

# **BB-06**

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## **MAINTENANCE MECHANIC TRAINING**

### **SKILL DEVELOPMENT GUIDE**

**Duty BB: Spindles**

**BB-06: Set Bearing Load**

**Issued 03/01/98**



## Task Preview

### Set Bearing Load

Setting the spindle bearing load is performed by a journeyman or an apprentice under a journeyman's direction. The bearing load can be adjusted in the machine in some cases, but often is done with the spindle removed from the machine.

When a spindle is rebuilt, the bearing load must be set. The bearing load should be checked when unusual bearing noise, spindle vibration, or a bad surface finish occurs. Adjustable spindle bearings' (bearings without sized spacers determining preload) load should be checked whenever these bearings are adjusted.

You must be able to read blueprints and operate precision measuring devices to set the bearing load correctly. If this task is performed incorrectly, an improper bearing load could damage the bearings, cause an out-of-round product, or cause finish problems in the product.

### How your skills will be checked

The Skill Check will require you to set the bearing load. All tools, materials, and resources will be available. The Evaluator will verify that your demonstration meets the skill objective by observing or measuring each task standard. You must demonstrate safe work practices during the Skill Check. Contact your Evaluator when you are ready for the Skill Check.



## **Skill Objective**

Given a spindle, bearings, spacers, and required components, set the bearing load for a spindle.

### **Task Standards**

1. The spindle bearing load must be set to meet manufacturer's specification for end-play and radial movement.
2. The spindle must cut without causing chatter or out-of-round bores.
3. When the spindle is turning, heat caused by the bearing must be within the manufacturer's specifications.

## What You Will Need

This section contains the safety information, tools, and resources you will need before setting the bearing load.



- Follow all Caterpillar facility safety standards when performing this task.
- Wear protective gloves when working with hazardous temperatures (extreme cold or heat).
- Spindles often have excessive weight; use caution when working on or around the spindle.



- precision measuring instruments: dial indicator, depth micrometer, and inside or outside micrometer
- rubber mallet
- pry bar
- deburring stone
- infrared or other thermometer
- grease (as recommended by the manufacturer)



- Engineering blueprint
- ERS history (to check for a repeated problem)



## Task Steps

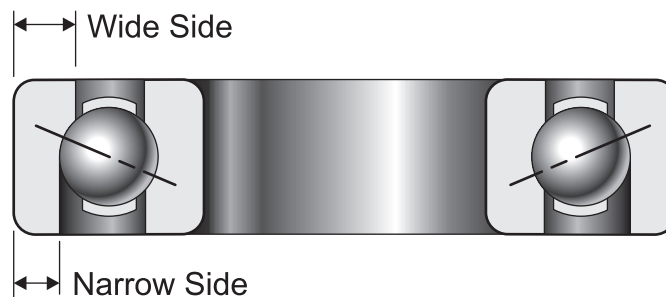
### Set Bearing Load

**Note:** The procedures for rebuilding a spindle and repairing a spindle often require setting the bearing load.

**Caution!** Stone or deburr all surfaces and check measurement twice.

#### 1. Preload the bearings.

- Angular contact bearings used in many applications are loaded by applying pressure along the spindle center-line to the inner and outer races in opposite directions.
- An outer race of this type bearing has a narrow and a wide side. If the outer race is “trapped” in a housing so it cannot move, pressure applied to the narrow side of the inner race moves the inner race towards the outer race, trapping the balls between the races. This loads the bearing.

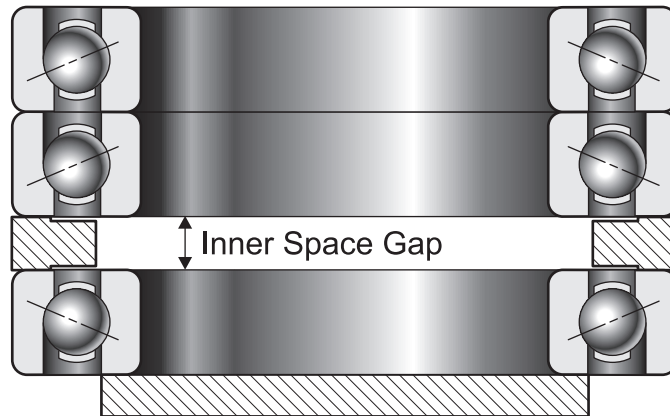


- “Preloading” is the process of applying pressure at assembly.

