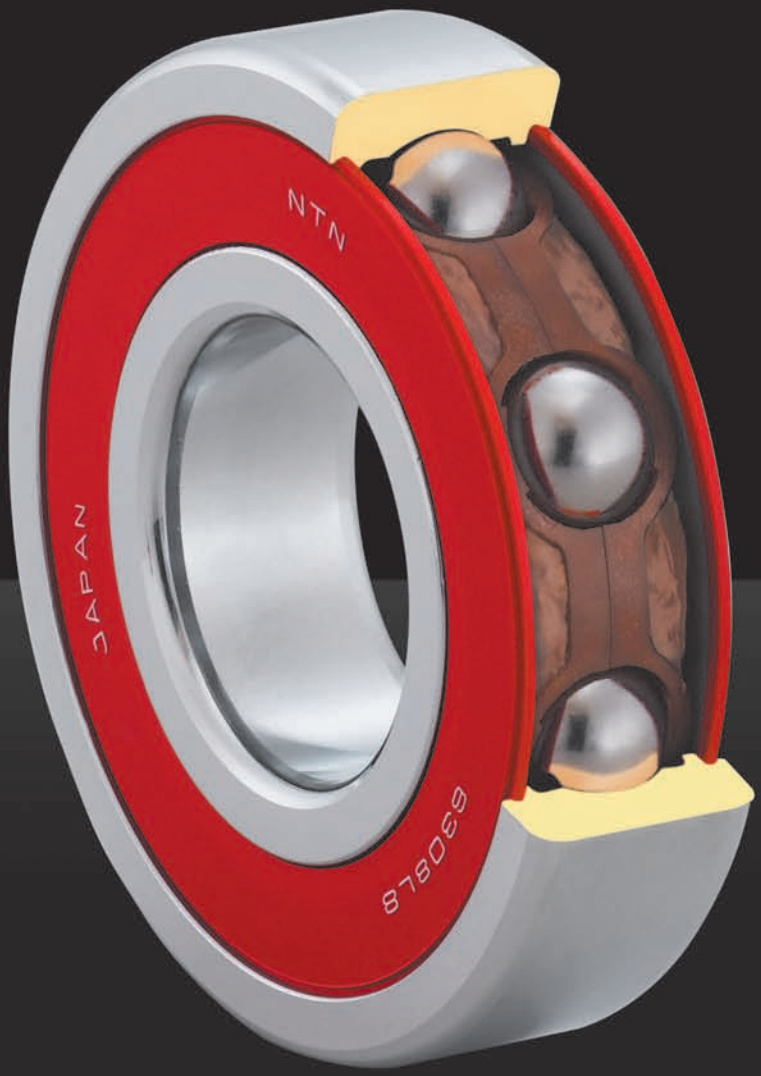
NTN®

Deep Groove Ball Bearings for High-speed Servo Motors

[Type MA]

ULTAGE



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Note: Markings on the seal are not white in actual bearings.

CAT. No. 3103/E

ULTAGE®

Grease Life 5 times *Commercial Grease*

Allowable Rotational Speed More the doubled! *NTN Standard Bearings*

Low Noise Reduced 3 dB-A *NTN Standard Cage*

Deep Groove Ball Bearings for High-speed Servo Motors [Type MA]

A new deep groove ball bearings for high-speed servo motors (Type MA) has been added to the ULTAGE series, which has achieved long life, hgih-speed, low noise and also contributes to the environmental society.

The ULTAGE series deep groove ball bearings for high-speed servo motors (Type MA) is a next generation bearing, which has improved the durability for high-speed and rapid acceleration/deceleration and extended the life of sealed grease by optimized internal design for high-speed servo motors.

Note: Markings on the seal are not white in actual bearings.

Fig. 1 MA Resin type cage

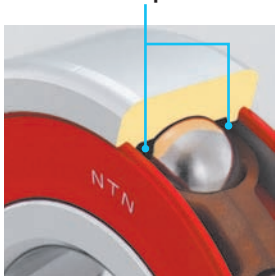
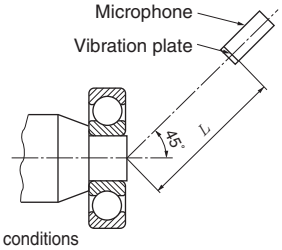


Fig. 2 Outer ring grease pocket



Test conditions
Bearing: 6308 Rotational speed: 1800 min^{-1}
Distance to microphone (L):100 mm Load: F_a 40N

Fig. 3 Noise measurement (Table 1)

Features

1. High Speed and High Reliability

The cage is made of a resin which is excellent in self lubricating performance, and cage deformation during high-speed operation is reduced by a new high rigid design cage (**Fig.1**). It has achieved $d_m n$ value of 1 million.

