TF steel
- Bearings reached 200% longer life than old bearings
- Reduced maintenance time
- No unexpected bearing failure and no unplanned downtime

Product Features

- Innovative heat treatment technology
- Outperforming standard bearing steel
- Up to 10 times service life with contaminated lubrication
- Up to twice the service life under clean lubrication
- Up to 4 times the service life at 160°C
- Less than one-third the rate of wear
- 40% improvement in seizure resistance

Bearings TF Series

Cost Saving Breakdown

Before		Cost p.a.	NSK Solution	Cost p.a.
	Bearing replacement costs	€ 21.788	Bearing replacement costs	€ 8.799
	Lost production: 2 hours x 2250€/hr x 52/year	€ 234.000	Lost production: 2 hours x 2250€/hr x 21/year	€ 94.500
	Labour costs: 31€/hr x 2 hrs x 2 People x 52/year	€ 6.448	Labour costs: 31€/hr x 2 hrs x 2 People x 21/year	€ 2.604
	Other material replacement	€ 4.000	Other material replacement	€ 400
Total Costs		**€ 266.236**		**€ 106.303**

Success Story

Industry: Steel and Metals

Application: Tandem Cold Mill

Cost Savings: 2.997.568 €

Introduction

A Polish steel plant started production in its tandem cold mill in the 1970s. After many years of operation, a refurbishment was necessary and to reduce costs the mill consulted with a local technical university to convert the roll mill bearings from oil mist to oil bath lubrication. Unfortunately, this did not result in the expected improvements and the mill was left with a large problem. NSK engineers were consulted to review the mill design and they proposed the use of sealed clean KVS bearings with grease lubrication. These were installed and after 1 year of operation the performance excellent. As a result, the customer adopted this solution for all its Tandem Cold Mills resulting in a superior lifetime and reduced maintenance costs.

Key Facts

- Tandem Cold Mill application
- Refurbished after many years operation
- Problem with oil-mist lubrication system
- Changing to oil bath did not bring positive results
- Installation of NSK Sealed-Clean KVS bearings produced great results
- Improved performance and productivity

↑ Steel Industry

Value Proposals

- Customer experienced poor performance from his oil bath lubricated bearings
- NSK were consulted and performed a design review with a proposal to adopt sealed clean KVS bearings
- A trial was conducted and after 1 year the bearings had performed very well
- Sealed-Clean 4-row Tapered Roller Bearings with grease lubrication

Product Features

- 2-4 time longer life than standard bearings
- Higher load capacity due to newly designed bearing internal geometry and special seal
- Main seal and seal holder are of a more compact design
- New type of bore seal prevents the build-up of negative pressure that can cause the entry of water through the main seals
- Special helical groove to prevent creeping on the roll neck shaft
- Newly designed bearing internal geometry - wider cage diameter

↑ Taper Roller Bearings - Sealed-Clean Four Row

Cost Saving Breakdown

Before		Cost p.a.	NSK Solution	Cost p.a.
	28 pcs	75.600 €	18 pcs	60.030 €
	Almost 61 working hours lost	4.373.117	Only 18 hours lost	1.405.645
	Costs of service hours	14.000 €	3 times less service hours than in previous solution	4.500 €
	Cost of mineral oil	5.026 €	Bearings equipped with preinstalled grease	0 €
Total Costs		**4.467.743 €**		**1.470.175 €**

Success Story

Industry: Steel and Metals

Application: Cold Rolling Mill

Cost Savings: 26,400 euros

Introduction

A major steel producer was not satisfied with the performance of the four-row tapered roller bearings that were installed in its cold rolling mill: steel shavings from the production process were getting into the bearings and having a detrimental effect on reliability. NSK performed a detailed analysis of the bearings on site together with a failed bearing and lubrication review. This prompted a recommendation to utilise NSK's Tough technology steels which have a far better resistance to damage caused by debris ingress.

Key Facts

- Cold rolling mill
- Damage of the bearings due to ingress of steel shavings from the production process
- NSK solution: Bearings of WTF steel
- More than 3× longer life-time
- Reduced downtime
- Cost savings for bearings and maintenance

↑ Steel foil

Value Proposals

- Analysis of the bearings, the grease, the structure and the design of the billet mill
- NSK bearings made of WTF steel are designed for extreme operating conditions such as those involving solid and liquid contamination
- Technical support including on site engineering consultancy and lab based bearing analysis

Product Features

- Steel material technology
- Special NSK heat-treatment technology
- Optimum chemical composition design technology
- Available for four-row cylindrical and four-row taper roller bearings
- Bearing life is 3 times longer than that of conventional bearing
- Reduced non-metallic inclusions on raceway surface inhibiting generation of surface cracks
- Grain boundaries have been strengthened to help prevent the propagation of cracks

4-row WTF (water tough) bearing

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
Bearing Life of the previous bearings: 4 months Lost production costs: € 1.000/h downtime × number of replacements × 4 unexpected downtimes per year	€ 44.000	Bearing Life of the new bearings: 12 months Lost production costs: € 1.000/h downtime × number of replacements × 1 unexpected downtime per year	€ 17.600
Total Costs	**€ 44.000**		**€ 17.600**

Success Story

Industry: Steel and Metals

Application: Cold Rolling Mill

Cost Savings: 16,300 euros

Introduction

A steel manufacturer was experiencing continued failures of bearings on their Cold Rolling Mill. NSK engineers conducted an application review and found the highly contaminated operating conditions were leading to unexpected failures. This resulted in costly unplanned shutdowns and a reduction in production ratios. NSK STF bearings were proposed, which are made of a long-life Super-Tough Steel, specially to combat debris contamination in the lubricant. After a four month running trial, the bearings were sent back to factory for inspection. The laboratory found a residual life between 29-50 months. To date the customer has replaced the bearings once per year during the annual scheduled maintenance.

Key Facts

- Cold Rolling Mill
- Highly contaminated operating conditions
- Extremely short lifetime of bearings : 3-4 months
- The analysis of bearings and grease sample revealed that contamination is the reason for the failure
- NSK Solution: Long-life Super-Tough Steel, Spherical Roller Bearings
- Longer life and superior resistance against wear, seizure and heat
- Significant increase of lifetime from 3-4 months to additional 29-50 months
- Cost saving realised

↑ Cold Rolling Mill

Value Proposals

- The NSK Technical Department analysed grease samples and inspected the bearings to find the root cause of failure
- NSK Engineers recommended Spherical Roller Bearings in Super-Tough Steel
- After a four month trial (equivalent to the original bearing lifetime), bearings were disassembled and returned to the plant for analysis
- The results showed that the bearing still could work for long time (10 times the initial lifetime)
- Significant cost savings were achieved based on reduced bearing replacement rate, less unexpected line stops, less manpower due to line stops

Product Features

- Special material
- Innovative heat treatment technology
- Outperforming standard bearing steel
- TF, NTF, HTF STF, WTF – material to cater to all your environments
- Up to 10 times service life with contaminated lubrication
- Up to twice the service life under clean lubrication
- Up to 4 times the service life at 160°C
- Less than one-third the rate of wear
- 40% improvement in seizure resistance

Long-Life Super-Tough Spherical Roller Bearings

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
Costs for standard Spherical Roller Bearing per year	€ 9.600	Costs for Super-Tough Steel Spherical Roller Bearings per year	€ 3.200
Three hours/stop to replace bearingsThree unexpected stops/year	€ 9.000	No unexpected downtimesBearings are replaced in the annual scheduled maintenance	€ 0
Three hours/stop to replace bearingsThree unexpected stops/year	€ 1.200	Mounting CostsIncluded in the annual scheduled maintenance	€ 300
Total Costs	**€ 19.800**		**€ 3.500**

Success Story

Industry: Steel and Metals

Application: Continuous Casting Machine

Cost Savings: 14,850 euros

Introduction

A Steel maker was experiencing problems with their continuous casting machine for steel sections. The lifetime of a Cylindrical Roller Bearing mounted on a continuous cast roller was about one to two months. The casting machine had a very complicated cooling and lubricating piping system. The main problem was the high maintenance costs because of the necessary process to reconnect the piping system. NSK proposed to assemble the rollers of one segment with Sealed Spherical Roller Bearings equipped with high temperature grease. This resulted in significant improvement of the bearing performance and time saving for maintenance works.

Key Facts

- Continuous Casting Machine
- Long replacement time for Cylindrical Roller Bearing with oil lubrication because of complicated process to reconnect the piping system
- NSK Solution: Sealed Spherical Roller Bearings specifically designed for the application
- Significant increase of the operating lifetime
- Improved bearing protection
- Eco-friendly due to lack of contamination from the equipment
- Substantial cost savings made by reducing the maintenance time

↑ Continuous Casting Machine

Value Proposals

- NSK analysed the application and proposed to assemble Sealed Spherical Roller Bearings in one segment
- With the new bearings, a dismantling and re-installation of the oil piping system was not necessary any more during the maintenance works
- Eco-friendly system reducing the oil consumption as bearings included high-temperature grease
- The time required for the replacement of the roller in the segments was reduced from 20 to 10 hours
- The operating lifetime was increased from 2 to 4 months

Product Features

- Special “outward-extending, spring loaded lip seal”
- Nitride rubber seal – or differing seals depending on temperature needs
- Special long-life grease: heat & pressure resistant
- Symmetrical roller & raceway design to prevent edge loading problems
- Special chamfer configuration for smooth axial movement
- Seal conserves grease offering longer running & improved efficiency
- Reduction in grease consumption & no grease leaks due to special seal & cleaner working environments
- Increased maintenance intervals

↑ Sealed Spherical Roller Bearing

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
6 Sets of bearings per segment per year	€ 25.200	3 Sets of bearings per segment per year	€ 28.350
6 Replacements per year x 3 hours	€ 18.000	3 Replacements per year x 3 hours	€ 9.000
6 Replacements x 20 hours	€ 12.000	3 Replacements x 10 hours	€ 3.000
Total Costs	**€ 55.200**		**€ 40.350**

Success Story

Industry: Steel and Metals

Application: Steel Tube Making Machine

Cost Savings: € 8.220

Introduction

An important manufacturer of raw steel materials (strip and tubes) was facing issues with standard bearings, mounted in the welding station of a tube making machine. The high temperature of the welding area shortened the bearing life, breaking after short operation and causing continuous production stoppages for bearing replacement. The customer calculated a loss in production of 500 kg of tubes at every stoppage plus partial scrap of actual production. NSK proposed bearings for high temperature environments with special grease. With this solution the customer increased the bearing life. He also established preventive maintenance periods. All These measures led to increased productivity and Elimination of scrap.

Key Facts

- Welding station on steel tube making machine
- Short life of bearings causing production stoppage
- Productivity reduced by 500 kg of tube per stoppage
- Every production stoppage causing partial scrap of actual production
- Temperature of welding area effected life of bearings
- NSK Solution: high temperature Deep Groove Ball Bearings
- Increased bearings life
- Customer was able to start a preventive maintenance programme
- Steel Tube Making Machine High Temperature Deep Groove Ball Bearings

↑ Steel Tube Making Machine

Value Proposals

- The customer explained that each stoppage caused a loss in production
- NSK recommended Deep Groove Ball Bearings for high temperature with a special grease
- A trial with the new bearings showed an increased bearing life
- The successful test resulted in reduced machine downtime and increased productivity
- The customer implemented a regular maintenance programme

Product Features

- Bearing steel heat stabilised to +200 °C
- High temperature Viton seal closures
- High temperature grease +160 °C
- Greater than normal clearance to accommodate bearing ring temperature differentials
- Bearing greased and sealed for life
- Bearing operating temperature +180 °C

↑ High Temperature Deep Groove Ball Bearings

Cost Saving Breakdown

Before	Cost p.a.	NSK Solution	Cost p.a.
6 Bearings set x 15 replacements/year	€ 180	6 Bearings set x 6 replacements/year	€ 360
1h downtime x 100€ labour cost x 15replacements/year	€ 1.500	1h downtime x 100€ labour cost x 6replacements/year	€ 600
Productivity loss of 1h x 15 replacements/year	€ 7.500	No costs	€ 0
Total Costs	**€ 9.180**		**€ 960**

Presentations

Continuous Casting

Rolling Mills

Continuous Casting – Bearings for Steel & Metal applications

CONTINUOUS CASTING
NSK bearings for Steel & Metal applications

Introduction

Did you know

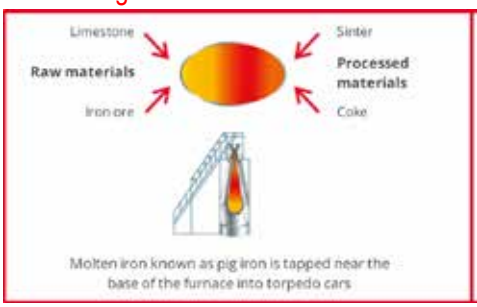
that a breakout (when a strand brakes and allows the still liquid steel within it to spill out) is the most detrimental incident associated with the process of continuous casting?

