



FAG Balls DIN 5401 (11.93) and ISO 3290
 FAG balls of rolling bearing steel have a hardness of 58 to 66 HRC.

The balls are available in various **classes G** or **grades** with various dimensional and form tolerances. The maximum and minimum permissible diameter deviations and the form tolerances are determined for the individual ball diameters of each grade.

The balls of one maximum/minimum tolerance range are **sorted** in ball gauges with very small diameter tolerance ranges. Balls of each gauge are separately packed, and the mean deviation is indicated on the box below the ball designation. P0 identifies zero, P a plus value, M identifies a minus value.

Example according to DIN 5401 and ISO 3290:

KU.12,7G10
 P0

The nominal diameter is 12.7 mm

For class G10 the gauge tolerance $I_G = 1 \mu\text{m}$ (table on page 595).

With P0 the mean lot diameter D_{wml} is between $12.700 + I_G/2 = 12.7005 \text{ mm}$ and $12.700 - I_G/2 = 12.6995 \text{ mm}$

If one shipment comprises several boxes, all boxes contain balls of one grade. The ball gauge may vary from box to box. The balls in one and the same box, however, are of the same gauge.

The gauge together with the ball quality and the nominal diameter of a ball is the most precise specification according to which balls can be ordered.

Codes for ordering FAG balls

The codes consist of

– **prefix*)**
 KU. Ball

– **Nominal diameter in mm**

– **Suffixes**

- G3** Ball of quality G3 (DIN/ISO)
- G5** Ball of quality G5 (DIN/ISO)
- G10** Ball of quality G10 (DIN/ISO)
- G16** Ball of quality G16 (DIN/ISO)
- G20** Ball of quality G20 (DIN/ISO)
- G28** Ball of quality G28 (DIN/ISO)
- G40** Ball of quality G40 (DIN/ISO)
- G100** Ball of quality G100 (DIN/ISO)
- G500** Ball of quality G500 (DIN)
- G600** Ball of quality G600 (DIN)
- G700** Ball of quality G700 (DIN)

Adding the gauge is not necessary but possible (see above).

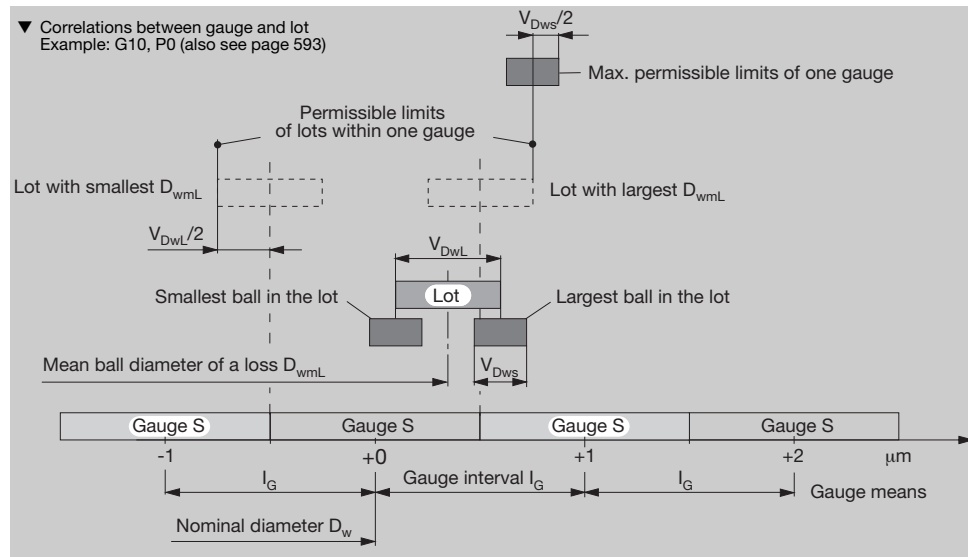
Please consult FAG for balls of sizes and types which are not listed in the tables, e.g. balls made of ceramic material or special steels.

*) Balls which are supplied by mass are prefixed KIKU.

