

**FAG**



## **Sealed Spherical Roller Bearings**

With reliable protection against contamination

**SCHAEFFLER**



# Contents

	Page
<b>Features</b>	
<b>X-life</b> .....	2
Sealing concepts .....	3
Potential savings .....	6
<b>Design and safety guidelines</b>	
Equivalent dynamic bearing load .....	8
Equivalent static bearing load .....	8
Rolling bearing reconditioning .....	9
<b>Dimension tables</b>	
Sealed spherical roller bearings, cylindrical bore.....	10
<b>Application examples</b>	
Continuous casting plant .....	14
Elevator plant .....	16

# Sealed spherical roller bearings

**Features** Spherical roller bearings are double row, self-retaining units comprising solid outer rings with a concave raceway, solid inner rings and barrel rollers with cages. The inner rings have cylindrical or tapered bores.

The symmetrical barrel rollers orient themselves freely on the concave outer ring raceway. As a result, shaft flexing and misalignment of the bearing seats are compensated.

Sealed spherical roller bearings are characterised by:

- very high basic dynamic and static load ratings
- lower frictional torque compared to the competition
- environmentally friendly characteristics
- lower grease consumption and disposal costs
- no requirement for expensive relubrication systems
- reduced maintenance outlay
- simple reconditioning of series 240 and 241
- longer operating life of the bearing.

Sealed spherical roller bearings are suitable for areas of operation such as continuous casting plant, conveyor belts, elevator plant or the food industry.

## X-life

Spherical roller bearings of the X-life design have improved kinematics and optimised surfaces, are made from higher performance materials and do not have a rigid central rib. As a result, the basic dynamic and static load ratings and, under identical operating conditions, the basic rating life of the bearings are significantly improved. In certain applications, this means that a smaller bearing arrangement can be designed.

X-life spherical roller bearings have the suffix E1.

## Sealing concepts

The sealed spherical roller bearings are fitted, depending on the series, with different sealing concepts.

Spherical roller bearings of series 222, 223

Features of the sealing concept of sealed spherical roller bearing series 222, 223, *Figure 1*:

- bearings with an oversize width identified by the prefix WS (WS = Wide Size). As standard, this affects the series 222 and 223. Example: WS22215-E1-2RSR
- solid brass cage or sheet steel cage
- greasing with a lubricant KP2K-20 in accordance with DIN 51825 for a temperature range of -20 °C to +130 °C; other greases are available by agreement
- 25% to 40% grease fill level of the bearing interior; different grease fill levels are available by agreement
- dimensional stabilisation up to +200 °C (standard)
- radial internal clearance Group N
- self-alignment facility 0,5° from the central position
- limiting speed  $n_g$  dependent on the grease and grease fill level
- standard design with a circumferential groove and three lubrication holes in the outer ring for simple relubrication
- bearings also available with a completely closed outer ring, suffix H40, see table, page 5
- contact seals made from nitrile rubber (NBR), suitable for temperatures of -30 °C to +100 °C; other sealing washer materials such as FKM available by agreement.



Seals made from fluoro rubber (FKM, FPM) comprise particularly high performance materials that may release vapour when heated to approx. +300 °C. This may occur if, for example, a welding torch is used in the dismantling of a bearing. In such cases, the appropriate safety data sheet must be observed and this is available upon request.



*Figure 1*  
Example:  
WS22212-E1-2RSR

## Sealed spherical roller bearings

Spherical roller bearings of series 240 and 241

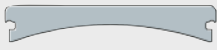

Features of the sealing concept of sealed spherical roller bearing series 240 and 241:

- main dimensions identical to those of the open bearing, allowing simple interchange
- basic load ratings identical to those of an open bearing
- X-life design
- sealing washers interchangeable
- internal bearing design with sheet steel cage and loose central rib
- greasing with a lubricant KP2R-30 in accordance with DIN 51825 for a temperature range of  $-30\text{ °C}$  to  $+180\text{ °C}$ ; other greases are available by agreement
- radial internal clearance Group N
- dimensional stabilisation up to  $+200\text{ °C}$
- 60% grease fill level of the bearing interior; different grease fill levels are available by agreement
- limiting speed  $n_g$  dependent on the grease and grease fill level
- self-alignment facility  $0,5^\circ$  from the central position
- standard design as a completely sealed bearing with a closed outer ring, suffix H40, see table and *Figure 2*, page 5
- for simple relubrication, design available with a circumferential groove and three lubrication holes in the outer ring, see table and *Figure 3*, page 5
- contact seals made from fluoro rubber, suitable for temperatures of  $-20\text{ °C}$  bis  $+200\text{ °C}$ ; other sealing washer materials such as NBR available by agreement.

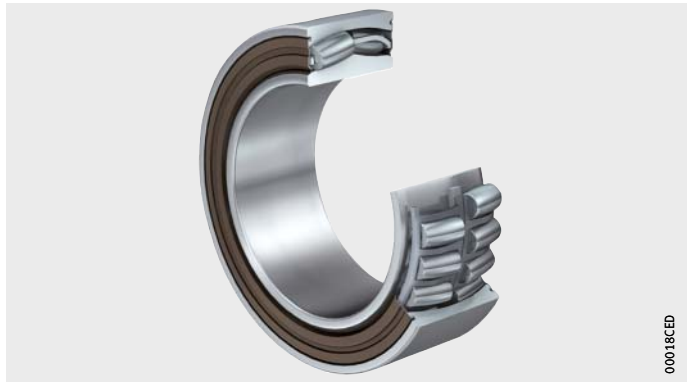


Seals made from fluoro rubber (FKM, FPM) comprise particularly high performance materials that may release vapour when heated to approx.  $+300\text{ °C}$ . This may occur if, for example, a welding torch is used in the dismounting of a bearing. In such cases, the appropriate safety data sheet must be observed and this is available upon request.

**Designs**

Description		Example
	Closed outer ring	<b>24028-E1-2VSR-H40</b>
	Circumferential groove and three lubrication holes, with relubrication facility	<b>24028-E1-2VSR</b>

*Figure 2*  
Sealing concept of series 240 and 241, closed outer ring



00018CED

*Figure 3*  
Sealing concept of series 240 and 241



00017CCD

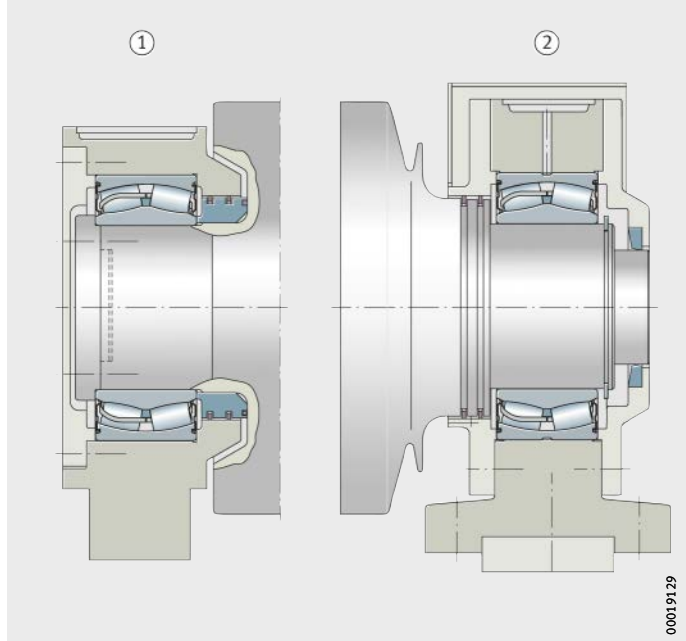
# Sealed spherical roller bearings

## Potential savings

In continuous slab casting plants, sealed spherical roller bearings are mounted as locating bearings and as non-locating bearings, *Figure 4.*

- ① Locating bearing
- ② Non-locating bearing

*Figure 4*  
Mounting example





The following comparison from the continuous casting sector shows the savings that are possible by the use of sealed spherical roller bearings instead of open bearings.

