

Koyo®

HIGH ABILITY BALL BEARING SERIES

Angular Contact Ball Bearings for Machining Tools

High Ability



ISO9001/QS-9000
Certificate No. 927265

KOYO SEIKO CO., LTD.

CAT.NO. 256E

Machining tools regularly improve in speed and efficiency in response to industrial demands for increased productivity and product machining efficiency. Consequently, bearings for machining tools are required to achieve the following performance levels.

- Ultrafast rotation to reduce machining time**
- Rapid acceleration/deceleration capability for improved efficiency**
- High rigidity with low increase in temperature for high precision machining**

Moreover, environmental concerns are now a major issue, bringing into question the oil-and-air lubrication and oil mist lubrication usually used with high-speed spindles. As an alternative, grease lubrication is gaining attention as it does not spray oil into the air and ensures the environment is free of contamination.

In response to these needs, **Koyo** has developed its High Ability bearing series. The newly developed bearings offer excellent high-speed performance and rapid acceleration and deceleration performance and allow grease lubrication for high-speed operations.



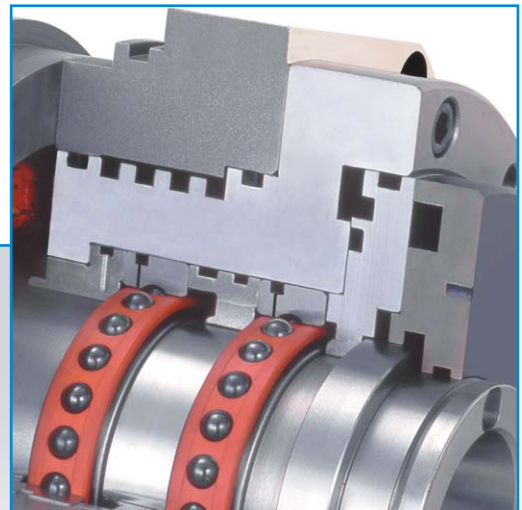
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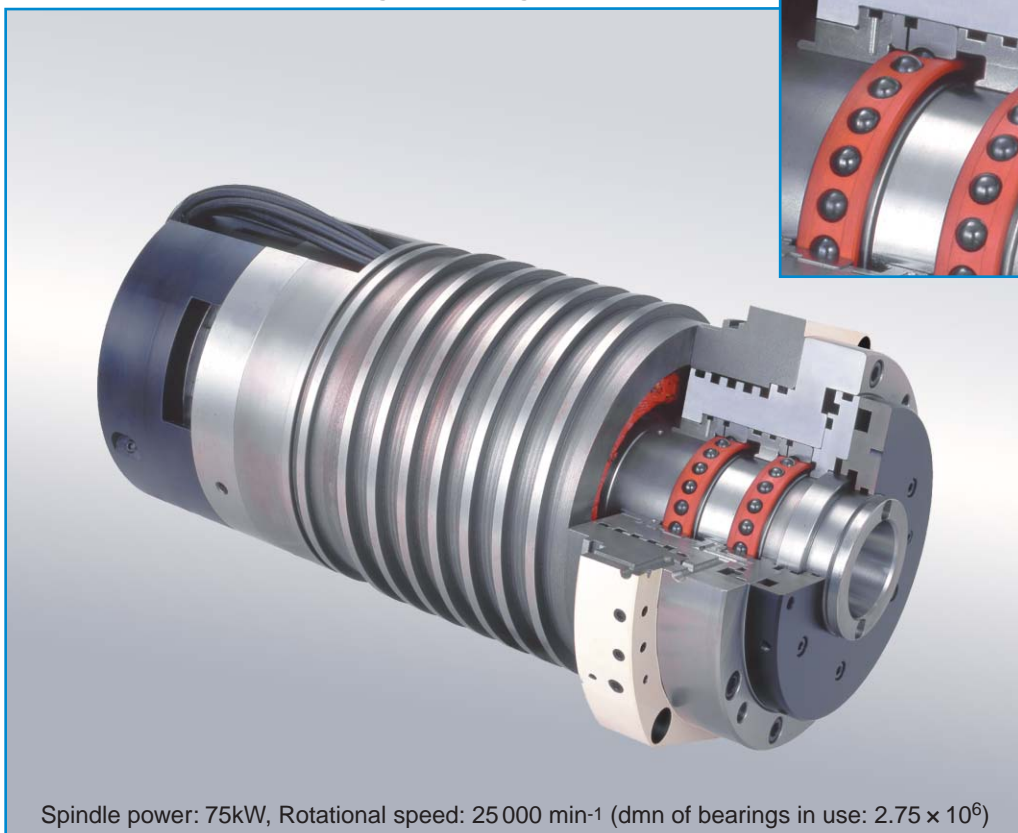
Type R	Steel Balls	7
Type R	Ceramic Balls	10
Type C	Ceramic Balls	13
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1. Features

- 1 20 to 30% reduction in temperature increase**
 (compared with Koyo's conventional products)
Koyo has conducted various tests and analyses and developed elaborate machining techniques to improve the performance of bearings used with machining tool spindles. The result is a substantial reduction in frictional heat generated in bearings rotating at a high speed.
- 2 1.2- to 1.5-fold increases in speed limits**
 (compared with Koyo's conventional products)
 Speed limits have been extended through re-designing for high-speed rotation and heat reduction. Use of ceramic balls as rolling elements enables additional high-speed rotation.
- 3 Improved high-speed performance achieved by position preloading**
 Low increases in temperature during operation ensure reduced changes in preload. Preload can be given by position preloading even at high speeds, which has been hitherto unavailable with conventional systems. The result is high-precision machining with stability.
- 4 Conventional bearings easily replaced**
 Dimensions of High Ability bearings conform to ISO standards. Replacement of conventional bearings with High Ability bearings requires minimal geometry changes of the present spindle or housing.



Example of application to a high-speed, high-power spindle



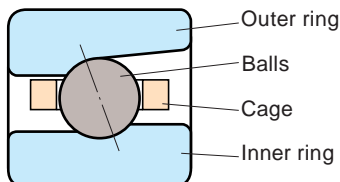
Spindle power: 75kW, Rotational speed: 25 000 min⁻¹ (dmn of bearings in use: 2.75 × 10⁶)

2. Construction

There are four types of High Ability bearings.

Type R

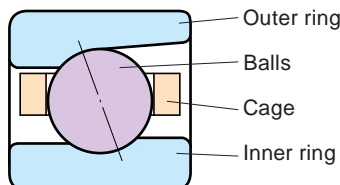
Standard High Ability bearing



This bearing has the same dimensions as conventional products. The limiting speed has been improved by raceways machined to optimal geometry for high-speed rotation. Balls are available in steel or ceramics.

Type C

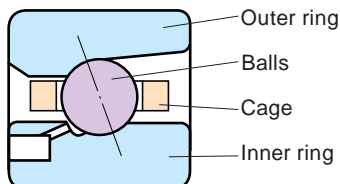
High Ability bearing with high load rating



An increased load rating has been achieved by increasing the size of the ball. The ball is ceramics to ensure high-speed performance.

Type D

Oil-and-air lubrication through inner ring

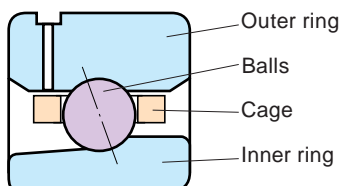


Type D is designed to supply oil to the ball via an oiling groove and nozzle provided in one side of the inner ring. Ceramic balls are used.

