

# 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.

## Back-up rollers

### Types

#### 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.

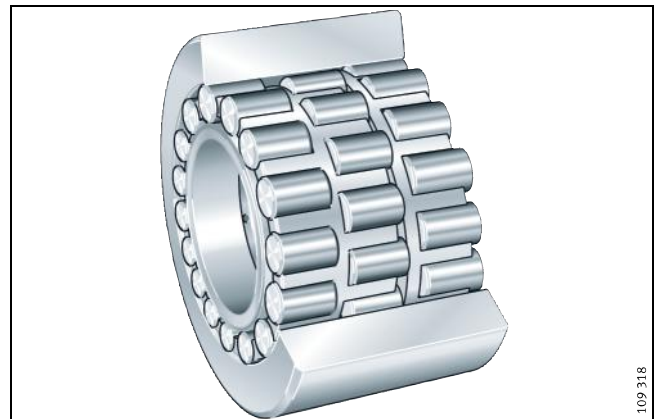


Figure 1 · Back-up roller – type 1

#### 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.

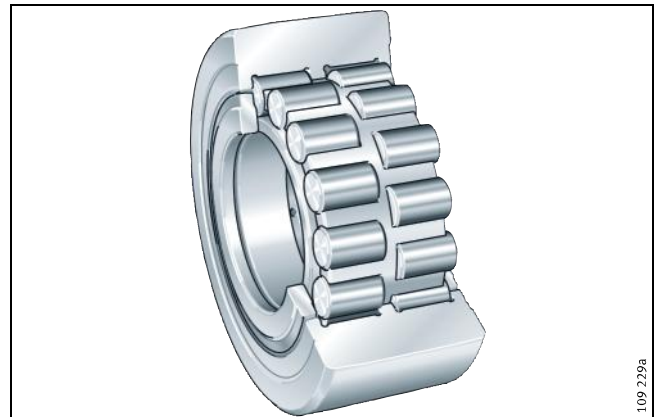


Figure 2 · Back-up roller – type 2

#### 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.

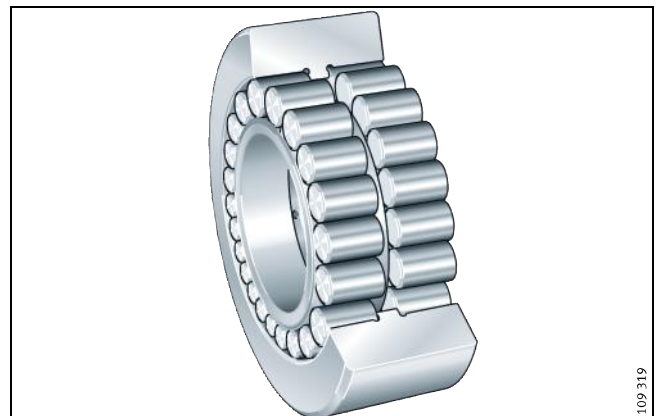


Figure 3 · Back-up roller – type 3

## Back-up rollers

### Design

#### 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.

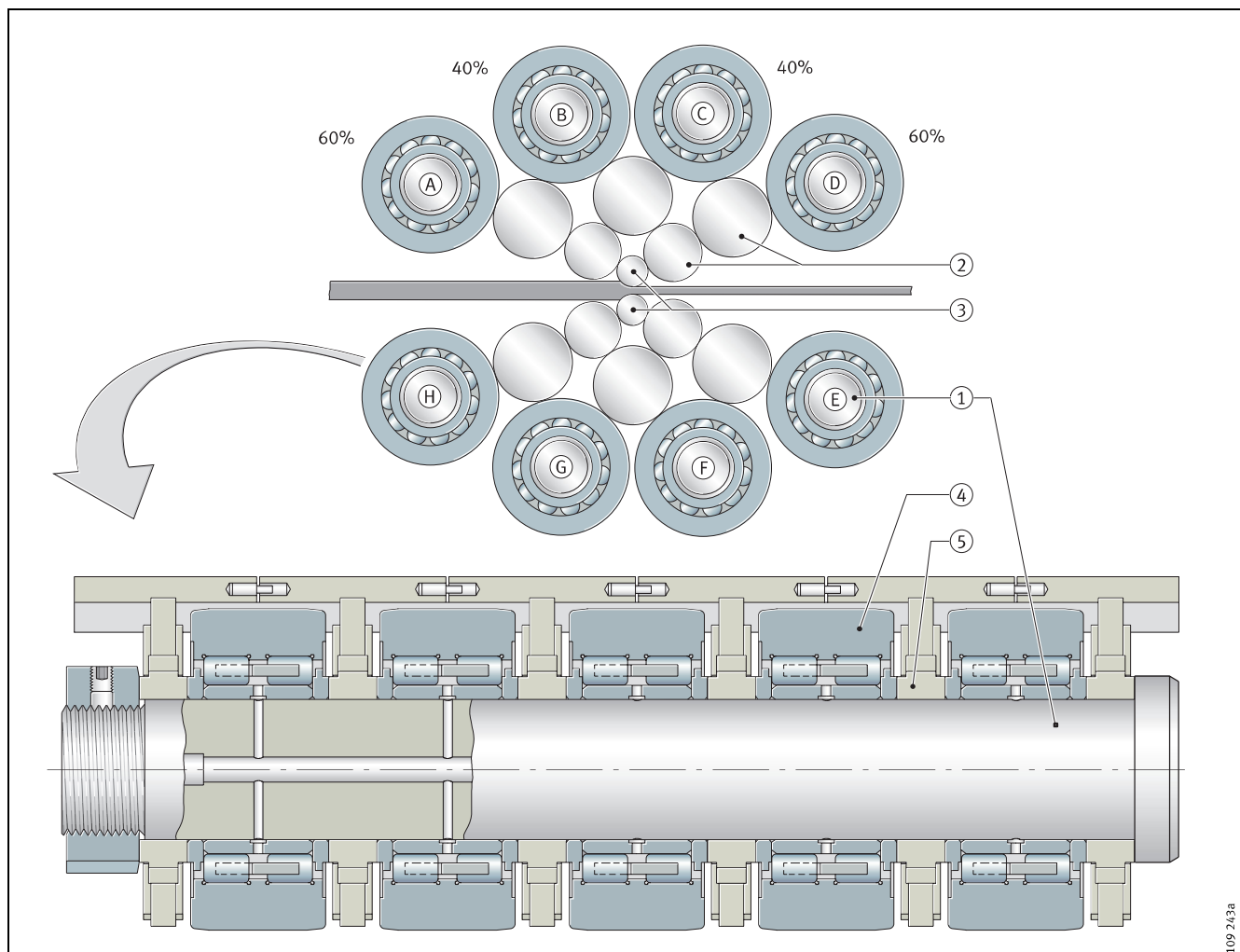


Figure 4 · Support shaft with back-up rollers (type 2) and support saddles

