

**BULLETIN 4702**

**P-222-31**

## **Installation Instructions**

**Overrunning Internal  
Backstop Clutches**

**Models FS 20  
2 thru 10**



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## Introduction

The FS 20 series clutches are intended primarily for use as a built-in backstop for backstopping applications.

- Formsprag FS 20 series clutches mount directly on the customer's shaft which acts as the inner race.
- The O.D. of the outer race corresponds to the outer race diameter of standard bearing series.
- The tolerance on the O.D. of the outer race is held to ensure a proper fit into a continuation of the bore that accommodates the adjacent bearing.

**⚠ WARNING** Failure to strictly follow the service and installation instructions set forth herein could result in severe personal injury or property damage. If for any reason you have a question as a result of reading these instructions or for any other reason not covered by these instructions contact Formsprag Application Engineering Department before attempting to install the clutch into the equipment.

## Pre-Installation

Before installing the clutch refer to the information in (Table 1) for the proper model. Table 1 shows the standard bearing size which corresponds to the O.D. of the clutch in Column A, the diameter of the customer's shaft that forms the inner race of the clutch assembly is Column B, the clutch nominal width is Column C, and the nominal keyseat in the clutch outer race is Column D.

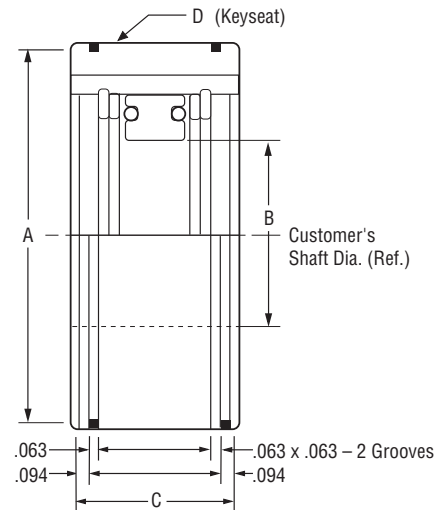
If the clutch you have on hand is not listed in Table 1, contact the Original Equipment Manufacturer or Formsprag Application Engineering Department for further details.

The shaft on which the clutch is mounted must be supported by a bearing. FS 20 series clutches are designed to be used with standard series bearings. The outside diameter of the clutch corresponds to the outside diameter of the bearing. The clutch outside diameter tolerance is held to ensure a proper fit (without pressing) into the housing bore. The tolerance on the housing bore should follow the bearing manufacturer's recommendation.

## Dimensions inches (mm)

Size	O.D. Standard Bearing Sizes	Outside Dia. A	Customer's Shaft Dia. (Ref.) B	Width (Nom.) C	Keyseat (Nom.) D
FS-20-3	203	1.5743/1.5728 (39.99/39.95)	0.650/0.649 (16.51/16.49)	1.0 (25.4)	1/8 x 1/16 (3.48 x 1.57)
FS-20-4	204	1.8498/1.8483 (46.98/46.95)	0.740/0.739 (18.80/18.77)	1.0 (25.4)	3/16 x 3/32 (4.75 x 2.36)
FS-20-5	205	2.0463/2.0448 (51.98/51.94)	0.930/0.929 (23.62/23.60)	1.0 (25.4)	3/16 x 3/32 (4.75 x 2.36)
FS-20-6	206	2.4403/2.4388 (61.98/61.95)	1.290/1.289 (32.77/32.74)	1.125 (28.58)	1/4 x 1/8 (6.35 x 3.18)
FS-20-7	207	2.8341/2.8326 (71.99/71.95)	1.657/1.656 (42.09/42.06)	1.125 (28.58)	1/4 x 1/8 (6.35 x 3.18)
FS-20-8	208	3.1491/3.1476 (79.99/79.95)	1.841/1.840 (46.76/46.74)	1.25 (31.75)	3/8 x 3/16 (9.52 x 4.75)
FS-20-10	210	3.5428/3.5413 (89.99/89.95)	2.209/2.208 (56.11/56.08)	1.25 (31.75)	3/8 x 3/16 (9.52 x 4.75)

**Table 1**



## New Installations

### 1. Shaft Extension (Customer Supplied)

**Shaft Size:** (See Table 1) Refer to Customer's Shaft Dia. "B" for the size of the shaft extension required to properly fit the corresponding clutch assembly. If the extension shaft is stepped down from the bearing bore diameter to the clutch diameter, a sufficient radius must be provided at the stepped down shoulder to reduce excessive stress concentrations in the shaft at the location.

