Clutch 25

Group Index, Alphabetical

Section	Section Number
Clutch Hydraulic System	
Clutch Linkage	
Eaton Fuller Solo Clutches	

Eaton Fuller Solo Clutches

Contents

Subject	Subject Number
General Information	
Service Operations	
Clutch Removal	
Clutch Inspection and Pre-Installation Procedures	
14-Inch Dual Disc Clutch Installation	
15.5-Inch Clutch Installation	
Resetting the Clutch	
Troubleshooting	300
Specifications	

General Information

General Description

Eaton Fuller Solo™ clutches are 14-inch (350-mm) single- or dual-disc assemblies used in medium-duty applications and 15.5-inch (394-mm) dual-disc assemblies used in heavy-duty applications. See Fig. 1 and Fig. 2. Both versions are mounted to a flat flywheel.

Solo clutches are adjustment-free: as the clutch wears, its wear-adjusting technology monitors clutch components and makes necessary adjustments. The wear-adjusting technology comes from two sliding cams, which rotate to maintain the proper adjustment. Atop the upper cam, a wear indicating tab mirrors the cam movement to let you know when it's time to replace the clutch. See **Fig. 3**. The wear indicating tab cannot be used as a mechanism for adjusting the clutch.

In the dual-disc versions of these clutches, the intermediate plate separating the driven discs is mounted directly to the flywheel. Four separator pins ensure an equal gap on all sides of the intermediate plate and increase the life of the clutch.

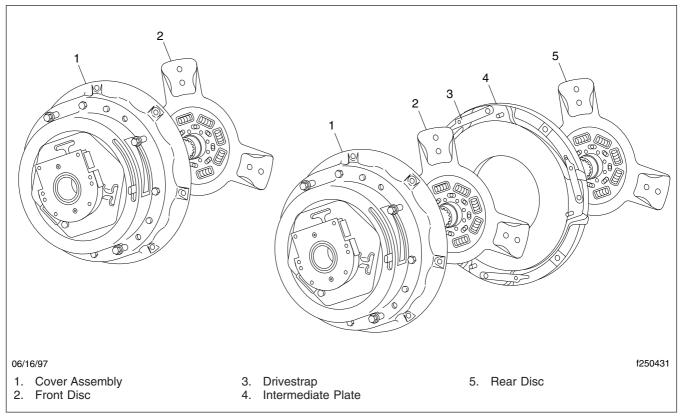


Fig. 1, Solo Medium-Duty Clutches

General Information

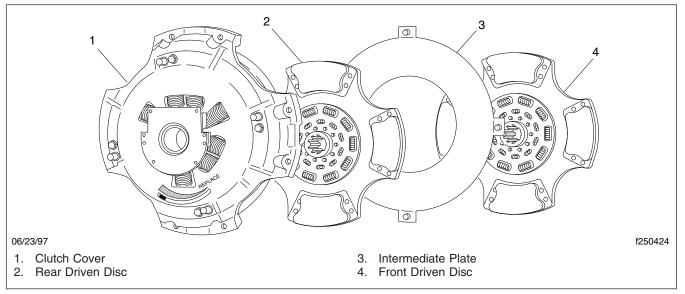


Fig. 2, Solo Heavy Duty Clutches

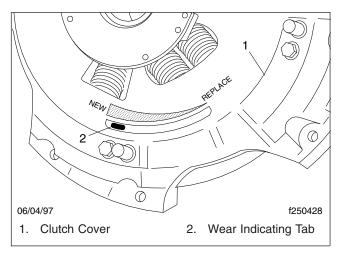


Fig. 3, Wear Indicator

Clutch Removal

Use the following procedure if you need to temporarily remove and then reinstall an Eaton Fuller Solo clutch. Failure to follow these steps could cause the Solo clutch to drag or not release upon installation.

IMPORTANT: Check the position of the wear indicating tab on the clutch cover. If the wear indicating tab is near the REPLACE position on the indicator, it is time to replace the clutch.

Removal

— NOTICE ———

For proper reinstallation of the Solo clutch, the wear indicating tab must be reset. Failure to reset this tab will prevent clutch release and result in possible clutch damage.

NOTE: This step requires two persons: one under the vehicle with access to the wear indicating tab, and the other in the vehicle to press the clutch pedal.

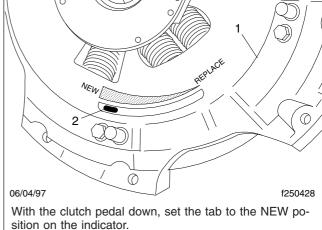
- 1. Reset the wear indicating tab with the clutch in the vehicle, as follows.
 - 1.1 From inside the cab, press the clutch pedal all the way down. Hold the clutch pedal down until the wear indicating tab is
 - 1.2 Through the clutch inspection cover, slide the wear indicating tab until it is at the NEW position on the indicator. See Fig. 1.
 - From inside the cab, release the clutch 1.3 pedal. Check to be sure the wear indicating tab stays at the NEW position on the indicator.

- NOTICE -

When removing the transmission from a vehicle equipped with a hydraulic clutch control system, disconnect the clutch grease tube to avoid component damage.

NOTE: Before pulling the transmission from the bell housing, disconnect the external clutch linkage and rotate the release yoke so the yoke will clear the release bearing when it is removed.

2. Remove the transmission. See Section 26.00.



- 1. Clutch Cover
- 2. Wear Indicating Tab

Fig. 1, Resetting the Wear Indicating Tab

NOTICE ———

Do not let the rear of the transmission drop, and do not let the transmission hang unsupported in the splined hubs of the clutch discs. Taking these precautions will prevent bending and distortion of the clutch discs.

Remove the clutch brake from the transmission input shaft. See Fig. 2.

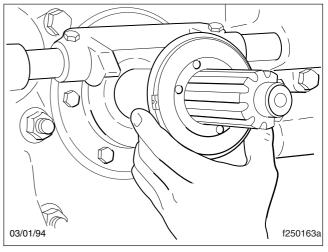


Fig. 2, Clutch Brake Removal

4. Install a spline aligning tool into the release bearing assembly, and through the driven discs. See

Clutch Removal

Fig. 3. An old transmission input shaft may be used for this purpose.

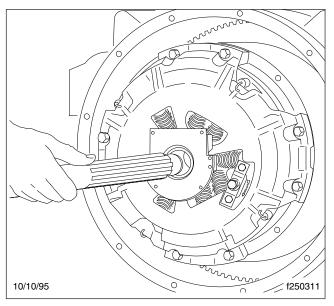


Fig. 3, Installing a Spline Aligning Tool

NOTE: Shipping bolts are installed on the clutch cover prior to removal to prevent the clutch adjustment mechanism from unloading.

5. Cage the pressure plate, as follows.

For a 14-inch clutch, install four 3/8–16 x 1-1/4 shipping bolts (if available) or hexhead machine screws into the four clutch cover holes, and tighten them finger-tight plus one full turn.

For a 15.5-inch clutch, install four 7/16–14 x 1-3/4 shipping bolts (if available) or hexhead machine screws into the four clutch cover holes, and tighten them finger-tight plus one full turn.

These bolts will cage the pressure plate, preventing the four plate spacers from moving out of position when the clutch is removed from the flywheel. See **Fig. 4**.

- Progressively loosen each of the mounting capscrews in the pattern shown in Fig. 5. This will prevent warping or bending within the clutch, and will ease removal of the clutch mounting capscrews.
- 7. Remove the two top mounting capscrews from the cover assembly, and install two guide studs in the open holes to help support the clutch as-

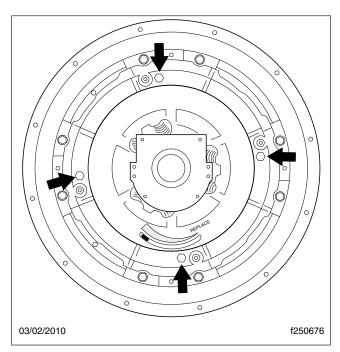


Fig. 4, Installed Shipping Bolts

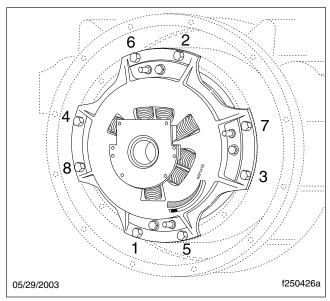


Fig. 5, Loosening Sequence

sembly during removal. See **Fig. 6**. For a 14-inch clutch, use 3/8–16 x 3 guide studs. For a 15.5-inch clutch, use 7/16–14 x 5 guide studs.

Clutch Removal

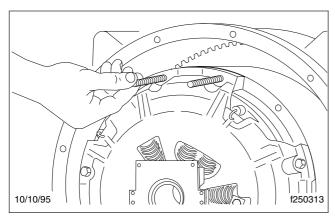


Fig. 6, Installing Guide Studs

NOTE: Mark the positions of the clutch components so they can be properly oriented during installation.



The clutch assembly is heavy. It should be removed and installed only with a lifting device. If the assembly is lifted incorrectly or dropped, it could cause serious personal injury.

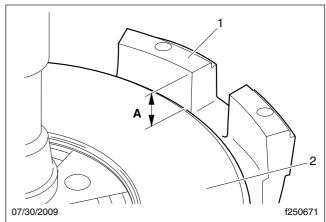
- 8. Remove the mounting capscrews, and carefully remove the clutch assembly together with the spline aligning tool.
- 9. Reset the pressure plate, as follows. See Fig. 7.
 - 9.1 Progressively tighten the four shipping bolts in a crisscross pattern.
 - 9.2 Measure the depth of the pressure plate, as follows.

For a 14-inch clutch, the pressure plate is reset when the face of the pressure plate is 0.50 inch (12.7 mm) below the mounting surface of the clutch cover.

For a 15.5-inch clutch, the pressure plate is reset when the face of the pressure plate is 1.75 to 1.78 inches (44.4 to 45.2 mm) below the mounting surface of the clutch cover.

NOTE: Resetting the pressure plate will allow the clutch to release after installation.

10. Use an appropriate puller to remove the pilot bearing. Inspect the old pilot bearing for any unusual wear or damage. Discard the pilot bearing.



NOTE: For a 14-inch clutch, the pressure plate will be reset when it is 0.50 inch (12.7 mm) below the mounting surface of the clutch cover. For a 15.5-inch clutch, the pressure plate will be reset when it is 1.75 to 1.78 inches (44.4 to 45.2 mm) below the mounting surface of the clutch cover.

- A. 0.50 inch (12.7 mm) for 14-inch clutches; 1.75 to 1.78 inches (44.4 to 45.2 mm) for 15.5-inch clutches
- 1. Mounting Surface
- 2. Pressure Plate

Fig. 7, Reset Pressure Plate

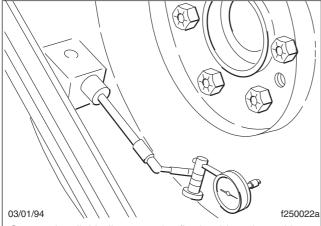
Inspection

NOTICE -

Misalignment of any parts described in these procedures will cause premature wear of drivetrain components.

IMPORTANT: When taking the following readings, rotate the engine by hand; do not crank the engine with the starter. The engine may be rotated by the pulley nut at the front of the crankshaft, the flywheel mounting bolts, or the starter ring-gear on the flywheel.

- Clean the surfaces being measured to ensure accurate measurements.
- Measure the runout of the flywheel face (friction surface), as follows. See Fig. 1 for the correct setup.



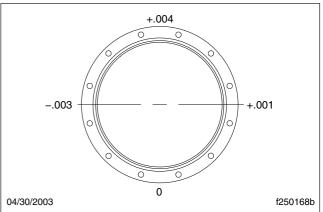
Secure the dial indicator to the flywheel housing, with the gauge finger against the flywheel face, and near the outer edge.

Fig. 1, Measuring the Flywheel Face

- 2.1 Secure the dial indicator to the flywheel housing, with the gauge finger against the face of the flywheel near the outer edge.
- 2.2 Turn the flywheel through one complete revolution. With chalk or soapstone, mark the high and low points on the flywheel face.

2.3 The total runout will be the difference between the highest plus and lowest minus readings. To calculate the runout, see Fig. 2.

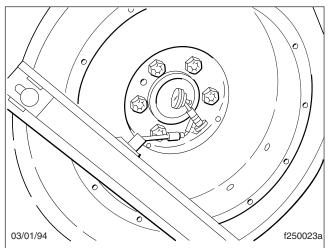
Example: The highest reading is +0.004 at 12 o'clock. The lowest reading is -0.003 at 9 o'clock. Therefore the total runout is 0.007 inch.



Take four readings, starting with zero at the 6 o'clock position, and going on to 9, 12, and 3 o'clock. Make sure the dial returns to zero at the original start position.

Fig. 2, Calculating the Runout

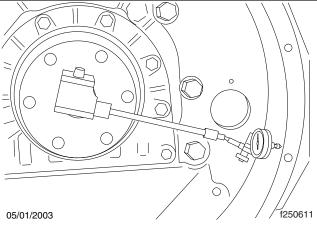
- 2.4 The SAE maximum total runout for the flywheel face is 0.008 inch (0.20 mm). If the readings are higher, see the engine manufacturer's manual for instructions.
- Measure the runout of the pilot-bearing bore in the flywheel, as follows. See Fig. 3 for the correct setup.
 - 3.1 With the indicator still secured to the flywheel housing, move the gauge finger to contact the surface of the pilot-bearing bore.
 - 3.2 Turn the flywheel through one complete revolution. With chalk or soapstone, mark the high and low points on the bore of the pilot bearing.
 - 3.3 Calculate the runout as before.
 - 3.4 The SAE maximum total runout for the pilot-bearing bore is 0.005 inch (0.13 mm). If the readings are higher, see the engine manufacturer's manual for instructions.



Secure the dial indicator to the flywheel housing, with the gauge finger on the surface of the pilot-bearing bore.

Fig. 3, Measuring the Pilot-Bearing Bore

4. Measure the runout of the flywheel housing bore, as follows. See **Fig. 4** for the correct setup.



Secure the dial indicator to the crankshaft, with the gauge finger against the side of the flywheel housing.

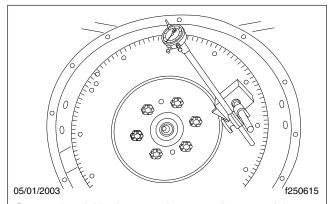
Fig. 4, Measuring the Flywheel Housing Bore

- 4.1 Secure the dial indicator to the crankshaft, with the gauge finger against the side of the flywheel housing.
- 4.2 Turn the flywheel through one complete revolution. With chalk or soapstone, mark the high and low points on the side of the flywheel housing.

4.3 Calculate the runout as before.

NOTE: Only if you have to reposition the flywheel housing is it necessary to mark the high and low runout readings in clock positions.