## Back-up rollers

### Design of bearing arrangements

#### 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.

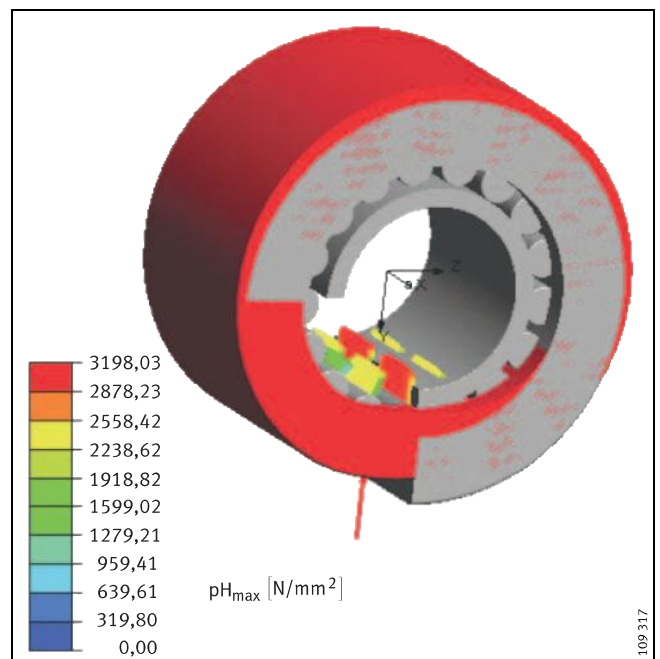


Figure 5 · Oval deformation of outer ring

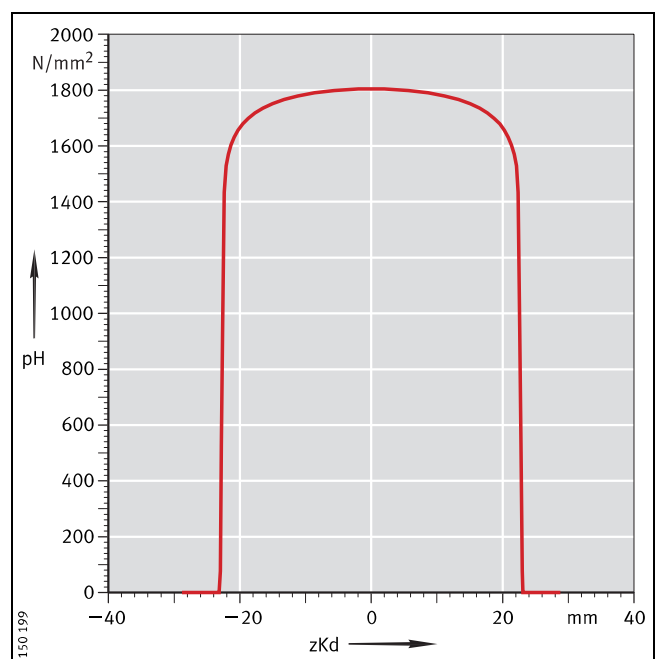


Figure 6 · Pressure on inner ring

Legend for Figure 6:

zKd = profiled contact (over complete length of roller)  
pH = contact pressure

## Back-up rollers

### Mounting and dismantling

#### Mounting and dismantling

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<br>Designation | Section height tolerance<br>µm |
|-------------------------------------|--------------------------------|
| I                                   | 0<br>–0,005                    |