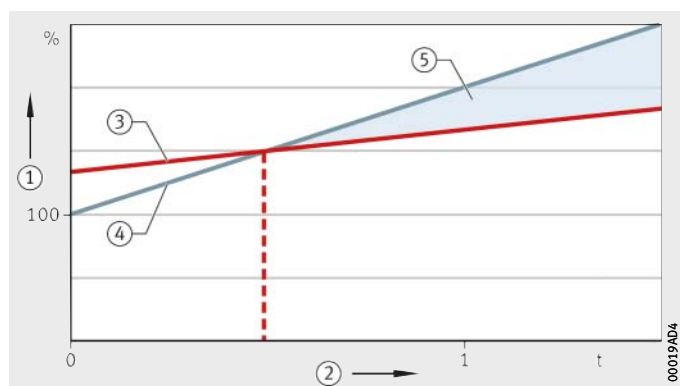
The grease costs for relubrication of an open bearing and a sealed bearing (seal lubrication of the housing) were taken into consideration along with the specific disposal and separation of the grease from the cooling circuit.

Due to the lower maintenance outlay and the generally longer life of the sealed spherical roller bearing, the higher purchase price compared to the open bearing is amortised after only a short time.

An example of the cost ratio in the life cycle of a sealed and an open bearing for a selected bearing position in a bearing position in a continuous casting plant (bearing price for the open bearing = 100%) is shown in *Figure 5*. The cost ratio and its development over time is decisively dependent on the bearing size.

- ① Cumulative costs in %
- ② Amortisation time in years
- ③ Price of sealed bearing
- ④ Price of open bearing
- ⑤ Saving

*Figure 5*  
Cost comparison of open and sealed spherical bearing



# Sealed spherical roller bearings

## Design and safety guidelines Equivalent dynamic bearing load

The equivalent dynamic bearing load  $P$  is valid for bearings that are subjected to radial and axial dynamic loads. It gives the same rating life as the combined bearing load occurring in practice.

For bearings under dynamic loading, the following applies:

### Load ratio and equivalent dynamic load

Load ratio	Equivalent dynamic bearing load
$\frac{F_a}{F_r} \leq e$	$P = F_r + Y_1 \cdot F_a$
$\frac{F_a}{F_r} > e$	$P = 0,67 \cdot F_r + Y_2 \cdot F_a$

$F_a$  N

Axial dynamic bearing load

$F_r$  N

Radial dynamic bearing load

$e, Y_1, Y_2$  –

Factors, see dimension tables

$P$  N

Equivalent dynamic bearing load for combined load.

## Equivalent static bearing load

The equivalent static bearing load for combined loads  $P_0$  is valid for bearings that are subjected to radial and axial static loads.

It induces the same load at the centre point of the most heavily loaded contact point between the rolling element and raceway as the combined bearing load occurring in practice.

For bearings under static loading, the following applies:

$$P_0 = F_{0r} + Y_0 \cdot F_{0a}$$

$P_0$  N

Equivalent static bearing load for combined load

$F_{0r}$  N

Radial static bearing load

$Y_0$  –

Factor, see dimension tables

$F_{0a}$  N

Axial static bearing load.

## Rolling bearing reconditioning

During the maintenance of machinery and plant, many rolling bearings are taken out of service and replaced by new ones as a precaution. In some cases, this safety-conscious approach blocks any appreciation of the potential cost savings. The fact is: reconditioned bearings generally give the same performance as new ones.

The reconditioning of rolling bearings and rolling bearing units is one of the core competences of the service arm of Schaeffler and is offered at several certified locations worldwide. Our services for rolling bearings of all types apply irrespective of manufacturer and are not restricted to Schaeffler products.

Schaeffler is in a position to recondition and modify rolling bearings with an outside diameter of up to 4 250 mm, *Figure 6*. It is thus an expert partner for customers from a very wide range of industrial sectors such as general and special machine building, steel and aluminium, pulp and paper production, wind power, shipbuilding, private and public railways and mining.