* Type D has been developed jointly with Mitsui Seiki Co., Ltd.

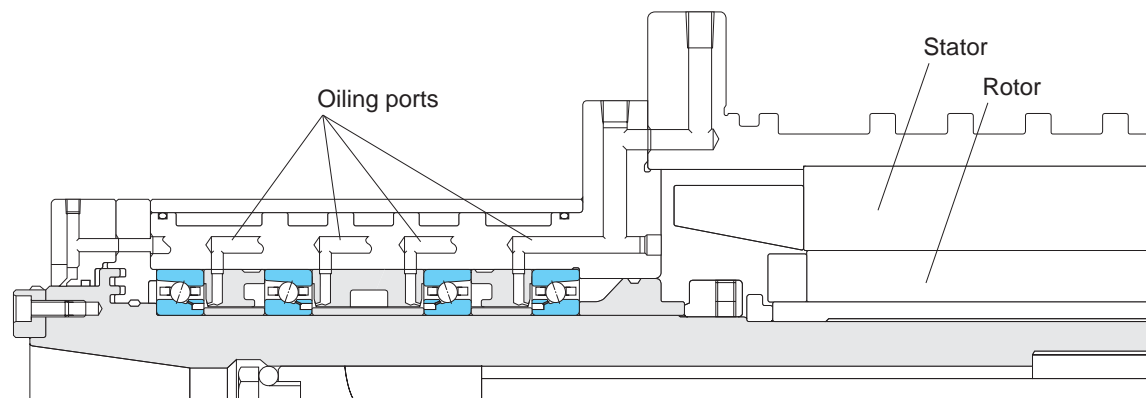
Type F

Oil-and-air lubrication through outer ring







An oiling groove and nozzle are provided in the outer ring for reliable lubrication of the guide way on the cage and the rolling contact surface of the ball. Type F is optimal for ultrafast rotation. Ceramic balls are used.

Example of mounting on a built-in motor spindle



3. Types and Bearing Numbers

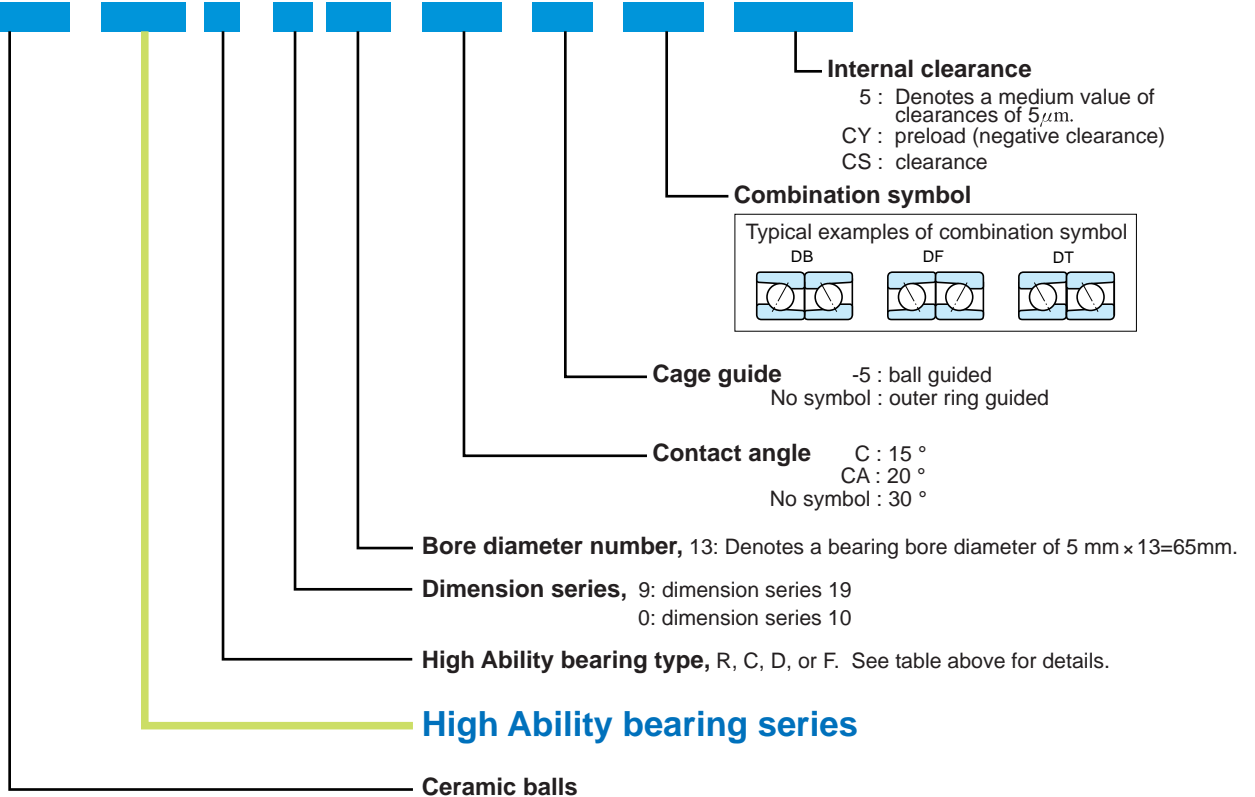
(1) High Ability bearing types and principal applications

Type	Specification			Remarks
	Bearing dimension series	Contact angle	Material of rolling element	
Type R 	10 19	15 ° 20 ° 30 °	Steel or ceramics	High-speed, high-rigidity type
Type C 	10 19	15 ° 20 °	ceramics	High-speed, high load-rating type
Type D 	10	20 °	ceramics	Ultrafast, low-noise type for oil-and-air lubrication
Type F 	10 19	20 °	ceramics	Extremely ultrafast type for oil-and-air lubrication

(2) Bearing number nomenclature

Example

3 NC HA R 0 13 CA -5 DB CS 5



4. Performance

The temperature of an operating bearing increases due to frictional heat produced within the bearing. This increase in temperature imposes a certain speed limit when the bearing is required to rotate at high speed.

The reason being that the bearing operation discontinues due to seizure caused by temperature increases above a certain temperature. Consequently, increases in bearing temperature during operation can serve as a measure in regard to speed limit.

High Ability bearings exhibit their maximum performance when used in pairs or when more than two units are combined and when preload is given by position preloading. Shown below is the operating performance of High Ability bearings with preload given by position preloading.

(1) High-speed performance of Types R and C

Fig.1 compares relationships between rotational speed and increases in bearing temperature of Types R and C and conventional high-precision bearings.

High Ability bearings exhibit smaller temperature increases and higher speed limits than conventional bearings whether grease lubrication or oil-and-air lubrication is applied.

