Index, Alphabetical

Section	Section Number
Clutch Brake	25.06
Clutch Control, Hydraulic System	25.03
Clutch Control, Mechanical Linkage System	25.02
Sachs Hydraulic Clutch System	25.07
Spicer® Angle-Ring® Single-Plate Clutches	25.00
Eaton Fuller Pull-Type Clutches	25.01
Valeo Clutches	25.04

Spicer Angle-Ring Single-Plate Clutches 25.00

Contents

Subject	Subject Number
General Description and Principles of Operation	050
Service Operations	
Clutch Removal, Inspection, and Installation	100
Troubleshooting	300
Specifications	400

General Description and Principles of Operation

Spicer Angle-Ring 310 mm and 350 mm clutches are a single-plate dry-disc design. There are no internal adjustments.

The clutch-cover assembly is bolted directly to the flywheel with twelve capscrews. The clutch-cover assembly drives the pressure plate through three drive straps. The driven disc uses ceramic friction material and has a spring-loaded center section for dampening.

The Angle-Ring clutch is a push-type release design. Depressing the clutch pedal moves the release (throwout) bearing toward the engine flywheel. As the clutch is depressed, the pressure plate retracts from contact with 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. The belleville spring exerts pressure through the levers onto the pressure plate causing the driven disc to be locked up between the friction surfaces of the pressure plate and the engine flywheel. The clutch is then engaged.

Clutch Removal, Inspection, and Installation

Removal

1. Park the vehicle. Apply the parking brake and chock the tires.
2. Remove the transmission. See the applicable section in **Group 26**.

NOTE: The release bearing will drop to the bottom of the bell housing when the transmission is removed.

3. Remove the bell housing.
   - 3.1 On vehicles with Mercedes-Benz engines remove the twelve capscrews.

     On vehicles with Cummins B Series engines, loosen the nuts on the U-bolt holding the exhaust pipe to the bell housing. See **Fig. 1**. Remove the two capscrews (**Fig. 2**) holding the U-bolt bracket to the housing, and rotate the U-bolt bracket out of the way.
   - 3.2 On vehicles with Cummins B Series engines, remove the remaining ten capscrews around the bell housing. See **Fig. 3**.

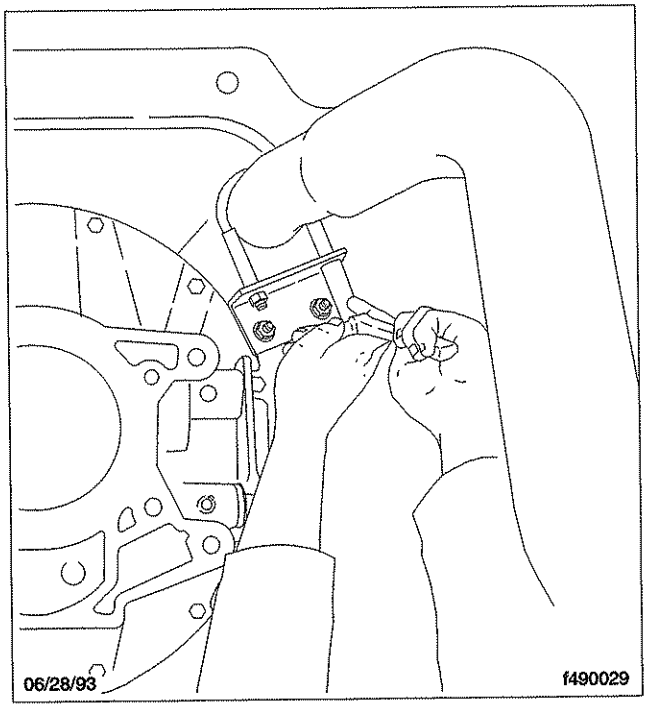


Fig. 1

   - 3.3 On all vehicles, lift off the housing. See **Fig. 4**.
4. Remove the clutch assembly.
   - 4.1 Insert the pilot tool. See **Fig. 5**.
   - 4.2 Remove two capscrews from the top of the clutch and install dowels to support the pressure plate and cover assembly. See **Fig. 6**. Remove the remaining capscrews.
   - 4.3 Remove the clutch disc, pressure plate, and cover assembly along with the pilot tool. See **Fig. 7**.
5. Using a puller, remove the pilot bearing. See **Fig. 8**.

Inspection

1. Clean the clutch assembly thoroughly to inspect the parts. If there is excessive wear or damage or if parts are in questionable condition, replace them with a new clutch and driven disc assembly.

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

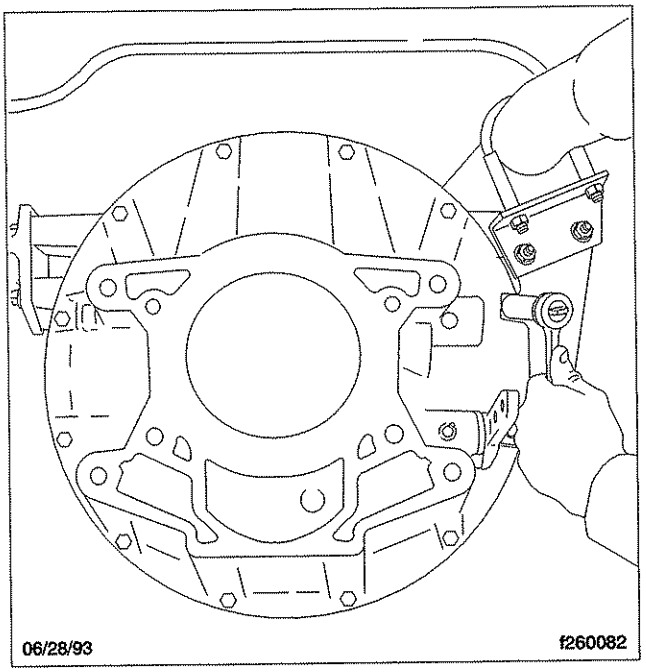


Fig. 2

Clutch Removal, Inspection, and Installation

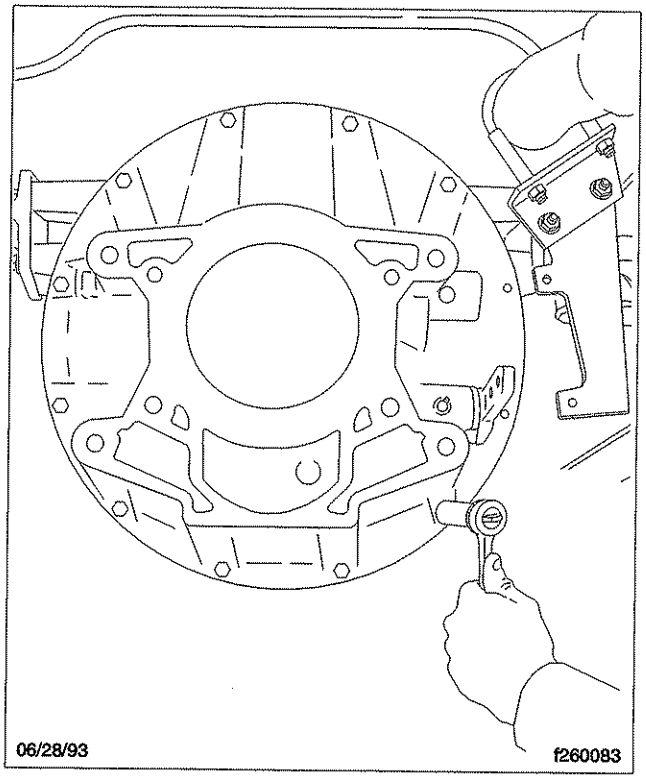


Fig. 3

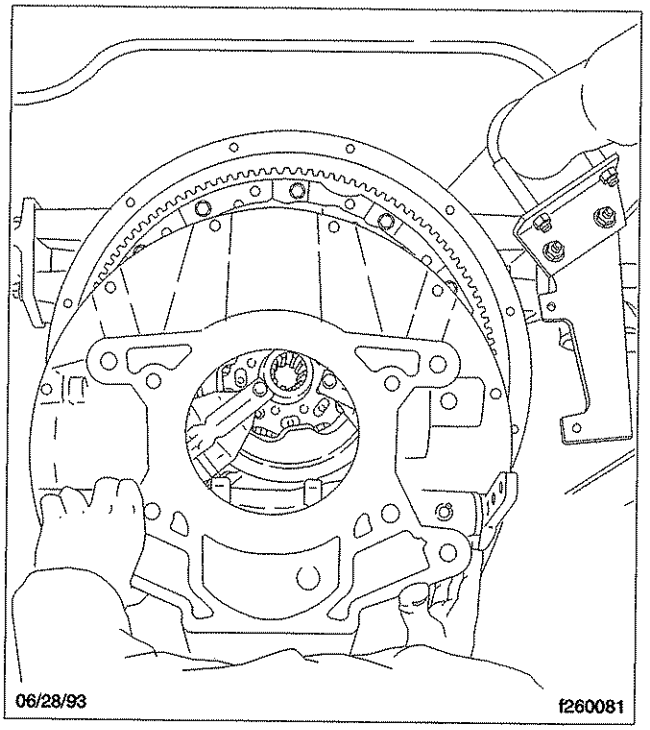


Fig. 4

flywheel-mounting bolts or the starter ring-gear on the flywheel.

NOTE: Due to the design of the clutch assembly, do not rebuild it.

2. Clean the surfaces being measured to ensure accurate measurements.

NOTE: Before measuring the flywheel or flywheel housing, check the end-play of the crankshaft. Mount the dial indicator on the flywheel housing, with the indicator's finger against the flywheel. Force the crankshaft back and forth with a pry bar. If end-play exceeds the maximum, correct it. For specifications and instructions, see the engine manufacturer's service manual.

3. Inspect for a worn or corroded pilot (**Fig. 9**) on both the bell housing, and the flywheel housing. The pilot lip of the clutch 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. Any measurable wear on either part will cause misalignment; replace the

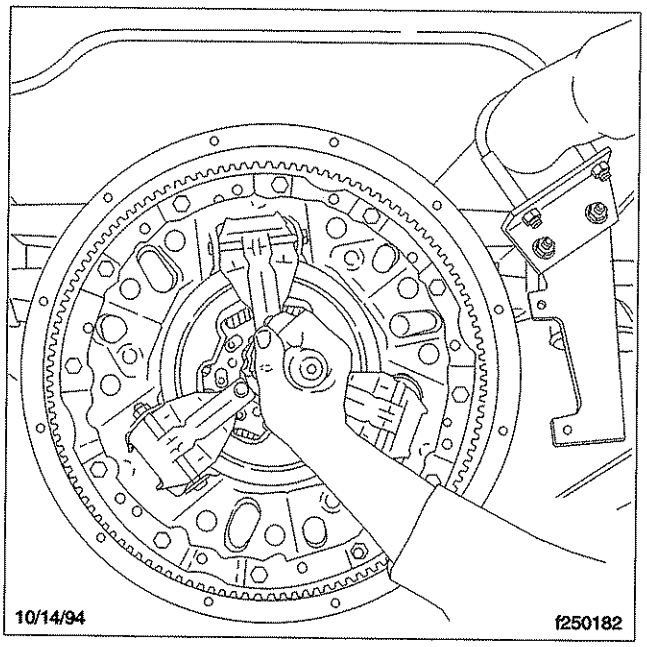


Fig. 5

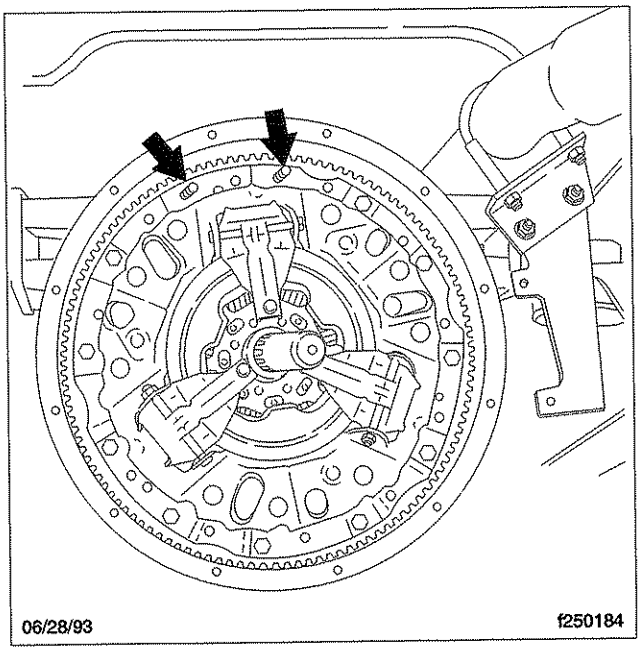


Fig. 6

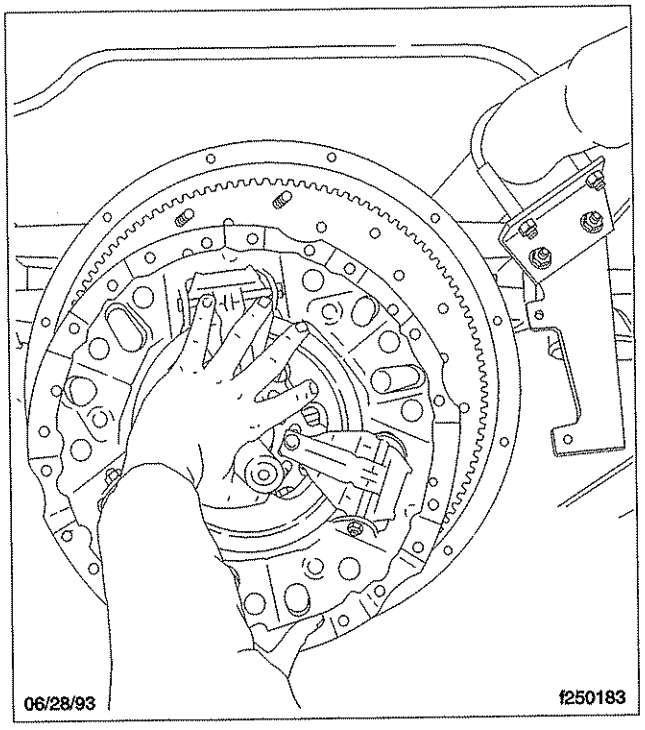


Fig. 7

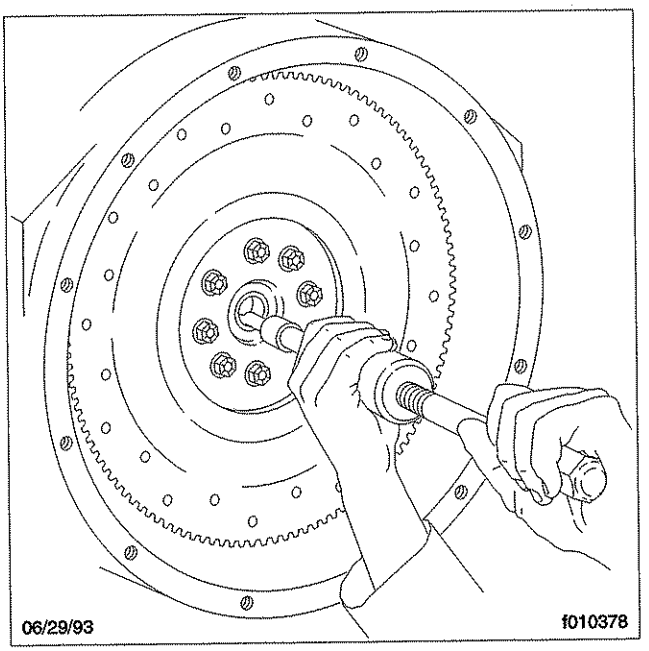


Fig. 8

part. Wear may first appear between the 3 o'clock and 8 o'clock positions. See **Fig. 10**.

3.1 Measure the runout of the pilot (bore) of the flywheel housing. Secure the dial indicator to the flywheel (or crankshaft), with the gauge finger against the housing pilot. See **Fig. 11**. With chalk or soapstone, mark the high and low points on the flywheel

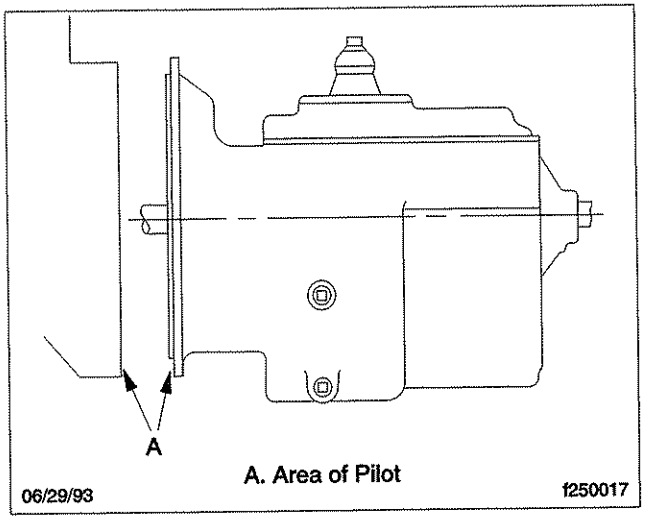


Fig. 9

Clutch Removal, Inspection, and Installation

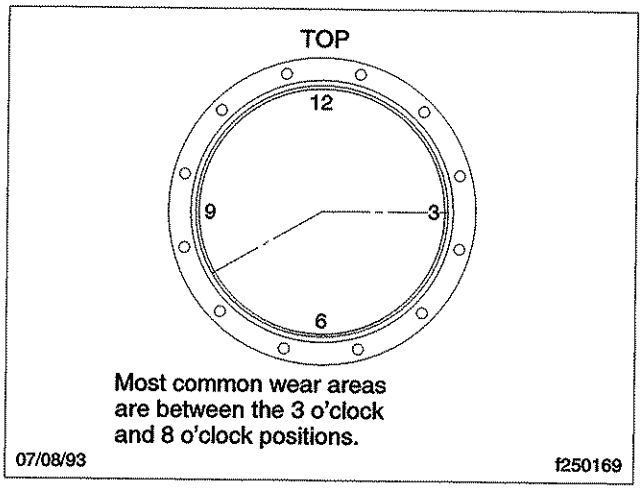


Fig. 10

housing flange, while rotating the flywheel (or crankshaft) by hand. The total runout will be the difference between the highest plus and minus readings. See **Fig. 12.**

The SAE maximum total runout for the flywheel housing pilot is 0.2 mm (0.008 inch). If the readings are higher, replace the housing. For instructions, see the engine manufacturer's service manual.

3.2 Measure the runout of the face of the flywheel housing. With the dial indicator secured to the flywheel (or crankshaft), move the finger to contact the face of the housing. See **Fig 13.** Mark the high and low points.

The SAE maximum total runout for the flywheel housing face is 0.2 mm (0.008 inch). If the readings are higher, replace the housing. For instructions, see the engine manufacturer's service manual.

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

4. Measure the runout of the flywheel face. Secure the dial indicator to the flywheel housing, with the gauge finger against the face of the flywheel near the outer edge. See **Fig. 14.** Turn the flywheel to obtain readings. With readings taken just outside the outer edge of the clutch disc wear pattern, the maximum tolerance is 0.18 mm (0.007 inch) for the 350-mm (14-inch) clutch and 0.17 mm (0.006 inch) for the 310-mm (13-inch) clutch. If the readings are higher, repair or replace the flywheel. See the engine manufacturer's service manual for instructions.

5. Measure the runout of the pilot-bearing bore of the flywheel. With the indicator secured to the flywheel housing, move the gauge finger to contact the

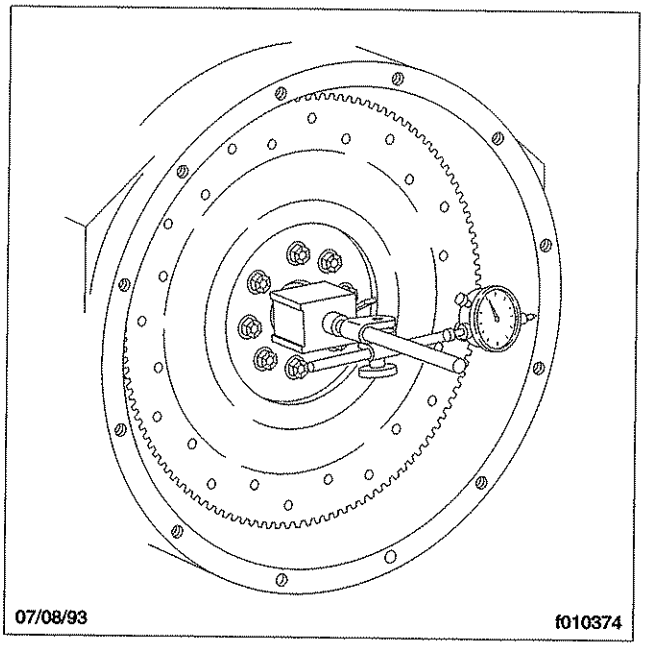


Fig. 11

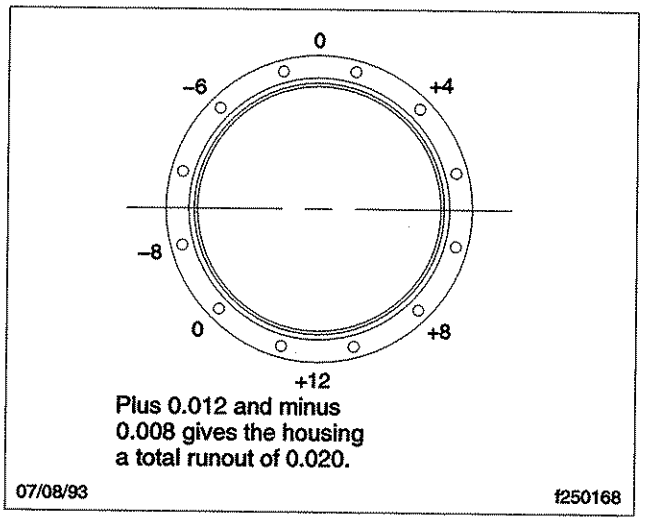


Fig. 12

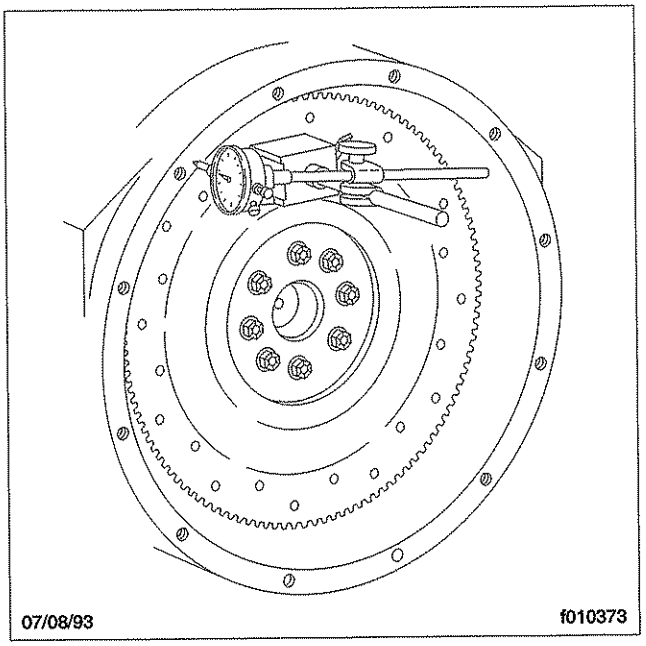


Fig. 13

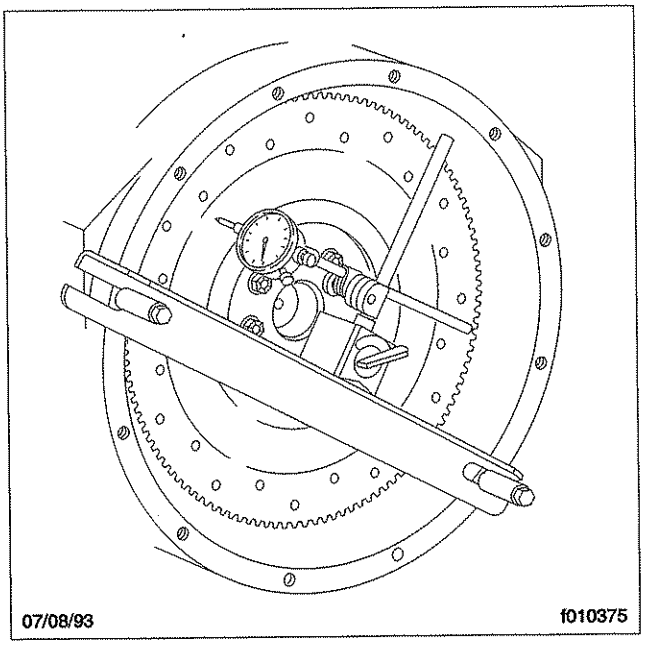


Fig. 14

pilot-bearing bore surface. See **Fig. 15**. Turn the flywheel to obtain the readings.

The SAE maximum total runout for the pilot-bearing bore is 0.13 mm (0.005 inch). If the readings are higher, see the engine manufacturer's service manual for instructions.

6. Measure the runout of the transmission clutch-housing face and pilot.

   The SAE maximum runout for the clutch-housing face and pilot is 0.20 mm (0.008 inch). If the readings are higher, replace the clutch housing; see the transmission manufacturer's service manual.

⚠ CAUTION

CAUTION: The engine and transmission must line up. Misalignment of any parts will cause premature wear of drivetrain components.

NOTE: The clutch-housing face and pilot cannot be checked accurately unless you have a set of case-bore plugs and shaft. This set consists of plugs to be tapped into the front and rear bores of the transmission case. They have a very close fit in the bores. A 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 clutch housing.

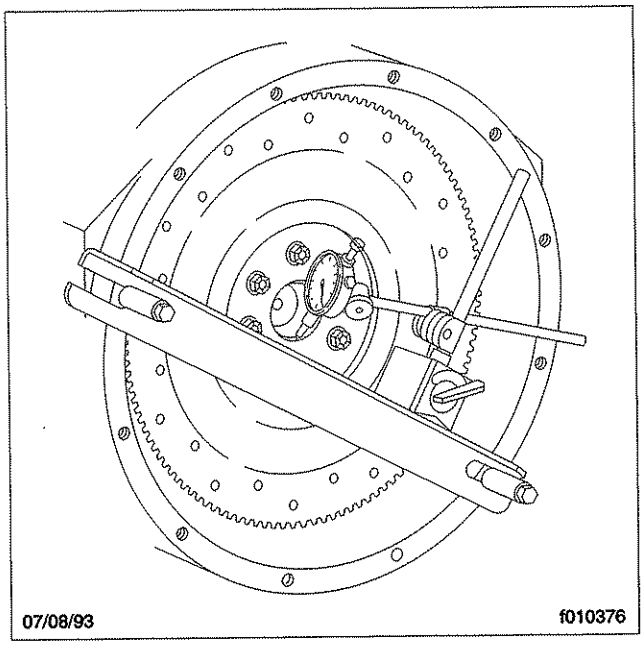


Fig. 15

Clutch Removal, Inspection, and Installation

7. Inspect the friction surface of the flywheel for unevenness, heat checks, scoring, and wear on the contact surface. Inspection for heat checks and scoring must be visual, and based on experience; however, measure the friction surface wear with a straightedge and feelers.

   Replace or repair the flywheel if the wear is extreme. For instructions, see the engine manufacturer's recommendations concerning flywheel replacement or rebuilding.

   If the flywheel has been replaced, measure the runout of the face and pilot diameters to make sure the measurements are within the engine manufacturer's specifications.

8. Check the fit of the splined hub of the clutch disc by sliding it on the transmission input shaft splines. The hub must slide freely so the clutch will release cleanly. If necessary, use a hand stone to dull the sharp edges of the splines. If the input shaft splines are badly worn or notched, replace the input shaft; for instructions, see the transmission manufacturer's service manual.

9. Check for wear on the fingers of the clutch release yoke, release shaft, and the release shaft bushings. Replace any worn parts.

10. Check the pilot bearing and release bearing. Replace parts as needed. Excessive wear can cause poor clutch performance and shortened clutch life.

11. Remove any oil or grease from the flywheel and bell housing area.

Installation

1. Using a driver, install a new pilot bearing. See **Fig. 16**.

2. Install the clutch assembly.

   2.1 Assemble the clutch disc and pressure plate on the pilot tool making sure the correct side of the disc will face the flywheel. See **Fig. 17**.

   2.2 If they were removed, install the dowels in the two upper holes in the flywheel.

   2.3 Lift the clutch disc, pressure plate, and pilot tool into position and hang them on the dowels. See **Fig. 7**.

   2.4 Install capscrews in the holes without dowels. Remove the dowels and install the remaining capscrews. Tighten them 45 N·m (33 lbf·ft) in the sequence shown in **Fig. 18**.

   2.5 Remove the pilot tool.

3. Lift the bell housing into position (**Fig. 4**) and install the twelve capscrews around the housing. Tighten the capscrews 54 N·m (40 lbf·ft).

NOTE: On vehicles with Cummins B Series engines some of the capscrews also hold brackets for the exhaust and various lines and cables (**Fig. 1** and **Fig. 2**).

4. Pull the clutch release fork back (**Fig. 19**); then, slide the release bearing into position.

5. Install the transmission. See the applicable section in **Group 26**.

6. Remove the chocks from the tires.

7. Test drive the vehicle to check for correct clutch operation.

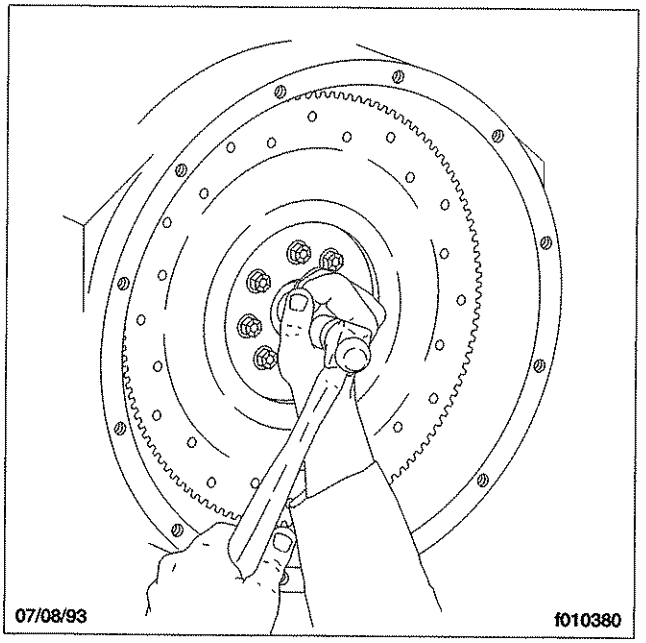


Fig. 16

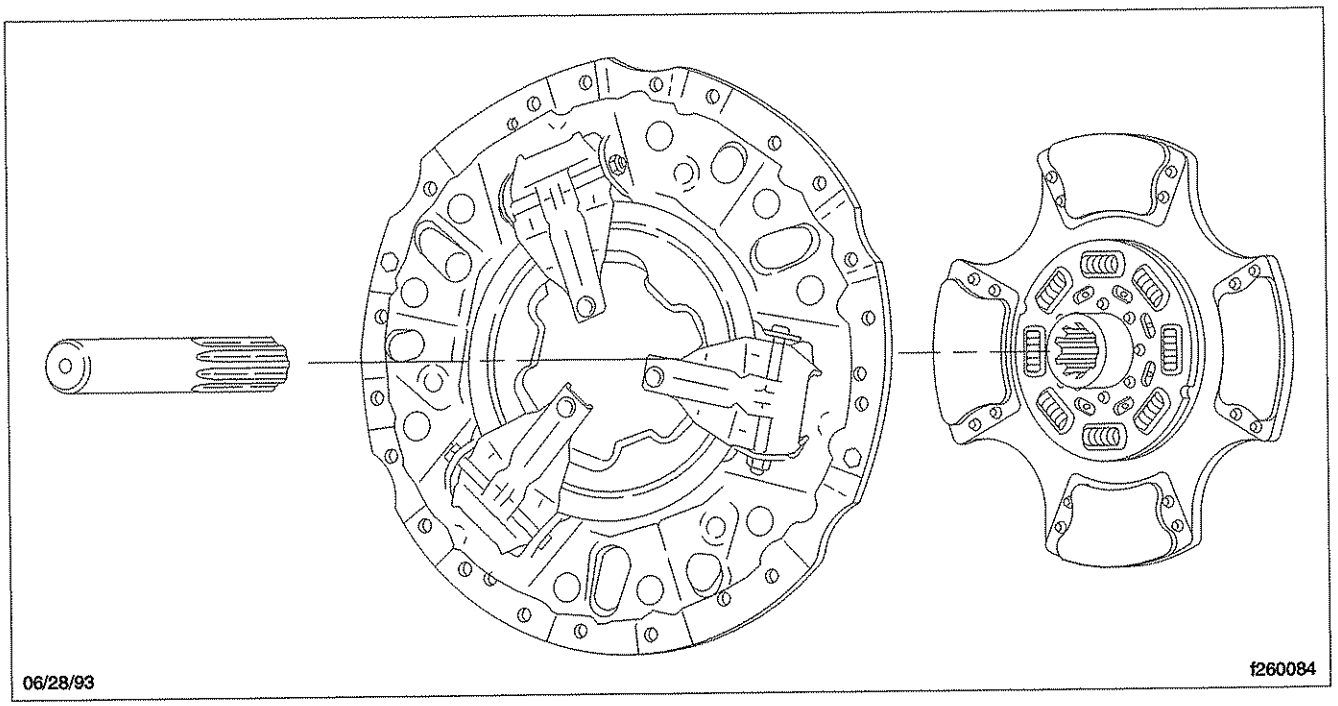


Fig. 17

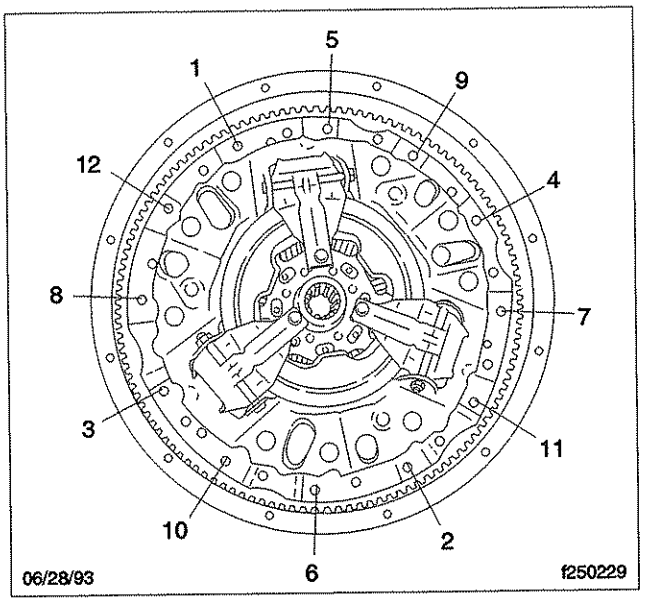


Fig. 18

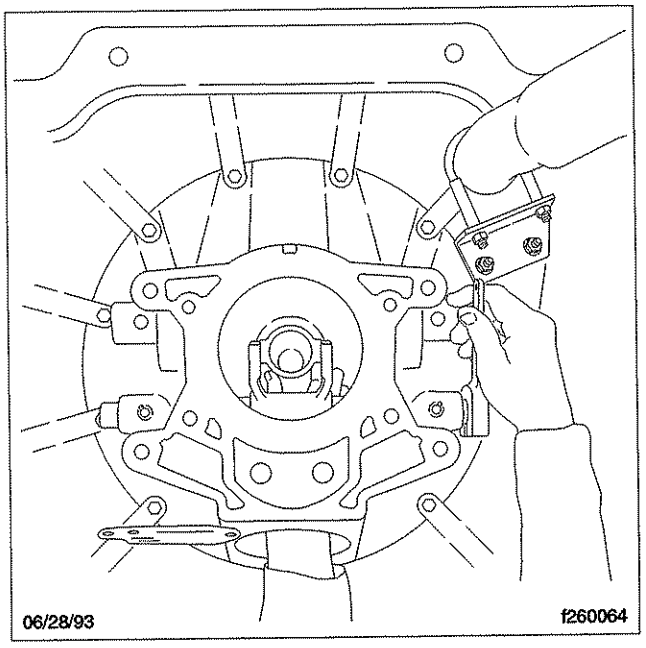


Fig. 19

This subject contains the following troubleshooting tables:

- Clutch Drags and Doesn't Release Completely
- Clutch Slips

Problem—Clutch Drags and Doesn't Release Completely

Possible Cause	Remedy
Slave cylinder is leaking or not working correctly.	Repair or replace the slave cylinder as needed.
Master cylinder is leaking or not working correctly.	Repair or replace the master cylinder as needed.
The clutch driven disc is bent or warped.	Replace the driven disc.

Problem—Clutch Slips

Possible Cause	Remedy
The shipping blocks were not removed.	Remove the shipping blocks and install the clutch correctly.
There is grease or oil on the clutch driven disk, the pressure plate, or the flywheel.	Clean the clutch components with isopropyl alcohol as needed. If the problem is due to a leaking rear crankshaft seal or transmission seal, replace seals as needed.
The driver is riding the clutch pedal.	Instruct the driver in the correct driving techniques. Slipping the clutch will cause clutch and flywheel damage.

Specifications

This subject contains the following tables:

- Torque Values
- Spicer Clutch Specifications

Description	Size (inches)	Torque N·m (lbf·ft)
Clutch-to-Flywheel Mounting Bolts	3/8	45 (33)
Transmission-to-Bell Housing Bolts	3/8	54 (40)

Table 1, Torque Values

Description	Clutch Size	
	310 mm (13 inch)	350 mm (14 inch)
Lever Height from Flywheel Surface	52.38 mm (2-1/16 inches)	61.93 mm (2-7/16 inches)
Bolt Circle Diameter	371.47 mm (14-5/8 inches)	393.7 mm (15-1/2 inches)
Rated Plate Load	10 700 N (2400 lbf)	10 700 N (2400 lbf)
Number of Splines	10	10
Spline Diameter	38.1 mm (1-1/2 inches)	38.1 mm (1-1/2 inches)
Driven Disc Facing Material	Ceramic	Ceramic
Facing Thickness (new)	10.16 mm (0.400 inch)	10.16 mm (0.400 inch)
Hub Type	Dampened 6-Spring	Dampened 8-Spring

Table 2, Spicer Clutch Specifications

Spicer® Angle-Spring®, Easy-Pedal®, and Solo™ 14 and 15-1/2 Inch Standard, Medium-Duty, Heavy-Duty, and Super-Duty Clutches

25.01

Contents

Subject	Subject Number
General Description and Principles of Operation	050
Service Operations	
Clutch Adjustments	100
Clutch Removal	110
Clutch Inspection	120
Clutch Installation	130
Troubleshooting	300
Specifications	400

General Description

EASY-PEDAL CLUTCHES

Spicer Easy-Pedal clutches are pull-type clutches of a dry-disc design. They are available in 14-inch (350-mm) and 15-1/2 inch (394-mm) two-plate versions. See **Fig. 1**. Internal clutch adjustments are done manually.