*Figure 6*  
Bearing examination by Schaeffler reconditioning specialists

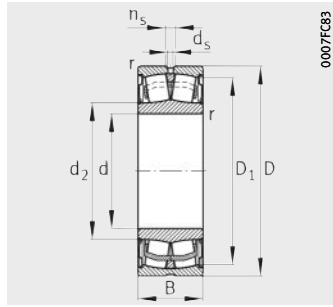
### Further information

- For information on the reconditioning of rolling bearings, see Technical Product Information TPI 207, Reconditioning of Rolling Bearings.

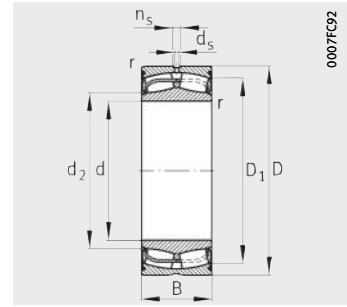
# Sealed spherical roller bearings

Cylindrical bore

**X-life**



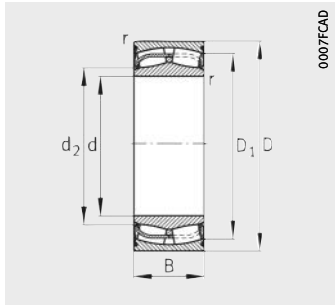
222, 223



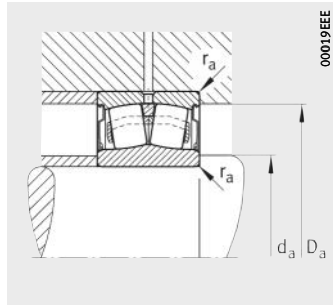
240, 241

**Dimension table** · Dimensions in mm

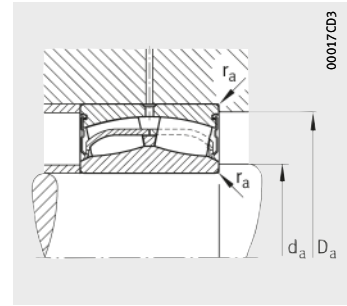
Designation			Mass m ≈kg	Dimensions							
Sealed	X-life	Open		d	D	B	r <sub>min</sub>	D <sub>1</sub>	d <sub>2</sub>	n <sub>s</sub>	d <sub>s</sub>
WS22205-E1-2RSR	XL	–	0,235	25	52	23	1	46,1	29,8	4,8	3,2
WS22206-E1-2RSR	XL	–	0,4	30	62	25	1	55,5	35	4,8	3,2
WS22207-E1-2RSR	XL	–	0,6	35	72	28	1,1	64,2	40,1	4,8	3,2
WS22208-E1-2RSR	XL	–	0,7	40	80	28	1,1	72,6	45,9	4,8	3,2
WS22308-E1-2RSR	XL	–	1,16	40	90	38	1,5	78,1	48,9	6,5	3,2
WS22209-E1-2RSR	XL	–	0,67	45	85	28	1,1	77,8	51,4	4,8	3,2
WS22210-E1-2RSR	XL	–	0,8	50	90	28	1,1	83,1	56	4,8	3,2
WS22211-E1-2RSR	XL	–	1,1	55	100	31	1,5	91,9	63,5	4,8	3,2
WS22311-E1-2RSR	XL	–	2,9	55	120	49	2	104,1	64,8	6,5	3,2
WS22212-E1-2RSR	XL	–	1,5	60	110	34	1,5	100,7	67,6	6,5	3,2
WS22312-E1-2RSR	XL	–	3,4	60	130	53	2,1	110,1	74,8	6,5	3,2
WS22213-E1-2RSR	XL	–	2	65	120	38	1,5	110,2	76,2	6,5	3,2
WS22214-E1-2RSR	XL	–	2,1	70	125	38	1,5	113,5	82,5	6,5	3,2
WS22314-E1-2RSR	XL	–	5,4	70	150	60	2,1	128	86,7	9,5	4,8
WS22215-E1-2RSR	XL	–	2,2	75	130	38	1,5	120,2	85,6	6,5	3,2
WS22216-E1-2RSR	XL	–	2,7	80	140	40	2	128,6	91,3	6,5	3,2
WS22217-E1-2RSR	XL	–	3,4	85	150	44	2	137,1	96,5	6,5	3,2
WS22218-E1-2RSR	XL	–	4,3	90	160	48	2	146,7	101,4	6,5	3,2



