Back-up rollers

for multi-roll cold rolling mills

SCHAEFFLER GROUP
INDUSTRIAL

Back-up rollers

The requirements placed on the quality of rolled products in relation to flatness, thickness tolerance and surface quality are continually increasing, thus placing very high demands on the back-up rollers used in multi-roll cold rolling mills. In close partnership with the customer, we therefore continually design, test and develop to production-ready status new bearings optimally suited to this application. The quality of FAG and INA back-up rollers is ensured by means of high precision machining and sophisticated measurement methods.

The Schaeffler Group has more than 100 years' experience in the development and manufacture of rolling bearings. Thanks to this comprehensive knowledge and experience, we can find the solution that is best suited to the customer and the most economical in overall terms. Just contact the FAG advisory service to see what we can do for you.

Technical Product Information TPI 129 replaces Technical Product Information TPI 104. Information in previous editions that does not agree with that given in this edition is therefore invalid.

Back-up rollers

Characteristics

Back-up rollers

Multi-roll cold mill stands are described using different terms depending on their type and manufacturer:

- 12 and 20 roll stand
- Z-High®
- S-High.

Multi-roll cold rolling mills are used to process high grade steel strip and non-ferrous metal strip. In order to prevent whipping of the work rolls, they are supported by means of intermediate rolls and support shafts. Several back-up rollers are arranged adjacent to each other on these support shafts and separated by support saddles. These allow the requisite distribution of roll load.

Depending on their type, back-up rollers can support high radial forces or high radial forces together with axial forces that are transmitted to the stand via the adjacent construction.

The quality of the rolled metal sheet is determined not only by the bending rigidity of the entire support shaft but also the section height tolerance, running accuracy and surface quality of the outer ring outside surface of the individual back-up rollers.

Back-up rollers

- are manufactured with restricted tolerances
- have a running accuracy better than P4
- are classified in three to seven section height groups each of 3 μm to 5 μm
- are suitable for high loads
- are suitable for high strip speeds, up to 1000 m/min depending on operating conditions
- are manufactured in 3 types.

These specific characteristics ensure the necessary surface quality and flatness of the rolled products. As a result, sheet metal can be produced economically to very fine thickness tolerances and optimum surface quality.

Features of type 1 – *Figure 1*

The outer ring is without ribs and the first and second rows of rollers are guided by a double comb cage, while the third row is guided by a single comb cage.

The rollers are guided axially by rib washers on the inner ring.

The back-up rollers are supplied without seals.
Unsealed bearings are preferably lubricated by the rolling emulsion; the lubricant can flow uniformly and without hindrance out of the bearings.

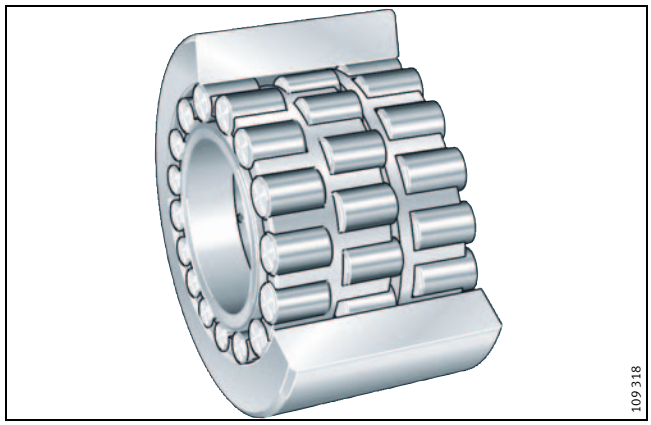


Figure 1 · Back-up roller – type 1

Features of type 2 – *Figure 2*

These double row back-up rollers have an outer ring with three ribs. The rollers are guided by a brass double comb cage.

These bearings are suitable for all the lubrication methods described on page 7. They are supplied sealed or unsealed in accordance with the lubrication method selected.

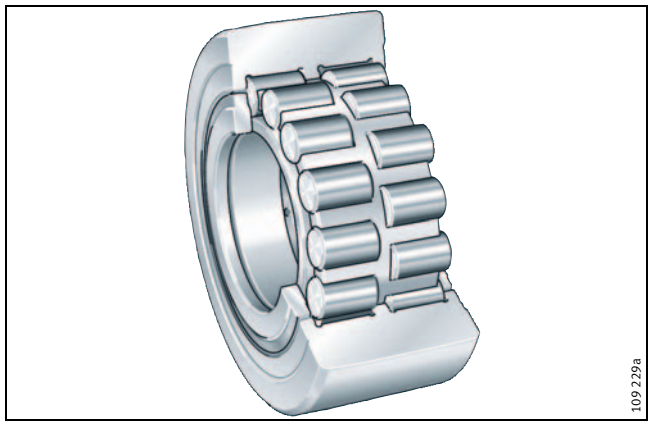


Figure 2 · Back-up roller – type 2

Features of type 3 – *Figure 3*

These double row, full complement back-up rollers have a central rib on the inner and outer ring.

The back-up rollers are supplied unsealed and are preferably lubricated by the rolling emulsion.

