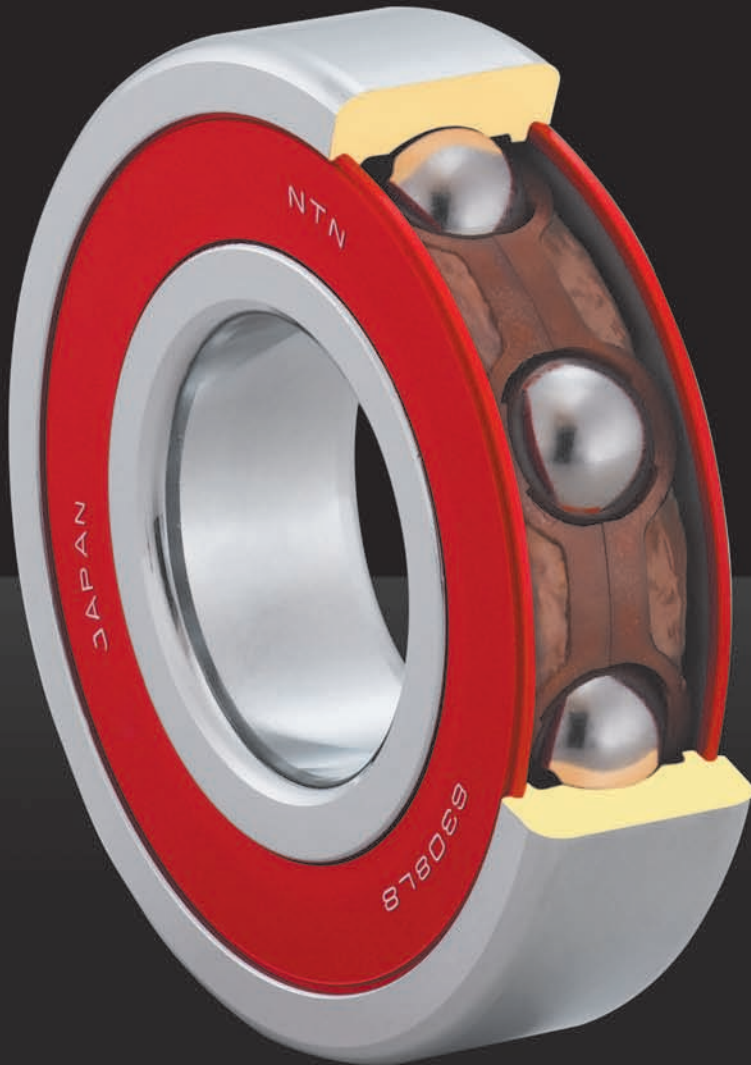


NTN®

Deep Groove Ball Bearings for High-speed Servo Motors

[Type MA]

ULTAGE



ULTAGE®

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, high-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.



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.

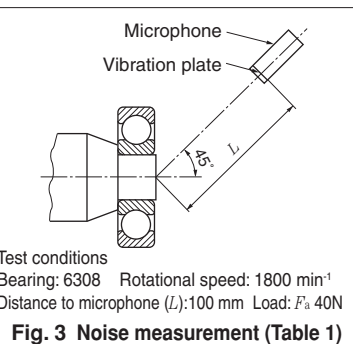
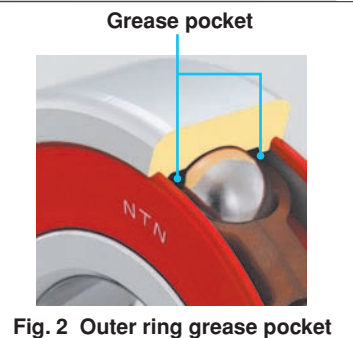
The new long life grease "ME-1" for motors is adopted (Refer to Table 4 for the properties). (Achieved a life of more than 5 times, compared to general-purpose lithium grease)

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 | | Deviation of mean bore diameter in a single plane | | Variation of bore diameter in a single plane | Variation of mean bore diameter | Radial runout of inner ring of assembled bearing | Perpendicularity of inner ring face with respect to the bore | Axial runout of inner ring of assembled bearing | Deviation of a single inner ring width | | Variation of inner ring width |
|-----------------------|------|---|-----|--|---------------------------------|--|--|---|--|------|-------------------------------|
| d mm | | Δd_{mp} Class 5 | | V_{dsp} Class 5 max | V_{dmp} Class 5 max | K_{ia} Class 5 max | S_d Class 5 max | S_{ia} Class 5 max | Δ_{BS} Class 5 | | V_{BS} Class 5 max |
| Over | Incl | High | Low | | | | | | High | Low | |
| 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