240-H40, 241-H40



Mounting dimensions  
222, 223



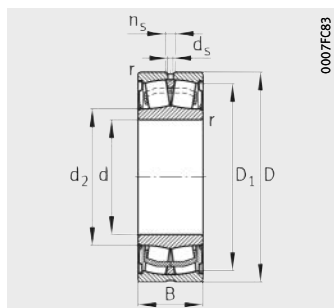
Mounting dimensions  
240, 241

Mounting dimensions			Basic load ratings		Calculation factors				Fatigue limit load $C_{ur}$ N	Limiting speed n min <sup>-1</sup>
$d_{a \min}$	$D_{a \max}$	$r_{a \max}$	dyn.	stat.	dyn.			stat.		
			C N	$C_{Or}$ N	e	Y1	Y2	Y0		
29,8	46,4	1	48 500	42 500	0,33	2,07	3,09	2,03	4 800	3 600
35	56,4	1	64 000	57 000	0,3	2,26	3,37	2,21	6 900	3 130
40,1	65	1,1	89 000	81 000	0,31	2,21	3,29	2,16	9 400	2 680
45,9	73	1	101 000	91 000	0,27	2,49	3,71	2,43	11 800	2 630
48,9	81	1,5	156 000	149 000	0,36	1,86	2,77	1,82	13 100	1 900
51,4	78	1	104 000	99 000	0,25	2,74	4,08	2,68	12 700	2 530
56	83,1	1	109 000	107 000	0,23	2,95	4,4	2,89	14 300	2 450
63,5	91,9	1,5	129 000	130 000	0,21	3,17	4,72	3,1	17 300	2 250
64,8	109	2	265 000	260 000	0,36	1,89	2,81	1,84	23 900	1 450
67,6	101	1,5	160 000	155 000	0,23	2,98	4,44	2,92	20 200	2 030
72	118	2,1	310 000	310 000	0,35	1,91	2,85	1,87	28 000	1 350
76,2	111	1,5	202 000	210 000	0,24	2,81	4,19	2,75	25 500	1 750
82,5	116	1,5	211 000	226 000	0,23	2,95	4,4	2,89	28 000	1 680
82	138	2,1	390 000	390 000	0,34	2	2,98	1,96	36 500	1 200
84	121	1,5	216 000	237 000	0,22	3,1	4,62	3,03	29 500	1 630
91	129	2	250 000	270 000	0,22	3,14	4,67	3,07	33 500	1 550
96	139	2	305 000	325 000	0,22	3,04	4,53	2,97	38 000	1 430
101	149	2	345 000	375 000	0,23	2,9	4,31	2,83	42 500	1 300