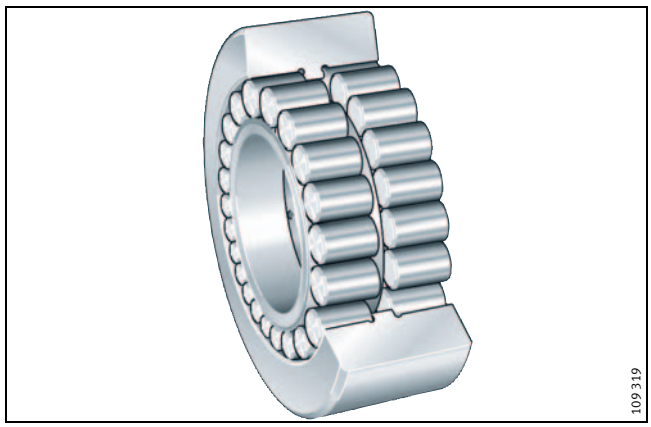


Figure 3 · Back-up roller – type 3

Design guidelines

The flow of forces in a 20 roll stand is dependent on the angular and diameter ratios of the work rolls, intermediate rolls and back-up rolls.

For an approximate representation, the following layout can be taken:

- shafts A, D, E and H are each subjected to 60% of the rolling force
- shafts B, C, F and G are each subjected to 40% of the rolling force.

Legend for *Figure 4*:

① Support shaft
② Intermediate rolls
③ Work rolls
④ Back-up roller, type 2
⑤ Support saddle.

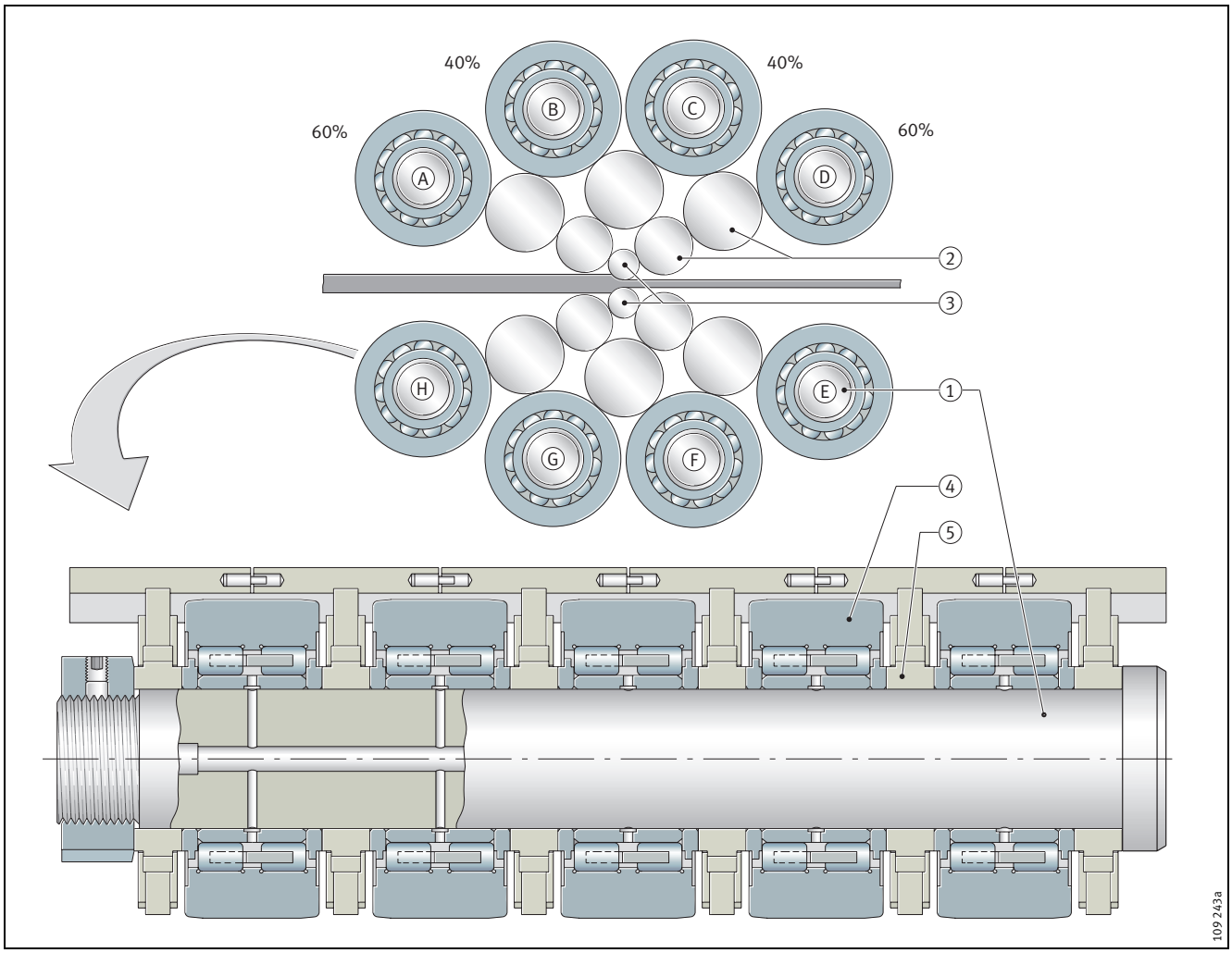


Figure 4 · Support shaft with back-up rollers (type 2) and support saddles

New rolling mill designs

Roll stand back-up rollers are precision machine elements that give optimum functioning and achieve their maximum operating only if they are precisely matched to the application.