| II                                  | –0,005<br>–0,010               |
| III                                 | –0,010<br>–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.

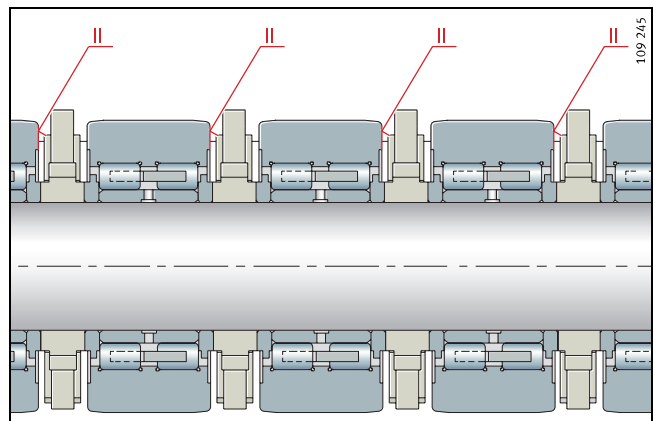


Figure 7 · Marking of section height group

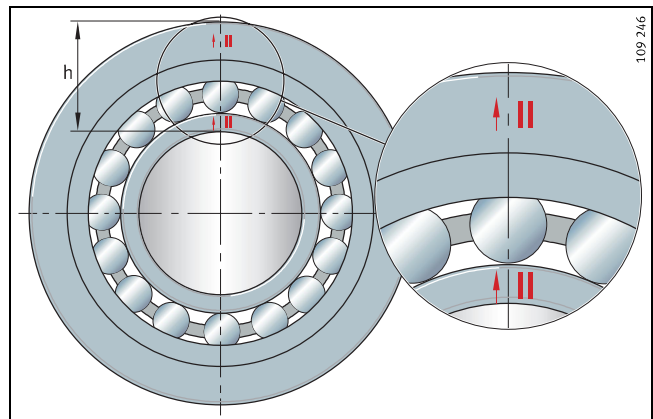


Figure 8 · Marking of largest wall thickness

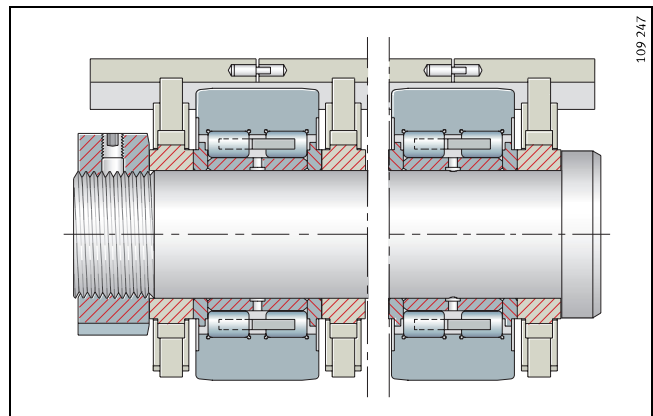


Figure 9 · Axial location of support shaft, back-up rollers and support saddles

## Back-up rollers

### Lubrication

#### 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  $\nu = 220 \text{ mm}^2/\text{s}$ . 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.