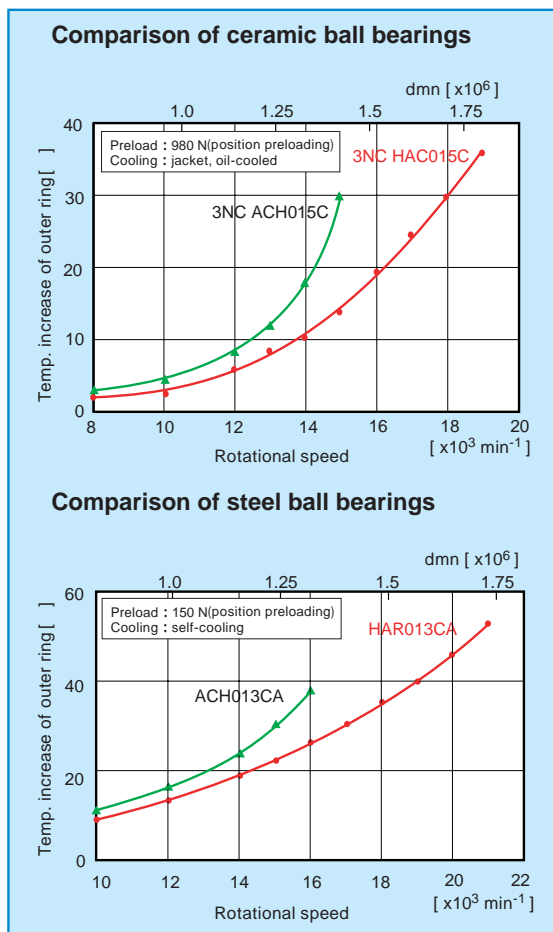


Fig. 1 Comparison of Increases in Bearing Temp. with Oil-and-air Lubrication

High Ability bearings also allow the possible change in lubrication of the spindle from oil-and-air to grease.

Fig.2 shows an evaluation example.

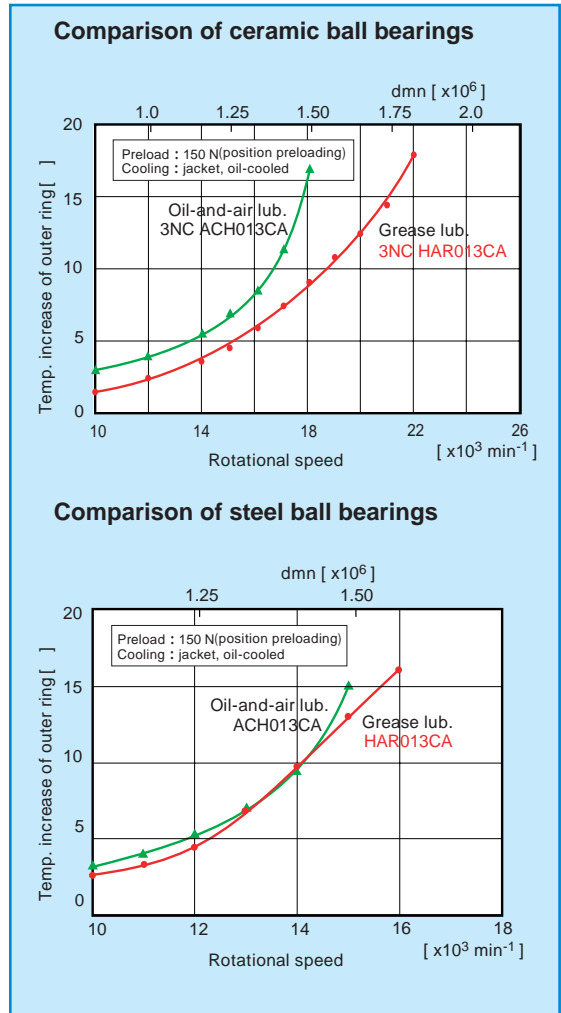


Fig. 2 Comparison of High-speed Performance Achieved by Grease Lubrication

Type R high ability bearing and grease lubrication exhibits better high-speed performance than conventional bearings using oil-and-air lubrication.

If steel balls are used, Type R with grease lubrication exhibits high-speed performance equal to or better than conventional bearings with oil-and-air lubrication.

(2) High-speed performance of Type D

High Ability Type D bearings are designed for oil-and-air lubrication. Their inner rings have an oiling groove to ensure lubrication on the rolling contact surface for improved lubrication reliability.

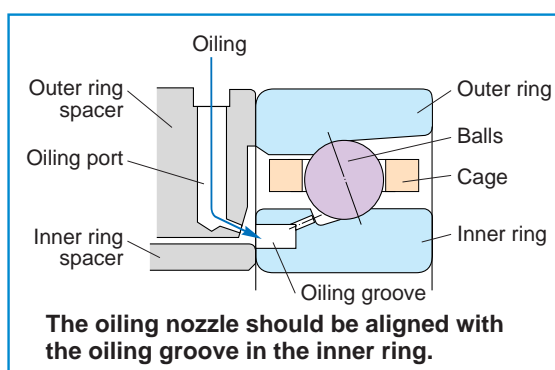


Fig. 3 Lubrication Method for Type D

Fig.4 compares the high-speed performance of Types D and R.

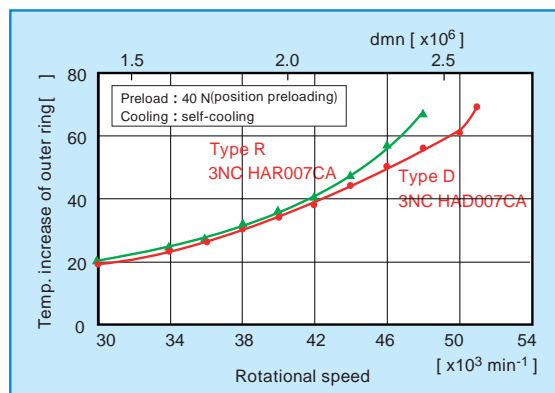


Fig. 4 Comparison of Increases in the Bearing Temp. of Types R and D

Furthermore, Type D bearings generate only a slight noise during rotation and are therefore also effective for noise reduction of spindle units (Fig. 5).

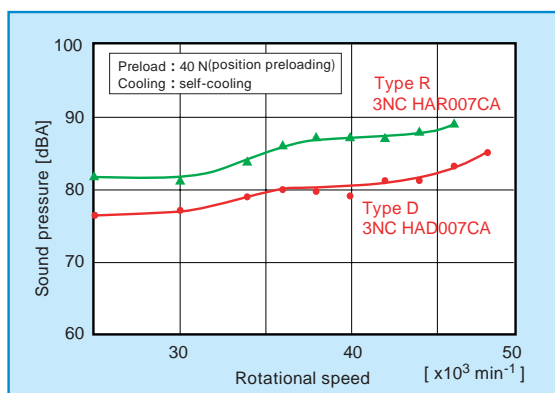


Fig. 5 Comparison of Noise by Types R and D

(3) High-speed performance of Type F

The oiling port in Type F is provided at its outer ring to ensure improved lubrication reliability on the guide ways of the cage. High Ability bearings of Type F deliver the best high-speed performance.

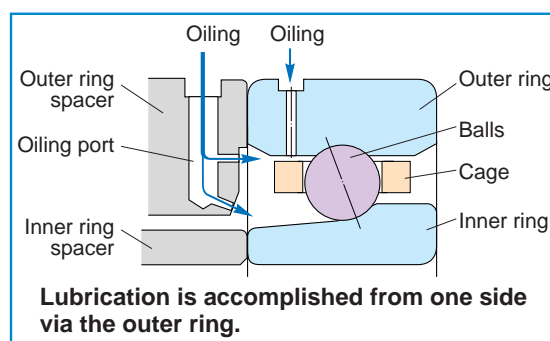


Fig. 6 Lubrication method used in Type F

Figure 7 shows an evaluation example of the Type F bearing operated with a preload given by constant pressure preloading. The maximum rotational speed achieved in this test, or 54 000 min^{-1} , equals 3.3×10^6 in dmn value.

