Orkot® Hydro Bearings
Installation Procedures

Fitting Methods

Orkot® Hydro Bearings can be fitted using any one of the following methods:

- Freeze fitting
  - Method 1: Using liquid nitrogen (immersion method)
  - Method 2: Using liquid nitrogen (vapour method)
  - Method 3: Using dry ice and alcohol
- Press fitting
- Bonding

Our preferred method is to freeze fit using liquid nitrogen. However descriptions of all methods can be found in this section.

Freeze Fitting

This is a fast and efficient assembly method for an Orkot® Hydro bearing. The thermal properties of the material allow a good clearance between the bearing and housing when frozen and the material does not become brittle at cryogenic temperatures.

Note:

Extreme care should be taken when using liquid nitrogen to avoid severe burns. Adequate ventilation should be provided because oxygen is depleted when gassing occurs in confined spaces, suppliers of the products will provide a data sheet advising on its use.

Method 1:

Using liquid nitrogen (immersion method)

A suggested procedure for method 1 is as follows:

1. Check the od of the bearing in at least 3 positions around the top, middle and bottom (a total of 9 measurements) making a note of the largest figure recorded.
2. Check the id of the housing in at least 3 positions around the top, middle and bottom (a total of 9 measurements) making a note of the smallest figure recorded.
3. Provide an insulated container capable of withstanding a temperature of -197°C (-320°F) and large enough to accommodate the bearing being fitted with enough clearance on the od to facilitate the insertion and removal of the bearing.
4. Place the bearing inside the container and make efforts to reduce its internal volume. This can be done by sealing off un-used areas of the container or filling any voids with rough cut timbers. This will reduce the amount of liquid nitrogen that will be required.
5. Cover the bearing with the liquid nitrogen and maintain this level for the duration of the procedure. The nitrogen level will constantly drop as the liquid boils, turns to gas and escapes to the atmosphere. Use an insulated lid to cover the container when possible. Once the liquid stops boiling and settles down to a simmer then the bearing can be lifted slightly from the liquid and the upper od measured to check for sufficient size reduction. If this has not been achieved then the bearing can be returned to the liquid for 10 to 20 minutes and then checked again
6. Once sufficient clearance between the bearing and the housing has been achieved then the bearing can be removed from the nitrogen and transported to the housing for fitting.
7. The apparatus used to transport the bearing after freezing will need to be resistant to the cryogenic temperatures they will encounter (e.g. polyester slings) and suitable to support the weights involved.
8. Ensure that the reduced bearing can be located quickly and easily. Once it comes into contact with any conductive surfaces the rate with which it will return to its original dimensions increases greatly.
9. Slide the bearing into position, ensuring that it is held there while its temperature normalises. Once the bearings surfaces have cleared of the ice that forms on them during normalisation then any supports can be removed.

Method 2:

Using liquid nitrogen (vapour method)

Orkot® bearings can be fitted without a metal container by vaporising the liquid nitrogen within the bearing. This uses less liquid nitrogen and is therefore safer and less expensive than the immersion method. Please note however that the rate of bearing contraction is a lot lower using this method when compared to the immersion method. As such the freezing procedure will take a lot longer

A suggested procedure for method 2 is as follows:

1. Check the od of the bearing in at least 3 positions around the top, middle and bottom (a total of 9 measurements) making a note of the largest figure recorded.
2. Check the id of the housing in at least 3 positions around the top, middle and bottom (a total of 9 measurements) making a note of the smallest figure recorded.
3. Prepare a plywood disk with an od half way between that of the od and the id of the bearing. Drill a 15 / 20mm diameter hole in the middle of this disk.
4. Place the bearing on a smooth, flat, none porous surface. Seal the joint between this and the id of the bearing with silicone sealant.

5. Manufacture a simple lance from 10 mm (.40") or similar copper tube, drill approximately twenty 1 mm (.40") diameter holes through both walls of the pipe and fit a bleed valve to the pipe to control the flow of liquid nitrogen. Ensure that you seal the open end of the lancee.
6. Place the plywood disk on top of the bearing, and connect the lance to a pressurised liquid nitrogen tank.
7. Turn the valves to control the flow on nitrogen until vapour can be seen escaping, under pressure from the lance. If liquid starts to exit the lance then the flow should be reduced until it stops.
8. Place the lance though the hole in the centre of the disk and into the bearing. Wrap the bearing in an insulating blanket to reduce energy loss from its surface.
9. During the procedure the nitrogen flow will need to be monitored and adjusted from time to time. Measure the od at the top of the bearing periodically.
10. Once sufficient clearance between the bearing and the housing has been achieved then the bearing can be transported to the housing for fitting.
11. The apparatus used to transport the bearing after freezing will need to be resistant to the cryogenic temperatures they will encounter (e.g. polyester slings) and suitable to support the weights involved.
12. Ensure that the reduced bearing can be located quickly and easily. Once it comes into contact with any conductive surfaces the rate with which it will return to its original dimensions increases greatly.
13. Slide the bearing into position, ensuring that it is held there while its temperature normalises. Once the bearings surfaces have cleared of the ice that forms on them during normalisation then any supports can be removed.

Method 3:

Using dry ice and alcohol

Freeze fitting using dry ice and alcohol will only provide the required clearance when using very light interferences. As such it is rarely a viable method in its own right and will often also require press fitting

Fitting with Hydraulic Press or Centre Pull Jacks

If a bearing is to be press fitted, installers should ensure that they have equipment available to deliver adequate force to press the bearing fully into the housing. The ease of fitting will vary dependent on the finish of the housing and this should be considered when calculating the force required. When press fitting a bearing it is important that it is in line and square with the bore before the operation beings, an adequate chamfer on the housing will prevent shaving of the bush.