With 14-inch (350-mm) Easy-Pedal clutches, the intermediate plate separating the driven discs is carried on six pins mounted in the flange of a "pot-type" flywheel. In the 15-1/2 inch (394-mm) versions, the intermediate plate separating the driven discs is carried on four lugs within the cover assembly. The cover assembly is mounted on a flat flywheel. All versions have four return springs attached to the cover assembly to retract the pressure plate when the clutch is disengaged.

Easy-Pedal clutches may be specified with ceramic or organic driven discs.

Clutch capacity for the Spicer Easy-Pedal clutches is indicated by the color code of the pressure springs in the cover assemblies. See the appropriate Easy-Pedal clutches table in **Specifications, 400** for color codes.

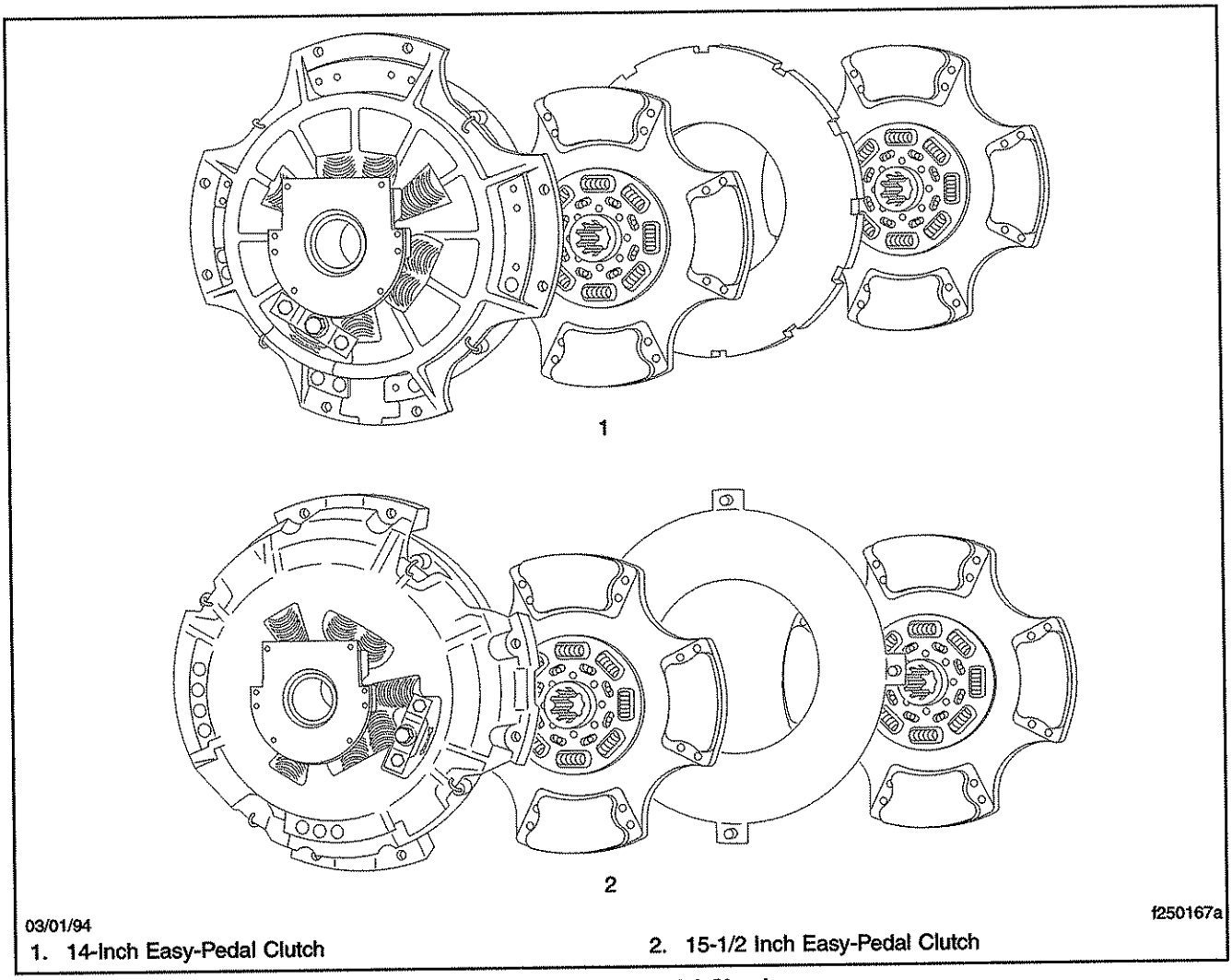


Fig. 1, Spicer Easy-Pedal Clutches

General Description and Principles of Operation

ANGLE-SPRING CLUTCHES

Spicer Angle-Spring clutches are pull-type clutches of a dry-disc design. They are available in 14-inch (350-mm) single-plate (SAS 1401) and two-plate (SAS 1402) versions. See **Fig. 2**. They may be specified with either a manual- or self-adjusting feature. Both versions are mounted to a flat flywheel.

In the two-plate versions, the intermediate plate separating the driven discs is mounted directly to the flywheel. The flywheel ring carries four drivestraps (Ref. 4) to retract the pressure plate when the clutch is disengaged.

Angle-Spring clutches may be specified with ceramic or organic driven discs.

Clutch capacity for the Spicer Angle-Spring clutches is indicated by the color code of the pressure springs in the cover assembly. See the appropriate Angle-Spring clutches table in **Specifications, 400** for color codes.

SOLO HEAVY-DUTY 15-1/2 INCH CLUTCH

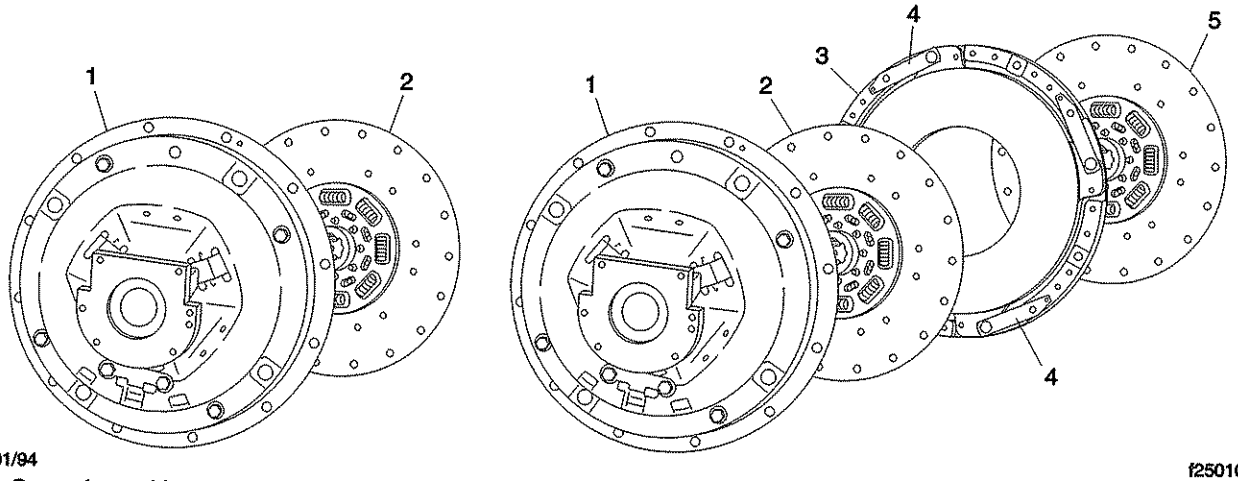
The Spicer Solo Heavy-Duty clutches are pull-type clutches of a dry-disc design. They are available in 15-1/2 inch (394-mm) two-plate assemblies. See **Fig. 3**. Spicer Solo Heavy-Duty clutches are totally adjustment free. As the clutch wears, its innovative wear-adjusting technology monitors clutch components and makes any 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 cams' movement to let you know when it's time to replace the clutch. See **Fig. 4**. This tab cannot be used as a mechanism for adjusting the clutch.

These clutch assemblies are available with either: ten spring, four or six paddle driven discs; nine spring, six paddle driven discs; seven spring, four paddle driven discs; or, six spring, six paddle driven discs. The driven disc paddles are formed from ceramic facing material. The intermediate plate separating the driven discs is carried on four lugs within the cover assembly, which is mounted on a flat flywheel. Four positive separator pins ensure equal plate separation (an equal gap on all sides of the intermediate plate) for long life.

For clutch capacities, see the appropriate Solo Heavy-Duty clutches table in **Specifications, 400**.

SOLO MEDIUM-DUTY 1401 AND 1402 CLUTCHES

Spicer Solo Medium-Duty 1401 and 1402 are pull-type clutches of a dry-disc design. These 14-inch (355.6-mm) clutch assemblies are available in two versions, which consist of either a single-plate (1401) or a two-plate (1402) design. Both versions are mounted to a flat flywheel.



1. Cover Assembly
2. Clutch Disc (Driven Disc)
3. Intermediate Plate
4. Drivestrap
5. Front Disc

Fig. 2, Spicer Angle-Spring Clutches

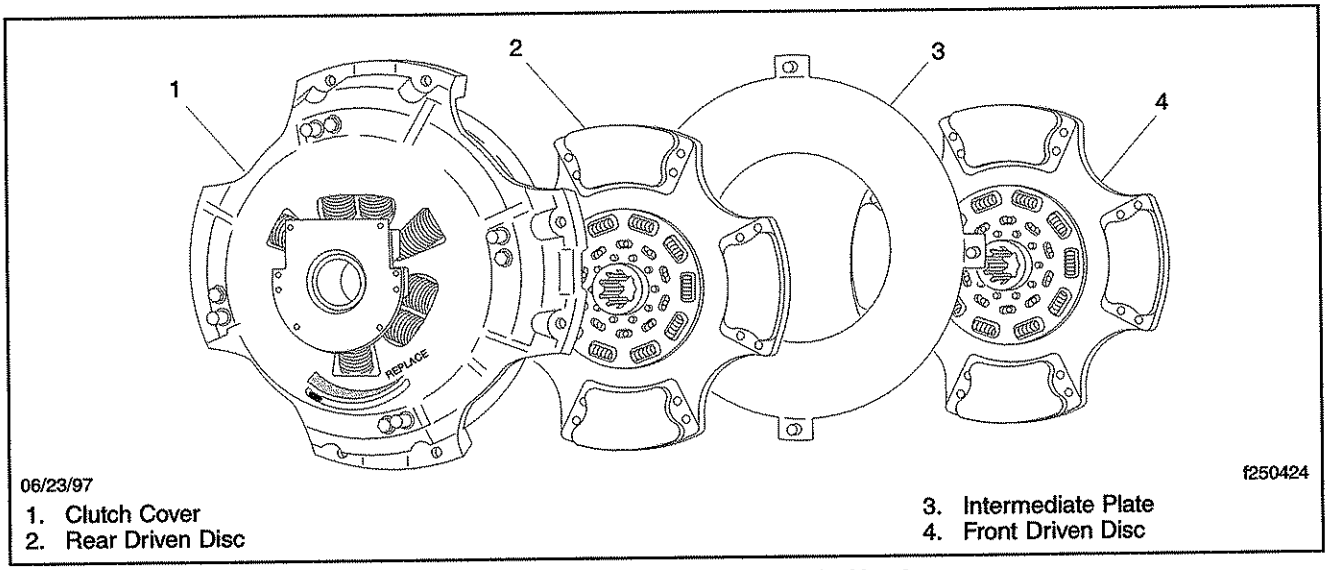


Fig. 3, Spicer Solo Heavy Duty 15-1/2 Clutch

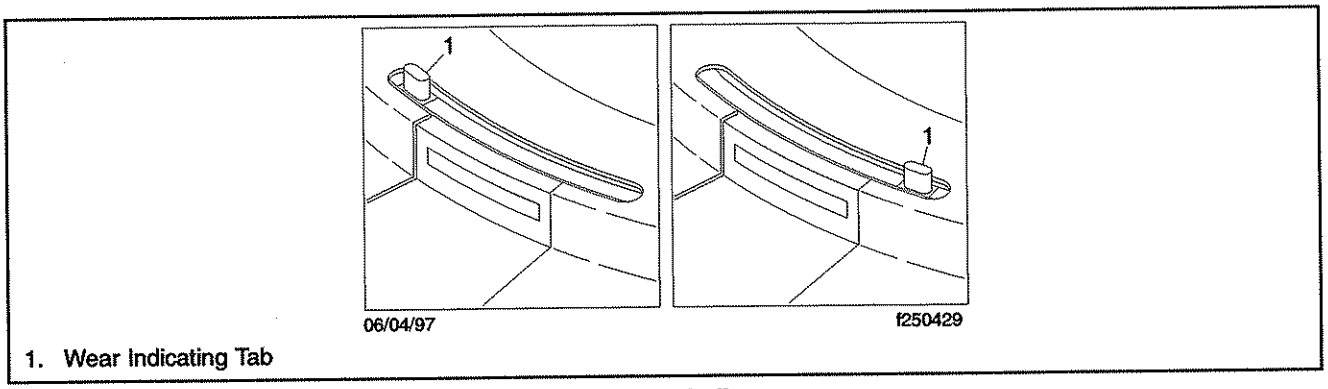


Fig. 4, Wear Indicator

See **Fig. 5**. They may also be specified for either a standard stroke mechanical linkage system or a short stroke hydraulic linkage system.

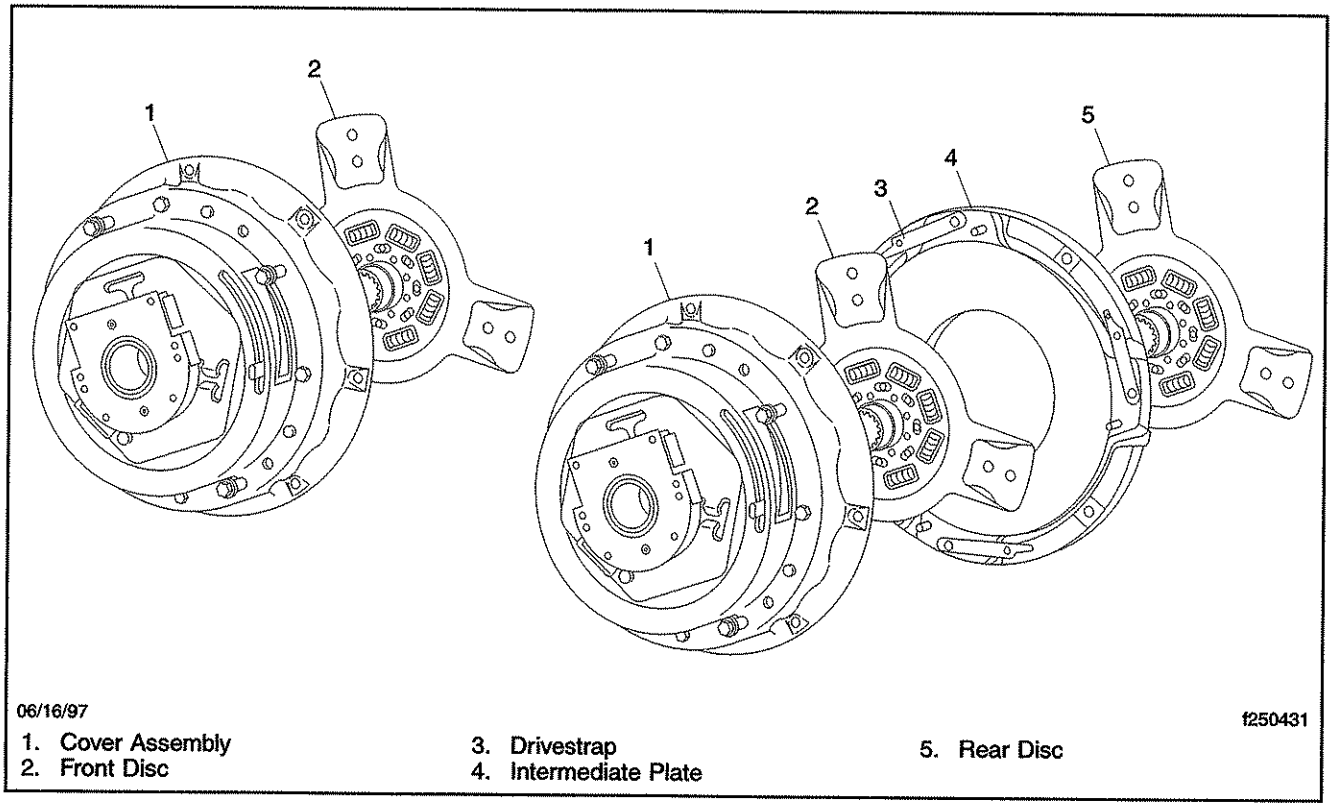
Spicer Solo Medium-Duty clutches are totally adjustment free. As the clutch wears, its innovative wear-adjusting technology monitors clutch components and makes any necessary adjustments. The wear-adjusting technology comes from two sliding cams, which rotate to maintain the proper adjustment. Atop the upper cam, a wear indicating tab mirrors the cams' movement to let you know when it's time to replace the clutch. See **Fig. 6**. This tab cannot be used as a mechanism for adjusting the clutch.

In the two-plate versions, the intermediate plate separating the driven discs is mounted directly to the flywheel. The flywheel ring carries four drivestraps (**Fig. 5**, Ref. 3) to retract the pressure plate when the clutch is disengaged. The clutch assembly has four positive separator pins that ensure equal plate separation (an equal gap on all sides of the intermediate plate) for long life.

Solo Medium-Duty clutches may be specified with ceramic or organic driven discs.

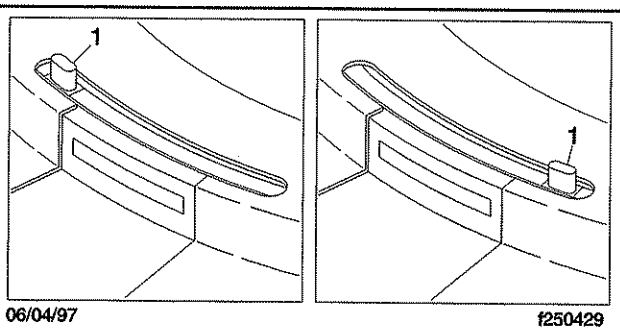
For Clutch capacities, see the appropriate Solo Medium-Duty clutches table in **Specifications, 400**.

General Description and Principles of Operation



1. Cover Assembly
2. Front Disc
3. Drivestrap
4. Intermediate Plate
5. Rear Disc

Fig. 5, Spicer Solo Medium-Duty Clutches



1. Wear Indicating Tab

Fig. 6, Wear Indicator

Principles of Operation

Mounted directly on the flywheel, the domed clutch-cover assembly houses most of the components, including the pressure plate. Six pressure springs inside the cover provide the force necessary to push the pressure plate forward and engage the clutch.

The transmission input shaft projects through the cover assembly and driven discs, and rests in a pilot bearing in the center of the flywheel. The splined hubs of the driven discs mesh with the splined input shaft to provide the direct link between the engine and the transmission. This allows the rest of the clutch assembly to spin freely around the input shaft when the clutch pedal is depressed.

When the vehicle is stationary, a clutch brake permits shifting into first gear or reverse gear without severe gear clash. The clutch brake may be a disc-type or a torque-limiting type. To prevent overloads to it, the torque-limiting clutch brake is designed to slip when loads of 20 to 25 lbf·ft (27 to 34 N·m) are reached. Clutch brakes are not designed for upshifting.

When starting a vehicle moving, and when upshifting the transmission, the engine flywheel is turning faster than the transmission input shaft. The clutch intermediate plate and pressure plate (driving discs) are attached to and turn at the same speed as the flywheel. The clutch driven discs are meshed with and turn at the same speed as the transmission input shaft.

When the clutch pedal is depressed, the release bearing (connected inside the cover assembly) pulls away from the pressure plate. This compresses the pressure springs, and allows the driven discs to slip freely, at a different speed than the driving discs.

As the pedal is being released, the pressure springs force the pressure plate toward the engine flywheel, squeezing the driven discs. Slippage occurs between the driving and driven discs because of the difference in their speeds. As the pedal is further released, the friction between the discs increases, and the slippage and difference in speeds decreases. When the pedal is fully released, pressure and friction are sufficient to stop the discs from slipping. With no slippage, the driving and driven members turn at the same speed.

The clutch is a friction-operated unit that allows smooth coupling and uncoupling of the engine (driving member) and the transmission (driven member).

Clutch brake engagement occurs approximately during the last 1 to 1-1/4 inches (25 to 33 mm) of downward pedal travel. The clutch brake is between the release-bearing housing and the transmission bearing cap, and is engaged by tangs to the transmission input shaft. When the pedal is fully depressed, the clutch brake is squeezed between the release-bearing housing and the transmission bearing cap, stopping the rotation of the main drive gear.

NOTE: Spicer Solo Heavy-Duty and Medium-Duty clutches are adjustment free. Therefore, the following procedures apply only to the Spicer Angle-Spring and Easy-Pedal clutches.

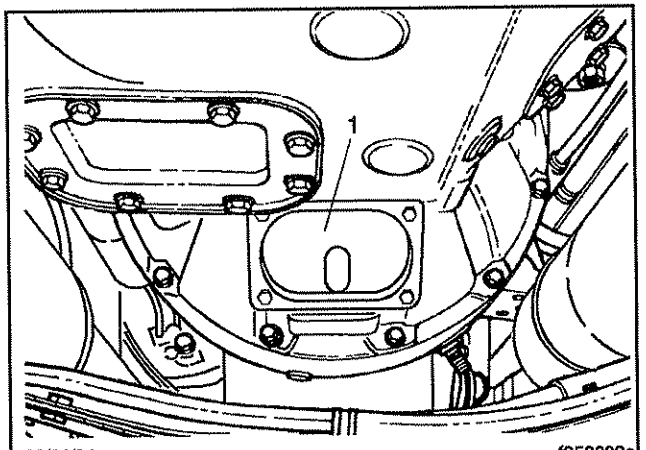
Release-Bearing Clearance Check (With Synchronized Transmissions)

IMPORTANT: Do not skip steps in the adjustment operations. Internal adjustments must be correct before making any linkage adjustments for pedal free-travel. Incorrect adjustments can cause transmission gear clash, and slipping and burning of clutch components.

1. Apply the parking brakes, and chock the tires.
2. Remove the clutch inspection cover from the bottom of the transmission clutch housing. See **Fig. 1**.

NOTE: When checking release bearing clearance, remove the free travel by pulling the release fork against the clutch release bearing. This eliminates any bearing movement.

3. Measure the clearance between the release bearing and the clutch cover. For a single-plate clutch, this clearance must be 1-7/8 inch (48 mm) in order for the release-bearing to release properly. For a dual-plate clutch, this clearance must be 3/4 inch (19 mm) in order for the release-bearing to release properly. See **Fig. 2**. If the release bearing clearance is not within the specifications, then an adjustment is needed. Go to " Internal Adjustment With Synchronized Transmissions."
4. If the release bearing clearance measurement is okay, check and adjust the clutch linkage free travel, for instructions see **Section 25.02** (manual linkage) or **Section 25.03** (hydraulic linkage).



03/01/94 f250002a

1. Clutch Inspection Cover

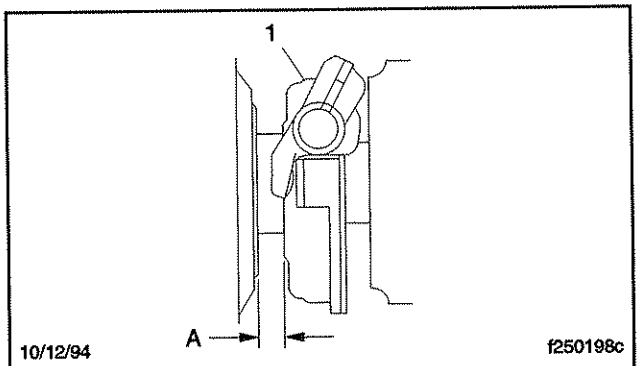
Fig. 1, Remove the Clutch Inspection Cover

Internal Adjustment With Synchronized Transmissions

Angle-Spring and Easy-Pedal clutches are adjusted with either a lockstrap (**Fig. 3**), or with the Spicer Kwik-Adjust® (**Fig. 4**).

ADJUSTMENT ON CLUTCHES WITH A LOCKSTRAP

1. Turn the engine flywheel until the lockstrap is aligned with the clutch inspection-cover opening. See **Fig. 1** and **Fig. 3**.
2. Remove the lockstrap. See **Fig. 3**.
3. 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.
4. Using a clutch adjusting tool, turn the adjusting ring clockwise to move the release bearing toward the transmission, or counterclockwise to move the release bearing toward the engine.

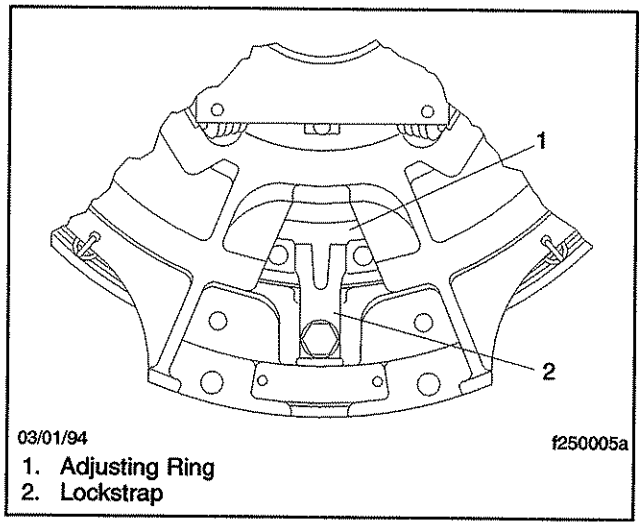


10/12/94 f250198c

A. Release-Bearing Clearance: Single-Plate, 1-7/8 inch (48 mm); Dual-Plate, 3/4 inch (19 mm).
1. Release Bearing

Fig. 2, Release Bearing Clearance

Clutch Adjustments



1. Adjusting Ring
2. Lockstrap

Fig. 3, Clutch Equipped with a Lockstrap

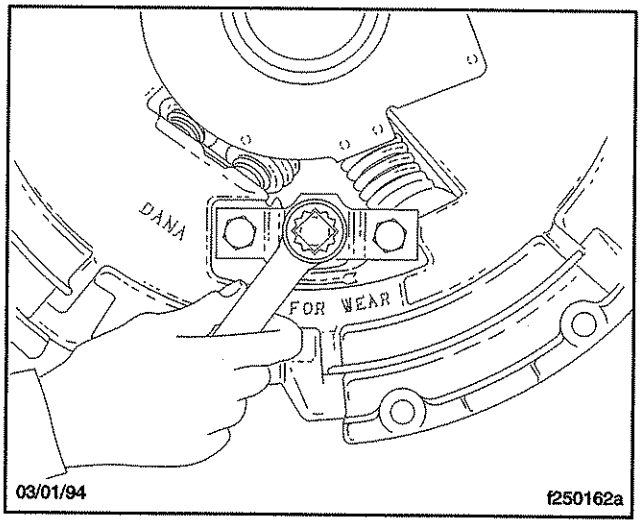


Fig. 4, Clutch Equipped with Kwik-Adjust

NOTE: Each notch in the adjusting ring represents about 0.020-inch (0.5-mm) release-bearing travel. Thus, three notches moved means 0.060 inch (1.5 mm) or about 1/16-inch release-bearing travel.

5. After adjusting, release the pedal, and check the clearance between the release-bearing housing and the clutch cover. For a single-plate clutch, when the clearance is 1-7/8 inch (48 mm), the internal adjustment is complete. For a dual-plate clutch, when the clearance is 3/4 inch (19 mm), the internal adjustment is complete.
6. Install the lockstrap, and tighten the bolt 35 to 40 lbf·ft (47 to 54 N·m).

IMPORTANT: Use the same length bolt when installing the lockstrap. A longer bolt will lock-up the clutch assembly.

NOTE: If the lockstrap will not engage the notches of the adjusting ring, check the clutch assembly for worn parts. For instructions, see **Subject 120**.

7. Proceed to the section on clutch linkage adjustment in this manual.

ADJUSTMENT ON CLUTCHES WITH A KWIK-ADJUST

1. Turn the engine flywheel until the lockstrap is aligned with the clutch inspection-cover opening. See **Fig. 1** and **Fig. 4**.
2. 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.

3. Insert a 12 point 3/4-inch socket or box-end wrench through the inspection cover opening. Depress the square bolt to adjust the release-bearing clearance.

   Rotate the adjusting ring counterclockwise to move the release-bearing toward the engine. Rotate the adjusting ring clockwise to move the release-bearing toward the transmission.

   Be sure the adjustment bolt is locked when you have completed the adjustment.

NOTE: Each quarter of a turn of the adjustment bolt represents about 0.017-inch (0.4-mm) release-bearing movement.

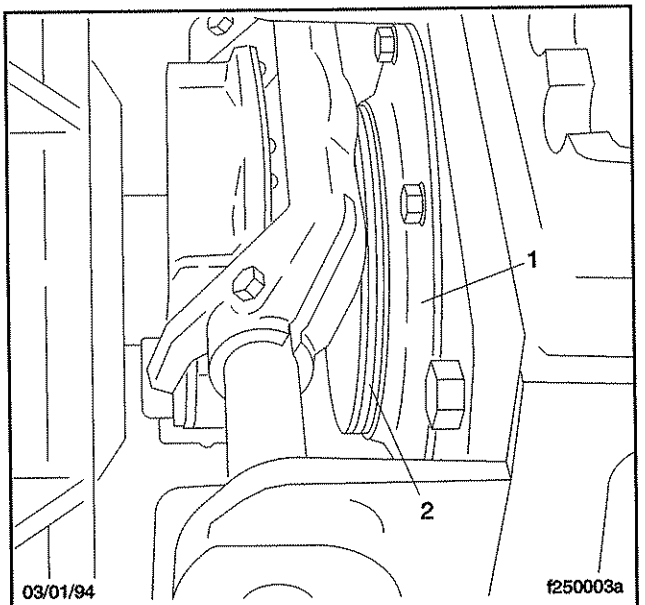
4. After adjusting, release the pedal, and check the internal clearance between the release-bearing housing and the clutch cover. For a single-plate clutch, when the internal clearance is 1-7/8 inch (48 mm), the adjustment is complete. For a dual-plate clutch, when the internal clearance is 3/4 inch (19 mm), the adjustment is complete.

   Proceed to the section on clutch linkage adjustment in this manual.

Release-Bearing Clearance Check (With Nonsynchronized Transmissions)

IMPORTANT: Do not skip steps in the adjustment operations. Internal adjustments must be correct before making any linkage adjustments for pedal free-travel. Incorrect adjustments can cause transmission gear clash, and slipping and burning of clutch components.

1. Apply the parking brakes, and chock the tires.
2. Remove the clutch inspection cover from the bottom of the transmission clutch housing. See **Fig. 1**.
3. Slide the clutch-brake discs and washer, or torque-limiting clutch brake, tight against the transmission input shaft bearing cap. See **Fig. 5**. Also, slide the release-bearing as far as possible towards the transmission.
4. Measure the internal clearance between the aft face of the release-bearing and the forward face of the clutch brake disc, or torque-limiting clutch brake. This internal clearance must be 1/2 inch to 9/16 inch (12.7 mm to 14.3 mm) in order for the release-bearing to release properly. See **Fig. 6**.



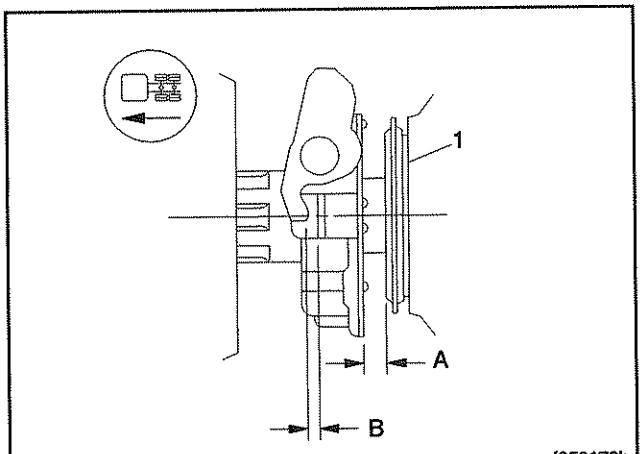
1. Transmission Input Shaft Bearing Cap
2. Clutch Brake Discs and Washer

Fig. 5, Position the Clutch Brake

IMPORTANT: An inspection tool A02–12419 (available through the PDCs) can be used to check the distance between the release-bearing and the clutch brake. See **Fig. 7**. 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.

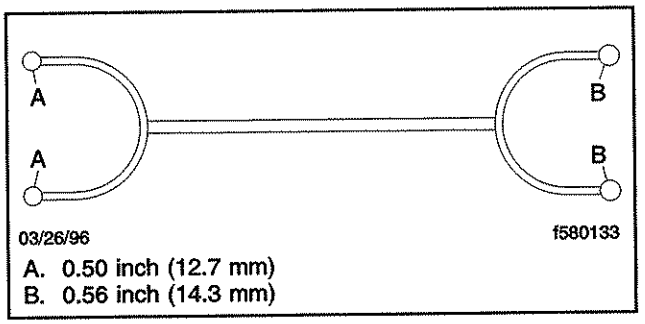
5. If using tool A02–12419 to check the distance between the release-bearing and the clutch brake, position the tool so that the legs straddle the transmission input shaft. Check the gap with both ends of the tool as follows:

   5.1 Insert the blue 0.56-inch (14.3-mm) end. If it fits loosely, the gap is too wide and adjustment is needed. Go to "Internal Adjustment With Nonsynchronized Transmis-



A. Release-travel: 1/2 to 9/16 inch (12.7 to 14.3 mm).
B. Free-travel 0.105 to 0.145 inch (2.7 to 3.7 mm) between yoke and wear pads.
1. Clutch Brake

Fig. 6, Clutch Travel Adjustments



A. 0.50 inch (12.7 mm)
B. 0.56 inch (14.3 mm)

Fig. 7, Inspection Tool A02-12419

Clutch Adjustments

sions: Manual Adjusting Clutch" or "Internal Adjustment With Nonsynchronized Transmissions: Self-Adjusting Clutch."

5.2 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 fits, snug or loose, then no adjustment is needed.

5.3 If the green end of the tool can't be inserted in the gap, adjustment is needed. Go to "Internal Adjustment With Nonsynchronized Transmissions: Manual Adjusting Clutch" or "Internal Adjustment With Nonsynchronized Transmissions: Self-Adjusting Clutch."

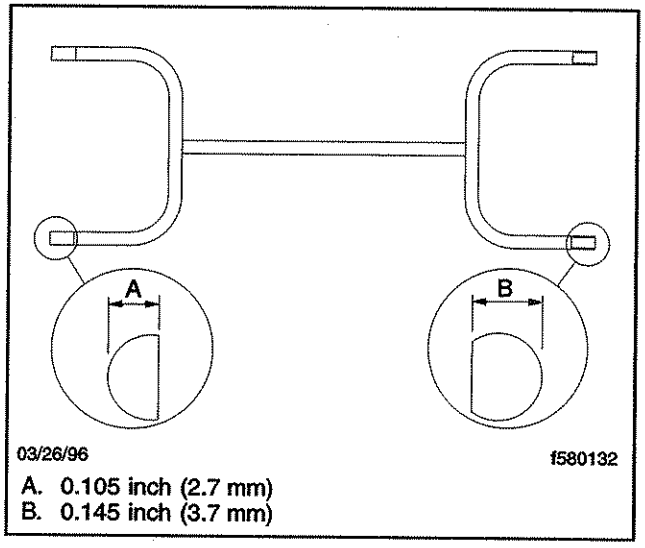
IMPORTANT: An inspection tool A02–12254 (available through the PDCs) can be used to check the distance between the release-bearing and the release yoke (free travel). See **Fig. 6** and **Fig. 8**. The legs on one end of the tool have green tape on them and are 0.105 inch (2.7 mm) thick; the legs on the other end have blue tape on them and are 0.145 inch (3.7 mm) thick.

6. If using tool A02–12254 to check the distance between the release-bearing and the release yoke, position the tool so it straddles the yoke to ensure that there won't be any misalignment. Check the distance with both ends of the tool as follows:

   6.1 Insert the blue 0.145-inch (3.7-mm) end. If it fits loosely, the gap is too wide and adjustment is needed. Go to the section on clutch linkage adjustment in this group.

   6.2 If the blue 0.145-inch (3.7-mm) end can't be inserted in the gap, then try to insert the green 0.105-inch (2.7-mm) end. If the green end of the tool fits, snug or loose, then no adjustment is needed.

   6.3 If the green end of the tool can't be inserted in the gap, adjustment is needed. Go to the section on clutch linkage adjustment in this group.



A. 0.105 inch (2.7 mm)
B. 0.145 inch (3.7 mm)

Fig. 8, Inspection Tool A02-12254

Internal Adjustment With Nonsynchronized Transmissions: Manual Adjusting Clutch

Angle-Spring and Easy-Pedal clutches are adjusted with either a lockstrap (**Fig. 3**), or with the Spicer Kwik-Adjust® (**Fig. 4**).

ADJUSTMENT ON CLUTCHES WITH A LOCKSTRAP

1. Turn the engine flywheel until the lockstrap is aligned with the clutch inspection-cover opening. See **Fig. 1** and **Fig. 3**.
2. Remove the lockstrap. See **Fig. 3**.
3. 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.
4. Using a clutch adjusting tool, turn the adjusting ring to adjust release travel (the clearance between the release-bearing housing and the forward clutch brake disc).

   If clearance between the release-bearing housing and the clutch brake is *less than* 1/2 inch (12.7 mm), rotate the adjusting ring counterclockwise to move the release-bearing toward the engine.

   If clearance between the release-bearing housing and the clutch brake is *more than* 9/16 inch (14.3 mm), rotate the adjusting ring clockwise to move the release-bearing toward the transmission.

   The lockstrap bolt may be installed and used as a fulcrum in turning the adjusting ring.

NOTE: Each notch in the adjusting ring represents about 0.020-inch (0.5-mm) release-bearing travel. Thus, three notches moved means 0.060-inch (1.5-mm) or about 1/16-inch release-bearing travel.

5. After adjusting, release the pedal, and check the clearance between the release-bearing housing and the forward clutch brake disc, or torque-limiting clutch brake. When the clearance is 1/2 inch to 9/16 inch (12.7 mm to 14.3 mm), the adjustment is complete.

6. Install the lockstrap, and tighten the bolt 35 to 40 lbf·ft (47 to 54 N·m).

IMPORTANT: Use the same length bolt when installing the lockstrap. A longer bolt will lock-up the clutch assembly.

NOTE: If the lockstrap will not engage the notches of the adjusting ring, check the clutch assembly for worn parts. For instructions, see **Subject 120**.

7. Proceed to the section on clutch linkage adjustment in this manual.

ADJUSTMENT ON CLUTCHES WITH A KWIK-ADJUST

1. Turn the engine flywheel until the lockstrap is aligned with the clutch inspection-cover opening. See **Fig. 1** and **Fig. 4**.

2. 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.

3. Insert a 12 point 3/4-inch socket or box-end wrench through the inspection cover opening. Depress the square bolt to adjust the release-bearing clearance.

   If clearance between the release-bearing housing and the clutch brake is *less than* 1/2 inch (12.7 mm), rotate the adjusting ring counterclockwise to move the release-bearing toward the engine.