When new enquiries are received for roll stand back-up rollers, a wide range of technical data are therefore required in order to design the bearing arrangement. The corresponding questionnaire is sent by agreement and forms the basis for reliable functioning of the bearings.

Deformation of the outer ring – *Figure 5*

The deformation of an elastic outer ring can be calculated using the calculation program BEARINX®. This allows the application of load via the outer ring, the outer ring material and the hardening process to be taken into consideration.

The following calculation results are generated for any position on the outer ring:

- the radial displacement of the outer ring
- the tangential stress (internal)
- the tangential stress (external)
- the internal load conditions in the rolling bearing
- the pressure distribution at each rolling contact of the individual rolling elements.

Due to the oval deformation, the load distribution is altered in the bearing. This is taken into consideration in the calculation program by an increase in the static and dynamic load. Calculation is then carried out again and the rating life of the back-up rollers is determined with higher accuracy.

Contact pressure – *Figure 6*

Figure 6 shows the pressure of one roller on the inner ring; it was possible to optimise the stress curve at the ends of the roller.

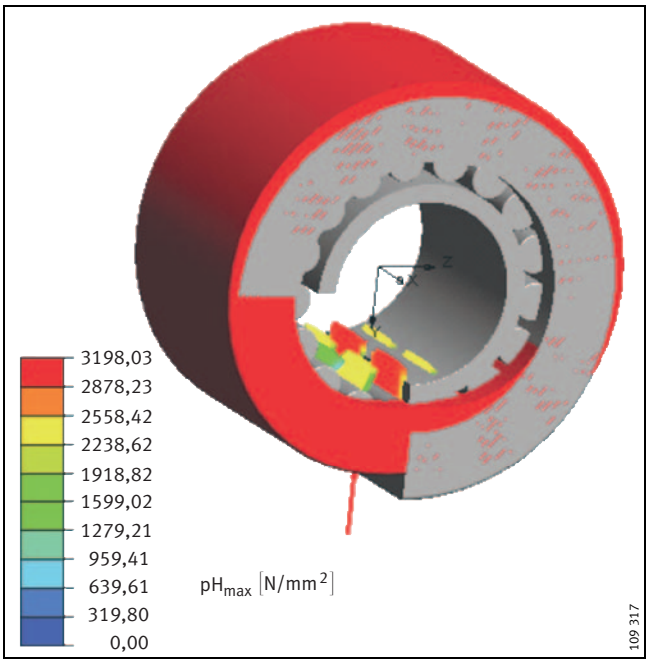


Figure 5 · Oval deformation of outer ring

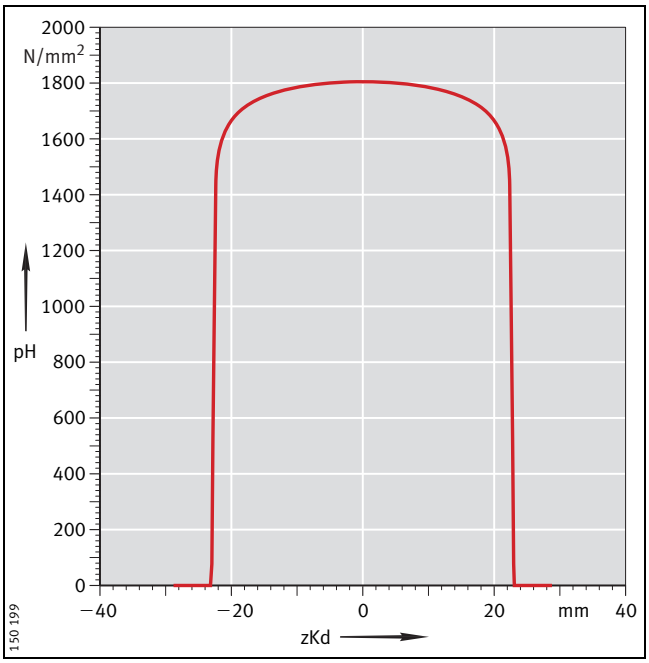


Figure 6 · Pressure on inner ring

Legend for *Figure 6*:
zKd = profiled contact (over complete length of roller)
pH = contact pressure

Mounting and dismounting

Back-up rollers have point load on the inner ring and can therefore be mounted with a close sliding fit on the shaft.

Caution!

Some back-up rollers are not self-retaining.
In order to prevent rolling elements escaping from the bearing during fitting, the inner rings should not be pushed out.

Bearing components must not be interchanged during fitting and dismantling.

Section height groups

The narrow tolerances for the rolled product require high bearing accuracy, especially in the outer ring runout and the bearing section height tolerance. This is achieved by heavily restricted manufacturing tolerances and subsequent sorting of all individual parts.

Back-up rollers are typically classified in three to seven section height groups – I to VII – each to 3 µm or 5 µm tolerance (Table 1).

Table 1 · Section height groups and tolerances

Section height group Designation	Section height tolerance µm
I	0 −0,005
II	−0,005 −0,010
III	−0,010 −0,015

Each back-up roller is marked with the designation of the section height group (*Figure 7*). The marking is applied to the position of greatest wall thickness on the inner and outer ring (*Figure 8*). The inner ring marking must be at the same position on all bearings on one support shaft in order to eliminate fluctuations in the inner ring wall thickness.

