CQ Tilting Pad Thrust Bearings

Installation and Maintenance Instructions

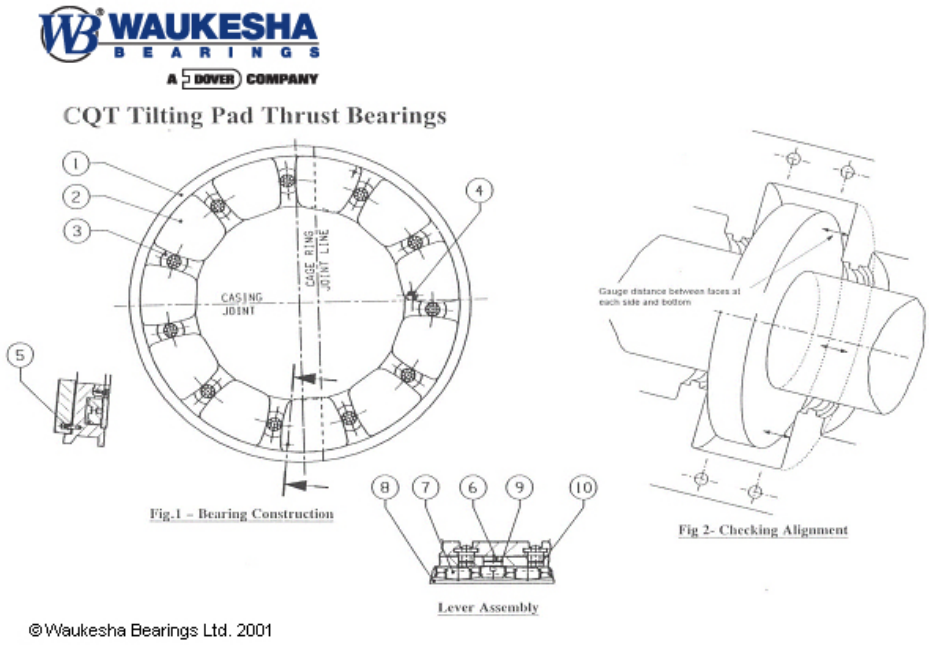
1. Introduction

The following notes provide installation and assembly instructions for Waukesha Bearings CQ tilting pad thrust bearings.

Reference should be made to the specific contract drawing for operational information and special features which may be provided.

2. General Description

The Waukesha Bearings CQ bearing is shown in Fig 1, and reference is made to this drawing in the following comments.



The CQ tilting pad thrust bearing consists of a number of thrust pads (item 2) supported in a cage ring (item 1). Each pad is loosely retained by pad stops (item 3) so that each pad is free to tilt and it is supported on a system of levers (item 7) to equalise load sharing between the pads. A screw held spacer plate (item 8) is fixed to the back face of the cage ring, securing the levers within the cage ring.

The spacer plate, normally supplied with a machining allowance, acts as an adjustable spacer (for adjusting axial bearing clearance and/or rotor position).

The cage ring can be supplied in a one piece, or in halves construction, with an annular groove around the bearing outside diameter to receive lubricating oil from the casing.

On bearings with rings in halves, pins (item 5) are provided near the joint line to ensure security of the pad and levers whilst the two halves of the bearing are separated. 'O' rings (items 9 and 10) are provided on the pillars and pad stops to retain their position in the cage ring.

The thrust bearing is prevented from rotating in the casing by an anti-rotation pin (item 4) situated in the back face of the cage ring.

3. Lubrication

The bearings are designed to be lubricated by a pressurised oil system, with oil supplied into the cage ring annular groove. The oil then feeds from the annulus to the thrust bearing chamber via a number of radial holes in the cage ring (which can also be used for rotating the ring in the casing).

With flooded lubrication, oil from the lever chamber is fed via radial holes in the inside wall of the cage ring, through to the shaft space, providing a continuous flow of oil which fills the whole bearing chamber.

For Directed Lubrication (DL) bearings, the oil feeds from the lever chamber to the bearing face via spray pad stops. With Directed Lubrication, the bearing housing should be provided with large drains to prevent an accumulation of oil (see contract drawing).

4. Pad Design

The thrust pads are normally manufactured from steel lined with a tin based whitemetal and are either offset pivot (single direction of rotation), or centre pivot (for both directions of shaft rotation).