   If clearance between the release-bearing housing and the clutch brake is *more than* 9/16 inch (14.3 mm), rotate the adjusting ring clockwise to move the release-bearing toward the transmission.

   Be sure the adjustment bolt is locked when you have completed the adjustment.

NOTE: Each quarter of a turn of the adjustment bolt represents about 0.017-inch (0.4-mm) release-bearing movement.

4. After adjusting, release the pedal, and check the clearance between the release-bearing housing and the forward clutch brake disc, or torque-limiting clutch brake. When the clearance is 1/2 inch to 9/16 inch (12.7 mm to 14.3 mm), the adjustment is complete.

   Proceed to the section on clutch linkage adjustment in this manual.

Internal Adjustment With Nonsynchronized Transmissions: Self-Adjusting Clutch

IMPORTANT: The self-adjusting clutch normally compensates for wear, and should only need adjustment when it is first installed. If the release-bearing clearance check shows the self-adjusting clutch to be out of adjustment, be sure that:

A. the actuator arm is correctly inserted into the release-bearing sleeve retainer (see **Fig. 9**);

B. the adjuster arm is not bent;

C. the release-bearing has at least a 1/2 inch to 9/16 inch (12.7 mm to 14.3 mm) travel;

D. other clutch parts (such as the adjusting ring) aren't frozen or damaged.

If the clutch is damaged, replace it.

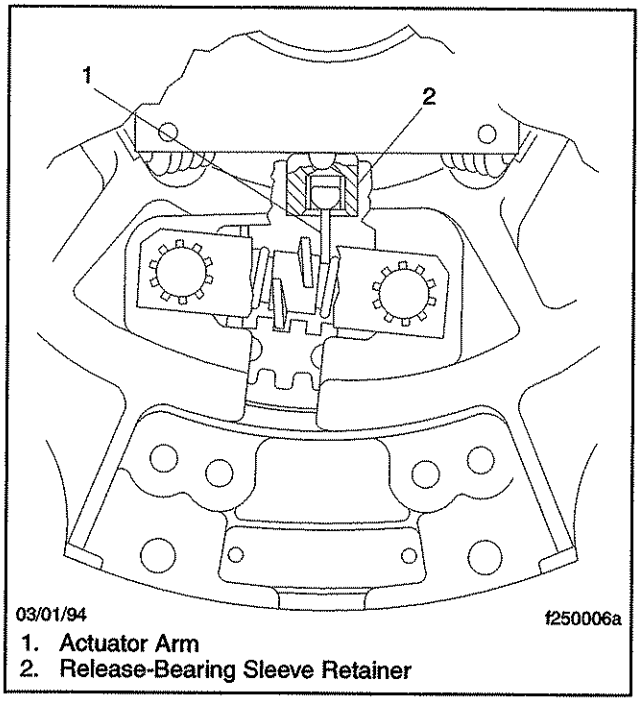
If adjustment is needed, do the following:

1. Turn the engine flywheel until the adjuster assembly is in line with the clutch inspection-cover opening. See **Fig. 1** and **Fig. 9**.

2. Remove the right-side bolt from the adjuster assembly, and loosen the left-side bolt one turn. See **Fig. 10**.

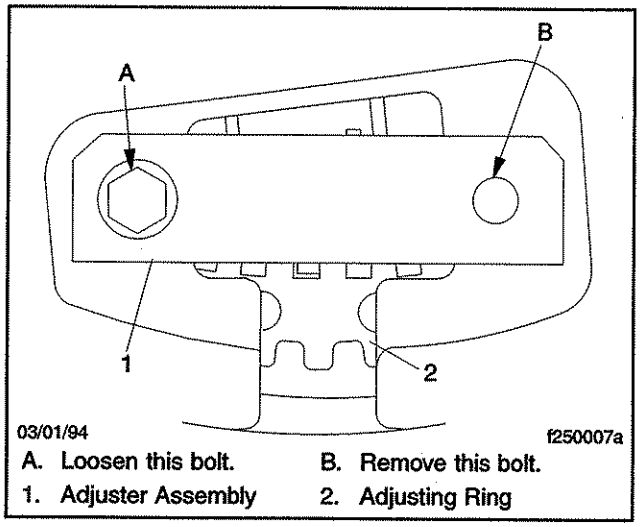
3. To allow manual adjustment, rotate the adjuster assembly upward. See **Fig. 11**. This will disengage the adjuster worm gear from the adjusting ring. Hold the adjuster assembly disengaged, and tighten the left-side bolt.

Clutch Adjustments



1. Actuator Arm
2. Release-Bearing Sleeve Retainer

Fig. 9, Correct Actuator Arm Insertion



A. Loosen this bolt. B. Remove this bolt.
1. Adjuster Assembly 2. Adjusting Ring

Fig. 10, Remove the Right-Side Bolt

4. Release the clutch by depressing the pedal; block it in this position.
5. Using a clutch adjusting tool in the lower teeth, turn the adjusting ring clockwise to move the release-bearing toward the transmission, or counterclockwise to move the release-bearing toward the engine. See **Fig. 11**.

⚠ CAUTION

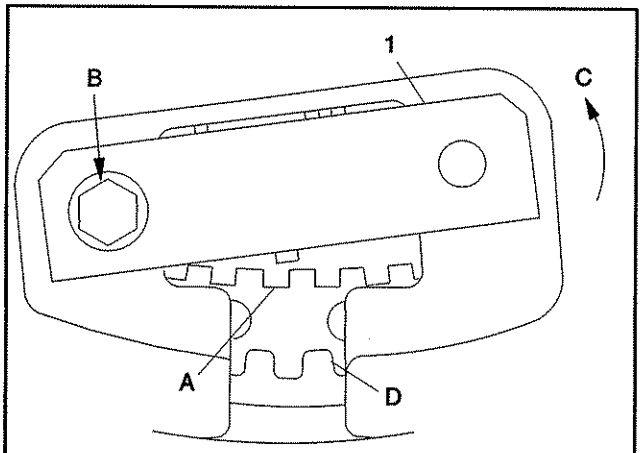
Do not pry on the innermost gear teeth of the adjusting ring. See Fig. 11. Doing so could damage the teeth, and prevent the clutch from self-adjusting.

NOTE: Each lower gear tooth of the adjusting ring represents about 0.010-inch (0.25-mm) release-bearing movement. Thus, six notches moved means 0.060-inch (1.5-mm) or about 1/16-inch release-bearing movement.

6. After adjusting, release the clutch pedal, and check the clearance between the release-bearing housing and the forward clutch brake disc, or torque-limiting clutch brake. When the clearance is 1/2 inch to 9/16 inch (12.7 mm to 14.3 mm), the adjustment is complete.

IMPORTANT: The clutch will not self-adjust if release-bearing travel is less than 1/2 inch (12.7 mm).

7. Loosen the left-side adjuster bolt, and rotate the adjuster assembly down, meshing the adjuster worm gear with the adjusting ring teeth. The ring



A. Do not pry on the innermost teeth.
B. Tighten the bolt.
C. Rotate up.
D. Use a clutch adjusting tool in the lower teeth.
1. Adjuster Assembly

Fig. 11, Rotate the Adjuster Assembly

may have to be moved slightly, to allow the worm to mesh. Install the right-side bolt, and tighten both bolts 30 to 35 lbf·ft (41 to 47 N·m).

8. Visually check that the actuator arm is inserted in the release-bearing sleeve retainer. See **Fig. 9**. If the adjuster assembly is installed correctly, the adjuster assembly spring will move back and forth as the clutch pedal is depressed and released.

IMPORTANT: The clutch will not self-adjust if the actuator arm is not correctly inserted in the release-bearing sleeve retainer.

After making release-bearing adjustments, go to the section on clutch linkage adjustment.

Clutch Removal

REMOVING THE SPICER ANGLE-SPRING AND EASY-PEDAL CLUTCHES

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.

1. Remove the transmission. For instructions, see **Group 26** in this manual.

⚠ CAUTION

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.

2. Remove the clutch brake from the transmission input shaft. See **Fig. 1**.
3. Install a spline aligning tool into the release-bearing assembly, and through the driven discs. See **Fig. 2**. An old transmission input shaft may be used for this purpose.
4. Insert two wooden spacer blocks between the flywheel ring and the release-bearing housing. The spacer blocks relieve the internal spring load in the clutch assembly, and facilitate clutch removal.

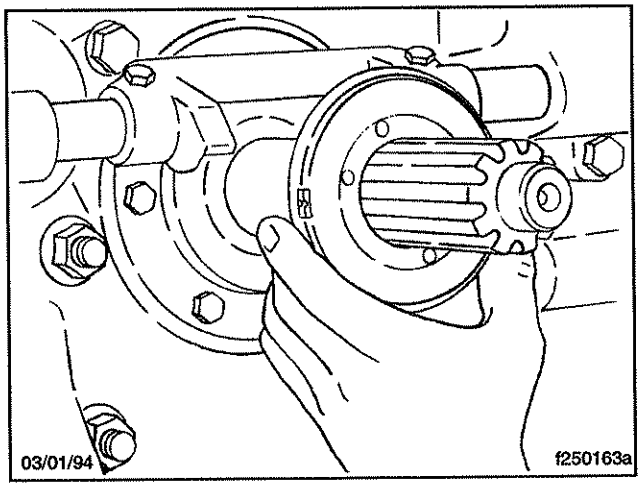


Fig. 1, Clutch Brake Removal

On Angle-Spring clutches, use two 1-1/2 inch (38-mm) spacer blocks. See **Fig. 3**.

On Easy-Pedal clutches, use a release tool to pull the bearing back, and use two 5/8-inch (16-mm) spacer blocks. See **Fig. 4**.

5. Remove the two top mounting capscrews from the cover assembly. Install guide studs in the open holes to help support the clutch assembly during

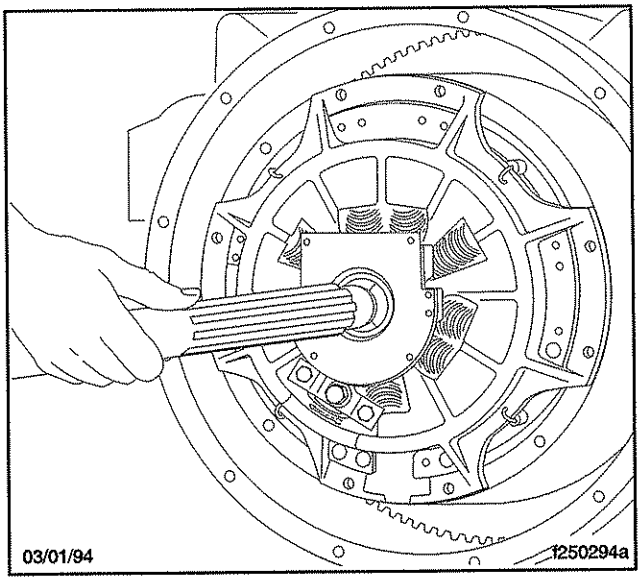


Fig. 2, Installing a Spline Aligning Tool

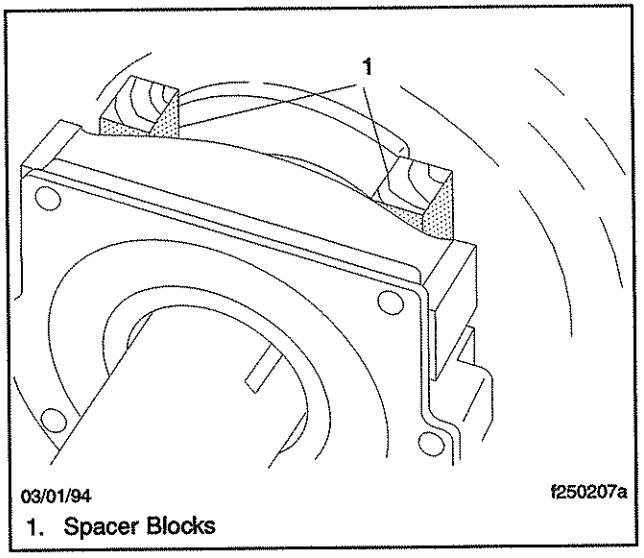


Fig. 3, Insert Two Spacer Blocks

Clutch Removal

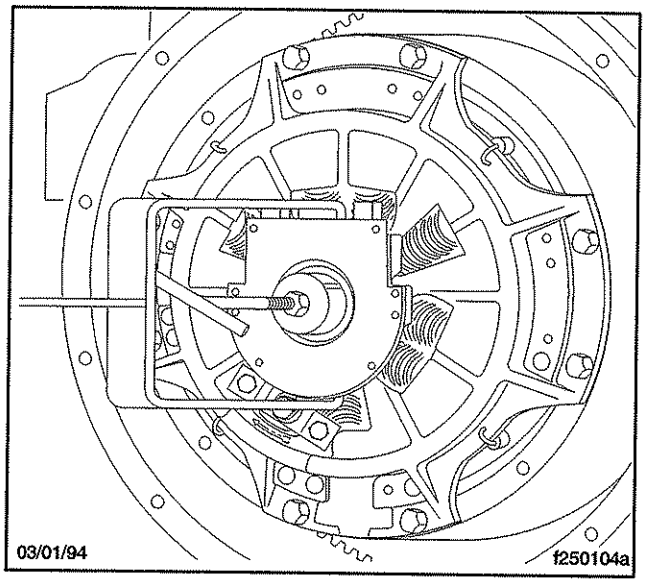


Fig. 4, Pull the Bearing Back

removal. For 14-inch (355.6-mm) clutches, use 3/8-16 by 2-1/2 inch guide studs. For 15-1/2 inch clutches, use 7/16-14 by 5-inch guide studs. See **Fig. 5** or **Fig. 6**.

6. Progressively loosen each of the capscrews in the pattern shown in **Fig. 7** or **Fig. 8**. This will prevent warping or bending within the clutch, and will ease removal of the clutch-mounting capscrews.

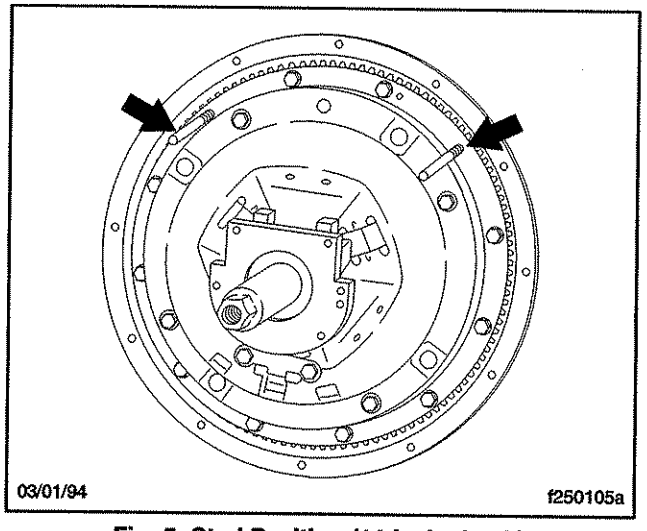


Fig. 5, Stud Position (14-inch clutch)

⚠ WARNING

The pressure plate and cover assembly is heavy and 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. Remove the mounting capscrews, and carefully remove the clutch assembly.

   With two-plate clutches, be careful to keep the spline aligning tool in place to retain the discs and intermediate plate. Remove the spline aligning tool, the rear driven disc, the intermediate plate, and the front driven disc.

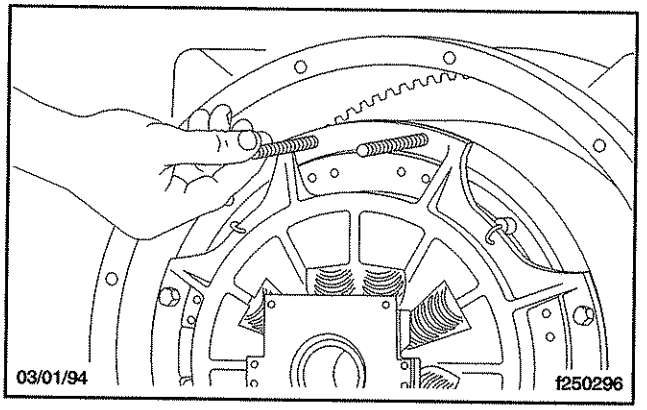


Fig. 6, Stud Position (15-1/2 inch clutch)

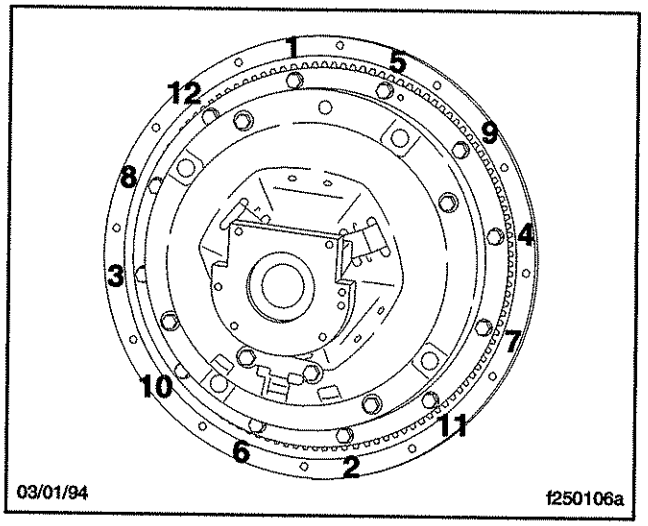


Fig. 7, 12-Bolt Pattern

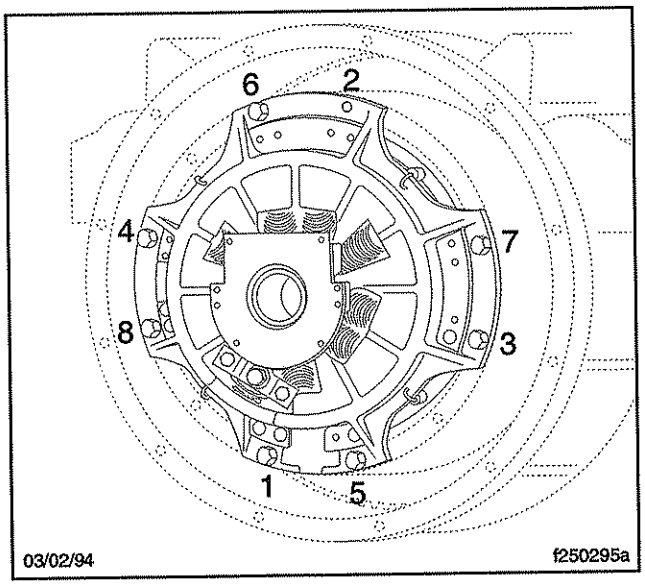


Fig. 8, 8-Bolt Pattern

8. Whenever the clutch assembly is serviced or the engine is removed, the pilot bearing in the flywheel should be removed and replaced. Use an appropriate puller to remove the pilot bearing.

   Inspect the old pilot bearing. Correct the cause of any unusual wear or damage. Discard the bearing.

REMOVING A SPICER SOLO HEAVY-DUTY 15-1/2 INCH CLUTCH

IMPORTANT: If clutch is to be reinstalled, take note of the position of the wear indicating tab on the clutch cover. If the wear indicating tab is near the replace position of the indicator, the clutch should be replaced.

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.

1. Reset the wear indicating tab.

   1.1 Fully depress the clutch pedal in the cab. Hold the clutch pedal in the depressed position until the wear indicating tab is reset.

   1.2 Through the inspection opening of the transmission, slide the wear indicating tab to the left until it is at the new position of the indicator. See **Fig. 9.**

   1.3 Release the clutch pedal in the cab. At this point, the wear indicating tab will stay at the new position of the indicator.

2. Remove the transmission. For instructions, see **Group 26** in this manual.

⚠ CAUTION

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.

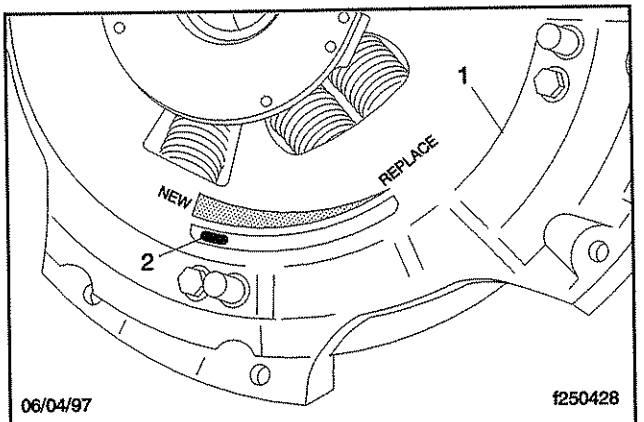
3. Remove the clutch brake from the transmission input shaft. See **Fig. 1.**

4. Install a spline aligning tool into the release-bearing assembly, and through the driven discs. See **Fig. 2.** An old transmission input shaft may be used for this purpose.

5. Locate four 7/16-inch by 14 by 1-3/4 inch hexhead machine screws (shipping bolts). These shipping bolts were installed on the clutch cover prior to installation.

6. Install the four 7/16-inch by 14 by 1-3/4 hexhead machine screws (shipping bolts) into the four clutch cover holes; turn them finger tight. See **Fig. 10.**

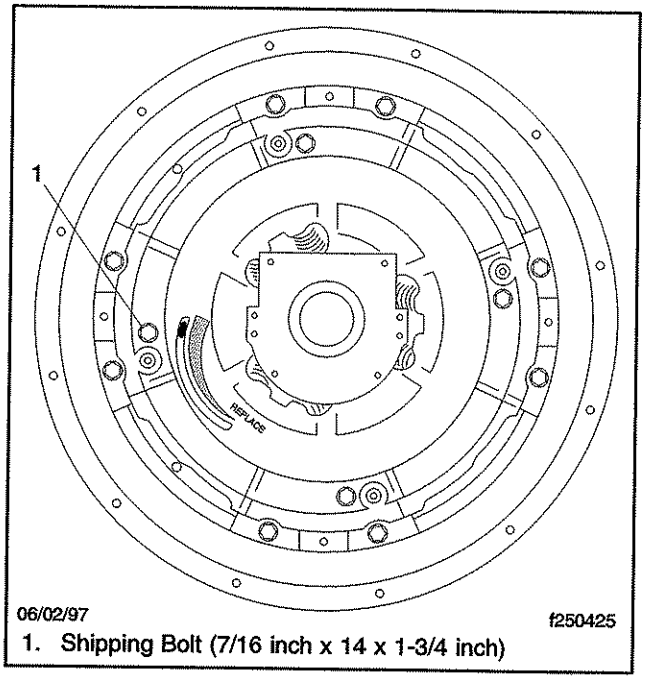
7. Remove the two top mounting capscrews from the cover assembly. Install two guide studs (7/16–14



1. Clutch Cover
2. Wear Indicating Tab

Fig. 9, Resetting the Wear Indicating Tab

Clutch Removal



1. Shipping Bolt (7/16 inch x 14 x 1-3/4 inch)

Fig. 10, Install the Shipping Bolts

by 5-inch long) in the open holes to help support the clutch assembly during removal. See **Fig. 6**.

8. Progressively loosen each of the mounting capscrews in the pattern shown in **Fig. 11**. This will prevent warping or bending within the clutch, and will ease removal of the clutch-mounting capscrews.

⚠ WARNING

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

9. Remove the mounting capscrews, and carefully remove the clutch assembly together with the spline aligning tool.

NOTE: For installation, mark the proper position of the discs and intermediate plate adaptor ring.

10. Progressively tighten, in a crisscross pattern, the four shipping bolts until the face of the pressure plate is 1.75 to 1.78 inches (44.45 to 45.243 mm) below the mounting surface. See **Fig. 12**.

NOTE: The previous step will reset the pressure plate wear pins and, as a result, allow the clutch to release after the installation.

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

    Whenever the clutch assembly is serviced or the engine is removed, the pilot bearing in the flywheel should be removed and replaced.

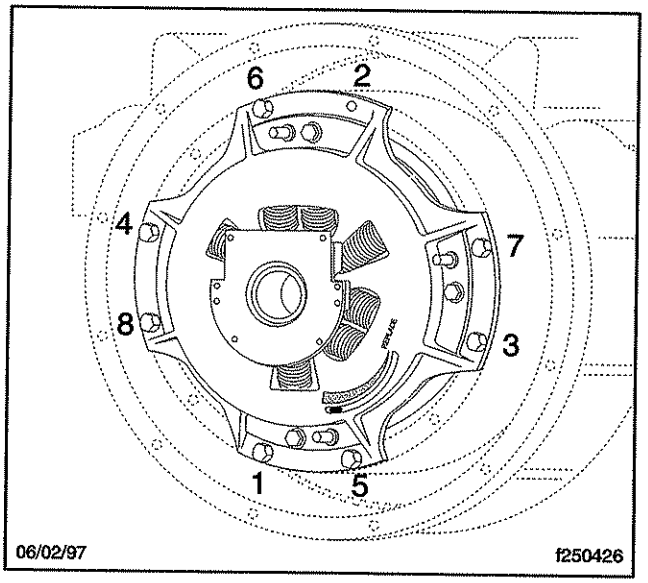
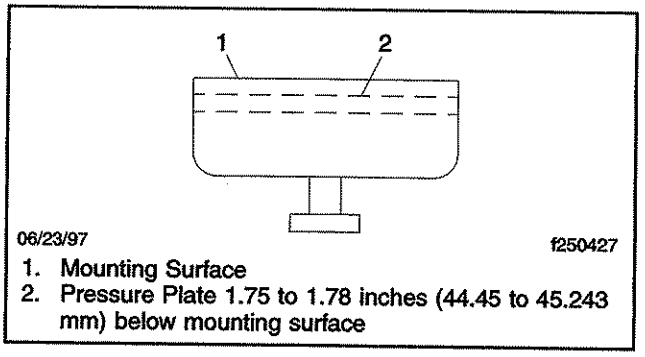


Fig. 11, Loosening Sequence



1. Mounting Surface
2. Pressure Plate 1.75 to 1.78 inches (44.45 to 45.243 mm) below mounting surface

Fig. 12, Reset Wear Pins

Resetting the Wear Indicating Tab

⚠ CAUTION

The wear indicating tab on the Solo clutch should be reset before the transmission is removed. If the transmission and clutch were removed without following the correct removal procedure (the wear indicating tab was not reset), this procedure must be performed before installation. If this procedure is not performed before installation, the clutch will not release and damage to the clutch may result.

1. Remove the four shipping bolts, if they have been installed.
2. 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. 13**.
3. Center the ram and press downward on the retainer until it comes to a stop. Lock the ram in position.

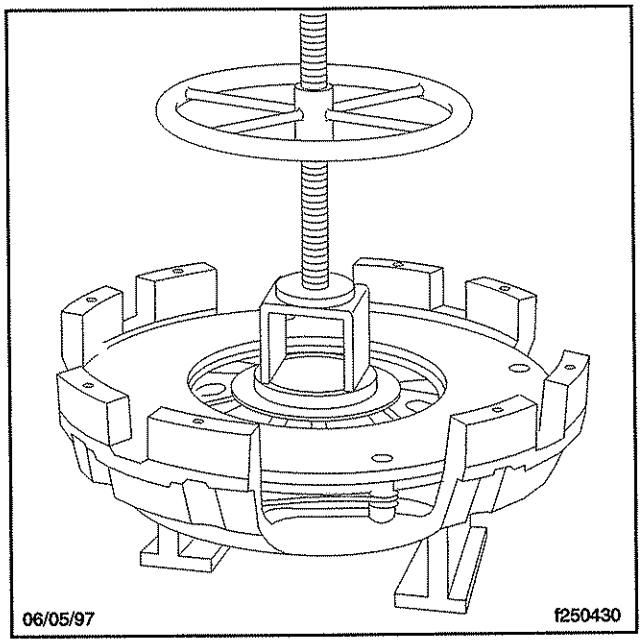


Fig. 13, Arbor Press Setup

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.
5. Locate four 7/16 inch by 14 by 1-3/4 inch hexhead machine screws (shipping bolts).
6. Install the four 7/16 inch by 14 by 1-3/4 hexhead machine screws (shipping bolts) into the four clutch cover holes; turn them finger tight. See **Fig. 10**.

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

7. Progressively tighten, in a crisscross pattern, the four shipping bolts until the face of the pressure plate is 1.75 to 1.78 inches (44.45 to 45.243 mm) below the mounting surface. See **Fig. 12**.

NOTE: The previous step will reset the pressure plate wear pins and, as a result, allow the clutch to release after the installation.

REMOVING A SPICER SOLO MEDIUM-DUTY 1401 AND 1402 CLUTCHES

IMPORTANT: If clutch is to be reinstalled, note the position of the wear indicating tab on the clutch cover. If the wear indicating tab is near the replace position of the indicator, the clutch should be replaced.

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.

1. Reset the wear indicating tab.
   - 1.1 Fully depress the clutch pedal in the cab. Hold the clutch pedal in the depressed position until the wear indicating tab is reset.
   - 1.2 Through the inspection opening of the transmission, slide the wear indicating tab to the left until it is at the new position of the indicator. See **Fig. 14**.
   - 1.3 Release the clutch pedal in the cab. At this point, the wear indicating tab will stay at the new position of the indicator.
2. Remove the transmission. For instructions, see **Group 26** in this manual.

Clutch Removal

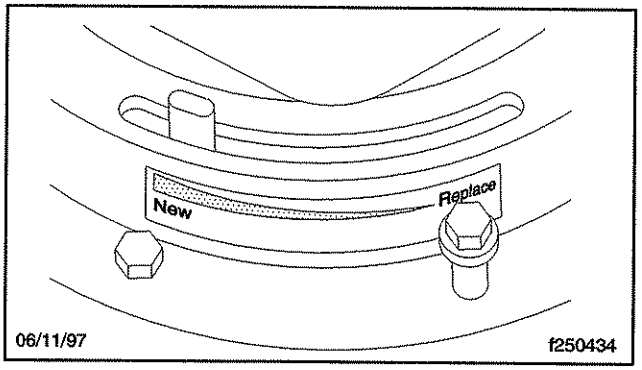


Fig. 14, Reset Wear Indicating Tab

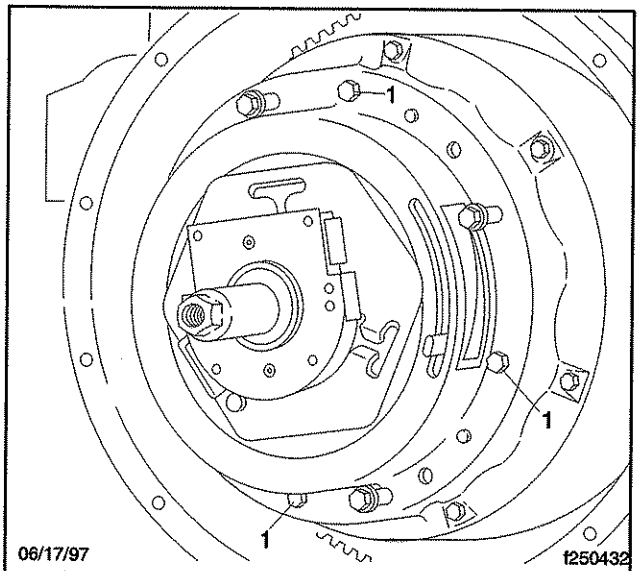
⚠ CAUTION

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.

3. Remove the clutch brake from the transmission input shaft. This step only applies to non-synchronized transmissions that use a clutch brake. See **Fig. 1**.
4. Install a spline aligning tool into the release-bearing assembly, and through the driven discs. See **Fig. 2**. An old transmission input shaft maybe used for this purpose.
5. Locate four 3/8-inch by 16 by 1-1/4 inch hexhead machine screws (shipping bolts). These shipping bolts were installed on the clutch cover prior to installation.
6. Install the four 7/16-inch by 14 by 1-3/4 hexhead machine screws (shipping bolts) into the four clutch cover holes; turn them finger tight. See **Fig. 15**.
7. Remove the two top mounting capscrews, at the 11 and 1 o'clock positions of the cover assembly, from the cover assembly. Install two guide studs (3/8–16 by 3-inch long) in the open holes to help support the clutch assembly during removal. See **Fig. 16**.
8. Progressively loosen each of the mounting capscrews in the pattern shown in **Fig. 17**. This will prevent warping or bending within the clutch, and will ease removal of the clutch-mounting capscrews.

⚠ WARNING

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



1. Shipping Bolt (3/8 inch x 16 x 1-1/4 inch)

Fig. 15, Install the Shipping Bolts

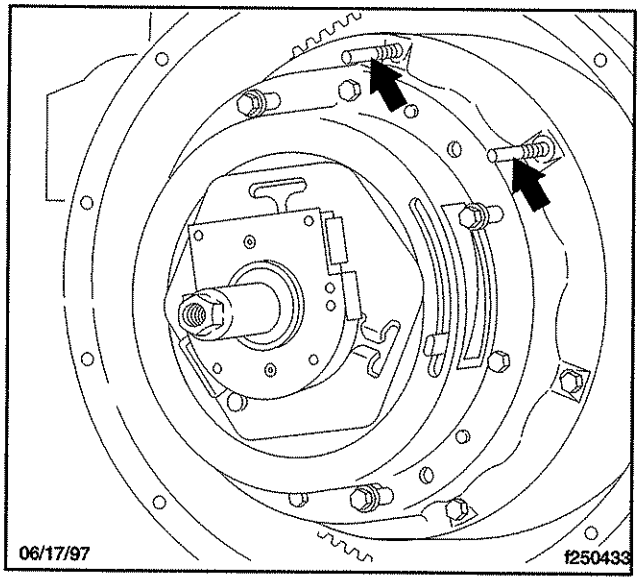


Fig. 16, Guide Stud Installation

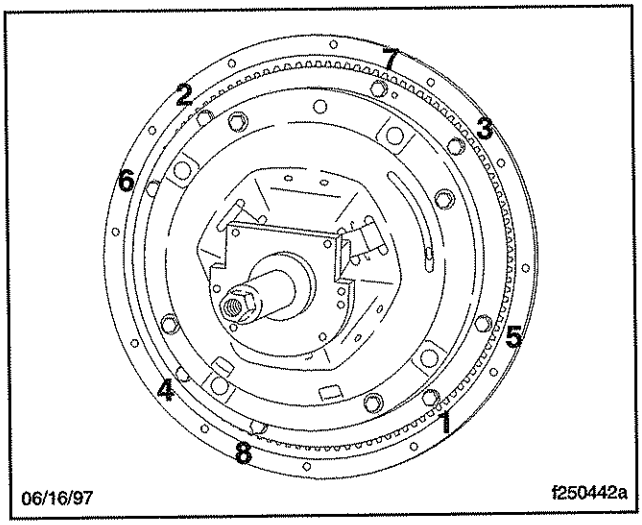


Fig. 17, Loosening Sequence

9. Remove the mounting capscrews, and carefully remove the clutch assembly together with the spline aligning tool.

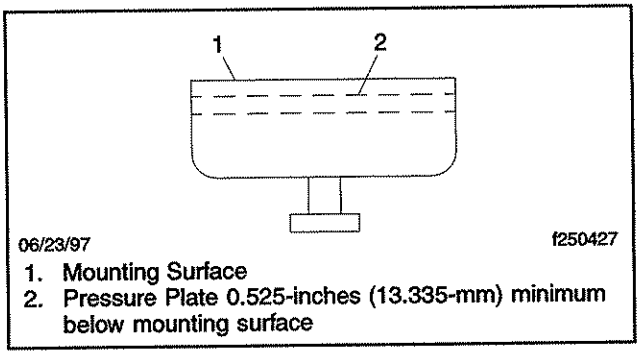
NOTE: For installation of the Splicer Solo Medium-Duty 1402 clutch, mark the proper position of the discs and intermediate plate and adaptor ring.

10. Progressively tighten, in a crisscross pattern, the four shipping bolts until the face of the pressure plate is at least 0.525 inch (13.335 mm) below the mounting surface. See **Fig. 18.**

NOTE: The previous step will reset the pressure plate wear pins and, as a result, allow the clutch to release after the installation.

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

    Whenever the clutch assembly is serviced or the engine is removed, the pilot bearing in the flywheel should be removed and replaced.



1. Mounting Surface
2. Pressure Plate 0.525-inches (13.335-mm) minimum below mounting surface

Fig. 18, Reset Wear Pins

Resetting the Wear Indicating Tab

⚠ CAUTION

The wear indicating tab on the Solo clutch should be reset before the transmission is removed. If the transmission and clutch were removed without following the correct removal procedure (the wear indicating tab was not reset), this procedure must be performed before installation. If this procedure is not performed before installation, the clutch will not release and damage to the clutch may result.

1. Support the clutch cover in an arbor press with the release-bearing facing down. When setting up the arbor press, allow at least one inch clearance for both movement of the release-bearing and access to install shipping bolts. See **Fig. 13.**
2. Center the ram and press downward on the retainer until it comes to a stop. Lock the ram in position.
3. Remove the four shipping bolts, if they have been installed.
4. Raise the ram approximately 1 inch (25 mm).
5. Press downward on the retainer until it comes to a stop. Lock the ram in this position.
6. With finger pressure, slide the wear indicating tab to the left until it is at the new position of the indicator (**Fig. 14**) and hold it in position.
7. Locate four 3/8 inch by 16 by 1-1/4 inch hexhead machine screws (shipping bolts).
8. Install the four 3/8 inch by 16 by 1-1/4 hexhead machine screws (shipping bolts) into the four clutch cover holes; turn them finger tight. See **Fig. 15.**

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

9. Progressively tighten, in a crisscross pattern, the four shipping bolts until the face of the pressure

Clutch Removal

plate is at least 0.525 inches (13.335 mm) below the mounting surface. See **Fig. 18.**

NOTE: The previous step will reset the pressure plate wear pins and, as a result, allow the clutch to release after the installation.

Clutch Inspection

The engine and transmission must line up. To check for this, make the following measurements.

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.

NOTE: Before measuring the engine flywheel or flywheel housing, check the end-play of the crankshaft. Mount the dial indicator on the flywheel housing, with the indicator's finger against the flywheel. Force the crankshaft back and forth with a pry bar. If end-play exceeds the maximum, correct it. For specifications and instructions, see the engine manufacturer's service manual.

1. Inspect for a worn or corroded pilot (**Fig. 1**) on both the transmission clutch housing, and engine flywheel housing. The 1/8-inch (3.0-mm) deep pilot lip of the clutch 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. Any measurable amount of wear on either part will cause misalignment; replace the part. Wear may first appear between the 3 o'clock and 8 o'clock positions. See **Fig. 2**. To check for wear, proceed as follows:

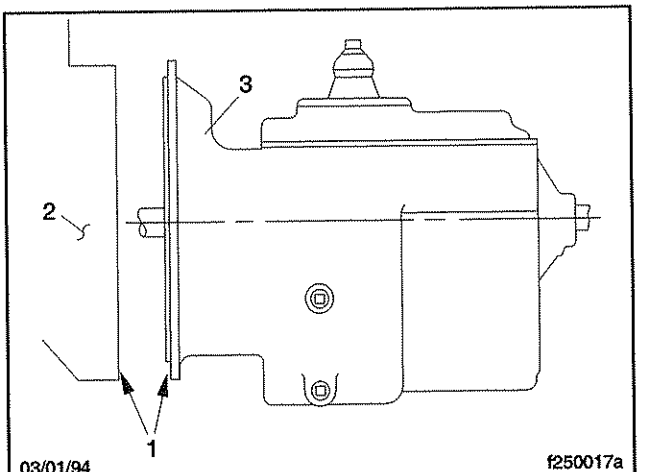
   1.1 Measure the runout of the pilot (bore) of the flywheel housing. Secure the dial indicator to the flywheel (or crankshaft), with the gauge finger against the housing pilot. See **Fig. 3**. With chalk or soapstone, mark the high and low points on the flywheel housing flange, while rotating the flywheel (or crankshaft) by hand. The total runout will be the difference between the highest plus and minus readings. See **Fig. 4**.