* $d_m n$ value: d_m (rolling element pitch diameter mm) x n (rotational speed min^{-1})

2. Extended Life of Lubricating Grease

A grease pockets (**Fig. 2**) are provided in the outer ring, and the grease is held near the rolling elements to improve the lubricating reliability.

The new long life grease "ME-1" for motors is adopted (Refer to **Table 4** for the properties). (Achieved a life of more than 5 times, compared to general-purpose lithium grease)

3. Low Noise

Noise level is reduced by the new type resin cage. Noise level is 3 dB-A lower compared to the bearing with ribbon type metal cage.

Table 1 Results of noise measurement

Specifications	Noise value
Metal wave type cage	57 dB-A
ULTAGE Product	**54 dB-A**

ULTAGE®

"ULTAGE®" (a name created from the combination of **"ultimate,"** signifying refinement,and **"stage,"** signifying **NTN**'s intention that this series of products be employed in diverse applications) is the general name for **NTN**'s new generation of bearings that are noted for their industry-leading performance.

Bearing Tolerances

1) Inner ring

Unit : μm

Nominal bore diameter d mm Over	Incl	Deviation of mean bore diamteter in a single plane Δd_{mp} Class 5 High	Low	Variation of bore diameter in a single plane V_{dsp} Class 5 max	Variation of mean bore diameter V_{dmp} Class 5 max	Radial runout of inner ring of assembled bearing K_{ia} Class 5 max	Perpendicularity of inner ring face with respect to the bore S_d Class 5 max	Axial runout of inner ring of assembled bearing S_{ia} Class 5 max	Deviation of a single inner ring witdth Δ_{BS} Class 5 High	Low	Variation of inner ring width V_{BS} Class 5 max
30	50	0	-8	6	4	5	8	8	0	-120	5
50	80	0	-9	7	5	5	8	8	0	-150	6

2) Outer ring

Unit : μm

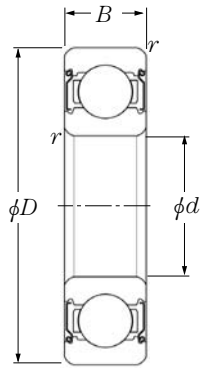
Nominal outside diameter D mm Over	Incl	Deviation of mean bore diamteter in a single plane ΔD_{mp} Class 5 High	Low	Variation of outside diameter in a single plane V_{Dsp} Class 5 max	Variation of mean outside diameter V_{Dmp} Class 5 max	Radial runout of outer ring of assembled bearing K_{ea} Class 5 max	Perpendicularity of outer ring outside surface with respect to the face S_D Class 5 max	Axial runout of outer ring of assembled bearing S_{ea} Class 5 max	Deviation of a single outer ring width Δ_{CS} Class 5 High	Low	Variation of outer ring width V_{CS} Class 5 max
80	120	0	-10	8	5	10	9	11	Depending on the Δ_{BS} allowance for d of same bearing.		8
120	150	0	-11	8	6	11	10	13			8

Bearing Number

6 3 08 MA LLB-BR C3 P5 / L700 QTK

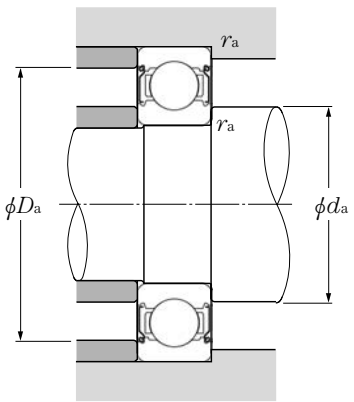
- **Lubricant quantity code**
- **Librication code** : ME-1
- **Tolerance code** : JIS Class 5
- **Radial internal clearance** : C3 clearance (15-33 μm)
- **Seal code** : Synthetic rubber seal (non-contact type)
- **Cage code** : ULTAGE Series Type MA
- **Bore diameter code** : 40 mm
- **Diameter series** : 3
- **Bearing type** : Deep groove ball bearing (Type 6)

Dimensions Table



Shielded type (ZZ)

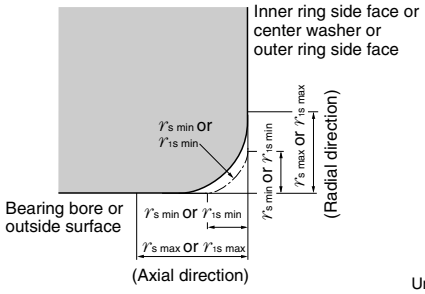
Non-contact seal type (LLB)