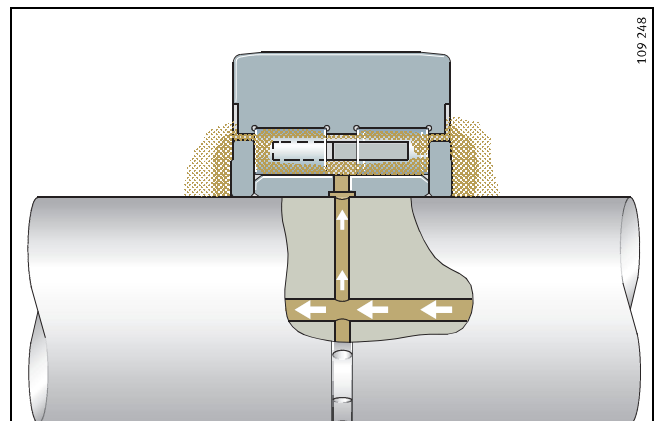


Figure 10 · Rolling emulsion lubrication – back-up roller

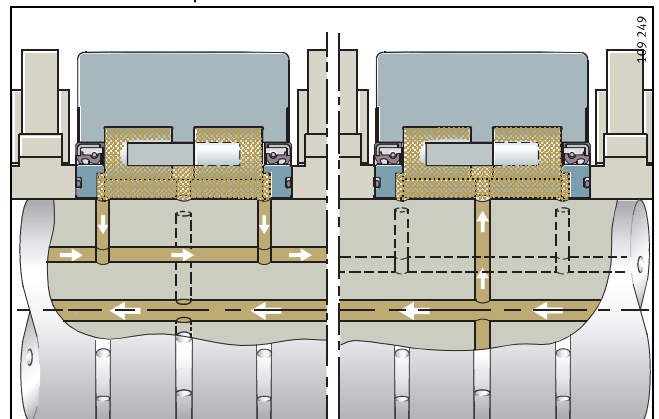


Figure 11 · Recirculating oil lubrication – back-up roller with rotary shaft seal

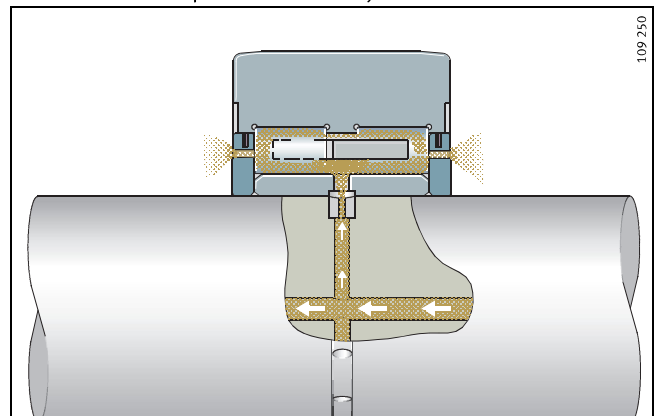


Figure 12 · Minimal quantity lubrication – back-up roller with Fey lamellar rings

#### 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.

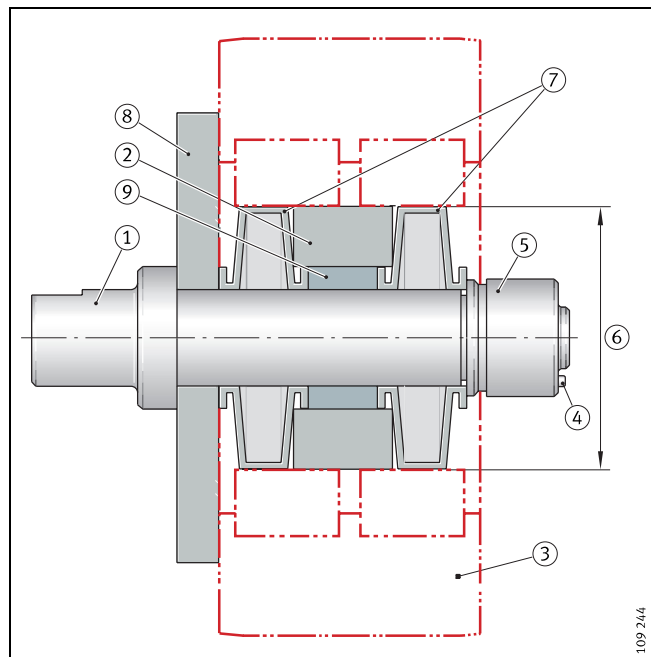


Figure 13 · Grinding device for back-up rollers of type 2

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.