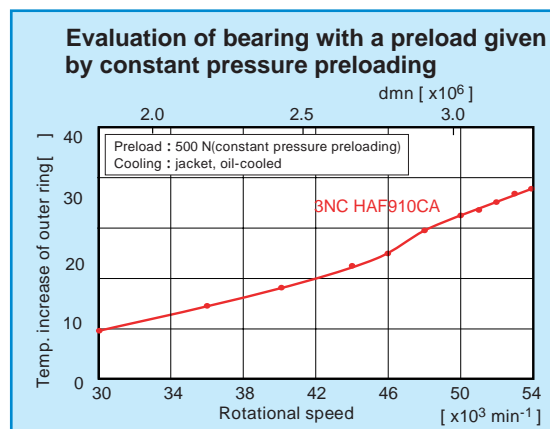


Fig. 7 Temp. Increases in Type F Bearing

The oiling port in the outer ring provides sufficient lubrication to achieve a substantial reduction of friction on guide ways of the cage. This lubrication method ensures excellent stability against rapid acceleration or deceleration during operation.

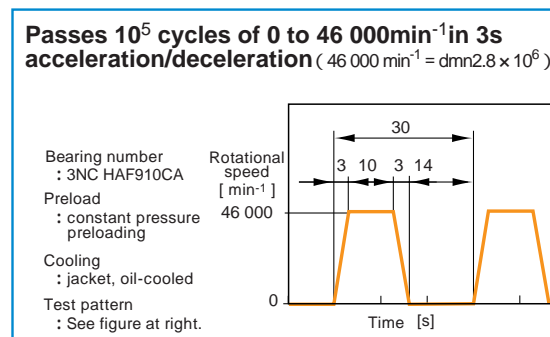


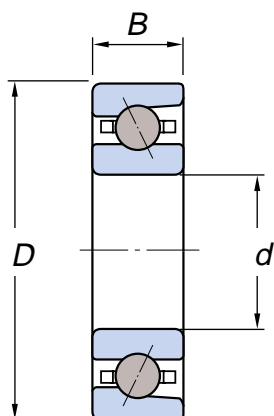
Fig. 8 Operating Pattern of Type F Involving Rapid Acceleration and Deceleration

Dimension table

Type **R**

Steel balls

d 30 – 70mm



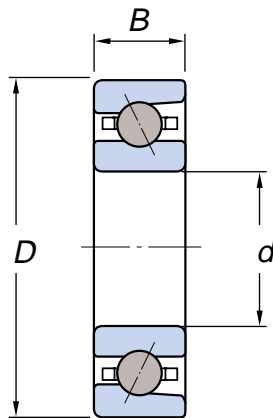
Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹	
d	D	B		C	C ₀	Grease lub.	Oil-and-air lub.
30	55	13	HAR006C	8.70	4.85	26 000	40 000
			HAR006CA	8.55	4.75	25 000	38 000
			HAR006	8.00	4.45	18 000	24 000
35	62	14	HAR007C	9.25	5.55	23 000	35 000
			HAR007CA	9.05	5.40	22 000	33 000
			HAR007	8.45	5.05	15 000	21 000
40	62	12	HAR908C	6.35	4.05	22 000	33 000
			HAR908CA	6.20	3.95	21 000	31 000
			HAR908	5.75	3.70	15 000	20 000
	68	15	HAR008C	9.70	6.20	20 000	31 000
			HAR008CA	9.50	6.05	19 000	30 000
			HAR008	8.85	5.65	14 000	19 000
45	68	12	HAR909C	7.15	5.05	19 000	30 000
			HAR909CA	7.00	4.95	19 000	28 000
			HAR909	6.50	4.60	13 000	18 000
	75	16	HAR009C	10.9	7.10	18 000	28 000
			HAR009CA	10.6	6.95	18 000	27 000
			HAR009	9.90	6.45	13 000	17 000
50	72	12	HAR910C	9.55	6.30	18 000	28 000
			HAR910CA	9.35	6.15	17 000	26 000
			HAR910	8.70	5.75	12 000	16 000
	80	16	HAR010C	11.4	7.85	17 000	26 000
			HAR010CA	11.1	7.65	16 000	25 000
			HAR010	10.4	7.15	12 000	15 000
55	80	13	HAR911C	10.1	7.65	16 000	25 000
			HAR911CA	9.85	7.50	16 000	24 000
			HAR911	9.15	6.95	11 000	15 000
	90	18	HAR011C	14.1	9.90	15 000	23 000
			HAR011CA	13.7	9.70	14 000	22 000
			HAR011	12.8	9.00	10 000	14 000
60	85	13	HAR912C	9.95	7.75	15 000	23 000
			HAR912CA	9.70	7.55	14 000	22 000
			HAR912	9.00	7.00	10 000	14 000
	95	18	HAR012C	14.7	10.8	14 000	22 000
			HAR012CA	14.3	10.6	14 000	21 000
			HAR012	13.4	9.85	10 000	13 000
65	90	13	HAR913C	11.8	9.45	14 000	22 000
			HAR913CA	11.5	9.25	14 000	21 000
			HAR913	10.7	8.55	10 000	13 000
	100	18	HAR013C	15.3	11.8	13 000	21 000
			HAR013CA	14.9	11.5	13 000	19 000
			HAR013	13.9	10.7	9 100	12 000
70	100	16	HAR914C	12.9	10.5	13 000	20 000
			HAR914CA	12.6	10.2	12 000	19 000
			HAR914	11.7	9.45	8 800	12 000
	110	20	HAR014C	20.7	15.5	12 000	19 000
			HAR014CA	20.2	15.1	12 000	18 000
			HAR014	18.9	14.1	8 300	11 000