Introduction

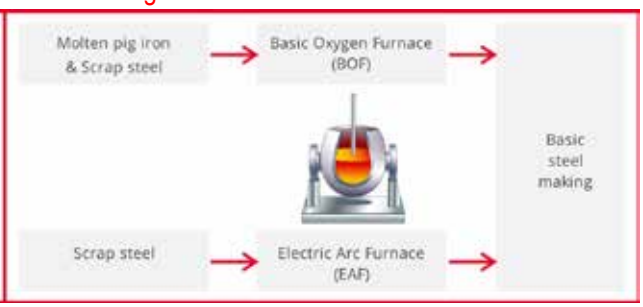
What is steel?

- Steel is a metallic material consisting primarily of iron but also containing carbon (generally 0.1% to 1.2% by weight).
- Often quantities of other metals are added to modify specific properties (hardness, corrosiveness, strength, weldability, etc.).
- These are then known as alloy steels.

Iron Making



Steel Making



Types of steel manufacturing facilities

Iron Making

1. Raw Materials Storage
2. Sintering Plant
3. Coke Plant
4. Blast Furnaces

Steel Making Area

5. Furnaces and Casting

Product Forming

6. Rolling Mills and Finishing lines

Types of steel manufacturing facilities

1. Raw Materials Storage

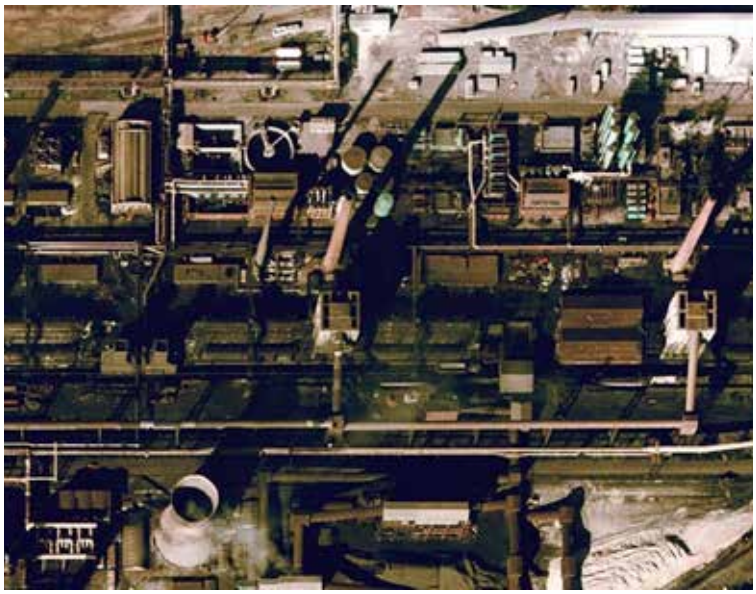
- The iron and steel-making process requires iron ore, coal and limestone.
- These raw materials are transported to the steel plant in bulk by ship and rail and stored in stockyards adjacent to the plant.
- Reclaimers distribute the ore into beds, where it is mixed to produce the most suitable blend.
- From the stockyards, coal is moved by conveyor to the coke ovens, while iron ore is mixed with coke and sent to the sinter plant.

Types of steel manufacturing facilities

2. Sintering

- In the sinter plant, iron ore and coke particles are fed through an oven, where the mixture is cooked to drive off impurities such as sulphur.
- The result is a solid clinker, known as sinter, which aids the efficient smelting of iron ore.
- The sinter plant is connected to the stockyard by a series of conveyors and is equipped with electrostatic precipitators to remove ash particles from flue gases before they reach the chimney stack.

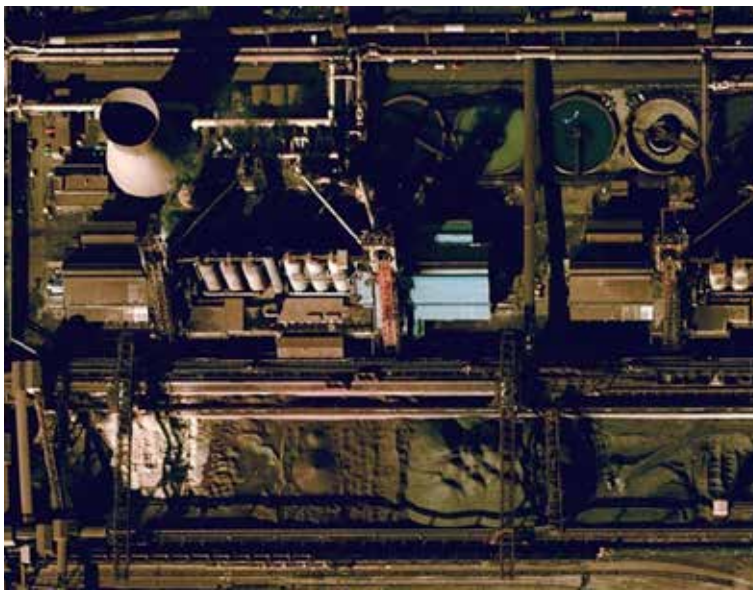
Types of steel manufacturing facilities



3. Coke production

- Coke is produced by heating coal in an oven, to drive out oil and tar before it is used in the blast furnace.
- A quenching car moves along rails parallel to a battery of coke ovens and transports hot coke, rammed into the car from the ovens, to the quenching tower.
- Here it is extinguished by water, and then dumped onto the coke-drying wharf.
- From there, it is graded in a screening tower before being moved to the blast furnace.
- A plume of steam on aerial imagery of a coke battery indicates an active quenching tower.

Types of steel manufacturing facilities



4. Iron production

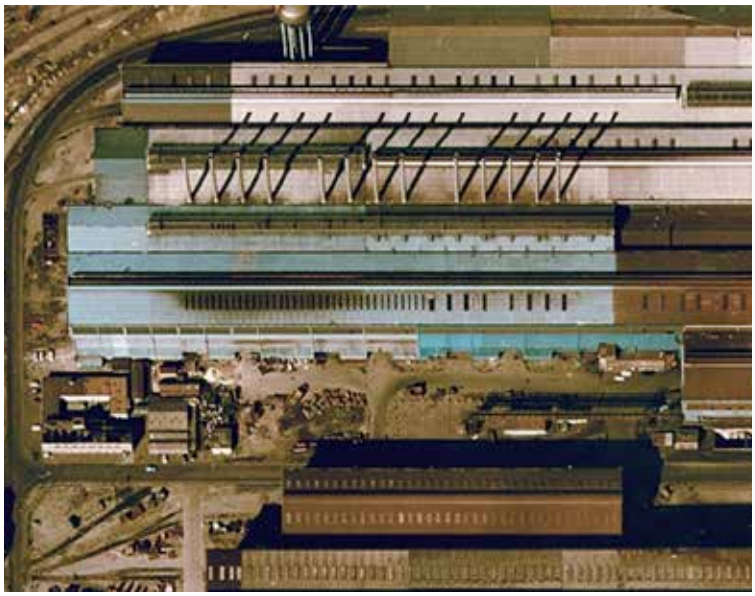
- Iron ore sinter, coke and limestone are tipped into the blast furnace, where their combustion is aided by very hot air blown in from an adjacent row of stoves.
- The iron ore reduces to molten metal, which is tapped at frequent intervals into torpedo-shaped rail wagons for onward transport to the steel furnace.
- Limestone can be identified on aerial imagery by its signature light tone; here, a stock of lime is visible adjacent to the blast furnace, at lower left.

Types of steel manufacturing facilities

5. Steel production

- In the Basic Oxygen Steelmaking (BOS) plant seen here, high-pressure oxygen is blown into a vessel containing scrap metal and molten iron brought from the blast furnaces.
- The oxygen combines with unwanted elements such as carbon, leaving behind liquid steel.
- A flux of lime combines with the impurities to form slag, while carbon monoxide gas is collected for use elsewhere in the plant.
- Many modern steel plants utilise a process of continuous casting (concast), whereby molten steel is cooled and shaped as it is poured from the furnace vessel.
- In this image, the concast building is visible to the right of the BOS plant, with a light-toned lime preparation building at photo south.

Types of steel manufacturing facilities



6. Casting and finishing

- Rolling mills take the shaped steel from the concast building and form it into steel plates, coils and bars by re-heating, rolling, squeezing and carefully cooling the steel.
- It is then ready for further processing, such as cutting, coating and pressing, before it is used to create an end-product. Finished steel is then stockpiled outside the mill, ready for onward distribution.

Types of steel manufacturing facilities

Iron Making

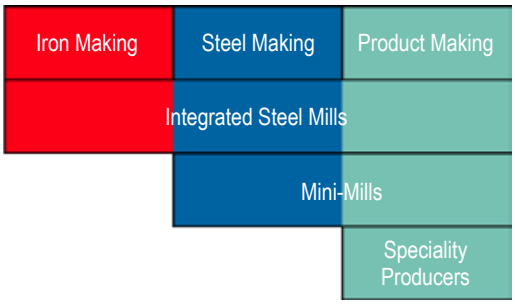
1. Raw Materials Storage
2. Sintering Plant
3. Coke Plant
4. Blast Furnaces

Steel Making Area

5. Furnaces and Casting

Product Forming

6. Rolling Mills and Finishing lines



click on fields in the graphic for more information

Types of steel manufacturing facilities

Iron Making

1. Raw Materials Storage
2. Sintering Plant
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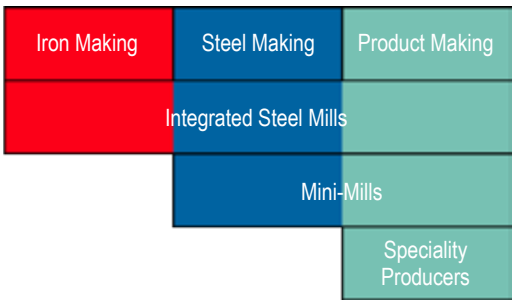
Steel Making Area

5. Furnaces and Casting

Product Forming

6. Rolling Mills and Finishing lines



Integrated Steel Mills

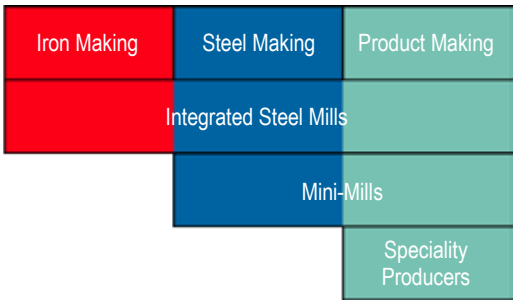
- Manufacture steel products using both iron ore and scrap steel as raw materials
- Primarily use oxygen fuelled furnaces for steel making but may also use electric arc furnaces with scrap steel

Types of steel manufacturing facilities

Iron Making
1. Raw Materials Storage
2. Sintering Plant
3. Coke Plant
4. Blast Furnaces

Steel Making Area
5. Furnaces and Casting

Product Forming
6. Rolling Mills and Finishing lines



Mini-Mills
- Generally facilities are smaller than integrated steel mills
- Usually specialise in making single type or finished product e.g. wire, rod, beam or coiled strip