Caution!

All the back-up rollers mounted on one support shaft should be of the same section height group, see *Figure 7*.

Axial location – *Figure 9*

Once the back-up rollers and support saddles have been mounted, the entire support shaft – with saddles and rollers – must be axially tensioned.

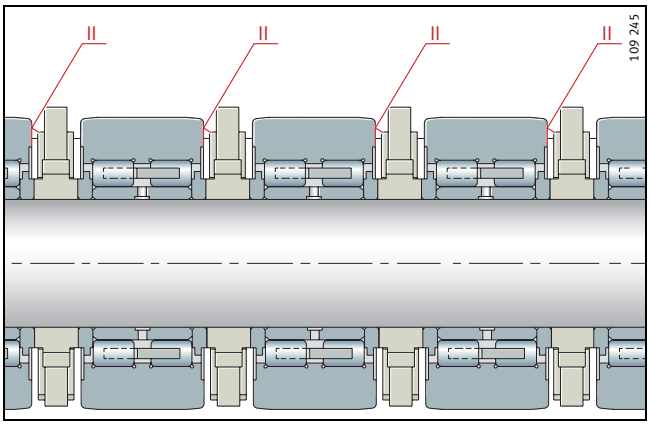


Figure 7 · Marking of section height group

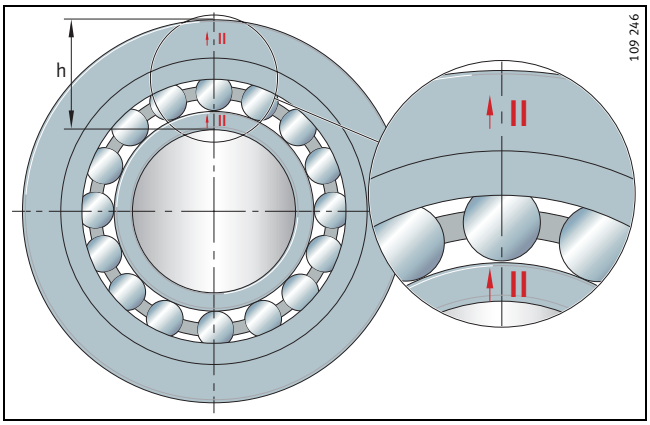


Figure 8 · Marking of largest wall thickness

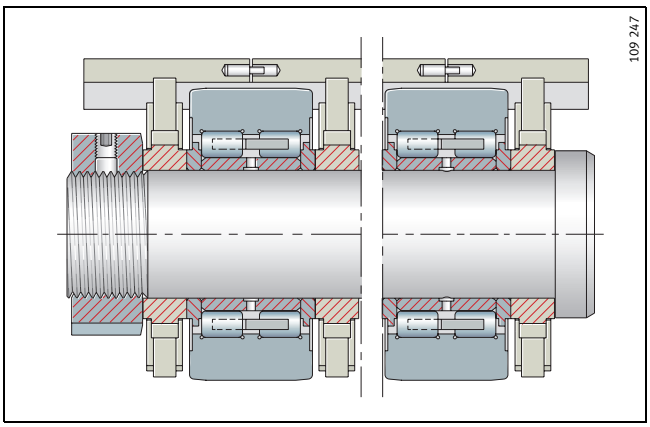


Figure 9 · Axial location of support shaft, back-up rollers and support saddles

Lubrication

Lubrication is a design element. The lubricant and lubrication method must therefore be selected in the development phase of the back-up rollers for the rolling mill.

Back-up rollers are designed such that the lubricant is distributed uniformly among the rollers and, in the case of back-up rollers lubricated with rolling emulsion, such that the rolling emulsion can flow out of the bearings on both sides without hindrance.

Caution!

The lubrication method, lubricant quantity and viscosity are dependent on the operating conditions of the back-up rollers.

It must be ensured that the back-up rollers are supplied with lubricant before the rolling mill is started.

Rolling emulsion lubrication – *Figure 10*

Lubrication with rolling emulsion is cost-effective since this is already available in large quantities for the rolling process. Due to the low viscosity of the rolling emulsion, however, a sufficiently large flow of oil through the bearings is necessary. The high rate of lubricant egress from the back-up rollers prevents the ingress of foreign matter into the bearings.

Bearings without seals are suitable for rolling emulsion lubrication.

Recirculating oil lubrication – *Figure 11*

The oil flows through the back-up rollers in its own recirculation system. Oils of higher viscosity can thus be used. This gives a decisive increase in the operating life of the back-up rollers. Attention must be paid to design measures for the oil inlet and outlet holes.

Bearings with lip seals are suitable for recirculating oil lubrication.

Minimal quantity lubrication – *Figure 12*

Clean compressed air free from moisture feeds oil to the bearings. Due to the gap seals, a slight excess pressure is generated in the back-up rollers that prevents the ingress of foreign matter. The oil particles adhere to the inner surfaces of the bearings; only a small quantity of oil escapes through the air vents. The viscosity should not be less than $\nu = 220\ mm^2/s$. Design measures for the supply of lubricant should be agreed with the manufacturer of the lubrication equipment.