Dimension table

Type **R**

Steel balls

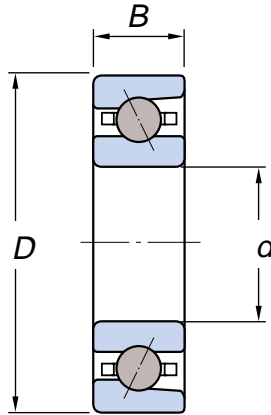
d 75–110mm



Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹	
d	D	B		C	C ₀	Grease lub.	Oil-and-air lub.
75	105	16	HAR915C	13.3	11.2	12 000	19 000
			HAR915CA	12.9	10.9	12 000	18 000
			HAR915	12.0	10.1	8 300	11 000
	115	20	HAR015C	21.1	16.2	12 000	18 000
			HAR015CA	20.6	15.8	11 000	17 000
			HAR015	19.2	14.7	7 900	11 000
80	110	16	HAR916C	13.6	11.9	12 000	18 000
			HAR916CA	13.3	11.6	11 000	17 000
			HAR916	12.3	10.8	7 900	11 000
	125	22	HAR016C	24.7	19.2	10 000	16 000
			HAR016CA	24.1	18.8	9 700	15 000
			HAR016	22.5	17.5	7 000	9 300
85	120	18	HAR917C	16.3	14.2	10 200	16 000
			HAR917CA	15.9	13.8	10 000	15 000
			HAR917	14.8	12.8	7 000	9 300
	130	22	HAR017C	25.1	20.1	9 700	15 000
			HAR017CA	24.5	19.6	9 300	14 000
			HAR017	22.8	18.3	6 600	8 800
90	125	18	HAR918C	16.8	15.1	9 700	15 000
			HAR918CA	16.4	14.7	9 300	14 000
			HAR918	15.2	13.7	6 600	8 800
	140	24	HAR018C	32.8	26.1	9 100	14 000
			HAR018CA	32.0	25.4	8 700	13 000
			HAR018	29.8	23.7	6 200	8 300
95	130	18	HAR919C	17.3	16.0	9 300	14 000
			HAR919CA	16.9	15.6	8 900	14 000
			HAR919	15.6	14.5	6 300	8 400
	145	24	HAR019C	33.4	27.2	8 700	13 000
			HAR019CA	32.6	26.6	8 300	13 000
			HAR019	30.4	24.7	5 900	7 900
100	140	20	HAR920C	24.2	21.7	8 700	13 000
			HAR920CA	23.6	21.2	8 300	13 000
			HAR920	21.9	19.7	5 900	7 900
	150	24	HAR020C	34.0	28.4	8 400	13 000
			HAR020CA	33.2	27.7	8 000	12 000
			HAR020	30.9	25.8	5 700	7 600
105	145	20	HAR921C	24.9	23.1	8 400	13 000
			HAR921CA	24.3	22.5	8 000	12 000
			HAR921	22.5	20.9	5 700	7 600
	160	26	HAR021C	38.6	32.5	7 900	12 000
			HAR021CA	37.6	31.7	7 500	11 000
			HAR021	35.0	29.5	5 400	7 200
110	150	20	HAR922C	24.2	22.6	8 000	12 000
			HAR922CA	23.6	22.0	7 700	12 000
			HAR922	21.9	20.4	5 500	7 300
	170	28	HAR022C	43.4	37.0	7 500	12 000
			HAR022CA	42.4	36.1	7 100	11 000
			HAR022	39.4	33.6	5 100	6 800

Dimension table

Type R
Steel balls
d 120–170mm



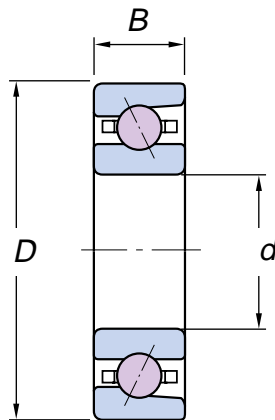
Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹	
d	D	B		C	C ₀	Grease lub.	Oil-and-air lub.
120	165	22	HAR924C	29.4	28.4	7 300	11 000
			HAR924CA	28.6	27.7	7 000	11 000
			HAR924	26.6	25.7	5 000	6 700
	180	28	HAR024C	44.9	39.9	7 000	11 000
			HAR024CA	43.8	39.0	6 700	10 000
			HAR024	40.7	36.2	4 800	6 300
130	180	24	HAR926C	35.1	35.1	6 700	10 000
			HAR926CA	34.2	34.3	6 400	9 800
			HAR926	31.7	31.8	4 600	6 100
	200	33	HAR026C	56.3	48.4	6 300	9 800
			HAR026CA	55.0	47.2	6 000	9 200
			HAR026	51.2	43.9	4 300	5 800
140	190	24	HAR928C	35.2	36.2	6 300	9 800
			HAR928CA	34.3	35.3	6 000	9 200
			HAR928	31.8	32.8	4 300	5 800
	210	33	HAR028C	61.3	56.2	6 000	9 200
			HAR028CA	59.9	54.8	5 700	8 700
			HAR028	55.7	51.0	4 100	5 400
150	210	28	HAR930C	48.9	48.9	5 500	8 500
			HAR930CA	47.7	47.6	5 300	8 000
			HAR930	44.3	44.2	3 800	5 000
	225	35	HAR030C	72.2	66.1	5 300	8 200
			HAR030CA	70.5	64.5	5 000	7 700
			HAR030	65.6	60.0	3 600	4 800
160	220	28	HAR932C	50.2	51.8	5 200	8 100
			HAR932CA	48.9	50.5	5 000	7 600
			HAR932	45.4	46.9	3 600	4 700
	240	38	HAR032C	78.3	72.7	5 000	7 700
			HAR032CA	76.4	71.0	4 700	7 200
			HAR032	71.1	66.0	3 400	4 500
170	230	28	HAR934C	51.4	54.8	5 000	7 700
			HAR934CA	50.1	53.4	4 700	7 200
			HAR934	46.4	49.6	3 400	4 500
	260	42	HAR034C	91.8	86.4	4 600	7 100
			HAR034CA	89.6	84.3	4 400	6 700
			HAR034	83.4	78.4	3 100	4 200

Dimension table

Type R

Ceramic balls

d 30 – 70mm



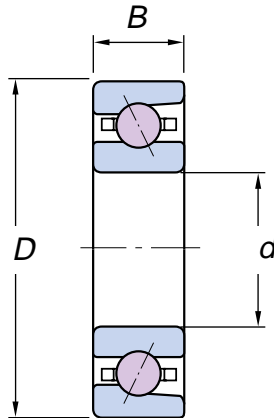
Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹	
d	D	B		C	C ₀	Grease lub.	Oil-and-air lub.
30	55	13	3NCHAR006C	8.70	4.85	35 000	59 000
			3NCHAR006CA	8.55	4.75	33 000	55 000
			3NCHAR006	8.00	4.45	25 000	35 000
35	62	14	3NCHAR007C	9.25	5.55	31 000	52 000
			3NCHAR007CA	9.05	5.40	29 000	48 000
			3NCHAR007	8.45	5.05	22 000	31 000
40	62	12	3NCHAR908C	6.35	4.05	29 000	49 000
			3NCHAR908CA	6.20	3.95	27 000	46 000
			3NCHAR908	5.75	3.70	21 000	29 000
	68	15	3NCHAR008C	9.70	6.20	28 000	46 000
			3NCHAR008CA	9.50	6.05	26 000	44 000
			3NCHAR008	8.85	5.65	19 000	28 000
45	68	12	3NCHAR909C	7.15	5.05	27 000	44 000
			3NCHAR909CA	7.00	4.95	25 000	42 000
			3NCHAR909	6.50	4.60	19 000	27 000
	75	16	3NCHAR009C	10.9	7.10	25 000	42 000
			3NCHAR009CA	10.6	6.95	23 000	39 000
			3NCHAR009	9.90	6.45	18 000	25 000
50	72	12	3NCHAR910C	9.55	6.30	25 000	41 000
			3NCHAR910CA	9.35	6.15	23 000	39 000
			3NCHAR910	8.70	5.75	17 000	25 000
	80	16	3NCHAR010C	11.4	7.85	23 000	38 000
			3NCHAR010CA	11.1	7.65	22 000	36 000
			3NCHAR010	10.4	7.15	16 000	23 000
55	80	13	3NCHAR911C	10.1	7.65	22 000	37 000
			3NCHAR911CA	9.85	7.50	21 000	35 000
			3NCHAR911	9.15	6.95	16 000	22 000
	90	18	3NCHAR011C	14.1	9.90	21 000	34 000
			3NCHAR011CA	13.7	9.70	19 000	32 000
			3NCHAR011	12.8	9.00	14 000	21 000
60	85	13	3NCHAR912C	9.95	7.75	21 000	34 000
			3NCHAR912CA	9.70	7.55	19 000	32 000
			3NCHAR912	9.00	7.00	14 000	21 000
	95	18	3NCHAR012C	14.7	10.8	19 000	32 000
			3NCHAR012CA	14.3	10.6	18 000	30 000
			3NCHAR012	13.4	9.85	14 000	19 000
65	90	13	3NCHAR913C	11.8	9.45	19 000	32 000
			3NCHAR913CA	11.5	9.25	18 000	30 000
			3NCHAR913	10.7	8.55	14 000	19 000
	100	18	3NCHAR013C	15.3	11.8	18 000	30 000
			3NCHAR013CA	14.9	11.5	17 000	28 000
			3NCHAR013	13.9	10.7	13 000	18 000
70	100	16	3NCHAR914C	12.9	10.5	18 000	29 000
			3NCHAR914CA	12.6	10.2	16 000	28 000
			3NCHAR914	11.7	9.45	12 000	18 000
	110	20	3NCHAR014C	20.7	15.5	17 000	28 000
			3NCHAR014CA	20.2	15.1	16 000	26 000
			3NCHAR014	18.9	14.1	12 000	17 000