The Recommended radius should be greater than 0.01 inches.

**Shaft Hardness:** The shaft extension must be carburized to an effective depth of .050 - .060 inches after grinding and be hardened to Rockwell "C" 58-62. The core hardness of the shaft must be Rockwell "C" 28-40.

**Taper:** Taper on the shaft and the housing bore must not exceed .0002 inch per inch.

**Shaft Finish:** The shaft extension must be ground to the diameter specified in Table 1, Column B, for the corresponding model. The micro-finish must be 15 - 25 RMS.

**Concentricity:** The concentricity between the shaft extension and the housing bore that fits the outer race of the clutch is critical. The Total Indicator Reading (T.I.R.) takes into consideration the effects of bearing end-play as well as machining eccentricities. The concentricity requirements are listed in (Table 2).

The base of a dial indicator can be mounted on the end of the extension shaft with the needle at the backstop bore in the housing, see Figure 1. Rotate the shaft sweeping the bore 360° which will give the T.I.R.

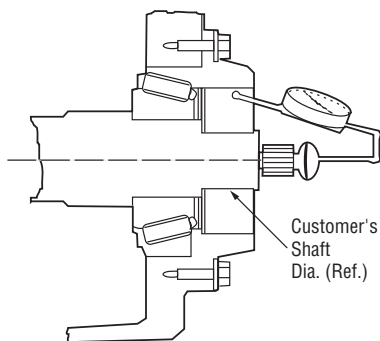


Figure 1

Model	T.I.R. (in.)
FS 20 - -3 to -10	.002

Table 2

**Shaft End-play:** If taper roller bearings are used check the amount of end-play of the extension shaft. The shaft end-play should not exceed .003 inches.

End-play is measured with a dial indicator at the end of the shaft (See Figure 2). The base of the indicator is attached to the reducer housing. From the other end of the shaft an axial force must be applied in both directions. Push and Pull.

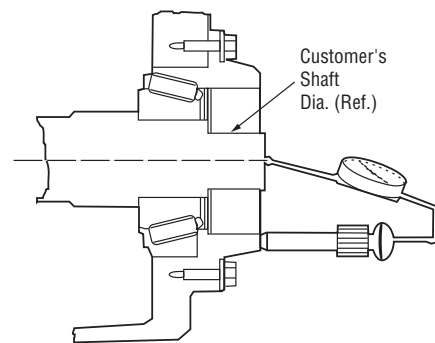


Figure 2

### 2. Key and Keyseat

**Housing Keyseat:** Refer to Keyseat - Nom. "D" for the nominal size of the keyseat in the O.D. of the outer race (See Table 1). The keyseat in the housing bore should allow for a line fit to .001 inch loose on the width dimension. The taper of the keyseat should not exceed .0002 inches per inch of length.

**Hardness:** Use a hardened key, Rockwell "C" 30 - 40. Use material AISI 1141, 1045 or 4130.

**Fit:** Break edges of the key before installing to prevent any bearing at these points. The key should be a line fit to .001 inch loose on the width dimension.

**Length:** The length of the key must be equal to the nominal width of the outer race, "C". (See Table 1)

### 3. Rotation

Check the application to determine in which direction the extension shaft must rotate freely while in operation.

## Replacement Units

**⚠ WARNING** To ensure drive does not unexpectedly start while removing the clutch, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

**⚠ WARNING** Removal of the clutch may cause unexpected machine movement. Remove or block all external loads before servicing unit. Failure to observe these precautions could result in bodily injury.

1. Before removing the old clutch check and record the direction of rotation of the extension shaft. The end of the backstop outer race is marked with an arrow that indicates the direction that the extension shaft rotates freely while in operation.

**⚠ CAUTION** The installation of the replacement backstop must provide for the same rotation as the previous backstop to prevent damage to equipment or bodily injury.