   The SAE maximum total runout for the flywheel housing pilot is 0.008 inch (0.20 mm). If readings are higher, replace the housing. For instructions, see the engine manufacturer's service manual.

   1.2 Measure the runout of the face of the flywheel housing. With the dial indicator secured to the flywheel (or crankshaft), move the finger to contact the face of the housing. See **Fig. 5**. Mark the high and low points.

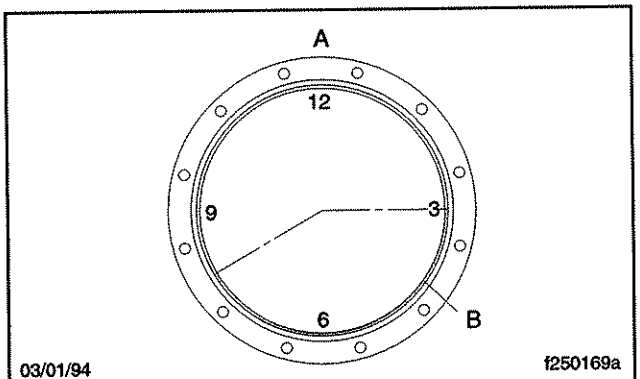
   The SAE maximum total runout for the flywheel housing face is 0.008 inch (0.20 mm). If the readings are higher, replace the housing. For instructions, see the engine manufacturer's service manual.

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



1. Pilot
2. Engine Flywheel Housing
3. Transmission Clutch Housing

Fig. 1, Inspect the Pilot



A. Top
B. The most common areas of wear are between the 3 o'clock and 8 o'clock positions.

Fig. 2, Checking for Wear

Clutch Inspection

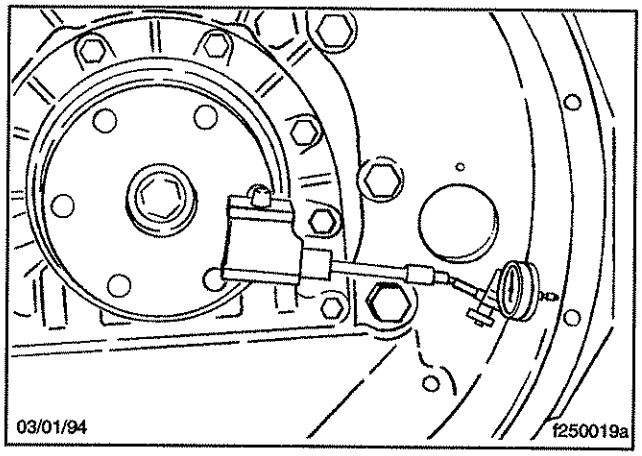
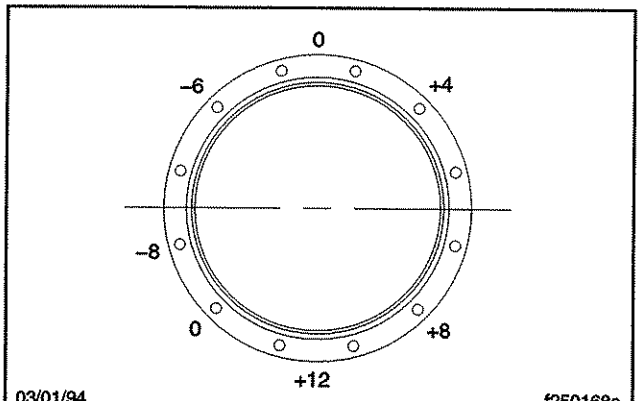


Fig. 3, Check the Pilot Bore Runout



NOTE: Plus 0.012 inch (0.30 mm) and minus 0.008 inch (0.20 mm) gives the housing a total runout of 0.020 inch (0.51 mm)

Fig. 4, Calculating the Runout

2. Measure the runout of the flywheel face. Secure the dial indicator to the flywheel housing, with the gauge finger against the face of the flywheel near the outer edge. See **Fig. 6**. Turn the flywheel to obtain readings.

   A 0.0005-inch (0.01-mm) runout or face wobble per inch of flywheel diameter is allowed. For example, if the vehicle has a 14-inch (355.6-mm) clutch, and the readings are taken just off the outer edge of the clutch disc wear area, the maximum tolerance would be 0.007 inch (0.177 mm). If the readings are higher, repair or replace the flywheel. See the engine manufacturer's service manual for instructions.

3. Measure the runout of the pilot-bearing bore of the flywheel. With the indicator secured to the flywheel housing, move the gauge finger to contact the pilot-bearing bore surface. See **Fig. 7**. Turn the flywheel to obtain the readings.

   The SAE maximum total runout for the pilot-bearing bore is 0.005 inch (0.10 mm). If the readings are higher, see the engine manufacturer's service manual for instructions.

4. Measure the runout of the transmission clutch-housing face and pilot.

NOTE: The clutch-housing face and pilot cannot be checked accurately unless you have a set of case-

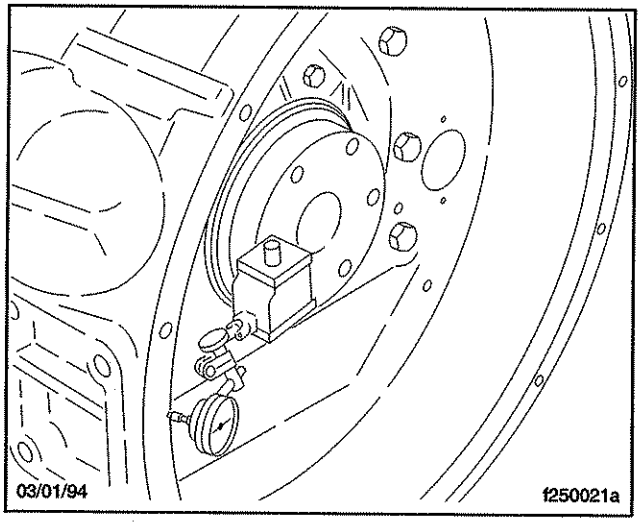


Fig. 5, Check the Housing Face Runout

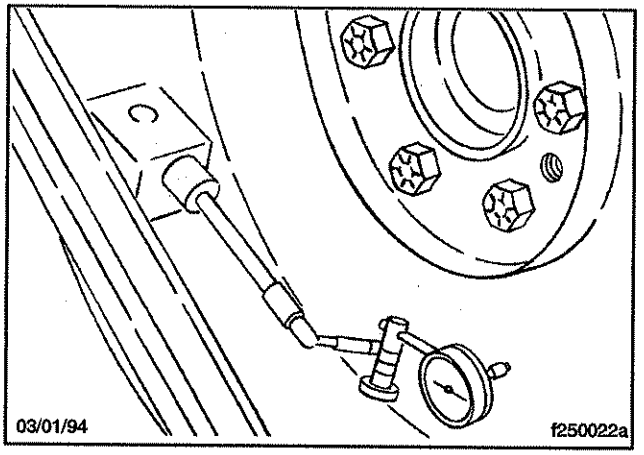


Fig. 6, Check the Flywheel Face Runout

bore plugs and shaft. This set consists of plugs that are tapped into the front and rear bores of the transmission case, and have very close fits in the bores. A 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 clutch housing.

The SAE maximum runout for the clutch-housing face and pilot is 0.008 inch. If the readings are higher, replace the clutch housing; see the transmission manufacturer's service manual.

5. Remove the flywheel (see the engine manufacturer's service manual), and measure the runout of the flywheel crankshaft face. Secure the dial indicator to the flywheel housing, with the gauge finger against the crankshaft face, near the outer edge. See **Fig. 8**. Turn the crankshaft to obtain readings.

   See the engine manufacturer's service manual for maximum runout, corrective measures, and flywheel installation instructions.

⚠ CAUTION

Misalignment of any parts described in the steps above will cause premature wear of drivetrain components.

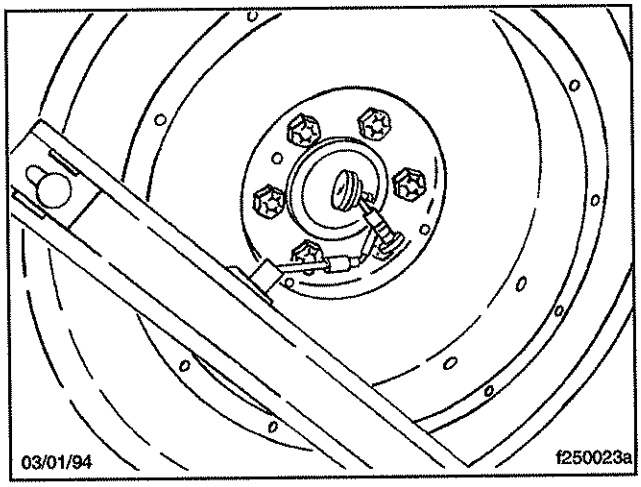


Fig. 7, Check the Pilot-Bearing Bore Runout

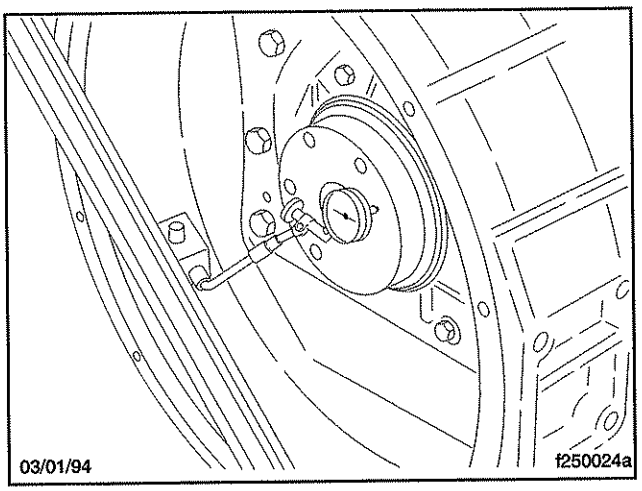


Fig. 8, Check the Crankshaft Face Runout

Installation

PRE-INSTALLATION CHECKS

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

1. Inspect the friction surface of the flywheel for smoothness, heat checks, scoring, and wear on the contact surface. Inspection for heat checks and scoring must be visual, and based on experience; however, measure the friction surface wear with a straightedge and feelers.

   Replace or repair the flywheel if the wear is extreme. For instructions, refer to the engine manufacturer's recommendations concerning flywheel replacement or rebuilding.

2. If the flywheel has been replaced, measure the runout of the face and pilot diameters to make sure the measurements are within the engine manufacturer's specifications.

3. Check the fit of the splined hubs of the front and rear friction discs by sliding them on the transmission input shaft splines. 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. If the input shaft splines are badly worn or notched, replace the input shaft; for instructions, refer to the transmission manufacturer's service manual

4. Check the following items for wear: the fingers of the clutch release yoke; the release shafts; the release shaft bushings; and the input shaft bearing cap. Replace any worn parts.

INSTALLING A SPICER 14-INCH EASY-PEDAL POT-TYPE FLYWHEEL CLUTCH

1. Install new drive pins in the flywheel:

   1.1 Remove the flywheel from the engine; for instructions, refer to the engine manufacturer's service manual.

⚠ WARNING

The drive pins are made of hardened steel. Wear eye protection when removing the old drive pins.

Do not hit steel parts with a steel hammer. Parts can break or chip and cause injury.

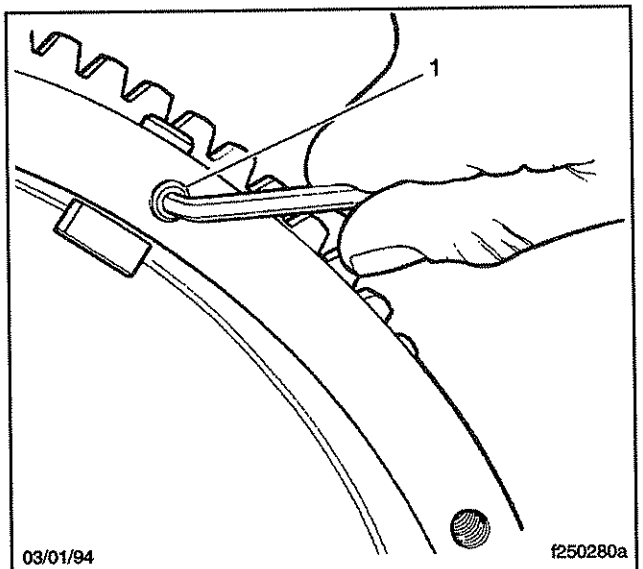
1.2 Remove the setscrews from each of the drive pins. See **Fig. 1**. Then, using a hammer and punch, remove the drive pins.

1.3 Install six new drive pins in the flywheel, equally spaced. Make sure that the shanks of the drive pins are press-fit in the flywheel rim, and that the heads are square with the friction face. See **Fig. 2**.

NOTE: Before doing the next step, place two small spacers on the friction surface of the flywheel. This will prevent the intermediate plate from pinching your fingers, and will also allow an easy fingerhold when removing the plate.

1.4 Carefully position the intermediate plate over the drive pins. Turn the intermediate plate in one direction as far as it will go. Check the clearance between each drive pin and drive slot. Check the same side of each pin.

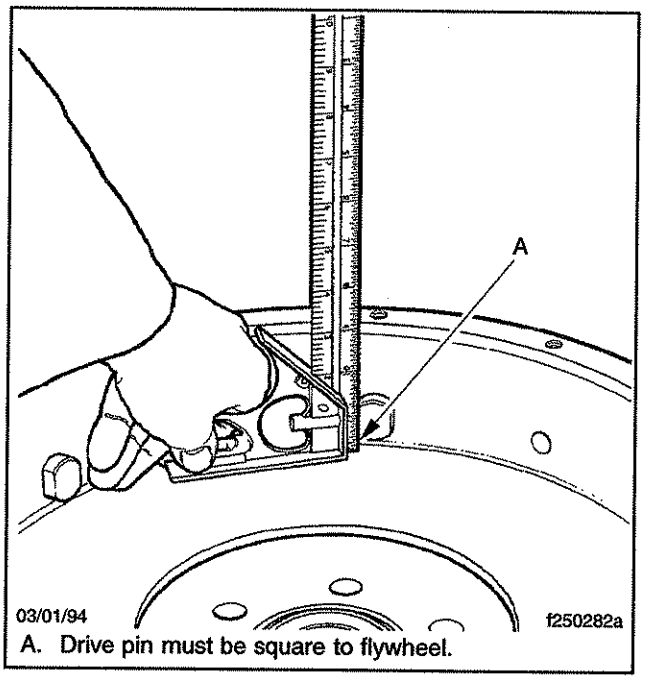
The minimum clearance between the drive pins and the drive slots is 0.006 inch (0.152 mm). See **Fig. 3**. If the clearance is correct, remove the intermediate plate, and check



1. Setscrew

Fig. 1, Remove the Setscrews

Clutch Installation



A. Drive pin must be square to flywheel.

Fig. 2, Install the Drive Pins

the squareness alignment of the drive-pin heads to the friction face.

⚠ CAUTION

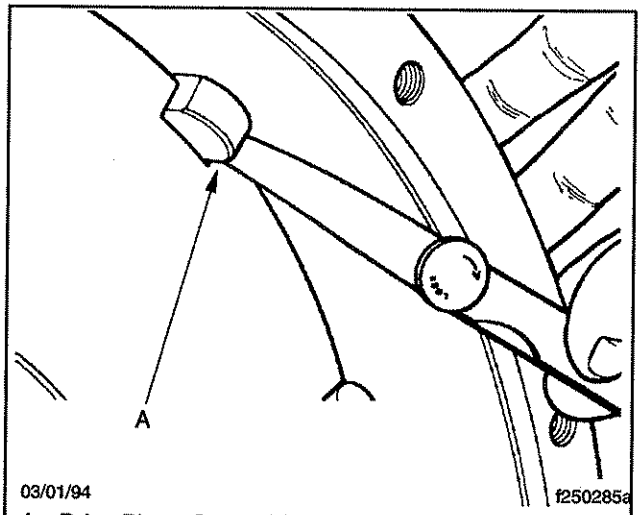
Don't file the intermediate-plate slots to obtain the correct clearance. Doing so will cause an unequal load on the pins. This is a frequent cause of poor- or no-release complaints in newly installed clutches, and can result in broken drive pins.

1.5 If the alignment and clearance are okay, remove the intermediate plate, and lock each of the pins in place with a new locking-type 3/8 by 3/8-inch setscrew.

If only non-locking setscrews are available, tighten them 25 lbf·ft (35 N·m).

1.6 Install the flywheel; for instructions, refer to the engine manufacturer's service manual.

2. Install a new pilot bearing. Make sure the bearing has a press-fit in the flywheel.
3. If the clutch is new, remove the protective coating from the pressure plate and the intermediate plate.
4. Place the front driven-disc assembly in the flywheel, with the side stamped *FLYWHEEL* facing the engine. See **Fig. 4**.
5. Install the intermediate plate in the flywheel, locating the drive slots on the drive pins. See **Fig. 5**.



A. Drive Pin-to-Center Plate Minimum Clearance: 0.006 inch (0.152 mm)

Fig. 3, Measure the Clearance

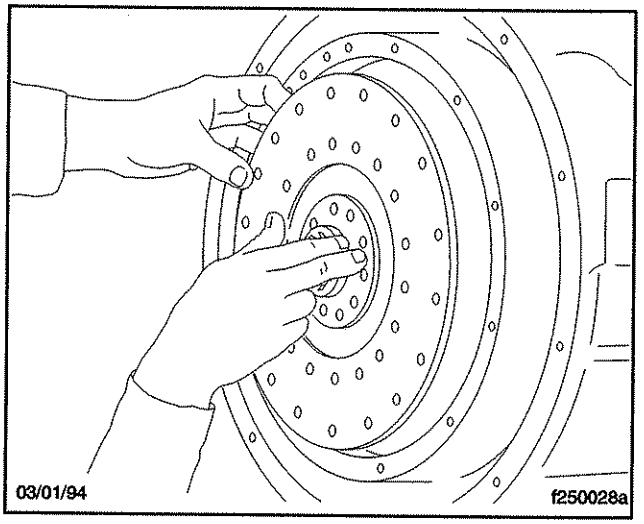


Fig. 4, Position the Front Driven-Disc

⚠ WARNING

Wear heavy gloves when installing the anti-rattle springs, otherwise the sharp edges can cut your hands.

6. On 14-inch (355.6-mm) Super-Duty clutch installations, use three anti-rattle springs equally spaced between the drive pins. Wearing heavy gloves, install the springs with the rounded sections toward the flywheel face. See **Fig. 6**. Push the springs toward the engine until they bottom against the face of the flywheel.

   The 14-inch (355.6-mm) Super-Duty clutches have thicker intermediate plates, and six ceramic buttons on each side of each disc. Do not mix standard and Super-Duty discs.

7. Insert a spline aligning tool through the hub of the rear driven disc, with the side stamped *PRESSURE PLATE* facing the transmission. Install the rear driven disc behind the intermediate plate. See **Fig. 7**.

NOTE: The side stamped *PRESSURE PLATE* must face the transmission.

8. Insert the aligning tool through the hub of the front driven disc, and into the pilot bearing.

9. Position the cover assembly on the flywheel, with the lockstrap aligned with the opening in the transmission clutch housing. See **Fig. 8**. Start the 3/8-inch clutch-mounting capscrews and lockwashers, and tighten them finger-tight to hold the assembly in place. Use capscrews that are 1-1/4 inches long.

10. Tighten the capscrews progressively in the sequence shown in **Fig. 9** to pull the clutch ring into position in the flywheel pilot. For the final torque, progressively tighten all of the capscrews 35 to 40 lbf·ft (47 to 54 N·m).

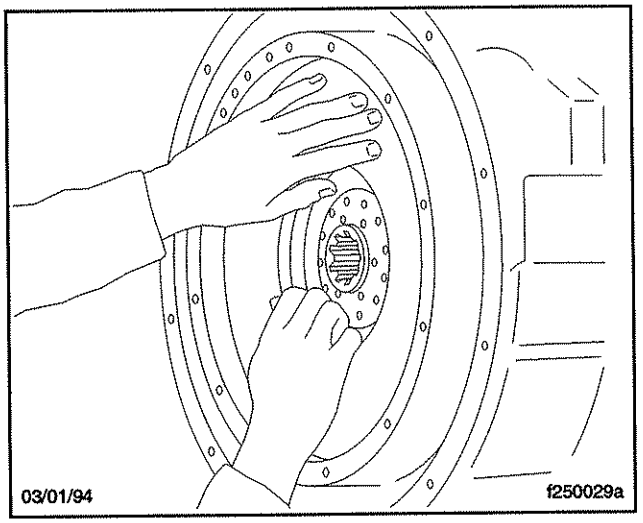


Fig. 5, Install the Intermediate Plate

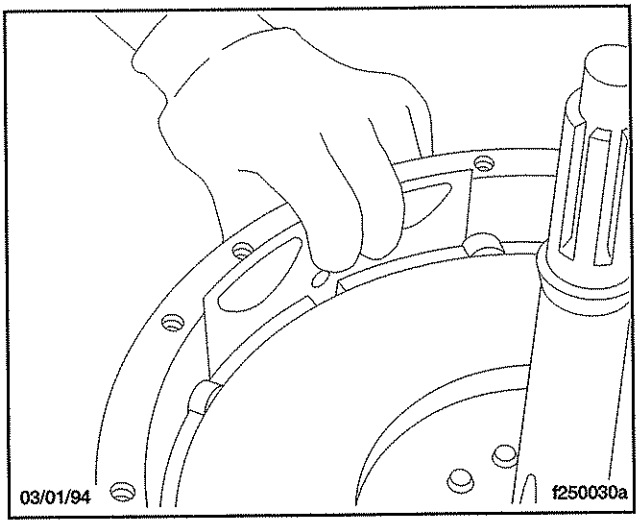
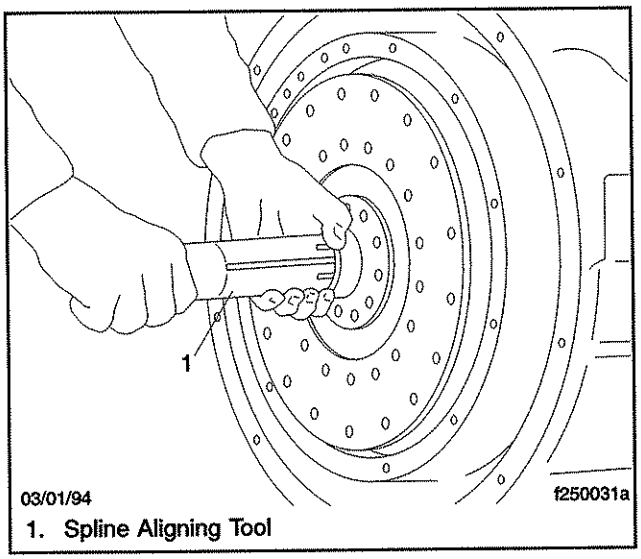


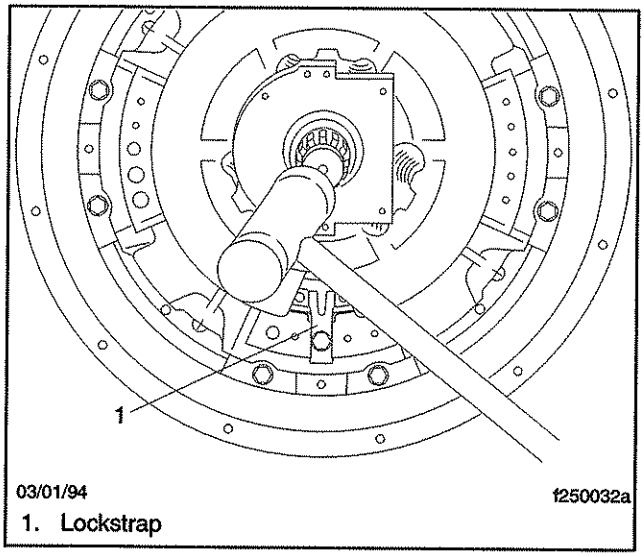
Fig. 6, Install the Anti-Rattle Springs



1. Spline Aligning Tool

Fig. 7, Insert the Spline Aligning Tool

Clutch Installation



1. Lockstrap

Fig. 8, Position the Cover Assembly

⚠ CAUTION

Failure to tighten the capscrews as described can cause clutch damage and an out-of-balance condition.

11. As the capscrews are tightened, the release-bearing spacers should fall free. If they don't, remove them. Remove the aligning tool; this may require a tap with a mallet. See **Fig. 8.**

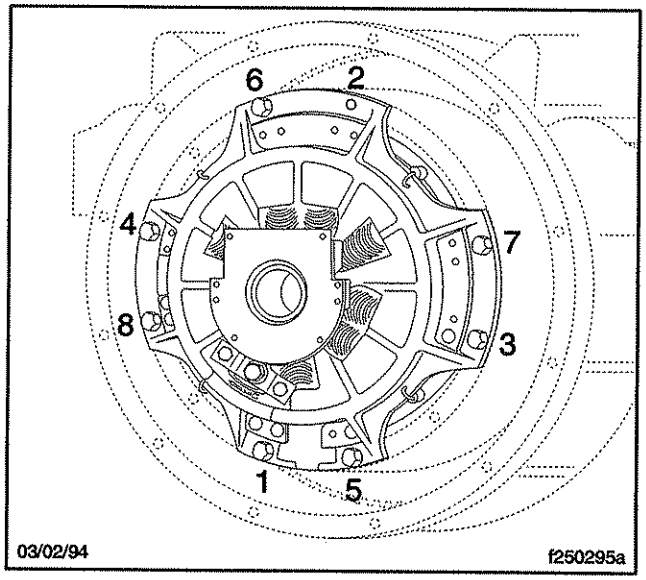


Fig. 9, Tightening Sequence

12. Using a clean cloth, remove all grease from the input shaft.
13. Install the clutch brake on the input shaft, as shown in **Fig. 10.** Slide it tight against the input shaft bearing cap.

    Torque-limiting clutch brakes are a one-piece assembly with a large and a small face. When installing a torque-limiting clutch brake on a Spicer transmission, install the larger face toward the transmission; when installing it on a Fuller transmission, install the smaller face toward the transmission.
14. Shift the transmission into gear, so the transmission input shaft can be rotated into line with the clutch driven-disc hub splines during assembly.
15. Install the transmission and attach the clutch linkage. For instructions, See **Group 26** in this manual.

⚠ CAUTION

Avoid springing the driven discs when the transmission is being installed. Don't force the transmission into the clutch or flywheel housing if it doesn't enter freely. Don't let the transmission drop or hang unsupported in the driven discs. These practices can damage the clutch assembly.

IMPORTANT: Be sure the release-bearing yoke clears the bearing, and is rotated over the wear pads as the

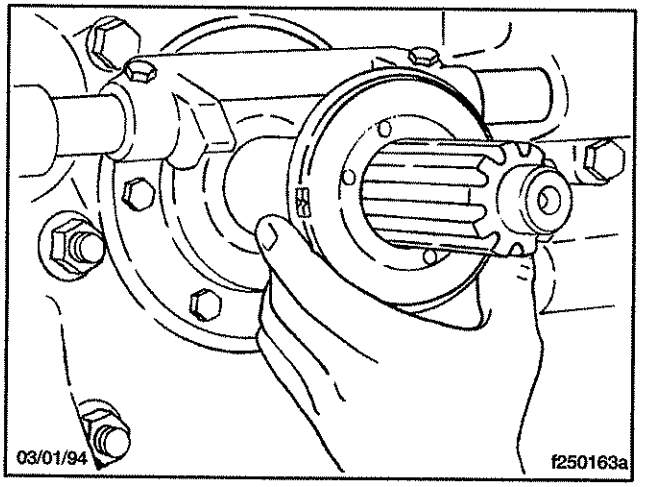


Fig. 10, Install the Clutch Brake

transmission is moved forward. See **Fig. 11**. Align the splines by turning the transmission output shaft.

16. Grease the release-bearing and release shafts. For instructions and recommended lubricants, see **Group 25** of the *Business Class Trucks Maintenance Manual*.

17. Adjust the clutch and linkage after installing the clutch. Refer to the appropriate section in this manual for procedures.

INSTALLING A SPICER 15-1/2 INCH EASY-PEDAL CLUTCH

NOTE: Do the pre-installation checks in this section before installing the clutch.

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

2. If not already installed, install two guide studs (7/16–14 by 5-inches long) in the upper mounting holes of the flywheel. See **Fig. 12**. Rotate the flywheel to level the guide studs.

3. If the clutch is new, 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. 13**.

5. Install the rear driven disc on the aligning tool, with the side stamped *PRESSURE PLATE* facing the pressure plate. See **Fig. 14**. Place the intermediate plate in the clutch cover; align the driving lugs of the plate with the notches in the cover. See **Fig. 15**.

   Clutches produced after January 1990 may have positive separator pins; make sure they point toward the flywheel side. See **Fig. 16**. The pins should be flush on the pressure plate side.

6. Install the front driven disc on the aligning tool, with the side stamped *FLYWHEEL* facing the engine. See **Fig. 17**.

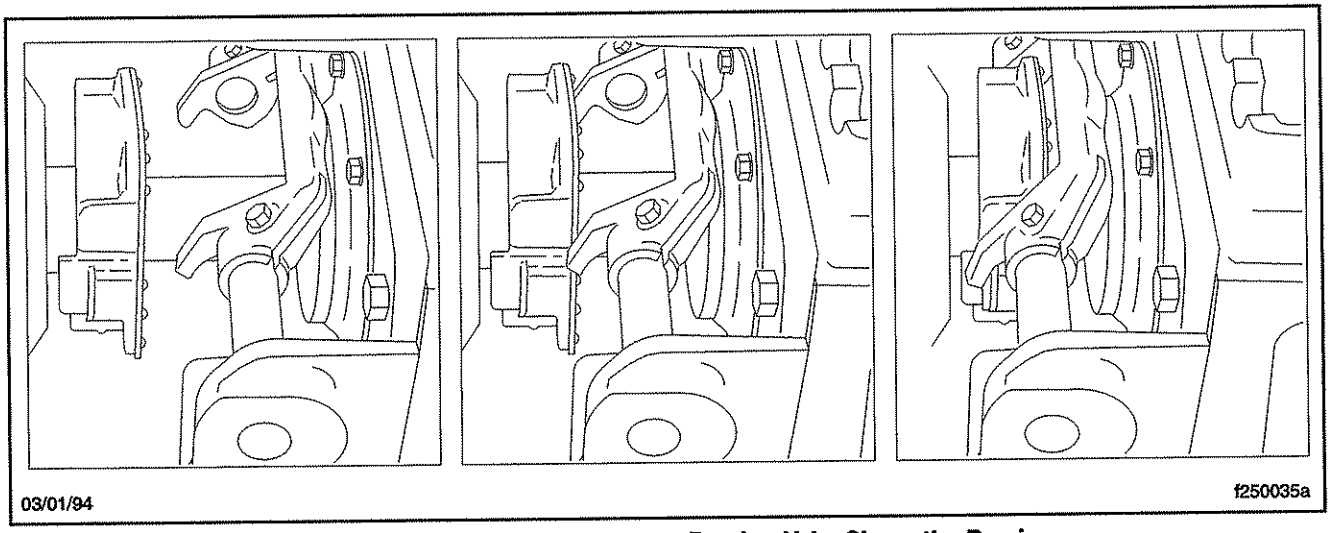
   Be sure that both driven discs are aligned as shown in **Fig. 18**.

⚠ WARNING

The pressure plate and cover assembly is heavy and 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 (**Fig. 19**), and slide the assembly forward until it starts in the flywheel pilot.

8. Start six 7/16–14 (grade 8) capscrews with lockwashers, and tighten them finger-tight. Tap the aligning tool (**Fig. 8**) to make sure it is centered and seated in the pilot bearing, then remove the two guide studs and replace them with 7/16–14 capscrews and lockwashers.



03/01/94 f250035a

Fig. 11, Make Sure that the Release-Bearing Yoke Clears the Bearing

Clutch Installation

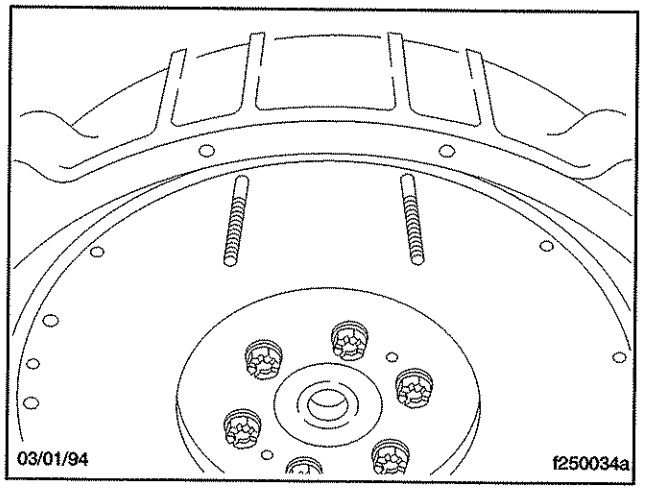


Fig. 12, Guide Stud Installation

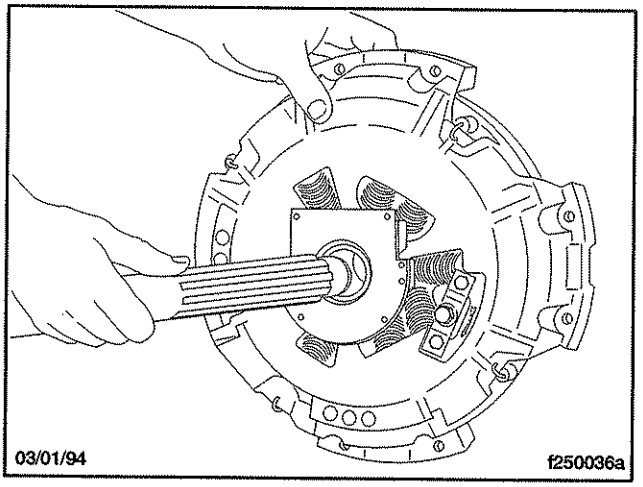


Fig. 13, Insert a Spline Aligning Tool

9. Tighten the eight clutch-mounting capscrews progressively, in the sequence shown in **Fig. 20.** The final torque is 45 to 50 lbf·ft (61 to 68 N·m).

⚠ CAUTION

If the capscrews are not tightened in sequence, clutch damage and an out-of-balance condition may occur.

10. As the capscrews are tightened, the release-bearing spacers should fall free. If they don't, remove them. Remove the aligning tool; this may require a tap with a mallet.