Boundary dimensions mm d	D	B	r_s min 1)	Basic load ratings dynamic C_r kN	static C_{0r} kN	dynamic C_r kgf	static C_{0r} kgf	Factor f_0	Allowable rotational speed min^{-1} Grease ZZ LLB	Bearing numbers Shielded type	Non-contact seal type
40	90	23	1.5	40.5	24.0	4,150	2,450	13.2	15,400	**6308MAZZ**	**6308MALLB**
45	85	19	1.1	32.5	20.4	3,350	2,080	14.1	14,300	**6209MAZZ**	**6209MALLB**
50	90	20	1.1	35.0	23.2	3,600	2,370	14.4	15,400	**6210MAZZ**	**6210MALLB**
	110	27	2.0	62.0	38.5	6,300	3,900	13.2	12,200	**6310MAZZ**	**6310MALLB**
60	130	31	2.1	82.0	52.0	8,350	5,300	13.2	10,500	**6312MAZZ**	**6312MALLB**

Note 1) Minimum allowable dimension of chamfer dimension r.
Remarks: Please contact **NTN** for bearing part numbers for other than those indicated in the series dimensions table.

Chamfer Dimensions



Unit : mm

$r_{s\,min}$ or $r_{1s\,min}$	Nominal bore diameter d over	incl.	$r_{s\,max}$ or $r_{1s\,max}$ Radial direction	Axial direction
1.0	—	50	1.5	3.0
	50	—	1.9	3.0
1.1	—	120	2.0	3.5
	120	—	2.5	4.0
1.5	—	120	2.3	4.0
	120	—	3.0	5.0
2.0	—	80	3.0	4.5
	80	220	3.5	5.0
	220	—	3.8	6.0
2.1	—	280	4.0	6.5
	280	—	4.5	7.0
2.5	—	100	3.8	6.0
	100	280	4.5	6.0
	280	—	5.0	7.0

Operating Temperature Range

- -20～+120˚C

Radial Internal Clearance

Unit : μm

Nominal bore diameter d mm Over	Incl	C2 min	C2 max	CN min	CN max	C3 min	C3 max	C4 min	C4 max	C5 min	C5 max
30	40	1	11	6	20	15	33	28	46	40	64
40	50	1	11	6	23	18	36	30	51	45	73
50	65	1	15	8	28	23	43	38	61	55	90

Bearing Fits

Recommended fit of bearings for motors (with bearing inner ring rotation)

Bearing type	Shaft fits: Shaft diameter mm Over	Incl	Shaft fits: Tolerance class	Housing fits: Housing bore diameter	Housing fits: Tolerance class
Deep groove ball bearings	～	18	j5	All sizes	H6 or J6
	18 ～	100	k5		
	100 ～	160	m5		

Allowable Rotational Speed

The allowable rotational speed refers to the rotational speed where the outer ring temperature is 80˚C or less in a constant operating condition at an ambient temperature after the standard grease ME-1 is sealed at 15-20% of the space volume of the bearing, applying a preload (shaft diameter d x 1) to the bearing, and performing a run-in operation.
The increase of the bearing temperature differs by the conditions to be used (operating load, environmental temperature, rotational speed pattern, etc.). Select an allowable rotational speed as indicated in the catalog with a margin.
Please contact **NTN** if the rotational speed will exceed 80% or more of the limitting speed indicated in the bearing dimension table.

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{f_o \cdot F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leqq e$ X	$\frac{F_a}{F_r} \leqq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

$P_{or} = 0.6F_r + 0.5F_a$

When $P_{or} < F_r$ use $P_{or} = F_r$

Abutment and fillet dimensions mm d_a Min	d_a Max	D_a Max	r_{as}	Mass kg (approx.)
48.0	54.0	82.0	1.5	0.634
51.5	55.5	78.5	1.0	0.398
56.5	60.0	83.5	1.0	0.454
59.0	68.5	101	2.0	1.070
71.0	80.5	119	2.0	1.730

Note: Markings on the seal are not white in actual bearings.

Technical Data

●FEM Analysis

Deformation of the new MA resin type cage caused by centrifugal force at high-speeds can be suppressed, and enables stable operation.

