

For New Technology Network

**NTN**®

NTNcorporation

# AEROSPACE BEARINGS

CAT. No. 8102-III/E





## Warranty

NTN warrants, to the original purchaser only, that the delivered product which is the subject of this sale (a) will conform to drawings and specifications mutually established in writing as applicable to the contract, and (b) be free from defects in material or fabrication. The duration of this warranty is one year from date of delivery. If the buyer discovers within this period a failure of the product to conform to drawings or specifications, or a defect in material or fabrication, it must promptly notify NTN in writing. In no event shall such notification be received by NTN later than 13 months from the date of delivery. Within a reasonable time after such notification, NTN will, at its option, (a) correct any failure of the product to conform to drawings, specifications or any defect in material or workmanship, with either replacement or repair of the product, or (b) refund, in part or in whole, the purchase price. Such replacement and repair, excluding charges for labor, is at NTN's expense. All warranty service will be performed at service centers designated by NTN. These remedies are the purchaser's exclusive remedies for breach of warranty.

NTN does not warrant (a) any product, components or parts not manufactured by NTN, (b) defects caused by failure to provide a suitable installation environment for the product, (c) damage caused by use of the product for purposes other than those for which it was designed, (d) damage caused by disasters such as fire, flood, wind, and lightning, (e) damage caused by unauthorized attachments or modification, (f) damage during shipment, or (g) any other abuse or misuse by the purchaser.

**THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

In no case shall NTN be liable for any special, incidental, or consequential damages based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory, and in no case shall total liability of NTN exceed the purchase price of the part upon which such liability is based. Such damages include, but are not limited to, loss of profits, loss of savings or revenue, loss of use of the product or any associated equipment, cost of capital, cost of any substitute equipment, facilities or services, downtime, the claims of third parties including customers, and injury to property. Some states do not allow limits on warranties, or on remedies for breach in certain transactions. In such states, the limits in this paragraph and in paragraph (2) shall apply to the extent allowable under case law and statutes in such states.

Any action for breach of warranty or any other legal theory must be commenced within 15 months following delivery of the goods.

Unless modified in a writing signed by both parties, this agreement is understood to be the complete and exclusive agreement between the parties, superceding all prior agreements, oral or written, and all other communications between the parties relating to the subject matter of this agreement. No employee of NTN or any other party is authorized to make any warranty in addition to those made in this agreement.

This agreement allocates the risks of product failure between NTN and the purchaser. This allocation is recognized by both parties and is reflected in the price of the goods. The purchaser acknowledges that it has read this agreement, understands it, and is bound by its terms.

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# NTN AEROSPACE Bearings

With its 80 years' vaunted experience and history, NTN pursues the limit of safety and reliability of aerospace bearings, by its application of the latest technology.



## Major characteristics of NTN Aerospace Bearings:

### High Reliability

Use of high quality materials  
Manufacture at the only specialized factory of aerospace bearings in Japan  
Thorough quality control including follow-up records

### Wide Variety of Types and Designs

Ball Bearings  
Cylindrical Roller Bearings  
Tapered Roller Bearings  
Needle Roller Bearings  
Self-Aligning Roller Bearings  
Miniature Ball Bearings  
Spherical Plain Bearings  
Bearee Plain Bearings

### Wide Variety of Sizes

Available from 1.5mm bore instrument bearings to 1500mm outside diameter rocket bearings.

## In order to increase the reliability, NTN implements the following:

- Magnetic Particle Test of races, steel balls, and rollers
- Eddy Current Test of races, steel balls, and rollers
- Acid Etch Test of races, steel balls, and rollers
- Fluorescent Penetrant Test of machined cages
- Silver Plate and Dynamic Balance Adjustment of machined cages
- Dynamic Balance Test of rollers
- Fiber Flow Formation of races

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**Engine bearings are divided broadly into two categories of use; for main shafts and for reduction gears (auxiliary drive system). High technology is required to design and manufacture main shaft bearings which are used in high speed and high temperature conditions.**

## JET ENGINE BEARINGS

Major jet engines in which NTN bearings are employed.

### Japanese Manufacture Engines

J3 (T-1B, P-2J),  
 JR100 (Trial Manufacture),  
 FJR710/10 (The First Trial Manufacture of STOL),  
 FJR710/20 (The Second Trial Manufacture of STOL),  
 FJR710/600 (ASUKA),  
 F3 (T-4)



Main shaft bearing



Reduction gear bearing

### Licensed Engines to Manufacture

J79-17 (F-4EJ), J805 (T-1A),  
 T53-13B (UH-1H), T53-703 (AH-IS),  
 T55 (CH-47), T56 (P-3C),  
 T58 (KV-107, HSS-2), T63 (OH-6J),  
 T64 (US-1), JT8D-9 (C-1), TF40 (F-1, T-2),  
 F100 (F-15J), T700(SH/UH-60J)