- 4.4 The SAE maximum total runout for the flywheel-housing bore is 0.008 inch (0.20 mm). If readings are higher, replace the flywheel housing. For instructions, see the engine manufacturer's manual.
- Measure the runout of the face of the flywheel housing, as follows. See Fig. 5 for the correct setup.



Secure the dial indicator to the outer diameter of the flywheel, with the gauge finger against the face of the flywheel housing.

Fig. 5, Measuring the Flywheel Housing Face

- 5.1 With the dial indicator secured to the outer diameter of the flywheel, move the gauge finger to contact the face of the flywheel housing.
- 5.2 Turn the flywheel through one complete revolution. With chalk or soapstone, mark the high and low points on the face of the flywheel housing.
- 5.3 Calculate the runout as before.

NOTE: Only if you have to reposition the flywheel housing is it necessary to mark the high and low runout readings in clock positions.

5.4 The SAE maximum total runout for the flywheel-housing face is 0.007 inch (0.18 mm) for a 14-inch clutch, and 0.008 inch

(0.20 mm) for a 15.5-inch clutch. If the readings are higher, replace the housing. For instructions, see the engine manufacturer's manual.

NOTE: Use a case-bore plug and shaft set to measure the bell-housing face and pilot. Case-bore plugs are tapped into the front and rear bores of the transmission case, and have very close tolerances. The shaft runs through the center of the plugs, and extends to the front far enough to secure a dial indicator and obtain a reading on the bell housing.

- Measure the runout of the bell housing face and pilot, as follows.
 - 6.1 Secure the dial indicator to the case-bore shaft, with the gauge finger against the face of the bell housing.
 - 6.2 Turn the case-bore shaft through one complete revolution. With chalk or soapstone, mark the high and low points on the face of the bell housing.
 - 6.3 Calculate the runout as before.
 - 6.4 The SAE maximum total runout for the bell-housing face is 0.008 inch (0.20 mm). If the readings are higher, replace the bell housing. See the transmission manufacturer's service manual for instructions.
- 7. Remove the flywheel (see the engine manufacturer's manual), and measure the runout of the flywheel crankshaft face. See **Fig. 6**.
 - 7.1 Secure the dial indicator to the flywheel housing, with the gauge finger against the crankshaft face, and near the outer edge.
 - 7.2 Turn the crankshaft through one complete revolution. With chalk or soapstone, mark the high and low points on the face of the crankshaft.
 - 7.3 Calculate the runout as before.
 - 7.4 See the engine manufacturer's manual for maximum runout, corrective measures, and flywheel installation instructions.

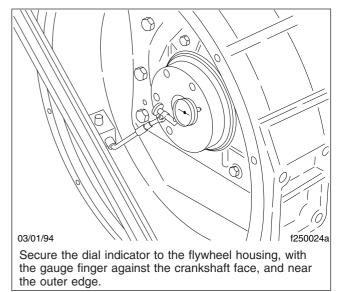


Fig. 6, Measuring the Crankshaft Face Runout

Resetting (clutch out of vehicle)

- NOTICE ----

Use this procedure if the clutch was removed without caging the pressure plate. Resetting the pressure plate allows the clutch to release after installation and prevents possible clutch damage.

- Remove the four shipping bolts if they have been installed. See Fig. 7.
- Support the clutch cover in an arbor press with the release bearing facing down. When setting up the arbor press, allow at least 1 inch (25 mm) clearance for both movement of the release bearing and access to install shipping bolts. See Fig. 8.
- Center the ram and press downward on the retainer until it comes to a stop. Lock the ram in position.
- 4. Slide the wear indicating tab to the left until it is at the NEW position of the indicator (Fig. 9) and hold it in position with a magnet.

NOTE: Shipping bolts are installed on the clutch cover prior to installation to prevent the clutch adjustment mechanism from unloading. See Fig. 7.

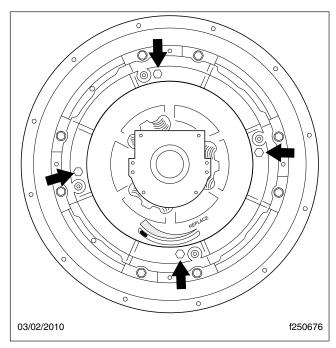


Fig. 7, Installed Shipping Bolts

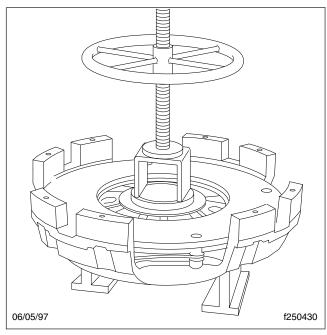


Fig. 8, Arbor Press Setup

5. For 14-inch clutches, install four 3/8–16 x 1-1/4 shipping bolts (if available) or hexhead machine

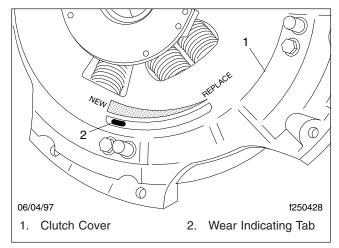


Fig. 9, Resetting the Wear Indicating Tab

screws into the four clutch cover holes, and tighten them finger-tight plus one full turn.

For 15.5-inch clutches, install four 7/16–14 x 1-3/4 shipping bolts (if available) or hexhead machine screws into the four clutch cover holes, and tighten them finger-tight plus one full turn.

NOTE: You may need to temporarily install slightly longer bolts to allow access of the shipping bolts.

- 6. Reset the pressure plate, as follows.
 - 6.1 Progressively tighten the four shipping bolts in a crisscross pattern.
 - 6.2 Measure the depth of the pressure plate. See Fig. 10.

For 14-inch clutches, the pressure plate is reset when the face of the pressure plate is 0.50 inch (12.7 mm) below the mounting surface of the clutch cover.

For 15.5-inch clutches, the pressure plate is reset when the face of the pressure plate is 1.75 to 1.78 inches (44.4 to 45.2 mm) below the mounting surface of the clutch cover.

Pre-Installation Procedures

Before installing a new, rebuilt, or used clutch, do the following procedures:

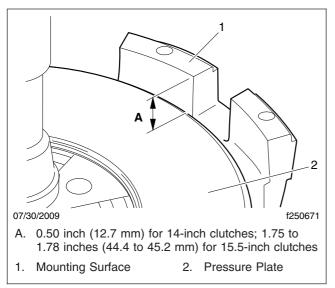


Fig. 10, Reset Pressure Plate

1. Install a new pilot bearing. Be sure that the pilot bearing has a press-fit in the flywheel.

NOTICE -

Tap on the outer race only. Tapping on the inner race could damage the pilot bearing.

NOTE: To discourage warranty claims for drag or clutch noise, use a premium grade C3/C4 pilot bearing. Due to increased operating temperatures and longer clutch life, the standard pilot bearings and grease are no longer acceptable.

- Check for wear on the mating surfaces of the flywheel housing and the transmission bell housing. Any noticeable wear on either part causes misalignment. If worn, replace the part. See Fig. 11.
- Check the flywheel housing for wear caused by the bell housing pilot (projecting lip of the bell housing). The correct dimension is 1/8-inch (3.2mm). Wear is most likely to appear between the 3 o'clock and 8 o'clock positions. See Fig. 12.

NOTE: The pilot (lip) of the bell housing can wear into the flywheel housing. This can be caused by the transmission loosening up, or by road and engine vibration after high mileage.

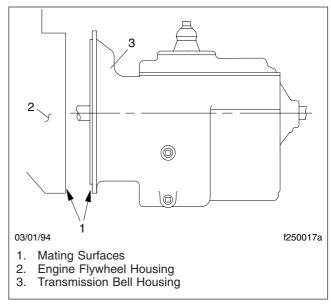


Fig. 11, Inspecting the Mating Surfaces

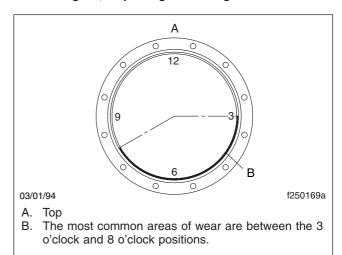


Fig. 12, Checking the Flywheel Housing for Wear

- 4. Inspect the flywheel, as follows. Replace or repair the flywheel if the wear is extreme.
 - 4.1 Visually inspect the friction surface of the flywheel for heat checks and scoring.
 - 4.2 Measure the friction surface wear with a straightedge and feeler gauge. For instructions, see the engine manufacturer's manual.
- 5. Inspect the input shaft, both the splined and the smooth area, as follows. See **Fig. 13**.

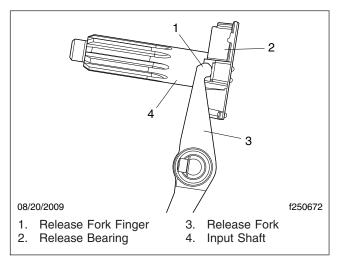
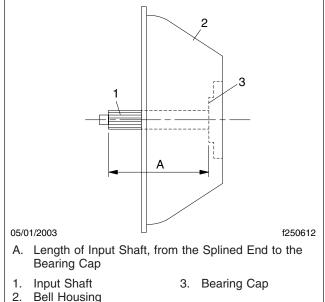


Fig. 13, Input Shaft, Release Bearing, and Release Fork

- 5.1 Check the fit of the splined hubs of the driven discs by sliding them along the splines of the input shaft. The hubs must slide freely so the clutch will release cleanly. If necessary, use a hand stone to dull the sharp edges of the splines.
- 5.2 If the input shaft splines are worn or notched, or if the hubs still do not slide freely, replace the input shaft. For instructions, see the transmission manufacturer's service manual.
- 5.3 Inspect the smooth area of the input shaft for wear and/or rough spots. Replace the input shaft if necessary.
- 6. Check for excessive wear at the fingers of the release fork. See **Fig. 13**.
- To prevent clutch brake wear, check the inputshaft bearing cap, as follows, and measure it as shown in Fig. 14.
 - 7.1 Visually check the bearing cap for excessive wear.
 - 7.2 Measure the distance between the splined end of the input shaft and the bearing cap (dimension A). If dimension A is greater than 8.71 inches (221.5 mm), replace the bearing cap.

NOTE: A torque-limiting clutch brake has facings on both sides. When installing it, orient the shallow side toward the transmission, and the deep



. Todomig

Fig. 14, Measuring the Input Shaft

side toward the engine to allow clearance for the release bearing.

- 8. On unsynchronized transmissions, install a new clutch brake on the transmission input shaft, as shown in **Fig. 15**. Slide it tight against the input-shaft bearing cap.
- Measure the diameter of the flywheel bore opening (this is the recessed area for the flywheel bolt circle). See **Table 1** for minimum flywheel bore diameters for each disc type.

Minimum Flywheel Bores		
Disc Type	Flywheel Bore in inch (mm)	
10-Spring	8.562 (217.48)	
9-Spring	9.750 (247.65)	
8-Spring	7.250 (184.15)	
7-Spring	9.750 (247.65)	
6-Spring	9.750 (247.65)	

Table 1, Minimum Flywheel Bores

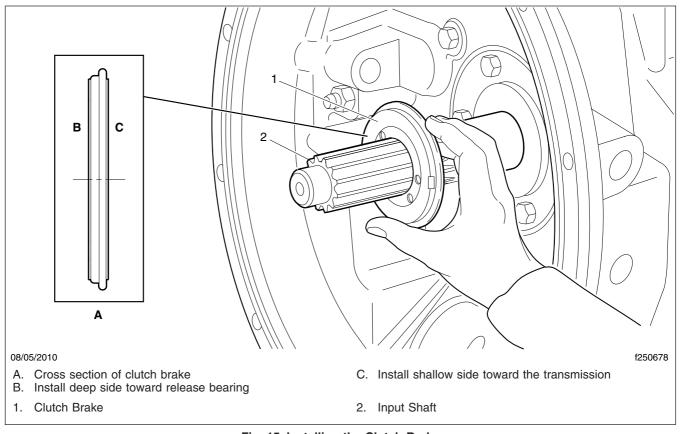


Fig. 15, Installing the Clutch Brake

Installation

- Do the clutch pre-installation procedures in Subject 110.
- 2. If not already in place, install two 3/8–16 x 3 guide studs in the two upper mounting holes of the flywheel. See Fig. 1.

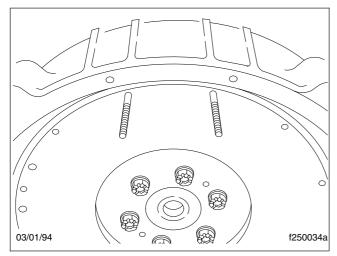


Fig. 1, Guide Studs, Installed

- If the clutch is new, remove any protective coating applied to the pressure plate and the intermediate plate.
- Insert an aligning tool through the splines of the front disc and, with the side marked FLYWHEEL SIDE facing the flywheel, install the front driven disc on the flywheel.

IMPORTANT: The drivestraps of the intermediate plate must face the pressure plate.

- Install the intermediate plate assembly over the two guide studs and slide it forward until it touches the flywheel. Make sure the side marked PRESSURE PLATE SIDE faces the pressure plate. See Fig. 2.
- 6. Make sure the separator pins protrude toward the flywheel side. The pins should be flush on the pressure-plate side.
- 7. Remove the aligning tool.
- 8. Insert the aligning tool through the splines of the rear driven disc and, with the side of the rear

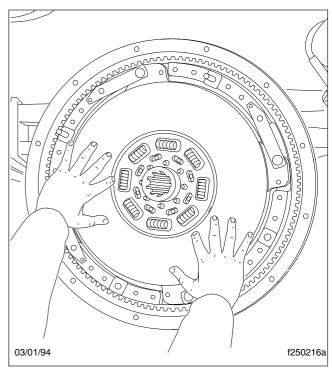


Fig. 2, Install the Intermediate Plate

disc marked *PRESSURE PLATE SIDE* facing the pressure plate, install the rear driven disc. See **Fig. 3**.

9. Make sure that the ceramic buttons on each disc are as closely aligned as possible. See Fig. 4.

NOTE: Aligning the discs aids the function of the separator pins.

- With the aligning tool still in place, slide the cover assembly over the aligning tool and the two guide studs until it rests against the intermediate plate assembly.
- 11. Install the clutch mounting capscrews, as follows. See Fig. 5 for the tightening sequence.

NOTICE —

If the capscrews are not tightened in sequence, it may cause permanent damage to the clutch cover and create an out-of-balance condition.

