MOTION & CONTROL™

NSK

Molded-Oil™ Bearings

Environmentally friendly Molded-Oil™ Bearings offer high performance in water- and dust-contaminated environments. Enhanced Molded-Oil™ strength makes these ever-evolving bearings ideal for high-speed operation.

Molded-Oil™ Bearings

Spherical roller bearing
22311L12CAM
For high-speed operation

Deep groove ball bearings[*1]
6206L12DDU
For high-speed operation

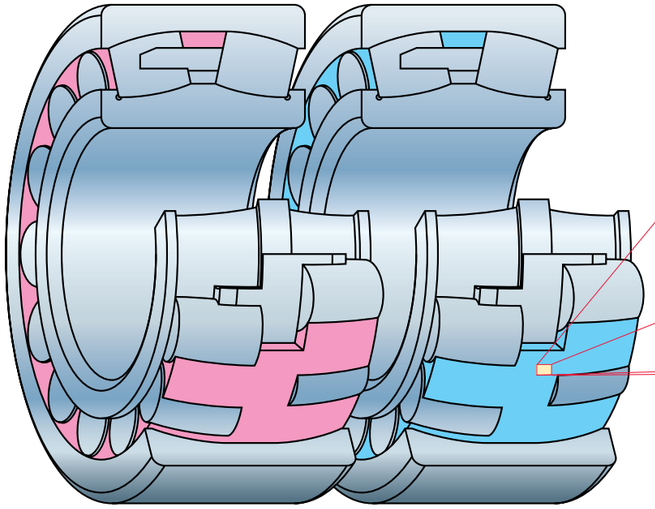
Spherical roller bearing
22311L11CAM
For general use

Deep groove ball bearings[*1]
6206L11DDU
For general use

Deep groove ball bearings[*1]
6000L11-H-20DD
For general use

Tapered roller bearing
HR32013XJL11
For general use

[*1] The bearings come with seals on both sides.



Molded-Oil™ Bearings are lubricated with NSK's own oil-impregnated material, Molded-Oil™. Molded-Oil™ consists of lubricating oil and polyolefin resin that has an affinity for oil. Oil slowly seeping from this material provides ample lubrication to the bearing for extended periods.

1. Features of Molded-Oil™ Bearings

1 Excellent performance in water- and dust-contaminated environments

The bearings are designed to prevent liquids such as water (which can wash the lubricating oil out) and dust from getting inside the bearings. Sealed types can be used in environments exposed to water and dust.[*2]

2 Environmentally friendly

Because they can be lubricated with minute quantities of oil that exudes from Molded-Oil™, the bearings are able to minimize oil leakage.

3 Low torque

Packing with Molded-Oil™ after providing the bearing surface with special treatment realizes smooth rotation of rolling elements.

4 Optimal composition and molding methods enable high-speed operation of Molded-Oil™ Bearings

Optimization of composition and molding method of Molded-Oil™ improves strength and enables high-speed operation of Molded-Oil™ Bearings.

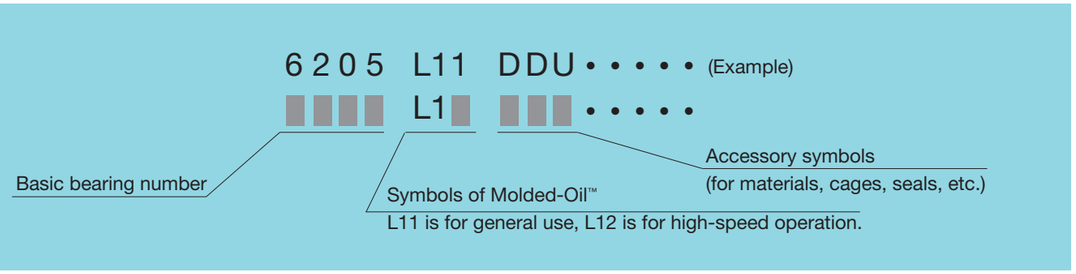
[*2] Water and dust dramatically accelerate bearing damage. In order to realize stable operation, we recommend using seals to prevent water and dust from getting in the bearing.

