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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Although care has been taken to assure the accuracy of the data compiled in this catalog, **NTN** does not assume any liability to any company or person for errors or omissions.
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
Bearere 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.
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)

- **Licensed Engines to Manufacture**
  J79-17 (F-4EJ), J805 (T-1A),
  T53-13B (UH-IH), 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)

- **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)
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)
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.

PROPELLEER 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)
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.
BETARINGS FOR SPACE DEVELOPMENT

- 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)