11.1 Start six 3/8–16 (grade 5 or better) mounting capscrews with lockwashers, and tighten them finger-tight.

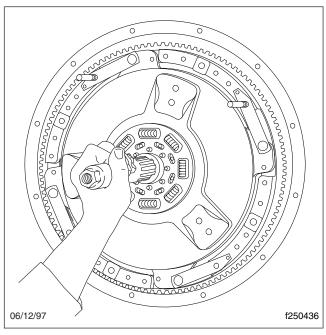


Fig. 3, Position the Rear Disc, Solo

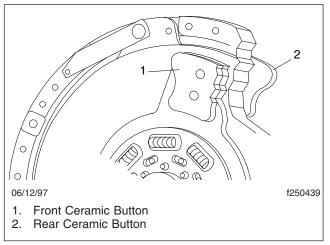


Fig. 4, Driven Disc Alignment

- 11.2 Remove the guide studs and replace them with the two remaining mounting capscrews, as above.
- 11.3 Tighten the eight capscrews progressively. The final torque is 30 to 35 lbf·ft (40 to 47 N·m).
- 12. Remove the aligning tool.

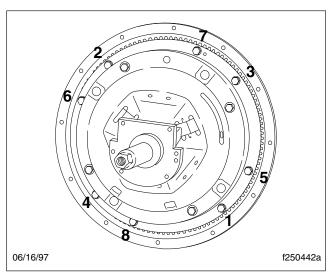


Fig. 5, Tightening Sequence

13. Follow a crisscross pattern to remove the four shipping bolts from the clutch cover. See Fig. 6.

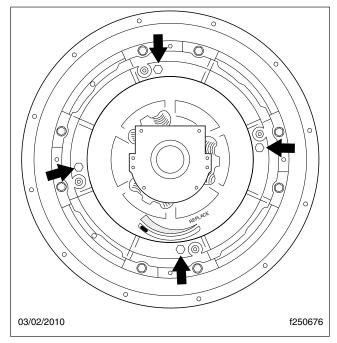


Fig. 6, Installed Shipping Bolts

NOTE: Retain the four shipping bolts. These bolts will be needed in the future to secure the clutch assembly during removal and installation.

A WARNING

Wear safety goggles when tapping the pins. If any of the metal parts were to chip, flying pieces of metal could cause eye injury.

NOTE: Only a small portion of each separator pin is visible through the access hole. See Fig. 7 and Fig. 8.

14. To ensure that all four separator pins are flush against the flywheel, insert a 1/4-inch (6-mm) diameter flat-nose punch through the access holes and lightly tap each of them toward the flywheel. See Fig. 9.

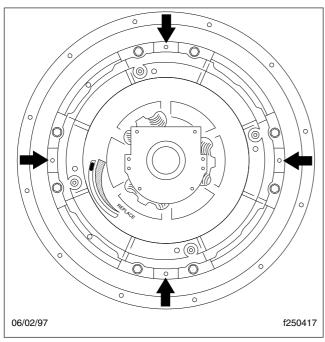


Fig. 7, Separator Pin Access Holes

NOTE: Do this step to ensure that all four pins are flush against the flywheel. This allows an equal gap on all sides of the intermediate plate during clutch disengagement.

- 15. Using a clean cloth, remove all grease from the input shaft.
- 16. Lubricate the release fork fingers. See Fig. 10.

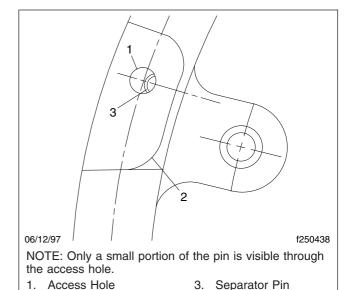


Fig. 8, Separator Pin Access

2. Clutch Cover

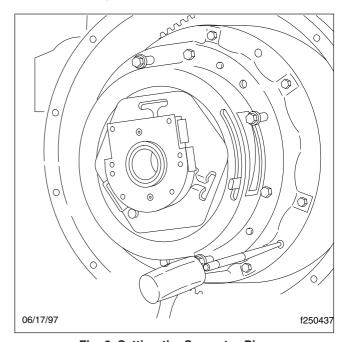


Fig. 9, Setting the Separator Pins

- 17. Shift the transmission into gear so that during assembly the transmission input shaft can be rotated into line with the clutch driven-disc hub splines.
- 18. Install the clutch brake, if equipped.

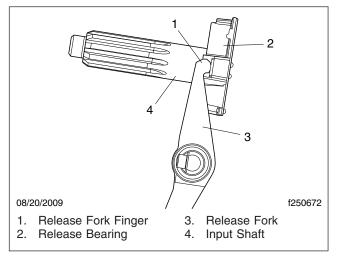


Fig. 10, Release Fork

- NOTICE -

Do not excessively force the transmission into the clutch assembly or engine housing. If it does not enter freely, investigate the cause of the problem and then make any necessary changes. Do not let the transmission drop or hang unsupported in the driven discs. If this should occur, the rear disc will become bent or distorted, causing the clutch to drag (not release).

- 19. Install the transmission and attach the clutch linkage. For instructions, see **Group 26**.
- 20. Lubricate the release bearing. Eaton Fuller recommends a lithium-base grease that can operate up to at least 325°F (163°C) and meets the NLGI Grade 1 or 2 specification.

Installation

- Do the clutch pre-installation procedures in Subject 110 before installing the clutch.
- 2. If not already installed, insert two 7/16–14 x 5 guide studs in the upper mounting holes of the flywheel. See **Fig. 1**. Rotate the flywheel to level the guide studs.

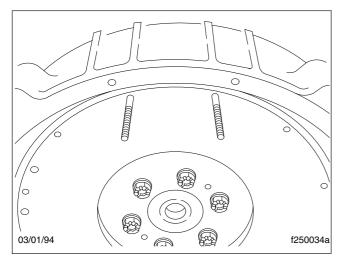


Fig. 1, Installing the Guide Studs

- 3. If installing a new clutch, remove the protective coating from the pressure plate and the intermediate plate.
- 4. Set the clutch cover upright, and insert a spline aligning tool through the release bearing sleeve. See Fig. 2.
- 5. Install the rear driven disc and intermediate plate, as follows.
 - 5.1 Install the rear driven disc on the aligning tool, with the side stamped INTERMEDI-ATE PLATE SIDE facing away from the clutch cover. See Fig. 3.
 - 5.2 Place the intermediate plate in the clutch cover. Align the drive lugs of the plate with the notches in the cover. See **Fig. 4**.
 - 5.3 Make sure the separator pins protrude toward the flywheel side. See **Fig. 4**. The pins should be flush on the pressure-plate side.

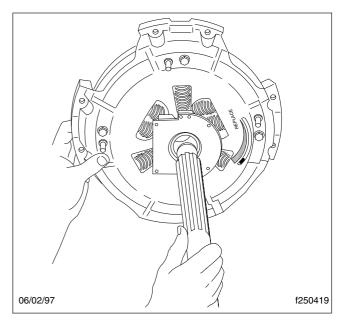


Fig. 2, Inserting an Aligning Tool

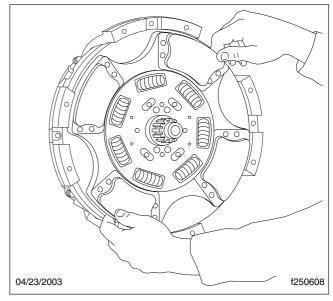


Fig. 3, Installing the Rear Driven Disc

6. Install the front driven disc on the aligning tool, with the side stamped *INTERMEDIATE PLATE SIDE* facing the intermediate plate. See **Fig. 5**.

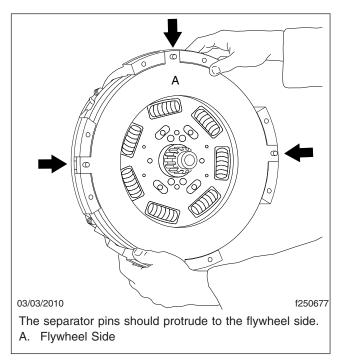


Fig. 4, Positioning the Intermediate Plate

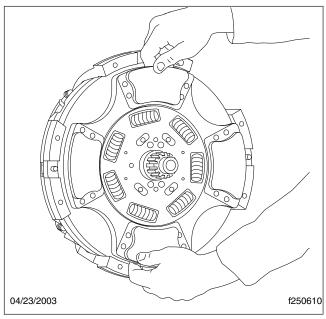


Fig. 5, Installing the Front Driven Disc

WARNING

The clutch assembly is heavy. It should be removed and installed only with a lifting device. If the assembly is lifted incorrectly or dropped, it could cause serious personal injury.

7. Position the clutch over the two guide studs, and slide the assembly forward until contact is made with the flywheel surface. See Fig. 6.

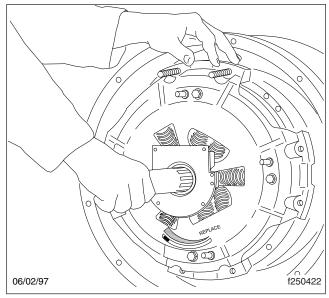


Fig. 6, Positioning the Clutch Cover

- 8. Install the mounting capscrews, as follows.
 - 8.1 Start six 7/16–14 x 2-1/4 (grade 5 or better) mounting capscrews with lockwashers, and tighten them finger-tight.
 - 8.2 Tap the aligning tool to make sure it is centered and seated in the pilot bearing. See Fig. 7.
 - 8.3 Remove the two guide studs and replace them with the two remaining 7/16–14 x 2-1/4 mounting capscrews and lockwashers.
- 9. Tighten the eight mounting capscrews progressively, in a crisscross pattern as shown in **Fig. 8**. Final torque is 40 to 50 lbf·ft (54 to 68 N·m).

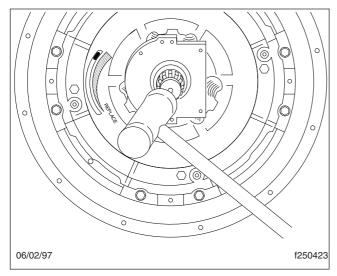


Fig. 7, Tap Aligning Tool

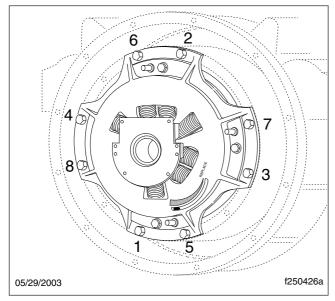


Fig. 8, Tightening Sequence

– NOTICE –

Failure to tighten the bolts according to this procedure can have the following effects:

- preventing the clutch cover from centering into the pilot area of the flywheel;
- causing the clutch assembly to be out-ofbalance with the flywheel;

- causing permanent damage to the clutch cover.
- Following a crisscross pattern, remove and retain the four shipping bolts from the clutch cover. See Fig. 9.

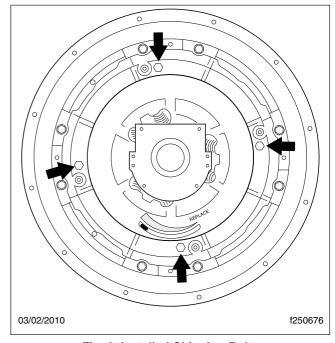


Fig. 9, Installed Shipping Bolts

NOTE: These bolts will be needed to secure future clutch assemblies during removal and installation.

11. Remove the aligning tool.

NOTE: Do not be concerned if the release bearing housing touches the clutch cover.



Wear safety goggles when tapping the pins. If any of the metal parts were to chip, flying pieces of metal could cause eye injury.

12. To ensure that all four separator pins are flush against the flywheel, insert a 1/4-inch (6-mm) diameter flat-nose punch through the access holes and *lightly* tap each of them toward the flywheel. See Fig. 10 and Fig. 11.

NOTE: Failure to perform this step properly may cause the clutch to drag or not release.

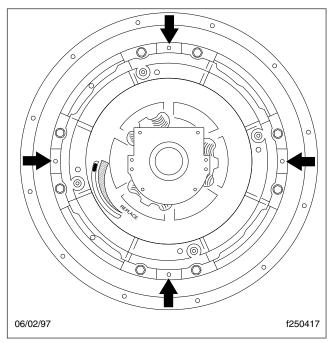


Fig. 10, Separator Pin Access Holes

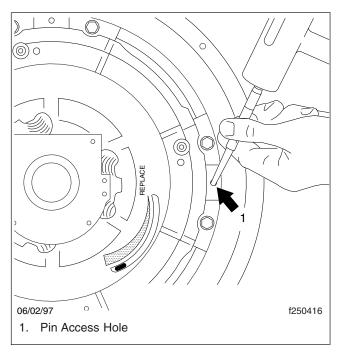


Fig. 11, Tapping A Separator Pin

13. Using a clean cloth, remove all grease from the input shaft.

NOTE: For lubrication of the release fork fingers, Eaton Fuller recommends a lithium-base grease that can operate up to at least 325°F (163°C) and meets the NLGI Grade 1 or 2 specification.

14. Lubricate the release fork fingers. See Fig. 12.

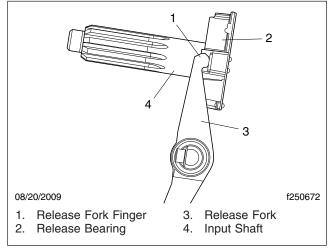


Fig. 12, Release Fork

- 15. Shift the transmission into gear so that during assembly the transmission input shaft can be rotated into line with the clutch driven-disc hub splines.
- 16. Install the clutch brake.

NOTICE

Do not excessively force the transmission into the clutch assembly or engine housing. If it doesn't enter freely, investigate the cause of the problem and then make any necessary changes. Don't let the transmission drop or hang unsupported in the driven discs. If this should occur, the rear disc will become bent or distorted, causing the clutch to drag (not release).

- Install the transmission and attach the clutch linkage.
- Lubricate the release bearing as needed; for instructions and recommended lubricants, see
 Group 25 of the Business Class M2 Maintenance Manual.

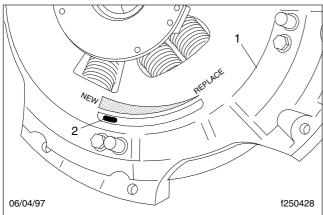
Resetting the Clutch

When there is excessive free pedal, try resetting the clutch.

Resetting

NOTE: This procedure requires two persons; one under the vehicle with access to the wear indicating tab, and the other in the vehicle to operate the clutch pedal.

- Park the vehicle on a level surface. Shut down the engine, set the parking brake, and chock the tires.
- 2. Inside the cab, press the clutch pedal all the way down, and hold it there until instructed to release it later in this procedure.
- Through the clutch cover inspection panel, use moderate force to slide the wear indicating tab leftward until it is at the NEW position on the indicator. See Fig. 1. If the tab does not move, use the clutch reset tool as described later in this subject.



With the clutch pedal down, set the tab to the "NEW" position on the indicator.

