Bearing Installation and Handling
Topics

- Remove Bearings
- Install Bearings
- Lubrication
- Handling and Storage
The Importance of Proper Installation

- Ensure safety
- Simplify and speed the process
- Make full use the bearing’s load capacity
- Get the longest possible bearing life
- Prevent rings from turning on or in their seats under load
Safety Warning

Proper maintenance and handling practices are critical. Failure to follow installation instructions and to maintain proper lubrication can result in equipment failure creating a risk of serious bodily harm.
Start With a Clean Work Area

- Clean the work area of debris or dirt that could find its way into the bearing
- Wipe any surface where the bearing will be placed to avoid contaminating the grease
Removing Bearings
Remove Bearing

- Guillotine puller
Remove Bearing

- Guillotine puller
Remove Bearing

- Rotate cone by hand
Remove Bearing

- Manual drivers
Remove Bearing

- Drive bearing off the shaft
Remove Bearing

- Drive bearing off the shaft
Remove Bearing

- Keep your tools organized
Remove Bearing

- Pullers
Remove Bearing

- Puller with hydraulic assist
Remove Bearing

- Maintain alignment: Apply force to tight fitted member
Clean Bearing

- Cleaning bearing components
Clean Bearing

- Cleaning bearing components
Clean Bearing

- Alkali cleaners
  - 2-3 ounces per gallon of heated water typical mixture

- Kerosene

- Other commercial cleaners / solvents
  - Environmental friendly cleaners are available
Clean Bearing

- Blow solvent out of bearing
Clean Bearing

**Warning!**

Never spin a bearing with compressed air. The rollers may be forcefully expelled creating a risk of serious bodily harm.
Inspecting Bearings

- Visual inspection
Inspecting Bearings

- Checking for spalls
Inspecting Bearings

- Checking for spalls
Uneven Wear Patterns

- Do not mix new with used components
Installing Bearings
Prepare for Installation

- Check for debris
Prepare for Installation

- Clean and wipe out gear case
Prepare for Installation

- Inspect and prepare the shaft
Prepare for Installation

- Inspect and prepare the shaft
Prepare for Installation

- Inspect and prepare the bearing seat
Prepare for Installation

- Inspect and prepare the bearing seat
Prepare for Installation

- Inspect and prepare the bearing seat
The bearing is backwards

Tim Kraft, 8/22/2006
Prepare for Installation

- Inspect and prepare the bearing seat
Prepare for Installation

- Inspect and prepare the bearing seat
Check Dimensions

- Check housing bore
Check Dimensions

- Check shaft
Optional Section

- 12-point Shaft & Housing Measurement Procedure

Click the bullet to view this section, click anywhere else to skip it.
Bottom line

- Precision bearings require proper support
- Shaft and housing condition is critical to bearing system performance
- Remember, a bearing is only as good as the shaft it’s mounted on, and the housing it’s mounted in
Check Shaft Shoulder Fillet Radius
Check Shaft Shoulder Fillet Radius
Shaft Fillet & Shoulder Diameter

- Shoulder diameter too small
- Shaft fillet diameter too large
- Shoulder diameter too large
- Correct shaft shoulder diameter and fillet
Install the Bearing

- Pregrease seal
Install the Bearing

- Drivers

Cup (Outer Ring) Drivers

Cone (Inner Ring) Driver
Install the Bearing

- Press bearings in through the face
Install the Bearing

- Drive the bearing on
Install the Bearing

- Drive the bearing on
Heat / Chill Bearings

- Freeze tight fitting outer rings to help installation in housing
- Chill limits (lowest)
  - Standard product: -65°F (-54°C)
    Use dry ice in alcohol bath
  - Precision product: -20°F (-29°C)
    Use freezer
Heat / Chill Bearings