Bearings with gap seals are suitable for minimal quantity lubrication.

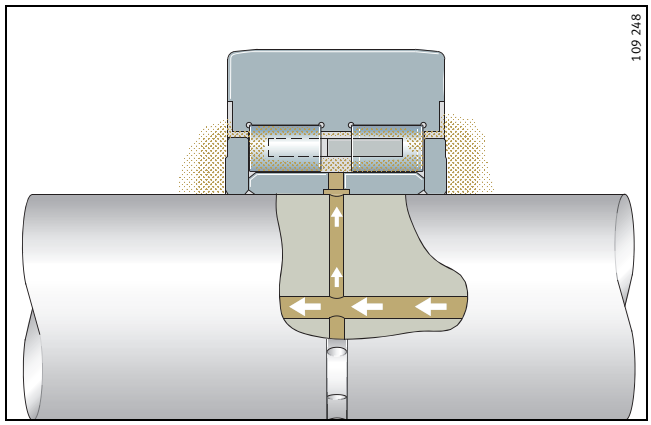


Figure 10 · Rolling emulsion lubrication – back-up roller

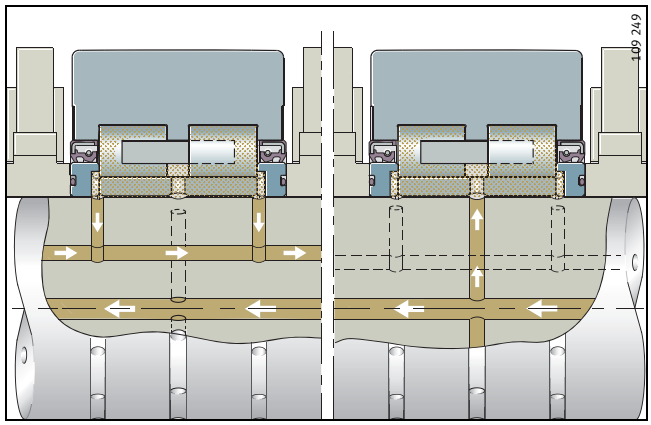


Figure 11 · Recirculating oil lubrication – back-up roller with rotary shaft seal

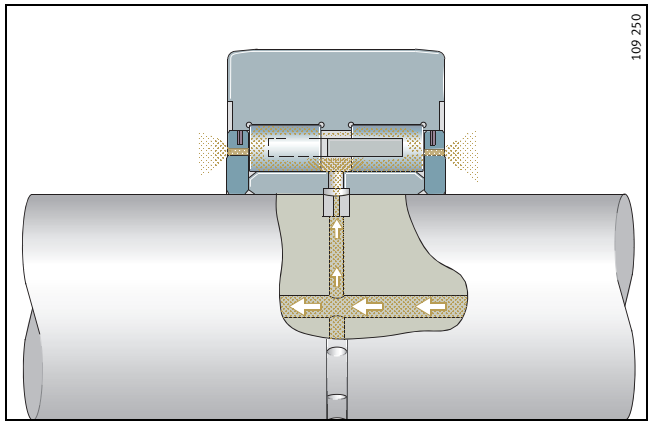


Figure 12 · Minimal quantity lubrication – back-up roller with Fey lamellar rings

Maintenance

Back-up rollers should be examined after defined running times. The bearings should be removed from the shaft and checked for damage and contamination.

The shafts in roll stands are subjected to different loads. Back-up rollers from a shaft subjected to higher load should therefore be interchanged on a regular basis with back-up rollers from a shaft subjected to lower load. Furthermore, the non-rotating inner rings should be rotated by 90° each time they are dismantled. This gives uniform wear of the bearings.

Depending on the required quality of the rolled material, back-up rollers must be checked at defined time intervals and the outer ring (outside diameter) reground if necessary.

Due to the special hardening process applied to the outer rings, these can be reground several times without loss of hardness. This removes wear marks, foreign body indentations, flattened areas and work hardening. Regrinding in stages is recommended. Please contact us to request an individual regrinding specification.

Regrinding mandrel

For regrinding of type 2, a special regrinding mandrel can be used (*Figure 13*).

The mandrel can be supplied by agreement.

The grinding mandrel centres the back-up rollers by means of the rolling elements and thus by means of the rolling element raceway of the outer ring. The grinding process is thus carried out using the same functional diameter as that subjected to load during operation of the back-up rollers in the rolling mill.

In order to eliminate the radial runout of the mandrel, the elastic clamping rings of the mandrel must be finish ground before initial regrinding of the back-up rollers.