Types of steel manufacturing facilities

Iron Making
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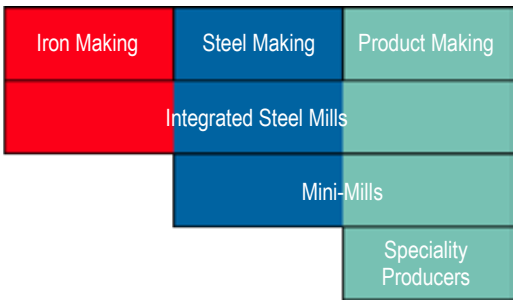
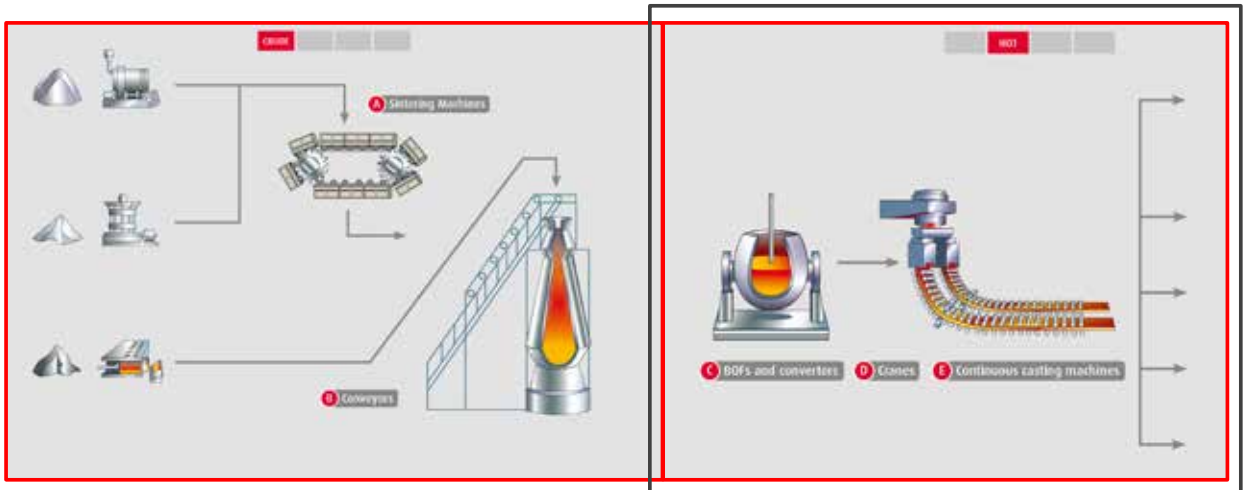


Speciality producers
- Perform auxiliary and finishing processes on steel that has already been formed into a semi-finished product
- Specialise in one or some of the many product forming processes performed by integrated mills

NSK in the steel industry – Continuous Casting

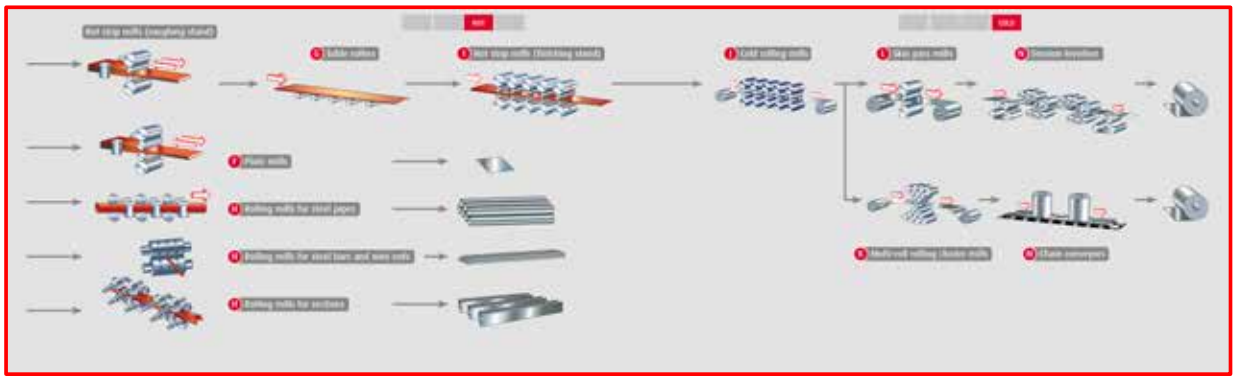


Iron Making

Steel Making

Continuous Casting

NSK in the steel industry



Product forming

What is casting?

- Casting is a manufacturing process in which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify.
- Traditional method is the teeming process where molten steel is poured into large molds and allowed to cool into ingots. But nowadays the majority of steel is cast in continuous casting machines (CCM) to obtain various shapes: slabs, blooms, billets, bars, blanks.

- Based on the type of product being made, continuous casters can be split into two large categories:
  1. Continuous casters for flat products – producing slabs
  2. Continuous casters for long products – producing blooms, billets, beams etc

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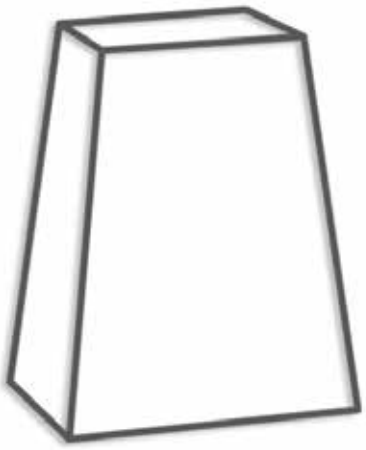
What is casting?

Casting

What is casting?



Ingots

Batch cast

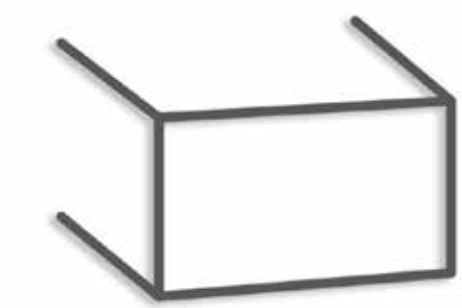
- 60 x 60 x 180 cm to
  120 x 120 x 304 cm

What is casting?

Slabs

- 5 x 23 cm thick
- 61 x 213 cm wide

What is casting?



Blooms

- 15 x 30 cm thick
- 15 x 30 cm wide

What is casting?

Billets

- 5 x 13 cm thick
- 5 x 13 cm wide

What is casting?

Bar (Round Billet)

- 1.3 x 20 cm diameter

What is casting?

Blank Various Shapes

- 1.3 x 20 cm diameter

What is casting?

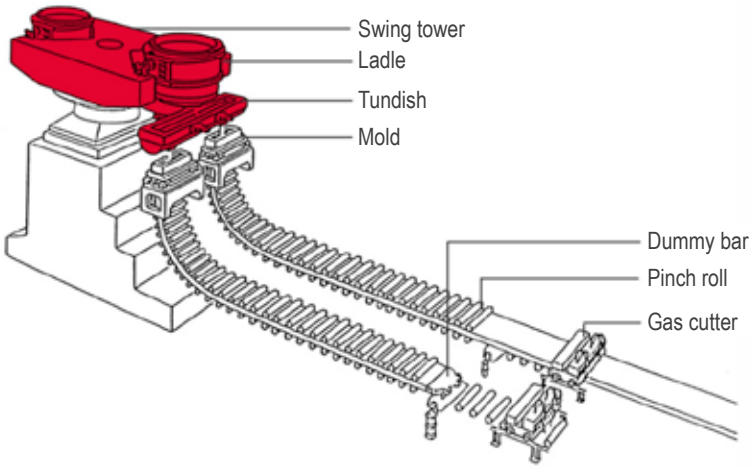
Continuous casters for flat products

What is casting?

Continuous casters for long products

How does casting work?

Schematic of a twin strand CCM

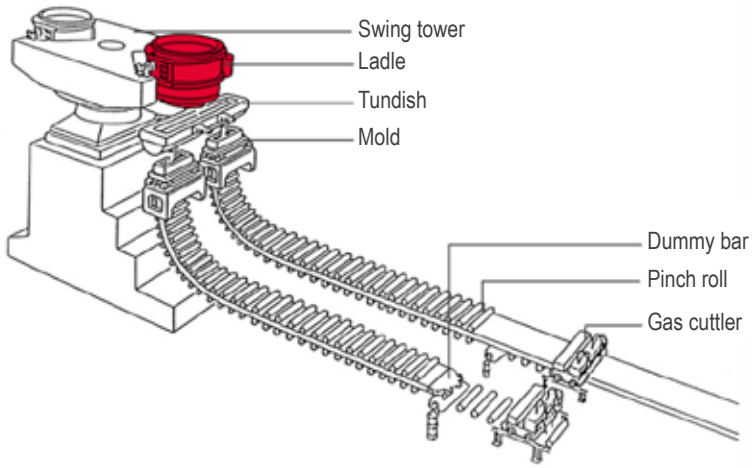


Molten steel is poured from the ladle into the tundish.

Next step

How does casting work?

Schematic of a twin strand CCM

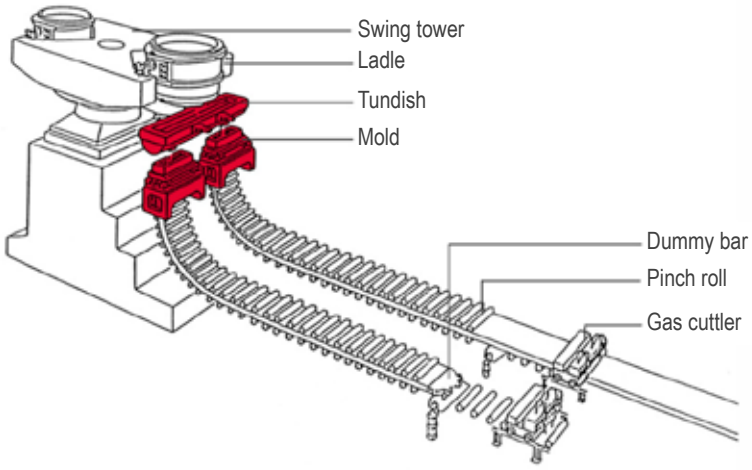


The ladle holds about 300 tons of liquid steel which is also known as a charge.

Next step

How does casting work?

Schematic of a twin strand CCM

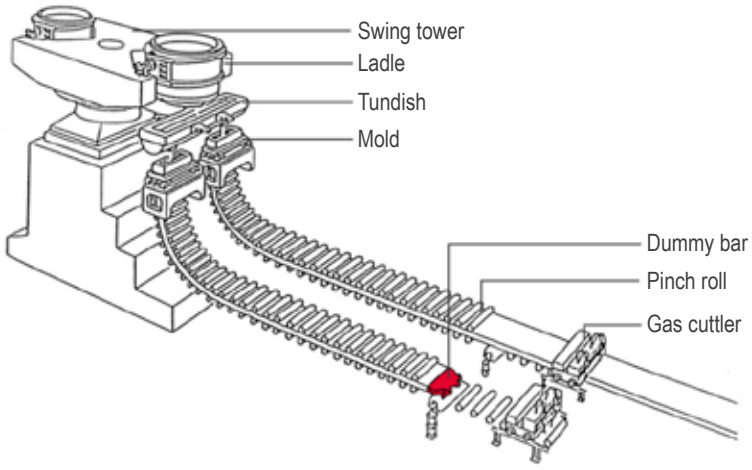


While one charge is being cast and flows from the tundish into the molds, the swing tower can rotate and allow for a new full ladle to be prepared for casting, while the empty one can be carried away to be refilled.

Next step

How does casting work?

Schematic of a twin strand CCM

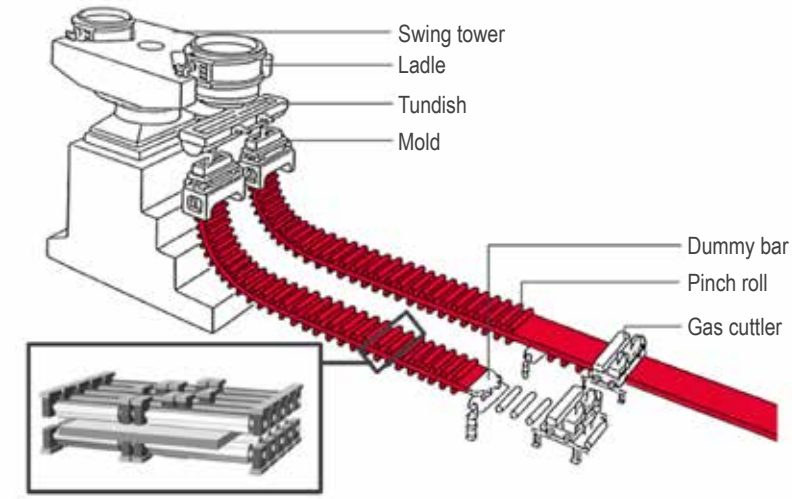


A dummy bar is used to plug the bottom of the mold in order to begin casting.

Next step

How does casting work?

Schematic of a twin strand CCM

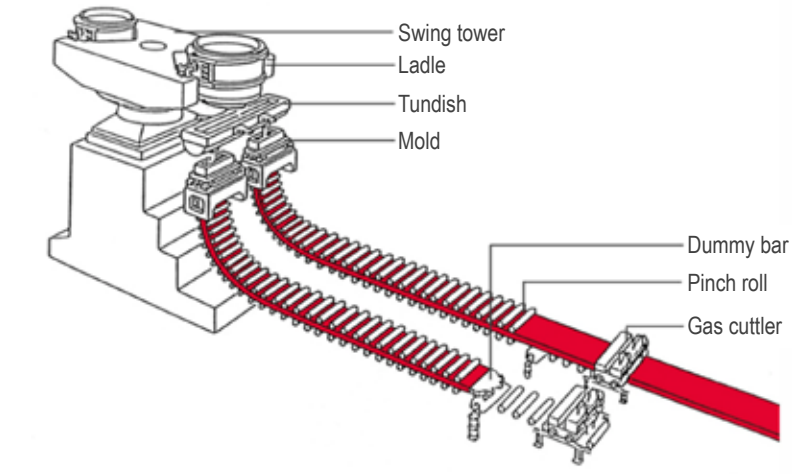


The CCM is divided into segments, each with guide rolls and pinch (drive) rolls.