Dimension table

Type R

Ceramic balls

d 75 – 110mm



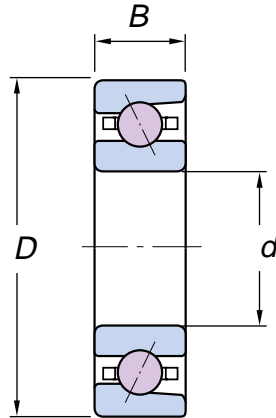
Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹	
d	D	B		C	C_0	Grease lub.	Oil-and-air lub.
75	105	16	3NCHAR915C	13.3	11.2	17 000	28 000
			3NCHAR915CA	12.9	10.9	16 000	26 000
			3NCHAR915	12.0	10.1	12 000	17 000
	115	20	3NCHAR015C	21.1	16.2	16 000	26 000
			3NCHAR015CA	20.6	15.8	15 000	25 000
			3NCHAR015	19.2	14.7	11 000	16 000
80	110	16	3NCHAR916C	13.6	11.9	16 000	26 000
			3NCHAR916CA	13.3	11.6	15 000	25 000
			3NCHAR916	12.3	10.8	11 000	16 000
	125	22	3NCHAR016C	24.7	19.2	14 000	23 000
			3NCHAR016CA	24.1	18.8	13 000	22 000
			3NCHAR016	22.5	17.5	10 000	14 000
85	120	18	3NCHAR917C	16.3	14.2	14 000	23 000
			3NCHAR917CA	15.9	13.8	13 000	22 000
			3NCHAR917	14.8	12.8	10 000	14 000
	130	22	3NCHAR017C	25.1	20.1	13 000	22 000
			3NCHAR017CA	24.5	19.6	12 000	21 000
			3NCHAR017	22.8	18.3	9 300	13 000
90	125	18	3NCHAR918C	16.8	15.1	13 000	22 000
			3NCHAR918CA	16.4	14.7	12 000	21 000
			3NCHAR918	15.2	13.7	9 300	13 000
	140	24	3NCHAR018C	32.8	26.1	12 000	21 000
			3NCHAR018CA	32.0	25.4	12 000	19 000
			3NCHAR018	29.8	23.7	8 700	12 000
95	130	18	3NCHAR919C	17.3	16.0	13 000	21 000
			3NCHAR919CA	16.9	15.6	12 000	20 000
			3NCHAR919	15.6	14.5	8 900	13 000
	145	24	3NCHAR019C	33.4	27.2	12 000	20 000
			3NCHAR019CA	32.6	26.6	11 000	19 000
			3NCHAR019	30.4	24.7	8 300	12 000
100	140	20	3NCHAR920C	24.2	21.7	12 000	20 000
			3NCHAR920CA	23.6	21.2	11 000	19 000
			3NCHAR920	21.9	19.7	8 300	12 000
	150	24	3NCHAR020C	34.0	28.4	11 000	19 000
			3NCHAR020CA	33.2	27.7	11 000	18 000
			3NCHAR020	30.9	25.8	8 000	11 000
105	145	20	3NCHAR921C	24.9	23.1	11 000	19 000
			3NCHAR921CA	24.3	22.5	11 000	18 000
			3NCHAR921	22.5	20.9	8 000	11 000
	160	26	3NCHAR021C	38.6	32.5	11 000	18 000
			3NCHAR021CA	37.6	31.7	10 000	17 000
			3NCHAR021	35.0	29.5	7 500	11 000
110	150	20	3NCHAR922C	24.2	22.6	11 000	18 000
			3NCHAR922CA	23.6	22.0	10 000	17 000
			3NCHAR922	21.9	20.4	7 700	11 000
	170	28	3NCHAR022C	43.4	37.0	10 000	17 000
			3NCHAR022CA	42.4	36.1	9 500	16 000
			3NCHAR022	39.4	33.6	7 100	10 000

Dimension table

Type **R**

Ceramic balls

d 120–170mm



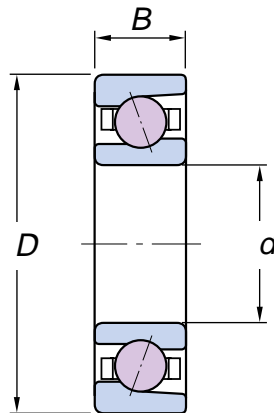
Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹	
d	D	B		C	C ₀	Grease lub.	Oil-and-air lub.
120	165	22	3NCHAR924C	29.4	28.4	10 000	17 000
			3NCHAR924CA	28.6	27.7	9 300	16 000
			3NCHAR924	26.6	25.7	7 000	10 000
	180	28	3NCHAR024C	44.9	39.9	9 500	16 000
			3NCHAR024CA	43.8	39.0	8 900	15 000
			3NCHAR024	40.7	36.2	6 700	10 000
130	180	24	3NCHAR926C	35.1	35.1	9 200	15 000
			3NCHAR926CA	34.2	34.3	8 600	14 000
			3NCHAR926	31.7	31.8	6 400	9 200
	200	33	3NCHAR026C	56.3	48.4	8 600	14 000
			3NCHAR026CA	55.0	47.2	8 100	14 000
			3NCHAR026	51.2	43.9	6 000	8 600
140	190	24	3NCHAR928C	35.2	36.2	8 600	14 000
			3NCHAR928CA	34.3	35.3	8 100	14 000
			3NCHAR928	31.8	32.8	6 000	8 600
	210	33	3NCHAR028C	61.3	56.2	8 100	14 000
			3NCHAR028CA	59.9	54.8	7 600	13 000
			3NCHAR028	55.7	51.0	5 700	8 100
150	210	28	3NCHAR930C	48.9	48.9	7 500	13 000
			3NCHAR930CA	47.7	47.6	7 000	12 000
			3NCHAR930	44.3	44.2	5 300	7 500
	225	35	3NCHAR030C	72.2	66.1	7 200	12 000
			3NCHAR030CA	70.5	64.5	6 700	11 000
			3NCHAR030	65.6	60.0	5 000	7 200
160	220	28	3NCHAR932C	50.2	51.8	7 100	12 000
			3NCHAR932CA	48.9	50.5	6 600	11 000
			3NCHAR932	45.4	46.9	5 000	7 100
	240	38	3NCHAR032C	78.3	72.7	6 800	11 000
			3NCHAR032CA	76.4	71.0	6 300	11 000
			3NCHAR032	71.1	66.0	4 700	6 800
170	230	28	3NCHAR934C	51.4	54.8	6 800	11 000
			3NCHAR934CA	50.1	53.4	6 300	11 000
			3NCHAR934	46.4	49.6	4 700	6 800
	260	42	3NCHAR034C	91.8	86.4	6 300	10 000
			3NCHAR034CA	89.6	84.3	5 900	9 800
			3NCHAR034	83.4	78.4	4 400	6 300