**Caution!** Pressure applied in the wrong direction can push these bearings apart.

**2. Measure spacer sizes for proper preload.**

- Stack the bearings and outer race spacer (leave inner race spacer out) (according to print) on a flat surface with the inner race of the bottom bearing supported.

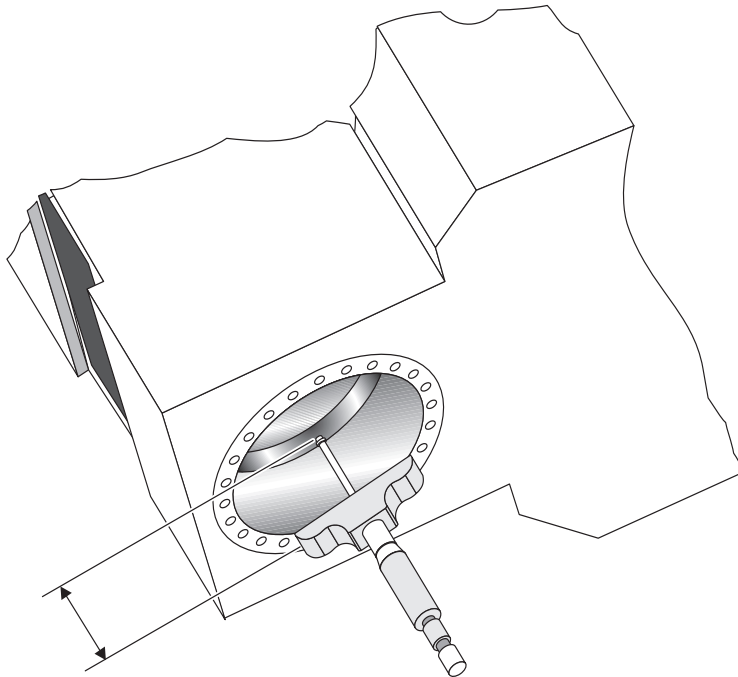


- Weight pulls the outer race of the lower bearing down until races and balls touch. Leaving out the inner race spacer allows the inner races to come together until races and balls touch. This is, in effect, a state of neither load nor unload.
  - Measure accurately the gap between inner races, using gage blocks. Sizing the width of the inner race spacer smaller than this gap will create preload.
- 3. Grind, shim, or make new the inner spacer to achieve the preload recommended by the manufacturer.**

## Trapping Bearings in Housing Bore

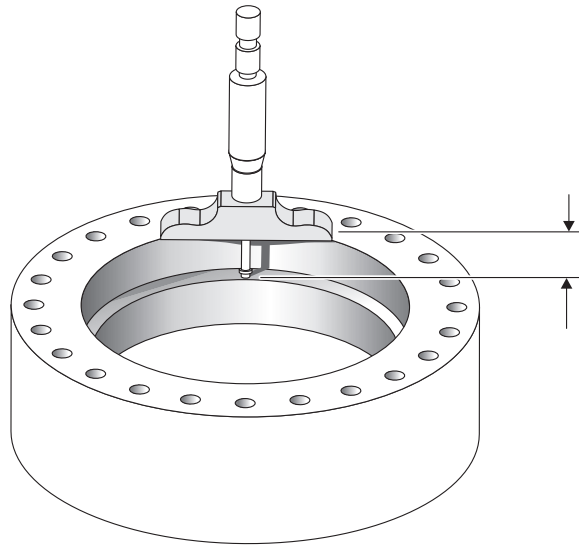
### 1. Measure the housing bore depth.

- Measure the depth of the housing counterbore from counterbore face to housing face with a depth micrometer as shown in the figure below.