2. Remove the used clutch from the extension shaft by pulling. Insert a tool, such as a screwdriver, in the groove around the O.D. of the backstop and pry the backstop from the housing bore.
3. Clean the area around the extension shaft and the housing bore with a clean cloth to ensure the removal of any contaminant or debris.
4. **Shaft Extension**  
**Shaft Size:** Measure and record the extension shaft diameter in the location where the sprags contact the shaft. Refer to Customer's Shaft Dia. "B" for the required extension shaft diameter for the clutch removed from the installation (See Table 1).  
If the shaft diameter is less than the minimum diameter specified, the shaft must be replaced with a new shaft.

**Shaft Hardness:** Check the extension shaft for any signs of excessive heat exposure. If the extension shaft shows any discolor such as a straw or blue color the shaft must be checked for hardness. The hardness should be checked in a location close to but not directly in line with the location of the sprags. The hardness of the extension shaft must be Rockwell "C" 58-62. If the shaft is less than the minimum specified hardness the shaft must be replaced.

**Taper:** Taper on the shaft and the housing bore must not exceed .0002 inches per inch.

**Shaft Finish:** The micro-finish of the shaft in the location where the sprags contact the shaft must be 15 – 25 RMS.

**Concentricity:** The concentricity between the shaft extension and the housing bore that fits the outer race of the clutch is critical. The Total Indicator Reading (T.I.R.) takes into consideration the effects of bearing end-play as well as machining eccentricities. The concentricity requirements are listed in Table 2.

The base of a dial indicator can be mounted on the end of the extension shaft with the needle at the clutch bore in the housing. (See Figure 1) Rotate the shaft sweeping the bore 360° which will give the T.I.R.

**Shaft End-play:** If the taper roller bearings are used check the amount of end-play of the extension shaft. It is possible that bearing wear or looseness might have increased the amount of end-play to an unacceptable level. The shaft end-play must not exceed .003 inches.

End-play is measured with a dial indicator at the end of the extension shaft (See Figure 2). The base of the indicator is attached to the reducer housing. From the other end of the shaft an axial force must be applied in both directions. Push and Pull.

### 5. Key and keyseat

Check the keyseat in the housing bore to ensure that the flanks of the keyseat are not worn. The keyseat in the housing bore should allow for a line fit to .001 inch loose on the width dimension. The taper of the keyseat must not exceed .0002 inches per inch of length.

**Hardness:** Use a hardened key, Rockwell "C" 30 – 40. Use material AISI 1141, 1045 or 4130.

**Fit:** Break edges of the key before installing, to prevent any bearing at these points. The key should be a line fit to .001 inch loose on the width dimension.

**Length:** The key must be equal to the length of the outer race.

## Installing

(See Figures 3, 4 and 5) for typical mounting arrangements on page 7.

1. Carefully determine in which direction the extension shaft must rotate freely while in operation. Match the arrow on the end face of the clutch outer race in the same direction.  
  
**Note:** The extension shaft must rotate freely in the same direction as the arrow on the clutch outer race while in operation. Reversing the clutch end for end changes the direction of the arrow.
2. For ease of installation slowly rotate the extension shaft in the same direction as the arrow on the clutch. Without removing the cardboard retainer from the clutch, gently push the clutch onto the extension shaft. When pushing the clutch onto the extension shaft it is very important not to hammer on the clutch although it can be tapped gently against the outer race with a soft tool if necessary. The cardboard retainer will be pushed onto the extension shaft. Throw away the cardboard retainer.
3. Line up the keyseats between the clutch and housing bore. Install the key with a push fit into the clutch and housing bore keyseat. Be sure the key seats squarely.  
**Do not use a force fit.**
4. Secure the clutch in position on the shaft. Use a snap ring, threaded retainer, retaining cover plate, etc. to keep the clutch in position on the shaft.
5. Check for proper installation by overrunning (freewheeling) the clutch by hand.

## Lubrication

Proper lubrication and lubricant maintenance are the most important maintenance factors for long, effective, trouble-free clutch operation. Read the following instructions and follow them carefully for maximum performance and utilization of Formsprag overrunning clutches.

If possible, FS 20 series clutches should be mounted below the oil level. The oil should not be below the inner race (shaft).

**Note:** If the clutch is mounted above the oil level, positive means such as spray or pressure lubrication should be provided to insure adequate lubrication.