Next step

How does casting work?

Schematic of a twin strand CCM

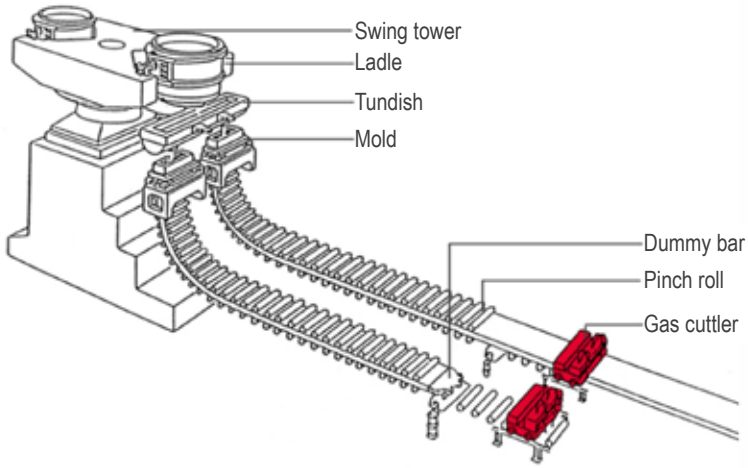


Steel flowing out of the mold runs through guide rolls and starts to solidify into the predetermined shape, while being gradually cooled.

Next step

How does casting work?

Schematic of a twin strand CCM



The product thus cast arrives on the horizontal section where it is cut to predetermined length by the gas cutter, to become a slab, bloom, etc.

Bearings in continuous casting machines

Let's have a look at the bearings!

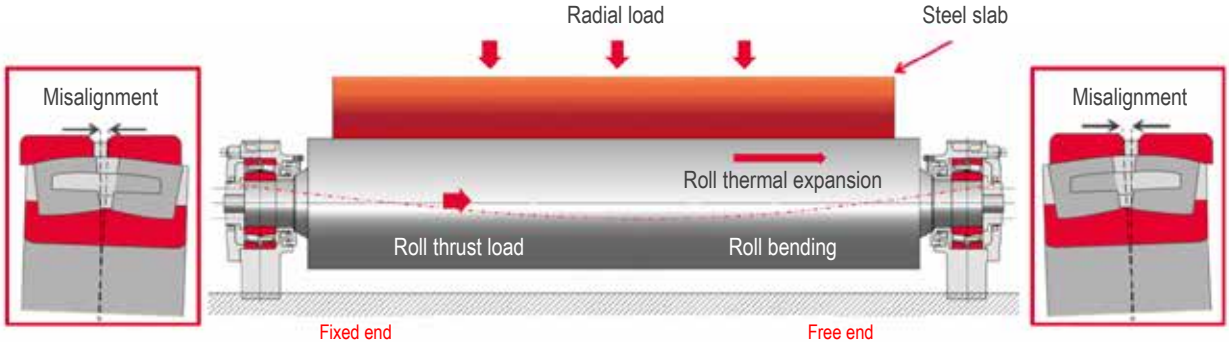
Bearings in continuous casting machines

Why are spherical roller bearings used for CCM?

- Spherical roller bearings are able to support large amounts of misalignment and heavy loads making them widely used for continuous casting machines.

Operating conditions – Harsh operating environment

Low speed & heavy loads	High temperature	Misalignment	Entry of debris / water



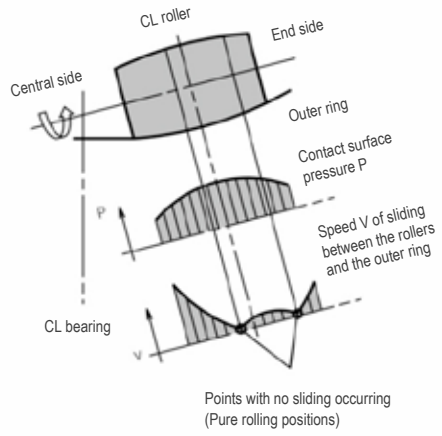
Fixed end
- Permit roll bending
- Support heavy radial and axial load

Free end
- Permit roll bending
- Support heavy radial load
- Allow for roll thermal expansion

Bearings in continuous casting machines

Failure mechanism of bearings in CCM

Differential sliding inside the bearing



1. Wear appears as a consequence of differential sliding and improper lubrication/contamination.
2. Pure rolling positions constitute stress concentration points, which generate flaking.
3. Bending stress within the bearing causes the existing flaking points to progess and to further develop into cracks.

Bearings in continuous casting machines

Super Wear Resistance Technology (SWR)

- SWR addresses the fundamental issue of sliding in spherical roller bearings through proprietary steel and heat treatment technology.

Operating conditions – Harsh operating environment

Low speed & heavy loads	High temperature	Misalignment	Entry of debris / water

click on (+) for more informations

Bearings in continuous casting machines

Super Wear Resistance Technology (SWR)

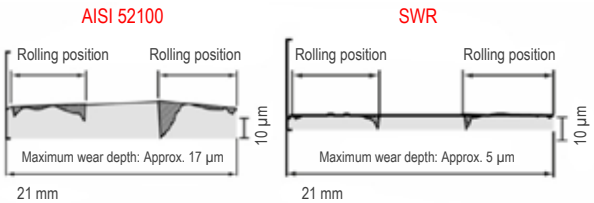
- SWR addresses the fundamental issue of sliding in spherical roller bearings through proprietary steel and heat treatment technology.

Operating conditions – Harsh operating environment

Low speed & heavy loads	High temperature	Misalignment	Entry of debris / water

click on (+) for more informations

It can withstand wear 3 times longer than standard bearing steel



Evaluation of an endurance test using 22210CD bearings

Bearings in continuous casting machines

Super Wear Resistance Technology (SWR)

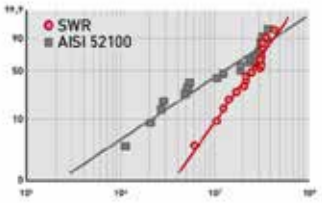
- SWR addresses the fundamental issue of sliding in spherical roller bearings through proprietary steel and heat treatment technology.

i click on (+) for more informations

Operating conditions – Harsh operating environment

Low speed & heavy loads	High temperature	Misalignment	Entry of debris / water

It can inhibit the formation of flaking, prolonging bearing lifetime by 5 times



Evaluation of operating life by thrust-type life test

Bearings in continuous casting machines

Super Wear Resistance Technology (SWR)

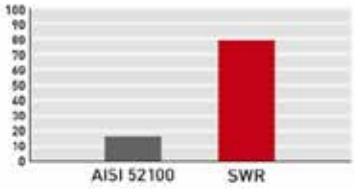
- SWR addresses the fundamental issue of sliding in spherical roller bearings through proprietary steel and heat treatment technology.

i click on (+) for more informations

Operating conditions – Harsh operating environment

Low speed & heavy loads	High temperature	Misalignment	Entry of debris / water

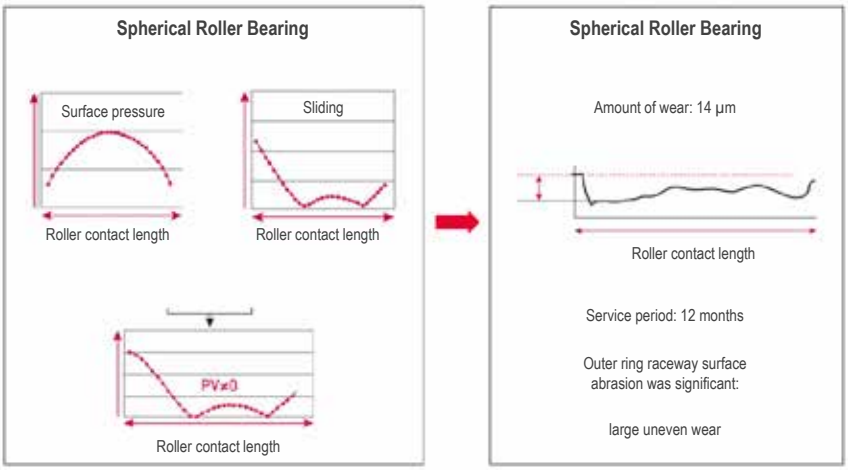
It can prevent the formation and propagation of cracks, improving core toughness by 5 times



Core fracture toughness KIC, MPa·m½

Bearings in continuous casting machines

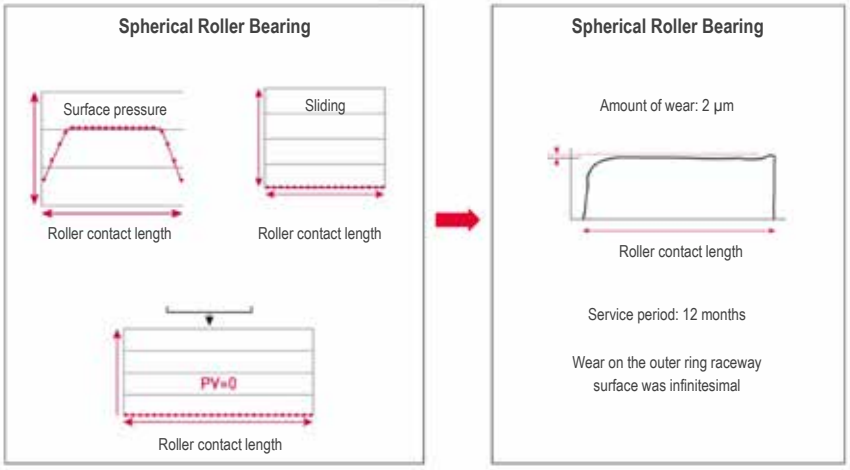
Wear comparison of spherical roller bearings and cylindrical roller bearings (1/2)



- Wear is also a combined function of surface pressure between rolling element and raceway (P) and sliding (V).
- Wear observation of tested bearings reflects the results of the theoretical model of analysis by looking at PV values (the combination of contact pressure and sliding).

Bearings in continuous casting machines

Wear comparison of spherical roller bearings and cylindrical roller bearings (2/2)

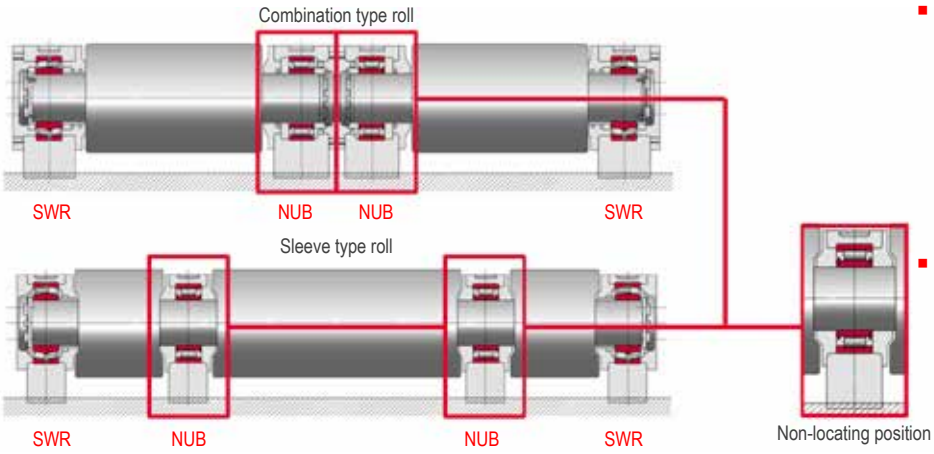


- That is why the cylindrical roller bearing model is a better suited design against this kind of failure mode.

Bearings in continuous casting machines

NUB bearings – NSK solution for floating or non-locating positions in CCM rolls

- Modern continuous casting machines use rolls supported by more than just 2 bearings, for improved productivity or heavier cast products and better control of roll bending.