**Bearing Entrapment Housing Depth**

- Measure the end-cap counterbore depth as shown in the figure below.



### **End-cap to Interior of Bearing Face**

- Add these two measurements together to determine total counterbore length.
- 2. Measure the bearing “stack”.**
    - Stack the bearings and spacers according to the manufacturer’s print.
    - Measure the bearing stack length with a micrometer or measure all bearings and spacers and add those dimensions together.
    - The stack must measure more than the counterbore length to ensure outer bearing races will not move inside the housing.
  - 3. Determine the part or machining needs.**
    - Grind or shim the end-cap counterbore step to achieve the proper “trap” of the outer bearing races in the bore.

### **Assembly**

- 1. Assemble the bearing stack onto the spindle.**
  - Place the bearings, spacers, and end-cap onto the spindle as shown on the print.
  - Bearings should fit snugly, but turn freely with bearings and spindle at room temperature. If necessary, to aid in assembly, freeze the spindle and/or heat the bearings.



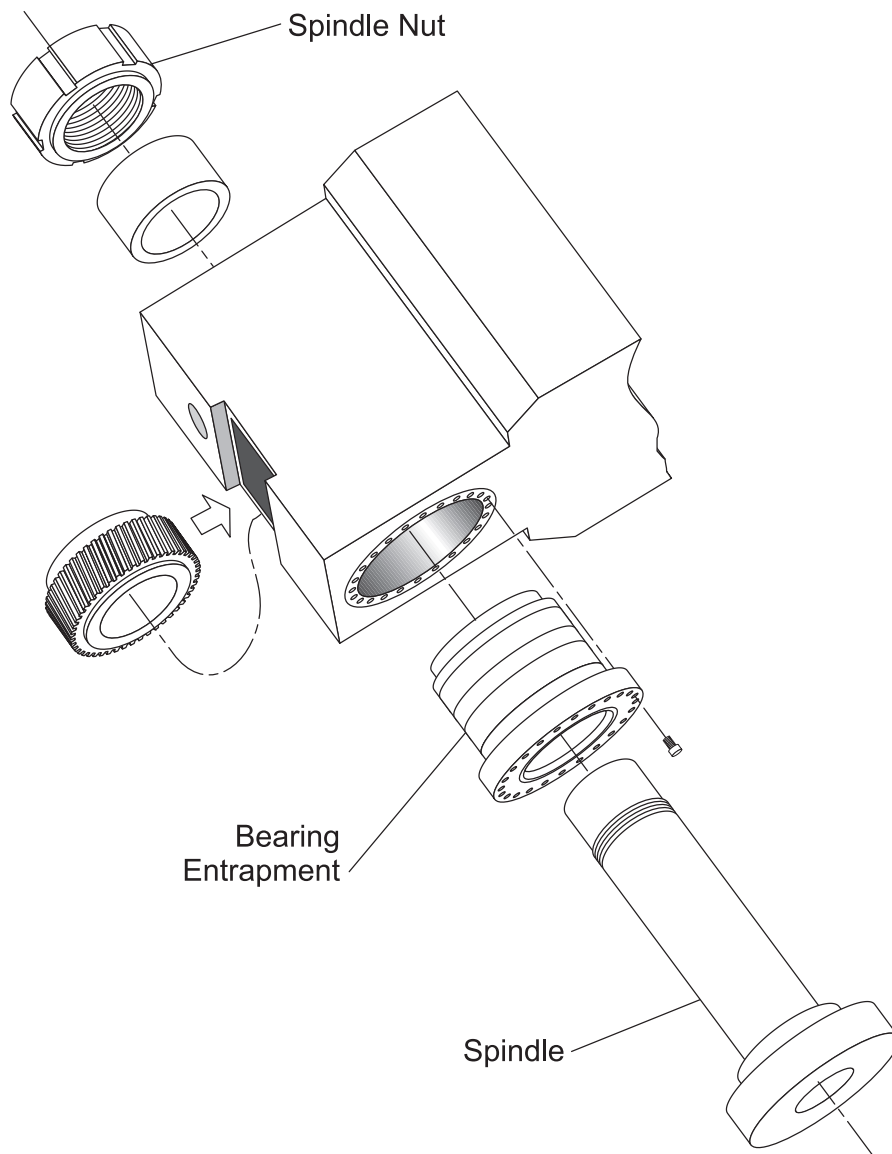
- Grease each bearing according to manufacturer's specifications.