## Back-up rollers

### Ordering example and ordering designation

#### Delivered condition and storage

#### 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.

#### 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 with 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.

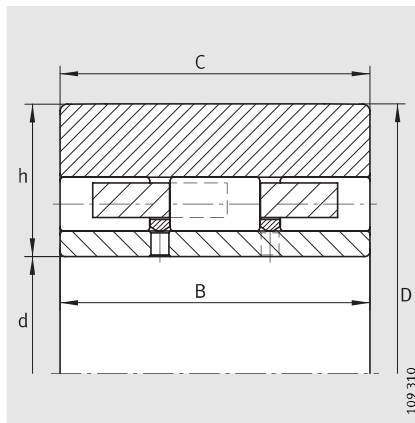
#### Caution!

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

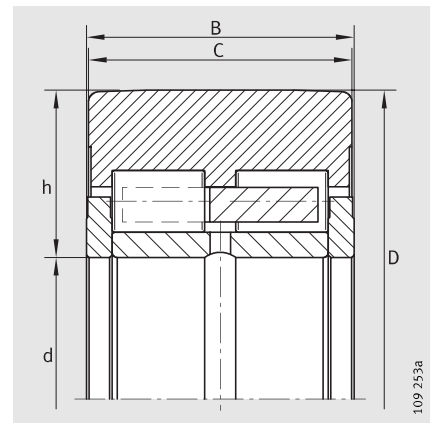


Figure 14 · Ordering example

# Back-up rollers



Type 1



Type 2

Dimension table · Dimensions in mm

| Designation             | Type                  | Mass<br>≈kg | Dimensions   |        |      |      |                        | Basic load ratings |                              |                             |                               | Outer<br>ring<br>material | Seals                  |
|-------------------------|-----------------------|-------------|--------------|--------|------|------|------------------------|--------------------|------------------------------|-----------------------------|-------------------------------|---------------------------|------------------------|
|                         |                       |             | d            | D      | B    | C    | Section<br>height<br>h | dyn.<br>C<br>N     | stat.<br>C <sub>0</sub><br>N | dyn.<br>C <sub>w</sub><br>N | stat.<br>C <sub>0w</sub><br>N |                           |                        |
| <b>WGTR 25×55×31,2</b>  | 2                     | 0,4         | <b>25</b>    | 55     | 31,2 | 30,5 | 15                     | 39 000             | 42 000                       | 30 000                      | 33 000                        | W <sup>2)</sup>           | optional <sup>7)</sup> |
| <b>WGTR 35×80×40</b>    | 2                     | 1,2         | <b>35</b>    | 80     | 40   | 39,2 | 22,5                   | 89 000             | 103 000                      | 69 000                      | 81 000                        | W <sup>2)</sup>           | optional <sup>7)</sup> |
| <b>F-82547</b>          | 2                     | 5,6         | <b>45</b>    | 125    | 78   | 77,5 | 40                     | 275 000            | 325 000                      | 225 000                     | 295 000                       | W <sup>2)</sup>           | WDR <sup>6)</sup>      |
| <b>WGTR 55×120×52</b>   | 2                     | 3,4         | <b>55</b>    | 120    | 52   | 51,2 | 32,5                   | 168 000            | 218 000                      | 123 000                     | 158 000                       | W <sup>2)</sup>           | optional <sup>7)</sup> |
| <b>WGTR 55×120×64</b>   | 2                     | 4,2         | <b>55</b>    | 120    | 64   | 63,2 | 32,5                   | 215 000            | 300 000                      | 155 000                     | 213 000                       | W <sup>2)</sup>           | optional <sup>7)</sup> |
| <b>F-560123.01</b>      | 2                     | 4,6         | <b>55</b>    | 126,02 | 64   | 63   | 35,5                   | 212 000            | 295 000                      | 163 000                     | 243 000                       | W <sup>2)</sup>           | SP <sup>7)</sup>       |
| <b>F-566100.01</b>      | 2                     | 7,9         | <b>60</b>    | 150    | 75   | 73   | 45                     | 270 000            | 335 000                      | 222 000                     | 310 000                       | W <sup>2)</sup>           | SP <sup>7)</sup>       |
| <b>WGTR 70×160×75</b>   | 2                     | 8,9         | <b>70</b>    | 160    | 75   | 74,2 | 45                     | 295 000            | 380 000                      | 231 000                     | 300 000                       | W <sup>2)</sup>           | optional <sup>7)</sup> |
| <b>WGTR 70×160×90</b>   | 2                     | 10,7        | <b>70</b>    | 160    | 90   | 89,2 | 45                     | 395 000            | 550 000                      | 300 000                     | 425 000                       | W <sup>2)</sup>           | optional <sup>7)</sup> |
| <b>F-566567.01</b>      | 2                     | 10,7        | <b>70</b>    | 165    | 90   | 88   | 47,5                   | 400 000            | 560 000                      | 310 000                     | 460 000                       | W <sup>2)</sup>           | –                      |