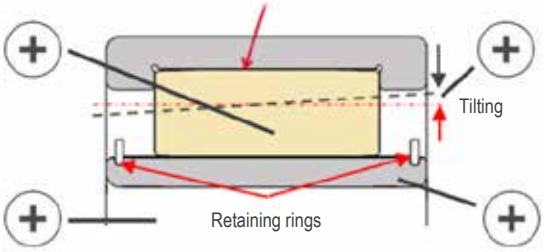


- Even with the increased number of supports on a single roll, still some of the positions must be fixed whilst others need to be floating or non-locating.
- NUB bearings have been developed by NSK as a specialised cylindrical roller bearing solution for this specific application.

Bearings in continuous casting machines

NUB bearings

Optimised crowning



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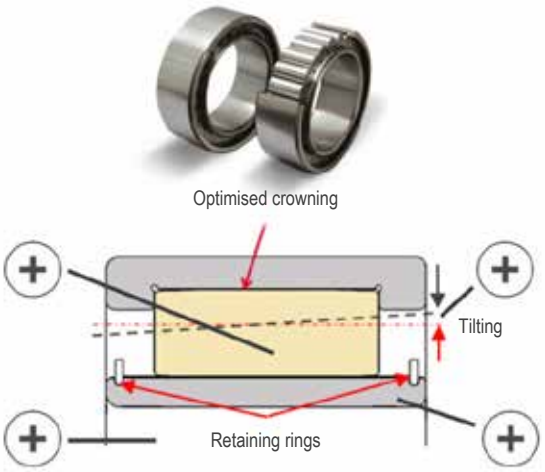
Operating conditions – Harsh operating environment

Low speed & heavy loads	High temperature	Misalignment	Entry of debris / water

Bearings in continuous casting machines



i click on (+) for more informations

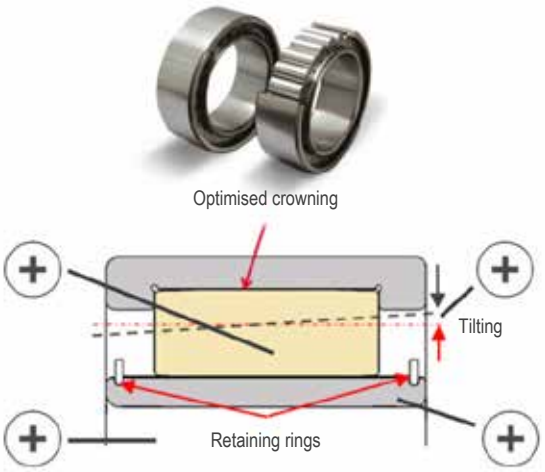
Operating conditions – Harsh operating environment

Low speed & heavy loads	High temperature	Misalignment	Entry of debris / water

Features:

- High capacity through optimised internal design and reduced wear due to cylindrical roller design.

Bearings in continuous casting machines



i click on (+) for more informations

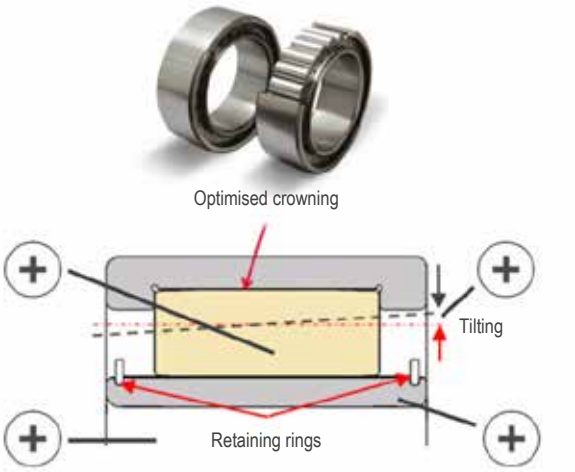
Operating conditions – Harsh operating environment

Low speed & heavy loads	High temperature	Misalignment	Entry of debris / water

Features:

- Easy handling as the retaining rings allow the bearing to be safely manipulated without the risk of self-disassembly.

Bearings in continuous casting machines



i click on (+) for more informations

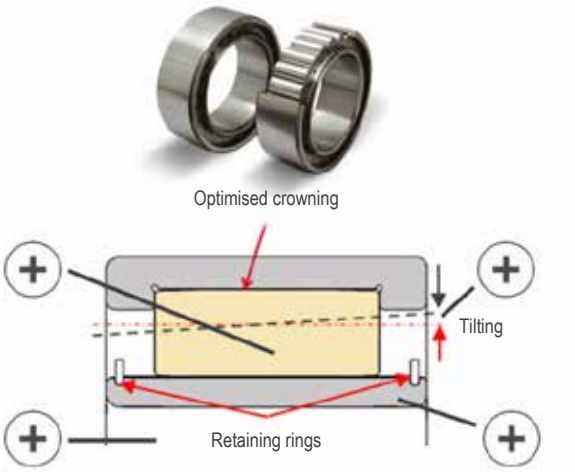
Operating conditions – Harsh operating environment

Low speed & heavy loads	High temperature	Misalignment	Entry of debris / water

Features:

- Self-aligning functionality due to crowning of raceway profiles.

Bearings in continuous casting machines



i click on (+) for more informations

Operating conditions – Harsh operating environment

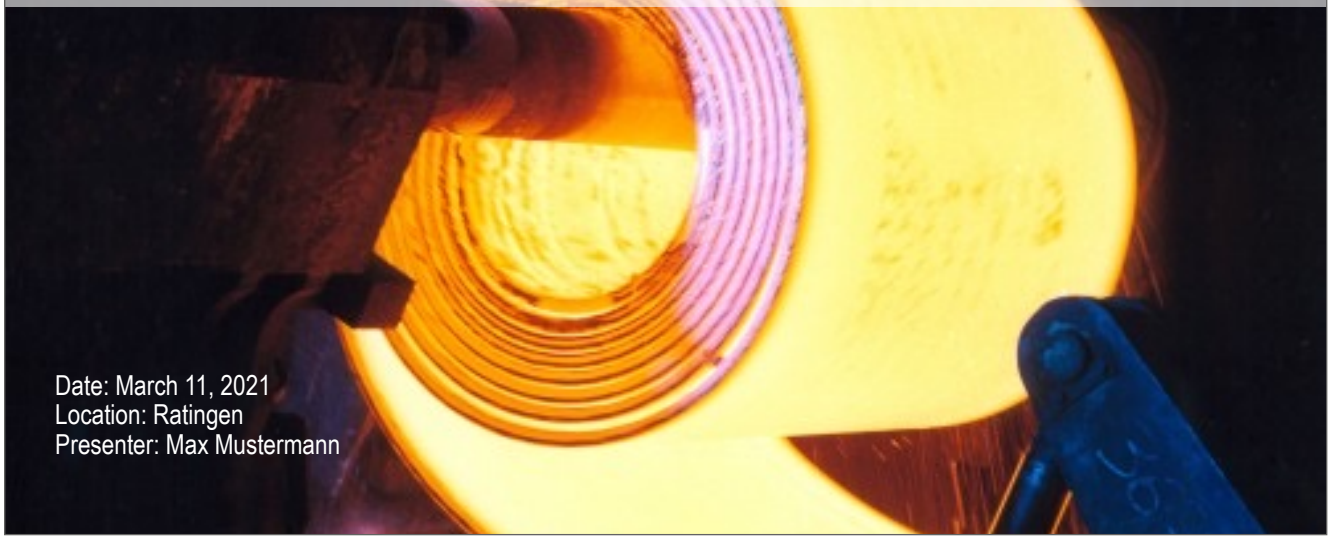
Low speed & heavy loads	High temperature	Misalignment	Entry of debris / water

Features:

- Free floating capability is accomplished smoothly between inner ring and rollers.

Rolling Mills – Bearings for Steel & Metal applications

ROLLING MILLS
NSK bearings for Steel & Metal applications



Date: March 11, 2021
Location: Ratingen
Presenter: Max Mustermann

Introduction

Did you know

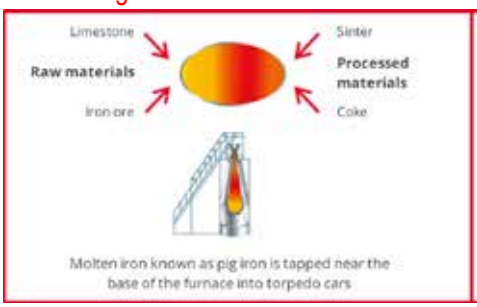
that when liquid iron is converted into steel it reaches temperatures of up to 1,700°C, significantly hotter than volcanic lava?

Introduction

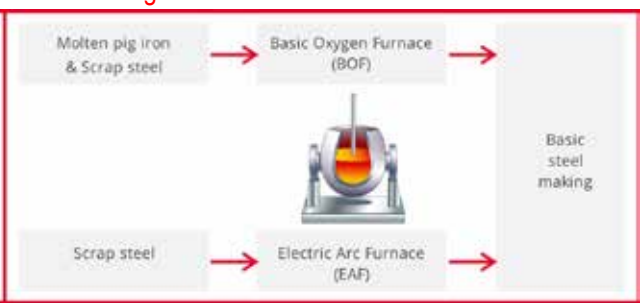
What is steel?

- Steel is a metallic material consisting primarily of iron but also containing carbon (generally 0.1% to 1.2% by weight).
- Often quantities of other metals are added to modify specific properties (hardness, corrosiveness, strength, weldability, etc.).
- These are then known as alloy steels.

Iron Making



Steel Making



Types of steel manufacturing facilities

Iron Making

1. Raw Materials Storage
2. Sintering Plant
3. Coke Plant
4. Blast Furnaces

Steel Making Area

5. Furnaces and Casting

Product Forming

6. Rolling Mills and Finishing lines

Types of steel manufacturing facilities

1. Raw Materials Storage

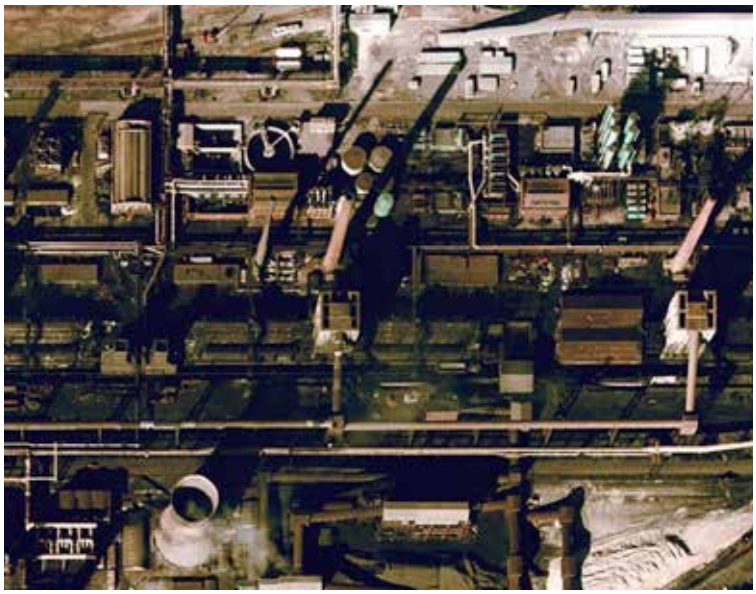
- The iron and steel-making process requires iron ore, coal and limestone.
- These raw materials are transported to the steel plant in bulk by ship and rail and stored in stockyards adjacent to the plant.
- Reclaimers distribute the ore into beds, where it is mixed to produce the most suitable blend.
- From the stockyards, coal is moved by conveyor to the coke ovens, while iron ore is mixed with coke and sent to the sinter plant.

Types of steel manufacturing facilities

2. Sintering

- In the sinter plant, iron ore and coke particles are fed through an oven, where the mixture is cooked to drive off impurities such as sulphur.
- The result is a solid clinker, known as sinter, which aids the efficient smelting of iron ore.
- The sinter plant is connected to the stockyard by a series of conveyors and is equipped with electrostatic precipitators to remove ash particles from flue gases before they reach the chimney stack.