NB: In the case of double thrust bearings with an offset pivot arrangement, note that the main and reverse pads are identical and interchangeable, as the pivot is built into the cage ring assembly, not the pads.

Pads can be removed from the cage ring by sufficiently raising each pad stop with a screwdriver or similar lever, whereby each pad can be withdrawn radially outwards.

5. Dismantling

Should it be necessary to completely dismantle the thrust bearing parts from the cage ring, the procedure is as follows:

- Remove the thrust pads together with the pad stops (they can be removed by sufficiently raising each pad stop with a screwdriver or similar lever, whereby each pad can be withdrawn radially outwards).
- Remove the spacer plate by removing the spacer screws (note that this should be done with the spacer plate in an uppermost position to prevent the levers becoming dislodged from the cage ring).
- Remove the levers.
- Remove the pillars.

When re-assembling the bearing, the above operations should be reversed, with pad stop/pillar shanks coated with clean oil to assist insertion. When re-assembling the thrust pads in a cage ring, ensure that with the pad stops pushed home, the pads are free to move.

6. Installation

6.1. Cleanliness

To obtain the most reliable performance from these bearings, it is necessary to observe high engineering cleanliness standards. The interior of the casing and all oil passages and pipes, especially on the supply side, must be perfectly clean and free from foundry sand, scale, welding spatter etc. Any unmachined surfaces should be shot blasted down to a clean metal surface.

6.2. Alignment

It is most important that the shaft and bearing housing are in correct alignment and this must always be checked carefully during erection of the machine.

So far as the thrust bearing is concerned, correct alignment means that the collar face and the thrust ring supporting face in the casing are parallel to each other (static alignment) and the collar face is normal to the shaft axis (dynamic alignment).

The following notes are included in the hope that they will be of assistance, but it is not intended that they should supplant methods already in use, which may be better suited to the individual case.

After assembly on its shaft the collar must be checked to ensure that it is running true, i.e., the face is normal to the axis, and this is most easily done with the shaft revolving in a lathe. If, however, the collar has to be removed subsequently for erection, it is better if it can be checked for truth after it is finally fitted to the shaft. This dynamic misalignment check should result in a total indicator reading (T.I.R) ideally less than or equal to 0.00004 mm/mm of collar diameter (same figure applies to integral collar arrangements).

Once the collar is known to be true (dynamic misalignment, i.e. swash), the correct alignment of the casing (static misalignment) can be checked by gauging the collar and casing faces, adjusting the alignment until the two faces are equidistant.

The alignment may be checked by gauging just below the casing joint and at the bottom, measuring to points just inside the collar periphery (see Fig 2, Page 1).

An alternative method is to replace the thrust ring by a temporary dummy ring having the same overall dimensions, the ring faces being accurately machined flat and parallel. The collar face is then smeared lightly with blue marking and the shaft rotated, keeping the collar face in contact with the dummy ring. A study of the marking of the ring will indicate whether the casing is in correct alignment. By smearing marking on the dummy ring, the collar can be checked for truth. It is not advisable to adopt this method using the actual thrust ring, since the pads are held only loosely and may collect marking on the faces when they are actually not in contact with the carrier ring, so giving a false impression.

When checking alignment, the rotating parts should be completely assembled with all masses in position as during operation. In some cases shafts are subjected to bending when in operation and it may be necessary to allow for the bending deflection when determining initial alignment, so that the bearings are correctly aligned when under full operating conditions.

This static alignment check should result in a slope less than 0.0015 mm/mm, although in practice slopes considerably less than this are achievable, and beneficial to bearing operation, within the normal engineering standards associated with rotating industrial machinery.

6.3.Assembling the Bearing in the Machine

The method to be adopted may depend upon the construction of the individual machine, so the following remarks cover only the broad principles.

Before commencing final assembly, always see that the interior of the casing and all oil passages and pipes are perfectly clean. Remove all loose dirt and wipe clean. If the casing has been painted with protective coating, wash this off and wipe clean. A good guide to the cleanliness is if a clean white cloth can be rubbed over the surfaces without being soiled. Use clean cotton cloths for cleaning – do not use waste as particles which are left behind can cause trouble.
See that the interior and shaft surfaces are freely coated with clean lubricating oil during assembly.