| <b>F-565718.01</b>      | 2                     | 10,7        | <b>70,02</b> | 160    | 90   | 89   | 44,988                 | 395 000            | 550 000                      | 300 000                     | 425 000                       | W <sup>2)</sup>           | SP <sup>7)</sup>       |
| <b>Z-540268.02.WGTR</b> | 1                     | 11,4        | <b>70</b>    | 160,02 | 90   | 90   | 44,971                 | 375 000            | 650 000                      | 285 000                     | 490 000                       | E <sup>1)</sup>           | –                      |
| <b>Z-541332.01.WGTR</b> | 3                     | 21          | <b>90</b>    | 220,02 | 94   | 94   | 65                     | 620 000            | 870 000                      | 455 000                     | 680 000                       | W <sup>2)</sup>           | –                      |
| <b>Z-541332.02.WGTR</b> | 3-VR <sup>4)</sup>    | 21          | <b>90</b>    | 220,02 | 94   | 94   | 65                     | 740 000            | 1 100 000                    | 530 000                     | 800 000                       | W <sup>2)</sup>           | –                      |
| <b>F-801941.WGTR</b>    | 2                     | 22,2        | <b>90</b>    | 220,02 | 96   | 94   | 65                     | 550 000            | 780 000                      | 415 000                     | 600 000                       | SH <sup>3)</sup>          | –                      |
| <b>Z-567709.01.WGTR</b> | 2                     | 20          | <b>90</b>    | 220,02 | 96   | 94   | 65                     | 460 000            | 630 000                      | 360 000                     | 510 000                       | W <sup>2)</sup>           | WDR <sup>6)</sup>      |
| <b>F-808398.WGTR</b>    | Special <sup>5)</sup> | 28,5        | <b>90</b>    | 220,02 | 120  | 120  | 65,01                  | 670 000            | 1 120 000                    | 485 000                     | 800 000                       | W <sup>2)</sup>           | –                      |
| <b>Z-517329.01.WGTR</b> | Special <sup>5)</sup> | 28,6        | <b>90</b>    | 220,02 | 120  | 120  | 65                     | 790 000            | 1 500 000                    | 540 000                     | 990 000                       | W <sup>2)</sup>           | –                      |
| <b>F-550356.01.WGTR</b> | 2                     | 27,1        | <b>90</b>    | 220,02 | 122  | 119  | 65                     | 710 000            | 1 030 000                    | 530 000                     | 770 000                       | W <sup>2)</sup>           | SP <sup>7)</sup>       |
| <b>F-801644.02.WGTR</b> | 2-VR <sup>4)</sup>    | 26          | <b>100</b>   | 225    | 120  | 119  | 62,5                   | 770 000            | 1 310 000                    | 560 000                     | 930 000                       | W <sup>2)</sup>           | WDR <sup>6)</sup>      |
| <b>F-801644.03.WGTR</b> | 2                     | 26          | <b>100</b>   | 225    | 120  | 119  | 62,5                   | 650 000            | 1 050 000                    | 485 000                     | 780 000                       | SH <sup>3)</sup>          | –                      |
| <b>Z-566148.WGTR</b>    | 2                     | 26          | <b>100</b>   | 225    | 120  | 119  | 62,5                   | 710 000            | 1 170 000                    | 520 000                     | 850 000                       | W <sup>2)</sup>           | SP <sup>7)</sup>       |
| <b>Z-543638.02.WGTR</b> | 1                     | 27,7        | <b>100</b>   | 225    | 120  | 120  | 62,5                   | 735 000            | 1 380 000                    | 530 000                     | 970 000                       | E <sup>1)</sup>           | –                      |
| <b>Z-575633.WGTR</b>    | 2                     | 31,9        | <b>110</b>   | 260    | 98   | 98   | 75                     | 700 000            | 1 010 000                    | 510 000                     | 760 000                       | W <sup>2)</sup>           | –                      |

<sup>1)</sup> Case hardening steel.