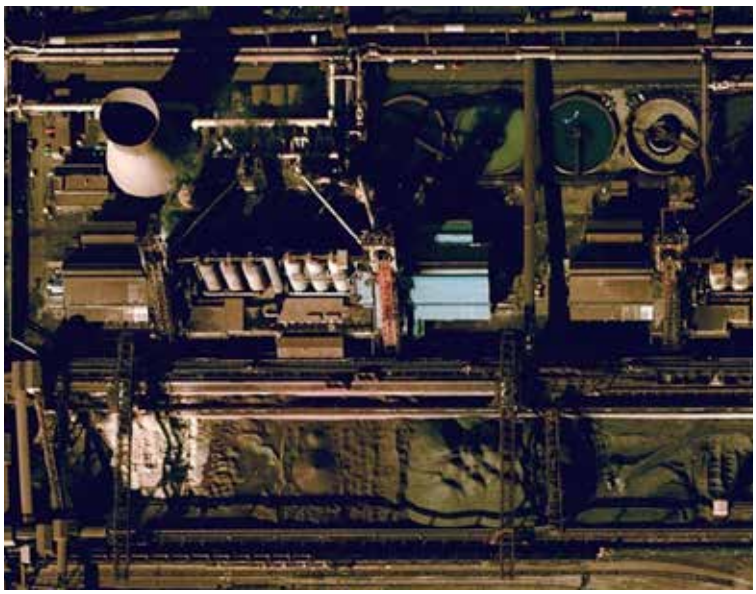
Types of steel manufacturing facilities



3. Coke production

- Coke is produced by heating coal in an oven, to drive out oil and tar before it is used in the blast furnace.
- A quenching car moves along rails parallel to a battery of coke ovens and transports hot coke, rammed into the car from the ovens, to the quenching tower.
- Here it is extinguished by water, and then dumped onto the coke-drying wharf.
- From there, it is graded in a screening tower before being moved to the blast furnace.
- A plume of steam on aerial imagery of a coke battery indicates an active quenching tower.

Types of steel manufacturing facilities



4. Iron production

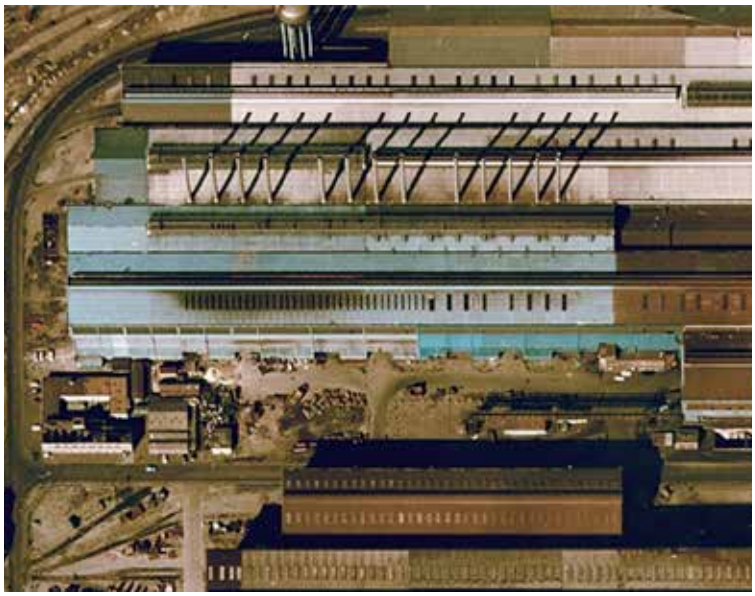
- Iron ore sinter, coke and limestone are tipped into the blast furnace, where their combustion is aided by very hot air blown in from an adjacent row of stoves.
- The iron ore reduces to molten metal, which is tapped at frequent intervals into torpedo-shaped rail wagons for onward transport to the steel furnace.
- Limestone can be identified on aerial imagery by its signature light tone; here, a stock of lime is visible adjacent to the blast furnace, at lower left.

Types of steel manufacturing facilities

5. Steel production

- In the Basic Oxygen Steelmaking (BOS) plant seen here, high-pressure oxygen is blown into a vessel containing scrap metal and molten iron brought from the blast furnaces.
- The oxygen combines with unwanted elements such as carbon, leaving behind liquid steel.
- A flux of lime combines with the impurities to form slag, while carbon monoxide gas is collected for use elsewhere in the plant.
- Many modern steel plants utilise a process of continuous casting (concast), whereby molten steel is cooled and shaped as it is poured from the furnace vessel.
- In this image, the concast building is visible to the right of the BOS plant, with a light-toned lime preparation building at photo south.

Types of steel manufacturing facilities



6. Casting and finishing

- Rolling mills take the shaped steel from the concast building and form it into steel plates, coils and bars by re-heating, rolling, squeezing and carefully cooling the steel.
- It is then ready for further processing, such as cutting, coating and pressing, before it is used to create an end-product. Finished steel is then stockpiled outside the mill, ready for onward distribution.

Types of steel manufacturing facilities

Iron Making

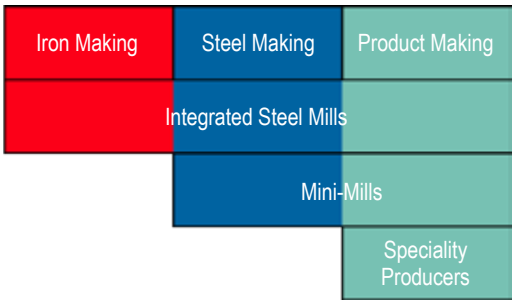
1. Raw Materials Storage
2. Sintering Plant
3. Coke Plant
4. Blast Furnaces

Steel Making Area

5. Furnaces and Casting

Product Forming

6. Rolling Mills and Finishing lines



click on fields in the graphic for more information

Types of steel manufacturing facilities

Iron Making

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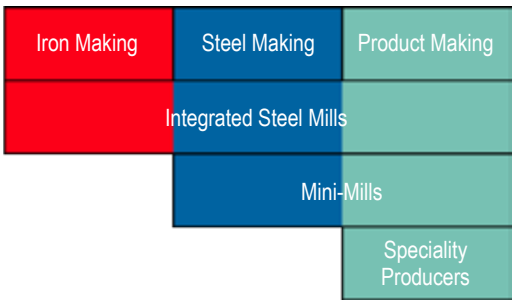

Integrated Steel Mills

- Manufacture steel products using both iron ore and scrap steel as raw materials
- Primarily use oxygen fuelled furnaces for steel making but may also use electric arc furnaces with scrap steel

Types of steel manufacturing facilities

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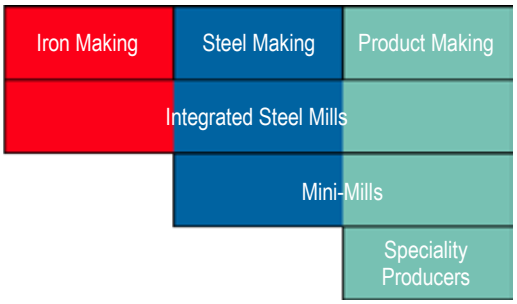

Mini-Mills
- Generally facilities are smaller than integrated steel mills
- Usually specialise in making single type or finished product e.g. wire, rod, beam or coiled strip

Types of steel manufacturing facilities

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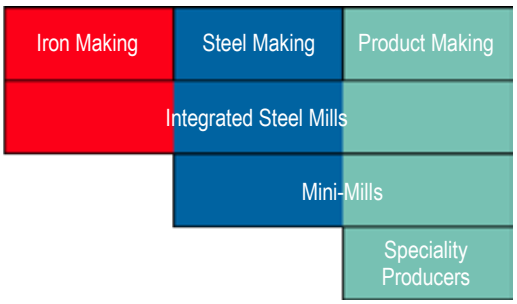
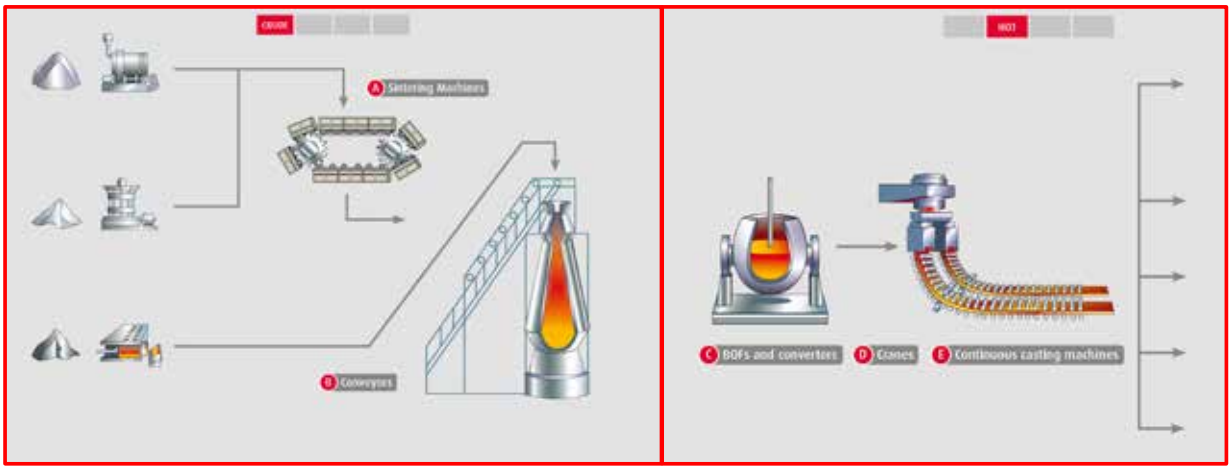
6. Rolling Mills and Finishing lines



Speciality producers
- Perform auxiliary and finishing processes on steel that has already been formed into a semi-finished product
- Specialise in one or some of the many product forming processes performed by integrated mills

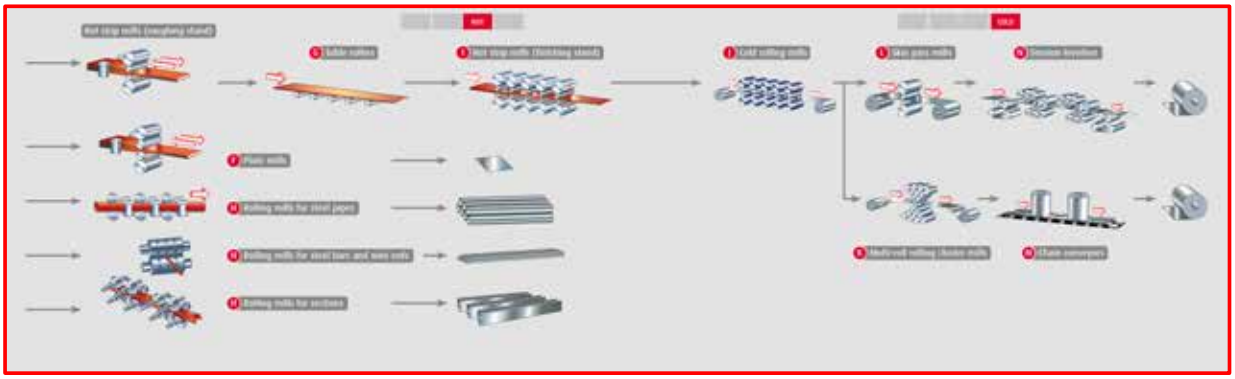
NSK in the steel industry



Iron Making

Steel Making

NSK in the steel industry – Rolling Mills



Product forming

What is rolling?

- Rolling is the most common process used to transform cast steel into more desirable forms. Forging process is also used.
- A Rolling Mill containing Mill stands is the equipment which performs rolling.
- Common terms used to describe the rolling process are:

Reversing	Continuous	Tandem
Universal	Roughing	Finishing

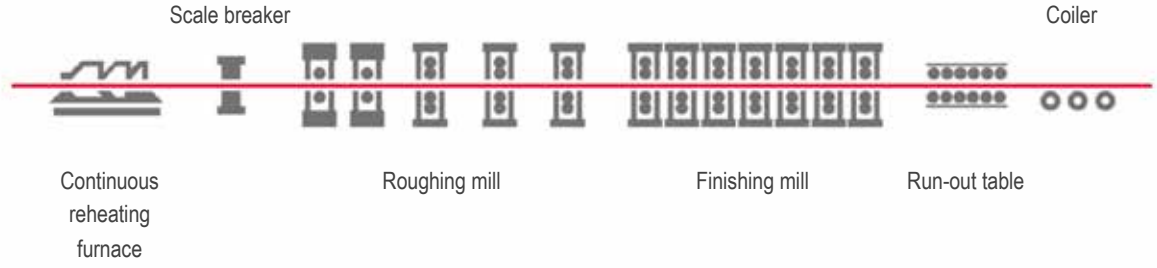
- Table rolls are used to transfer steel from one rolling process to the next.
- Most common shapes that steel is rolled into are:

Plates	Sheet	Coiled strip
Wire	Bar/Rod	Various structural shapes (I-beams, pillings…)