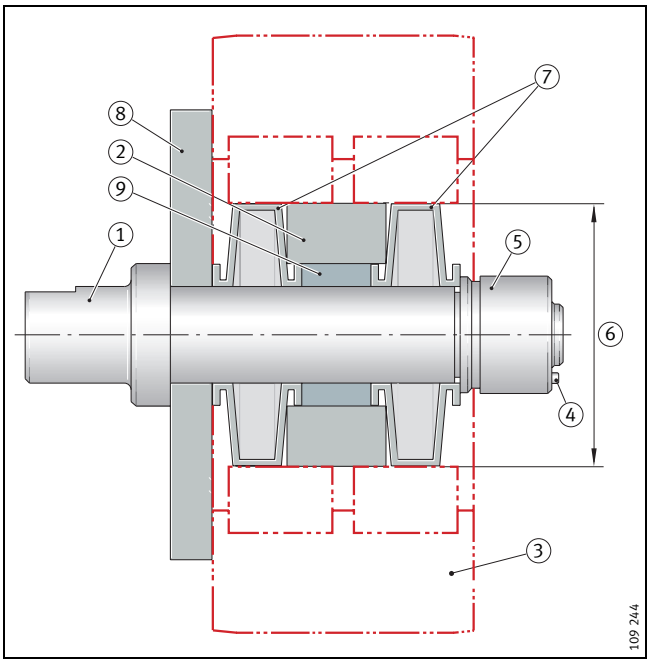


Figure 13 · Grinding device for back-up rollers of type 2

Legend for *Figure 13*:

① Regrinding mandrel
② Plastic spacer ring
③ Back-up roller
④ Screw for mechanical stress application
⑤ Locking nut
⑥ Enveloping circle of back-up roller
⑦ Elastic clamping rings
⑧ Support washer
⑨ Spacer ring.

Ordering example and ordering designation – *Figure 14*

The appendix includes a table containing the main dimensions. Our back-up rollers can be supplied in section height groups.

Example of an ordering designation from the table:

- Z-578270.01.WGTR-9S

In this example, nine bearings (9S) in one section height group are supplied.

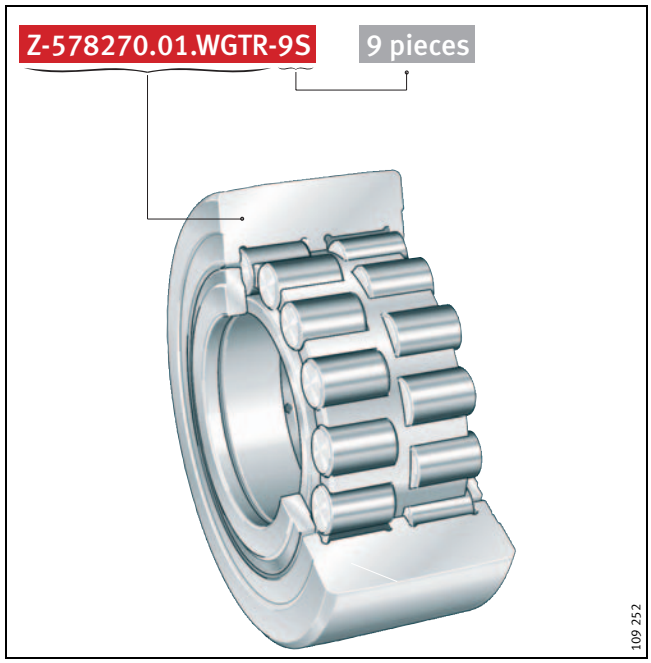


Figure 14 · Ordering example

Delivered condition

As standard, back-up rollers are wet preserved by means of an anti-corrosion agent with a mineral oil base or dry preserved using VCI paper. The anti-corrosion agents in bearings with an oil-based preservative are compatible and miscible with rolling emulsions and oils having a mineral oil base.

Storage

Back-up rollers should always be stored

- in the original packaging
- in dry rooms
  (relative atmospheric humidity not more than 65%)
- at a constant temperature between 0 °C and +40 °C
- with protection against chemical agents such as vapours, gases and fluids.

For different storage conditions, longer storage times or overseas transport, back-up rollers can also be provided wit a long term preservative.

In such cases, please contact us.

Removal from packaging

Perspiration from handling leads to corrosion. Hands should be kept clean and dry and protective gloves worn if necessary. Bearings should only be removed from their original packaging immediately before assembly.

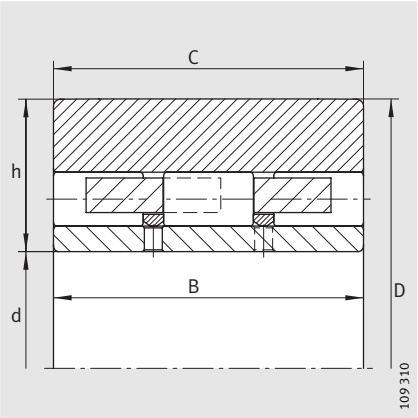
If bearings are removed from multi-item packaging with a dry preservative, the package must be closed again immediately afterwards, since the protective vapour phase is only effective while the packaging is closed.

Caution!

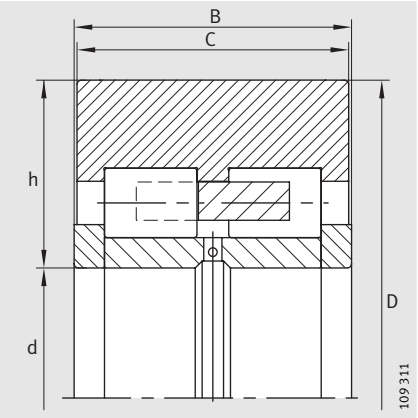
Bearings should be oiled as soon as they are removed from the packaging.