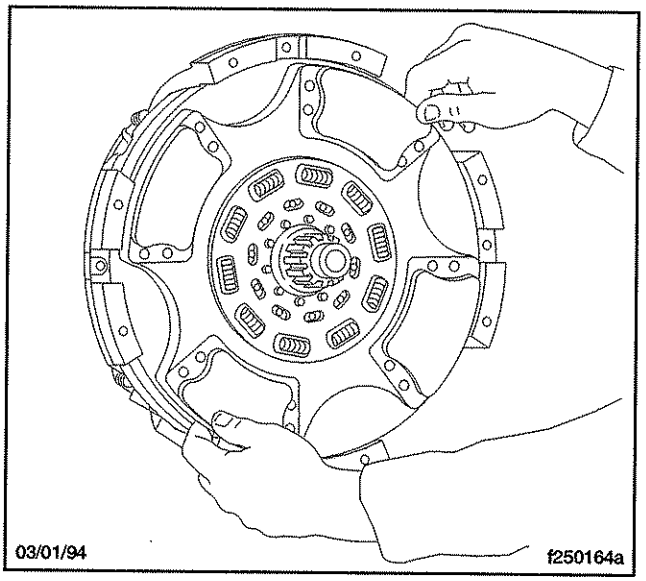


Fig. 14, Installing a Driven Disc

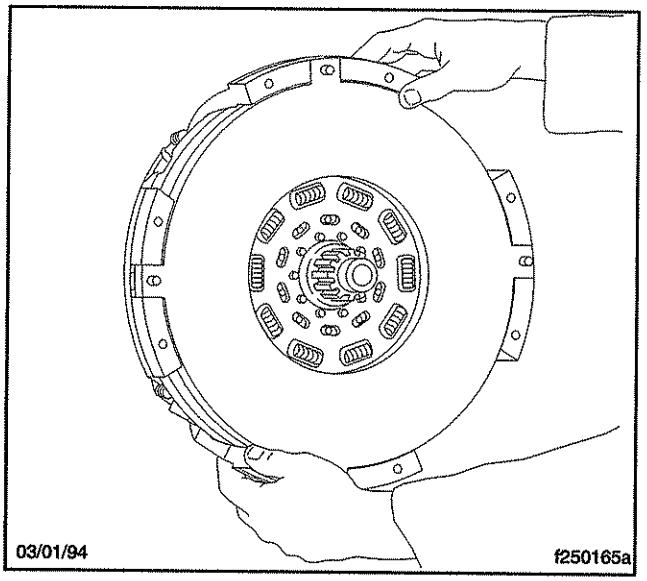
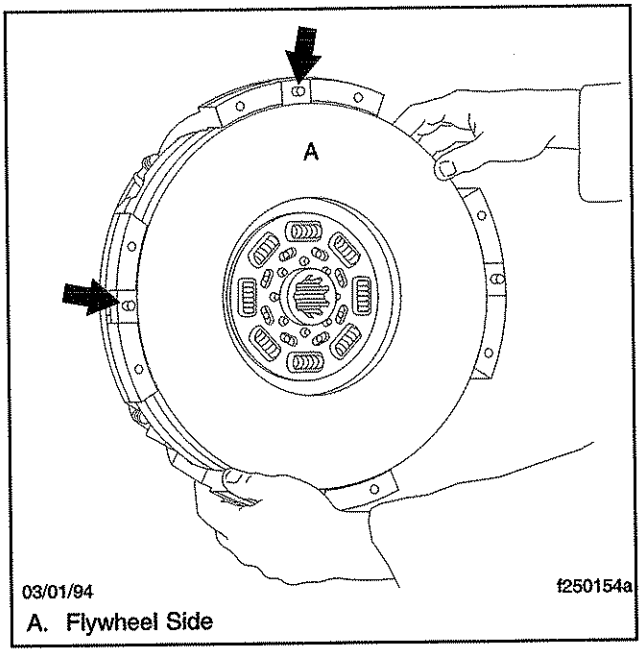


Fig. 15, Position the Intermediate Plate

11. For clutches without the "positive separator," go on to the next step. Otherwise set the positive separator pins.

    11.1 For positive separator clutches locate the pin access holes. See **Fig. 21.**



A. Flywheel Side

Fig. 16, Positive Separator Pins

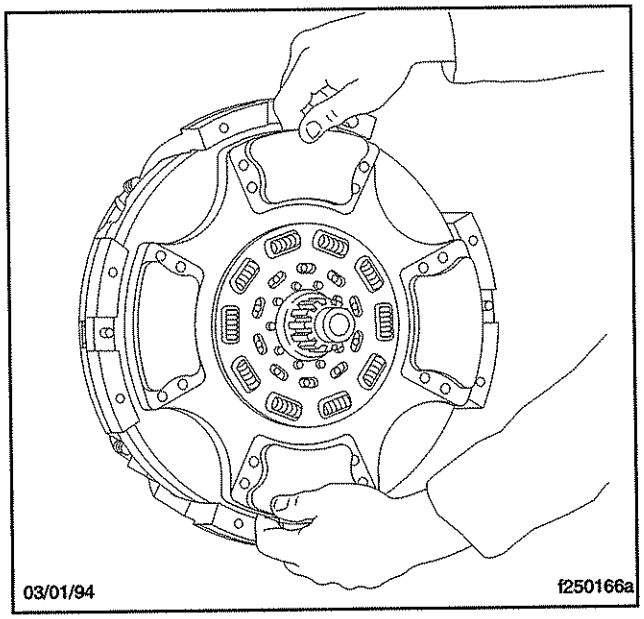
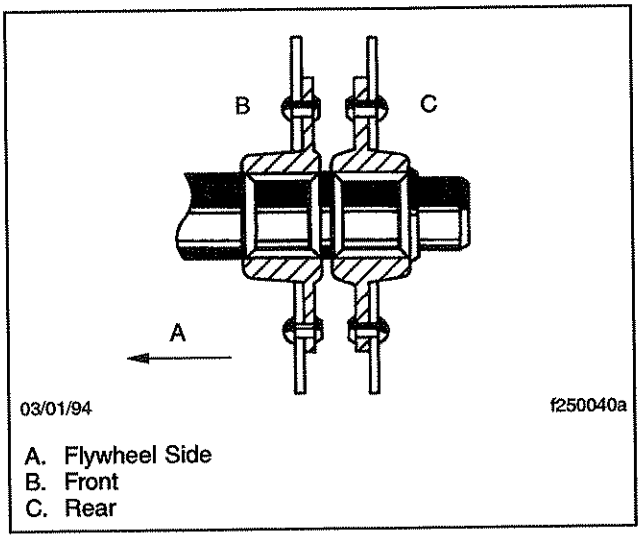


Fig. 17, Installing the Second DrivenDisc



A. Flywheel Side
B. Front
C. Rear

Fig. 18, Checking the Disc Alignment

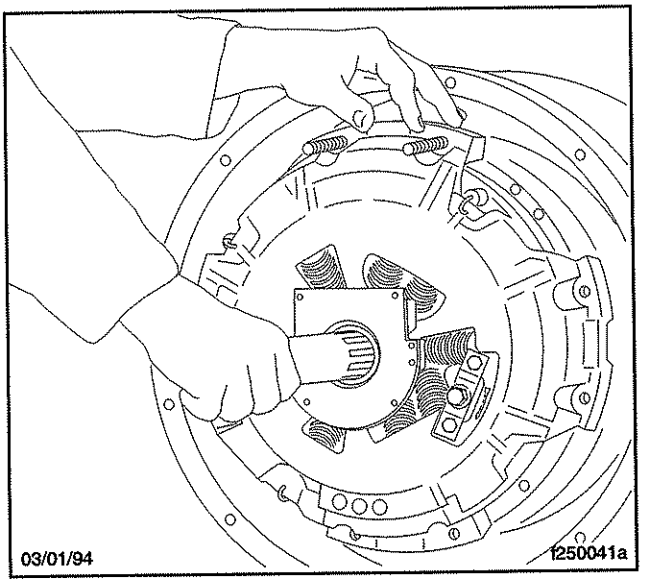


Fig. 19, Positioning the Clutch

⚠ WARNING

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

11.2 Using a 1/4-inch (6-mm) diameter driver, *lightly* tap each pin toward the flywheel through the access holes. See **Fig. 22.**

Clutch Installation

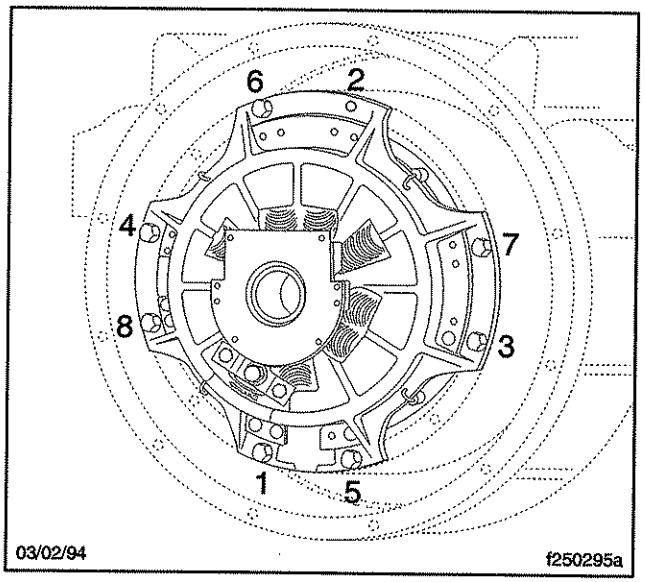


Fig. 20, Tightening Sequence

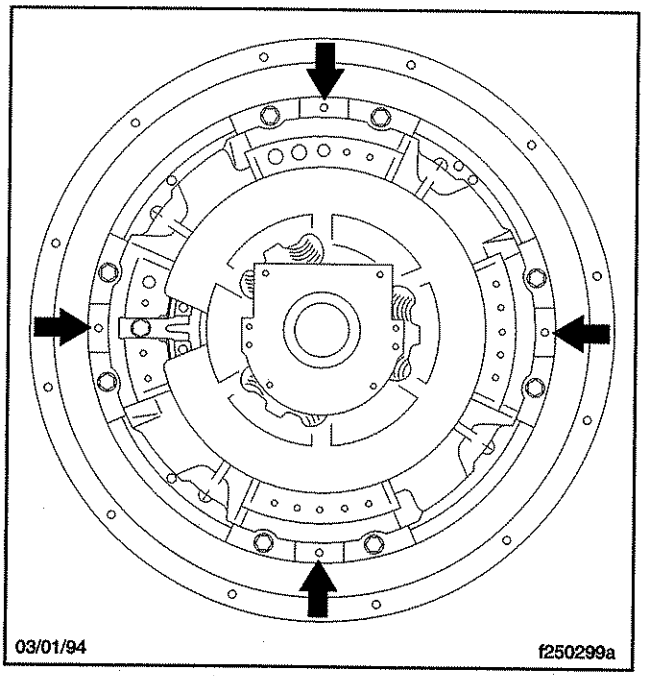


Fig. 21, Pin Access Holes

NOTE: The separator pin will allow the intermediate plate to move back 0.025 to 0.030 inch (0.635 to 0.762 mm) when the clutch is released, giving an approximately equal gap on both sides of the intermediate plate. See **Fig. 23**.

12. Using a clean cloth, remove all grease from the input shaft.
13. Install the clutch brake on the transmission input shaft, as shown in **Fig. 24**. Slide it tight against the input shaft bearing cap.

    Torque-limiting clutch brakes are a one-piece assembly with a large and a small face. When installing a torque-limiting clutch brake on a Spicer transmission, install the larger face toward the transmission; when installing it on a Fuller transmission, install the smaller face toward the transmission.
14. Shift the transmission into gear, so that the transmission input shaft can be rotated into line with the clutch driven-disc hub splines, during assembly.
15. Install the transmission and attach the clutch linkage. For instructions, see **Group 26** in this manual.

IMPORTANT: Be sure the release-bearing yoke clears the bearing, and is rotated over the wear pads as the transmission is moved forward. See **Fig. 11**. Align the splines by turning the transmission output shaft.

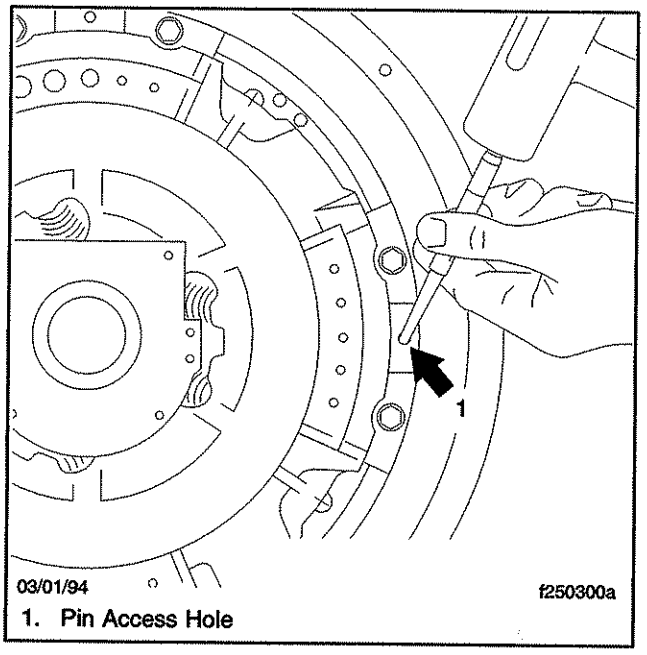


Fig. 22, Tapping the Pin

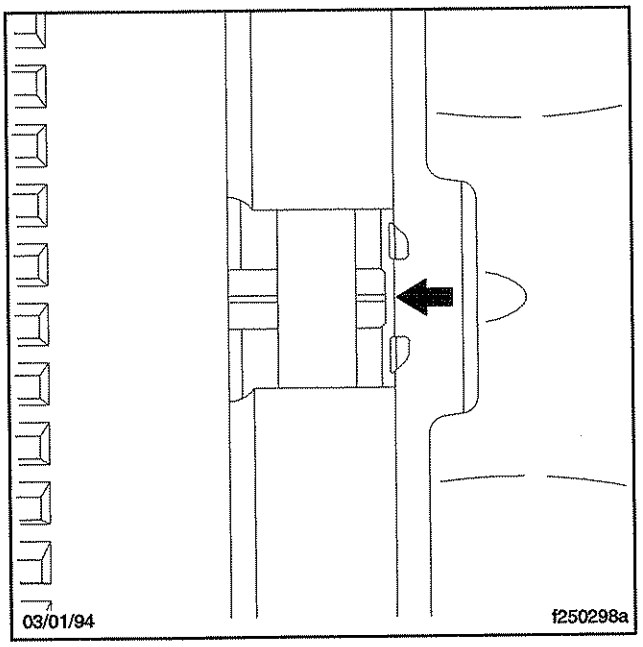


Fig. 23, Intermediate Plate Gap

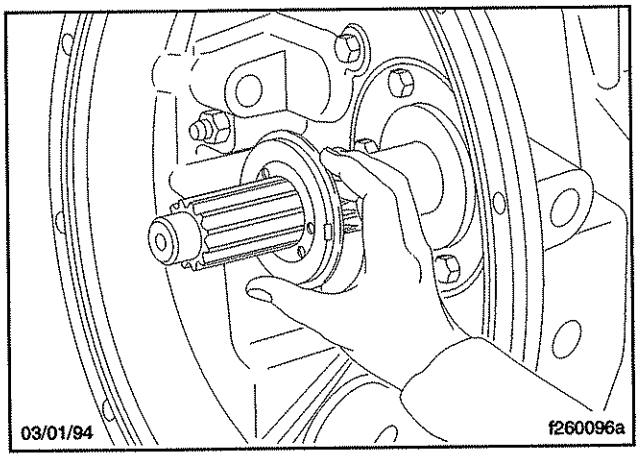


Fig. 24, Install the Clutch Brake

⚠ CAUTION

Avoid springing the driven discs when the transmission is being installed. Don't force the transmission into the clutch or flywheel housing if it doesn't enter freely. Don't let the transmission drop or hang unsupported in the driven discs. These practices can damage the clutch assembly.

16. Grease the release-bearing and release shafts. For instructions and recommended lubricants, see **Group 25** of the *Business Class Trucks Maintenance Manual.*
17. Adjust the clutch and the clutch linkage after installing the clutch. See the appropriate section in this group for procedures.

INSTALLING A SPICER ANGLE-SPRING ONE-PLATE CLUTCH

NOTE: Do the pre-installation checks in this section before installing the clutch.

1. Install a new pilot bearing. Be sure that the pilot bearing has a press-fit in the flywheel.
2. If the clutch is new, remove the protective coating from the pressure plate.
3. If not already in place, install two 3/8-16 by 2-inch guide studs in two upper mounting holes of the flywheel. See **Fig. 25**.
4. Insert an aligning tool through the splines of the driven disc. Insert the aligning tool into the pilot bearing. See **Fig. 26**. Be sure the side marked *PRESSURE PLATE SIDE* faces the pressure plate. See **Fig. 27** for the driven disc installed position.

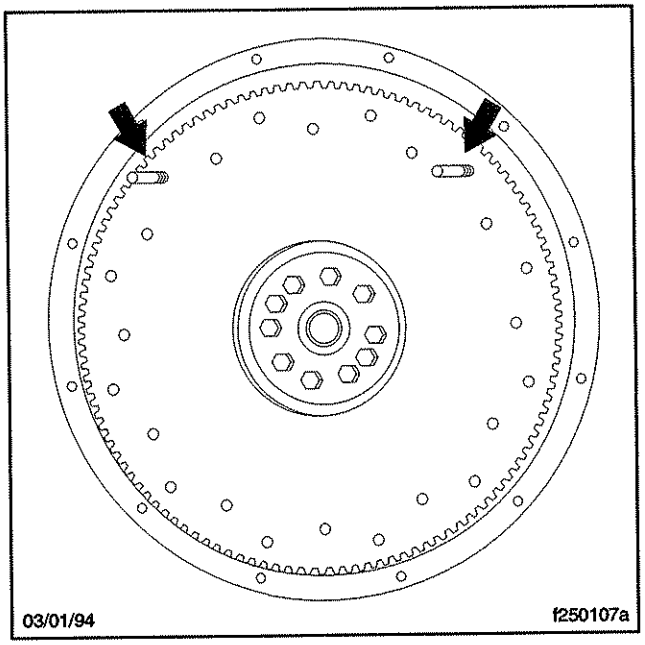


Fig. 25, Install the Guide Studs

Clutch Installation

⚠ WARNING

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

5. With the aligning tool still in place, slide the cover assembly over the aligning tool. Align the lockstrap or self-adjuster with the access opening in the bell housing. See **Fig. 28**.

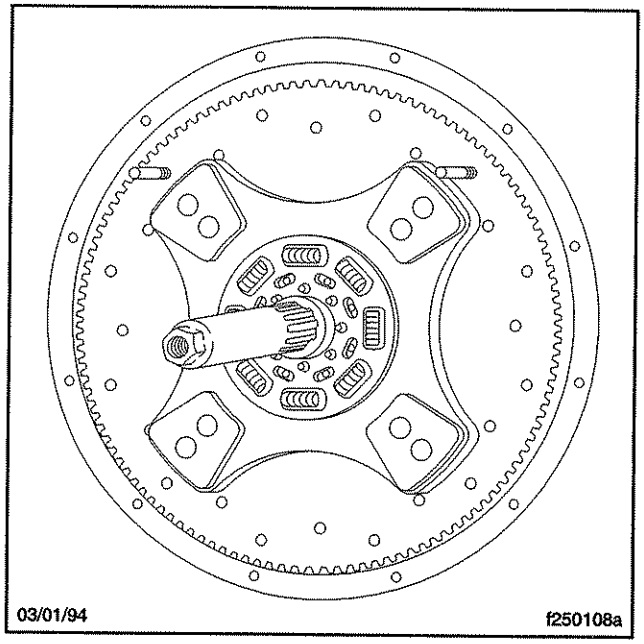
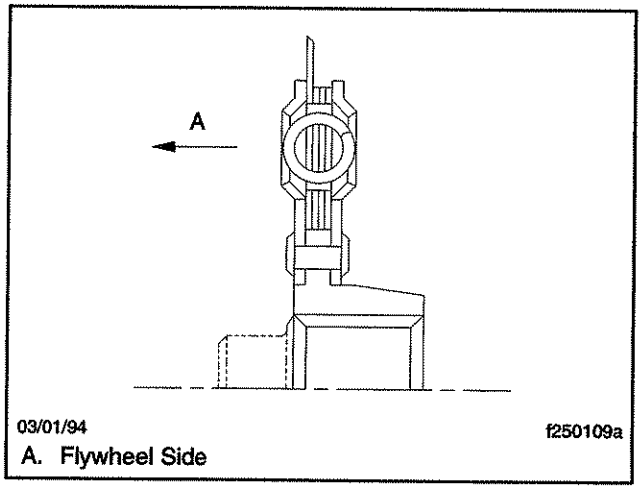


Fig. 26, Insert an Aligning Tool



A. Flywheel Side

Fig. 27, Driven Disc Installed

6. Start ten 3/8–16 grade 8 capscrews with lockwashers in the cover plate. Tighten them snugly. Remove the guide studs. Install two 3/8–16 grade 8 capscrews with lockwashers. Then, following the sequence shown in **Fig. 29**, tighten the capscrews 35 to 40 lbf·ft (47 to 54 N·m).

⚠ CAUTION

If the capscrews are not tightened in the sequence shown, clutch damage and an out-of-balance condition may result.

7. Remove the alignment tool. Remove the wooden spacer blocks.
8. Adjust the clutch and the clutch linkage after installing the clutch. See the appropriate section in this group for procedures.

INSTALLING A SPICER ANGLE-SPRING TWO-PLATE CLUTCH

NOTE: Do the pre-installation checks in this section before installing the clutch.

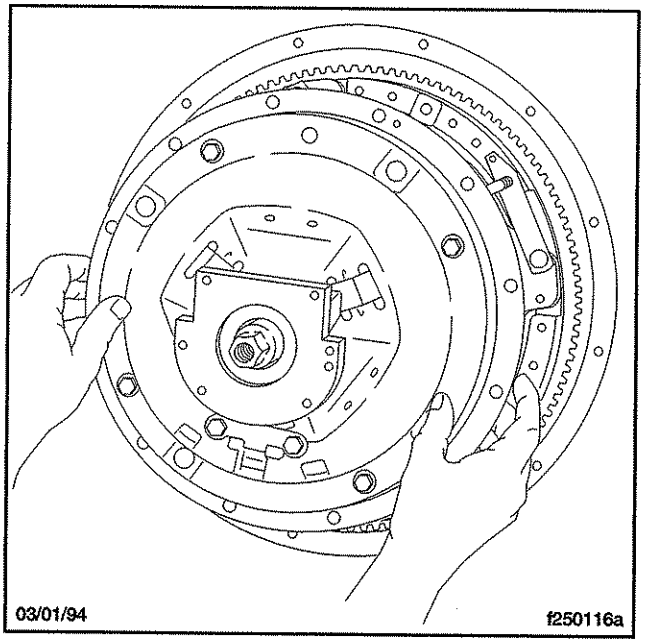


Fig. 28, Position the Clutch Cover

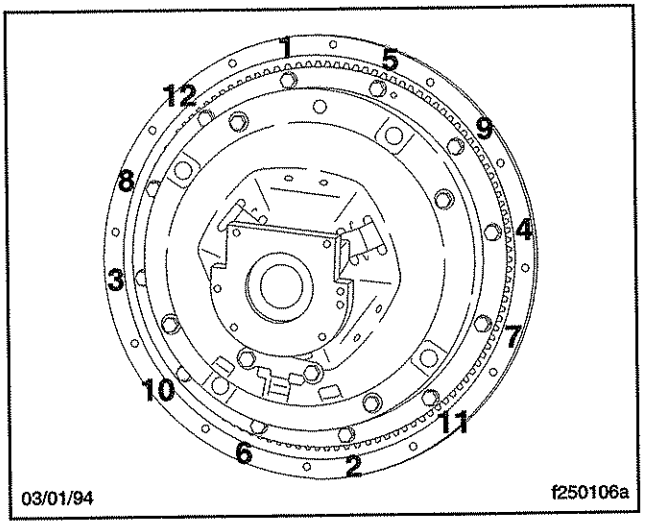


Fig. 29, Tightening Sequence

1. Install a new pilot bearing. Be sure that the pilot bearing has a press-fit in the flywheel.
2. If the clutch is new, remove the protective coating from the pressure plate.
3. Place the front disc in the bell housing with the side marked *FLYWHEEL SIDE* facing the flywheel. See **Fig. 30**.
4. If not already in place, install two 3/8-16 by 2-inch guide studs in two upper mounting holes of the flywheel. See **Fig. 31**.
5. Install the drivestrap intermediate plate over the guide studs. Make sure the side marked *FLYWHEEL SIDE* faces the flywheel. See **Fig 32**.

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

NOTE: The four holes through the drivestraps are the pilot holes for the adapter ring.

6. Raise the front disc to fit into the intermediate plate opening.
7. Install an aligning tool through the splines of the rear disc. Install the rear disc by inserting the aligning tool into the pilot bearing. See **Fig. 33**. Be sure the side marked *PRESSURE PLATE SIDE* faces the pressure plate. See **Fig. 34** for driven disc installed position.

⚠ WARNING

The pressure plate and cover assembly is heavy and should be removed and installed only with a

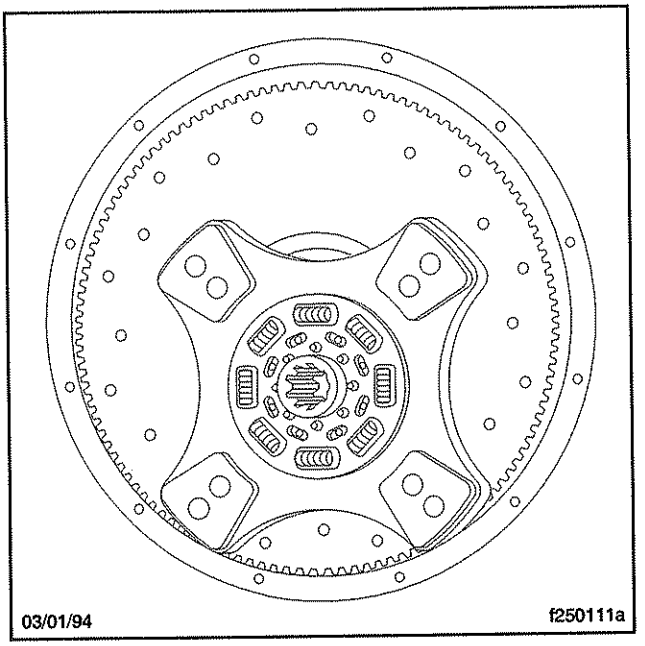


Fig. 30, Position the Front Disc

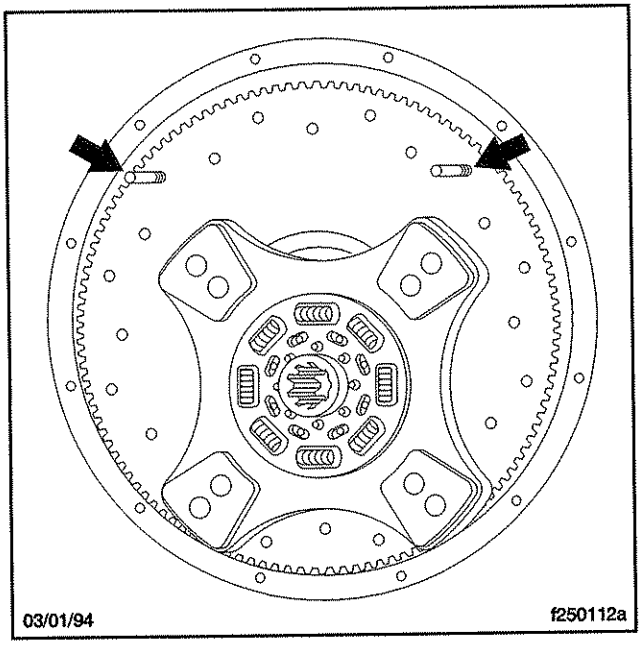


Fig. 31, Install the Guide Studs

Clutch Installation

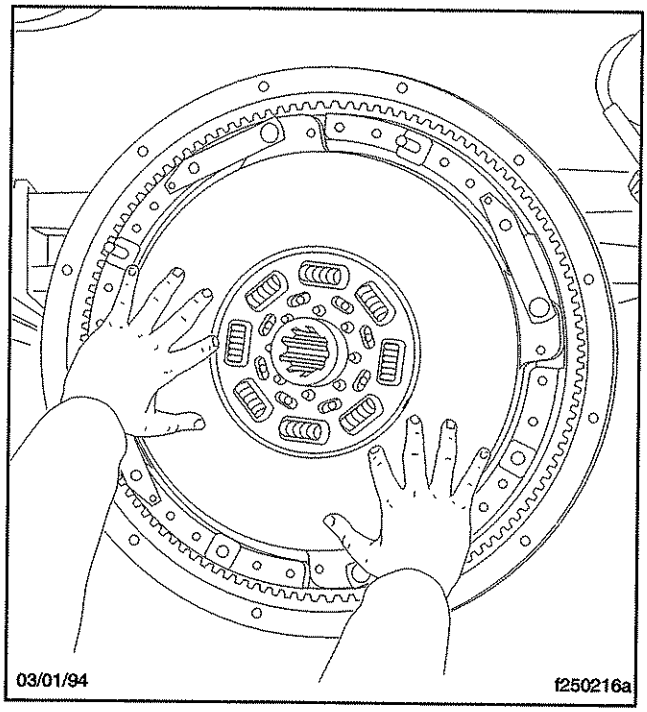


Fig. 32, Install the Intermediat Plate

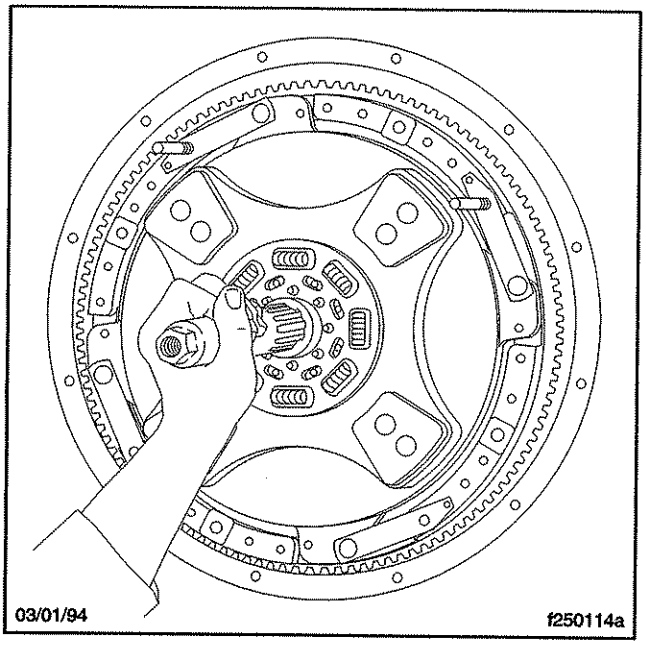


Fig. 33, Install an Aligning Tool

lifting device. If the assembly is lifted incorrectly or dropped, it could cause serious personal injury.

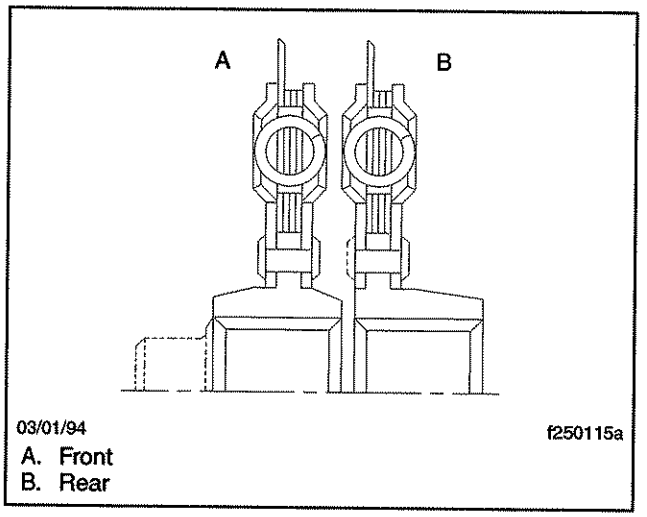


Fig. 34, Driven Discs Installed

8. With the aligning tool still in place, carefully slide the clutch assembly over the aligning tool. See **Fig. 35**. Align the lockstrap or self-adjuster with the access hole in the bell housing.

   Slide the clutch assembly over the guide studs and against the spacer ring.

9. Start ten 3/8–16 grade 8 capscrews with lockwashers in the cover plate. Tighten them

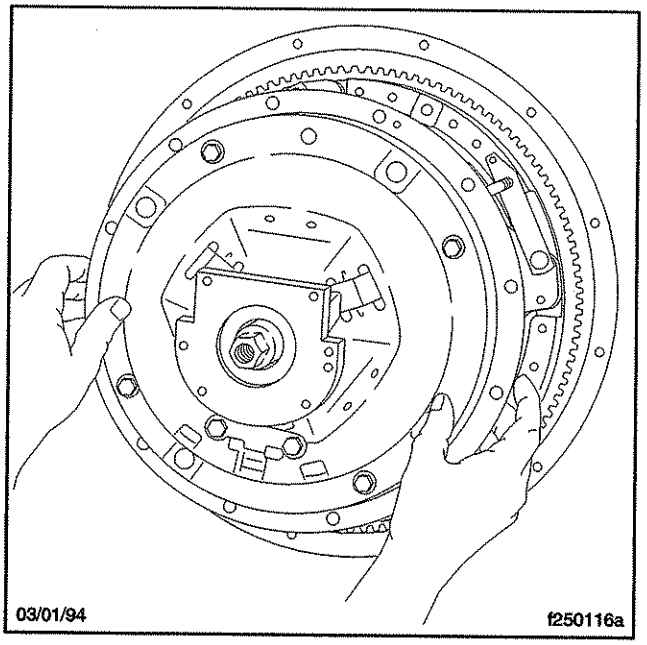


Fig. 35, Position the Clutch Cover

snugly. Remove the guide studs. Install two 3/8–16 grade 8 capscrews with lockwashers. Then, following the sequence in **Fig. 36**, tighten the capscrews 35 to 40 lbf·ft (47 to 54 N·m).

⚠ CAUTION

If the capscrews are not tightened in the sequence shown, clutch damage and an out-of-balance condition may result.

10. Remove the alignment tool. Remove the wooden spacer blocks.
11. Adjust the clutch and the clutch linkage after installing the clutch. See the appropriate section in this group for procedures.

INSTALLING A SPICER SOLO HEAVY-DUTY 15-1/2 INCH CLUTCH

NOTE: Do the pre-installation checks in this subject before installing the clutch.

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

⚠ CAUTION

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

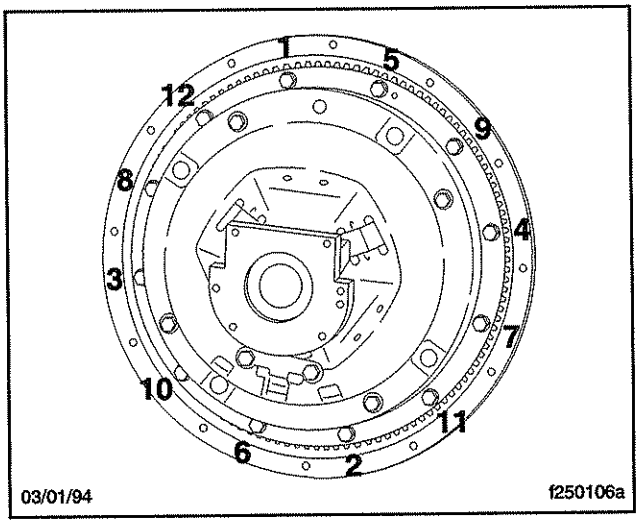


Fig. 36, Tightening Sequence

NOTE: Spicer Clutch strongly recommends the use of a premium grade pilot bearing. The operating temperatures that the pilot bearing sees has increased in the last several years. This creates operating conditions that are no longer acceptable to the standard pilot bearings and grease. In addition, the life of the clutch has increased. Failure of the pilot bearing usually results in a warranty claim for drag or clutch noise.

2. Verify diameter of the flywheel cavity (this is the recessed area for the flywheel mounting bolts). The ten spring driven discs require a minimum diameter of 8-9/16 inches (21.749 cm). The six spring (VCT) driven discs require a minimum diameter of 9-3/4 inches (24.765 cm). The seven spring driven discs require a minimum diameter of 9-3/4 inches (24.765 cm). And, the nine spring driven discs require a minimum diameter of 9-3/4 inches (24.765 cm).
3. If not already installed, install two guide studs (7/16–14 by 5-inches long) in the upper mounting holes of the flywheel. See **Fig. 37**. Rotate the flywheel to level the guide studs.
4. If the clutch is new, and if a protective coating has been applied to the surfaces of the pressure plate and the intermediate plate, remove the protective coating from the pressure plate and the intermediate plate.
5. Set the clutch cover upright, and insert a spline aligning tool through the release-bearing sleeve of the new clutch. See **Fig. 38**.
6. Install the rear driven disc on the aligning tool, with the side stamped *INTERMEDIATE PLATE SIDE* facing the intermediate plate. See **Fig. 39**.

NOTE: The previous step describes the specific procedure for installing a six spring or seven spring rear driven disc. When installing either the nine or ten spring rear driven disc, follow the instructions stamped on the rear disc. These instructions will ensure proper orientation toward the pressure plate. Installing the disc backwards or switching the front and rear discs with each other will prevent the clutch from functioning properly (i.e. the clutch doesn't release, or cannot obtain proper adjustment, etc.). The six spring and seven spring discs require no special orientation. These front and rear discs share the same part number and are symmetrical (mirror image).

7. Place the intermediate plate into the four slots of the clutch cover, with the side stamped

Clutch Installation

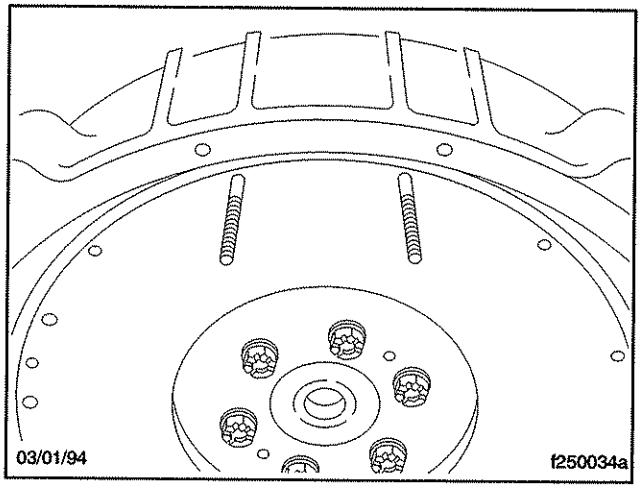


Fig. 37, Install the Guide Studs

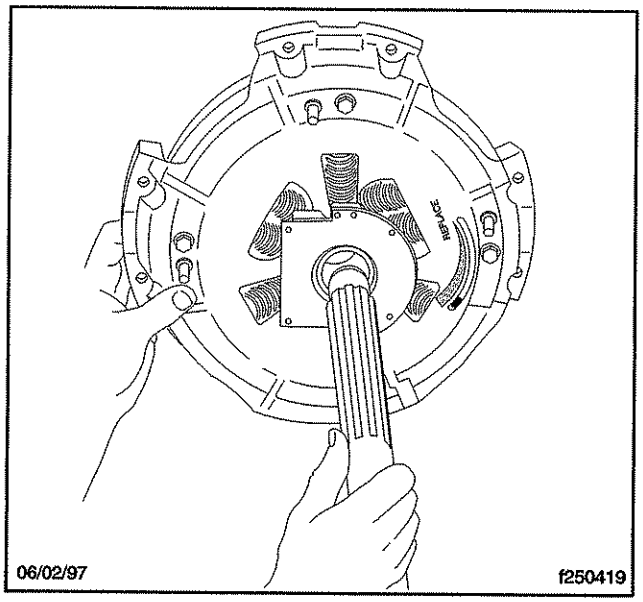


Fig. 38, Insert an Aligning Tool

FLYWHEEL SIDE facing the flywheel. See **Fig. 40.**

8. Install the front driven disc on the aligning tool, with the side stamped *INTERMEDIATE PLATE SIDE* facing the Intermediate plate. See **Fig. 41.**

NOTE: The previous step describes the specific procedure for installing a six spring or seven spring front driven disc. When installing either the nine or ten spring front driven disc, follow the instructions stamped on the front disc. These instructions will en-

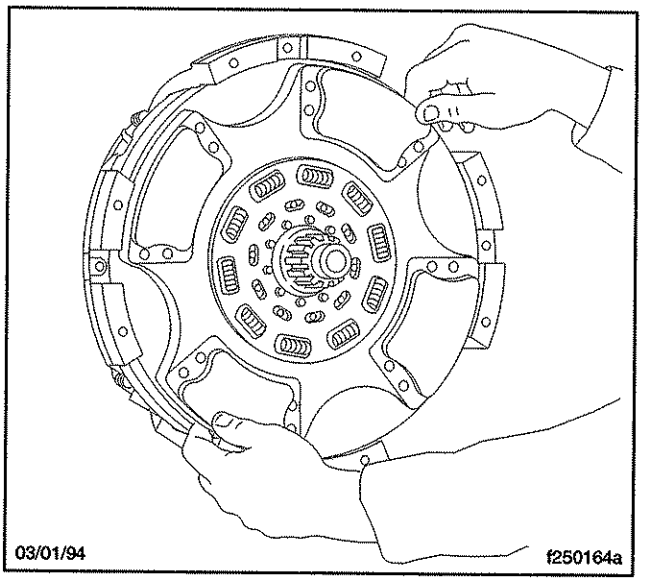


Fig. 39, Installing a Driven Disc

sure proper orientation toward the flywheel. Installing the disc backwards or switching the front and rear discs with each other will prevent the clutch from functioning properly (i.e. the clutch doesn't release, or cannot obtain proper adjustment, etc.). The six spring and seven spring discs require no special orientation. These front and rear discs share the same part number and are symmetrical (mirror image).