Symbols, definitions, explanations

- G** Grade · Combination of dimensional tolerances and form tolerances, surface roughness and diameter scatter, see page 595.
- D_w Nominal ball diameter
- D_{wm} Mean diameter of one ball · The arithmetical mean of the largest and smallest single diameters D_{ws} of the ball
- D_{wml} Mean ball diameter of one lot · The arithmetical mean of the mean diameter of the largest ball and that of the smallest ball in the lot
- D_{ws} Single diameter of a ball; distance between two parallel planes tangent to the surface of the ball
- I_G Gauge interval; amounts into which the admissible tolerance of the ball is divided equally
- Lot** A definite quantity of balls manufactured under conditions which are presumed uniform
- R_a Surface roughness · Average roughness value as specified in DIN 4768
- S** Gauge · The amount by which the mean ball diameter D_{wml} of a lot differs from the nominal ball diameter D_w . Each ball

- gauge is a rounded whole multiple of the gauge interval I_G .
- t_{Dw} Deviation from the spherical form · Largest radial distance between every circle circumscribing the ball and the ball surface
- V_{DwA} Diameter variation in one grade · The difference between the mean diameter D_{wm} of the largest ball and that of the smallest ball in one grade · Applies from G500 to G700.
- V_{DwL} Variation of the ball diameter in one lot · The difference between the mean diameter D_{wm} of the largest ball and that of the smallest ball in one lot · Applies from G3 to G200.
- V_{Dws} Ball diameter variation · The difference between the largest and smallest actual single diameters D_{ws} of one single ball
- General:**
The lots are allocated to the gauge mean value based on their mean value D_{wml} , i.e. both limits of the gauge can be exceeded by maximum $V_{DwL}/2$.
The limits may be further exceeded by $V_{Dws}/2$ (see figure below).
All balls in a package must be within the lot diameter variation V_{DwL} .



▼ Tolerances of hardened steel balls according to ISO 3290: 1998 (values for G500 to G700 not standardized)

Grade	Nominal ball diameter		Tolerance of a ball in the lot			Tolerance		Gauge range and sorting in gauges	
	D_w over mm	to	Diameter variation V_{Dws} max. μm	Deviation from spherical form t_{Dw} max. μm	Surface roughness R_a max. μm	Lot diameter variation V_{DwL} max. μm	Gauge interval I_G μm	Gauge limits μm	
G3	-	12.7	0.08	0.08	0.01	0.13	0.5	-5	+5
G5	-	13.5	0.13	0.13	0.014	0.25	1	-5	+5
G10	-	25.4	0.25	0.25	0.02	0.5	1	-9	+9
G16	-	38.1	0.4	0.4	0.025	0.8	2	-10	+10
G20	-	38.1	0.5	0.5	0.032	1	2	-10	+10
G28	-	38.1	0.7	0.7	0.05	1.4	2	-12	+12
G40	25.4	38.1	1	1	0.06	2	4	-16	+16
G100	-	152.4	2.5	2.5	0.1	5	10	-40	+40
G200	-	152.4	5	5	0.15	10	15	-60	+60
G500	-	25.4	25	25	0.2	50	50	-50	+50
	25.4	50.8	25	25	0.2	75	75	-75	+75
	50.8	76.2	25	25	0.2	100	100	-100	+100
	76.2	101.6	32	32	0.2	125	125	-125	+125
	101.6	127	38	38	0.2	150	150	-150	+150
	127	152.4	44	44	0.4	175	175	-175	+175
	152.4	320	88	88	0.4	200	200	-200	+200
G600	all	-	-	-	-	400	-	-	-
G700	all	-	-	-	-	2000	-	-	-

1) Tolerance V_{DwA} for G500 to G700 instead of V_{DwL} .

FAG Cylindrical Rollers

Tolerances

FAG cylindrical rollers DIN 5402 (edition 12.93)

FAG cylindrical rollers of rolling bearing steel have a hardness between 58 and 65 HRC. The roller profile is adapted to the raceway profile (logarithmic profile) in such a way that edge stressing is largely avoided. All rollers are graded according to the mean deviations from diameter and length. The tolerance depends on the diameter and on the length of the rollers. Each roller gauge is packed separately. The mean deviations of diameter and length are indicated on the container below the roller designation.

P0 identifies zero, P a plus value, M a minus value.

Example: ZRO.6,5x9
P0/M6

Nominal diameter $D_w = 6.5$ mm

Length $L_w = 9$ mm

Mean deviation of the diameter ± 0 μ m

Mean deviation of the length -6 μ m

The actual finished diameter is between 6.499 and 6.501 mm

The actual finished length is between 8.991 and 8.997 mm

If a consignment of rollers of the same nominal size comprises several boxes, the gauge may vary from box to box. Each individual box, however, contains rollers of identical gauge.