Back-up rollers

Drawing bearings



Type 1

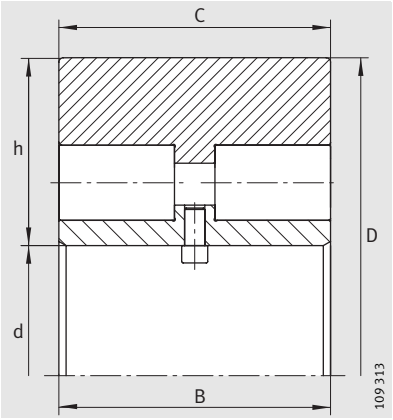


Type 2

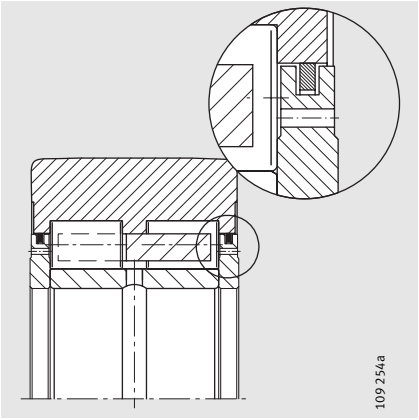
Dimension table · Dimensions in mm

Designation	Type	Mass	Dimensions					Basic load ratings				Outer ring material	Seals
		m	d	D	B	C	Section height	dyn. C	stat. C_0	dyn. C_w	stat. C_{0w}		
		≈kg					h	N	N	N	N		
Z-540268.02.WGTR	1	11,4	**70**	160,02	90	90	44,971	375 000	650 000	285 000	490 000	E[1]	–
Z-541332.01.WGTR	3	21	**90**	220,02	94	94	65	620 000	870 000	455 000	680 000	W[2]	–
Z-541332.02.WGTR	3-VR[4]	21	**90**	220,02	94	94	65	740 000	1 100 000	530 000	800 000	W[2]	–
F-801941.WGTR	2	22,2	**90**	220,02	96	94	65	550 000	780 000	415 000	600 000	SH[3]	–
Z-567709.01.WGTR	2	20	**90**	220,02	96	94	65	460 000	630 000	360 000	510 000	W[2]	WDR[6]
F-808398.WGTR	Special[5]	28,5	**90**	220,02	120	120	65,01	670 000	1 120 000	485 000	800 000	W[2]	–
Z-517329.01.WGTR	Special[5]	28,6	**90**	220,02	120	120	65	790 000	1 500 000	540 000	990 000	W[2]	–
F-801644.02.WGTR	2-VR[4]	26	**100**	225	120	119	62,5	770 000	1 310 000	560 000	930 000	W[2]	WDR[6]
F-801644.03.WGTR	2	26	**100**	225	120	119	62,5	650 000	1 050 000	485 000	780 000	SH[3]	–
Z-566148.WGTR	2	26	**100**	225	120	119	62,5	710 000	1 170 000	520 000	850 000	W[2]	SP[7]
Z-543638.02.WGTR	1	27,7	**100**	225	120	120	62,5	735 000	1 380 000	530 000	970 000	E[1]	–
Z-575633.WGTR	2	31,9	**110**	260	98	98	75	700 000	1 010 000	510 000	760 000	SH[3]	–
Z-577888.WGTR	2	54,9	**130**	300,02	130	129	85,01	1 040 000	1 560 000	760 000	1 180 000	SH[3]	WDR[6]
Z-578270.01.WGTR	2	56,5	**130**	300,02	132	129	85,01	1 040 000	1 560 000	760 000	1 180 000	SH[3]	–
Z-564604.WGTR	2	60	**130**	300,02	150	149	85	1 200 000	1 860 000	890 000	1 450 000	SH[3]	–

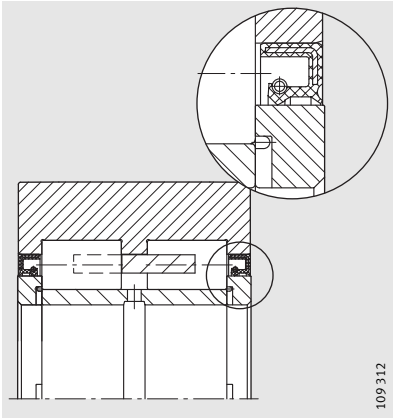
1) Case hardening steel.
2) Rolling bearing steel (chromium steel).
3) Shell hardened steel.
4) VR = full complement design.
5) Special type.
6) Rotary shaft seal.
7) Gap seal.