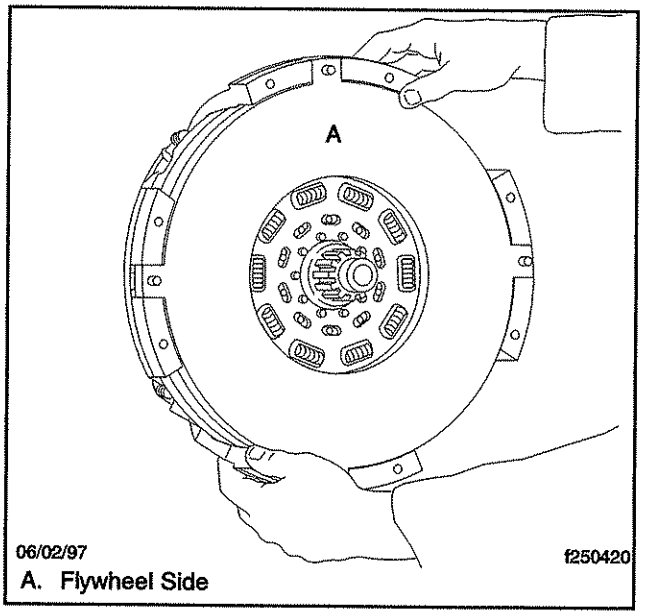


Fig. 40, Position the Intermediate Plate

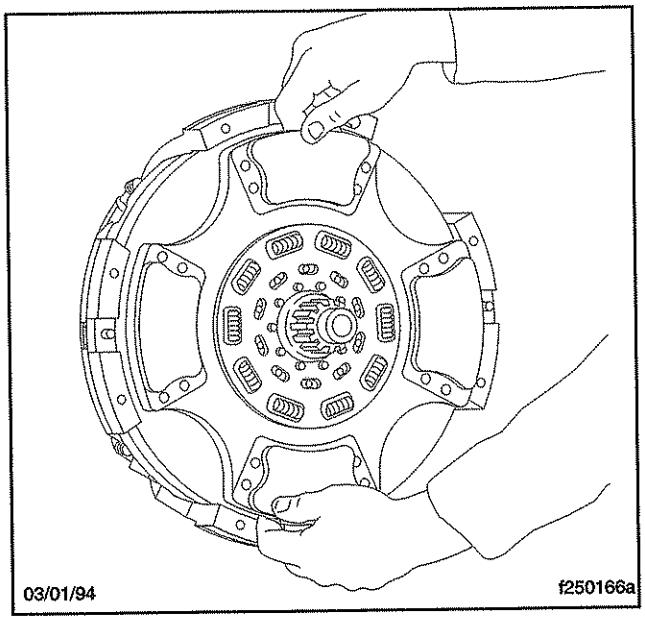


Fig. 41, Installing the Second Driven Disc

⚠ WARNING

The clutch assembly should be removed and installed with a lifting device. The assembly is heavy, it weighs approximately 150 pounds. If the assembly is lifted incorrectly or dropped, it could cause serious personal injury.

9. Position the clutch over the two guide studs (**Fig. 42**), and slide the assembly forward until contact is made with the flywheel surface.
10. Start six 7/16 x 2-1/4 inch (grade 5 or better) mounting capscrews with lockwashers, and tighten them finger-tight. Tap the aligning tool (**Fig. 43**) to make sure it is centered and seated in the pilot bearing, then remove the two guide studs and replace them with two remaining 7/16 x 2-1/4 inch mounting capscrews and lockwashers.
11. Tighten the eight mounting capscrews progressively, in a crisscross pattern as shown in **Fig. 44**. The final torque is 40 to 50 lbf·ft (54 to 68 N·m).

⚠ CAUTION

Failure to tighten these bolts in this manner can: prevent the clutch cover from centering into the pilot area of the flywheel; cause the clutch assembly to be out-of-balance with the flywheel; cause permanent damage to the clutch cover.

12. Remove, in a crisscross pattern, the four yellow colored shipping bolts from the clutch cover. See **Fig. 45.**

NOTE: If this is a new clutch, save these four yellow colored shipping bolts. These bolts will be needed in the future to both remove and reinstall the clutch.

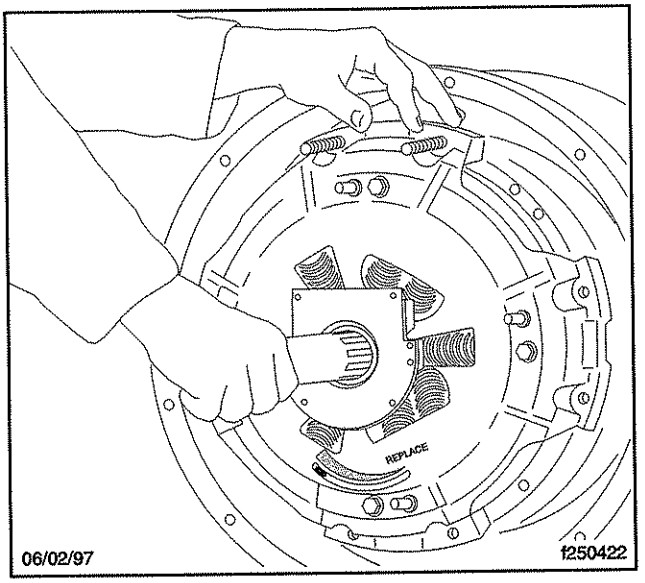


Fig. 42, Positioning the Clutch Cover

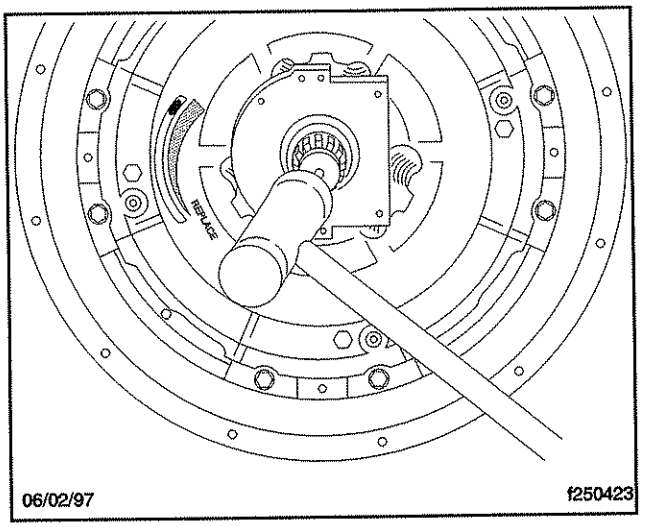


Fig. 43, Tap Aligning Tool

Clutch Installation

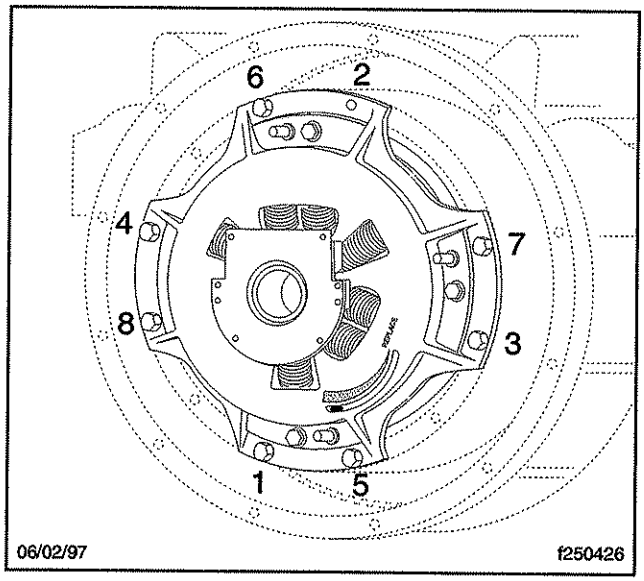


Fig. 44, Tightening Sequence

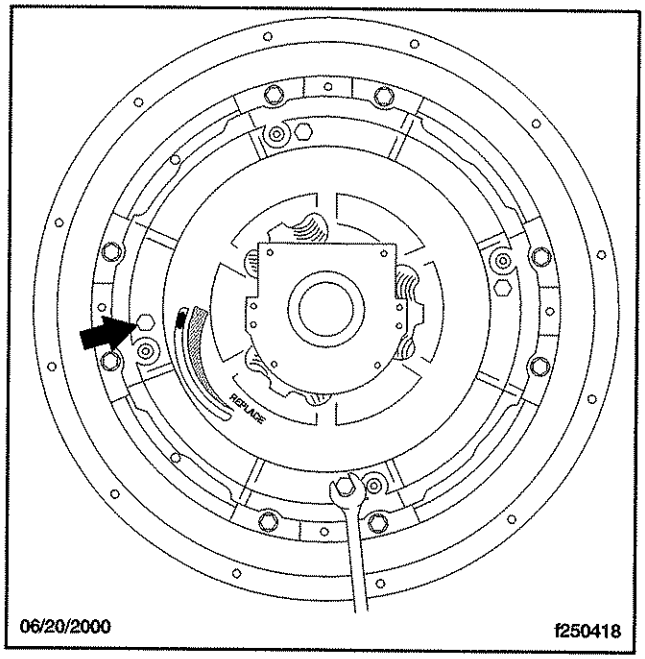


Fig. 45, Remove the Shipping Bolts

13. Remove the aligning tool; this may require a tap with a mallet.

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

14. Set the positive separator pins:

    14.1 Locate the pin access holes. See **Fig. 46.**

⚠ WARNING

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

    14.2 Using a 1/4-inch (6-mm) diameter flat nose punch, *lightly* tap each of the four positive separator pins toward the flywheel through the access holes. This step verifies that all the four pins are flush against the flywheel. See **Fig. 47.**

NOTE: Failure to perform this step properly may cause the clutch to drag (clutch does not release). If necessary, after the transmission has been installed, the four pins can be set through the inspection opening of the transmission bell housing.

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

16. Install the clutch brake on the transmission input shaft, as shown in **Fig. 48.** Slide it tight against the input shaft bearing cap.

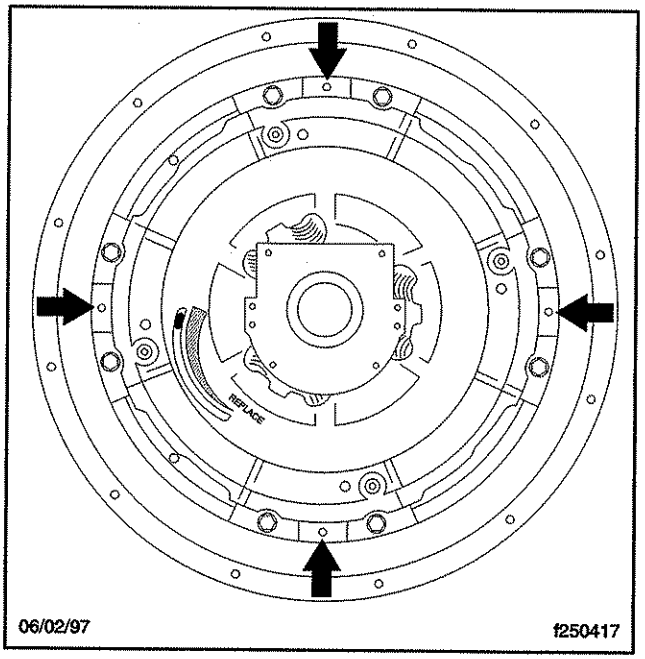
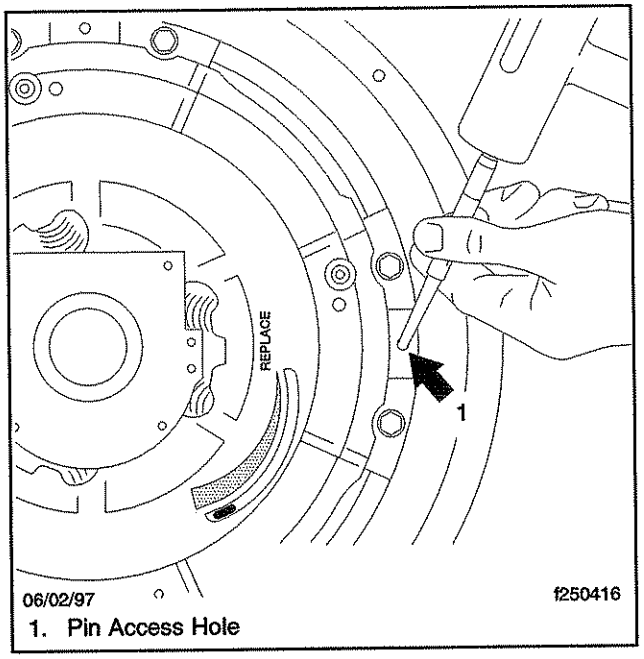


Fig. 46, Pin Access Holes



1. Pin Access Hole

Fig. 47, Tapping the Pin

NOTE: Torque-limiting clutch brakes are a one-piece assembly with a large and a small face. When installing a torque-limiting clutch brake on a Spicer transmission, install the larger face toward the transmission; when installing it on a Fuller transmission, install the smaller face toward the transmission.

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.

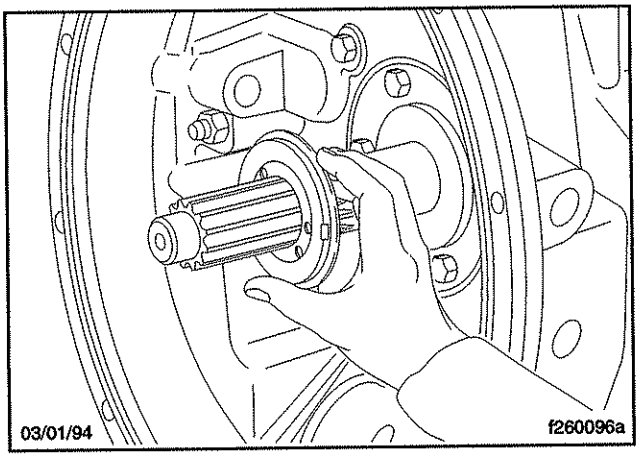


Fig. 48, Install the Clutch Brake

18. Install the transmission and attach the clutch linkage. For instructions, see **Group 26** in this manual.

⚠ CAUTION

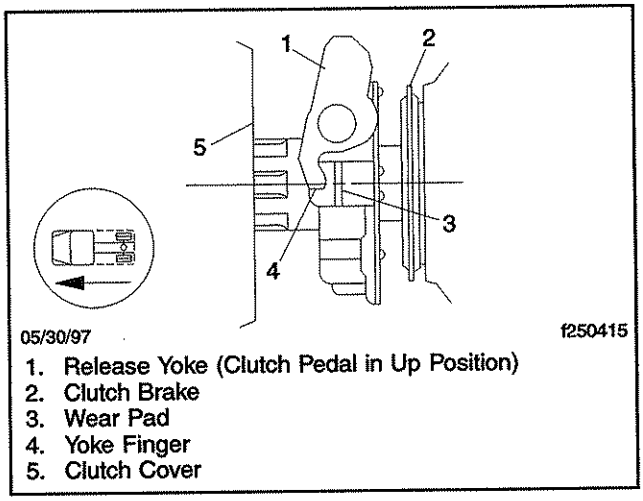
Avoid springing the driven discs when the transmission is being installed. Do not excessively force the transmission into the clutch assembly or engine housing. If it doesn't enter freely, investigate the cause of the problem and then make any necessary changes. Don't let the transmission drop or hang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

IMPORTANT: Be sure the release-bearing yoke clears the bearing, and is rotated over the wear pads as the transmission is moved forward. See **Fig. 11**. Align the splines by turning the transmission output shaft.

19. Adjust the clutch linkage until the fingers of the release yoke contact the release-bearing wear pads. You should have zero free play at the clutch pedal when this step has been completed. See **Fig. 49**.

20. Fully depress the clutch pedal a minimum of five times. As a result, the clutch pedal will establish free play. If no free play is achieved, investigate the linkage system to determine what (if anything) is preventing the linkage from being fully stroked.

21. If necessary, repeat the previous two steps until the release-bearing squeezes the clutch brake.



1. Release Yoke (Clutch Pedal in Up Position)
2. Clutch Brake
3. Wear Pad
4. Yoke Finger
5. Clutch Cover

Fig. 49, Zero the Clutch Free Play

Clutch Installation

See **Fig. 50**. This release-bearing to clutch brake contact will ensure that the clutch is adjusted, and the linkage is capable of pulling the bearing far enough to obtain clutch brake squeeze.

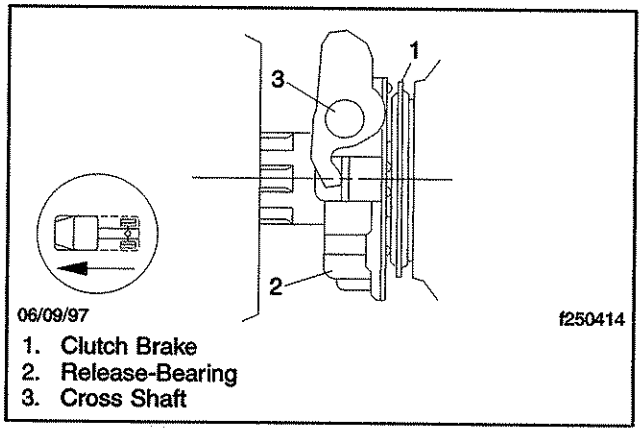
NOTE: Instead of performing the previous three steps above, there is an alternative technique to ensure that the clutch is adjusted. Completion of the following technique will require an adequate amount of clearance surrounding the cross shaft release lever. This alternative technique proceeds as follows: position a pipe or similar tool over the cross shaft release lever and rotate it until the release-bearing comes to a complete stop against the clutch brake. See **Fig. 50**. Repeat this procedure a minimum of five times.

22. Readjust the clutch linkage until you obtain a 1/8-inch (3.2-mm) measure of free play between the release yoke fingers and the release-bearing wear pads. See **Fig. 51**. This will result in the correct amount of free play at the clutch pedal.

NOTE: The free play may increase, then stabilize during the break-in period.

23. Verify that the clutch brake is being squeezed approximately 1/2 to 1 inch (12.7 to 25.4 mm) from the bottom of the clutch pedal stroke. If you cannot obtain any clutch brake squeeze, you will need to increase the overall clutch pedal travel. To do this, use the adjustable pedal stop. Again, readjust the linkage to obtain a 1/8-inch (3.2-mm) measure of free travel.

24. Lubricate the release-bearing and cross-shaft bushings. For instructions and recommended lubricants, see **Group 25** of the *Business Class Trucks Maintenance Manual.*



1. Clutch Brake
2. Release-Bearing
3. Cross Shaft

Fig. 50, Clutch Brake Squeeze

INSTALLING A SPICER SOLO MEDIUM-DUTY 1401 CLUTCH

NOTE: Do the pre-installation checks in this subject before installing the clutch.

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

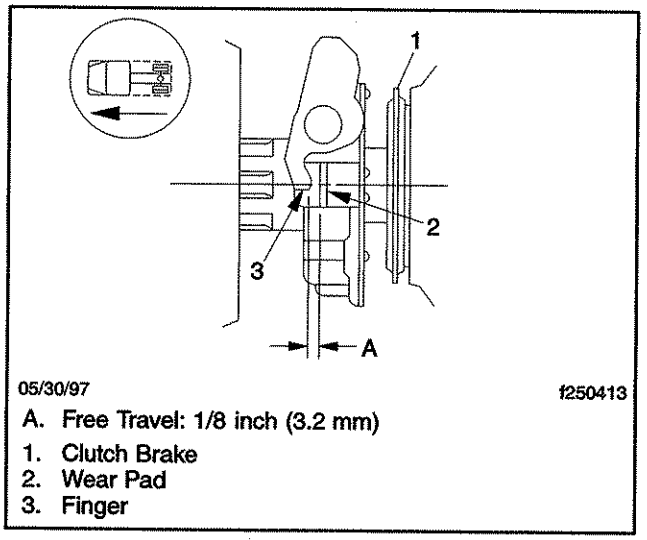
⚠ CAUTION

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

NOTE: Spicer Clutch strongly recommends the use of of a premium grade pilot bearing. The operating temperatures that the pilot bearing sees has increased in the last several years. This creates operating conditions that are no longer acceptable to the standard pilot bearings and grease. In addition, the life of the clutch has increased. Failure of a pilot bearing usually results in a warranty claim for a clutch drag or clutch noise.

⚠ WARNING

Before proceeding to the next step, see the label on the shipping box to verify that the clutch's maximum torque rating is greater than the engine's peak torque rating. Premature failure (a slipping clutch) will occur if the engine's torque rating exceeds that of the clutch.



A. Free Travel: 1/8 inch (3.2 mm)
1. Clutch Brake
2. Wear Pad
3. Finger

Fig. 51, Adjust Free Travel

2. If the clutch is new, and if a protective coating has been applied to the surface of the pressure plate, remove the protective coating from the pressure plate.
3. If not already in place, install two 3/8–16 by 3-inch guide studs in the two upper mounting holes (the 11 and 1 o'clock positions) of the flywheel. See **Fig. 52**.
4. Insert an aligning tool through the splines (**Fig. 53**) of the driven disc. Together, insert the aligning tool and the driven disc into the pilot bearing. Be sure the side marked *PRESSURE PLATE SIDE* faces the pressure plate.
5. With the aligning tool still in place, slide the cover assembly over the aligning tool and the two guide studs. See **Fig. 54**.
6. Start six 3/8-16 grade 5 or better mounting capscrews in the cover plate. Tighten them snugly. Remove the guide studs. Install the two remaining 3/8-16 mounting capscrews. Then, following the sequence in **Fig. 55**, progressively tighten the capscrews 41 to 47 N·m (30 to 35 lbf·ft).

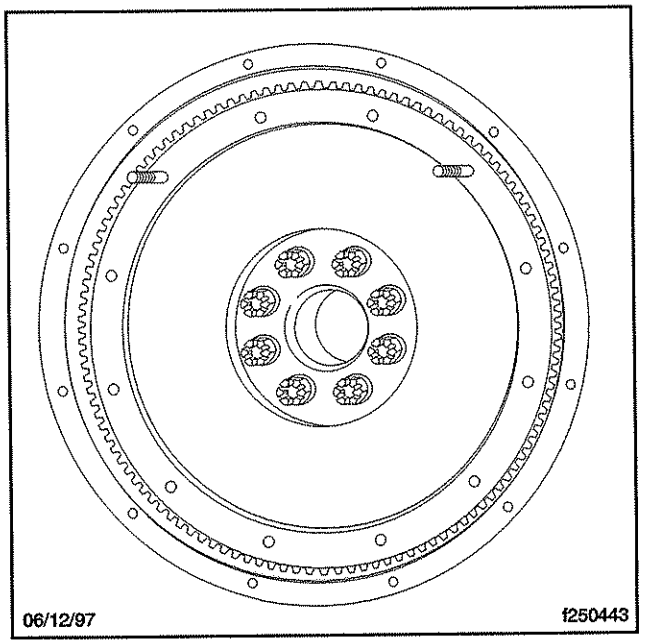


Fig. 52, Install the Guide Studs

⚠ CAUTION

If the capscrews are not tightened in the sequence shown, clutch damage and an out-of-balance condition may result.

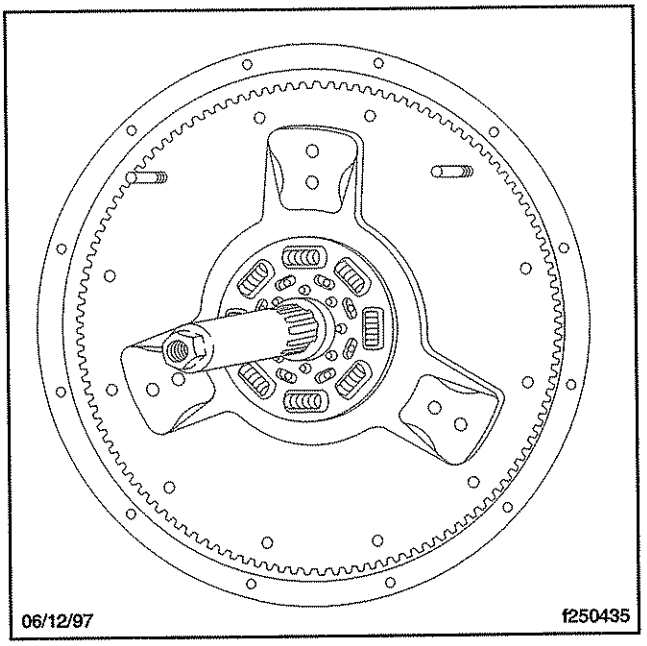


Fig. 53, Position the Driven Disc

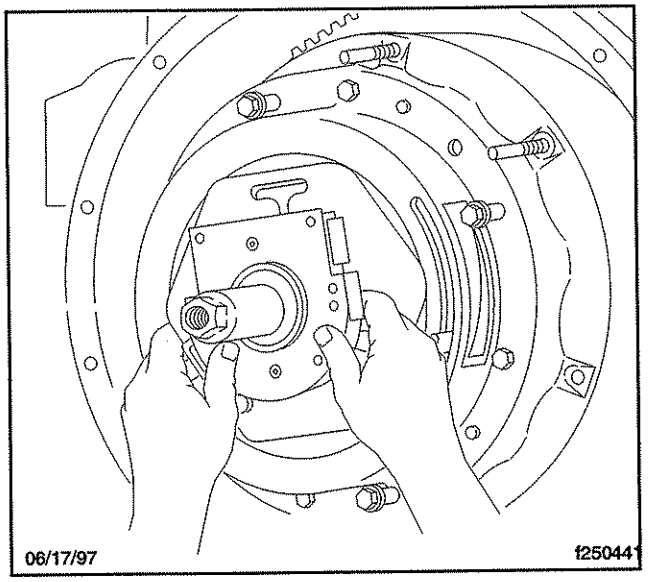


Fig. 54, Positioning the Clutch Cover

Clutch Installation

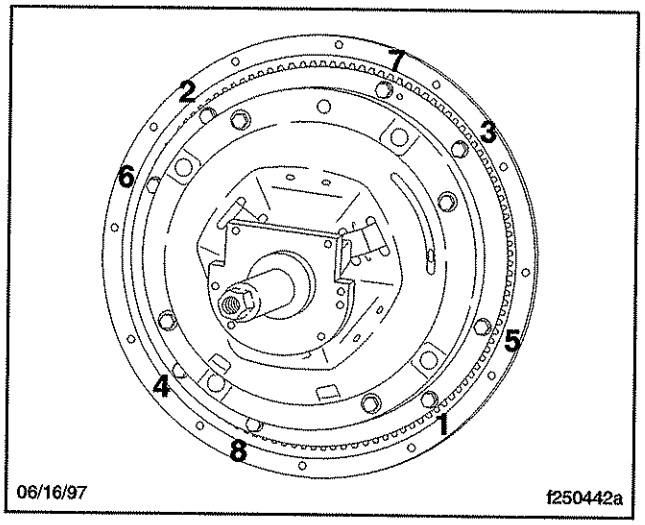


Fig. 55, Tightening Sequence

7. Using a 9/16-inch socket, remove the four yellow colored shipping bolts in a crisscross pattern from the clutch cover. See **Fig. 56**.

NOTE: Save the four shipping bolts for future use. Should the clutch ever need to be removed and re-installed, the shipping bolts will need to be re-installed before the clutch is removed.

8. Remove the alignment tool.

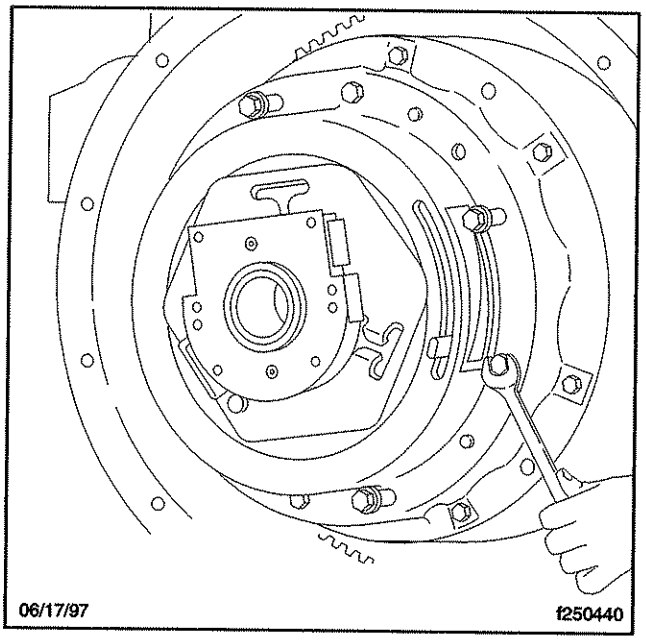


Fig. 56, Remove the Shipping Bolts

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

10. Install the clutch brake on the transmission input shaft. Slide it tight against the input shaft bearing cap. This step only applies to non-synchronized transmissions that use a clutch brake.

NOTE: Torque-limiting clutch brakes are a one-piece assembly with a large and a small face. When installing a torque-limiting clutch brake on a Spicer transmission, install the larger face toward the transmission; when installing it on a Fuller transmission, install the smaller face toward the transmission.

11. 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.

12. Install the transmission. For instructions, see **Group 26** in this manual.

⚠ CAUTION

Avoid springing the driven disc when the transmission is being installed. 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 disc. if this should occur, the driven disc will become bent or distorted, causing the clutch to drag (won't release).

IMPORTANT: Be sure the release-bearing yoke clears the bearing, and is rotated over the wear pads as the transmission is moved forward. See **Fig. 11**. Align the splines by turning the transmission output shaft. Also, do not use the cross shaft release lever to pull the transmission into its final position. Doing so may cause the Spicer Solo clutch to over adjust in its new environment.

13. Position a pipe, or similar tool, over the cross shaft release lever and rotate it until the release bearing comes to a complete stop. Repeat this procedure a total of five times. Performing this will ensure that the Spicer Solo clutch is adjusted.

14. Reconnect and adjust clutch linkage system. If the vehicle has a mechanical linkage system, adjust it until there is a 1/8-inch (3.2-mm) measure of free travel. See **Fig. 57**. If the vehicle has a hydraulic

linkage system, for clutch adjustment procedures, see **Section 25.03**.

15. This step only applies to non-synchronized transmissions with a clutch brake. Verify that the clutch brake is being squeezed approximately 1/2 to 1 inch (12.7 to 25.4 mm) from the bottom of the clutch pedal stroke. If you cannot obtain any clutch pedal squeeze, you will need to increase the over all clutch pedal travel. To do this, use the adjustable pedal stop. After the proper clutch pedal squeeze is obtained, re-adjust the clutch linkage free travel.
16. Lubricate the release bearing and the cross shaft bushings. For instructions and recommended lubricants, see **Group 25** of the *Business Class Trucks Maintenance Manual.*

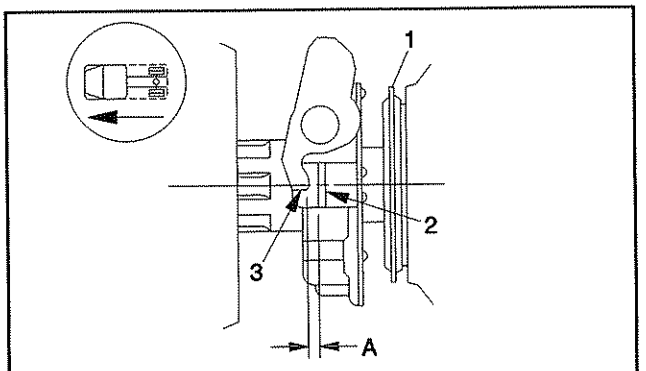
INSTALLING A SPICER SOLO MEDIUM-DUTY 1402 CLUTCH

NOTE: Do the pre-installation checks in this subject before installing the clutch.

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

⚠ CAUTION

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



05/30/97 f250413

A. Free Travel: 1/8 inch (3.2 mm)
1. Clutch Brake
2. Wear Pad
3. Finger

Fig. 57, Adjust Free Travel

NOTE: Spicer Clutch strongly recommends the use of of a premium grade pilot bearing. The operating temperatures that the pilot bearing sees has increased in the last several years. This creates operating conditions that are no longer acceptable to the standard pilot bearings and grease. In addition, the life of the clutch has increased. Failure of a pilot bearing usually results in a warranty claim for a clutch drag or clutch noise.

⚠ WARNING

Before proceeding to the next step, see the label on the shipping box to verify that the clutch's maximum torque rating is greater than the engine's peak torque rating. Premature failure (a slipping clutch) will occur if the engine's torque rating exceeds that of the clutch.

2. If the clutch is new, and if a protective coating has been applied to the surface of the pressure plate, remove the protective coating from the pressure plate.
3. If not already in place, install two 3/8–16 by 3-inch guide studs in the two upper mounting holes (the 11 and 1 o'clock positions) of the flywheel. See **Fig. 58**.
4. Insert an aligning tool through the splines of the front driven disc. Together, insert the aligning tool and the front driven disc into the pilot bearing. See **Fig. 59**. Be sure the side marked *FLYWHEEL SIDE* faces the flywheel.
5. 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. 60**.

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

6. Remove the aligning tool and install it through the splines of the rear driven disc. Now, together, insert the aligning tool and the rear driven disc through the front driven disc and also through the pilot bearing bearing. See **Fig. 61**. Be sure the side of the rear disc marked *PRESSURE PLATE SIDE* faces the pressure plate. As you complete this step, ensure that the ceramic buttons align with each other as closely as possible. See **Fig. 62**.

Clutch Installation

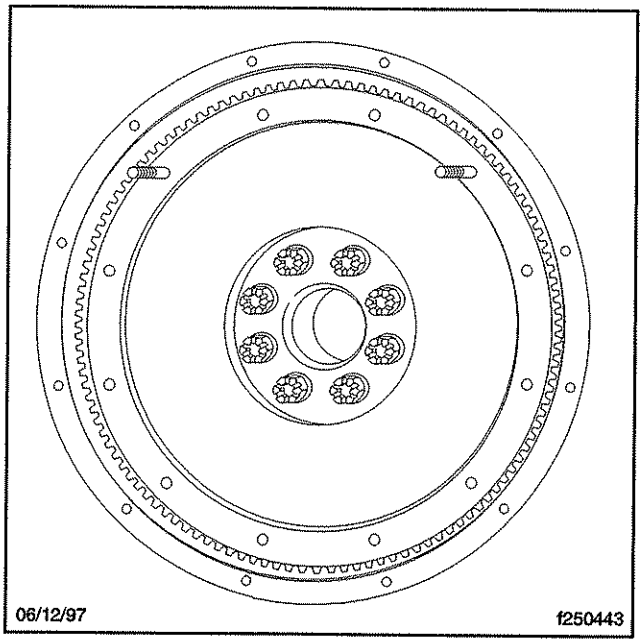


Fig. 58, Install the Guide Studs

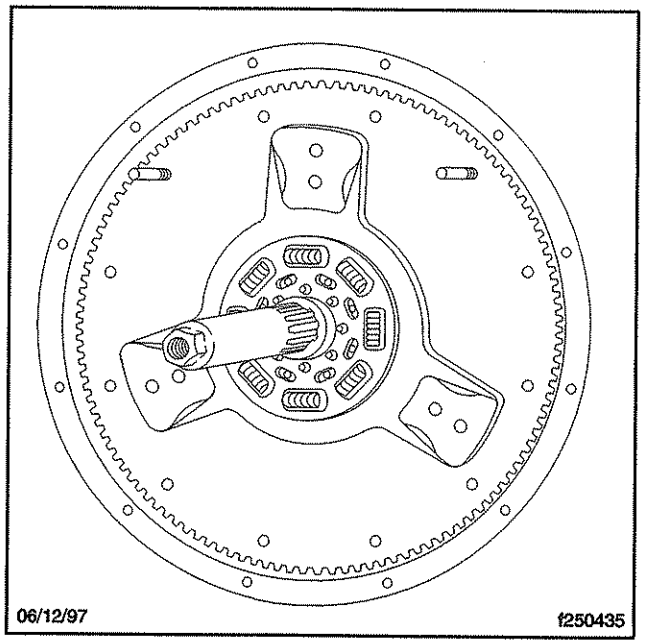


Fig. 59, Position the Front Driven Disc

Doing so will aid the function of the positive separator pins.

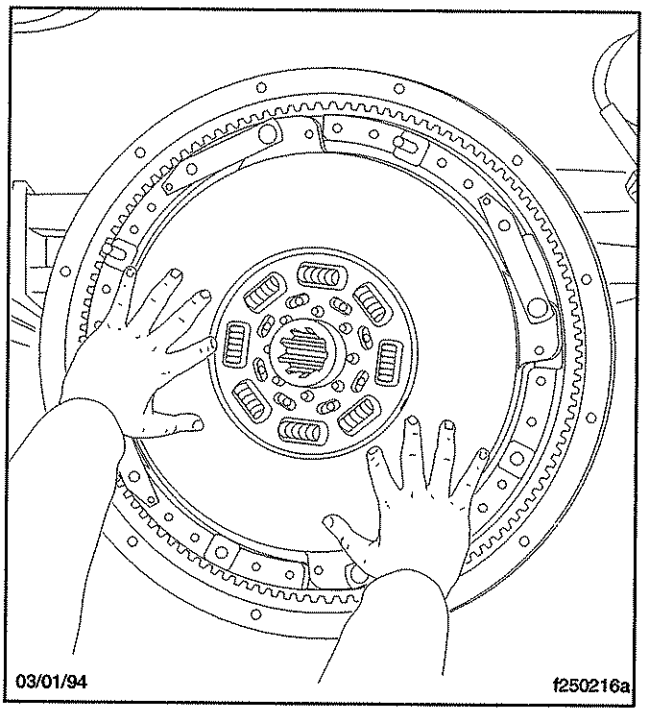


Fig. 60, Install the Intermediate Plate

7. With the aligning tool still in place, slide the cover assembly over the aligning tool and the two guide

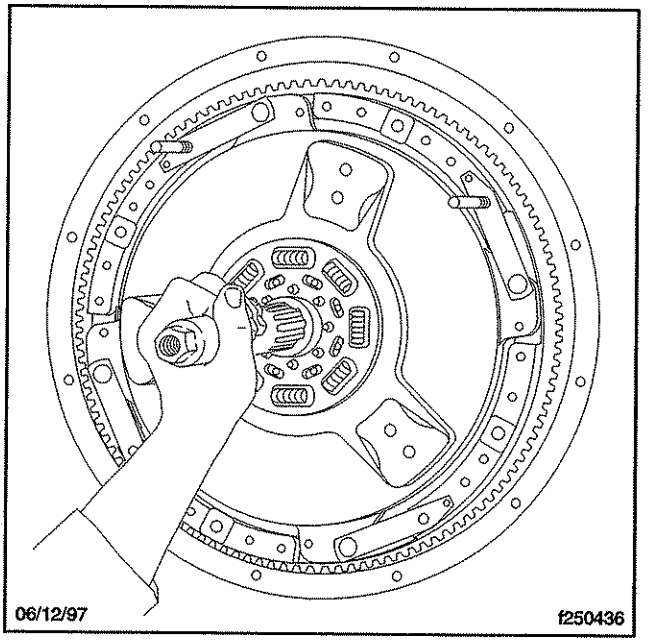
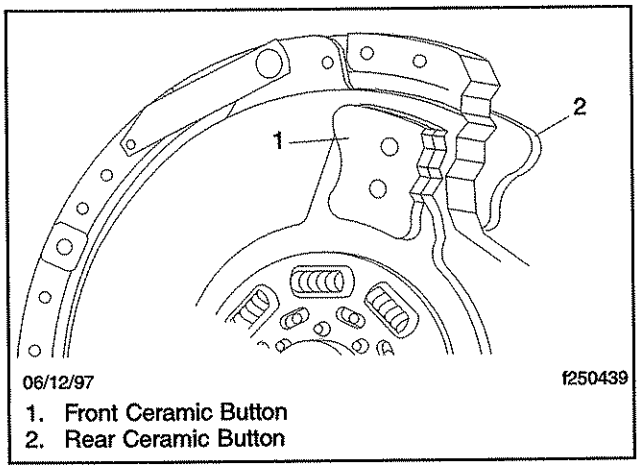


Fig. 61, Position the Rear Driven Disc



1. Front Ceramic Button
2. Rear Ceramic Button

Fig. 62, Driven Disc Alignment

studs until it rests against the intermediate plate assembly. See **Fig. 63**.