Note for ordering

Cylindrical rollers can be ordered

– either with diameter gauge (e.g. ZRO.6,5x9M4)

or

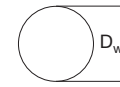
– with diameter grade range (e.g. ZRO.6,5x9P2M6)

Dimensional and form accuracy of hardened cylindrical rollers													Corner of the cylindrical rollers												
Dimensions in mm													Dimensions in mm												
Nominal dimension r													Nominal dimension r												
0.3 0.4 0.5 0.6 0.7 0.8 1 1.2 1.5 1.8 2 2.5													0.3 0.4 0.5 0.6 0.7 0.8 1 1.2 1.5 1.8 2 2.5												
r_{min}													r_{min}												
0.2 0.2 0.3 0.4 0.4 0.5 0.6 0.7 0.9 1.2 1.4 1.8													0.2 0.2 0.3 0.4 0.4 0.5 0.6 0.7 0.9 1.2 1.4 1.8												
r_{max}													r_{max}												
0.4 0.6 0.7 0.8 1 1.1 1.4 1.7 2.1 2.4 2.6 3.2													0.4 0.6 0.7 0.8 1 1.1 1.4 1.7 2.1 2.4 2.6 3.2												

Diameter D_w Nominal over to mm	Tolerance		Sorting in gauges													Roundness tolerance DIN ISO 1101 μ m			
	Deviation high μ m	low μ m	of the gauge μ m	Mean deviation of gauge μ m															
26	+7	-9	2	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7	-8	0.8
26 40	+7.5	-10.5	3			+6	+4.5	+3	+1.5	0	-1.5	-3	-4.5	-6	-7.5	-9			1.2
40 75	+7.5	-10.5	3			+6	+4.5	+3	+1.5	0	-1.5	-3	-4.5	-6	-7.5	-9			2
75 100	+12.5	-12.5	5			+10	+7.5	+5	+2.5	0	-2.5	-5	-7.5	-10					2.5

Length L_w Nominal over to mm	Tolerance		Sorting in gauges													Axial runout tolerance DIN ISO 1101 μ m			
	Deviation high μ m	low μ m	of the gauge μ m	Mean deviation of gauge μ m															
48	+9	-15	6	+6	0	-6	-12												6
48 160	+15	-35	10	+10	0	-10	-20	-30											10

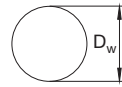
FAG Steel Balls



Rolling bearing steel: The mass is based on 7.85 kg/dm³ (DIN 5401)

Diameter			Mass	Diameter			Mass
D_w			\approx 1000 pieces	D_w			\approx 100 pieces
mm	in	FAG	kg	mm	in	FAG	kg
0.635	1/40	KU.0,635	0.001	21.431	27/32	KU.21,431	4.05
0.794	1/32	KU.0,794	0.002	22.225	7/8	KU.22,225	4.51
1		KU.1	0.004	23.019	23/32	KU.23,019	5.01
1.191	3/64	KU.1,191	0.007	23.812	15/16	KU.23,812	5.55
1.588	1/16	KU.1,588	0.016	24.606	31/32	KU.24,606	6.12
2		KU.2	0.033	25.4	1	KU.25,4	6.74
2.381	3/32	KU.2,381	0.055	26.194	1 1/32	KU.26,194	7.39
2.778	1/8	KU.2,778	0.088	26.988	1 1/16	KU.26,988	8.08
3		KU.3	0.111	27.781	1 3/32	KU.27,781	8.81
3.175	1/8	KU.3,175	0.132	28.575	1 1/8	KU.28,575	9.59
3.969	5/32	KU.3,969	0.257	29.369	1 5/32	KU.29,369	10.4
4.762	3/16	KU.4,762	0.444	30.162	1 3/16	KU.30,162	11.3
5		KU.5	0.514	31.75	1 1/4	KU.31,75	13.2
5.556	7/32	KU.5,556	0.705	33.338	1 5/16	KU.33,338	15.2
6		KU.6	0.888	34	1 3/8	KU.34	16.2
6.35	1/4	KU.6,35	1.05	34.925	1 3/8	KU.34,925	17.5
6.747	11/64	KU.6,747	1.26	35.719	1 13/32	KU.35,719	18.7
7.144	9/32	KU.7,144	1.5	36.512	1 7/16	KU.36,512	20
7.938	5/16	KU.7,938	2.06	38.1	1 1/2	KU.38,1	22.7
8.731	11/32	KU.8,731	2.74	39.688	1 9/16	KU.39,688	25.7
9.525	3/8	KU.9,525	3.55	40.481	1 19/32	KU.40,481	27.3
10		KU.10	4.11	41.275	1 5/8	KU.41,275	28.9
10.319	13/32	KU.10,319	4.52	42.862	1 11/16	KU.42,862	32.4
10.5		KU.10,5	4.76	43.656	1 23/32	KU.43,656	34.2
11.112	7/16	KU.11,112	5.64	44.45	1 3/4	KU.44,45	36.1
11.5		KU.11,5	6.25	45.244	1 25/32	KU.45,244	38.1
11.906	15/32	KU.11,906	6.94	46.038	1 13/16	KU.46,038	40.1
12.5		KU.12,5	8.03	47.625	1 7/8	KU.47,625	44.4
12.7	1/2	KU.12,7	8.42	48.419	1 29/32	KU.48,419	46.7
13		KU.13	9.03	50.403	1 63/64	KU.50,403	52.6
13.494	17/32	KU.13,494	10.1	50.8	2	KU.50,8	53.9
14.288	9/16	KU.14,288	12	51.5		KU.51,5	56.1
15.081	19/32	KU.15,081	14.1	52.5		KU.52,5	59.5
15.875	5/8	KU.15,875	16.4	53.975	2 1/8	KU.53,975	64.6
16.669	21/32	KU.16,669	19	55		KU.55	68.4
17.462	11/16	KU.17,462	21.9	55.562	2 3/16	KU.55,562	70.5
18.256	23/32	KU.18,256	25	56.356	2 7/32	KU.56,356	73.6
19.05	3/4	KU.19,05	28.4	57.15	2 1/4	KU.57,15	76.7
19.844	25/32	KU.19,844	32.1	59		KU.59	84.4
20.638	13/16	KU.20,638	36				