The diagram (Figure 8) illustrates a method of ensuring the bush is square before the fitting starts.

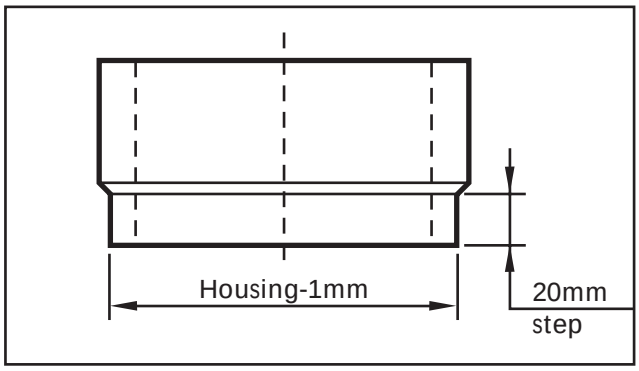

Figure 8: Method of ensuring the bush is square before the fitting starts.

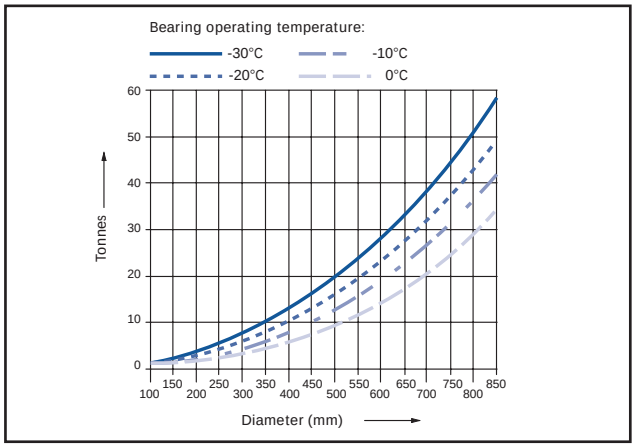

Figure 9: Fitting force (Tonnes)

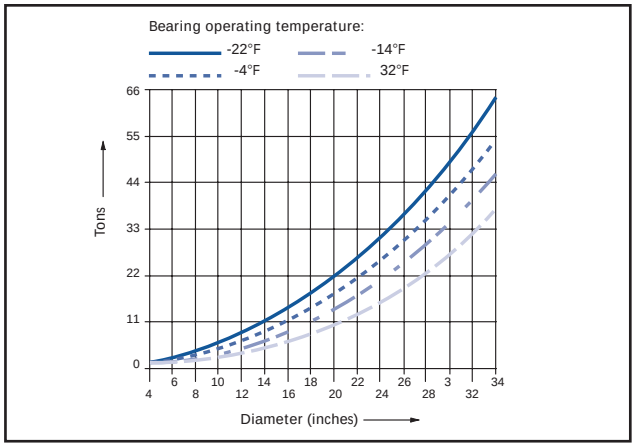

Figure 10: Fitting force (Tons)

Figures 9 and 10 show the typical fitting force of a bearing, length/diameter ratio 1:1

An initial force to move the bearing may be higher than given in the graph

The actual force will vary dependent on the condition of the housing, leading chamfers and the length/ diameter ratio.

Bonding

The method of fixture will depend upon the design employed, however the key point to be emphasised here is that in addition to traditional mechanical fixing, Orkot® materials can be bonded to both itself and metallic substrates. Please note that if the assembly is to experience in excess of 60-70°C then interference fitting should be replaced with adhesive bonding.

Numerous adhesives are compatible with Orkot® and have been tested within our laboratory facilities.

Generally the most suitable adhesives are:

- Epoxies.
- Acrylics .
- Cyanoacrylates.
- Polyurethanes.

The following is a list of adhesive suppliers whose products have been tested and are approved for use with Orkot® materials:

- Araldite
- Belzona
- Bisonite
- Chockfast
- Loctite
- Permabond

For specific details of bonding agents and conditions please contact our Technical department.

General terms and preparations are required irrespective of the adhesive to be used.

Terms:

- The bonding agent is referred to as the adhesive.
- The material/surface to which the Orkot® is to be bonded is the substrate.
- The distance between the Orkot® and the substrate is the gap.
- The ability of the adhesive to bridge and fill the gap is the gap fill.

Preparations:

- Suitable substrates are Orkot® materials themselves and various metals (including stainless steel).
- Plastics such as polyethylene, polypropylene, polycarbonate, PVC, PTFE are unsuitable substrates for bonding to Orkot® materials.
- The key to effective adhesion is in the preparation of the substrate and the material to be bonded.
- Ensure no boundary layers such as oxides or grease are present. Degrease with a suitable solvent ensuring local health and safety guidelines are followed. Orkot® can be degreased by using a quick wipe with a solvent such as acetone, but exposure to the solvent must be kept brief so as not to attack the Orkot® material. Oxides can be removed by use of fine abrasive paper or wire wool.
- Roughen the surface. Ideally where metals are involved use shot blasting. Ensure any remaining particulates are removed from the surface. Generally the slightly fibrous surface of Orkot® does not require roughening, though the use of abrasive paper is acceptable so long as any dust is removed.
- The assembled components may need support while the adhesive sets. This cure time will vary with the conditions under which the adhesive is used. Typically a rule of thumb is that the cure time will half for every 10°C increase in temperature.
- In terms of assembly, avoid butt joints in favour of lap, so that loads applied to the adhesive joint will act across the assembly in shear.