Dimension table

Type **C**

Ceramic balls

d 10 – 45mm



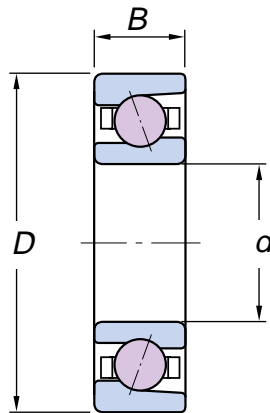
Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹	
d	D	B		C	C ₀	Grease lub.	Oil-and-air lub.
10	22	6	3NCHAC900C 3NCHAC900CA	2.05 2.00	0.77 0.76	94 000 88 000	156 000 147 000
	26	8	3NCHAC000C 3NCHAC000CA	3.50 3.50	1.25 1.25	86 000 80 000	143 000 134 000
12	24	6	3NCHAC901C 3NCHAC901CA	2.15 2.10	0.87 0.86	83 000 78 000	139 000 131 000
	28	8	3NCHAC001C 3NCHAC001CA	3.90 3.85	1.50 1.50	73 000 68 000	122 000 115 000
15	28	7	3NCHAC902C 3NCHAC902CA	3.20 3.15	1.35 1.30	70 000 65 000	116 000 109 000
	32	9	3NCHAC002C 3NCHAC002CA	4.45 4.40	1.90 1.85	64 000 60 000	106 000 100 000
17	30	7	3NCHAC903C 3NCHAC903CA	3.40 3.35	1.50 1.45	63 000 58 000	104 000 98 000
	35	10	3NCHAC003C 3NCHAC003CA	4.95 4.85	2.30 2.25	57 000 53 000	94 000 89 000
20	37	9	3NCHAC904C 3NCHAC904CA	4.95 4.85	2.35 2.30	53 000 49 000	88 000 82 000
	42	12	3NCHAC004C 3NCHAC004CA	7.50 7.35	3.35 3.30	48 000 44 000	79 000 75 000
25	42	9	3NCHAC905C 3NCHAC905CA	5.40 5.30	2.75 2.70	44 000 41 000	73 000 69 000
	47	12	3NCHAC005C 3NCHAC005CA	8.35 8.20	4.10 4.00	42 000 39 000	69 000 65 000
30	47	9	3NCHAC906C 3NCHAC906CA	5.75 5.65	3.20 3.10	39 000 36 000	65 000 61 000
	55	13	3NCHAC006C 3NCHAC006CA	10.8 10.6	5.60 5.50	35 000 33 000	59 000 55 000
35	55	10	3NCHAC907C 3NCHAC907CA	8.65 8.50	4.90 4.80	33 000 31 000	56 000 52 000
	62	14	3NCHAC007C 3NCHAC007CA	13.0 12.8	7.00 6.85	31 000 29 000	51 000 48 000
40	62	12	3NCHAC908C 3NCHAC908CA	10.9 10.6	6.30 6.20	29 000 27 000	49 000 46 000
	68	15	3NCHAC008C 3NCHAC008CA	14.1 13.8	8.10 7.90	28 000 26 000	46 000 43 000
45	68	12	3NCHAC909C 3NCHAC909CA	11.5 11.3	7.15 7.00	27 000 25 000	44 000 42 000
	75	16	3NCHAC009C 3NCHAC009CA	16.8 16.4	9.80 9.60	25 000 23 000	42 000 39 000

Dimension table

Type **C**

Ceramic balls

d 50 – 95mm



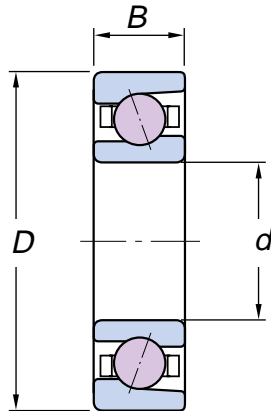
Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹	
d	D	B		C	C ₀	Grease lub.	Oil-and-air lub.
50	72	12	3NCHAC910C 3NCHAC910CA	12.2 11.9	7.95 7.80	25 000 23 000	41 000 39 000
	80	16	3NCHAC010C 3NCHAC010CA	17.9 17.6	11.2 10.9	23 000 21 000	38 000 36 000
55	80	13	3NCHAC911C 3NCHAC911CA	13.8 13.5	9.40 9.20	22 000 21 000	37 000 35 000
	90	18	3NCHAC011C 3NCHAC011CA	23.5 23.0	14.6 14.3	21 000 19 000	34 000 32 000
60	85	13	3NCHAC912C 3NCHAC912CA	16.3 15.9	11.1 10.8	21 000 19 000	34 000 32 000
	95	18	3NCHAC012C 3NCHAC012CA	24.2 23.7	15.6 15.3	19 000 18 000	32 000 30 000
65	90	13	3NCHAC913C 3NCHAC913CA	14.7 14.3	10.8 10.6	19 000 18 000	32 000 30 000
	100	18	3NCHAC013C 3NCHAC013CA	25.7 25.2	17.5 17.1	18 000 17 000	30 000 28 000
70	100	16	3NCHAC914C 3NCHAC914CA	20.3 19.9	14.7 14.4	18 000 16 000	29 000 28 000
	110	20	3NCHAC014C 3NCHAC014CA	32.4 31.7	21.9 21.4	17 000 16 000	28 000 26 000
75	105	16	3NCHAC915C 3NCHAC915CA	20.7 20.2	15.5 15.1	17 000 16 000	28 000 26 000
	115	20	3NCHAC015C 3NCHAC015CA	33.3 32.6	23.2 22.7	16 000 15 000	26 000 25 000
80	110	16	3NCHAC916C 3NCHAC916CA	21.1 20.6	16.2 15.8	16 000 15 000	26 000 25 000
	125	22	3NCHAC016C 3NCHAC016CA	40.6 39.7	28.1 27.5	14 000 13 000	23 000 22 000
85	120	18	3NCHAC917C 3NCHAC917CA	27.4 26.7	20.6 20.1	14 000 13 000	23 000 22 000
	130	22	3NCHAC017C 3NCHAC017CA	41.7 40.8	29.8 29.2	13 000 12 000	22 000 21 000
90	125	18	3NCHAC918C 3NCHAC918CA	27.9 27.3	21.6 21.1	13 000 12 000	22 000 21 000
	140	24	3NCHAC018C 3NCHAC018CA	49.6 48.5	35.2 34.4	12 000 12 000	21 000 19 000
95	130	18	3NCHAC919C 3NCHAC919CA	28.5 27.8	22.6 22.1	13 000 12 000	21 000 20 000
	145	24	3NCHAC019C 3NCHAC019CA	50.9 49.8	37.3 36.5	12 000 11 000	19 000 18 000