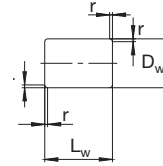
FAG Steel Balls



Rolling bearing steel: The mass is based on 7.85 kg/dm³ (DIN 5401)

Diameter		Code	Mass ≈ 100 pieces
D _w			kg
mm	in	FAG	
60.325	2 3/8	KU.60,325	90.2
62		KU.62	98
63.5	2 1/2	KU.63,5	105
66.675	2 5/8	KU.66,675	122
69.85	2 3/4	KU.69,85	140
73.025	2 7/8	KU.73,025	160
76.2	3	KU.76,2	182
80		KU.80	210
82.55	3 1/4	KU.82,55	231
88.9	3 1/2	KU.88,9	289
92		KU.92	320
95.25	3 3/4	KU.95,25	355
98.425	3 7/8	KU.98,425	392
101.6	4	KU.101,6	431
105		KU.105	476
107.95	4 1/4	KU.107,95	517
110		KU.110	547
114.3	4 1/2	KU.114,3	614
120		KU.120	710
125		KU.125	803
127	5	KU.127	842
130		KU.130	903
135		KU.135	1010
140		KU.140	1130
145		KU.145	1250
150		KU.150	1390
155		KU.155	1530
160		KU.160	1680
165		KU.165	1850
170		KU.170	2020
175		KU.175	2200
190		KU.190	2820
195		KU.195	3050
200		KU.200	3290
220		KU.220	4380