- 1. Clutch Cover
- 2. Wear Indicating Tab

Fig. 1, Resetting the Wear Indicating Tab

- 4. Release the clutch pedal.
- 5. Through the clutch inspection cover, remove the gap between the sleeve and the pin, as follows. See Fig. 2.

For a 14-inch clutch, install four 3/8–16 x 1-1/4 shipping bolts (if available) or hexhead machine screws into the four clutch cover holes, and use

a hand tool to tighten them until the gap is removed and the bolts are snug.

For a 15.5-inch clutch, install four 7/16–14 x 1-3/4 shipping bolts (if available) or hexhead machine screws into the four clutch cover holes, and use a hand tool to tighten them until the gap is removed and the bolts are snug.

- 6. Remove the bolts.
- 7. Press the clutch pedal all the way down, and squeeze the clutch brake five times to reposition the bearing.

NOTE: The release bearing travel tool A02–12419 may be used in the following step. This tool is available through the PDCs.

 Measure the distance between the clutch brake and the release bearing. It should be between 0.49 and 0.56 inch (12.5 to 14.2 mm). If it is not within this range, refer to the literature available on the Roadranger website, www.roadranger..com.

If you are using the release bearing travel tool A02–12419 (see **Fig. 3**) for this measurement, position it so that the legs at the blue 0.56-inch (14.3-mm) end straddle the transmission input shaft. If it fits loosely, the gap is too wide. If it does not fit in the gap, try inserting the green 0.50-inch (12.7-mm) end. If the green end of the tool fits, snug or loose, then no adjustment is needed. If the gap is too wide or the green end does not fit in the gap, refer to literature available on the Roadranger website, **www.roadranger.com**.

Using the Clutch Reset Tool

See **Table 1** for more information about the clutch reset tool.

 While an assistant holds down the clutch pedal, insert the tip of the clutch reset tool through the access panel and position it under the bearing. Align the tool so that the threaded bolt extends into the slot in the cam. See Fig. 4.

NOTICE —

Use the clutch reset tool carefully. Do not use heavy force on it; heavy force can break the cam.

Resetting the Clutch

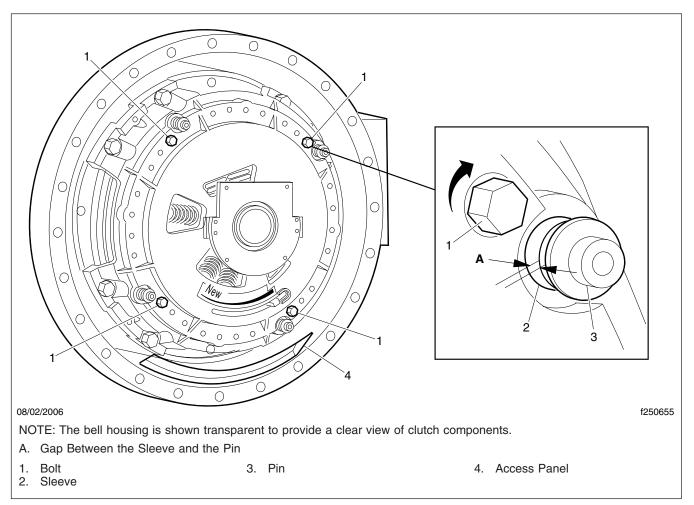


Fig. 2, Removing the Gap Between the Sleeve and the Pin

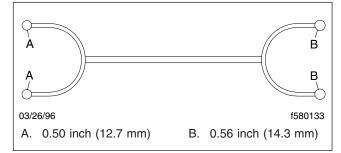


Fig. 3, Release Bearing Travel Tool A02-12419

Using the tool, carefully try to move the cam toward the NEW position.

If the cam moves easily, resume the resetting procedure.

If the cam does not move, go to the next step.

- 3. Loosen the transmission, and install 1/4" spacers between the flywheel housing and bell housing.
- 4. While an assistant holds down the clutch pedal, use the clutch reset tool to move the tab to the NEW position.
- 5. Once the tab is in the NEW position, release the clutch pedal and remove the spacers.
- Tighten the transmission mounting bolts; see Group 26 for torque values.
- 7. Resume the resetting procedure.

Resetting the Clutch

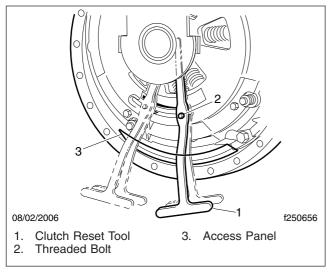


Fig. 4, Resetting the Clutch with the Clutch Reset Tool

Clutch Reset Tool		
Tool	Description	Eaton Tool Part Code
f580427	Clutch Reset Tool	CLPI-SOLOTOOL

Table 1, Clutch Reset Tool

Troubleshooting Tables

Problem—The Clutch Does Not Release Completely

Problem—The Clutch Does Not Release Completely		
Possible Cause	Remedy	
The clutch pedal height is incorrect.	Make adjustments to obtain the following settings:	
	 1/2 to 9/16 inch (12.7 to 14.3 mm) release bearing travel; 	
	• 1/2 to 1 inch (12.7 to 25.4 mm) clutch brake squeeze.	
	For clutches with mechanical linkage, also make adjustments to obtain 0.105 to 0.145 inch (2.7 to 3.7 mm) release yoke free-travel. (Clutches with hydraulic linkage will have constant contact between the yoke and clutch bearing pads.)	
The bushing in the release bearing sleeve assembly is damaged.	Replace the clutch cover.	
The clutch cover assembly is not properly seated into the flywheel.	Re-seat the clutch cover assembly into the flywheel. Use a crisscross pattern when tightening the mounting bolts.	
The intermediate plate and/or pressure plate is cracked or broken.	Replace any damaged parts.	
The cross shafts protrude through the release yoke (a side-loading condition exists).	Check for protruding cross shafts. Repair or replace as necessary.	
The release yoke fingers are bent or worn (a side-loading condition exists).	Install a new release yoke.	
The engine housing and bell housing are misaligned (a side-loading condition exists).	Check for loose transmission mounting bolts. Tighten the transmission mounting bolts to the proper torque.	
The clutch linkage is set up improperly (a side-loading condition exists).	Thoroughly examine the clutch linkage and adjust as necessary.	
The driven discs are distorted or warped.	Replace any distorted or warped driven discs. If the transmission is allowed to hang unsupported during clutch installation, the driven discs may become distorted.	
The driven discs are installed backwards, or the front and rear driven discs were switched with each other.	Install new driven discs. Also, check the clutch cover for any damage. Replace the clutch cover if damaged.	
The input shaft spline is worn.	Replace the input shaft. Also, check the driven disc hubs for wear. Replace the driven discs if worn.	
The input shaft spline is coated with grease, anti-seize compound, etc.	Clean and dry the input shaft spline before installation.	
The input shaft splines are twisted.	Select a new driven disc and slide it along the full length of the splines. If the disc does not slide freely, replace the input shaft.	
The input-shaft bearing cap is worn.	Replace the input-shaft bearing.	
The flywheel pilot bearing fits either too tight or too loose in the flywheel and/or end of input shaft.	Check the pilot bearing for proper fit and replace it if worn.	
The pilot bearing is dry or damaged.	Replace the pilot bearing.	

Problem—The Clutch Does Not Release Completely		
Possible Cause	Remedy	
The separator pins are bent, damaged or incorrectly set.	Be sure to use the proper tool when setting the separator pins. Also, take great care when handling the intermediate plate. For procedures, see the appropriate clutch installation subject.	
The clutch brake is damaged and/or not functioning.	Install a new clutch brake.	
The driven disc faces are coated with oil or grease.	Replace the driven disc assemblies. Cleaning the old driven discs is not recommended.	
There is foreign material (dirt, chaff, salt, etc.) inside the clutch cover.	Remove the foreign material and make sure the clutch inspection cover is installed.	

Problem—The Clutch Rattles or Is Noisy

Problem—The Clutch Rattles or Is Noisy		
Possible Cause	Remedy	
There is excessive flywheel runout.	Repair or replace the flywheel. For procedures, see the engine manufacturer's manual.	
There is corrosion between the input shaft spline and the driven disc hubs.	Clean the mating parts between the input shaft and driven discs to ensure that the discs slide freely over the input shaft spline.	
The engine idle is too fast.	Readjust engine idle to proper idling speed.	
The clutch release bearing is dry or damaged.	Lubricate the clutch release bearing. If the noise persists, install a new clutch cover.	
The flywheel pilot bearing is dry or damaged.	Replace the flywheel pilot bearing.	
The bridge of the release yoke is hitting the clutch cover (an over-stroking condition exists).	Check for a worn, broken or missing clutch brake. Also, check the release yoke and input-shaft bearing cap for wear. Replace any worn parts.	
The release yoke fingers are hitting the clutch cover.	Check if the release bearing, clutch cover, or release yoke fingers are worn or broken. Replace worn parts.	
The clutch inspection cover is not installed.	Re-install the clutch inspection cover.	
The sleeve bushings are worn.	Investigate for any side-loading conditions on the release bearing housing. If there is a side-loading condition, determine its cause. Also, before installing the new clutch, make sure that the side-loading condition has been corrected.	
The clutch linkage is rattling excessively.	Clean, lubricate and reassemble or replace missing/worn parts.	
An idle gear rattle is coming from the transmission.	Specify low-vibration driven discs. Check the engine for correct idle speed. For procedures, consult the engine manufacturer's manual.	
The damper spring cover of the driven disc assembly is interfering with the flywheel.	Install the correct clutch assembly.	

Problem—The Clutch Vibrates

Problem—The Clutch Vibrates			
Possible Cause	Remedy		
The flywheel is loose.	Retighten the flywheel mounting bolts to the proper specifications.		
The universal joints are worn.	Replace the worn parts.		
The driveshaft is not properly phased.	Investigate and correct the phasing of the driveshaft.		
The driveshaft is not balanced.	Balance and straighten the driveshaft.		
The driveline angles are incorrect.	Shim the drivetrain components to equalize universal joint angles.		
The flywheel is not balanced.	Balance the flywheel.		
The pilot area of the clutch is not completely seated into the flywheel.	Ensure that no dirt, burrs, etc., are preventing the clutch cover from completely seating into the flywheel mounting surface.		
The engine mounts are loose, damaged, or worn out.	Replace any worn or damaged parts. Retighten all bolts to proper specifications.		
The engine is misfiring.	The engine is not in tune. To correct the problem, see the engine manufacturer's manual.		
There is excessive flywheel runout.	Repair or replace the flywheel. For procedures, see the engine manufacturer's manual.		

Problem—The Clutch Needs Frequent Adjustments

Problem—The Clutch Needs Frequent Adjustments			
Possible Cause	Remedy		
The clutch specification is incorrect.	Check the clutch specifications in Subject 400 . Install a new clutch with the proper specifications, if necessary.		
The cross shafts and/or clutch linkage system is worn.	Investigate the entire clutch linkage system to determine if it is binding or operating sporadically and/or worn excessively.		
The clutch driven discs are worn down to the rivets.	Install a new clutch.		
The crankshaft has excessive end play.	Repair or replace the crankshaft. Consult the engine manufacturer's manual for procedures.		

Problem—The Clutch Slips

Problem—The Clutch Slips			
Possible Cause	Remedy		
The clutch is overloaded.	Verify that the proper clutch has been specified for the particular vehicle application.		
The release mechanism is binding.	Free up the release mechanism and linkage. Also, check the clutch linkage adjustment.		
The driven disc faces are coated with oil or grease.	Replace the driven disc assembly.		
The driver is riding the clutch pedal.	Use correct driving procedures.		
The input shaft spline is worn.	Replace the input shaft.		

Problem—The Clutch Grabs or Chatters

Problem—The Clutch Grabs or Chatters			
Possible Cause	Remedy		
The clutch is worn out.	Replace the clutch and all worn components.		
The linkage system is not operating freely.	Check the clutch linkage for binding or excessive wear. Replace all worn parts.		
The driven disc faces are coated with oil or grease.	Replace the driven disc assembly.		
The engine mounts are loose.	Retighten the engine mounts to manufacturer's specifications.		
The release yoke fingers and/or the release bearing wear pads are worn excessively.	Replace all the worn parts.		

Specifications

Clutch Torque Values				
Description	Size	Grade	Torque: lbf·ft (N·m)	
Mounting Bolts, Clutch Cover to Flywheel on 14-inch clutch	3/8–16 x 1-1/4	5	30–35 (40–47)	
Mounting Bolts, Clutch Cover to Flywheel on 15.5-inch clutch	7/16–14 x 2-1/4	5	40-50 (54-68)	

Table 1, Clutch Torque Values

Minimum Flywheel Bores			
Disc Type	Minimum Flywheel Bore in inch (mm)		
10-Spring	8.562 (217.48)		
9-Spring	9.750 (247.65)		
8-Spring	7.250 (184.15)		
7-Spring	9.750 (247.65)		
6-Spring	9.750 (247.65)		

Table 2, Minimum Flywheel Bores

Contents

Subject	Subject Number
General Information	
Service Operations	
Clutch Linkage Adjustment	100
Specifications	400

General Information

General Information

The clutch linkage transfers the motion of the clutch pedal to the clutch release bearing.

Free play in the clutch pedal is required to ensure that the fingers of the release bearing do not run against the release bearing. There should not be any play or looseness in the connections and joints of the clutch linkage.

There are two types of clutches: the pull-type and the push-type.

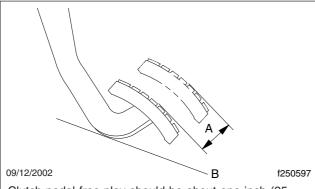
- On push-type clutches, depressing the clutch pedal moves the release bearing toward the engine flywheel. As the clutch is depressed, the pressure plate moves away from the driven disc assembly, and the clutch is disengaged. As the clutch pedal is released, the release bearing and clutch levers move away from the engine flywheel. This locks the driven disc between the friction surfaces of the pressure plate and the engine flywheel. The clutch is then engaged.
- On pull-type clutches, depressing the clutch pedal moves the release bearing away from the pressure plate, disengaging the clutch. As the clutch pedal is released, the pressure plate is forced toward the engine flywheel until the driving and driven discs turn at the same speeds, engaging the clutch.

IMPORTANT: On pull-type clutches, release bearing and release fork clearance are internal clutch adjustments, and *can not be adjusted* by adjusting the clutch linkage. For internal clutch adjustments, see the clutch manufacturer's service literature.

Clutch Linkage Adjustment

Adjustment

- Observe the following points before beginning clutch linkage adjustment:
 - If the clutch pedal free play is less than 3/4 inch (19 mm), adjust the clutch internally, not at the linkage. See Fig. 1.
 - Be sure internal clutch adjustments are correct before making adjustments to the clutch linkage.
 - Adjust the clutch linkage only after repair or replacement of the clutch or clutch linkage components.
 - If the cab is equipped with an air suspension, be sure the air springs are properly inflated. If the air springs are not inflated, the clutch linkage can't be adjusted correctly.