<sup>2)</sup> Rolling bearing steel (chromium steel).

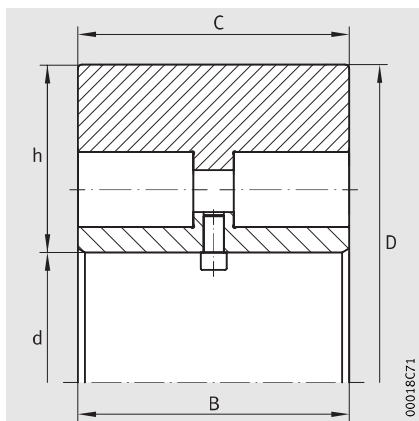
<sup>3)</sup> Shell hardened steel.

<sup>4)</sup> VR = full complement design.

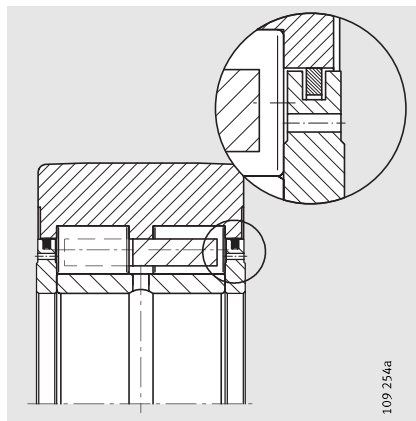
<sup>5)</sup> Special type.

<sup>6)</sup> Rotary shaft seal.

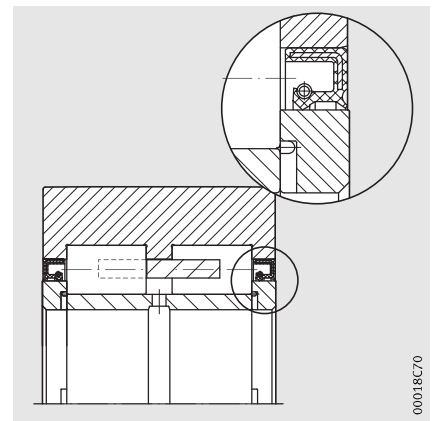
<sup>7)</sup> Gap seal.