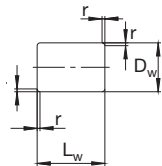
FAG Cylindrical Rollers



Mass according to DIN 5402

Diameter	Length	Corner	Code	Mass ≈ 100 pieces	Diameter	Length	Corner	Code	Mass ≈ 100 pieces
D _w	L _w	r		kg	D _w	L _w	r		kg
mm			FAG		mm			FAG	
5	5	0.4	ZRO.5x5	0.077	14	14	0.6	ZRO.14x14	1.7
5	8	0.4	ZRO.5x8	0.123	14	15	0.6	ZRO.14x15	1.81
5	10	0.4	ZRO.5x10	0.154	14	20	0.6	ZRO.14x20	2.4
5.5	5.5	0.4	ZRO.5,5x5,5	0.103	14	22	0.6	ZRO.14x22	2.66
5.5	6	0.4	ZRO.5,5x6	0.112	15	15	0.6	ZRO.15x15	2.08
5.5	8	0.4	ZRO.5,5x8	0.149	15	16	0.6	ZRO.15x16	2.22
5.5	9	0.4	ZRO.5,5x9	0.2	15	17	0.6	ZRO.15x17	2.36
6	6	0.4	ZRO.6x6	0.133	15	22	0.6	ZRO.15x22	3.05
6	8	0.4	ZRO.6x8	0.178	15	24	0.6	ZRO.15x24	3.33
6	10	0.4	ZRO.6x10	0.222	16	16	0.6	ZRO.16x16	2.5
6	12	0.4	ZRO.6x12	0.266	16	17	0.6	ZRO.16x17	2.7
6.5	6.5	0.4	ZRO.6,5x6,5	0.169	16	24	0.6	ZRO.16x24	3.8
6.5	7	0.4	ZRO.6,5x7	0.182	16	27	0.6	ZRO.16x27	4.3
6.5	9	0.4	ZRO.6,5x9	0.234	17	17	0.7	ZRO.17x17	3
6.5	10	0.4	ZRO.6,5x10	0.26	17	24	0.7	ZRO.17x24	4.3
7	7	0.4	ZRO.7x7	0.211	18	18	0.7	ZRO.18x18	3.6
7	10	0.4	ZRO.7x10	0.302	18	19	0.7	ZRO.18x19	3.8
7	14	0.4	ZRO.7x14	0.423	18	26	0.7	ZRO.18x26	5.2
7.5	7.5	0.4	ZRO.7,5x7,5	0.26	18	30	0.7	ZRO.18x30	6
7.5	9	0.4	ZRO.7,5x9	0.312	19	19	0.7	ZRO.19x19	4.2
7.5	11	0.4	ZRO.7,5x11	0.381	19	20	0.7	ZRO.19x20	4.5
8	8	0.4	ZRO.8x8	0.316	19	28	0.7	ZRO.19x28	6.2
8	9	0.4	ZRO.8x9	0.355	19	32	0.7	ZRO.19x32	7.1
8	12	0.4	ZRO.8x12	0.474	20	20	0.7	ZRO.20x20	4.9
9	9	0.5	ZRO.9x9	0.449	20	35	0.7	ZRO.20x35	8.6
9	10	0.5	ZRO.9x10	0.499	20	40	0.7	ZRO.20x40	9.9
9	13	0.5	ZRO.9x13	0.6	21	21	0.8	ZRO.21x21	5.7
9	14	0.5	ZRO.9x14	0.699	21	22	0.8	ZRO.21x22	6
10	10	0.5	ZRO.10x10	0.6	21	30	0.8	ZRO.21x30	8.2
10	11	0.5	ZRO.10x11	0.678	21	32	0.8	ZRO.21x32	8.7
10	14	0.5	ZRO.10x14	0.863	22	22	0.8	ZRO.22x22	6.6
10	16	0.5	ZRO.10x16	0.986	22	24	0.8	ZRO.22x24	7.2
11	11	0.5	ZRO.11x11	0.821	22	34	0.8	ZRO.22x34	10.1
11	12	0.5	ZRO.11x12	0.895	23	23	0.8	ZRO.23x23	7.5
11	15	0.5	ZRO.11x15	1.12	23	24	0.8	ZRO.23x24	7.8
11	18	0.5	ZRO.11x18	1.34	23	32	0.8	ZRO.23x32	10.4
12	12	0.5	ZRO.12x12	1.07	23	34	0.8	ZRO.23x34	11.1
12	14	0.5	ZRO.12x14	1.24	23	36	0.8	ZRO.23x36	11.7
12	17	0.5	ZRO.12x17	1.51	24	24	0.8	ZRO.24x24	8.5
12	18	0.5	ZRO.12x18	1.6	24	26	0.8	ZRO.24x26	9.2
12	21	0.5	ZRO.12x21	1.86	24	36	0.8	ZRO.24x36	12.8
13	13	0.6	ZRO.13x13	1.35	24	38	0.8	ZRO.24x38	13.5
13	18	0.6	ZRO.13x18	1.9					
13	20	0.6	ZRO.13x20	2.08					