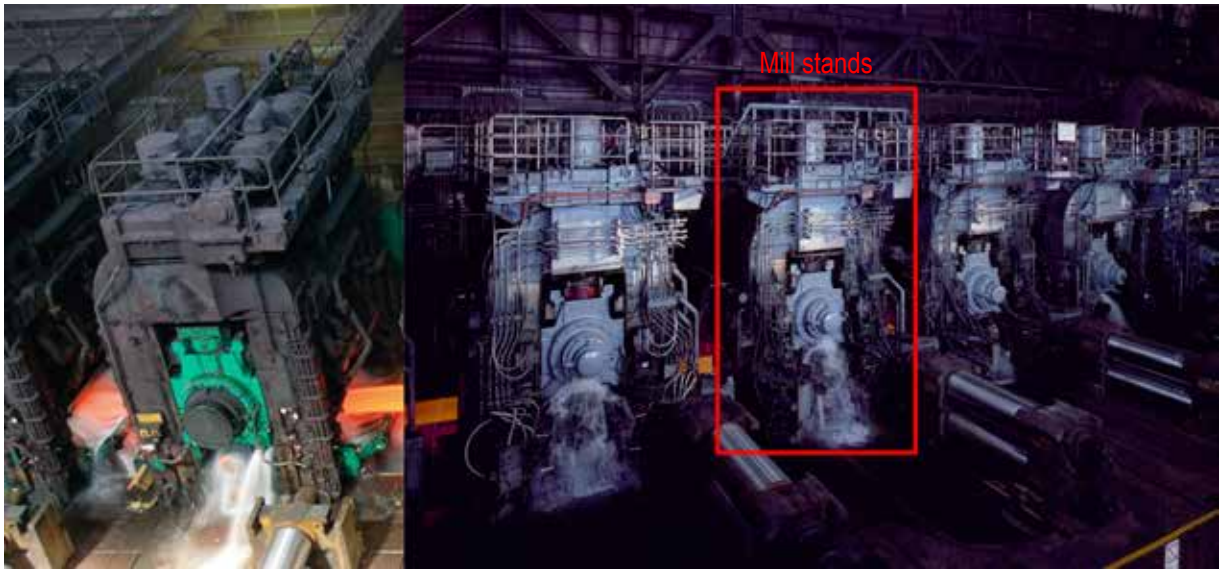
i click on the red words for more informations

What is rolling?

Rolling mill

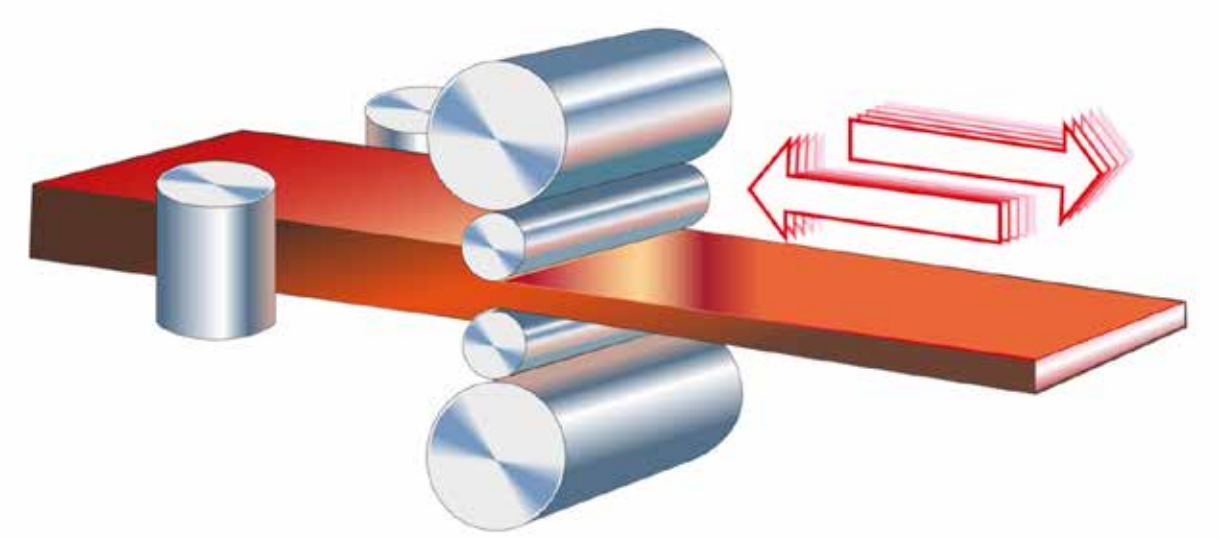


What is rolling?



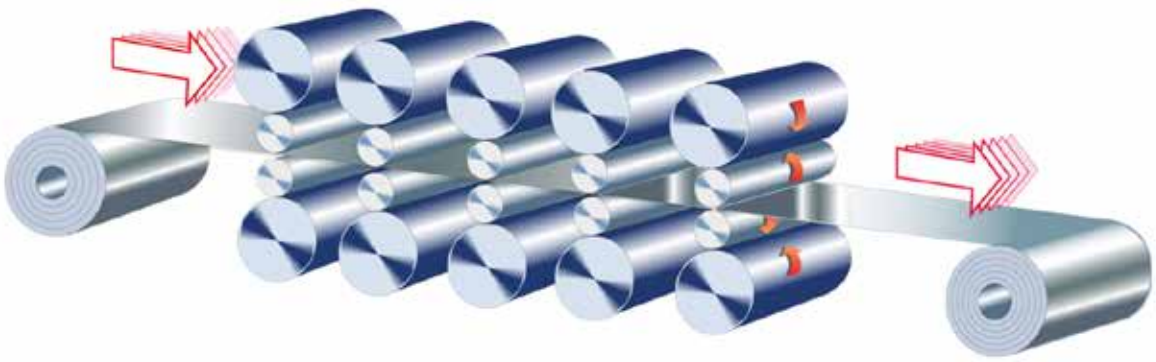
What is rolling?

Reversing



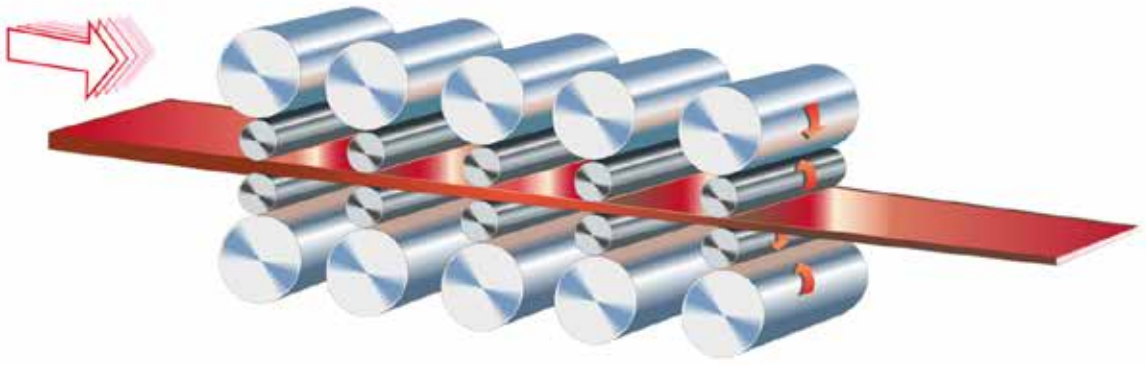
What is rolling?

Continous



What is rolling?

Tandem



What is rolling?

Plates

What is rolling?

Sheet

What is rolling?

Coiled strip

What is rolling?

Wire

What is rolling?

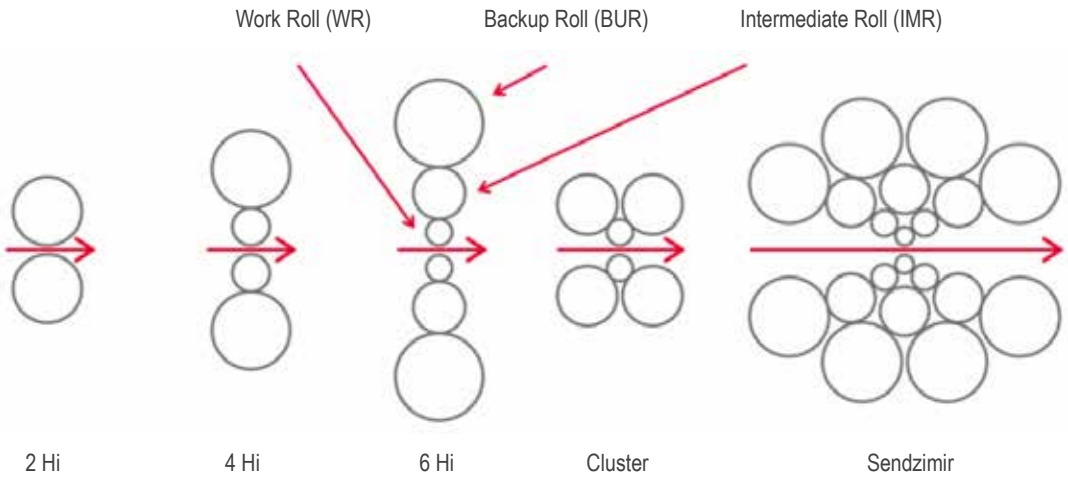
Bar/Rod

What is rolling?

Various structural shapes

Typical Rolling Mill types

Rolling Mill types categorised by number and arrangement of rolls



What is rolling?

Rolling load flow

Acting rolling forces (Drive side and work side)

↓

BUR barrel through radial bearings

↓

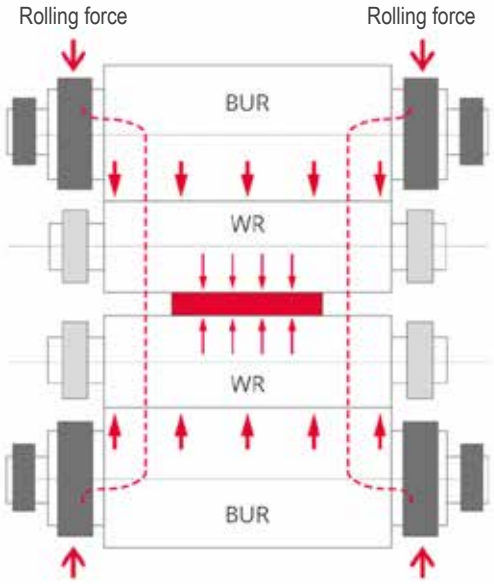
WR barrel (WR bearing is not carrying the rolling load)

↓

Plate

↓

Bottom position's WR and BUR which support the top roll force through the bottom BUR bearings
(WR bearing is not carrying the rolling load)



Bearings in a Rolling Mill

Let's have a look at the bearings!

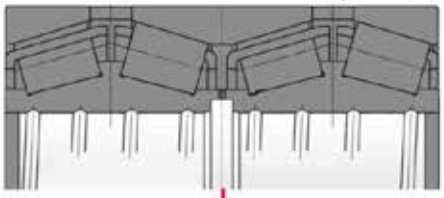
Bearings in a Rolling Mill

Work Roll bearings

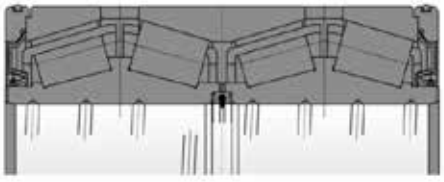
Operating conditions – Harsh operating environment

High Speed / Low speed	Heavy loads	Vibration & Impact	Entry of Debris / Water

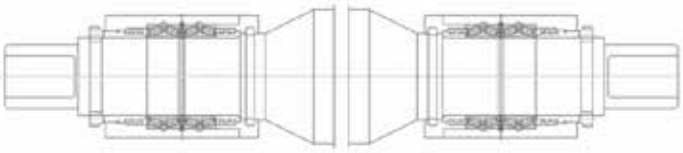
Standard four row tapered roller bearing – KV type



Sealed four row tapered roller bearing – KVS type



Work Roll assembly



Bearings in a Rolling Mill

Sealed four row tapered roller bearing – KVS type

Operating conditions – Harsh operating environment

High Speed / Low speed	Heavy loads	Vibration & Impact	Entry of Debris / Water

High capacity design

- New internal specification design
- Increased bearing capacity due to new seal type

New type bore seal

- Preventing water intrusion by reducing bearing internal negative pressure (vacuum)
- Easy mounting and dismounting

Adoption of new main seal and seal-holder type

- Improve handling and prevent seal damage

Bearings in a Rolling Mill

AQGRD R1

- Long-life water-resistant grease for sealed four row tapered roller bearings

Operating conditions – Harsh operating environment

High Speed / Low speed	Heavy loads	Vibration & Impact	Entry of Debris / Water

Work Roll bearing typical environment

Bearings in a Rolling Mill

AQGRD R1

- Long-life water-resistant grease for sealed four row tapered roller bearings

Benefits of water-resistant grease technology

- Inhibits water entry to rolling surface
- Minimises premature flaking and rust
- More than doubled life with new grease