- Heat or chill bearings to ease installations
- Heat limits (maximums)
  - Standard product, metallic cage, no seals:
    200°F (93°C) for 24 hours
    250°F (121°C) for 8 hours
  - Standard product, nonmetallic cage and polymer or elastomer seals:
    200°F (93°C) 24 hours
  - Precision product:
    150°F (66°C) 24 hours
Heating Bearings

- Oil bath method
  - Temperature: < 250°F
  - Duration: varies according to size
  - 15 minutes to two hours soak time
Heating Bearings

- Heating lamp
Heating Bearings

- Induction Heating
Heating Bearings

- Induction Heater
Heating Bearings

- Avoid using a torch to heat bearings
Heating Bearings

- Handling hot bearing
Heating Bearings

- Handling hot bearing
Heating Bearings

- Hold bearing in position while cooling
Heating Bearings

- Cooling bearing
Protect the Bearing
Check Fit

- 0.002” (.05 mm) shim stock / feeler gage
Check Fit

- 0.002” (.05 mm) shim stock / feeler gage
Check Fit

- 0.002" (.05 mm) shim stock / feeler gage
Check Fit

- 0.002” (.05 mm) shim stock / feeler gage
Lubricating Bearings
Lubrication

- The lubricant reduces friction between mating surfaces
- Helps to keep the bearings, and the equipment, running cooler
- Protects bearings from debris and corrosion.
Lubrication

- Select the right type and grade of grease
- When regreasing, ensure that the new grease is compatible with the existing grease in the bearing
Lubrication

- Place grease in your hand and work it through the rolling elements
Lubricating the Bearing

- Mechanical grease packers
Lubricating the Bearing

- Mechanical grease packers
Lubricating the Bearing: Grease Fill

- Do not overgrease!
  - Fill roller bearings from 1/3 to 2/3 of their free volume

Over-lubricated and incorrectly lubricated
Over-lubricated or incorrectly lubricated
Proper lubrication
Install the Bearing
Install the Bearing
Install the Bearing

- Ensure bearing is flush with shaft shoulder

.002” feeler gage
Storing Bearings
Protecting the Bearings
Storing Bearings
Bearing Adjustment
Adjusting Bearings

- Some bearings are “adjustable” … the distance between the rolling elements and raceways can be set during installation.

- For non-adjustable bearings, you can slightly modify the rolling element/raceway clearance through an interference fit.
Shaft and Housing Dimensions

- **Size**
  - OD tolerance

- **Roundness**
  - One-half OD tolerance

- **Straightness**
  - One-half OD tolerance
Ensure Proper Shaft Tolerances
Proper Shaft and Housing Conditions

- Provide bearing support
  - Effective capacity
- Prevent relative motion
  - Holding torque
- Minimize component fretting
  - Limit wear
- Improve machine operation
  - Limit runout / vibration
Important Shaft and Housing Attributes

- **Size**
  - Average diameter

- **Form**
  - Roundness, straightness (taper)

- **Surface roughness**
  - Topography
## Surface Finish Requirements

<table>
<thead>
<tr>
<th></th>
<th>Straight</th>
<th>Tapered</th>
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</thead>
<tbody>
<tr>
<td><strong>Shaft</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>63 rms</td>
<td>50 rms</td>
<td></td>
</tr>
<tr>
<td><strong>Housing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>125 rms</td>
<td>63 rms</td>
<td></td>
</tr>
</tbody>
</table>
Roundness and Straightness Tolerance Requirements

- Roundness equals one half of size tolerance
- 80% conformity required
Correct Shaft Mounting

- Equal support
  - minimum 80% conformity
- Effective holding torque
- Minimal fretting
Stepped Shaft Installation

- Uneven support
- High wear potential
- Exaggerated loading
- Inner ring axial bending
- Reduced holding torque
Bowed Shaft Installation

- Uneven support
- Exaggerated loading
- Inner ring axial bending
- Reduced holding torque
Hollow Shaft Installation

- Exaggerated loading
- Inner ring axial bending
- Extreme uneven support
- Reduced holding torque
Tapered Shaft Installation