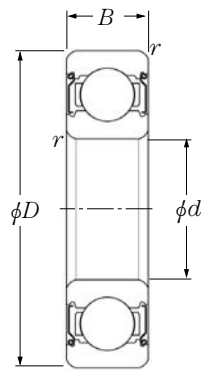
| Nominal outside diameter | | Deviation of mean bore diameter in a single plane | | Variation of outside diameter in a single plane | Variation of mean outside diameter | Radial runout of outer ring of assembled bearing | Perpendicularity of outer ring outside surface with respect to the face | Axial runout of outer ring of assembled bearing | Deviation of a single outer ring width | | Variation of outer ring width |
|--------------------------|------|---|-----|---|------------------------------------|--|---|---|---|-----|-------------------------------|
| D mm | | ΔD_{mp} Class 5 | | V_{Dsp} Class 5 max | V_{Dmp} Class 5 max | K_{ea} Class 5 max | S_D Class 5 max | S_{ea} Class 5 max | Δ_{CS} Class 5 | | V_{CS} Class 5 max |
| Over | Incl | High | Low | | | | | | High | Low | |
| 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

| | | | | | | | | | | |
|---|---|----|----|--------|----|----|---|------|-----|--|
| 6 | 3 | 08 | MA | LLB-BR | C3 | P5 | / | L700 | QTK | |
| | | | | | | | | | | Lubricant quantity code |
| | | | | | | | | | | Lubrication 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) |

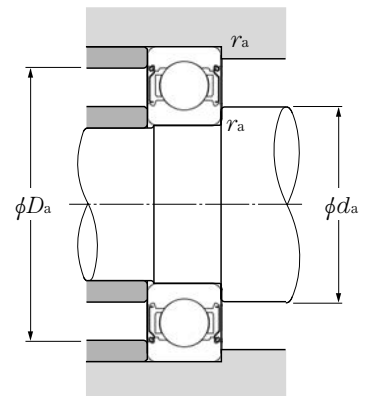
Dimensions Table



Shielded type
(ZZ)



Non-contact seal type
(LLB)

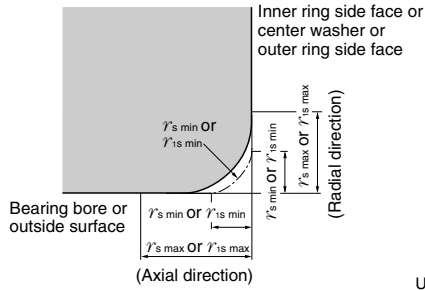


| Boundary dimensions mm | | | | Basic load ratings | | | | Factor f_0 | Allowable rotational speed min^{-1} Grease ZZ LLB | Bearing numbers | |
|---------------------------|-----|-----|------------------------|------------------------|--------------------|-------------------------|--------------------|-----------------|---|-----------------|-----------------------|
| d | D | B | $r_s \text{ min}^{-1}$ | dynamic C_r kN | static C_{0r} | dynamic C_r kgf | static C_{0r} | | | 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's max | Nominal bore diameter <i>d</i> | | r's max OR r's min | |
|--------------------------|-----------------------------------|-------|--------------------|-----------------|
| | over | incl. | 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 <i>d</i> mm | | C2 | | CN | | C3 | | C4 | | C5 | |
|---|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Over | Incl | min | max | min | max | min | max | min | max | min | 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 | | Housing fits | |
|---------------------------|----------------------|-----------------|-----------------------|-----------------|
| | Shaft diameter mm | Tolerance class | Housing bore diameter | Tolerance class |
| Deep groove ball bearings | ~ 18 | j5 | All sizes | H6 |
| | 18 ~ 100 | k5 | | or |
| | 100 ~ 160 | m5 | | J6 |

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 limiting speed indicated in the bearing dimension table.

Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

| $\frac{f_0 \cdot F_a}{C_{or}}$ | <i>e</i> | $\frac{F_a}{F_r} \leq e$ | | $\frac{F_a}{F_r} > e$ | |
|--------------------------------|----------|--------------------------|----------|-----------------------|----------|
| | | <i>X</i> | <i>Y</i> | <i>X</i> | <i>Y</i> |
| 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

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

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

| Abutment and fillet dimensions mm | | | | Mass kg (approx.) |
|--------------------------------------|------|------------------------------|------------------------|-------------------------|
| Min | Max | <i>D</i> _a Max | <i>r</i> _{as} | |
| 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.