The FS 20 series clutch is oil dipped at the factory but must be lubricated to the proper level before operation.

When replacing a clutch in an existing application such as an internal backstop in gear reducer or in torque arm (hollow shaft) speed reducers, use only the recommended lubricant as specified by the equipment's original manufacturer. Formsprag Clutch makes no other stated or implied recommendations. Consult the Original Equipment Manufacturer for further details concerning the type of lubricant and the oil lubrication maintenance procedure.

**Formsprag Clutch is not responsible for any changes made by the manufacturers in their lubricants.**

If a FS 20 series clutch is being installed into a totally new application which is not covered as a replacement part in an existing OEM piece of equipment, use lubricants selected from the following according to the clutch ambient temperature and the application.

The model FS 20 has a special srag design that will work with all types of lubricants those with EP additives.

## Oil Lubrication

### Overrunning & Backstopping Applications:

#### Temperature Range Recommended Lubricant

+20°F to +150°F (-7°C to + 65°C) (Max. permissible ambient temperature)	Mobil DTE Heavy Medium AMOCO Industrial Oil 68 Exxon Teresstic 68 Any Automatic Transmission Fluid
-10°F to +20°F (-23° to -7°C)	Mobil Gargoyle Arctic C Heavy Chevron Oil 46 AMOCO Oil 46 Any Automatic Transmission Fluid
-40°F to +150°F (-40°C to +65°C)	Mobil Jet Oil 2 Shell Turbine Oil 500 Exxon Turbo Oil 2389 Military Oils MIL-L-7808 or MIL-L-23699

### Indexing Applications:

#### Temperature Range Recommended Lubricant

+20°F to +150°F (-7°C to +65°C) (Max. permissible ambient temperature)	Mobil DTE Light Oil AMOCO Industrial Oil 15 Exxon Teresstic 32 Any Automatic Transmission Fluid
-10°F to +20°F (-23°C to -7°C)	Sunoco Sunvis 916 Exxon Zerice 46 Any Automatic Transmission Fluid
-10°F or below (-23°C)	Consult Formsprag Service Department

Other oils that contain Extreme Pressure (EP) additives with similar viscosity to the oils listed in the above chart can be used.

**⚠ WARNING** Do not mix the above oils, they are not compatible. When switching from one brand to another, drain old oil and flush clutch with mineral sprits before adding new oil. Do not use Carbon Tetrachloride.

## Oil Lubrication Maintenance

1. Lubrication is the most important clutch maintenance factor for longer service life.
2. Fill the clutch with oil once each month. For an indexing application, fill with oil every two weeks or after one hundred (100) hours of operation, whichever comes first. When clutch indexes at more than 150 strokes per minute or overruns at high speed in rugged duty cycle oiling may be required at shorter intervals.
3. To assure continued efficiency of operation, flush the clutch every six (6) months with mineral spirits. Do not use Carbon Tetrachloride.  
**⚠ WARNING** Under severe operating conditions such as heavy dust or twenty-four hours per day operation, flushing may be required at shorter intervals.
4. Flush with mineral spirits and relubricate before use if the clutch has been stored or out of use for six (6) months or more. Flushing will remove waxes or gums formed by vaporization of the oil.

## Grease Lubrication

### For grease lubrication use:

- Fiske Brothers Lubriplate Low-Temp

### Grease lubrication may be used if:

- The clutch is inaccessible for frequent maintenance.
- Conditions do not permit the type of maintenance required for oil lubricated clutches.
- The clutch is mounted on a vertical shaft.
- The clutch is operated continuously.
- The clutch is operated in the presence of severe abrasive dust.

Use no other greases unless a specific recommendation has been made by Formsprag Clutch.

For maximum life the overrunning speeds are reduced 50% if the clutch is grease lubricated. Contact Formsprag if you have any questions.

The ambient temperature for operation of a greased clutch is above +20°F to +150°F (-7°C to +65°C).

For indexing rates in excess of 250 strokes per minute, where grease lubrication is required, consult Formsprag Clutch for lubricant recommendation.