8. Start six 3/8-16 grade 5 or better mounting capscrews in the cover plate. Tighten them snugly. Remove the guide studs. Install the two remaining 3/8-16 mounting capscrews. Then, following the sequence in **Fig. 64**, progressively tighten the capscrews 30 to 35 lbf·ft (41 to 47 N·m).

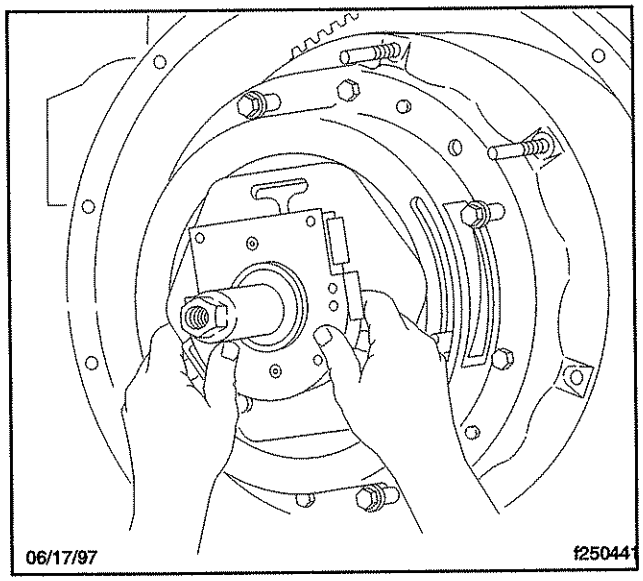


Fig. 63, Position the Clutch Cover

⚠ CAUTION

If the capscrews are not tightened in the sequence shown, clutch damage and an out-of-balance condition may result.

9. Using a 9/16-inch socket, remove the four yellow colored shipping bolts in a crisscross pattern from the clutch cover. See **Fig. 65**.

NOTE: Save the four shipping bolts for future use. Should the clutch ever need to be removed and re-installed, the shipping bolts will need to be re-installed before the clutch is removed.

10. Remove the alignment tool.

11. Set the positive separator pins:

    11.1 Locate the positive separator pin access holes. See **Fig. 66**.

⚠ WARNING

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

    11.2 **LIGHTLY** tap the four positive separator pins, role pins, through the access holes of the clutch cover. Do this using a light weight hammer (approximately twelve oz.) and a 1/4-inch (6-mm) flat nose punch. See **Fig. 67**. Performing this step will

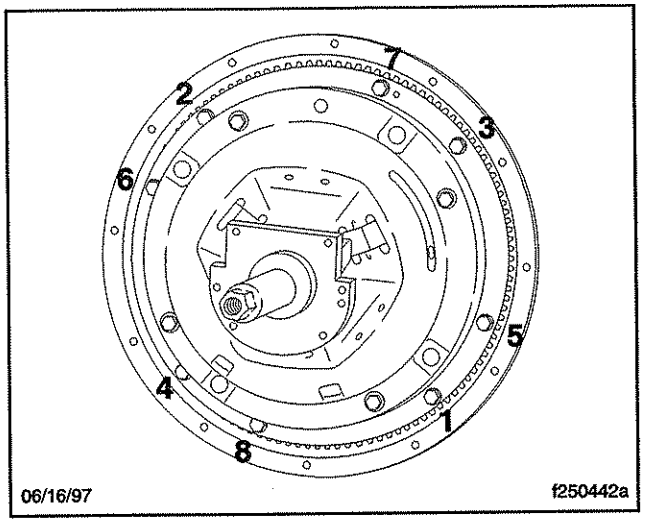


Fig. 64, Tightening Sequence

Clutch Installation

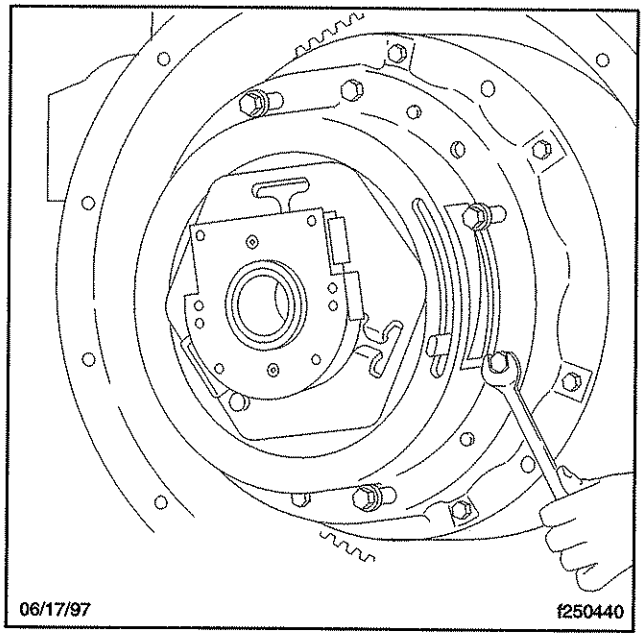


Fig. 65, Remove the Shipping Bolts

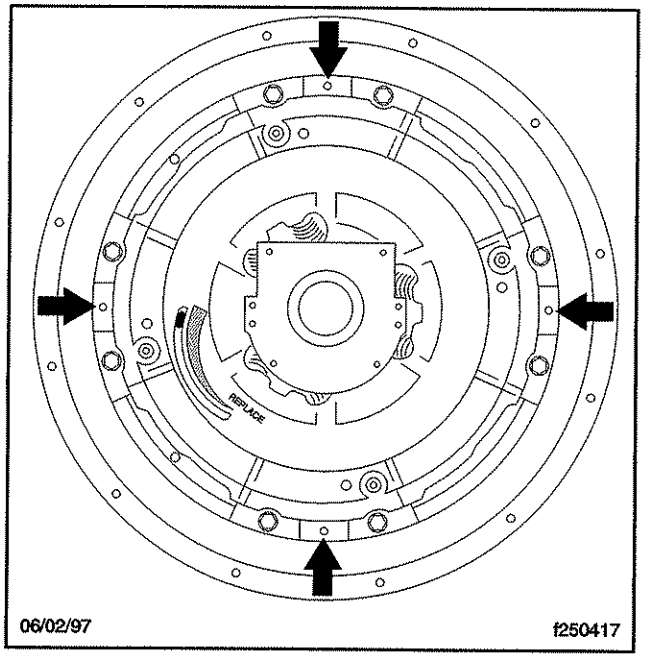


Fig. 66, Pin Access Holes

ensure that all four role pins are against the flywheel, thus allowing an equal gap on all sides of the intermediate plate during clutch disengagement.

⚠ CAUTION

Notice that only a small portion of the roll pin is visible through the access hole. Consequently, the roll pins can become damaged if struck with excessive force. See Fig. 68.

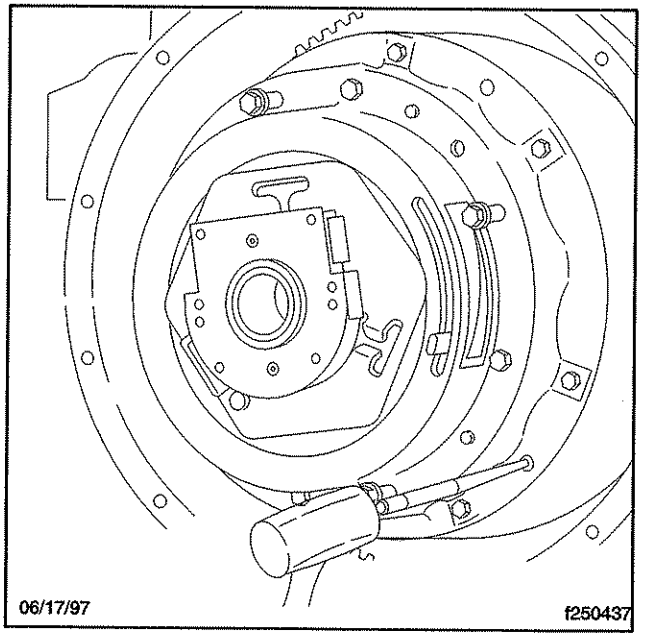
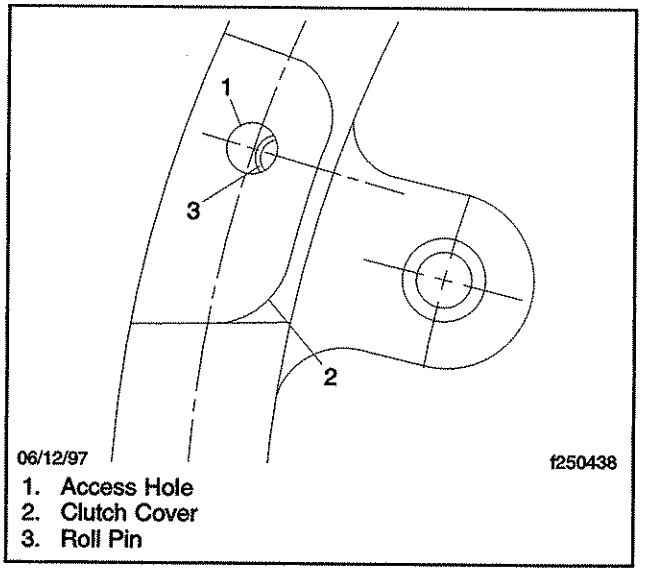


Fig. 67, Setting Positive Separator Pin



1. Access Hole
2. Clutch Cover
3. Roll Pin

Fig. 68, Positive Separator Pin

12. Using a clean cloth, remove all grease from the input shaft.
13. Install the clutch brake on the transmission input shaft. Slide it tight against the input shaft bearing cap. This step only applies to non-synchronized transmissions that use a clutch brake.

NOTE: Torque-limiting clutch brakes are a one-piece assembly with a large and a small face. When installing a torque-limiting clutch brake on a Spicer transmission, install the larger face toward the transmission; when installing it on a Fuller transmission, install the smaller face toward the transmission.

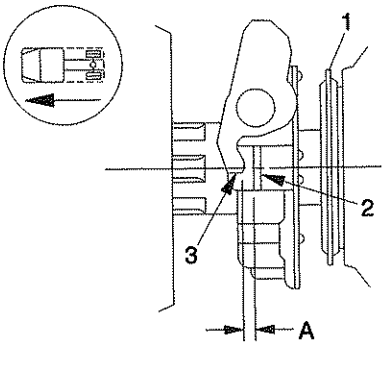
14. Shift the transmission into gear so that during assembly the transmission input shaft can be rotated into line with the clutch driven-disc hub splines.
15. Install the transmission. For instructions, see **Group 26** in this manual.

⚠ CAUTION

Avoid springing the driven disc when the transmission is being installed. 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 disc. if this should occur, the driven disc will become bent or distorted, causing the clutch to drag (won't release).

IMPORTANT: Be sure the release-bearing yoke clears the bearing, and is rotated over the wear pads as the transmission is moved forward. See **Fig. 11**. Align the splines by turning the transmission output shaft. Also, do not use the cross shaft release lever to pull the transmission into its final position. Doing so may cause the Spicer Solo clutch to over adjust in its new environment.

16. Position a pipe, or similar tool, over the cross shaft release lever and rotate it until the release bearing comes to a complete stop. Repeat this procedure a total of five times. Performing this will ensure that the Spicer Solo clutch is adjusted.
17. Reconnect and adjust clutch linkage system. If the vehicle has a mechanical linkage system, adjust it until there is a 1/8-inch (3.2-mm) measure of free travel. See **Fig. 69**. If the vehicle has a hydraulic linkage system, for clutch adjustment procedures, See **Section 25.03**.
18. This step only applies to non-synchronized transmissions with a clutch brake. Verify that the clutch brake is being squeezed approximately 1/2 to 1 inch (12.7 to 25.4 mm) from the bottom of the clutch pedal stroke. If you cannot obtain any clutch pedal squeeze, you will need to increase the over all clutch pedal travel. To do this, use the adjustable pedal stop. After the proper clutch pedal squeeze is obtained, re-adjust the linkage free travel.
19. Lubricate the release bearing and the cross shaft bushings. For instructions and recommended lubricants, see **Group 25** of the *Business Class Trucks Maintenance Manual*.



05/30/97 f250413

A. Free Travel: 1/8 inch (3.2 mm)
1. Clutch Brake
2. Wear Pad
3. Finger

Fig. 69, Adjust Free Travel

Troubleshooting Tables

Problem—Poor Clutch Release

Problem—Poor Clutch Release	
Possible Cause	**Remedy**
The intermediate plate is sticking on drive lugs due to cocked drive pins (Easy-Pedal & Angle Spring only).	The drive pins must be ninety degrees square to the flywheel surface with a 0.006-inch (1.524-mm) minimum clearance between drive pins and intermediate plate slots.
The pressure plate is not fully retracting (Easy-Pedal & Angle Spring only).	Check the pressure plate return springs for being bent, stretched, or broken. Note: These springs can be replaced through the inspection opening of the transmission. Transmission removal is not necessary.
The release bearing travel is excessive and is causing the lever to contact the pressure plate (Easy-Pedal & Angle Spring only).	Adjust the release bearing travel from 1/2 to 9/16 inch (12.7 to 14.3 mm).
Incorrect clutch pedal height.	Set the clutch pedal height so you can obtain: 1/2 to 9/16 inch (12.7 to 14.3 mm) release bearing travel; 1/8 inch (3.175 mm) free travel at the release yoke; and 1/2 to 1 inch (12.7 to 25.4 mm) clutch brake squeeze.
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 spacer ring and the intermediate plate assembly were bolted up backwards onto the flywheel (Solo and Angle-Spring 1402 only).	If the clutch cover has already been bolted to the flywheel, it is important that it be replaced with a new intermediate plate assembly. The reason is that permanent damage may have occurred to the drivestraps and spacer ring. Also, thoroughly inspect the clutch cover for any damage and replace it if damaged.
The intermediate plate and or pressure plate is either cracked or broken.	Replaced any damaged parts
A side loading condition exists; the cross shafts protrude through the release yoke.	Check for protruding cross shafts.
A side loading condition exists; the release yoke fingers are bent.	Install a new release yoke.
A side loading condition exists; the engine housing to transmission housing are misaligned.	Check for loose transmission mounting bolts. Tighten the transmission mounting bolts to the proper torque.
A side loading condition exists; the clutch linkage is set up improperly.	Thoroughly examine the clutch linkage to determine if it can be contributing to a side loading condition.
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 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.
The pilot bearing is dry or damaged.	Replace the pilot bearing.

Troubleshooting

Problem—Poor Clutch Release	
Possible Cause	**Remedy**
The three anti-rattle springs are not installed (Easy-Pedal and Angle-Spring super duty clutches only).	Always install the new anti-rattle spring package with each 14-inch super duty clutch.
The three anti-rattle springs were installed backwards (Easy-Pedal and Angle-Spring super duty clutches only).	Install the anti-rattle springs so the rounded sections are pointed toward the flywheel/engine.
The positive separator pins are bent, damaged or incorrectly set.	Be sure to use the proper tool when setting the positive separator pins. Also, take great care when handling the intermediate plate.
The clutch brake is damaged and/or not functioning.	Install a new clutch brake.
The input shaft spline is coated with grease, never seize, etc..	The input shaft spline should be clean and dry before installation.
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 on the internal workings of the clutch cover (dirt, chaff, salt, etc.).	Remove the foreign material and make sure the transmission inspection hole cover is installed.

Problem—Rattling/Noisy Clutch

Problem—Rattling/Noisy Clutch	
Possible Cause	**Remedy**
There is excessive flywheel runout.	Repair or replace the flywheel. Consult the engine manufacturer's service 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.
An over stroking condition exists, the bridge of the release yoke is hitting the clutch cover.	Check for a worn, broken or missing clutch brake. Also, check the release yoke and input shaft retainer 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 transmission inspection hole cover is not installed.	Re-install the transmission inspection hole cover.
The anti-rattle springs are not installed (Easy-Pedal and Angle-Spring super duty clutches only).	Always install the new anti-rattle spring package with each 14-inch super duty clutch.
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 itself is rattling excessively.	Clean, lubricate and reassemble or replace missing/worn parts.

Problem—Rattling/Noisy Clutch	
Possible Cause	**Remedy**
An idle gear rattle is coming from the transmission.	Specify driven disc assemblies which feature the Free-Travel design. Check the engine for correct idle speed. Consult the engine manufacturer's service manual.
Resulting from the wrong clutch installation, the dampener spring cover of the driven disc assembly is interfering with the flywheel.	Install the correct clutch assembly.
The rivets of the rear driven disc are interfering with the retainer assembly (Easy-Pedal & Angle-Spring only).	Adjust the clutch internally (via the adjusting ring).

Problem—Vibrating Clutch

Problem—Vibrating Clutch	
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.
Improper phasing of the driveshaft.	Investigate for correct yoke phasing.
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.	See the engine manufacturer's service manual.
There is excessive flywheel runout	Repair or replace the flywheel. Consult the engine Manufacturer's service manual.
The rivets of the rear driven disc are interfering with the retainer assembly (Easy-Pedal & Angle-Spring clutches only).	Adjust the clutch internally (via the adjusting ring).

Problem—Clutch Needs Frequent Adjustments

Problem—Clutch Needs Frequent Adjustments	
Possible Cause	**Remedy**
The clutch linkage free travel is insufficient.	After first adjusting the clutch for 1/2 to 9/16 inch (12.7 to 14.3 mm) release bearing travel, adjust the clutch linkage to obtain an 1/8 inch (3.2) free travel (the distance between the release yoke fingers and the release bearing wear pads).
The clutch application is incorrect.	If a service clutch, determine whether the clutch is properly specified for the vehicle's particular application.
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.

Troubleshooting

Problem—Clutch Needs Frequent Adjustments	
Possible Cause	**Remedy**
The clutch driven discs are worn down to the rivets.	Install a new clutch.
The crankshaft has excessive end play.	Consult the engine manufacturer's service manual.

Problem—Clutch Slippage

Problem—Clutch Slippage	
Possible Cause	**Remedy**
The clutch pedal has no free travel.	Readjust the clutch.
The clutch is overloaded.	Verify that the proper clutch has been specified for the vehicle's particular 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.	Check and deter the driver from riding the clutch pedal.
The input shaft spline is worn.	Replace the input shaft.

Problem—Clutch Grabs/Chatters

Problem—Clutch Grabs/Chatters	
Possible Cause	**Remedy**
The clutch is worn out.	Replace 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.

Spicer 14 and 15-1/2 Inch Standard and Super-Duty Clutch Specifications		
Description	14-Inch Clutch	15-1/2 Inch Clutch
	inch (mm)	
Flywheel-Housing Pilot Diameter	14.750/14.747 (374.65/374.5738)	17.156/17.15 (435.7624/435.6862)
Flywheel-Housing Bolt Circle	15.500 (393.7)	16.62 (422.275)
Flywheel Pot Depth	2-15/16 (74.6125)	Flat
Driven Disc and Facing Thickness	0.463/0.42 (11.7602/10.8712)	0.487/0.45 (12.3698/11.4808)
Disc Assembly, Maximum Runout	0.015 (0.381)	0.015 (0.381)
Driven Disc Assembly, Maximum Out of Flat	0.020 (0.508)	0.020 (0.508)
Hub Spline Size (inches [mm], number of splines)	1-3/4 (44.45) -10	1-3/4 (44.45) -10
	2 (50.8) -10	2 (50.8) -10
Release-Sleeve Bushing Diameter (new)	1.754/1.750 (44.5516/44.45)	1.754/1.750 (44.5516/44.45)
	2.010/2.008 (51.054/51.0032)	2.010/2.008 (51.054/51.0032)
Intermediate Plates, Driving Pins to Slot Clearance (minimum new/maximum worn)	0.006/0.020 (0.1524/0.508)	0.006/0.020 (0.1524/0.508)
Pressure Plates, Driving Lugs to Slot Clearance (new/maximum worn)	0.004-0.008/0.020 (0.1016-0.2032/0.508)	0.003-0.010/0.021 (0.0762-0.254/0.5334)
Intermediate Plates and Pressure Plates: Out of Flat	0.000-0.004 (0.000-0.1016) Concave	0.000-0.004 (0.000-0.1016) Concave
Scoring: Maximum Depth That Can Be Re-Used	0.015 (0.381)	0.015 (0.381)
Release Sleeve Retainer, Driving Lugs to Slot Clearance (maximum worn)	0.020 (0.508)	0.020 (0.508)

Table 1, Spicer 14 and 15-1/2 Inch Standard and Super-Duty Clutch Specifications

Spicer Solo Heavy-Duty Clutch Specifications					
Spicer Solo Part Number	Size inch (mm)	Spline Size inch (mm)	Damper Style	Springs	Paddles
109700–91	15.5 (394)	2 (50.8)	Low Rate	9	6
109701–82	15.5 (394)	2 (50.8)	Low Rate	7	4
109701–74	15.5 (394)	2 (50.8)	Coax F.T.	10	4
109701–93	15.5 (394)	2 (50.8)	Coax F.T.	10	6
109701–10	15.5 (394)	2 (50.8)	Vibration Control Technology V.C.T.-Low Rate	6	6
109701–15	15.5 (394)	2 (50.8)	Vibration Control Technology V.C.T.-Low Rate	6	6

Table 2, Spicer Solo Heavy-Duty Clutch Specifications

Specifications

Spicer Solo Medium-Duty Clutch Specifications					
Spicer Solo Model Number	Size inch (mm)	Spline Size inch (mm)	Disc(s)	Stroke	Linkage
1401	14 (350)	1-3/4 (44.45)	Single	Standard	Mechanical
1401	14 (350)	1-3/4 (44.45)	Single	Short	Hydraulic
1402	14 (350)	1-3/4 (44.45)	Two	Standard	Mechanical
1402	14 (350)	2 (50.8)	Two	Short	Hydraulic

Table 3, Spicer Solo Medium-Duty Clutch Specifications

Spicer Easy-Pedal Clutch Specifications		
Description	14-Inch Clutch	15-1/2 Inch Clutch
	inch (mm)	
Driven Disc and Facing Thickness (new):		
Disc and Ceramic Facing—Standard	0.445 to 0.455 (11.303 to 11.557)	0.445 to 0.455 (11.303 to 11.557)
Disc and Ceramic Facing—Super Duty	0.355 to 0.365 (9.017 to 9.271)	—
Disc and Organic Facing	0.440 to 0.460 (11.176 to 11.684)	0.440 to 0.460 (11.176 to 11.684)
Intermediate Plate Thickness (new):		
Standard	0.6250 to 0.6300 (15.875 to 16.002)	0.7570 to 0.7620 (19.2278 to 19.3548)
Super Duty	0.8050 to 0.8100 (20.447 to 20.574)	—
14-Inch—Flat Flywheel	0.8050 to 0.8100 (20.447 to 20.547)	—
Driven Disc Assembly:		
Maximum Out-of-Flat	0.050 (1.27)	
Pressure Plate; Driving Lugs to Slot Clearance (maximum worn; minimum new)	0.200 to 0.003 (5.08 to 0.0762)	
Pin Separator Gap (new)	—	0.023 to 0.037 (0.5842 to 0.9398)

Table 4, Spicer Easy-Pedal Clutch Specifications

Spicer Easy-Pedal Clutch Capacity; Spring Color Codes			
Clutch Size	**Spring Color Code**	**Facing**	**Recommended Maximum Engine Torque lbf.ft (N.m)**
14 Inch (350 mm)	Red	Organic	820 (1112)
	Red	Ceramic (3 buttons)	1000 (1356)
	Plain	Organic	1000 (1356)
	Red	Super-Duty Ceramic (4 buttons)	1250 (1695)
	Plain	Super-Duty Ceramic (4 buttons)	1400 (1898)
	Yellow	Organic	1150 (1559)
15-1/2 Inch (394 mm)	Red	Organic	940 (1274)
	Red	Ceramic	1200 (1627)
	Plain	Organic	1070 (1451)
	Plain	Ceramic	1400 (1898)
	Yellow	Organic	1250 (1695)
	Yellow	Ceramic	1650 (2237)
	White	Organic	1400 (1898)
	White	Organic (10-spring)	1450 (1966)

Table 5, Spicer Easy-Pedal Clutch Capacity; Spring Color Codes

Spicer Angle-Spring Clutch Capacity; Spring Color Codes			
Clutch Type	**Spring Color Code**	**Facing**	**Recommended Maximum Engine Torque lbf.ft (N.m)**
SAS 1401 (14-inch [350 mm]; single-plate)	Blue	Organic	350 (475)
	Purple	Organic	400 (542)
	Blue	Ceramic	500 (678)
	Purple	Ceramic	560 (759)
SAS 1402 (14-inch [350 mm]; two-plate)	Blue	Organic	560 (759)
	Green	Ceramic	800 (1085)
	Blue	Ceramic	800 (1085)
	Purple	Organic	800 (1085)
	Purple	Ceramic	800 (1085)

Table 6, Spicer Angle-Spring Clutch Capacity; Spring Color Codes

Specifications

Spicer Solo Heavy-Duty 15-1/2 Inch Clutch Capacity			
Spicer Solo Part Number	**Plate Load lbf (N)**	**Torque lbf·ft (N·m)**	**Facing Material**
109700–91	3600 (16013.592)	1650 (2237)	Ceramic
109701–82	3600 (16013.592)	1650 (2237)	Ceramic
109701–74	3600 (16013.592)	1650 (2237)	Ceramic
109701–93	4000 (17792.88)	1860 (2522)	Ceramic
109701–10	4000 (17792.88)	1860 (2522)	Ceramic
109701–15	4000 (17792.88)	2050 (2780)	Ceramic

Table 7, Spicer Solo Heavy-Duty 15-1/2 Inch Clutch Capacity

Spicer Solo Medium-Duty 14 Inch Clutch Capacity			
Spicer Solo Model Number	**Plate Load lbf (N)**	**Torque lbf·ft (N·m)**	**Facing Material**
1401	3000 (13344.66)	680 (920)	Ceramic
1401	2500 (11120.55)	580 (780)	Ceramic
1401	3000 (13344.66)	445 (600)	Organic
1402	2000 (8896.44)	900 (1220)	Ceramic
1402	2800 (12455.016)	800 (1080)	Organic

Table 8, Spicer Solo Medium-Duty 14 Inch Clutch Capacity

Cover-to-Flywheel Clutch Torque Values			
Angle-Spring lbf·ft (N·m)	**Easy-Pedal lbf·ft (N·m)**	**Solo Heavy Duty lbf·ft (N·m)**	**Solo Medium Duty lbf·ft (N·m)**
35–40 (47–54)	45–50 (61–68)	40–50 (54–68)	30–35 (41–47)

Table 9, Cover-to-Flywheel Clutch Torque Values

Clutch Pedal Height Settings					
Description	**Release Bearing Travel (Nonsynchronized Transmissions) * inch (mm)**	**Release Yoke Free Travel † inch (mm)**	**Single-Plate Clutch, Release Bearing Clearance Adjustment (Synchronized Transmissions)‡ inch (mm)**	**Dual-Plate Clutch, Release Bearing Clearance Adjustment (Synchronized Transmissions)‡ inch (mm)**	**Clutch Brake Squeeze (Pedal Adjustment) inch (mm)**
Adjustment Specification	1/2 to 9/16 (12.7 to 14.3)	1/8 (3.2)	1-7/8 (48)	3/4 (19)	1/2 to 1 (12.7 to 25.4)

* The internal adjustment, the distance between the release bearing and the clutch brake.
† The external adjustment, the distance between the release yoke fingers and the release bearing wear pads.
‡ The distance between the release bearing and the clutch cover.

Table 10, Clutch Pedal Height Settings

Clutch Control, Mechanical Linkage System 25.02

Contents

Subject	Subject Number
General Information	050
Service Operations	
Clutch Linkage Adjustment	100
Clutch Pedal Removal and Installation, RH DR	110
Specifications	400

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.

Two types of clutches may be installed on the vehicle: pull or push.

- 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 causing the driven disc to be locked up 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 pulls 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 either the applicable clutch section in this group, or the clutch manufacturer's service literature.

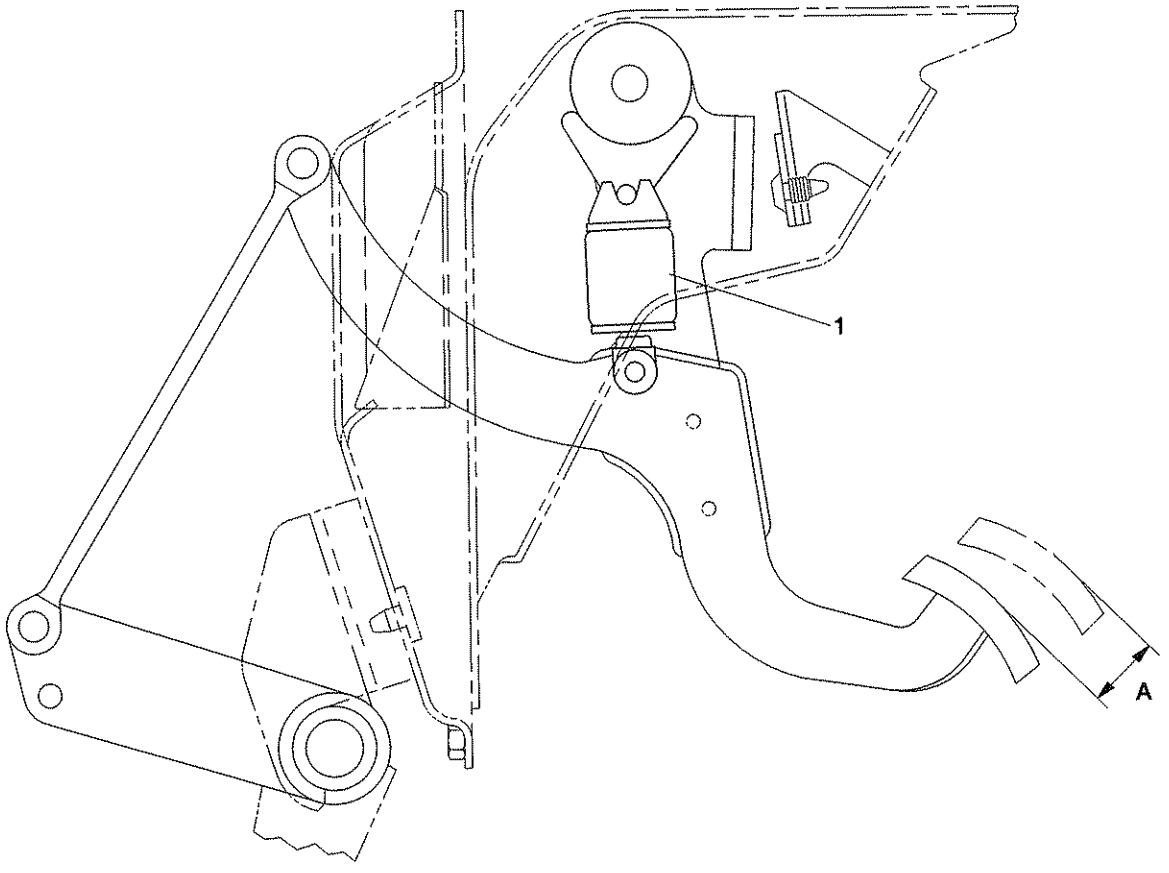
On vehicles with right-hand drive, the clutch pedal is installed with the brake pedal inside a special pedal box assembly. Both pedals must be removed as a unit. Clutch adjustment procedures are not affected by this change.

Clutch Linkage Adjustment

IMPORTANT: Vehicles equipped with Rockwell clutches use clutch pedals with an over-center spring. See **Fig. 1**. Clutch pedals without an over-center spring are used on all vehicles except those equipped with Rockwell clutches. See **Fig. 2**.

Pull-Type Clutch

1. Observe the following points before beginning clutch linkage adjustment:
   - If the clutch free pedal is less than 19 mm (3/4 inch), adjust the clutch internally, not at the linkage. See **Fig. 1**, Ref. A.
   - Be sure internal clutch adjustments are correct before making adjustments to the clutch linkage. For instructions, refer to the applicable clutch section in this group.
   - Adjust the clutch linkage only after repair or replacement of the clutch or clutch linkage components.
   - If equipped with cab air-suspension, be sure the air bags are properly inflated. If the air bags are not inflated, the clutch linkage can't be adjusted correctly.
2. Tilt the hood.



06/06/94

A. Clutch free pedal should be about 51 mm (2 inches)
1. Over-Center Spring

Fig. 1, Clutch Pedal With Over-Center Spring

Clutch Linkage Adjustment

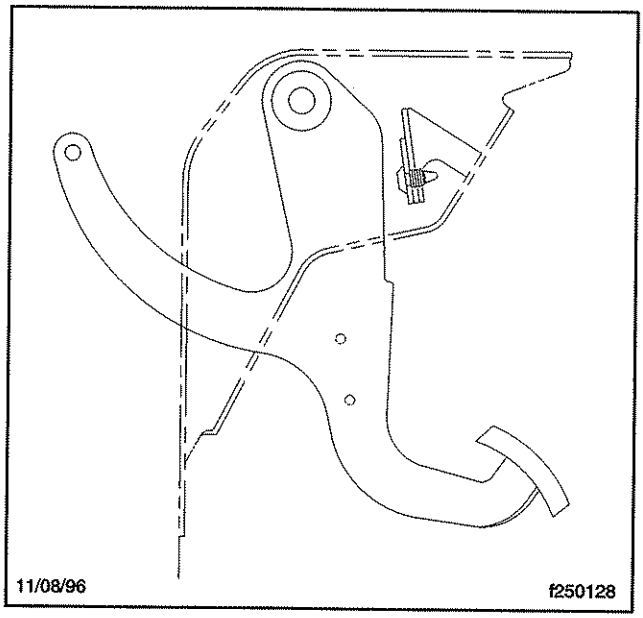


Fig. 2, Clutch Pedal Without Over-Center Spring

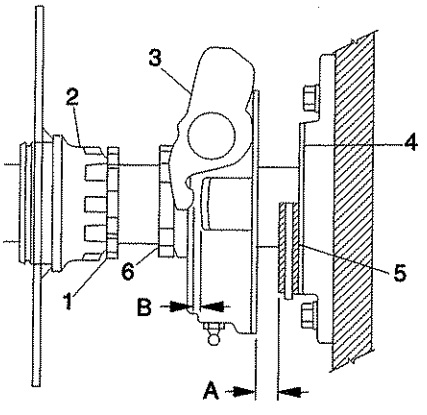
3. Remove the clutch inspection cover from the bottom of the bell housing.
4. Be sure the clutch pedal is all the way up, against the upper stop.
5. Check the internal clutch adjustment. Refer to the applicable clutch section in this group for instructions, and adjust if needed.
6. Measure the distance between the release yoke and the release bearing. See **Fig. 3**. If this measurement is 2.7 to 3.7 mm (0.105 to 0.145 inch), no further work is needed. If the measurement is incorrect, do all of the remaining steps.
7. Remove the nut that attaches the lower clutch rod to the relay lever. Disconnect the lower clutch rod from the relay lever. Loosen the jam nut (**Fig. 4**, Ref. 6) on the lower clutch rod.

IMPORTANT: On vehicles built before January 1996, and if the clutch pedal has an over-center spring, adjust the clutch linkage using a special tool, part number 02–12448–000. See **Fig. 5**. If the clutch pedal doesn't have an over-center spring, adjust the clutch linkage using a different special tool, part number 02–12447–000. See **Fig. 6**. On vehicles built from January 1996, adjust the clutch linkage using a special tool, part number H18–33130–000. See **Fig. 7**. These special tools may be ordered from the PDCs.

8. Place the special tool between the clutch pedal and the plastic pedal stop. See **Fig. 5**, **Fig. 6**, or **Fig. 7**.

IMPORTANT: Don't apply excessive force when pulling the lower clutch rod forward as this could partially disengage the clutch.

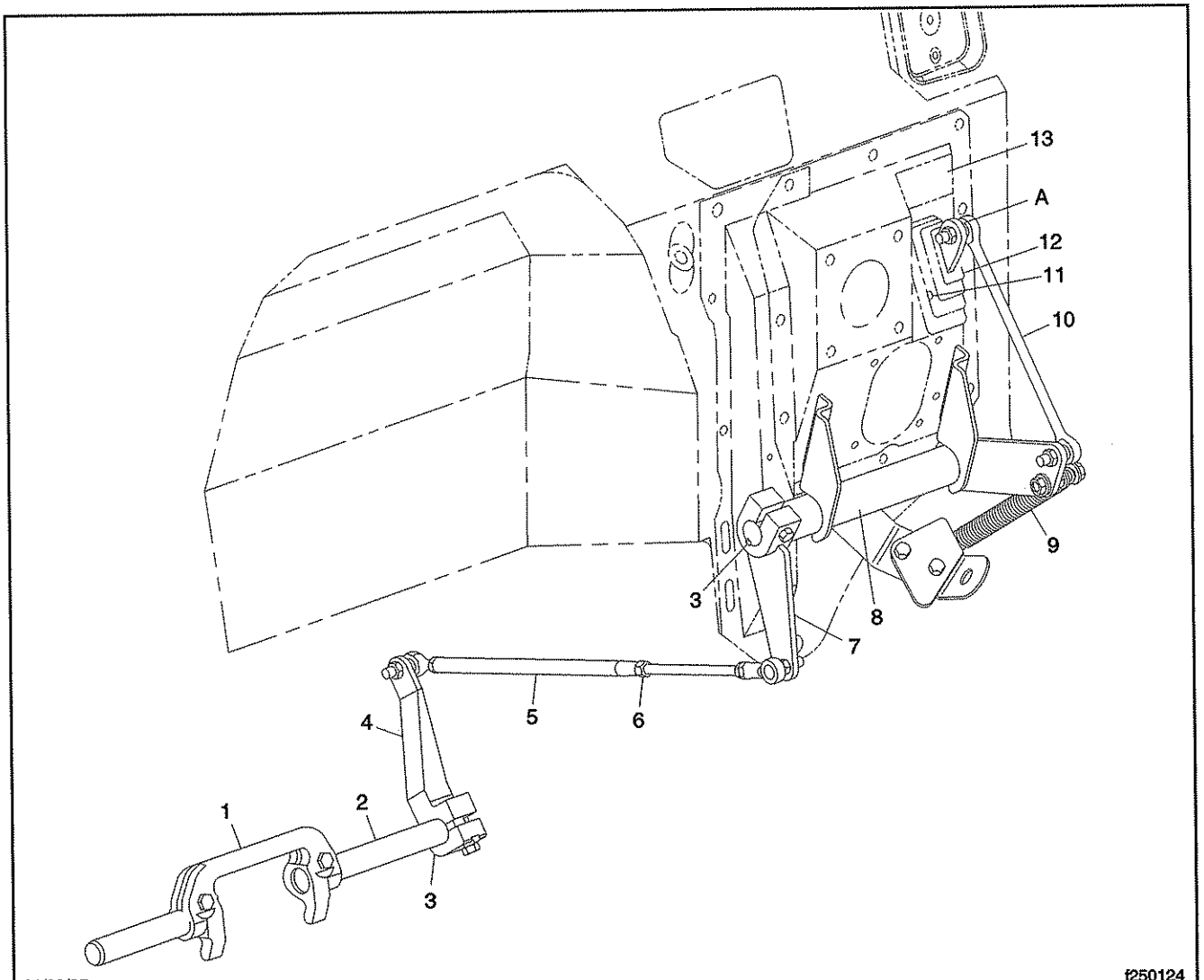
9. Pull the lower clutch rod forward until resistance is felt. The release yoke is now touching the release bearing.
10. Hold the rod in the same position. Adjust the rod length (in or out) until the rod end lines up with the hole in the relay lever. Install the rod end in the relay lever. Tighten the nut 35 to 45 N·m (26 to 33 lbf·ft).
11. Tighten the jam nut on the lower clutch rod 16 to 20 N·m (12 to 15 lbf·ft).
12. Remove the special tool from the clutch pedal.
13. Measure the distance between the release yoke and the release bearing. If this measurement is 2.7 to 3.7 mm (0.105 to 0.145 inch), go to the next step. If the measurement is incorrect, repeat the previous steps.