Type 3



Type 2 with gap seal



Type 2 with rotary shaft seal

**Dimension table** (continued) · Dimensions in mm

| Designation             | Type | Mass<br>≈kg | Dimensions |        |        |       |                        | Basic load ratings |                              |                             |                               | Outer<br>ring<br>material | Seals             |
|-------------------------|------|-------------|------------|--------|--------|-------|------------------------|--------------------|------------------------------|-----------------------------|-------------------------------|---------------------------|-------------------|
|                         |      |             | d          | D      | B      | C     | Section<br>height<br>h | dyn.<br>C<br>N     | stat.<br>C <sub>0</sub><br>N | dyn.<br>C <sub>w</sub><br>N | stat.<br>C <sub>0w</sub><br>N |                           |                   |
| <b>Z-577888.WGTR</b>    | 2    | 54,9        | <b>130</b> | 300,02 | 130    | 129   | 85,01                  | 1040 000           | 1560 000                     | 760 000                     | 1180 000                      | SH <sup>3)</sup>          | WDR <sup>6)</sup> |
| <b>Z-578270.01.WGTR</b> | 2    | 56,5        | <b>130</b> | 300,02 | 132    | 129   | 85,01                  | 1040 000           | 1560 000                     | 760 000                     | 1180 000                      | SH <sup>3)</sup>          | —                 |
| <b>Z-564604.WGTR</b>    | 2    | 60          | <b>130</b> | 300,02 | 150    | 149   | 85                     | 1200 000           | 1860 000                     | 890 000                     | 1450 000                      | SH <sup>3)</sup>          | —                 |
| <b>Z-548963.WGTR</b>    | 2    | 67,4        | <b>130</b> | 300,02 | 161,5  | 160,5 | 85                     | 1200 000           | 1880 000                     | 910 000                     | 1490 000                      | SH <sup>3)</sup>          | WDR <sup>6)</sup> |
| <b>Z-567455.01.WGTR</b> | 2    | 71,3        | <b>130</b> | 300,02 | 172,65 | 171,6 | 85                     | 1440 000           | 2370 000                     | 1010 000                    | 1680 000                      | SH <sup>3)</sup>          | —                 |
| <b>Z-567998.01.WGTR</b> | 2    | 73,5        | <b>130</b> | 300,02 | 172,65 | 171,6 | 85,01                  | 1440 000           | 2370 000                     | 1010 000                    | 1680 000                      | E <sup>1)</sup>           | SP <sup>7)</sup>  |
| <b>Z-549722.WGTR</b>    | 2    | 73,6        | <b>130</b> | 300,02 | 172,65 | 171,6 | 85,01                  | 1440 000           | 2370 000                     | 1010 000                    | 1680 000                      | SH <sup>3)</sup>          | SP <sup>7)</sup>  |
| <b>Z-549722.01.WGTR</b> | 2    | 73,6        | <b>130</b> | 300,02 | 172,65 | 171,6 | 85,01                  | 1440 000           | 2370 000                     | 1010 000                    | 1680 000                      | SH <sup>3)</sup>          | WDR <sup>6)</sup> |
| <b>Z-512497.03.WGTR</b> | 1    | 74,8        | <b>130</b> | 300,02 | 172,64 | 172,6 | 84,955                 | 1500 000           | 2700 000                     | 1030 000                    | 1810 000                      | SH <sup>3)</sup>          | —                 |
| <b>Z-564247.WGTR</b>    | 2    | 125         | <b>180</b> | 406,4  | 171,04 | 170   | 113,2                  | 1710 000           | 3000 000                     | 1250 000                    | 2190 000                      | SH <sup>3)</sup>          | —                 |
| <b>Z-564247.02.WGTR</b> | 2    | 125         | <b>180</b> | 406,4  | 171,04 | 170   | 113,2                  | 1710 000           | 3000 000                     | 1250 000                    | 2190 000                      | SH <sup>3)</sup>          | WDR <sup>6)</sup> |
| <b>F-804209.WGTR</b>    | 2    | 174         | <b>180</b> | 406,4  | 224    | 220   | 113,2                  | 1910 000           | 3450 000                     | 1420 000                    | 2600 000                      | SH <sup>3)</sup>          | SP <sup>7)</sup>  |
| <b>F-800115.01.WGTR</b> | 2    | 132         | <b>180</b> | 406,42 | 171,04 | 170   | 113,143                | 1570 000           | 2650 000                     | 1170 000                    | 2040 000                      | SH <sup>3)</sup>          | WDR <sup>6)</sup> |
| <b>Z-527502.03.WGTR</b> | 1    | 130         | <b>180</b> | 406,42 | 171,04 | 171   | 113,155                | 2080 000           | 3850 000                     | 1420 000                    | 2550 000                      | SH <sup>3)</sup>          | —                 |
| <b>Z-543307.01.WGTR</b> | 1    | 130         | <b>180</b> | 406,42 | 171,04 | 171   | 113,2                  | 2080 000           | 3850 000                     | 1420 000                    | 2550 000                      | E <sup>1)</sup>           | —                 |
| <b>F-809717.WGTR</b>    | 2    | 136         | <b>180</b> | 406,42 | 176    | 170   | 113,2                  | 1710 000           | 3000 000                     | 1250 000                    | 2190 000                      | SH <sup>2)</sup>          | —                 |
| <b>Z-514278.01.WGTR</b> | 1    | 150         | <b>180</b> | 406,42 | 217    | 217   | 113,143                | 2500 000           | 4900 000                     | 1720 000                    | 3250 000                      | SH <sup>3)</sup>          | —                 |
| <b>Z-523247.02.WGTR</b> | 1    | 169         | <b>180</b> | 406,42 | 224    | 224   | 113,2                  | 2600 000           | 5100 000                     | 1790 000                    | 3350 000                      | SH <sup>3)</sup>          | —                 |
| <b>Z-523247.03.WGTR</b> | 1    | 169         | <b>180</b> | 406,42 | 224    | 224   | 113,2                  | 2600 000           | 5100 000                     | 1790 000                    | 3350 000                      | E <sup>1)</sup>           | —                 |