Dimension table

Type **C**

Ceramic balls

d 100–170mm



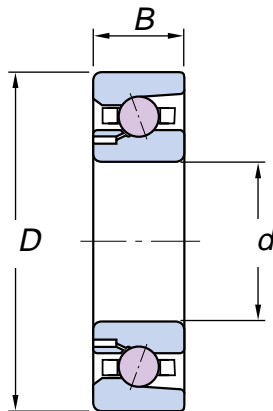
Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹	
d	D	B		C	C ₀	Grease lub.	Oil-and-air lub.
100	140	20	3NCHAC920C 3NCHAC920CA	39.0 38.1	29.7 29.0	12 000 11 000	20 000 19 000
	150	24	3NCHAC020C 3NCHAC020CA	52.4 51.2	39.3 38.4	11 000 11 000	19 000 18 000
105	145	20	3NCHAC921C 3NCHAC921CA	39.9 38.9	31.2 30.5	11 000 11 000	19 000 18 000
	160	26	3NCHAC021C 3NCHAC021CA	61.0 59.6	45.6 44.6	11 000 9 900	18 000 17 000
110	150	20	3NCHAC922C 3NCHAC922CA	40.7 39.8	32.7 31.9	11 000 10 000	18 000 17 000
	170	28	3NCHAC022C 3NCHAC022CA	69.9 68.4	51.6 50.4	10 000 10 000	17 000 16 000
120	165	22	3NCHAC924C 3NCHAC924CA	50.5 49.3	41.2 40.3	10 000 9 300	17 000 16 000
	180	28	3NCHAC024C 3NCHAC024CA	74.0 72.3	57.5 56.2	9 500 8 900	16 000 15 000
130	180	24	3NCHAC926C 3NCHAC926CA	61.3 59.8	50.7 49.6	9 200 8 600	15 000 14 000
	200	33	3NCHAC026C 3NCHAC026CA	89.7 87.7	69.8 68.2	8 600 8 100	14 000 14 000
140	190	24	3NCHAC928C 3NCHAC928CA	62.3 60.8	53.2 52.0	8 600 8 100	14 000 14 000
	210	33	3NCHAC028C 3NCHAC028CA	91.9 89.9	73.8 72.1	8 100 7 600	14 000 13 000
150	210	28	3NCHAC930C 3NCHAC930CA	83.2 81.3	69.8 68.2	7 500 7 000	13 000 12 000
	225	35	3NCHAC030C 3NCHAC030CA	105 103	85.7 83.7	7 100 6 700	12 000 11 000
160	220	28	3NCHAC932C 3NCHAC932CA	84.8 82.8	73.3 71.6	7 100 6 600	12 000 11 000
	240	38	3NCHAC032C 3NCHAC032CA	119 116	98.1 95.9	6 800 6 300	11 000 11 000
170	230	28	3NCHAC934C 3NCHAC934CA	88.6 86.5	79.7 77.8	6 800 6 300	11 000 11 000
	260	42	3NCHAC034C 3NCHAC034CA	142 139	119 117	6 300 5 900	10 000 9 800

Dimension table

Type D

Ceramic balls

d 10 – 170mm



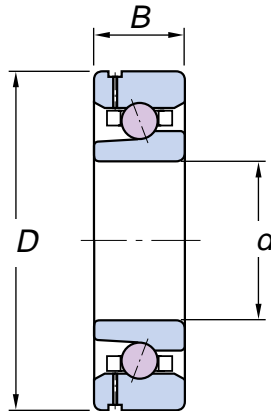
Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹ Oil-and-air lub.
d	D	B		C	C ₀	
35	62	14	3NCHAD007CA	8.40	4.90	52 000
40	68	15	3NCHAD008CA	9.20	5.80	46 000
45	75	16	3NCHAD009CA	9.95	6.30	42 000
50	80	16	3NCHAD010CA	10.8	7.35	38 000
55	90	18	3NCHAD011CA	13.0	8.90	34 000
60	95	18	3NCHAD012CA	13.6	9.75	32 000
65	100	18	3NCHAD013CA	14.2	10.7	30 000
70	110	20	3NCHAD014CA	19.1	13.9	28 000
75	115	20	3NCHAD015CA	19.5	14.6	26 000
80	125	22	3NCHAD016CA	22.9	17.3	23 000
85	130	22	3NCHAD017CA	23.3	18.2	22 000
90	140	24	3NCHAD018CA	30.4	23.5	21 000
95	145	24	3NCHAD019CA	31.0	24.6	20 000
100	150	24	3NCHAD020CA	31.6	25.7	19 000
105	160	26	3NCHAD021CA	37.6	31.7	18 000
110	170	28	3NCHAD022CA	42.4	36.1	17 000
120	180	28	3NCHAD024CA	43.8	39.0	16 000
130	200	33	3NCHAD026CA	55.0	47.2	14 000

Dimension table

Type **F**

Ceramic balls

d 10–170mm



Boundary dimensions mm			Bearing numbers	Basic load ratings kN		Limiting speeds min ⁻¹ Oil-and-air lub.
d	D	B		C	C ₀	
30	55	13	3NCHAF006CA	7.90	4.20	88 000
35	62	14	3NCHAF007CA	7.85	4.30	77 000
40	62	12	3NCHAF908CA	6.05	3.80	71 000
	68	15	3NCHAF008CA	8.70	5.20	69 000
45	68	12	3NCHAF909CA	6.45	4.40	63 000
	75	16	3NCHAF009CA	9.70	5.95	61 000
50	72	12	3NCHAF910CA	9.10	6.40	57 000
	80	16	3NCHAF010CA	10.5	7.00	56 000
55	80	13	3NCHAF911CA	9.40	7.00	52 000
	90	18	3NCHAF011CA	12.3	8.00	51 000
60	85	13	3NCHAF912CA	9.25	7.05	48 000
	95	18	3NCHAF012CA	13.3	9.30	47 000
65	90	13	3NCHAF913CA	10.2	7.80	45 000
	100	18	3NCHAF013CA	13.9	10.2	44 000
70	100	16	3NCHAF914CA	12.6	10.2	41 000
	110	20	3NCHAF014CA	18.7	13.2	40 000
75	105	16	3NCHAF915CA	12.9	10.9	39 000
	115	20	3NCHAF015CA	19.0	13.9	38 000
80	110	16	3NCHAF916CA	13.3	11.6	37 000
	125	22	3NCHAF016CA	22.3	16.6	35 000
85	120	18	3NCHAF917CA	15.9	13.8	32 000
	130	22	3NCHAF017CA	22.8	17.4	32 000
90	125	18	3NCHAF918CA	16.4	14.7	31 000
	140	24	3NCHAF018CA	29.6	22.4	30 000
95	130	18	3NCHAF919CA	16.8	15.7	30 000
	145	24	3NCHAF019CA	30.2	23.6	28 000
100	140	20	3NCHAF920CA	23.5	21.2	28 000
	150	24	3NCHAF020CA	30.8	24.7	27 000
105	145	20	3NCHAF921CA	24.2	22.6	27 000
	160	26	3NCHAF021CA	36.9	30.5	26 000
110	150	20	3NCHAF922CA	24.4	23.3	26 000
	170	28	3NCHAF022CA	41.5	34.7	24 000
120	165	22	3NCHAF924CA	28.6	27.7	23 000
	180	28	3NCHAF024CA	43.0	37.6	23 000
130	180	24	3NCHAF926CA	33.0	32.5	21 000
	200	33	3NCHAF026CA	53.8	45.3	21 000

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