Applications

- Steel mill equipment
- Paper mill equipment
- Liquid crystal display and semiconductor manufacturing equipment
- Agricultural machines
- Food processing equipment
- Cleaning equipment and lines
- Conveying equipment

2. Bearing Model Numbers

2.1 Combination of model numbers



2.2 Samples of model numbers

Bearing types	Molded-Oil™ types	Model numbers	Remarks
Spherical roller bearings	For general use	22311L11CAM	Machined brass cage
		22311L11EA	Pressed steel cage
	For high-speed operation	22311L12CAM	Machined brass cage
Deep groove ball bearings	For general use	6205L11DDU	——
		6001L11-H-20DDU	Stainless-steel bearing
	For high-speed operation	6205L12DDU	——
Tapered roller bearings	For general use	HR32024XJL11	——

Handling Precautions

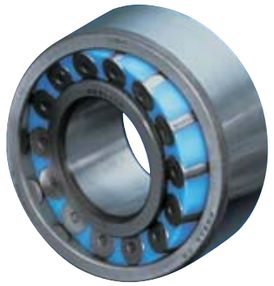
To maintain the excellent long-term lubricating capacity of Molded-Oil™ Bearings, the following precautions should be observed:

- Molded-Oil™ melts at about 120 ℃, therefore the bearings must not be heated over 100 ℃ by using an induction heater. Additionally, the bearings should not be heated by the oil bath method.
- The bearings should not be used under conditions involving liquid degreasing agents such as organic solvents that can affect Molded-Oil™. The bearings also should not be used under conditions involving corrosive liquids or gases that can damage the parts of the bearing.

2.3 Bearing numbers of delivered products

2.3.1 Spherical roller bearings

Spherical roller bearing
For high-speed operation



Spherical roller bearing
For general use

Bearing numbers of delivered products	Boundary dimensions (mm)				Basic load ratings (N)	
	Bore diameter	Outside diameter	Width	Chamfer dimension (minimum)	C_r	C_{0r}
✻ 21307L12CAM	35	80	21	1.5	71 000	76 000
21308L11ACAM	40	90	23	1.5	82 000	93 000
22308L11CAM	40	90	33	1.5	122 000	129 000
22209L11CAM	45	85	23	1.1	78 000	88 000
✻ 22309L12CAM	45	100	36	1.5	148 000	167 000
22210L11CAM	50	90	23	1.1	82 000	93 000
✻ 22311L12CAM	55	120	43	2	209 000	241 000
✻ 22212L12CAM	60	110	28	1.5	127 000	154 000
22213L11CAM	65	120	31	1.5	152 000	190 000
22313L11CAM	65	140	48	2.1	265 000	315 000
✻ 22313L12CAM	65	140	48	2.1	265 000	315 000
22214L11CAM	70	125	31	1.5	163 000	205 000
✻ 22315L12CAM	75	160	55	2.1	340 000	415 000
22216L11CAM	80	140	33	2	181 000	232 000
✻ 22217L12CAM	85	150	36	2	215 000	276 000
✻ 22218L12CAM	90	160	40	2	256 000	340 000
✻ 22219L12CAM	95	170	43	2.1	296 000	395 000
23120L11CAM	100	165	52	2	345 000	530 000
22320L11CAM	100	215	73	3	600 000	785 000
✻ 22222L12CAM	110	200	53	2.1	425 000	585 000
23024L11CAM	120	180	46	2	315 000	525 000
✻ 23124L12CAM	120	200	62	2	465 000	720 000
22226L11CAM	130	230	64	3	565 000	815 000
23932L11CAM	160	220	45	2	360 000	675 000

Note ✻ For high-speed operation (L12)
Remarks: The above table lists examples of available bearing numbers for the Molded-Oil™ bearing. Consult with NSK for information about other bearing types listed in the table under section 3.1 on page 7.