- Exaggerated loading
- Inner ring axial bending
- Uneven support
- Reduced holding torque
Irregular Shaft Installation

- Exaggerated loading
- Uneven support
- Limited holding torque
- High wear potential
Optional Topics

- Tapered Bearing Adjustment
- Multiple-Row Spacer Bearing Adjustment
- TDO Bearing Measurement

Click a bullet item to jump to that section of the presentation, click anywhere else for the next slide.
Bearing Installation and Handling
Optional Content
Roller Scoring
12-point Shaft and Housing Measurement Procedure
12-Point Process Requirements

- Clean environment
- Calculation data sheet
- Precision straight-edge, sine bar
- Application shaft size and tolerance
- Application housing size and tolerance
- Two-point diameter gages accurate to .0001” (.003 mm)
Select three measurement planes to define bearing housing / shaft contact.
Identify four angular positions within each plane for diameter measurement.
12-Point Measurement Worksheet

<table>
<thead>
<tr>
<th>Application</th>
<th>Press roll</th>
<th>Machine</th>
<th>#1</th>
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<tbody>
<tr>
<td>Measured by</td>
<td>Ken Holmes</td>
<td>Date</td>
<td>2/2/04</td>
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### Bearing

<table>
<thead>
<tr>
<th>Bearing</th>
<th>23264YMBW507C08</th>
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<tbody>
<tr>
<td>Bore</td>
<td>12.5984 (in.)</td>
</tr>
<tr>
<td>Minimum</td>
<td>12.6023 (in.)</td>
</tr>
<tr>
<td>Maximum</td>
<td>22.8379 (in.)</td>
</tr>
<tr>
<td>Tolerance</td>
<td>0.0015 (in.)</td>
</tr>
<tr>
<td>O.D.</td>
<td>22.8346 (in.)</td>
</tr>
<tr>
<td>Tolerance</td>
<td>0.0028 (in.)</td>
</tr>
<tr>
<td>Width</td>
<td>8.1890 (in.)</td>
</tr>
<tr>
<td>Form</td>
<td>0.00075 (in.)</td>
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### SHAFT

#### Angular Measurement

<table>
<thead>
<tr>
<th>Plane</th>
<th>0</th>
<th>45</th>
<th>90</th>
<th>135</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>12.6008</td>
<td>12.6012</td>
<td>12.6020</td>
<td>12.6015</td>
</tr>
<tr>
<td>B</td>
<td>12.6018</td>
<td>12.6030</td>
<td>12.6023</td>
<td>12.6023</td>
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<tr>
<td>C</td>
<td>12.5995</td>
<td>12.6002</td>
<td>12.6008</td>
<td>12.6002</td>
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#### Form

<table>
<thead>
<tr>
<th>Plane</th>
<th>Average Round Taper Planes (in.)</th>
<th>Taper Planes (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.00120 A-B 0.00097</td>
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</tr>
<tr>
<td>B</td>
<td>0.00120 B-C 0.00217</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.00130 A-C 0.00120</td>
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</table>

### HOUSING

#### Angular Measurement

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<th>90</th>
<th>135</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>22.8356</td>
<td>22.837</td>
<td>22.8360</td>
<td>22.8364</td>
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<tr>
<td>B</td>
<td>22.8346</td>
<td>22.8356</td>
<td>22.8352</td>
<td>22.8350</td>
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<tr>
<td>C</td>
<td>22.8376</td>
<td>22.8384</td>
<td>22.8381</td>
<td>22.8384</td>
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</table>

#### Form

<table>
<thead>
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<th>Plane</th>
<th>Average Round Taper Planes (in.)</th>
<th>Taper Planes (in.)</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>0.00140 A-B 0.00115</td>
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</tr>
<tr>
<td>B</td>
<td>0.00100 B-C 0.00303</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.00080 A-C 0.00187</td>
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</tbody>
</table>