FAG Cylindrical Rollers



Mass according to DIN 5402

Diameter D _w mm	Length L _w	Corner r	Code FAG	Mass ≈ 100 pieces kg	Diameter D _w mm	Length L _w	Corner r	Code FAG	Mass ≈ 100 pieces kg
25	25	0.8	ZRO.25x25	9.6	48	48	1.5	ZRO.48x48	68
25	27	0.8	ZRO.25x27	10.4	48	65	1.5	ZRO.48x65	92.1
25	30	0.8	ZRO.25x30	11.6	48	75	1.5	ZRO.48x75	106
25	36	0.8	ZRO.25x36	13.9	48	80	1.5	ZRO.48x80	113
25	40	0.8	ZRO.25x40	15.4	50	50	1.5	ZRO.50x50	76.9
25	52	0.8	ZRO.25x52	20	50	75	1.5	ZRO.50x75	115
26	26	0.8	ZRO.26x26	10.8	50	85	1.5	ZRO.50x85	131
26	28	0.8	ZRO.26x28	11.7	50	88	1.5	ZRO.50x88	136
26	40	0.8	ZRO.26x40	16.7	50	100	1.5	ZRO.50x100	154
27	48	1	ZRO.27x48	21.5	50	110	1.5	ZRO.50x110	169
28	28	1	ZRO.28x28	13.5	52	52	1.5	ZRO.52x52	86.5
28	30	1	ZRO.28x30	14.4	52	90	1.5	ZRO.52x90	150
28	40	1	ZRO.28x40	19.3	54	54	1.5	ZRO.54x54	96.8
28	44	1	ZRO.28x44	21.2	54	80	1.5	ZRO.54x80	144
30	30	1	ZRO.30x30	16.6	54	85	1.5	ZRO.54x85	153
30	34	1	ZRO.30x34	18.8	54	90	1.5	ZRO.54x90	161
30	48	1	ZRO.30x48	26.6	54	95	1.5	ZRO.54x95	170
30	64	1	ZRO.30x64	35.4	54	120	1.5	ZRO.54x120	215
32	32	1	ZRO.32x32	20.1	56	56	1.5	ZRO.56x56	108
32	40	1	ZRO.32x40	25.2	56	70	1.5	ZRO.56x70	135
32	52	1	ZRO.32x52	32.8	56	90	1.5	ZRO.56x90	174
34	34	1	ZRO.34x34	24.1	56	112	1.5	ZRO.56x112	216
34	55	1	ZRO.34x55	39.1	58	100	1.8	ZRO.58x100	207
34	75	1	ZRO.34x75	53.4	60	60	1.8	ZRO.60x60	133
36	36	1.2	ZRO.36x36	28.6	60	90	1.8	ZRO.60x90	199
36	58	1.2	ZRO.36x58	46.2	60	95	1.8	ZRO.60x95	211
38	38	1.2	ZRO.38x38	33.7	60	100	1.8	ZRO.60x100	222
38	42	1.2	ZRO.38x42	37.3	62	62	1.8	ZRO.62x62	147
38	60	1.2	ZRO.38x60	53.3	62	80	1.8	ZRO.62x80	189
38	62	1.2	ZRO.38x62	55.1	64	64	1.8	ZRO.64x64	161
40	40	1.2	ZRO.40x40	39.3	64	70	1.8	ZRO.64x70	177
40	65	1.2	ZRO.40x65	64	64	75	1.8	ZRO.64x75	189
40	70	1.2	ZRO.40x70	68.9	64	100	1.8	ZRO.64x100	253
40	87	1.2	ZRO.40x87	85.7	64	105	1.8	ZRO.64x105	265
42	42	1.2	ZRO.42x42	45.5	64	128	1.8	ZRO.64x128	323
42	70	1.2	ZRO.42x70	75.9	64	135	1.8	ZRO.64x135	341
42	75	1.2	ZRO.42x75	81.4	68	68	2	ZRO.68x68	193
42	80	1.2	ZRO.42x80	86.8	68	75	2	ZRO.68x75	213
42	82	1.2	ZRO.42x82	89	68	110	2	ZRO.68x110	313
42	84	1.2	ZRO.42x84	91.2	70	70	2	ZRO.70x70	211
45	45	1.5	ZRO.45x45	56	70	110	2	ZRO.70x110	332
45	65	1.5	ZRO.45x65	81	72	100	2	ZRO.72x100	320
45	70	1.5	ZRO.45x70	87.2					
45	75	1.5	ZRO.45x75	93.4					
45	98	1.5	ZRO.45x98	122					

FAG Cylindrical Rollers

Mass according to DIN 5402

Diameter D _w mm	Length L _w	Corner r	Code FAG	Mass ≈ 100 pieces kg
75	75	2	ZRO.75x75	260
75	80	2	ZRO.75x80	277
75	110	2	ZRO.75x110	381
75	115	2	ZRO.75x115	398
75	120	2	ZRO.75x120	416
75	125	2	ZRO.75x125	433
75	155	2	ZRO.75x155	537
80	80	2.5	ZRO.80x80	315
80	85	2.5	ZRO.80x85	335
80	90	2.5	ZRO.80x90	355
80	115	2.5	ZRO.80x115	453
80	120	2.5	ZRO.80x120	473
80	130	2.5	ZRO.80x130	513
80	160	2.5	ZRO.80x160	631