Bearings in a Rolling Mill

Part numbering

STF343KVS4557EgS3CG150 RN1

STF	Special material
343	Bore diameter (343 ~ 343.999 mm)
KV(S)	4 row tapered roller bearing (Sealed)* KVE – old designation of KVS
45	Bearing OD (450 ~ 459.999 mm)
5	Tolerances; 0 ~ 4 Metric, 5 ~ 9 inch
7	Sequence number; 1 ~ 9
E	Spiral lube groove in bore
g	Case carburised material
S3	Special surface treatment – inner ring only
CG150	Radial clearance (150 µm)
RN1	Grease type – sealed version only

Bearings in a Rolling Mill

Total Cost of Ownership (TCO) - sealed vs. open WR bearings

Maintenance cost

Bearing specifications	Grease	Bearing usage cost and seal repair cost	Maintenance work cost for bearings
Open type bearings (without seal) Maintenance cycle: 3 months			
Sealed bearings Maintenance cycle: 6 months	90% reduction		50% reduction
Sealed bearings with AQGRD grease Maintenance cycle: 6 months	90% reduction	50% reduction	50% reduction

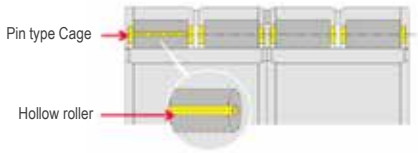
Bearings in a Rolling Mill

Backup Roll bearings

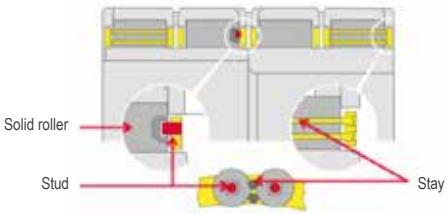
Operating conditions – Harsh operating environment

High Speed / Low speed	Heavy loads	Vibration & Impact	Entry of Debris / Water

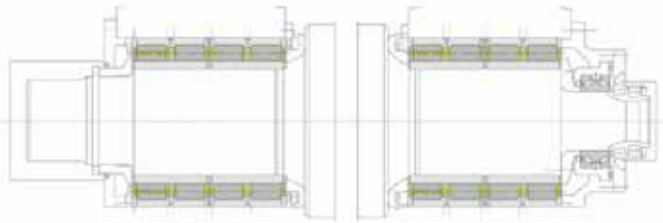
Standard four row tapered roller bearing – RV type



Four row cylindrical roller bearing – RV with stud type cage



Backup Roll assembly

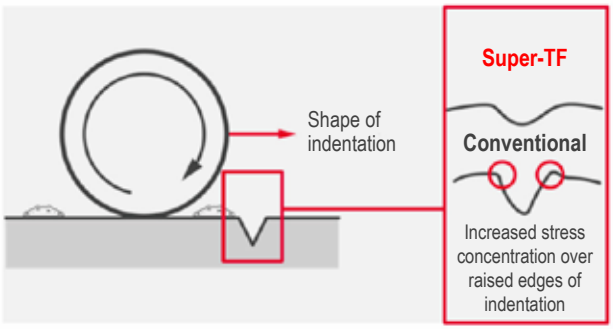


Bearings in a Rolling Mill

Super-Tough (STF) Material

Operating conditions – Harsh operating environment

High Speed / Low speed	**Heavy loads**	Vibration & Impact	**Entry of Debris / Water**



Bearings in a Rolling Mill

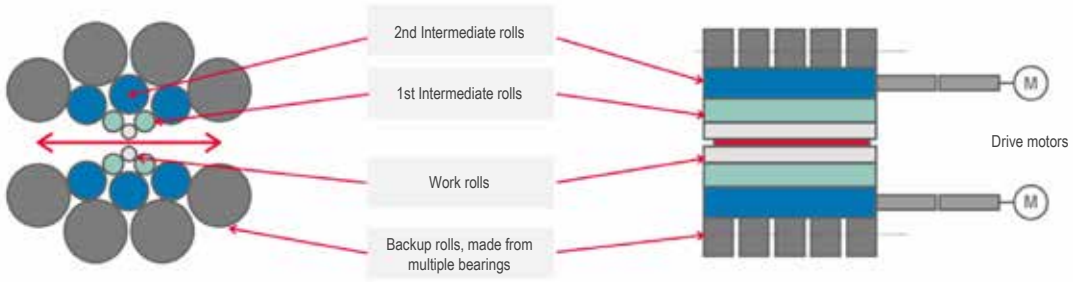
Part numbering

STF600RV8711gS8CR370P5A

STF	Special material
600	Bore diameter (600 mm)
RV	4 row cylindrical roller bearing
87	Bearing OD (870 ~ 879.999 mm)
1	Tolerances; 0 ~ 4 Metric, 5 ~ 9 inch
1	Sequence number; 1 ~ 9
g	Case carburised material
S8	Special surface treatment – specific areas only
CR370	Radial clearance (370 µm)
P5A	Special tolerance class

Bearings in a Rolling Mill

Sendzimir mills (20 Hi mills)



Features of Sendzimir mills

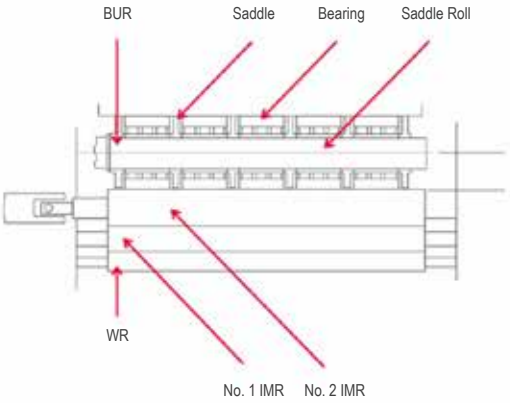
- Can apply much higher rolling pressure without bending the work rolls
- This allows for rolling of harder and more elastic materials, without compromising quality of rolled material (thickness variation, surface finish, etc.)
- Hard materials (stainless steel, titanium) can be consistently rolled to very thin gauges, with tight thickness variation tolerances

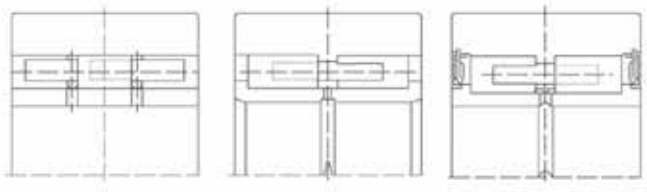
Bearings in a Rolling Mill

Sendzimir mill bearings

Operating conditions – Harsh operating environment

High Speed / Low speed	Heavy loads	Vibration & Impact	Entry of Debris / Water





3PL TYPE | 2U TYPE | 2U TYPE (Sealed)

Bearings in a Rolling Mill

Sendzimir mill bearings

Operating conditions – Harsh operating environment

High Speed / Low speed	Heavy loads	Vibration & Impact	Entry of Debris / Water

New sealing concept

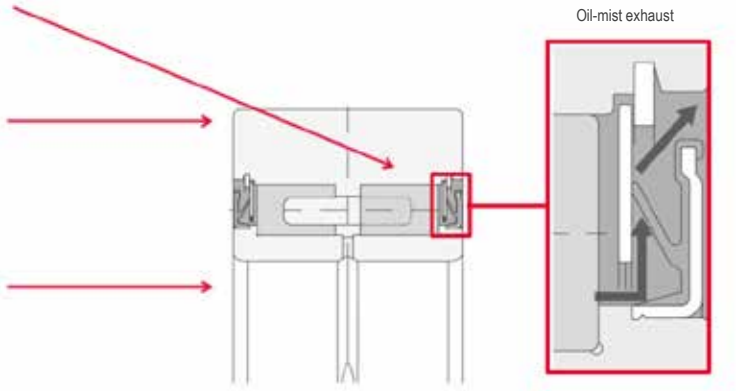
- Improved seal wear, by discharging the oil-mist pressure through the seal lip

Carburised steel outer ring

- Optionally, the outer ring can be manufactured out of carburised steel, for higher resistance to cracks and fractures

STF steel inner ring

- In severely contaminated environments, the inner rings can be specified as STF material, for up to twice the lifetime of standard steel



Bearings in a Rolling Mill

Part numbering

STF3PL180-2AgCCG93UPBDR7

STF	Special material
3PL	3 row cylindrical roller bearing, no ribs on inner and outer rings
180	Bore diameter (180 mm)
2A	Design number and modification
g	Case carburised material
CCG93	Matched radial clearance (93 µm)
UPB	Special accuracy class
DR7	Bearing supplied in matched sets of 7 bearings

Product Information

NUB Series

Water Resistant Bearing Grease for Rolling Mills

Roll Neck Bearing Manual

Super-TF and HI-TF Bearings

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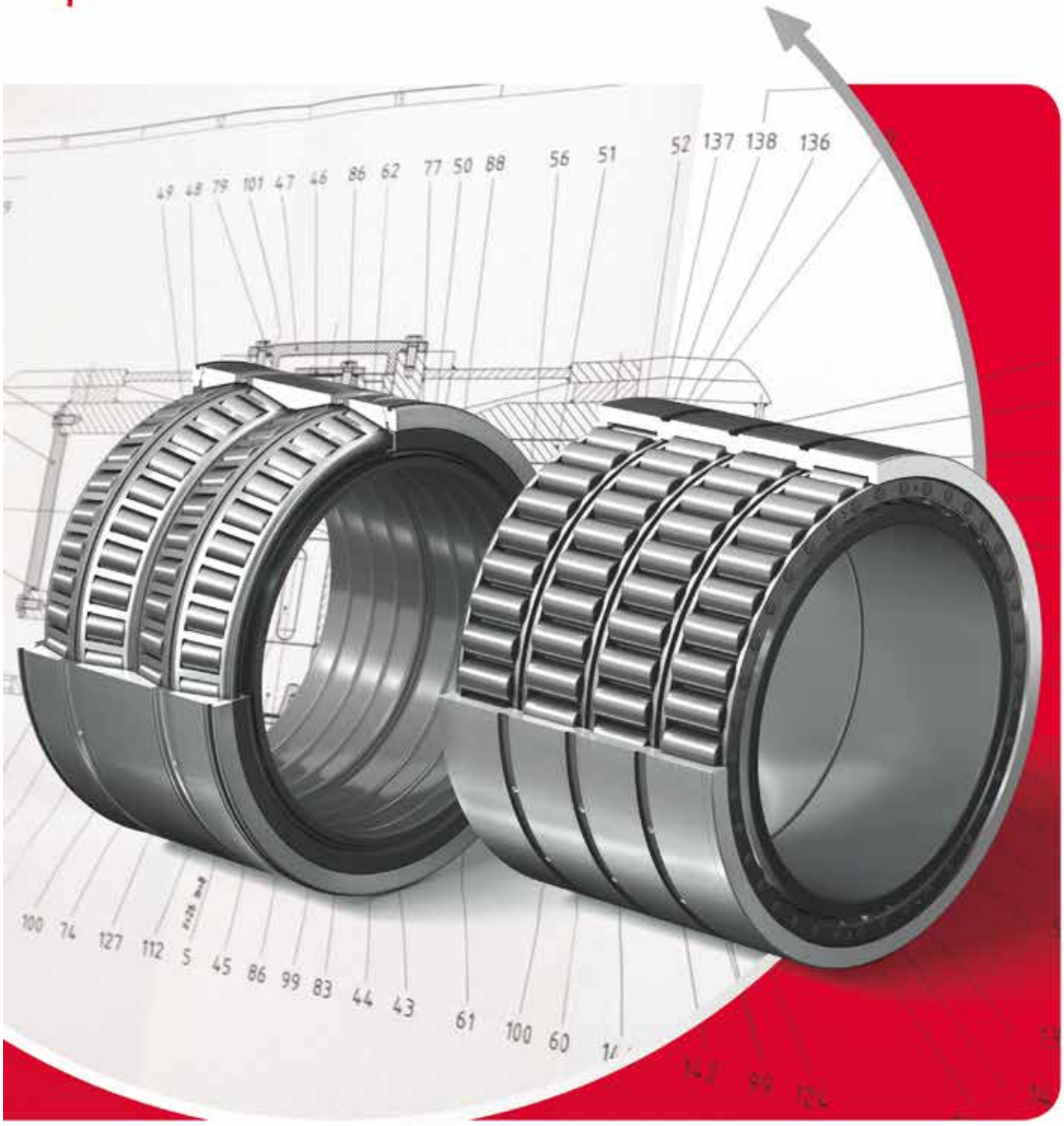
ROLL NECK BEARING MANUAL



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