2.3.2 Deep groove ball bearings

Deep groove ball bearings

For general use

Bearing steel

Bearing numbers of delivered products		Boundary dimensions (mm)				Basic load ratings (N)	
	Sealed type	Bore diameter	Outside diameter	Width	Chamfer dimension (minimum)	C_r	C_{0r}
6900L11	DD1	10	22	6	0.3	2 700	1 270
6000L11	DD	10	26	8	0.3	4 550	1 970
6200L11	DDU	10	30	9	0.6	5 100	2 390
6901L11	DD1	12	24	6	0.3	2 890	1 460
6001L11	DDU	12	28	8	0.3	5 100	2 370
6201L11	DDU	12	32	10	0.6	6 800	3 050
6902L11	DD1	15	28	7	0.3	4 350	2 260
6002L11	DDU	15	32	9	0.3	5 600	2 830
6202L11	DDU	15	35	11	0.6	7 650	3 750
6003L11	DDU	17	35	10	0.3	6 000	3 250
6203L11	DDU	17	40	12	0.6	9 550	4 800
6004L11	DDU	20	42	12	0.6	9 400	5 000
6204L11	DDU	20	47	14	1	12 800	6 600
6005L11	DDU	25	47	12	0.6	10 100	5 850
6205L11	DDU	25	52	15	1	14 000	7 850
6305L11	DDU	25	62	17	1.1	20 600	11 200
6006L11	DDU	30	55	13	1	13 200	8 300
6206L11	DDU	30	62	16	1	19 500	11 300
6306L11	DDU	30	72	19	1.1	26 700	15 000
6007L11	DDU	35	62	14	1	16 000	10 300
6207L11	DDU	35	72	17	1.1	25 700	15 300
6307L11	DDU	35	80	21	1.5	33 500	19 200
6008L11	DDU	40	68	15	1	16 800	11 500
6208L11	DDU	40	80	18	1.1	29 100	17 900
6308L11	DDU	40	90	23	1.5	40 500	24 000
6009L11	DDU	45	75	16	1	20 900	15 200
6209L11	DDU	45	85	19	1.1	31 500	20 400
6309L11	DDU	45	100	25	1.5	53 000	32 000
6010L11	DDU	50	80	16	1	21 800	16 600
6210L11	DDU	50	90	20	1.1	35 000	23 200
6310L11	DDU	50	110	27	2	62 000	38 500

Remarks 1. The above table lists examples of available bearing numbers for the Molded-Oil™ bearing. Consult with NSK for information about other bearing types listed in the table under section 3.1 on page 7.
2. Not applicable to deep groove ball bearing with plastic cages.

Deep groove ball bearings

For general use

Stainless steel

Bearing numbers of delivered products		Boundary dimensions (mm)				Basic load ratings (N)	
	Sealed type	Bore diameter	Outside diameter	Width	Chamfer dimension (minimum)	C_r	C_{0r}
6900L11-H-20	DD1	10	22	6	0.3	2 290	1 020
6000L11-H-20	DD	10	26	8	0.3	3 900	1 580
6200L11-H-20	DDU	10	30	9	0.6	4 350	1 910
6901L11-H-20	DD1	12	24	6	0.3	2 460	1 170
6001L11-H-20	DDU	12	28	8	0.3	4 350	1 890
6201L11-H-20	DDU	12	32	10	0.6	5 800	2 440
6902L11-H-20	DD1	15	28	7	0.3	3 700	1 810
6002L11-H-20	DDU	15	32	9	0.3	4 750	2 270
6202L11-H-20	DDU	15	35	11	0.6	6 500	2 980
6003L11-H-20	DDU	17	35	10	0.3	5 100	2 600
6203L11-H-20	DDU	17	40	12	0.6	8 150	3 850
6004L11-H-20	DDU	20	42	12	0.6	7 950	4 000
6204L11-H-20	DDU	20	47	14	1	10 900	5 250
6005L11-H-20	DDU	25	47	12	0.6	8 550	4 650
6205L11-H-20	DDU	25	52	15	1	11 900	6 300
6006L11-H-20	DDU	30	55	13	1	11 300	6 600

Remarks 1. The above table lists examples of available bearing numbers for the Molded-Oil™ bearing. Consult with NSK for information about other bearing types listed in the table under section 3.1 on page 7.
2. Not applicable to deep groove ball bearing with plastic cages.