Clutch pedal free play should be about one inch (25 mm) from the top end of the pedal stroke.

- A. Clutch Pedal Free Play
- B. End of Free Play; Start of Disengagement

Fig. 1, Clutch Pedal Free Play

- Raise the hood, apply the parking brakes, and chock the front tires.
- 3. Remove the clutch inspection cover from the bottom of the bell housing.
- Be sure the clutch pedal is all the way up, against the upper stop.
- 5. Check the internal clutch adjustment. For procedures, see the clutch manufacturer's manual.
- Measure the distance between the release yoke and the release bearing.

If this measurement is 0.125 to 0.145 inch (3.2 to 3.8 mm), no further work is needed. See **Fig. 2**. If the measurement is incorrect, do all of the remaining steps.

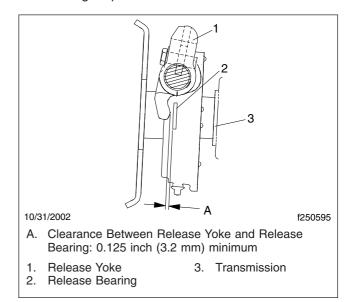


Fig. 2, Clutch Adjustments

- 7. Disconnect the clutch linkage. See Fig. 3.
 - 7.1 Remove the nut that attaches the clutch rod to the upper lever arm.
 - 7.2 Disconnect the clutch rod from the upper lever arm.
 - 7.3 Loosen the jam nut on the clutch rod.
- 8. Adjust the clutch linkage.
 - 8.1 Hold the clutch rod in the same position.
 Adjust the rod length in or out, as needed.
 Shorten the rod to increase the clearance.
 Lengthen the rod to decrease the clearance.
 - 8.2 Attach the rod end to the upper lever arm.
 - 8.3 Tighten the nut on the upper lever arm 23 to 29 lbf·ft (31 to 39 N·m).
 - 8.4 Tighten the jam nut on the clutch rod 12 to 15 lbf·ft (16 to 20 N·m).

NOTE: Each complete turn of the rod equals about .04 inch (1 mm) of movement. After lengthening the linkage, at least 3/8 inch

25.01 Clutch Linkage

Clutch Linkage Adjustment

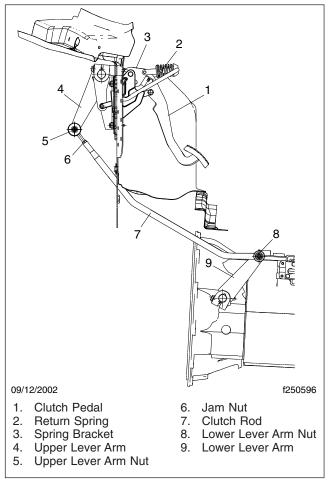


Fig. 3, Clutch Linkage

(9.5 mm) of thread must remain engaged in the clutch rod (nine turns of the rod end).

- 9. Measure the distance between the release yoke and the release bearing. If this measurement is 0.125 to 0.145 inch (3.2 to 3.8 mm), go to the next step. If the measurement is not within these limits, go back to the "Disconnect the clutch linkage" step and adjust the linkage until it is correct.
- Install the inspection cover on the bottom of the bell housing.
- 11. Check the clutch pedal free play. See Fig. 1.
- 12. Remove the chocks from the front tires.

Specifications

Torque Values, Clutch Linkage Adjustment			
Description Torque in lbf·ft (N·m)			
Jam Nut	12 to 15 (16 to 20)		
Upper Lever Arm Nut	23 to 29 (31 to 39)		

Table 1, Torque Values, Clutch Linkage Adjustment

Contents

Subject	Subject Number
General Information	
Service Operations	
Pedal Unit Removal and Installation	
Hydraulic Subassembly Replacement	
Slave Cylinder Replacement	
SACHS 365 mm Clutch Removal and Installation	
Fluid Filling and Bleeding	
Release Bearing and Yoke Assembly Replacement	
Hydraulic Hose Replacement	
Clutch Switch Replacement	
SACHS 395 XTend Clutch Removal and Installation	
Hydraulic Clutch Adjustment	
Troubleshooting	300
Specifications	400
Special Tools	

General Information

General Information

The hydraulic clutch control system consists of a pedal unit and a slave cylinder, connected by a hydraulic hose that is fastened with quick-disconnect clips. See **Fig. 1**. The hydraulic system is self-adjusting, and it uses DOT 4 brake fluid.

The pedal unit includes a hydraulic subassembly, composed of the master cylinder and reservoir, which can be removed from the pedal unit for service purposes; see **Subject 110** for instructions.

Principles of Operation

When the clutch pedal is pressed, the fluid in the master cylinder is forced through a hydraulic line to the slave cylinder. The fluid pressure moves the slave cylinder piston, pushing the plunger rod and clutch release lever, which disengages the clutch.

Clutches

The hydraulic system has been designed to work with three types of clutches: adjustment-free, manually adjusted, and self adjusting. Check the adjustment of manually adjusted clutches regularly.

NOTICE —

Operating a vehicle with a manually adjusted clutch that is incorrectly adjusted could result in failure of the clutch or clutch brake.

The SACHS 365 mm (adjustment-free) and 395 XTend (self-adjusting) are push-type clutches that are part of the hydraulic clutch systems for the MBT520 and MBT660 medium-duty transmissions. They do not need to be manually adjusted. For removal and installation procedures, see **Subject 130** for the SACHS 365 mm, and **Subject 180** for the 395 XTend.

Eaton Stamped Angle-Spring and Easy-Pedal clutches are optional with some Eaton transmissions. These clutches are manually adjusted. When combined with a hydraulic clutch system, there is no "free pedal" to tell the driver when the clutch needs adjustment. Periodic inspection and manual adjustment is required to maintain proper release bearing travel and prevent premature clutch wear. Release bearing travel is the clearance between the rear surface of the release bearing housing and the forward surface of the clutch brake disc. This distance must

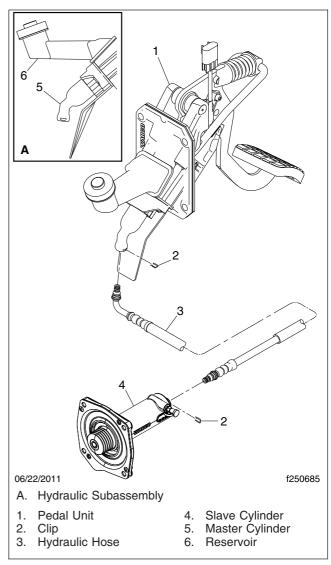


Fig. 1, Components, Hydraulic Clutch Control

be maintained between 1/2 and 9/16 inch (12.7 and 14.3 mm). For the adjustment procedure, see **Subject 190**.

Pedal Unit Removal and Installation

Removal

A WARNING

Clutch hydraulic fluid (DOT 4 brake fluid) is hazardous. It may be a skin irritant and can cause blindness if it gets in your eyes. Always wear safety glasses when handling clutch hydraulic fluid or bleeding hydraulic lines. If you get clutch hydraulic fluid on your skin, wash it off as soon as possible.

- 1. Shut down the engine.
- 2. Apply the parking brakes, chock the front and rear tires, and open the hood.
- Using a flat-head screwdriver, remove the quickdisconnect clamp that attaches the hydraulic hose to the pedal unit. See Fig. 1. Retain the clamp for later installation.

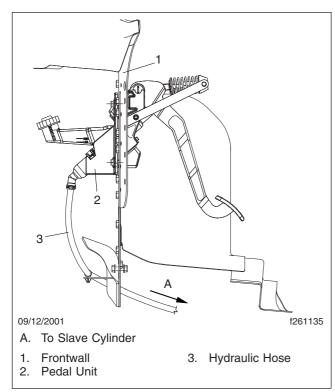


Fig. 1, Pedal Unit and Hose

4. Drain the hydraulic fluid from the entire system.

- 4.1 Using a drain pan or other suitable container, collect the fluid that drains from the pedal unit, not more than 0.5 quarts (0.5 liters).
- 4.2 Allow the open end of the drain hose to remain over the drain pan.
- 4.3 Press down on the pedal several times, until no more fluid drains from the pedal unit.
- 4.4 Cover the hose to avoid contamination of the hydraulic fluid.
- 5. Disconnect the clutch control electrical connector located under the dash above the clutch pedal.
- 6. Remove the rubber pedal pad from the pedal. Retain the pedal pad for later installation.
- 7. Loosen the four mounting plate capscrews attaching the pedal unit to the frontwall.
- 8. After bracing the pedal unit so that it does not fall, remove the four mounting plate capscrews. Retain the capscrews for later installation.

A WARNING

Do not attempt to disassemble the preloaded assist spring. Sudden release of the assist spring could cause property damage and serious personal injury.

9. Remove the pedal unit from the vehicle. Drain any remaining fluid and discard the gasket.

IMPORTANT: Handle the pedal unit carefully to prevent spillage.

Installation

- 1. Mount the pedal unit on the frontwall, as removed. Install a new gasket.
- 2. Install the four mounting plate capscrews and tighten them 13 lbf-ft (18 N·m).
- 3. Fit the rubber pedal pad over the pedal.
- 4. Connect the hydraulic hose to the pedal unit.
- 5. Install the clamp, as removed.
 - 5.1 Install the clamp in the recessed area on the nozzle of the master cylinder.
 - 5.2 Snap the hydraulic hose into place.

Pedal Unit Removal and Installation

5.3 Tug on the hose to make sure it is installed correctly. The hose should not pull out easily.

NOTE: Don't force the hose into the master cylinder. If the clamp is incorrectly installed, the hose will not snap into place.

WARNING

Use only approved clutch hydraulic fluid (DOT 4 brake fluid). Do not mix different types of brake fluid. The wrong fluid will damage the rubber parts of the system, causing loss of clutch function and the risk of serious personal injury.

- 6. Fill the reservoir with approved DOT 4 hydraulic brake fluid and bleed the system according to the procedures in **Subject 140**.
- Connect the clutch control electrical connector, and check the function of the clutch actuation system according to the procedures under the heading "Clutch Actuation System Check" in Troubleshooting, 300.

Hydraulic Subassembly Replacement

Replacement

- Place a suitable container under the master cylinder to collect the fluid that will drain as the hose is removed from the master cylinder.
- Use a flat-tip screwdriver to remove the quickdisconnect clip that locks the hydraulic hose into the master cylinder. See Fig. 1. Remove the hose and, with the end pointing upwards to prevent fluid spillage, secure it temporarily to a safe point on the vehicle. Retain the clip for later installation.

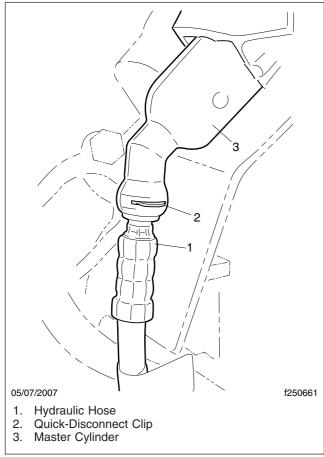


Fig. 1, Quick-Disconnect Clip at the Master Cylinder

- Drain the fluid from the master cylinder.
- 4. Remove the two screws that attach the hydraulic subassembly to the mounting plate. See Fig. 2.

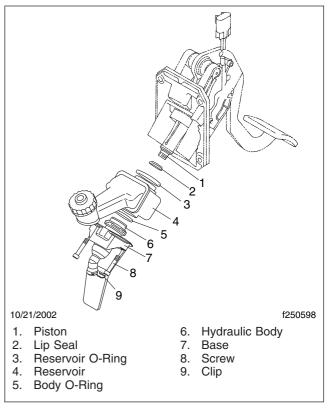


Fig. 2, Hydraulic Subassembly

- Pull carefully on the hydraulic subassembly until it comes loose from the pedal unit. Discard the old hydraulic subassembly.
- 6. Carefully remove the lip seal from the piston of the master cylinder. Discard the lip seal.

NOTE: Avoid damaging the piston.

Lubricate a new lip seal and mount it on the piston. See Fig. 3.

NOTICE —

Use only the special grease provided in the assembly kit. Do not use mineral oil or any other lubricant which could damage the seals and cause loss of clutch function.

- 8. Lubricate the new O-rings and the O-ring seats in the new reservoir and hydraulic body.
- 9. Put the reservoir and hydraulic body together with the O-rings properly seated and lubricated.

Hydraulic Subassembly Replacement

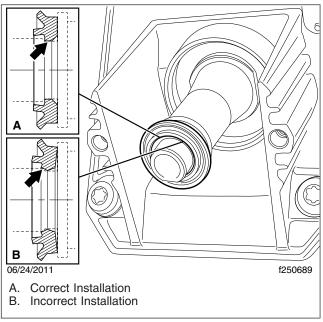


Fig. 3, Hydraulic Subassembly

- 10. While holding the reservoir and hydraulic body together, insert the base over the hydraulic body.
- 11. Install the screws, and tighten them to 44 lbf⋅in (500 N⋅cm).
- 12. Install the quick-disconnect clip and hydraulic hose, as follows.
 - 12.1 Insert the clip arms into the recessed areas on the nozzle of the master cylinder.
 - 12.2 Snap the hydraulic hose into place.
 - 12.3 Tug on the hose to make sure it is installed correctly. The hose should not pull out.

IMPORTANT: Do not force the hose into the slave cylinder. If the clip is incorrectly installed, the hose will not snap into place.

WARNING

Use only approved clutch hydraulic fluid (DOT 4 brake fluid). Do not mix different types of brake fluid. The wrong fluid will damage the rubber parts of the system, causing loss of clutch function and the risk of serious personal injury.

- 13. Fill the reservoir with approved DOT 4 hydraulic brake fluid and bleed the system as instructed in **Subject 130**.
- 14. Check the function of the clutch actuation system as instructed in **Subject 300**.

Slave Cylinder Replacement

Replacement

WARNING

Clutch hydraulic fluid (DOT 4 brake fluid) is hazardous. It may be a skin irritant and can cause blindness if it gets in your eyes. Always wear safety glasses when handling clutch hydraulic fluid or bleeding hydraulic lines. If you get clutch hydraulic fluid on your skin, wash it off as soon as possible.

- 1. Shut down the engine.
- 2. Apply the parking brakes, chock the front and rear tires, and open the hood.
- Using a flat-head screwdriver, remove the quickdisconnect clamp that attaches the hydraulic hose to the slave cylinder. Retain the clamp for later installation.

A WARNING

Never remove the slave cylinder from the gear case while it is still connected to the hydraulic hose and the system is filled with hydraulic fluid. Depressing the pedal in this situation could release, at high speed, the metal pushrod inside the cylinder, causing component damage and serious personal injury.