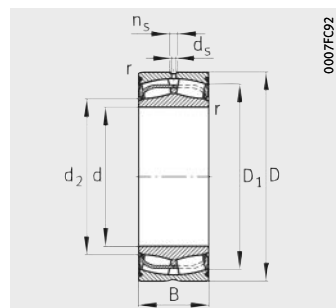
# Sealed spherical roller bearings

Cylindrical bore

X-life



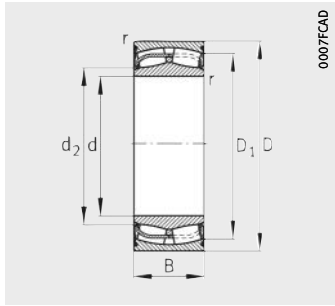
222, 223



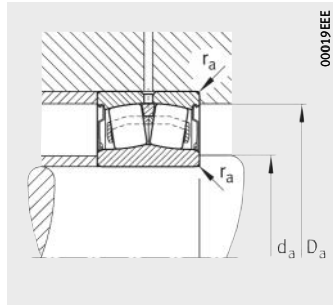
240, 241

Dimension table (continued) · Dimensions in mm

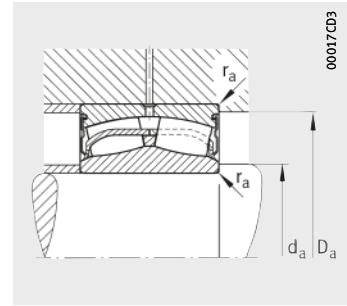
Designation			Mass m ≈ kg	Dimensions							
Sealed	X-life	Open		d	D	B	r <sub>min</sub>	D <sub>1</sub>	d <sub>2</sub>	n <sub>s</sub>	d <sub>s</sub>
WS22220-E1-2RSR	XL	–	6,3	100	180	55	2,1	169,1	115	9,5	4,8
WS22222-E1-2RSR	XL	–	9	110	200	63	2,1	182,6	124,9	9,5	4,8
24122-E1-2VSR-H40	XL	–	6,8	110	180	69	2	167,1	120,8	6,5	3,2
WS22224-E1-2RSR	XL	–	11,3	120	215	69	2,1	203,4	136,8	12,2	6,3
24124-E1-2VSR-H40	XL	–	10,4	120	200	80	2	184,5	131,1	–	–
24024-E1-2VSR-H40	XL	–	5,6	120	180	60	2	170,5	131	–	–
WS22226-E1-2RSR	XL	–	12,8	130	230	75	3	217,5	146,6	12,2	6,3
24126-E1-2VSR-H40	XL	–	11	130	210	80	2	196,1	143,1	–	–
24026-E1-2VSR-H40	XL	–	8,4	130	200	69	2	187,2	142,1	–	–
24128-E1-2VSR-H40	XL	–	13,8	140	225	85	2,1	209,9	153,5	–	–
24028-E1-2VSR-H40	XL	–	8,4	140	210	69	2	198,5	153,3	–	–
24130-E1-2VSR-H40	XL	–	20,6	150	250	100	2,1	228,9	163,1	–	–
24030-E1-2VSR-H40	XL	–	11,1	150	225	75	2,1	213,2	164	–	–
24132-E1-2VSR-H40	XL	–	25,4	160	270	109	2,1	245,6	175,5	–	–
24032-E1-2VSR-H40	XL	–	12,7	160	240	80	2,1	226,9	174,8	–	–
24134-E1-2VSR-H40	XL	–	26,4	170	280	109	2,1	257,3	186,7	–	–
24034-E1-2VSR-H40	XL	–	17,2	170	260	90	2,1	243,3	184,8	–	–
24136-E1-2VSR-H40	XL	–	33,2	180	300	118	3	276,3	196,2	–	–
24036-E1-2VSR-H40	XL	–	22,7	180	280	100	2,1	259,6	195,6	–	–
24138-E1-2VSR-H40	XL	–	41,5	190	320	128	3	292,6	208	–	–
24038-E1-2VSR-H40	XL	–	23,7	190	290	100	2,1	271,1	206,2	–	–
24140-E1-2VSR-H40	XL	–	49,5	200	340	140	3	309,5	216,2	–	–
24040-E1-2VSR-H40	XL	–	30,1	200	310	109	2,1	287,8	217	–	–
24144-E1-2VSR-H40	XL	–	64	220	370	150	4	338,5	236,2	–	–



