# Thrust Bearings

In this technical information sheet, the following topics are cover on Thrust bearings:

Overview, Bearing Cages, Shields, Life and Loading, Fitting and Mounting, Nomenclature

## Overview

Two types of thrust bearings are available, they are the ball and the roller type thrust bearings. Utilized in similar applications, single direction thrust bearings are designed to take purely axial loads in one direction. These types of bearings cannot accommodate any radial loading. Generally consisting of a shaft washer, housing washer, and a ball/roller cage assembly, the single direction thrust bearings are separable to ease mounting.

Double direction thrust bearing are available to accommodate axial loads in two directions. Similar in design to single direction thrust bearings, double direction thrust bearings consist of a shaft washer, two housing washers, and two ball/roller cage assemblies. Also, like the single direction thrust bearings, the double direction bearings are separable to ease installation.

Cylindrical roller type thrust bearings are available with single or multiple rows of rollers. Multiple row roller thrust bearings can withstand even greater axial loads than either the single row roller, or ball type thrust bearings. Roller thrust bearings consisting of 3 or more rows of rollers have rollers that vary in length, and are alternately mounted. One side of each of the roller is sphered to avoid side friction.

Both types of thrust bearing utilize washers that are generally manufactured from bearing steels, hardened to 58-65HRc, then ground and lapped. The washers can also be made of case hardening steels, where the case hardened layer after grinding is .3mm thick, and has a hardness of 58-65HRc. For ball thrust bearings, washers can be flat or grooved, while cylindrical thrust bearings have flat washers.

Neither type of thrust bearings can accommodate any misalignment. Any error of angle between the position of the shaft washer axis and the position of the housing washer axis can cause a failure of the bearing. Thrust ball bearings can be provided with a sphered housing washer and accompanying sphered seat washer to compensate for some misalignment between housing and shaft.

## Bearing Cages

Both thrust ball bearings and thrust roller bearings come standard with pressed steel sheet cages to guide the ball/rollers around each washer surface. Machined Brass cages are available for larger and special application bearings. For lower speed/higher load applications, bearings can also be supplied without a cage to allow for a full ball/roller complement.

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**Shields**

While none of the thrust bearings are available with "seals" as other bearing types may be, they are available with metal shields to prevent contamination. Bearings that come with shields are non-separable.

**Life and Loading**

Thrust bearing loads can be calculated very similarly to standard radial ball/roller bearings with some exceptions. Since thrust bearing can only withstand axial loading, any radial load components must be eliminated. The equivalent dynamic load formula for a thrust bearing is shown below:

$$P = F_a$$

The equivalent static load formula is shown below:

$$P = F_a$$

Both ball and roller thrust bearing require a minimum axial load to ensure a proper arrangement of balls/rollers along each raceway. In the case of ball thrust bearings operated at higher speeds, centrifugal forces and gyroscopic moments can have detrimental influence on the balls, i.e. sliding movements between the raceways and balls. In most cases, the weight of the components supported by the bearing, combined with external forces is enough to meet the minimum load requirement. In cases where this is not met, preloading by way of a spring is recommended. The minimum load calculation for ball thrust bearings is shown below:

$$F_{amin} = M\,(n/1000)^2$$

Where: $F_{amin}$ = minimum axial load

M = minimum load factor

N = bearing speed, rpm

In the case of roller thrust bearings, the minimum axial load calculation is shown below:

$$F_{amin} = 4.5C_{oa}\ x10^{-5}$$

Where : $C_{oa}$ = Basic static load

Thrust bearing life expectancy ($L_{10}$ Life) is the expected life of the bearing in hours, and can be calculated by using the following formulas. For a ball thrust bearing, use the formula shown below:

$$L_{10h} = (16{,}666/n)\ x\ (C/P)^3$$

Where: n = Bearing speed, rpm

C = Load Capacity

P = Applied load

For a roller thrust bearing, the following formula applies for $L_{10}$ life calculation:

$$L_{10h} = (16{,}666/n) \times (C/P)^{10/3}$$

**Fitting and Mounting**

Generally, thrust bearings are mounted with a loose fit between the housing and housing washer outside diameter, and a transitional fit between the shaft and shaft washer bore. The housing washer bore is roughly .007" larger than the shaft washer bore to provide clearance for the shaft. Fits that are too tight, or have too much interference, can possibly distort the washers leading to early failure of the bearings.

For proper location of the shaft and housing washers, the respective shaft and housing mounting radii should be properly sized to ensure correct seating of the bearing. Shoulder height should also be size properly to account for the bearings mounting chamfer. Please consult AST engineering for any question about proper mounting and fitting of bearings.

**Nomenclature**

Ball thrust bearings are manufactured to SR3921 and SR3922 standards while Roller Thrust bearing are made to SR 11220 standards. AST offers ball thrust bearings in the following bearing series:

**FM** – 3-10mm bore, grooved raceways

**F** – 2-10mm bore, non-grooved

**511** – Standard Single direction Thrust Ball bearing >10mm bore

**512** – Single Direction Thrust ball bearing, higher capacity than 511 series >10mm bore

**513**- Single Direction Thrust ball bearing, higher capacity than 512 series >10mm bore

**514** – Single Direction Thrust ball bearing, higher capacity than 513 series >10mm bore

**522** – Standard Double Direction Thrust ball bearing, >10mm bore

**523** – Double Direction Thrust ball bearing, higher capacity than 522 series

**524** - Double Direction Thrust ball bearing, higher capacity than 523 series

AST offer Roller thrust bearings in the Following series:

**811** – Standard Roller thrust bearing

**812** – Roller thrust bearing with higher capacity that 811 series

**893** – Double row roller thrust bearing

**851** – 3+ row roller thrust bearing

Following the bearing series is the bore size designation:

**00** – 10mm bore

**01** – 12mm bore

**02** – 15mm bore

**03** – 17mm bore

**>04** – bore size x 5mm (example: 08 bore code = 40mm bore)

In addition to the bearing series and size, each bearing has available options that can be manufactured into the bearing. They are as follows:

**M** – Machined brass cage

**V** – bearing without cage, full complement

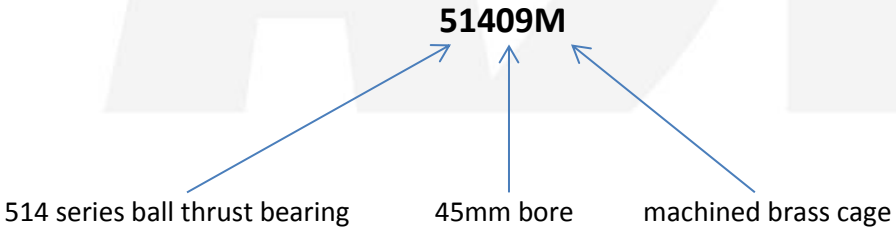
**P6** – Tighter tolerance than standard P0 bearing

**P5** – Tighter tolerance than P6 bearing

**U** – Sphered housing washer (ball thrust bearings only)

**Z** – Shielded

## EXAMPLE:




In this example a ball thrust bearing, series 514, with a 45mm bore, and a machined brass cage is described.

Please contact AST Engineering for any further questions you may have on Thrust Bearings.

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