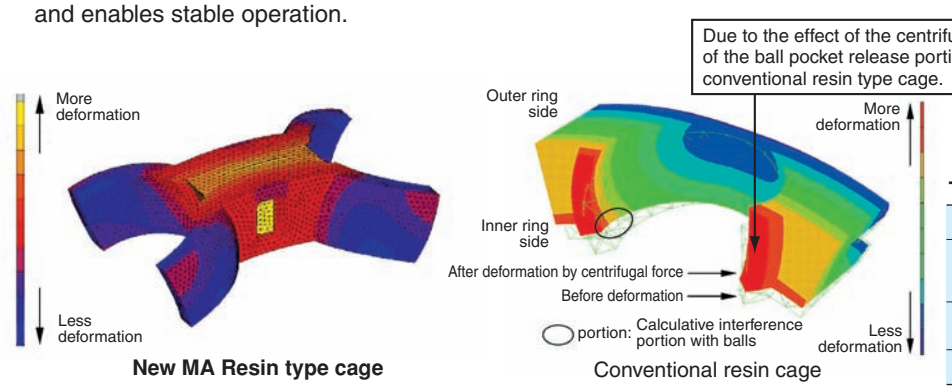


Fig. 4 Example of FEM Analysis by centrifugal force

Table 2 Analysis conditions

Bearing part number	6308
Inner ring rotational speed, min^{-1}	15000 (d_mn value 1 million)
Ambient temperature, ˚C	60
Material	PA Resin

●Temperature increase test

In the test results of each ULTAGE (MA Type) bearing, the outer ring temperature was 80˚C or less at a d_mn value of 1 million.

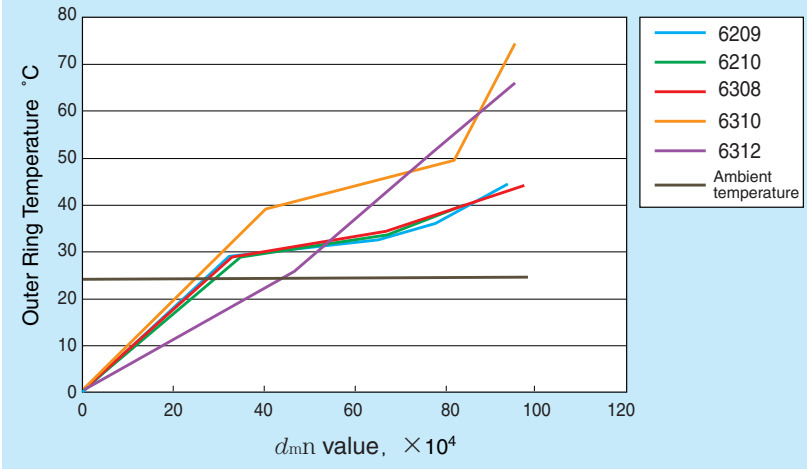


Fig. 5 Results of outer ring temperature increase test

Table 3 Test conditions

Bearing part number	Preload: F_a
6209	450N
6210	490N
6308	392N
6310	490N
6312	588N

(1) Radial Inner Clearance: C3
(2) Bearing Accuracy: JIS Class 5
(3) Sealed Grease: ME-1
(4) Grease Amount: 15 - 20% (space volume)
* Differs by part number
(5) Outer ring temperature was measured after 1 hour of operation at rotational speed
(6) Based on our test machine

●Rapid acceleration/ Deceleration durability performance

[Test conditions]

Bearing Part Number: 6308
Rotational Speed: 15,000 min^{-1}
Rapid acceleration/deceleration cycle: 8 sec/cycle
0→15,000 min^{-1}; 3 sec, 15,000 min^{-1} hold; 1 sec,
15,000 →0 min^{-1}; 3 sec, 0 min^{-1} hold; 1 sec
Temperature: Ambient Temperature
Load: F_a=392N

[Test results]

No abnormalities after 1 million cycles of operation

Fig. 6 Internal photo of bearing after test

●ME-1 Grease properties

In the ME-1 grease, a urea compound is used as a thickener, and synthetic oil as the base oil.

Table 4 Typical properties

	ME-1	Test Method
Thickener	UREA	—
Base oil	Synthetic Oil	—
Base oil viscosity, mm^2/s	60	JIS K2220.23
Worked Penetration, 60W 25˚C	250	JIS K2220.7
Dropping Point, ˚C	250 or more	JIS K2220.8

●Grease high temperature durability

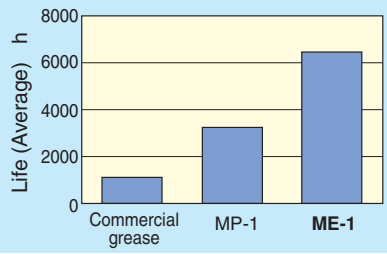


Fig. 7 Results of high temperature durability test