240-H40, 241-H40



Mounting dimensions  
222, 223



Mounting dimensions  
240, 241

Mounting dimensions			Basic load ratings		Calculation factors				Fatigue limit load	Limiting speed
d <sub>a min</sub>	D <sub>a max</sub>	r <sub>a max</sub>	dyn.	stat.	dyn.			stat.	C <sub>ur</sub>	n
			C	C <sub>Or</sub>	e	Y1	Y2			
			N	N					N	min <sup>-1</sup>
112	169,1	2,1	430 000	475 000	0,24	2,84	4,23	2,78	52 000	1 140
122	188	2,1	550 000	600 000	0,25	2,71	4,04	2,65	62 000	1 030
120,8	169	2	530 000	750 000	0,34	1,96	2,92	1,92	84 000	840
132	203,4	2,1	640 000	740 000	0,25	2,71	4,04	2,65	71 000	910
131	189	2	680 000	950 000	0,37	1,84	2,74	1,8	101 000	740
129	171	2	450 000	690 000	0,29	2,33	3,47	2,28	84 000	860
144	217,5	2,5	760 000	890 000	0,26	2,62	3,9	2,56	79 000	780
141	199	2	710 000	1 050 000	0,34	1,98	2,94	1,93	109 000	700
139	191	2	570 000	860 000	0,31	2,21	3,29	2,16	101 000	780
152	213	2,1	800 000	1 190 000	0,34	1,99	2,96	1,94	124 000	660
149	201	2	590 000	930 000	0,28	2,37	3,53	2,32	109 000	740
162	238	2,1	1 050 000	1 520 000	0,37	1,83	2,72	1,79	148 000	590
160	215	2,1	680 000	1 090 000	0,29	2,32	3,45	2,26	123 000	690
172	258	2,1	1 220 000	1 800 000	0,37	1,8	2,69	1,76	168 000	550
170	230	2,1	770 000	1 240 000	0,29	2,32	3,45	2,26	137 000	640
182	268	2,1	1 260 000	1 900 000	0,36	1,9	2,83	1,86	179 000	530
180	250	2,1	940 000	1 480 000	0,31	2,2	3,27	2,15	158 000	600
194	286	2,5	1 460 000	2 170 000	0,36	1,86	2,77	1,82	203 000	500
190	270	2,1	1 130 000	1 770 000	0,32	2,1	3,13	2,06	180 000	550
204	306	2,5	1 680 000	2 550 000	0,37	1,82	2,7	1,78	226 000	460
200	280	2,1	1 160 000	1 860 000	0,31	2,2	3,27	2,15	192 000	540
214	326	2,5	1 880 000	2 800 000	0,39	1,71	2,54	1,67	250 000	450
210	300	2,1	1 350 000	2 150 000	0,32	2,13	3,17	2,08	216 000	500
236,2	353	3	2 190 000	3 250 000	0,39	1,74	2,59	1,7	290 000	410

# Continuous casting plant

In continuous casting plant, the cast strand is supported by rolls. In order to restrict deflection, the rolls are supported at several points along their length by rolling bearings. These bearings are subjected to high loads, low speeds, spray water and high temperatures. Spherical roller bearings of sealed design are used to support the rolls, *Figure 1*.



*Figure 1*  
Continuous casting plant

## Requirements

The demands on the design are:

- high static load carrying capacity
- maximum resistance to the ingress of foreign matter.