- Drain the hydraulic fluid from the entire system. See Fig. 1. For detailed procedures, see Subject 100.
- Loosen the four M8 slave cylinder mounting capscrews attaching the slave cylinder to the bell housing.
- After bracing the slave cylinder so that it does not fall, remove the four slave cylinder mounting capscrews. Retain the capscrews for later installation.

IMPORTANT: Handle the slave cylinder carefully to prevent spillage.

7. Remove the slave cylinder from the gear case. Drain any remaining fluid.

IMPORTANT: Be sure to mount the slave cylinder with the bleed valve on top of the unit and horizontal to the ground, as shown in **Fig. 1**.

- 8. Mount the slave cylinder on the gear case, as removed.
 - 8.1 Make sure that the pushrod is attached to the clutch fork and inserted into the pushrod bore in the slave cylinder.
 - 8.2 Push the slave cylinder against the gear case to compress the internal spring.
- 9. Install the four slave cylinder mounting capscrews and tighten them 13 lbf·ft (18 N·m).
- 10. Connect the hydraulic hose to the slave cylinder.
- 11. Install the clamp, as removed.
 - 11.1 Install the clamp in the recessed area on the nozzle of the master cylinder.
 - 11.2 Snap the hydraulic hose into place.
 - 11.3 Tug on the hose to make sure it is installed correctly. The hose should not pull out easily.

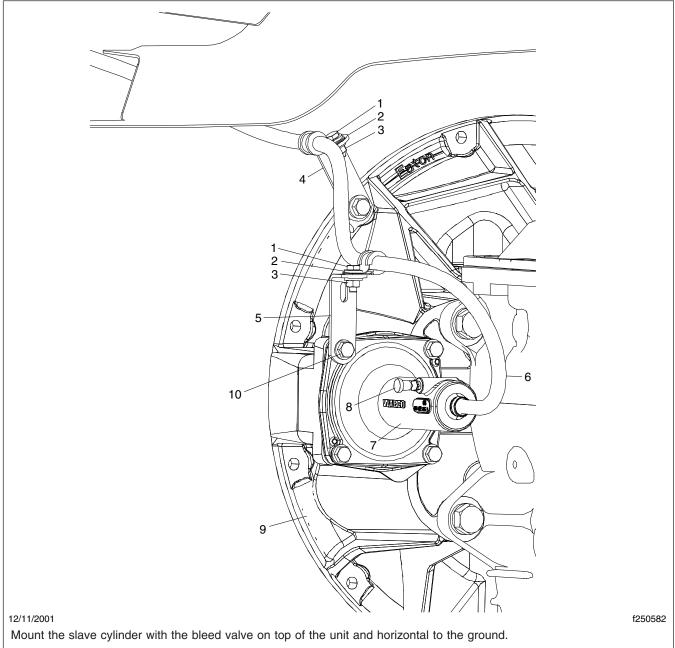
NOTE: Don't force the hose into the master cylinder. If the clamp is incorrectly installed, the hose will not snap into place.

A WARNING

Use only approved clutch hydraulic fluid (DOT 4 brake fluid). Do not mix different types of brake fluid. The wrong fluid will damage the rubber parts of the system, causing loss of clutch function and the risk of serious personal injury.

- 12. Fill the reservoir with approved DOT 4 hydraulic brake fluid. Flush and bleed the system according to the procedures in **Subject 140**.
- Check the function of the clutch actuation system according to the procedures under the heading "Clutch Actuation System Check" in Troubleshooting, 300.

Slave Cylinder Replacement



- 1. Clamp Mounting Bolt, 1/4-20
- 2. Steel-Plated Washer
- 3. Locknut, 1/4-20
- 4. Bell Housing Standoff Bracket
- 5. Slave Cylinder Standoff Bracket

- 6. Hydraulic Hose
- 7. Slave Cylinder
- 8. Bleed Valve
- 9. Bell Housing
- 10. Slave Cylinder Mounting Capscrew, M8

Fig. 1, Clutch Slave Cylinder

Special Tools

A special tool is used for this procedure. See **Table 1**.

Special Tool					
Tool	Description	Manufacturer	Part Number		
f580335	Clutch Centering Pin	Kent-Moore	J-45719		

Table 1, Special Tool

NOTE: To check tool availability, and to order tools, call SPX Kent-Moore at 1-800-328-6657.

Removal

- 1. Remove the transmission from the engine.
 - For instructions for the Mercedes-Benz Automated Transmission, see Section 26.03, Subject 100.
 - For instructions for the Mercedes-Benz Manual Transmission, see Section 26.04, Subject 100.
- 2. Insert the centering pin (Table 1) through the clutch disc and into the pilot bearing.

IMPORTANT: The clutch is under tension. If one capscrew is loosened too much, it places too much tension on the cover assembly.

- Remove the cover assembly. See Fig. 1. In a star pattern, incrementally loosen the capscrews; take care not to loosen any one capscrew too much before loosening the next one.
- 4. Remove the clutch disc assembly.

Installation

 Grease the splines of the input shaft and the hub of the disc assembly. Remove any excess grease. NOTE: Do not grease the guide of the release bearing. Greasing it would attract dirt particles that lead to excessive wear.

 Insert the centering pin (Table 1) into the pilot bearing. Then, with the clutch disc assembly oriented so the side marked "flywheel side" faces the flywheel, center the disc assembly on the flywheel.

IMPORTANT: Do not remove the centering pin until the clutch is completely installed.

- 3. Install "guide pins" at the 10 o'clock and 2 o'clock positions to ensure proper centering of the clutch cover assembly. See Fig. 2.
 - "Guide pins" are long, headless capscrews that are temporarily installed in the flywheel to support the weight of the clutch, allowing you to align it precisely with the flywheel. Without guide pins, proper clutch installation is extremely difficult. If necessary, cut off the heads of two 6-inch (15 cm) capscrews to make a set.
- 4. Install the cover assembly, as follows.

IMPORTANT: Never allow the diaphragm spring to rest on the centering pin.

- 4.1 Slide the clutch cover assembly onto the guide pins, and position it inside the raised rim of the flywheel. See Fig. 3.
- 4.2 Ensure the cover assembly is situated completely within the rim of the flywheel

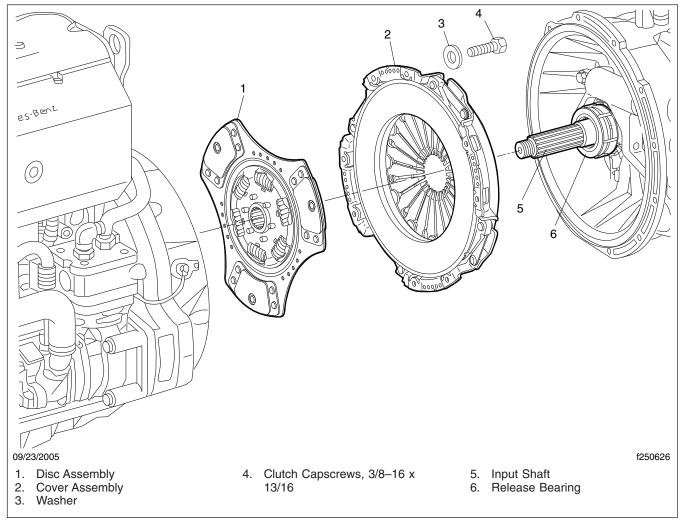


Fig. 1, Clutch Assembly

- and not overlapping it. Use a flashlight to help verify the positioning if needed.
- 4.3 Install and hand-tighten six of the eight capscrews using the sequence shown in Fig. 4 (skipping the guide pin positions).
- 4.4 Remove the two guide pins, then install and hand-tighten the remaining two capscrews.
- 4.5 Using the sequence shown in **Fig. 4**, tighten the eight clutch capscrews progressively: first to 20 lbf·ft (27 N·m), and finally to 37 lbf·ft (50 N·m). Do not put

- more tension on one side of the clutch than the other.
- 5. When all capscrews have been tightened, remove the centering pin.
- 6. Install the transmission on the engine.
 - For instructions for the Mercedes-Benz Automated Transmission, see Section 26.03, Subject 100.
 - For instructions for the Mercedes-Benz Manual Transmission, see Section 26.04, Subject 100.

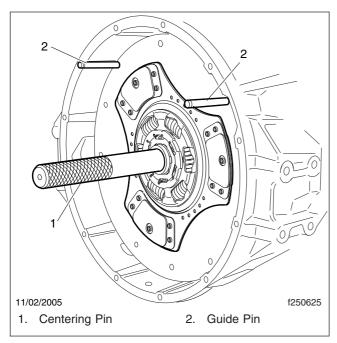


Fig. 2, Centering the Clutch

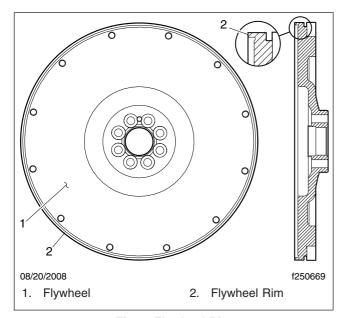


Fig. 3, Flywheel Rim

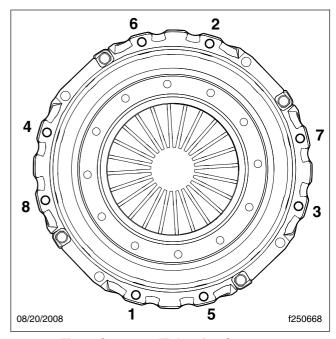


Fig. 4, Capscrew Tightening Sequence

Fluid Filling and Bleeding

WARNING

Hydraulic clutch control fluid (DOT 4 brake fluid) is hazardous. It may be a skin irritant and can cause blindness if it gets in your eyes. Always wear safety glasses when handling it or bleeding hydraulic lines. If you get it on your skin, wash it off as soon as possible.

- NOTICE -

Do not spill hydraulic clutch control fluid on the cab paint. Clean it off immediately if any is spilled. Brake fluid can damage paint.

Filling

The hydraulic system holds approximately 0.5 quart (0.5 liter) of fluid. Use new DOT 4 brake fluid from a tightly sealed container to fill the system until the fluid level is between the MIN and MAX lines marked on the side of the reservoir.

Bleeding

The hydraulic clutch control can be bled by using a pressure adaptor or manual bleeding. Pressure bleeding can be done by one person and manual bleeding requires two.

Pressure Bleeding

A pressure bleeder hose (J-29532) and a bleed adaptor (J-35798) for the fluid reservoir are available through SPX Kent-Moore Tools and may be used to complete the pressure bleeding procedure. To order these parts, call Kent-Moore at 1-800-328-6657.

- 1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
- 2. Open the hood.
- Prepare the pressure bleeding equipment according to the manufacturer's instructions. Use new DOT 4 brake fluid from a tightly sealed container. Pressurize the bleed adaptor to 15 psi (103 kPa).
- 4. Remove the reservoir cap (see Fig. 1) and install the pressure bleed adaptor on the reservoir.

5. Pressurize the reservoir to fill the system. Open the bleed valve on the bleed tank of the adaptor.

NOTE: The hydraulic system holds approximately 0.5 quart (0.5 liter) of fluid. It may need to be refilled during the bleeding process to prevent air from re-entering the system.

- 6. Bleed the hydraulic system as follows.
 - 6.1 Remove the cap from the bleed valve of the slave cylinder. See **Fig. 2**. On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it does not fall off when fluid is pumped out.
 - 6.2 Open the bleed valve on the slave cylinder.

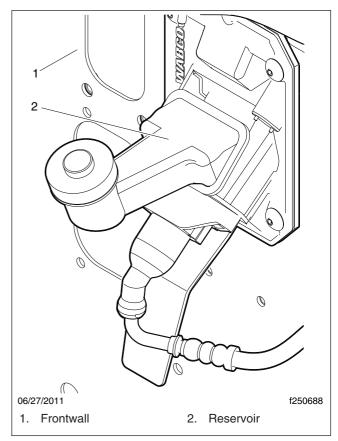


Fig. 1, Master Cylinder, Hydraulic Clutch Control

6.3 When the draining fluid is clear and free of air bubbles, close the bleed valve.

Fluid Filling and Bleeding

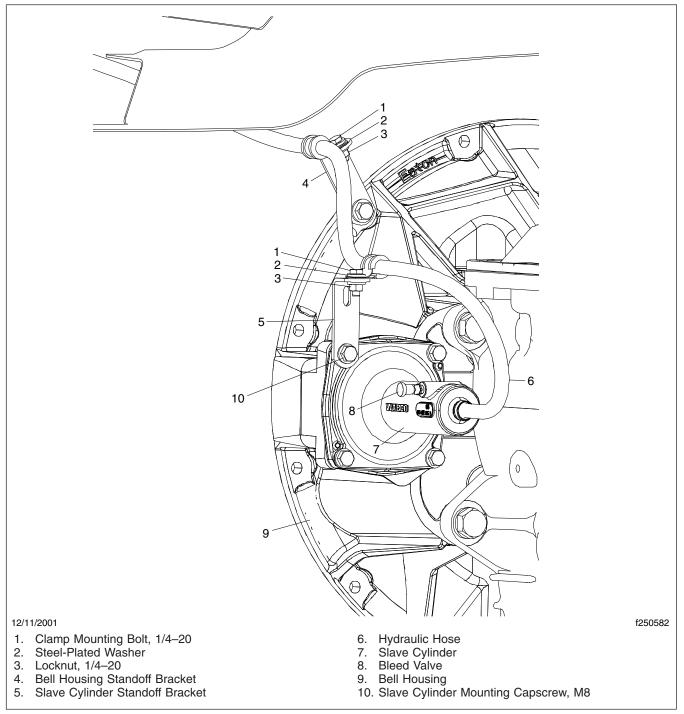


Fig. 2, Slave Cylinder, Hydraulic Clutch Control

Fluid Filling and Bleeding

- 7. Disconnect the transparent hose. Tighten the bleed valve 88 lbf·in (1000 N·cm) and install the cap on the slave cylinder bleed valve.
- 8. Check the fluid level in the reservoir. If necessary, add or drain fluid to bring the fluid level to between the MIN and MAX lines marked on the side of the reservoir. Install the reservoir cap.
- 9. Depress the clutch pedal a few times. There should be resistance over the full pedal stroke.

Manual Bleeding

- Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
- 2. Open the hood.

NOTE: The hydraulic system holds approximately 0.5 quart (0.5 liter) of fluid. It may need to be refilled during the bleeding process to prevent air from re-entering the system.