The red-shaded range identifies the out-of-tolerance condition.
Confirm surface topography across bearing seat
Prussian blue and precision straight edge or sine bar confirms surface topography

- Check in angular planes
- 80% conformity required
Tapered Roller Bearing Adjustment
Tapered Bearing Adjustment

Internal Axial Clearance: Endplay
Bearing Adjustment
Bearing Adjustment

Clearance

Seated Bearing

Unseated Bearing

End Play
(Shaft Movement Relative to Housing)

Position 1
Right Bearing Seated

Position 2
Left Bearing Seated
Bearing Adjustment

No Shaft Movement

Seated Bearing

Seated Bearing

No Clearance

No Clearance

Bearing Handling and Maintenance – T60
Bearing Adjustment

Housing

Line-to-Line Contact

Shaft
Bearing Adjustment

Remove Shims To Compress The System

Remove Shims To Compress The System
Bearing Adjustment

Load Exerted by Housing

Load exerted by housing
Bearing Adjustment

- Internal Clearance (Endplay)
- Zero Clearance
- Preload
- Excessive Preload
Bearing Adjustment

Relative Life Vs. Operating Bearing Settings

Preload ↔ Endplay

Relative Life Increase
Bearing Adjustment

- Using a dial indicator while pushing / pulling the bearing
Bearing Adjustment

- Need to oscillate the bearing so the rollers climb the taper and fully seat against the large rib
Bearing Adjustment

- Use torque wrench to check rolling torque
Bearing Adjustment

Gear radius (inches) \times \text{Pull (pounds)} = \text{Torque ((inch/pounds)}}
Bearing Adjustment
Multiple-Row Spacer Bearings
Multiple-Row Bearings

TDO

TDI
Multiple-Row Bearing Applications

- Usually mounted with tight fitted cones on rotating shafts
  - Where cones can be loose fitted, may want to use a TDI at one position (can use TDO at other)
- One bearing commonly "fixed" and one "float"
Preset Assemblies

- Spacer bearings
  - Bench Endplay or Bench Preload, the endplay or preload measured on the bench in manufacturing facility
Preset Assemblies

- Spacer bearings
  - Components are not interchangeable
  - Components are supplied as "matched" assemblies
  - Identified by cone part number & assembly* number

* Not inscribed on the bearing
Preset Assemblies

- Spacer bearing assembly number

5 6 6 9 0 2 A 1

Cone number          Sequential number

Class *             Various Meanings (county, etc.)

Indicates Assembly

* For bearings made after mid 1990s only. Prior to that, a random number.
Preset Assemblies

- Spacer bearing 566 - 902A2
  - (2) 566 cones
  - (1) 563D cup
  - (1) X2S-566 cone spacer
  - Bench endplay (BEP) = 0.008” (0.20mm)
  - Inspection = 20024
Preset Assemblies

- Spacer bearing 566 - 902A1
  - Same components and inspection
  - Bench preload (BPL) = 0.001” (0.03 mm)
Measuring Bench Endplay / Preload

Preset Assemblies - Spacer Bearings

1. Measure bearing on bench (drop method): $B = (AB + CB) - AC$
Measuring Bench Endplay / Preload

Preset Assemblies - Spacer Bearings

2. Determine spacer length
Measuring Bench Endplay / Preload

Preset Assemblies - Spacer Bearings

3. Mark assembly components with serial number
Mounted Setting

- Endplay or preload in a mounted bearing as a result of changes in lateral due to tight cone or cup fits, or both
Operating Setting

- Amount of endplay or preload in a bearing system at operating conditions
Bench End Play

- Establish Bench End Play
  – Chosen for desired performance

Operating Setting = BEP - \( \text{lateral loss due to fits} \) - \( \text{lateral loss due to thermal changes} \)
Fixed/Float Bearings

**Fixed Bearing**
- Restrained from axial movement

**Float Bearing**
- Able to move or “float” axially
25 years later, I can finally stop looking at this bearing!

Bob Roseman