## Grease Lubrication Maintenance

Application	Add Grease	Add Grease Under Rugged Conditions*
Overrunning	Every 3 months	Every 2 weeks
Backstopping	Every 3 months	Every 2 weeks
Indexing	Once a month	Every 2 weeks

\*24 hours per day or operation in severe abrasive dust

## Packaging

Your Formsprag clutch is carefully wrapped in Vapor Inhibitor type activated paper for corrosion protection and packed in a shipping box conforming to the requirements of Rule 41, Uniform Freight Classification. It may be stored for up to two (2) years and reshipped without added packaging. To store in an unprotected area, or if the original package is opened, wrap the box with a waterproof covering.

For additional technical and dimensional information on FS clutches refer to Formsprag Overrunning Clutch Catalog P-956 or 1-800-927-3262.

## Rotating Equipment

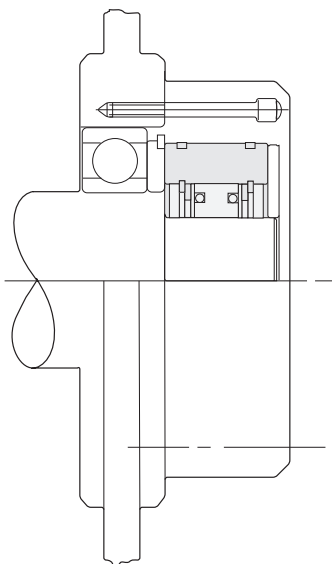
Rotating equipment is potentially dangerous and should be properly guarded. The user should check for all applicable safety codes in his area and provide a suitable guard.

These instructions cannot cover all details or variations in equipment and application nor provide for every possible contingency which may be met in installation, operation or maintenance. Should further information be needed, contact Formsprag Clutch.

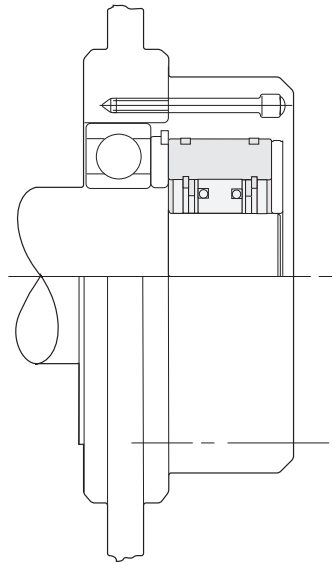
## Clutch Rebuilding

Disassembly and repair of Formsprag clutches in the field is not recommended. Formsprag clutches are precision devices manufactured under careful controls to meet exacting standards.

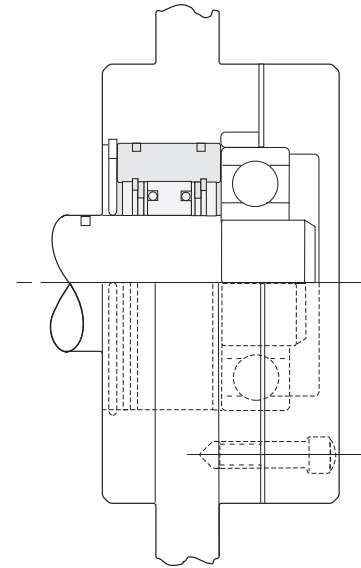
## Typical Mounting Arrangements



**Figure 3**  
Series FS 20 Clutch mounted inside the bearing retainer cap



**Figure 4**  
Series FS 20 Clutch mounted with an optional snap ring bearing



**Figure 5**  
Series FS 20 Clutch mounted directly in the housing bore

## Warranty

Formsprag LLC warrants that it will repair or replace (whichever in its sole discretion it deems advisable) any product it manufactured and sold which proves to be defective in material or workmanship within a period of one (1) year from date of original purchase for consumer, commercial or industrial use. This warranty extends only to the original purchaser and is not transferable or assignable without Formsprag LLC's prior consent.

This warranty covers normal use and does not cover damage or defect which results from alterations, accident, neglect, disassembly, or improper installation, operation, or maintenance.

Formsprag LLC's obligation under this warranty is limited to the repair or replacement of the defective product. In no event shall Formsprag LLC be liable for consequential, indirect or incidental damages of any kind incurred by reason of manufacture, sale or use of any defective product. Formsprag LLC neither assumes nor authorizes any other person to give any other warranty or to assume any other obligation or liability on its behalf.



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