Type 3



Type 2 with gap seal



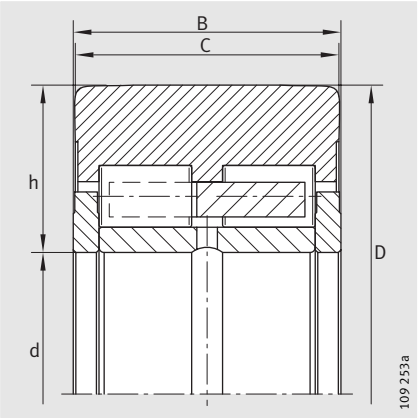
Type 2 with rotary shaft seal

Dimension table (continued) · Dimensions in mm

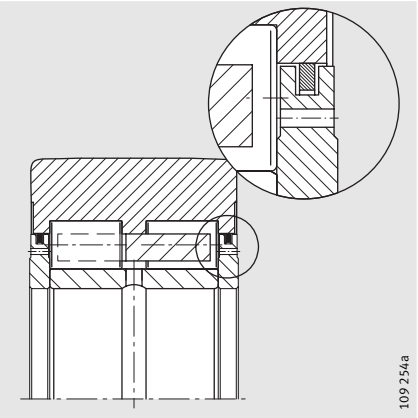
Designation	Type	Mass	Dimensions					Basic load ratings				Outer ring material	Seals
		m	d	D	B	C	Section height	dyn. C	stat. C_0	dyn. C_w	stat. C_{0w}		
		≈kg					h	N	N	N	N		
Z-548963.WGTR	2	67,4	**130**	300,02	161,5	160,5	85	1 200 000	1 880 000	910 000	1 490 000	SH[3]	WDR[6]
Z-567455.01.WGTR	2	71,3	**130**	300,02	172,65	171,6	85	1 440 000	2 370 000	1 010 000	1 680 000	SH[3]	–
Z-567998.01.WGTR	2	73,5	**130**	300,02	172,65	171,6	85,01	1 440 000	2 370 000	1 010 000	1 680 000	E[1]	SP[7]
Z-549722.WGTR	2	73,6	**130**	300,02	172,65	171,6	85,01	1 440 000	2 370 000	1 010 000	1 680 000	SH[3]	–
Z-549722.01.WGTR	2	73,6	**130**	300,02	172,65	171,6	85,01	1 440 000	2 370 000	1 010 000	1 680 000	SH[3]	WDR[6]
Z-512497.03.WGTR	1	74,8	**130**	300,02	172,64	172,6	84,955	1 500 000	2 700 000	1 030 000	1 810 000	SH[3]	–
Z-564247.WGTR	2	125	**180**	406,4	171,04	170	113,2	1 710 000	3 000 000	1 250 000	2 190 000	SH[3]	–
Z-564247.02.WGTR	2	125	**180**	406,4	171,04	170	113,2	1 710 000	3 000 000	1 250 000	2 190 000	SH[3]	WDR[6]
F-804209.WGTR	2	174	**180**	406,4	224	220	113,2	1 910 000	3 450 000	1 420 000	2 600 000	SH[3]	SP[7]
F-800115.01.WGTR	2	132	**180**	406,42	171,04	170	113,143	1 570 000	2 650 000	1 170 000	2 040 000	SH[3]	WDR[6]
Z-527502.03.WGTR	1	130	**180**	406,42	171,04	171	113,143	2 080 000	3 850 000	1 420 000	2 550 000	SH[3]	–
Z-543307.01.WGTR	1	130	**180**	406,42	171,04	171	113,2	2 080 000	3 850 000	1 420 000	2 550 000	E[1]	–
F-809717.WGTR	2	136	**180**	406,42	176	170	113,2	1 710 000	3 000 000	1 250 000	2 190 000	SH[2]	–
Z-514278.01.WGTR	1	150	**180**	406,42	217	217	113,143	2 500 000	4 900 000	1 720 000	3 250 000	SH[3]	–
Z-523247.02.WGTR	1	169	**180**	406,42	224	224	113,2	2 600 000	5 100 000	1 790 000	3 350 000	SH[3]	–
Z-523247.03.WGTR	1	169	**180**	406,42	224	224	113,2	2 600 000	5 100 000	1 790 000	3 350 000	E[1]	–

Back-up rollers

Standard bearings



Type 2



Type 2 with gap seals, suffix .2Z

Dimension table · Dimensions in mm

Designation	Type	Mass	Dimensions					Basic load ratings				Outer ring material	Seals
		m	d	D	B	C	Section height	dyn. C	stat. C_0	dyn. C_w	stat. C_{0w}		
		≈kg					h	N	N	N	N		
WGTR 25×55×31,2	2	0,4	**25**	55	31,2	30,5	15	39 000	42 000	30 000	33 000	W[1)]	optional[2)]
WGTR 35×80×40	2	1,2	**35**	80	40	39,2	22,5	89 000	103 000	69 000	81 000	W[1)]	optional[2)]
WGTR 55×120×52	2	3,4	**55**	120	52	51,2	32,5	168 000	218 000	123 000	158 000	W[1)]	optional[2)]
WGTR 55×120×64	2	4,2	**55**	120	64	63,2	32,5	215 000	300 000	155 000	213 000	W[1)]	optional[2)]
WGTR 70×160×75	2	8,9	**70**	160	75	74,2	45	295 000	380 000	231 000	300 000	W[1)]	optional[2)]
WGTR 70×160×90	2	10,7	**70**	160	90	89,2	45	395 000	550 000	300 000	425 000	W[1)]	optional[2)]

[1)] Rolling bearing steel (chromium steel).

[2)] Gap seal.

MATNR 032716419-000 / TPI 129 / GB-D / 2007011 / Printed in Germany by Mandelkow GmbH

Schaeffler KG

Georg-Schäfer-Strasse 30
97421 Schweinfurt
Internet www.fag.de
E-Mail steel@schaeffler.com

In Germany:
Phone 0180 5003872
Fax 0180 5003873

From Other Countries:
Phone +49 9721 91-0
Fax +49 9721 91-3100

TPI 129 GB-D