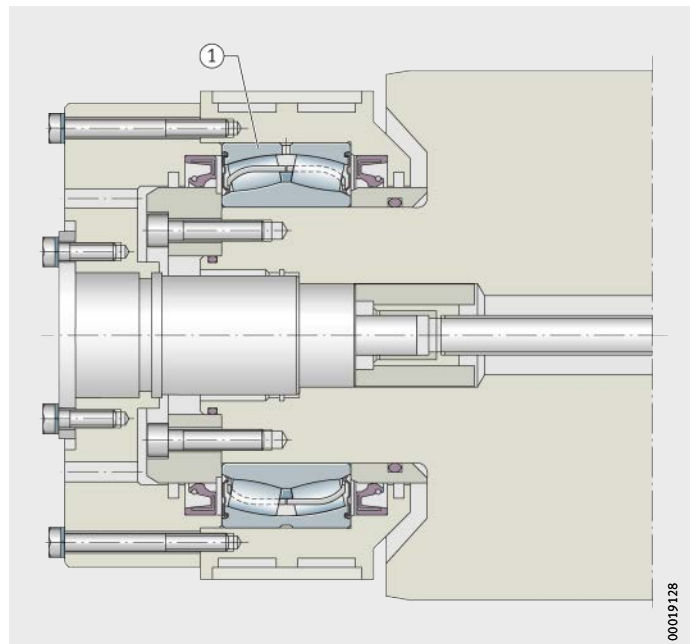
## Design solution

Sealed spherical roller bearings E1 offer a high standard of reliability, cost-efficiency and technical performance capacity in the metal-producing and metal-processing industry.

Due to the particularly compact bearing seals in series 240 and 241, the internal construction used can be the same as in the open type, *Figure 2*. The advantages of the field tested X-life design are now also accessible for sealed spherical roller bearings. The external dimensions of course remain identical to those of the unsealed variant. The extremely reliable sealing arrangement using a high temperature elastomer (FKM) and a special high temperature lubricant allows a longer bearing operating life, leading to higher machine availability and thus to greater added value.

The maintenance-friendly sealing concept of series 240 and 241 also contributes to rapid amortisation.

For the specific applications, the grease operating life as well as the relubrication quantity and the service life must be checked.



*Figure 2*  
Strand guide roll

## Products used

- ① 24028-E1-2VSR-C4.

# Elevator systems

Due to their optimised bearing kinematics and minimal frictional torque, sealed spherical roller bearings are an ideal choice for use in elevator plant, *Figure 1*.



*Figure 1*  
Elevator system

## Requirements

The demands on the design are:

- a low-maintenance bearing arrangement
- maximum operating life.

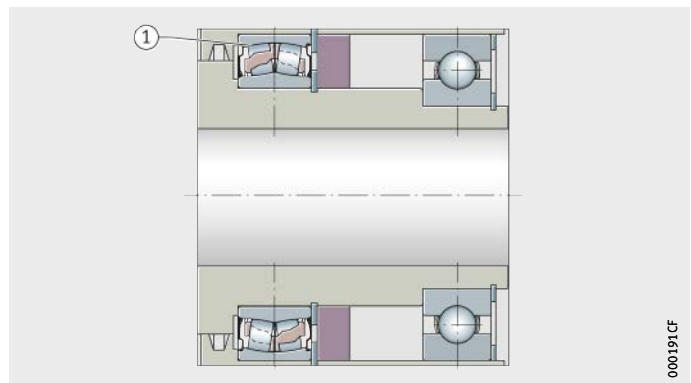
## Design solution

The extremely reliable sealing arrangement using an elastomer already subjected to field tests allows extended operating life and thus a possibility of approaching freedom from maintenance.

The consistently very high basic load ratings of the spherical roller bearings also permits downsizing of existing bearing arrangements or in new designs. We address the increasing requirements in the travel height and travel speed of elevators using our sealed spherical roller bearings with high basic load ratings and smooth running characteristics, *Figure 2*.

Furthermore, a particularly low noise level can be achieved by ordering specially developed low noise designs.

For the specific applications, the grease operating life as well as the relubrication quantity and the service life must be checked.



*Figure 2*  
Elevator roller

## Products used

- ① WS22212-E1-2RSR-TVPA-H40-L055.









**Schaeffler Technologies AG & Co. KG**

Georg-Schäfer-Straße 30  
97421 Schweinfurt  
Germany  
Internet [www.fag.com](http://www.fag.com)  
E-mail [faginfo@schaeffler.com](mailto:faginfo@schaeffler.com)

In Germany:

Phone 0180 5003872  
Fax 0180 5003873

From other countries:

Phone +49 9721 91-0  
Fax +49 9721 91-3435

Every care has been taken to ensure the correctness of the information contained in this publication but no liability can be accepted for any errors or omissions. We reserve the right to make technical changes.

© Schaeffler Technologies AG & Co. KG  
Issued: 2015, August

This publication or parts thereof may not be reproduced without our permission.  
TPI 218 GB-D