Main shaft bearing



Reduction gear bearing

### Overseas Manufacture Engines Main Shaft

CF6-80C2, CF6-80E1, CFE738, CT7, CF34-3

### Overseas Manufacture Engines Gear Box

CF6-80C2, CF6-80E1, GE90, CT7, CF34-8C,  
 CF34-10

### Engines Developed by International Joint Cooperation

RJ500 (Joint Development of Japan and  
 England), V2500 (Joint Development of  
 Japan, USA, England, Germany, and Italy)



Main shaft bearing



Reduction gear bearing



**Functioning with many rotary parts, helicopters require various specially designed bearings.**

## HELICOPTER BEARINGS

**NTN bearings are used for various applications.**

Input Gearbox Tail Rotor Retention  
 Main Gearbox Main Rotor Shafts  
 Intermediate Gearbox Main Rotor Blade Retention  
 Tail Gearbox Swash Plates  
 Tail Drive Shaft Rotor Control Linkages

**For use in these applications, NTN supplies following bearings:**

Self-Aligning Seat Ring Type Thrust Bearings  
 Axially Loaded Duplex Ball Bearings  
 Duplex Split Inner Ring Ball bearings  
 Thin Section Ball Bearings for Swash Plate  
 Double-Row Cylindrical Roller Bearings for Planetary Gears  
 Self-Aligning Roller Bearings for Planetary Gears  
 Single-Row Self-Aligning Roller Bearings  
 Tapered Roller Bearings with Brass Cage  
 Special Needle Roller Bearings  
 Spherical Plain Bearings

**Major helicopters in which NTN bearings are employed.**

S-61 (SIKORSKY LICENCE)  
 HSS-2/-2B (SIKORSKY LICENCE)  
 KV-107 (VERTOL LICENCE)  
 BK117 (Joint Development of Japan and Germany)  
 UH-1H (BELL LICENCE)  
 OH-6J (HUGHES LICENCE)  
 AH-1S (BELL LICENCE)  
 OH-1 (DOMESTIC PRODUCT)  
 MH2000 (DOMESTIC PRODUCT)  
 MD900/902 (Joint Development of Japan and USA)  
 AB139 (Joint Development of Japan and Italy)  
 SH/UH-60J/K (SIKORSKY LICENCE)



Rotor blade retention bearing



Swash plate bearing



Reduction gear bearing





## AUXILIARY BEARINGS, PROPELLER SHANK BEARINGS

### AUXILIARY BEARINGS

NTN manufactures and supplies a great variety of bearings for use in Generators, Motors, Starters, Fuel Pumps, Oil Pumps, Cabin Super Chargers, Air Cycle Machines, Auxiliary Power Devices and other components.

For these applications, the following bearings are used. Sealed or Shielded Ball Bearing with Quiet Running Characteristics.

Heat Resistant Ball Bearings and Roller Bearings, High Precision Ball Bearings of ABEC 9 or a higher grade of the ABMA Standard.

High Precision Roller Bearings of grade 4 or a higher grade of the JIS Standard.



Auxiliary bearings

### PROPELLER SHANK BEARINGS

Specially designed Thrust Roller Bearings are used on blade shanks of variable-pitch propellers.

NTN is one of the few manufacturers capable of producing these Thrust Roller Bearings.

Major propellers in which NTN bearings are employed  
63E60 (HAMILTON STANDARD LICENCE)  
54H60 (HAMILTON STANDARD LICENCE)



Propeller shank bearings



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**Satellites and Space Rockets require various bearings created under special specifications of structure, design, material and manufacturing process, and NTN is one of the top manufacturers in this field.**

## BEARINGS FOR SPACE DEVELOPMENT

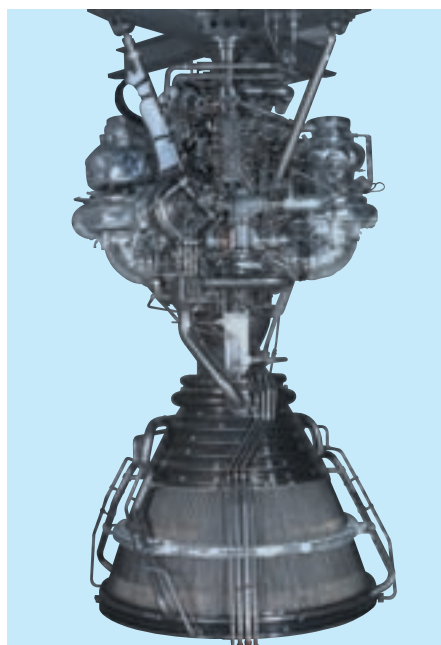


Liquid Hydrogen Turbo Pump Bearings



Satellite Bearings

- The 1st and the 2nd Stage Liquid Fuel Rocket Engines (For LE-5B, LE-7A use)
- Rocket Engine Jimbal (For H-IIA use)
- Rocket Auxiliary Turbine
- Rocket Fuel Main Valve (For H-IIA use)
- Various instruments used in space development (Earth Sensors, Paddle Drive Mechanism and others for Satellites)



LE-7A Engine  
H-IIA Rocket First Stage

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H-IIA Rocket  
Standard Model

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