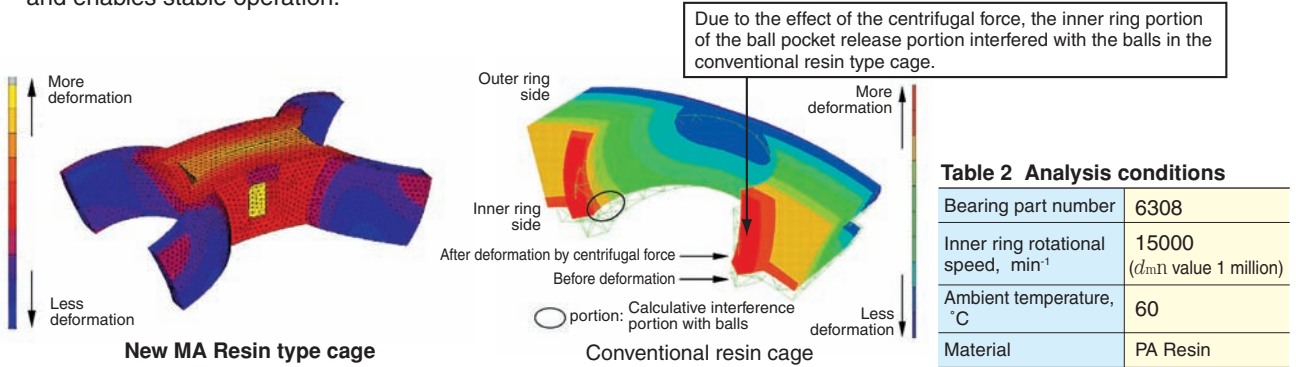


Fig. 4 Example of FEM Analysis by centrifugal force

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.

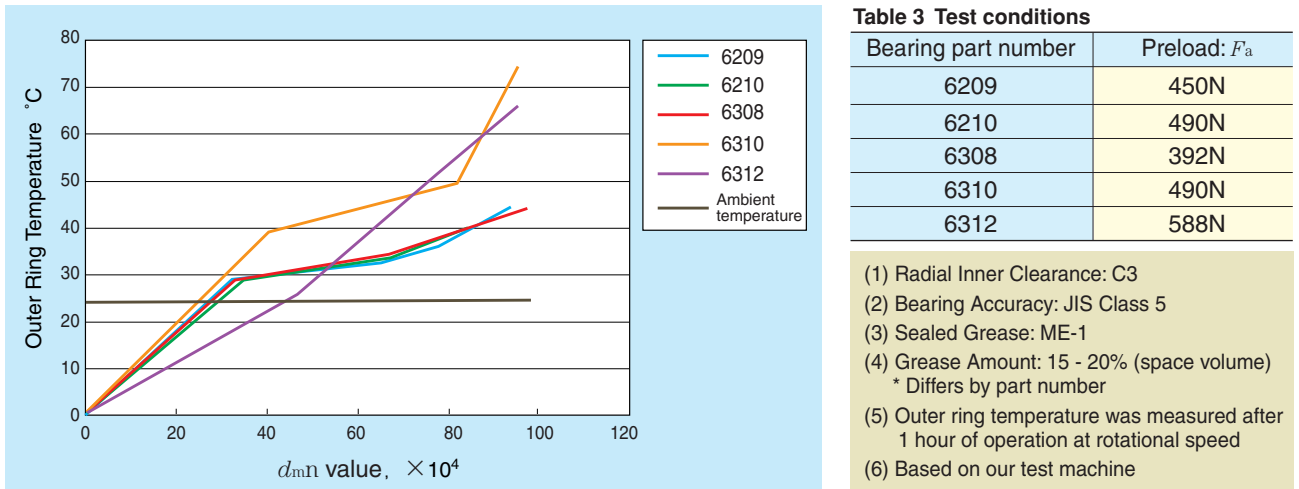


Fig. 5 Results of outer ring temperature increase test

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

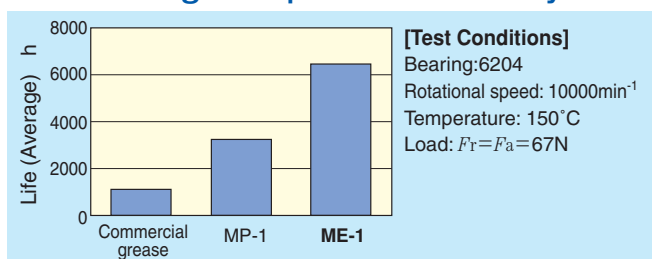


Fig. 7 Results of high temperature durability test