2.3.3 Tapered Roller Bearing

Tapered roller bearing

For general use

Bearing numbers of delivered products	Boundary dimensions (mm)					Basic load ratings (N)	
	Bore diameter	Outside diameter	Width	Chamfer dimension Outer ring (minimum)	Chamfer dimension Inner ring (minimum)	C_r	C_{0r}
HR30208JL11	40	80	19.75	1.5	1.5	63 500	70 000
HR32208JL11	40	80	24.75	1.5	1.5	77 000	90 500
HR32010XJL11	50	80	20	1	1	61 000	87 000
HR30210JL11	50	90	21.75	1.5	1.5	76 000	91 500
HR32210JL11	50	90	24.75	1.5	1.5	87 500	109 000
HR30310JL11	50	110	29.25	2	2.5	130 000	148 000
HR32011XJL11	55	90	23	1.5	1.5	81 500	117 000
HR32211JL11	55	100	26.75	1.5	2	110 000	137 000
HR32912JL11	60	85	17	1	1	49 000	84 500
HR32212JL11	60	110	29.75	1.5	2	131 000	167 000
HR32013XJL11	65	100	23	1.5	1.5	86 500	132 000
HR30213JL11	65	120	24.75	1.5	2	122 000	151 000
HR32213JL11	65	120	32.75	1.5	2	157 000	202 000
HR30216JL11	80	140	28.25	2	2.5	157 000	195 000
HR32018XJL11	90	140	32	1.5	2	170 000	273 000
HR32024XJL11	120	180	38	2	2.5	242 000	405 000

Remarks: The above table lists examples of available bearing numbers for the Molded-Oil™ bearing. Consult with NSK for information about other bearing types listed in the table under section 3.1 on page 7.

3. Bearing Types and Availability

3.1 Available Molded-Oil™ Bearing type, cage type, limiting speed, and size (outside diameter, mm)

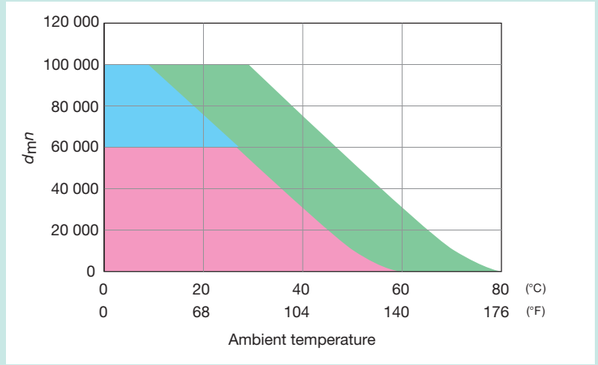
Bearing types	Molded-Oil™ types	Cage types	Limiting speeds ($d_m n$)	Sizes (outside diameter, mm)
Spherical roller bearings	For general use (L11)	Machined brass (CA)	Less than 60 000	70≦OD≦250
		Pressed steel (EA)	Less than 30 000	70≦OD≦215
	For high-speed operation (L12)	Machined brass (CA)	60 000 – 100 000	70≦OD≦215
Deep groove ball bearings	For general use (L11)	Pressed steel	Less than 150 000	19≦OD≦250
	For high-speed operation (L12)	Pressed steel	150 000 – 200 000	19≦OD≦215
Tapered roller bearings	For general use (L11)	Pressed steel	Less than 40 000	80≦OD≦215

- $d_m n$ = (Bearing bore diameter, mm + Bearing outside diameter, mm) ÷ 2 × inner ring rotational speed, min^{-1}.
- Some large spherical roller bearing numbers may not be available.
- Conditions including abutment and fillet dimensions must be taken into consideration for tapered roller bearings.
- For tapered roller bearings and spherical roller bearings with pressed steel cages (EA), Molded-Oil™ Bearings for high-speed operation (L12) are not available.
- For the application under the condition of low speed and low temperature, Molded-Oil™ Bearings for general use (L11) are recommended.

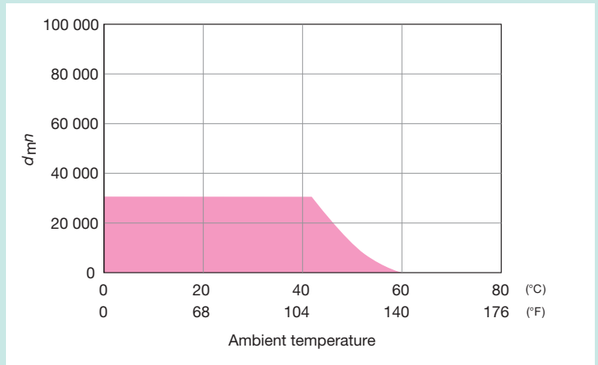
3.2 Ambient temperature and limiting speed ($d_m n$)

The relation between limiting speed and ambient temperature is as follows:

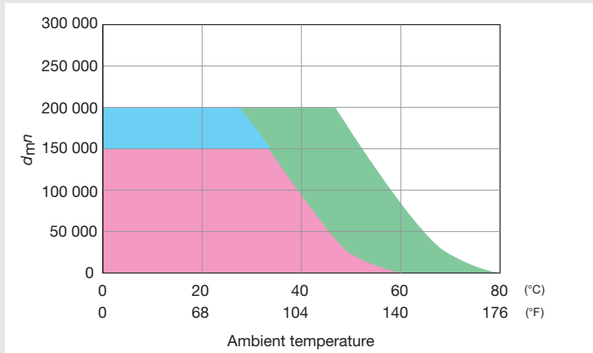
a. Spherical roller bearings (CA)



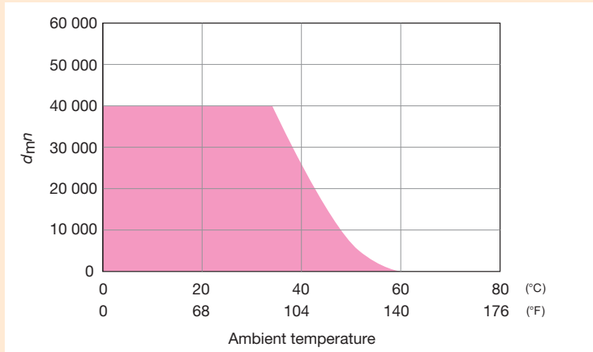
b. Spherical roller bearings (EA)



c. Deep groove ball bearings



d. Tapered roller bearings



- Limiting speeds ($d_m n$) of “a” to “d” shown above are examples for general housing. If there is a source of heat near the bearings, or the cooling effect by the radiation or the heat transmission, the above limiting speed cannot be expected due to the application.

Precautions for Selecting

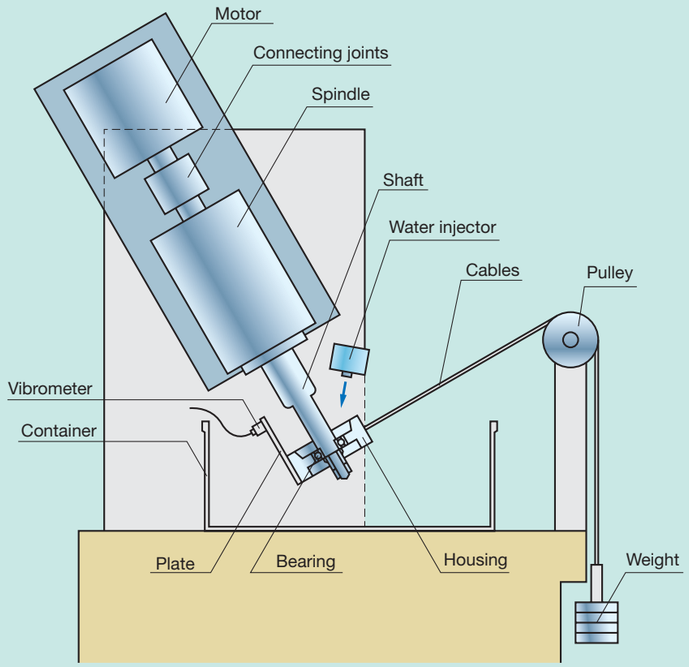
The following precautions should be considered to maintain the high performance of Molded-Oil™ Bearings:

- For low-temperature and low-speed applications, Molded-Oil™ Bearings for general use (L11) are recommended.
- For the condition of high ambient temperature, Molded-Oil™ Bearings for high-speed operation (L12) are recommended.
- To rotate the bearings properly, it is necessary to apply the radial load. As a standard of the radial load, more than 1% of the basic dynamic load rating is recommended.
- Since Molded-Oil™ Bearings are lubricated by oil seeped from a Molded-Oil™, the bearings cannot be used under the condition where the bearings are exposed to water directly for an extended period of time (the oil could be washed away). If the application requires such exposure, consider using extra seals.

4. Performance Test

Molded-Oil™ Bearings feature a number of excellent functions. Extensive test data and field results demonstrate the outstanding performance of Molded-Oil™ Bearings.

Fig. 1 Testing device under conditions of exposure to water



4.1 Durability test under conditions of exposure to water

Grease lubrication allows operation for extended periods of time even if exposed to mist or submerged in water. Continuous operation with grease lubrication: approximately 20 days; with Molded-Oil™ Bearings: 50 days or more Molded-Oil™ Bearings can be operated for longer time than the bearings with grease lubrication even if exposed to mist or submerged in water.