**Caution! Too much grease can be as harmful as not enough grease.**

- If assembling matched duplex (two), triplex (three), or quad (four) bearing sets, align the bearing assembly marks. These marks align bearings to each other.

## **2. Assemble spindle in housing.**

- Insert the spindle, bearings, and cap as a unit into the housing.



### **Reassembling the Spindle and Bearing Entrapment**

- Fasten the end-cap to the housing. This “traps” the outer bearing races in the bore.

**3. Tighten the spindle nut.**

- Tightening the spindle nut will set the bearing load created by the spacers. If the spacers are properly sized, one can tighten the nut securely.
- Gears, spacers, spindle nuts, or other parts may require assembly from inside the housing.

**4. Perform bearing run-in procedure.**

- Operate the spindle for approximately five minutes at a low rpm. Monitor the bearing temperature with an infrared or another thermometer. Follow manufacturer’s specifications on bearing heat.
- If preload is too high, heat will climb quickly.
- Stop spindle and allow bearings to cool.
- Repeat the process until spindle end play, radial movement, and bearing temperature are within print specifications. This gives all components an opportunity to expand/contract and distributes the force of the preload.

**Bearings Without Spacers**

**1. Adjust the spindle nut.**

- If no spacers exist to determine preload, how much nut is tightened determines load. Timken tapered-roller bearings are often loaded this way.
- Tighten the spindle nut until some resistance to turning the spindle by hand is felt.

**2. Operate the spindle to check end play, radial movement, and bearing temperature.**

- Operate the spindle for about five minutes at a low rpm. Monitor the bearing temperature with an infrared or other thermometer. Follow the manufacturer’s specifications on bearing heat.
- If the nut is too tight, the heat will climb quickly.
- Stop the spindle.
- Repeat the process until the spindle end play, radial movement, and bearing temperature are within print specifications.



## Concept Check

### Set Bearing Load

Answer the following questions to check your understanding of setting the bearing load. Circle the correct answer in each question. Then compare your responses with the answers at the bottom of this page. Some of the questions may have more than one correct answer. If you have difficulty answering a question, review the Skill Development Guide or ask your Trainer for assistance.

1. The bearing load can be adjusted while the spindle body is:
  - a. installed on the machine.
  - b. in the shop, only.
  - c. running.
  - d. in deep freeze.
  
2. Measure the depth of the housing with:
  - a. an outside micrometer.
  - b. a dial indicator.
  - c. a depth micrometer.
  - d. an inside micrometer.
  
3. Bearings should fit tightly and turn smoothly after the bearing and spindle reach:
  - a. the shop.
  - b. peak rpm.
  - c. the spindle unit facing.
  - d. room temperature.

4. To complete setting the bearing load:
  - a. the machine must be turned on.
  - b. the spindle nut must be tightened.
  - c. the spindle unit must reattached.
  - d. the spacers must be ground.

Answers: (1. a 2. c 3. d 4. b)

### **Next Step**

If you are ready to demonstrate the task now, ask your Evaluator or Trainer to schedule the Skill Check. However, if you need to practice some of the steps first, continue to the next section.



## **Practice**

The following practice will help prepare you for the Skill Check. Ask your Trainer to set up the practice for you. After you complete a practice, ask your Trainer to check your work.

### **Practice**

Practice indicating parts and comparing them to print specifications. Read a print and identify a part. Locate the part and measure it to verify that it is within print specified tolerance.

### **Practice Objective**

You must show that the part measurement matches the print specifications.

## **Next Step**

Continue to practice until you are ready for the Skill Check. When you are ready to demonstrate the task, ask your Evaluator or Trainer to schedule the Skill Check.