In the case of one piece thrust rings, pass the ring over the free end of the shaft, presenting the stop pin to its recess, until the ring sits snugly in position. Then fit the collar, tighten up and lock securely.

In the case of thrust rings in halves, installation in its housing should commence as follows:
The lower half ring (without a stop pin) should be inverted over the shaft with the pad faces touching the collar face and wheeled into the lower half casing until the joint face is horizontal.
The upper half ring (with a stop pin) should now be placed on the lower half ring ensuring that both the pads and the equalising levers are correctly engaged in both halves.

Note: No excessive force should be necessary to bring the two cage ring joint faces into contact when correct engagement has occurred.
The final operation is to rotate the complete ring until the stop pin rests on the casing joint face (or groove). In all standard bearings the stop pin is at the right hand side when looking on the face of the thrust pads.

After the above operations, the upper casing is placed in position ensuring the stop pin engages with the hole or recess in the casing top. This closure should be as soon as possible to exclude dirt and other foreign bodies. Before finally closing the bearing however, all surfaces should be liberally smeared with clean oil.
When dismantling the bearings the above operations should be reversed.

Note that, as the thrust rings are trapped into position, when the casing top is lifted, there is no danger of the half rings being lifted with it and, subsequently, falling with the risk of damage to the pad or collar faces.

Note: The bearings as supplied, including any protective coating of oil, can be installed directly into the machine.

6.4.Axial clearance

Some axial clearance, or end play, is essential to give room for the formation of the oil film between the collar and the thrust pads and also to allow for expansion of the parts as the bearing warms up to its operating temperature. In the case of double thrust bearings, allowance must be made for the oil films on both sides of the collar, noting that the idle, or non-loaded side will have a thicker oil film than the working, or load-carrying face.

The total minimum axial clearance required is given in the contract drawing.
If the clearance is too small, excessive pressures will be built up in the oil films causing a high bearing temperature and excessive power loss; end even, in extreme cases, leading to bearing damage.
A clearance larger than necessary will not cause any harm to the bearing.

The clearance must be checked at erection and this must be done with all surfaces wiped clean and dry or a false figure will result. Never use feelers between the face and collar since this will tend to give false readings, apart from the risk of damaging the pad faces. The simplest method of checking the clearance will depend largely upon the individual machine, but the most reliable method is to jack the rotor axially in each direction and measure the total movement.
Alternatively, the rotor may be pushed against one face and the clearance measured by feelers between the back of the opposite thrust ring and the casing.

Note: In order to overcome lever/assembly settlement, it is recommended that a reasonable load be applied to the bearing when taking these measurements (see contract drawing).

If the thrust bearings are supplied with a machining allowance on the external face of the spacer plate (item 8), it is important that they should be laid on a flat horizontal surface (taking care to protect the whitemetal faces) with the spacer plate (item 8)

uppermost to allow its removal for machining. Whilst the spacer plate is detached, the bearing should not be moved, to prevent the levers from coming loose.

Each thrust bearing spacer plate should be machined on the external face to reduce its thickness by the appropriate amount.

It is advised that on no account should the thrust bearings be dismantled after the initial set-up operation except in circumstances where this can not be avoided.

6.5. Temperature Sensors

If temperature sensors are provided in the thrust bearings, their location will be shown in the contract drawing.

Great care should be taken when installing and dismantling the thrust rings to ensure that the sensor leads are not damaged by sharp bends or nipping between two parts. The leads should also be kept well clear of moving elements in the machine.

6.6. 'O' rings

The 'O' rings (items 9 & 10) fitted to the stems of the pillars and pad stops are primarily intended to retain these components in the cage ring during assembly and dismantling. They also restrict oil leakage and therefore should be fitted to avoid excessive oil flow through the bearing.

7. Bearing wear

If the thrust bearings are installed in accordance with these instructions and are operated within the design conditions specified in the contract (and/or drawing), no measurable wear should occur during prolonged service; the only change could be a dulling of the whitemetal surface. It is recommended that when this dulling has spread to more than one half of the pad surface, the thrust pads should be replaced.

The minimum whitemetal thickness on the thrust pads is of the order of 0.5 mm on the smallest pads up to 2 mm on the larger sizes. It must be emphasised that any measurable movement of the collar in an axial direction (say 0.05 mm or more) indicates that the bearing is not functioning correctly and an inspection should be made immediately. This is particularly important if the axial movement occurs over a short period of time.