4.1.1 Environment where exposed to water —cleaning equipment is assumed

Test conditions	Test bearings	6000-H-DD (stainless steel with contact seal)
	Rotational speed	1 000 min^{-1}
	Radial load	79.4 N
	Axial load	29.4 N
	Water exposure	0.8 cm^3/min
	Spray pressure	0.2 MPa

4.1.2 Environment of submerged condition —under water vehicle and facilities are assumed

Test conditions	Test bearings	6000-H-DD (stainless steel with contact seal)
	Rotational speed	1 000 min^{-1}
	Radial load	79.4 N
	Axial load	29.4 N

Fig. 2 Durability test results under exposing to water

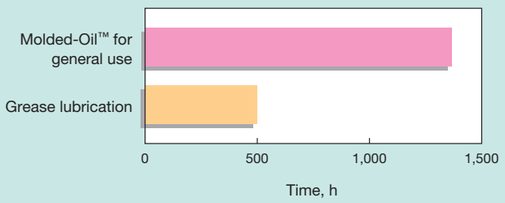
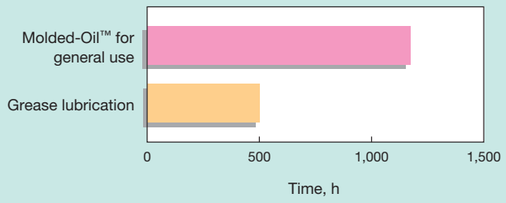


Fig. 3 Durability test results under submerged condition

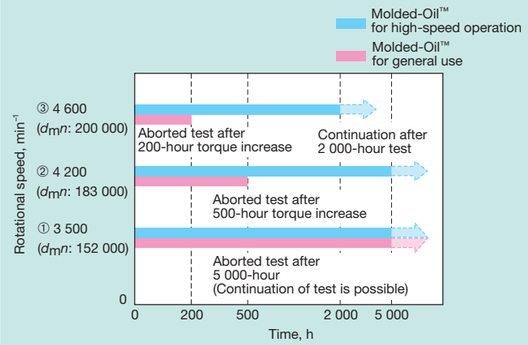


4.2 Durability performance test

Slow seeping of the lubricant from Molded-Oil™ provides excellent lubrication performance for extended periods. Molded-Oil™ Bearings for general use cannot be used under conditions of high-speed rotation, but Molded-Oil™ Bearings for high-speed operation perform with excellent durability under such conditions.

Test conditions	Test bearings	6305DDU
	Radial load	98 N
	Axial load	245 N
	Rotational speed	① 3 500 min^{-1} ($d_m n$: 152 000)
		② 4 200 min^{-1} ($d_m n$: 183 000)
		③ 4 600 min^{-1} ($d_m n$: 200 000)

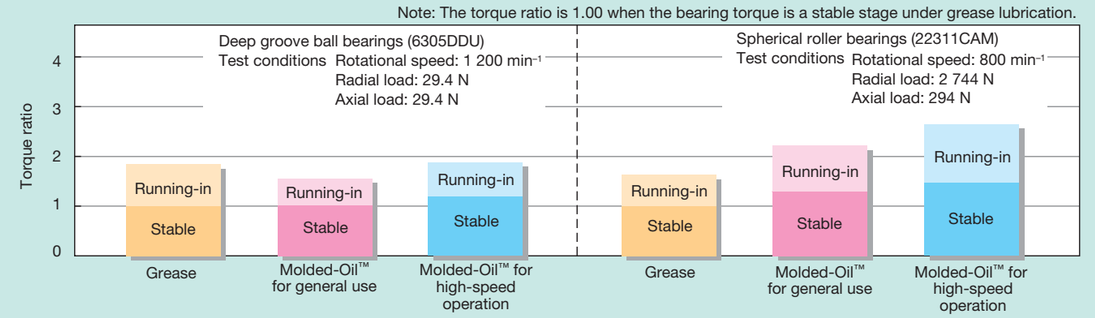
Fig. 4 Durability test results of deep groove ball bearings



4.3 Bearing torque

Fig. 5 compares the torque of grease-lubricated bearings and Molded-Oil™ Bearings.

Fig. 5 Bearing torque comparison



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