- Remove the reservoir cap (see Fig. 1) and fill the reservoir with new DOT 4 brake fluid from a tightly sealed container.
- 4. Remove the cap from the bleed valve of the slave cylinder. See Fig. 2. On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it does not fall off when fluid is pumped out.
- Open the slave cylinder bleed valve. Observe the flow of clutch hydraulic fluid through the drain hose.
- 6. Have an assistant slowly pump the clutch pedal to purge the fluid/air mixture.
- 7. When the draining fluid is clear and free of air bubbles, close the bleed valve.
- 8. Disconnect the transparent hose. Tighten the bleed valve 88 lbf·in (1000 N·cm) and install the cap on the slave cylinder bleed valve.
- Check the fluid level in the reservoir. If necessary, add or drain fluid to bring the fluid level to between the MIN and MAX lines marked on the side of the reservoir. Install the reservoir cap.
- 10. Depress the clutch pedal a few times. There should be resistance over the full pedal stroke.

Release Bearing and Yoke Assembly Replacement

Replacement

- 1. Remove the transmission from the engine.
 - For instructions for Eaton Fuller Transmissions, see Section 26.00, Subject 100.
 - For instructions for the Mercedes-Benz Automated Transmission, see Section 26.03, Subject 100.
 - For instructions for the Mercedes-Benz Manual Transmission, see Section 26.04, Subject 100.
- 2. Remove the release bearing from the release yoke. See Fig. 1.

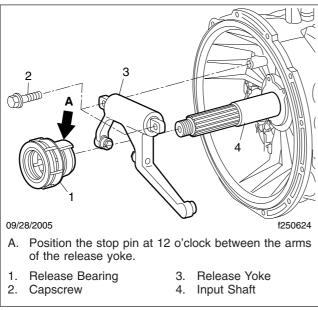


Fig. 1, Release Yoke Installation

IMPORTANT: The clips that secure the bearing to the bearing guide must be handled carefully. Repositioning or damaging these clips can lead to premature clutch failure. See **Fig. 2**.

- 3. Remove the two capscrews that attach the release yoke to the bell housing. Remove the release yoke from the transmission.
- 4. Install the release yoke. Tighten the two capscrews 33 lbf·ft (45 N·m).

IMPORTANT: Position the release bearing with the stop pin located at 12 o'clock between the two arms of the release yoke. See **Fig. 1**.

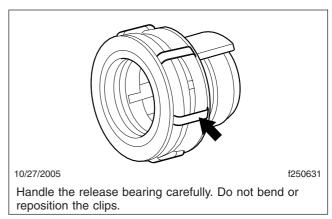


Fig. 2, Release Bearing Clip

5. Install the bearing onto the release yoke.

NOTE: Do not grease the guide of the release bearing. It is made from an advanced composite with embedded lubricating elements, and greasing it would attract dirt particles that lead to excessive wear.

- 6. Install the transmission on the engine.
 - For instructions for Eaton Fuller Transmissions, see **Section 26.00**, **Subject 100**.
 - For instructions for the Mercedes-Benz Automated Transmission, see Section 26.03, Subject 100.
 - For instructions for the Mercedes-Benz Manual Transmission, see Section 26.04, Subject 100.

Hydraulic Hose Replacement

Replacement

- Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
- 2. Open the hood.



Clutch hydraulic fluid (DOT 4 brake fluid) is hazardous. It may be a skin irritant and can cause blindness if it gets in your eyes. Always wear safety glasses when handling clutch hydraulic fluid or bleeding hydraulic lines. If you get clutch hydraulic fluid on your skin, wash it off as soon as possible.

- 3. Using a flat-tip screwdriver, remove the quickdisconnect clip that attaches the hydraulic hose to the slave cylinder. Retain the clip. See Fig. 1.
- 4. Drain the hydraulic fluid from the entire system.
- 5. At the quick-disconnect clip that attaches the hydraulic hose to the master cylinder, note the position of the clip for later installation, then remove it using a flat-tip screwdriver. See Fig. 2.
- 6. Route the new hydraulic hose between the slave cylinder and the master cylinder.
- 7. Install the quick-disconnect clip and hydraulic hose, as follows.
 - 7.1 Insert the clip arms into the recessed areas on the nozzle of the master cylinder.

IMPORTANT: Do not force the hose into the slave cylinder. If the clip is incorrectly installed, the hose will not snap into place.

- 7.2 Snap the hydraulic hose into place.
- 7.3 Tug on the hose to make sure it is installed correctly. The hose should not pull out.
- 7.4 Insert the clip at the slave cylinder, and install the hose as described above.

WARNING

Use only approved clutch hydraulic fluid (DOT 4 brake fluid). Do not mix different types of brake fluid. The wrong fluid will damage the rubber

parts of the system, causing loss of clutch function and the risk of serious personal injury.

- 8. Fill the reservoir with approved DOT 4 hydraulic brake fluid and bleed the system as instructed in **Subject 130**.
- 9. Check the function of the clutch actuation system as instructed in **Subject 300**.

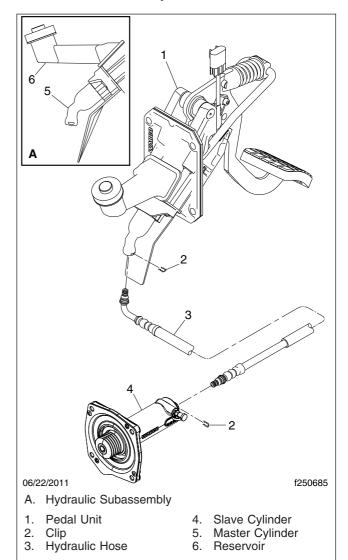


Fig. 1, Components, Hydraulic Clutch Control

Hydraulic Hose Replacement

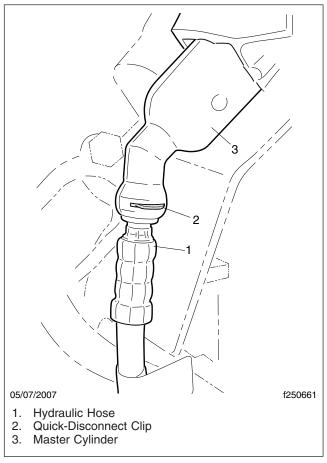


Fig. 2, Quick-Disconnect Clip at the Master Cylinder

Clutch Switch Replacement

Replacement

- 1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
- 2. Open the hood.
- Disconnect the clutch control switch located under the dash and above the clutch pedal, as follows. See Fig. 1.
 - 3.1 Retract the secondary lock. See Fig. 2.
 - 3.2 Depress the latch to unlock the switch connector, then separate the clutch control switch from the wire harness.
- 4. Remove the screw that holds the switch assembly to the pedal unit, and remove the switch.
- Mount the new switch assembly on the connector and tighten the M5 screw 23 lbf·in (260 N·cm).
- Check the function of the clutch actuation system as instructed in Subject 300.

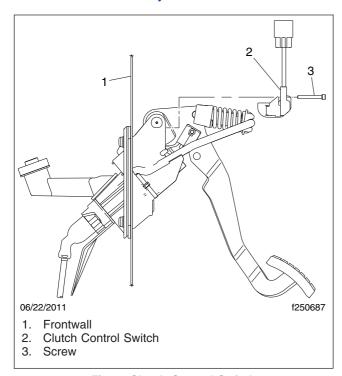


Fig. 1, Clutch Control Switch

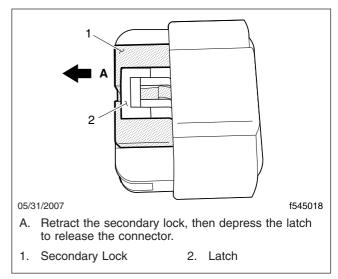


Fig. 2, Clutch Control Switch Connector

Special Tools

A special tool is used for this procedure. See **Table 1**.

Special Tool					
Tool	Description	Manufacturer	Part Number		
f580335	Clutch Centering Pin	Kent-Moore	J-45719		

Table 1, Special Tool

NOTE: To check tool availability, and to order tools, call SPX Kent-Moore at 1-800-328-6657.

Removal

- 1. Remove the transmission from the engine.
 - For instructions for the Mercedes-Benz Automated Transmission, see Section 26.03, Subject 100.
 - For instructions for the Mercedes-Benz Manual Transmission, see Section 26.04, Subject 100.
- 2. Insert the centering pin (Table 1) through the clutch disc and into the pilot bearing.

IMPORTANT: Do not remove the stop bolt. Also, forgetting to loosen this bolt may cause internal components to dislodge and render the clutch unusable.

Loosen the stop bolt about two turns. See Fig. 1 for the stop bolt location.

IMPORTANT: The clutch disc is under tension. If one capscrew is loosened too much, it places excessive tension on the cover assembly.

- Remove the cover assembly. See Fig. 2. Loosen the capscrews in a star pattern, taking care not to loosen any one capscrew too much before loosening the next one.
- 5. Remove the clutch disc assembly.

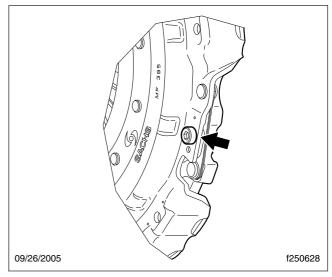


Fig. 1, Stop Bolt

NOTE: If a SACHS 395 XTend cover assembly is covered with oil (e.g. defective shaft seal) or grease, do not reinstall it—even if it has been cleaned.

Installation

NOTE: When replacing a SACHS 365 mm clutch with a 395 XTend, replace the flywheel as well. For instructions, see the manufacturer's service literature.

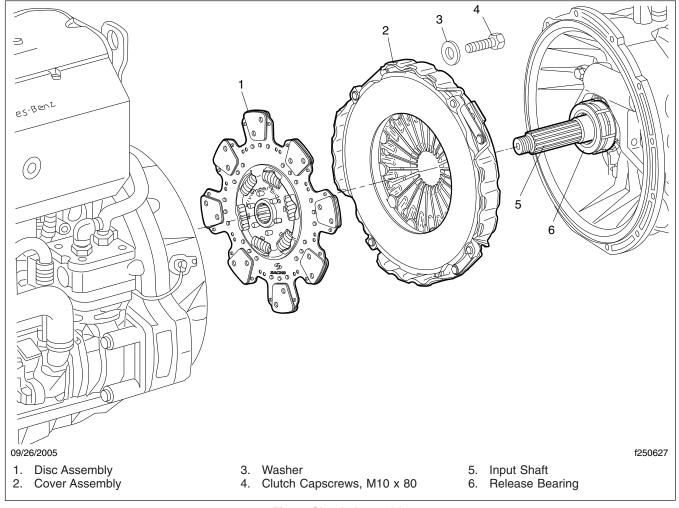


Fig. 2, Clutch Assembly

 Grease the splines of the input shaft and the hub of the disc assembly. Remove any excess grease.

NOTE: Do not grease the guide of the release bearing. It is made from an advanced composite with embedded lubricating elements, and greasing it would attract dirt particles that lead to excessive wear.

 Insert the centering pin (Table 1) into the pilot bearing. Then, with the clutch disc assembly oriented so the side marked "flywheel side" faces the flywheel, center the disc assembly on the flywheel. IMPORTANT: Do not remove the centering pin until the clutch is completely installed.

- Install guide pins at the 10 o'clock and 2 o'clock positions to ensure proper centering of the clutch cover assembly. See Fig. 3.
 - "Guide pins" are long, headless capscrews that are temporarily installed in the flywheel to support the weight of the clutch, allowing you to align it precisely with the flywheel. Without guide pins, proper clutch installation is extremely difficult. If necessary, cut off the heads of two 6-inch (15 cm) capscrews to make a set.
- 4. Install the cover assembly, as follows.

IMPORTANT: Never allow the diaphragm spring to rest on the centering pin.

- 4.1 Slide the clutch cover assembly onto the guide pins, and position it inside the raised rim of the flywheel. See **Fig. 4**.
- 4.2 Ensure the cover assembly is situated completely within the rim of the flywheel. Use a flashlight to help verify the positioning if needed.
- 4.3 Install and hand-tighten six of the eight capscrews using the sequence shown in Fig. 5 (skipping the guide pin positions).
- 4.4 Remove the two guide pins, then install and hand-tighten the remaining two capscrews.
- 4.5 Using the sequence shown in **Fig. 5**, tighten the eight clutch capscrews progressively: first to 20 lbf·ft (27 N·m), and finally to 33 lbf·ft (44 N·m). Do not put more tension on one side of the clutch than the other.
- 4.6 If the clutch was previously mounted and the stop bolt loosened for removal, tighten the stop bolt to 26 to 32 lbf·ft (35 to 43 N·m). If it is a new clutch, do not tighten the stop bolt.
- When all capscrews have been tightened, remove the centering pin.
- 6. Install the transmission on the engine.
 - For instructions for the Mercedes-Benz Automated Transmission, see Section 26.03, Subject 100.
 - For instructions for the Mercedes-Benz Manual Transmission, see Section 26.04, Subject 100.

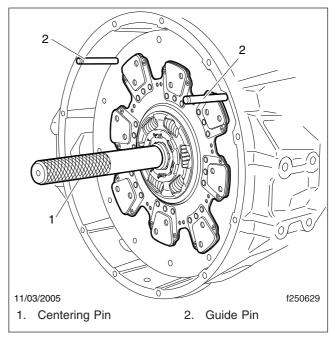


Fig. 3, Centering the Clutch

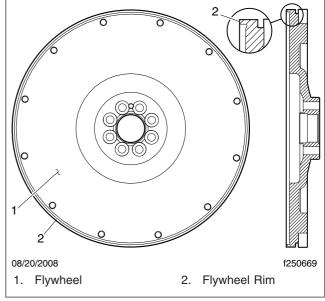


Fig. 4, Flywheel Rim

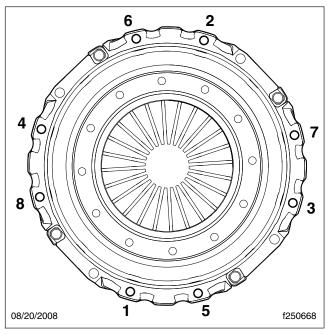


Fig. 5, Capscrew Tightening Sequence

Hydraulic Clutch Adjustment

General Information

Most hydraulically actuated clutches are auto-adjusting and require no manual adjustment under normal operating conditions. Eaton Easy-Pedal and Stamped Angle Spring clutches are manually adjusted models, and require periodic inspection and adjusting to maintain proper clutch clearance and achieve maximum clutch disc life. Approximately 75 percent of Business Class® M2 vehicles equipped with non-synchronized transmissions and hydraulically actuated clutches are equipped with manually adjusted clutches. This combination of components (hydraulic actuation and manual adjustment) does not allow the driver to feel when the clutch must be adjusted, because the clutch pedal has no free travel.

Release bearing travel is the clearance between the rear surface of the release bearing housing and the forward surface of the clutch brake disc. This distance must be maintained between 1/2 and 9/16 inch (12.7 and 14.3 mm).

