

**The Lifetime Reliability Solutions
Certificate Course in Maintenance and Reliability
Module 4 – Precision Maintenance Techniques for Machinery**

**Session 16
R/E Bearings – Handling, Storage and Installation.**

1. Introduction.

In the previous session we have considered the rolling-element bearing as a precision device that needs to be installed with careful attention to shaft and housing tolerances if maximum life is to be obtained.

In these next two sessions we will look at practical advice relating to optimising the life of bearings. Remember that we are focussing on reliability improvement in this training course. While there is an incredible amount of information that we could consider in relation to rolling-element bearings we have reduced the course content to include just those things that we have found to be important contributors to bearing life extension.

In this Session we will look at those matters that concern the bearing in its non-operating environments. Reference to ‘bearing’ means a rolling-element bearing.

2. Storage and Handling.

New bearings should be transported and stored in the horizontal position. Why? Because a new bearing has a protective coating of a rust-inhibiting compound only – no grease – and therefore any significant shock that could be caused through heavy handling or vibration needs to be spread over all rolling elements. If the bearing is sitting vertically then there is the potential for point loading on just one or two elements and resulting permanent surface indentations which are called ‘brinelling’.

Which is a good time to introduce the important subjects of brinelling and false brinelling.

Swedish engineer J A Brinell (1849-1925) developed a method for determining the hardness of metal surfaces by measuring the force required to impress a hard steel ball into a surface. The Brinell Number describes the hardness of a material when tested by a defined procedure.

The indentation of a bearing raceway through mechanical loading is therefore known as ‘brinelling’. This can easily occur when the raceways of a bearing are permanently marked through excessive loading caused by dropping or incorrect driving methods during installation.

Obviously brinelling is highly undesirable and can lead to premature failure of the bearing. More on this later.

‘False brinelling’ is the term used to describe the marks on the surface of a raceway not caused by excessive point loading but rather by mechanical or chemical etching of the surface. The appearance is similar but, because the marking is generated by chemical or mechanical means, it is quite descriptively referred to a ‘false brinelling’.

False brinelling also has potential to cause premature bearing failure and is remarkably common, as we will see.

So, back to storage and handling, procedures should be put in place to ensure that bearings are stored in a low-vibration, dry environment and transported to the work site with care.

Another form of storage is the bearings installed in spare machines. Recently we visited a manufacturing plant having hundreds of small to medium sized electric motors. The maintenance approach is basically ‘breakdown’ so when an electric motor fails there is a spare available to install. We found about 30 spare motors sitting on the floor at one side of the main production building, right next to an open roller-door. As we stood looking at the motors we could feel plant vibration in the floor.

We could scarcely imagine a worse situation. Floor vibration would undoubtedly generate false brinelling as the constant relative movement in the bearings would remove the oil film and allow metal to metal contact. In addition the exposure to moisture from outside – in addition to the humidity inside – would create a situation where moisture would add to the etching process. No wonder the reliability performance of electric motors was generally thought to be poor in this plant!

Spare motors should be stored well away from sources of background vibration, on above-floor racks and in a dry and well-ventilated area. In addition, spare machines should be rotated a few turns every so often, perhaps weekly or fortnightly. This ensures that a fresh oil film is generated from the grease and the opportunity for false brinelling is minimised.

3. Transport of Machines.

The risks of brinelling and false brinelling are at a maximum during transport of assembled machines. Electric motors are particularly vulnerable because of the large, heavy rotors, but all machines are prone to damage.

It would be our assessment that every electric motor imported to Perth by ship, road or rail would have some damage to bearing raceways, ranging from very minor to quite severe. The problem is greatly compounded when road transport to remote sites is required. The poor condition of country roads almost guarantees that the bearings will have been significantly damaged by arrival at the remote site.

Some efforts have been made to minimise transport damage. It is quite common for ‘shaft locks’ to be applied. These are simple clamps on the shaft which hold the shaft in an axial pre-load to minimise relative axial movement of the shaft to the housing. Others have mounted the machines on rubber pads to reduce vibration and shock loading, with perhaps some benefit. Our observation is that the selection of these vibration isolators has generally been done without any real understanding of the dynamics involved. (Refer to Session 8 in Module 2).

We believe that there are three practical approaches to reducing transport damage.

- (i) **Avoid cylindrical roller bearings.** Electric motors are supplied as standard with cylindrical roller bearings at the drive-end. These are for universal application including belt drives where radial bearing loads are high. Unfortunately, cylindrical roller bearings are very prone to false brinelling due to the relative sliding motion if the shaft vibrates axially during transport.

Deep-groove ball bearings are less likely to suffer mechanical etching due to the fact that the balls can ‘roll’ in all directions. Therefore, electric motors that are never going to be used for

- belt drives should be specified to have deep-groove bearings at both ends. Another reason in support of this is the matter of bearing loading, to be covered later.
- (ii) **Install effective shock and vibration isolators.** This is particularly relevant to remote site transport by road. A set of rubber block-type isolators chosen to provide rigidity at low frequencies but effective shock isolation from, say, 15 Hz upwards are a good choice. By this means the chance of brinelling due to impact is greatly minimised and likewise false brinelling due to low-frequency axial motion of the shaft. Each motor size and type justifies careful selection of isolators.
 - (iii) **Shaft Locks.** The widely used shaft locks are certainly useful and will be much more effective when applied together with shock isolation.

(A case history concerning acceptance tests on two large motors that suffered bearing damage due to transport will be detailed at this point).

4. Installation and Removal of Bearings.

There is much information available from bearing manufacturers on the proper techniques for the installation and removal of bearings. Unfortunately we continue to see evidence of poor installation techniques and consequently bearing life - and hence machine reliability - is compromised.

Investment in the right tools for preparation, fitting and removal of bearings can represent a large capital outlay. However, we believe that the investment would be justified by improved service reliability of machines locally overhauled.

Some form of quality assurance from external contractors should also be instituted. Evidence that they have the right equipment and appropriate fitting procedures should be sought and periodic inspections made.

FAG Australia have supplied an excellent video on the subject of bearing installation and removal titled "Mounting and Dismounting Rolling Bearings" and, to finish this session, we will look at the video and discuss the material presented in there.