Clutch Adjustment

- 1. Apply the parking brakes and chock all the tires.
- 2. Remove the clutch inspection cover from the bell housing. See **Fig. 1**.
- 3. Slide the clutch brake tight against the transmission input-shaft bearing cap.

IMPORTANT: Release bearing travel tool A02-12419-000 is available through the PDCs. One end of the tool has green tape on it and is 0.50 inch (12.7 mm) in diameter; the other end has blue tape on it and is 0.56 inch (14.3 mm) in diameter. See **Fig. 2**.

4. Measure the release bearing travel. See Fig. 3 for the correct dimension to measure. Using both ends of the release bearing travel tool, check this gap as follows:

Position the tool so that the legs at the blue 0.56-inch (14.3-mm) end straddle the transmission input shaft. If the tool fits loosely, the gap is too wide and adjustment is needed. Go to the next step.

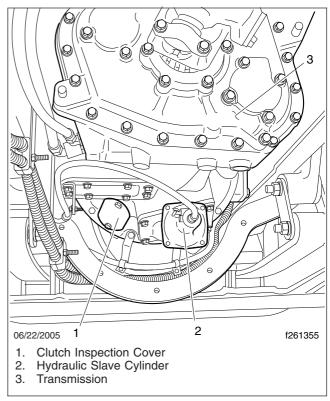


Fig. 1, View from Underneath the Vehicle Looking Forward

If the blue 0.56-inch (14.3-mm) end can't be inserted in the gap, then try to insert the green 0.50-inch (12.7-mm) end.

If the green end of the tool can't be inserted in the gap, adjustment is needed. Go to the next step.

If the green end of the tool fits — snugly or loosely — then no adjustment is needed. Nothing more needs to be done. Install the clutch inspection cover and remove the chocks from the tires.

- 5. Turn the engine flywheel until the lockstrap is aligned with the clutch inspection-cover opening.
- 6. Release the clutch by depressing the pedal. Block the pedal in the released position, or have someone assist you by holding the pedal down during the adjustment procedure.

NOTE: An open-end wrench is not recommended for the following step.

Hydraulic Clutch Adjustment

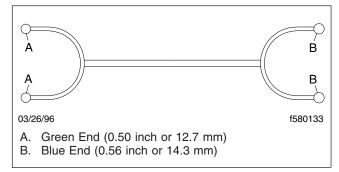
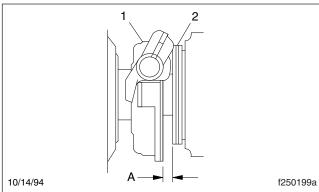


Fig. 2, Release Bearing Travel Tool A02-12419-000



- A. Clearance between release bearing housing and clutch brake (release bearing travel) must be 1/2 to 9/16 inch (12.7 to 14.3 mm).
- 1. Release Bearing Housing
- 2. Clutch Brake

Fig. 3, Release Bearing Travel Measurement

- Adjust the clutch, using a 5/8-inch box-end or socket wrench on the adjustment bolt. See Fig. 4.
 - 7.1 Insert the 5/8-inch box-end or socket wrench through the inspection cover opening.
 - 7.2 To begin the adjustment, release the adjustment bolt by pressing down on the bolt head.

NOTE: Normal wear increases the gap between the release bearing and the transmission. See **Fig. 3**, dimension A.

7.3 To decrease the gap: If clearance between the release bearing housing and the clutch brake is more than 9/16 inch (14.3 mm), turn the adjustment bolt clockwise (the

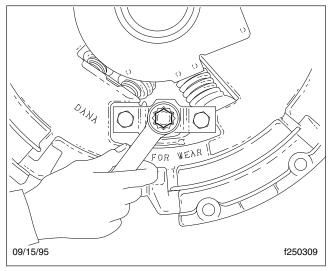


Fig. 4, Adjustment with Kwik-Adjust (bell housing shown removed)

release bearing moves toward the transmission).

To increase the gap: If clearance between the release bearing housing and the clutch brake is less than 1/2 inch (12.7 mm), turn the adjustment bolt counterclockwise (the release bearing moves toward the engine).

7.4 When the adjustment is complete, make sure the adjustment bolt is locked (pulled up flush with the mounting bolts).

NOTE: On Easy-Pedal 2000 clutches, each complete turn of the adjustment bolt represents about 0.125 inch (3 mm) of release bearing movement. On earlier Easy-Pedal models, each complete turn of the adjustment bolt represents about 0.02 inch (0.5 mm) of release bearing movement.

- After adjusting, release the pedal and check the clearance between the release bearing housing and the clutch brake. When the adjustment is correct, the green end of the tool should go in and the blue should not (clearance of 1/2 to 9/16 inch, or 12.7 to 14.3 mm).
- Install the clutch inspection cover on the bell housing.
- 10. Remove the chocks from the tires.

Diagnostic Checks

IMPORTANT: If any problems are noticed during these diagnostic checks, take corrective action using the information under the heading "Troubleshooting Tables."

When repairing any components, bleed the clutch hydraulic system before restoring the vehicle to service. This will prevent air from remaining in the system.

Clutch Switch Check

- 1. Shut down the engine.
- 2. Apply the parking brakes, chock the front and rear tires, and open the hood.
- 3. Disconnect the clutch control switch connector located under the dash just above the clutch pedal.
- 4. To check the upper position switch, do a continuity check between pin 2 and pin 3 of the connector. See Fig. 1.
 - 4.1 With the pedal not pressed, the circuit should be closed (continuity should be present).
 - 4.2 With the pedal pressed down about 4 inches (10 cm), the circuit should be open (no indication of continuity).
- To check the lower position switch, do a continuity check between pin 1 and pin 3 of the connector.
 - 5.1 With the pedal not pressed, the circuit should be open (no indication of continuity).
 - 5.2 With the pedal pressed down all the way to the floor, the circuit should be closed (continuity should be present).
- 6. If either check gives an incorrect result, replace the clutch switch.

Clutch Actuation System Check



Air in the clutch hydraulic system can prevent the gears from engaging properly, and cause a serious accident resulting in personal injury.

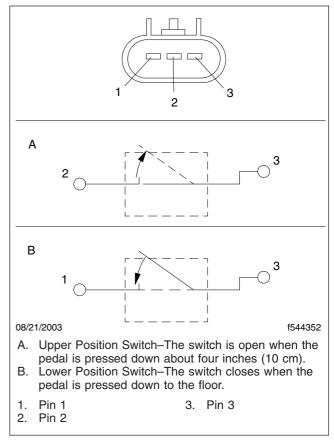


Fig. 1, Clutch Switch

- 1. Shut down the engine.
- Apply the parking brakes and chock the front and rear tires.
- 3. Do the "Clutch Actuation System Leak Check."
- 4. Press the pedal all the way to the floor several times and check the action of the pedal. The pedal should be easy to operate and return without difficulty to its original position. It should feel firm and responsive, not soft or spongy.
- 5. With both the brake and the clutch pedals pressed down, start the engine.
 - 5.1 If the engine does not start, take corrective action using the information under the heading "Troubleshooting Tables."
 - 5.2 If the clutch does not disengage properly, take corrective action using the information under the heading "Troubleshooting Tables."

- 6. Remove the chocks from the front and rear tires.
- Test drive the vehicle.
 - 7.1 Check for proper clutch functioning while shifting gears.
 - 7.2 If the clutch makes noise when shifting out of neutral into another gear, do the "Clutch Incomplete Disengagement Check."
 - 7.3 With cruise control on, press the clutch pedal down. If cruise control does not deactivate, take corrective action using the information under the heading "Troubleshooting Tables."

Clutch Actuation System Leak Check

- 1. Shut down the engine.
- 2. Apply the parking brakes, chock the front and rear tires, and open the hood.

NOTE: This step requires two persons.

 Have one person press down on the clutch pedal while the other person checks the clutch hydraulic system for signs of leakage.

Clutch Incomplete Disengagement Check

NOTE: Do this check only on vehicles with synchronized transmissions.

- Chock the front tires and apply the parking brake.
- 2. Put the gear shift lever in neutral.
- Start the engine.
- 4. Press the clutch pedal all the way to the floor.
- 5. Shift the transmission into 1st gear.
- 6. With the clutch pedal still on the floor, shift into 2nd gear.
- 7. Listen for noise and feel for difficult shifting. If there is noise or difficulty in getting the gears to shift, the clutch is not completely disengaged. Take corrective action using the information under the heading "Troubleshooting Tables."

Troubleshooting Tables

Problem-The Clutch Pedal Feels Soft or Spongy

Problem-The Clutch Pedal Feels Soft or Spongy			
Possible Cause Remedy			
There is air in the hydraulic system.	Bleed the hydraulic system. See Subject 140 for instructions.		
There is a hydraulic fluid leak.	Check the fluid level. Check for leakage and replace any components found to be leaking. Fill and bleed the hydraulic system.		

Problem-The Clutch Pedal Is Unusually Hard To Operate

Problem-The Clutch Pedal Is Unusually Hard To Operate			
Possible Cause Remedy			
The clutch is damaged.	Remove the clutch and inspect it for damage. Replace the clutch if damaged, or make any necessary repairs. For the SACHS 365 mm clutch, see Subject 130 . For the SACHS 395 XTend clutch, see Subject 180 .		
The clutch is not functioning properly.	Check clutch function and make any necessary repairs. See the instructions under the heading "Clutch Actuation System Check."		

Problem-The Clutch Pedal Is Unusually Hard To Operate				
Possible Cause	Remedy			
The return or assist spring is broken.	Replace the pedal unit. See Subject 100 for instructions.			
	MARNING			
	Do not attempt to disassemble the preloaded assist spring. Sudden release of the assist spring could cause property damage and serious personal injury.			
The pedal assembly is worn or jammed.	Replace the pedal unit. See Subject 100 for instructions.			
The master cylinder has components that are jammed or broken.	Replace the hydraulic subassembly. See Subject 110 for instructions.			

Problem-The Clutch Does Not Completely Disengage; Shifting Is Difficult and Noisy

Problem-The Clutch Does Not Completely Disengage; Shifting Is Difficult and Noisy			
Possible Cause	Remedy		
There is air in the hydraulic system.	Bleed the hydraulic system. See Subject 140 for instructions.		
There is a hydraulic fluid leak.	Check the fluid level. Check for leakage and replace any components found to be leaking. Fill and bleed the hydraulic system.		
Components of the pedal unit are defective.	Replace the pedal unit. See Subject 100 for instructions.		
The slave cylinder is defective.	Replace the slave cylinder. See Subject 120 for instructions.		
The slave cylinder is loose.	Tighten the M8 slave cylinder mounting capscrews 12 lbf·ft (16 N·m).		
The wrong type of brake fluid was used.	Replace the complete system. Fill only with approved DOT 4 brake fluid.		

Problem-The Clutch Is Slipping

Problem-The Clutch Is Slipping				
Possible Cause Remedy				
The clutch is worn.	Replace the clutch. For the SACHS 365 mm clutch, see Subject 130 . For the SACHS 395 XTend clutch, see Subject 180 .			
Contamination (e.g. oil, grease, etc.).	Replace the clutch. For the SACHS 365 mm clutch, see Subject 130 . For the SACHS 395 XTend clutch, see Subject 180 .			
The clutch actuation system is "preloading." Check the clutch actuation system. See the procedures under the heading "Clutch Actuation System Check."				

Problem-The Clutch Switch Does Not Activate

Problem-The Clutch Switch Does Not Activate				
Possible Cause Remedy				
The switch contacts are damaged or worn.	Replace the clutch switch assembly. See Subject 170 for instructions.			
The switch wiring is damaged.	Repair the wiring. See Section 54.03 for instructions.			
The switch cam is damaged. Replace the pedal unit. See Subject 100 for instructions.				

Problem-The Clutch Pedal Does Not Return

Problem-The Clutch Pedal Does Not Return				
Possible Cause Remedy				
The return or assist spring is broken.	Replace the pedal unit. See Subject 100 for instructions.			
	▲ WARNING			
	Do not attempt to disassemble the preloaded assist spring. Sudden release of the assist spring could cause property damage and serious personal injury.			

Problem-Cruise Control or Engine Brake Does Not Deactivate When the Clutch Pedal Is Pressed Down

Problem-Cruise Control or Engine Brake Does Not Deactivate When the Clutch Pedal Is Pressed Down			
Possible Cause Remedy			
The upper position switch is damaged.	Check switch function and make any necessary repairs. See the instructions under the heading "Clutch Switch Check."		
There has been an external electrical failure.	See Section 54.03 for instructions.		

Problem-Starter Does Not Operate

Problem-Starter Does Not Operate			
Possible Cause Remedy			
The lower position switch is damaged.	Check switch function and make any necessary repairs. See the instructions under the heading "Clutch Switch Check."		
There has been an external electrical failure.	See Section 54.03 for instructions.		

Specifications

For fastener torque values, see the tables below.

Torque Values, SACHS 365 mm Clutch				
Description	Size	Grade/Class	Torque: lbf·ft (N·m)	Torque: Ibf·in (N·cm)
Bleed Screw	M7	_	_	88 (1000)
Clutch Capscrews	3/8–16	5	37 (50)	_
Clutch Switch Mounting Screw	M5	_	_	23 (260)
Hydraulic Sub-Assembly Retainer	_	_	_	44 (500)
Pedal Unit Mounting Plate Capscrews	M8	8.8	13 (18)	_
Release Yoke Mounting Capscrews	_	_	33 (45)	_
Slave Cylinder Mounting Capscrews	M8	10.9	13 (18)	_
Standoff Bracket Mounting Capscrews	1/4–20	8	10 (14)	_

Table 1, Torque Values, SACHS 365 mm Clutch

Description	Size	Grade/Class	Torque: lbf-ft (N·m)	Torque: Ibf·in (N·cm)
Bleed Screw	M7	_	_	88 (1000)
Clutch Capscrews	M10	10.9	33 (45)	_
Clutch Switch Mounting Screw	M5	_	_	23 (260)
Hydraulic Sub-Assembly Retainer	_	_	_	44 (500)
Pedal Unit Mounting Plate Capscrews	M8	8.8	13 (18)	_
Release Yoke Mounting Capscrews	_	_	33 (45)	_
Slave Cylinder Mounting Capscrews	M8	10.9	13 (18)	_
Standoff Bracket Mounting Capscrews	1/4–20	8	10 (14)	_
Stop Bolt	_	_	29 (41)	_

Table 2, Torque Values, SACHS 395 XTend Clutch

Special Tools

Special Tools				
Tool	Description	Manufacturer	Part Number	
f580335	Clutch Centering Pin	Kent-Moore	J-45719	
f580133a	Clutch Release Bearing Travel Tool	PDC	A02-12419-000	

Table 1, Special Tools