A. 12.7 to 14.3 mm (1/2 to 9/16 inch) With Clutch Brake
B. 2.7 to 3.7 mm (0.105 to 0.145 inch)

1. Locknut Ring
2. Release Bearing Coupler
3. Release Yoke
4. Bearing Cover
5. Bearing Pad
6. Adjuster Ring

Fig. 3, Clutch Adjustment Specifications



01/30/95 f250124

A. To clutch pedal.

1. Clutch Release Yoke
2. Clutch Release Shaft
3. Clutch Release Key
4. Clutch Release Lever
5. Lower Clutch Rod
6. Jam Nut
7. Clutch Relay Lever
8. Bellcrank Pivot Assembly
9. Return Spring
10. Upper Clutch Rod
11. Crosshead Screw
12. Boot
13. Pie-Pan Assembly

Fig. 4, Linkage for Pull-Type Clutch

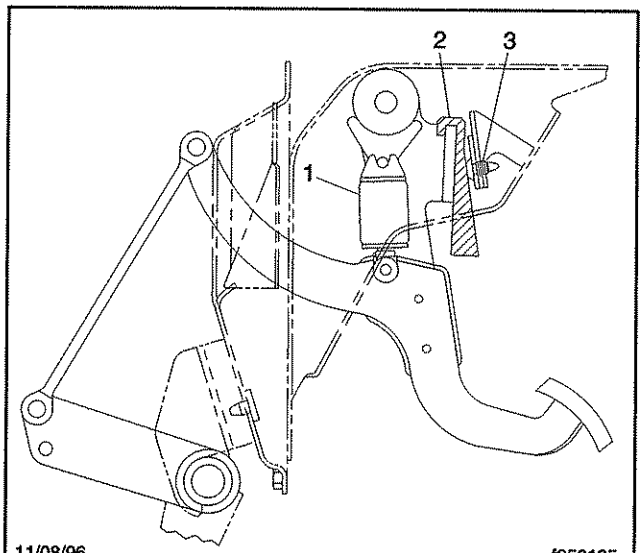
14. Install the inspection cover on the bottom of the bell housing.
15. Check the clutch free pedal. See **Fig. 1**, Ref. A.

Push-Type Clutch

IMPORTANT: If the clutch free pedal is less than 19 mm (3/4 inch), adjust the clutch at the linkage, not internally. See **Fig. 1**, Ref. A.

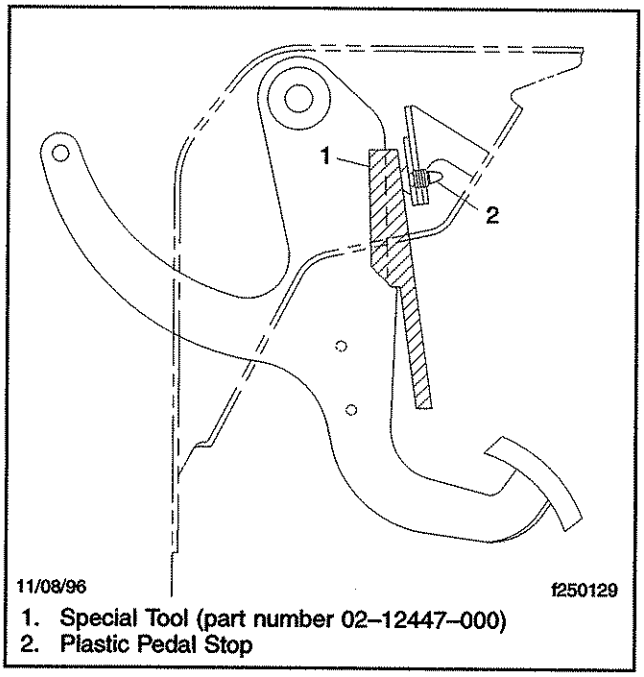
1. Tilt the hood.

Clutch Linkage Adjustment



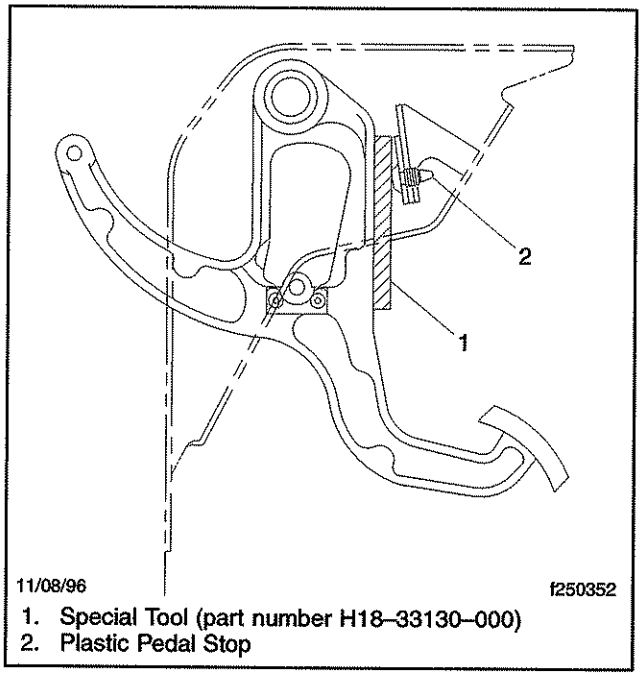
1. Over-Center Spring
2. Special Tool (part number 02–12448–000)
3. Plastic Pedal Stop

Fig. 5, Adjusting a Clutch Pedal with Over-Center Spring (vehicles built before January 1996)



1. Special Tool (part number 02–12447–000)
2. Plastic Pedal Stop

Fig. 6, Adjusting a Clutch Pedal without an Over-Center Spring (vehicles built before January 1996)



1. Special Tool (part number H18–33130–000)
2. Plastic Pedal Stop

Fig. 7, Adjusting a Cast Clutch Pedal (vehicles built from January 1996)

2. Remove the nut that attaches the lower clutch rod to the relay lever. Disconnect the lower clutch rod from the relay lever. Loosen the jam nut (**Fig. 8**, Ref. 7) on the lower clutch rod.

3. On vehicles built before January 1996, place the special tool 02–12447–000 between the clutch pedal and the plastic pedal stop. **See Fig. 6**. On vehicles built from January 1996, place the special tool H18–33130–000 between the clutch pedal and the plastic pedal stop. See **Fig. 7**.

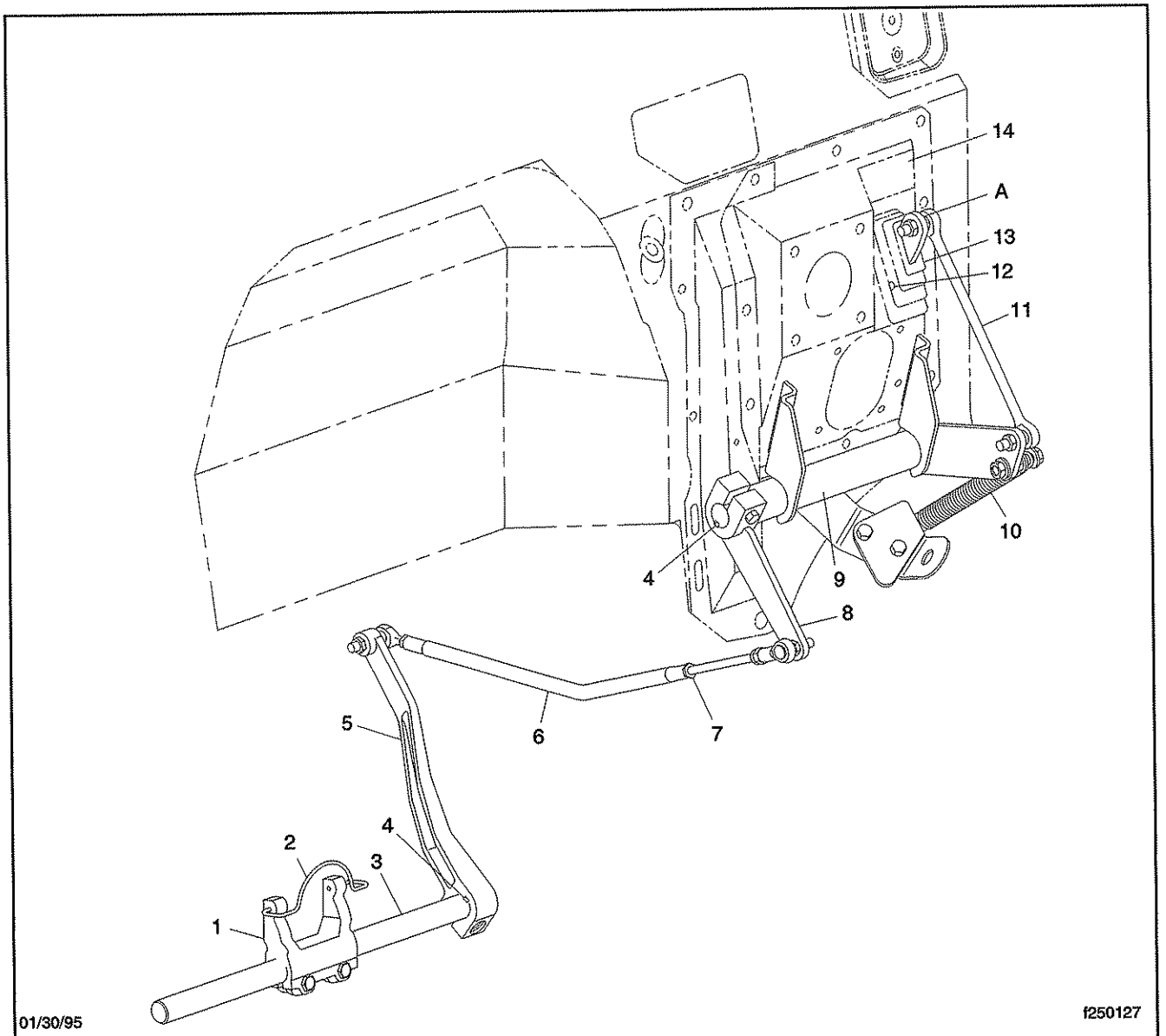
IMPORTANT: Don't apply excessive force when pulling the lower clutch rod forward as this could partially disengage the clutch.

4. Pull the lower clutch rod forward until resistance is felt. The release yoke is now touching the release bearing.

5. Hold the rod in the same position. Adjust the rod length (in or out) until the rod end lines up with the hole in the relay lever. Install the rod end in the relay lever. Tighten the nut 35 to 45 N·m (26 to 33 lbf·ft).

6. Tighten the jam nut on the lower clutch rod 16 to 20 N·m (12 to 15 lbf·ft).

Clutch Linkage Adjustment



A. To clutch pedal.
1. Clutch Release Yoke
2. Retainer Clip
3. Clutch Release Shaft
4. Clutch Release Key
5. Clutch Release Lever
6. Lower Clutch Rod
7. Jam Nut
8. Clutch Relay Lever
9. Bellcrank Pivot Assembly
10. Return Spring
11. Upper Clutch Rod
12. Crosshead Screw
13. Boot
14. Pie-Pan Assembly

Fig. 8, Linkage for Push-Type Clutch

7. Remove the special tool from the clutch pedal.
8. Check the clutch free pedal. See **Fig. 1**, Ref. A.

Clutch Pedal Removal and Installation, RH DR

Removal

IMPORTANT: It is easier to remove the clutch pedal with the steering column removed. See **Section 46.02, Subject 110** for procedures.

1. Set the parking brake and chock the tires.
2. Remove the clutch stop and allow the overcenter bolt to fall down. Set aside the washer, spring and plastic nut for later installation. See **Fig. 1**.
3. Disconnect the clutch switch harness.
4. Tilt the hood.
5. From the outside of the cab, disconnect the clutch linkage. See **Fig. 2**.
6. Remove the two 1/4–20 foot valve mounting capscrews on the RH side of the pedal box.
7. From inside the cab, remove the six M10 bolts on the pedal box.
8. Remove the pedal box assembly from the cab. See **Fig. 3**.
9. With the pedal box assembly removed, disconnect the brake pedal return spring.

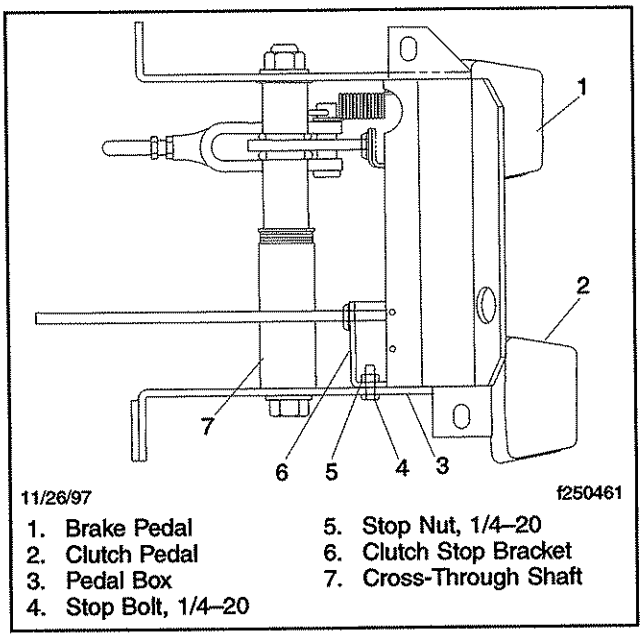


Fig. 1, Remove the Clutch Stop

10. Remove the cross-through bolt, nut and washers from the pedal box assembly. See **Fig. 4**.

IMPORTANT: There are many small parts installed on the cross-through shaft. Be careful to preserve the correct order for reassembly.

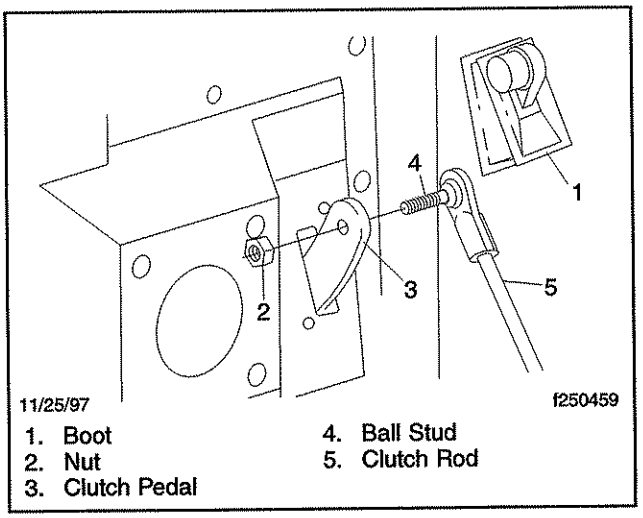


Fig. 2, Disconnect the Clutch Linkage

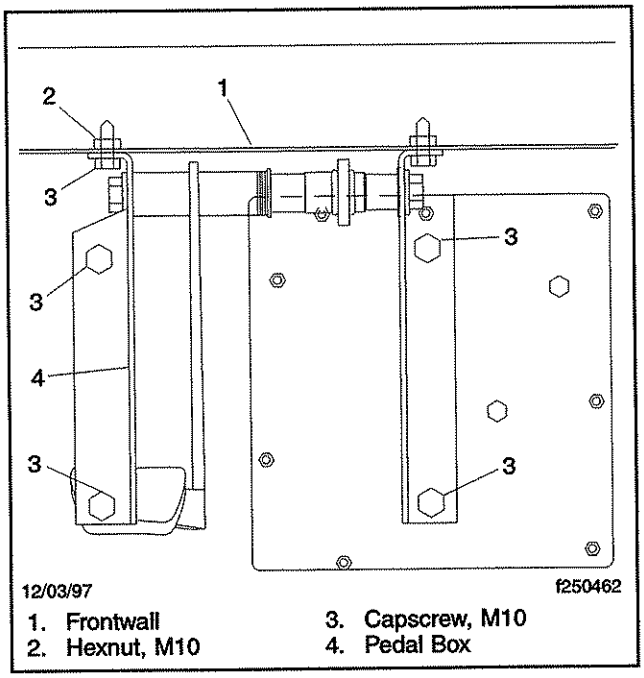
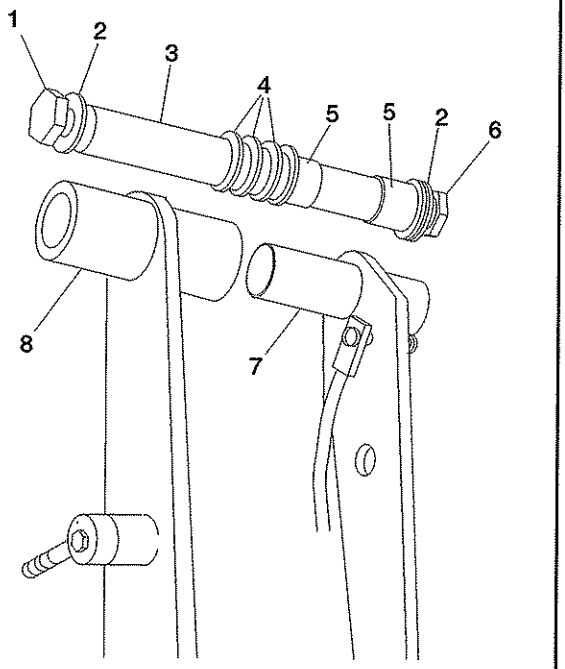


Fig. 3, Pedal Box Assembly

Clutch Pedal Removal and Installation, RH DR



12/08/97 f250460

1. Cross-Through Bolt
2. Washer
3. Cross-Through Shaft
4. Spacers
5. Plastic Sleeve
6. Cross-Through Nut
7. Brake Pedal
8. Clutch Pedal

Fig. 4, Cross-Through Shaft

11. Remove the cross-through shaft, with the clutch pedal and brake pedal, from the pedal box.

Installation

1. Install the cross-through shaft in the pedal box. Make sure the spacers, plastic sleeve, and washers are installed in the correct order, as removed. See **Fig. 4.**

   1.1 Install the plastic sleeve onto the brake pedal.

   1.2 Insert the brake pedal, plastic sleeve, spacers, and clutch pedal onto the cross-through shaft.

   1.3 Spread the pedal box slightly and insert the cross-through shaft into the space between the two ends of the box.

2. Insert the cross-through bolt, with washers, and attach the nut. Tighten the nut 135 lbf·ft (183 N·m).
3. Install the brake pedal return spring.
4. Seat the pedal box assembly in the cab. The assembly is seated properly when the bolt holes line up with the holes in the frontwall and the clutch pedal extends through the slot provided. See **Fig. 3.**

⚠ CAUTION

When installing the pedal box assembly, be careful not to damage the plastic HVAC tubing.

   4.1 From inside the cab, install the six M10 bolts to hold the box in place.

   4.2 From outside the cab, install the two 1/4–20 foot valve mounting capscrews and tighten them 84 lbf·in (940 N·cm).

   4.3 Install the M10 nuts on the M10 capscrews and tighten the nuts 30 lbf·ft (41 N·m).

5. Install the overcenter spring. See **Fig. 1.**

   5.1 Pull the clutch pedal out as far as it will go.

   5.2 Slip the washer, spring and plastic retainer onto the stop bolt.

   5.3 Push the clutch pedal in.

6. Install the clutch stop. Tighten the stop bolt 84 lbf·in (940 N·cm).
7. From outside the cab, connect the clutch linkage. See **Fig. 2.**
8. Attach the clutch switch electrical connector.
9. If removed, install the steering column. See **Section 46.02, Subject 110** for procedures.
10. Lower the hood and remove the chocks from the tires.

Specifications

Torque Values, Clutch Adjustment	
Description	**Torque lbf·ft (N·m)**
Clutch Rod Nut	26 to 33 (35 to 45)
Jam Nut	12 to 15 (16 to 20)

Table 1, Torque Values, Clutch Adjustment

Torque Values, Clutch Pedal Installation		
Description	**Torque**	
	lbf·ft (N·m)	**lbf·in (N·cm)**
Foot Valve Mounting Capscrew, 1/4–20	—	84 (940)
Clutch Stop Mounting Capscrew, 1/4–20	—	84 (940)
Cross-Through Nut	135 (183)	—
Pedal Box Mounting Capscrews, M10	30 (41)	—

Table 2, Torque Values, Clutch Pedal Installation

Clutch Control, Hydraulic System 25.03

Contents

Subject	Subject Number
General Information and Principles of Operation	050
Service Operations	
Master Cylinder Removal and Installation	100
Slave Cylinder Removal and Installation	120
Clutch Hydraulic System Filling and Bleeding	140
Clutch Linkage Adjustment	150

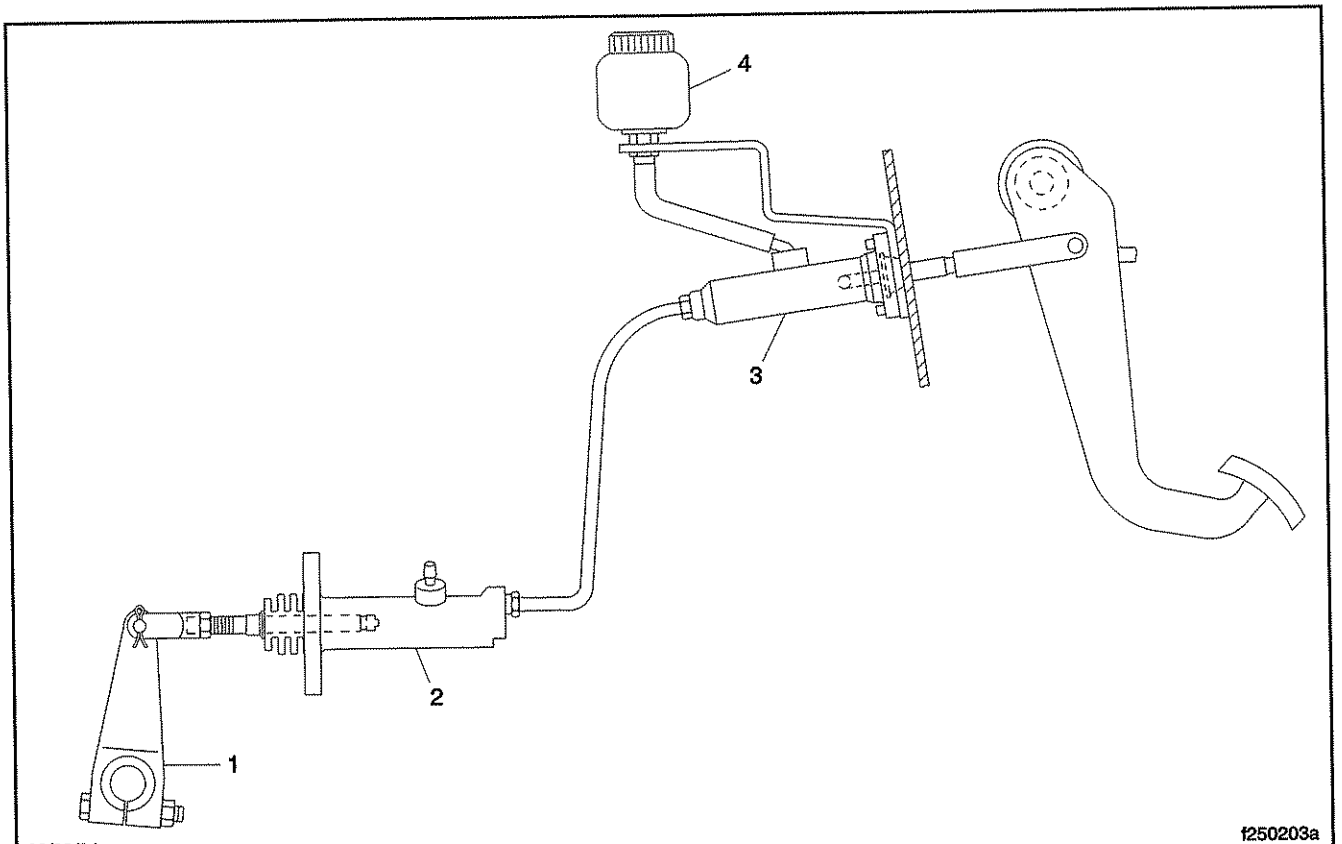
General Information and Principles of Operation

General Information

The clutch linkage uses a hydraulic system consisting of a fluid reservoir, a master cylinder, and a slave cylinder. **See Fig. 1.**

Principles of Operation

When the clutch pedal is depressed, 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. The system is self-adjusting. No "linkage" adjustment is required. Some clutch models have an internal adjustment, however.



03/08/94

1. Clutch Release Lever
2. Slave Cylinder
3. Master Cylinder
4. Reservoir

Fig. 1

Master Cylinder Removal and Installation

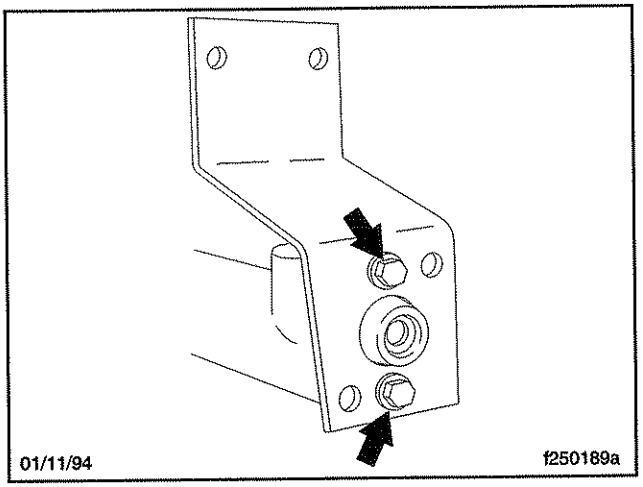
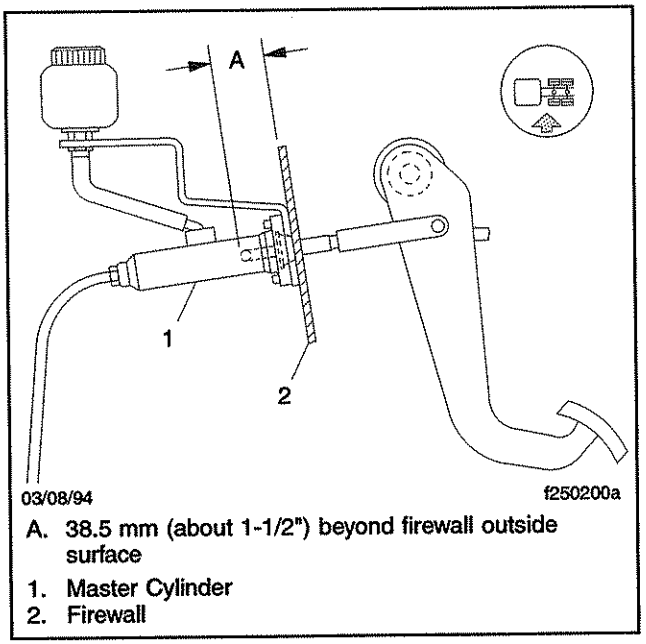


Fig. 5



A. 38.5 mm (about 1-1/2") beyond firewall outside surface
1. Master Cylinder
2. Firewall

Fig. 6, Plunger Adjustment

2.3 Install the mounting capscrews (**Fig. 4**) and tighten them 20 N·m (15 lbf·ft).

2.4 Install and fill the hydraulic fluid reservoir.

2.5 Connect the hydraulic line to the master cylinder. Tighten the fitting (**Fig. 3**) 18 to 24 N·m (13 to 18 lbf·ft).

2.6 Mount the reservoir and its bracket onto the master cylinder mounting bracket. Tighten the two capscrews (**Fig. 1**) 1080 N·cm (96 lbf·in).

2.7 Connect the hydraulic fluid line from the master cylinder to the reservoir. Tighten the hose clamp (**Fig. 2**).

2.8 Fill the reservoir with D.O.T. #3 hydraulic brake fluid.

3. On vehicles built since December 1992, install the master cylinder.

3.1 Connect the hydraulic line to the master cylinder. Tighten the fitting 18 to 24 N·m (13 to 18 lbf·ft).

3.2 Connect the hydraulic fluid line from the master cylinder to the reservoir. Tighten the hose clamp.

3.3 Position the master cylinder and hydraulic fluid reservoir mounting bracket on the firewall. Install and tighten the two capscrews 20 N·m (15 lbf·ft).

3.4 Fill the reservoir with D.O.T. #3 hydraulic brake fluid.

4. Bleed the clutch hydraulic system. For instructions, **refer to Subject 140.**

Master Cylinder Removal and Installation

Removal

⚠ WARNING

WARNING: Hydraulic 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 hydraulic brake fluid or bleeding hydraulic lines. If you get hydraulic brake fluid on your skin, wash it off as soon as possible.

⚠ CAUTION

CAUTION: Do not spill hydraulic fluid on the cab paint. Clean it off immediately if any is spilled. Hydraulic brake fluid can damage paint.

1. On vehicles built since December 1992, go to the next step.

   On vehicles built before December 1992, remove the capscrews (**Fig. 1**) holding the reservoir mounting bracket to the master cylinder mounting bracket.

   1.1 Pour the hydraulic fluid out of the reservoir and safely discard it.

   1.2 Disconnect the hydraulic line from the reservoir and remove the reservoir. **See Fig. 2.**

   1.3 Unscrew the fitting (**Fig. 3**) at the bottom end of the master cylinder and disconnect the hydraulic line.

   1.4 Remove the two capscrews (**Fig. 4**) that hold the master cylinder mounting bracket to the firewall.

   1.5 From the backside of the mounting bracket remove the two capscrews (**Fig. 5**) that mount the master cylinder to the bracket.

2. On vehicles built from December 1992, remove the fasteners that attach the master cylinder and the hydraulic fluid reservoir mounting bracket to the firewall.

   2.1 Remove the cap from the hydraulic fluid reservoir and empty the reservoir into a container. Safely discard the fluid.

   2.2 Unscrew the fitting at the bottom end of the master cylinder and disconnect the hydraulic line.

   2.3 Disconnect the hydraulic line from the reservoir and remove the master cylinder.

Installation

1. Adjust the master cylinder plunger rod.

   1.1 Before attaching the master cylinder, loosen the plunger rod jam nut.

⚠ CAUTION

CAUTION: Adjust the plunger rod to extend 38.5 mm (about 1-1/2 inches) beyond the outside surface of the firewall. If the rod extends too far, the piston seals will be damaged when the piston travels too far in the master cylinder bore. In addition,

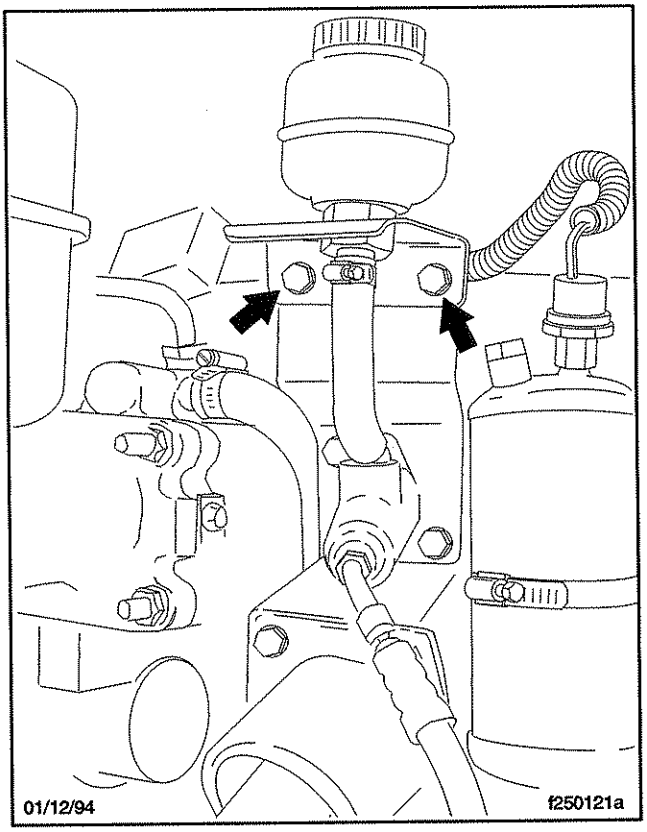


Fig. 1

Master Cylinder Removal and Installation

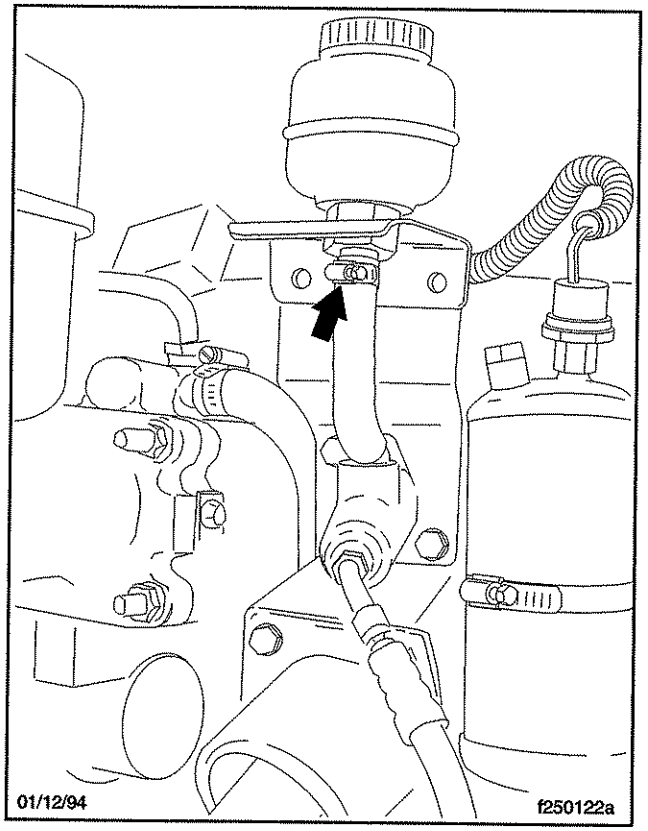


Fig. 2

the clutch will not self-adjust because the opening to the clutch fluid reservoir will be blocked. If the rod doesn't extend far enough, there will be play at the clutch pedal.

NOTE: There is normally no play with a hydraulic clutch linkage.

1.2 Adjust the plunger rod by turning it in or out of the clevis yoke until it extends 38.5 mm (1-1/2 inches) beyond the firewall outside surface. **See Fig. 6.**

1.3 Tighten the jam nut.

2. On vehicles built since December 1992, go to the next step. On vehicles built before December 1992, install the master cylinder.

2.1 Position the master cylinder on the master cylinder mounting bracket. Install the two capscrews (**Fig. 5**). Tighten them 880 N·cm (78 lbf·in).

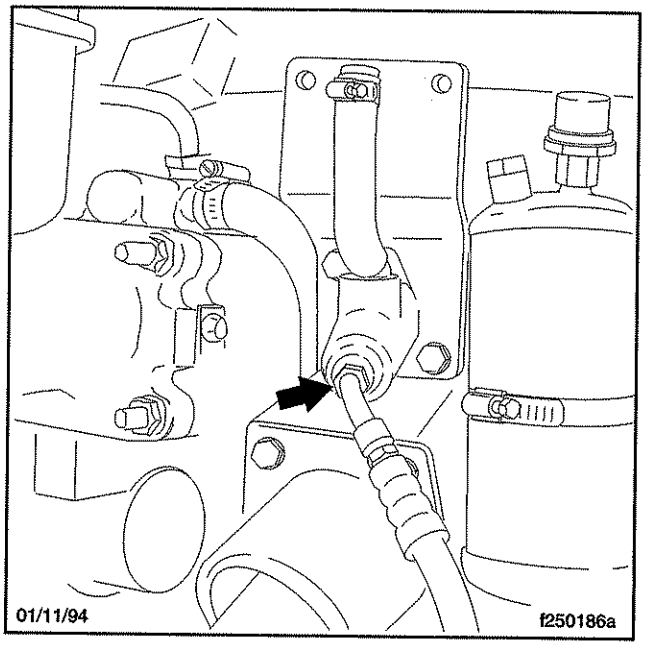


Fig. 3

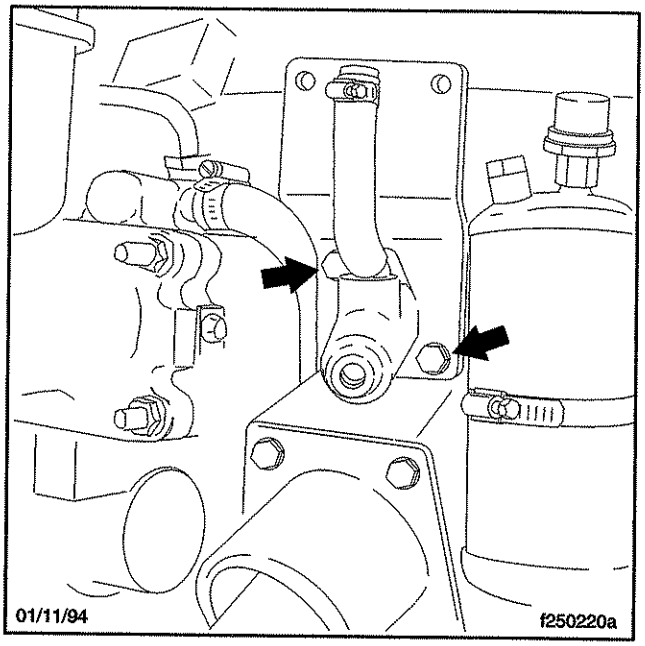


Fig. 4

2.2 Position the master cylinder mounting bracket on the firewall, sliding the plunger rod through the rubber wiper until it seats in the master cylinder.

Slave Cylinder Removal and Installation

Removal

⚠ WARNING

WARNING: Hydraulic 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 hydraulic brake fluid or bleeding hydraulic lines. If you get hydraulic brake fluid on your skin, wash it off as soon as possible.

1. Disconnect the hydraulic line from the slave cylinder and drain the fluid into a container.
2. Remove the rubber boot from the plunger rod. Remove the slave cylinder mounting capscrews (**Fig. 1**) and nuts; then, remove the slave cylinder.

Installation

1. Make sure that the index marks on the clutch release lever and the release shaft are aligned. **See Fig. 2.**
2. Install the slave cylinder.
   - 2.1 Place a new rubber boot on the plunger rod. Position the clutch slave cylinder on its bracket, making sure that the slave cylinder bleeding valve is pointing up.

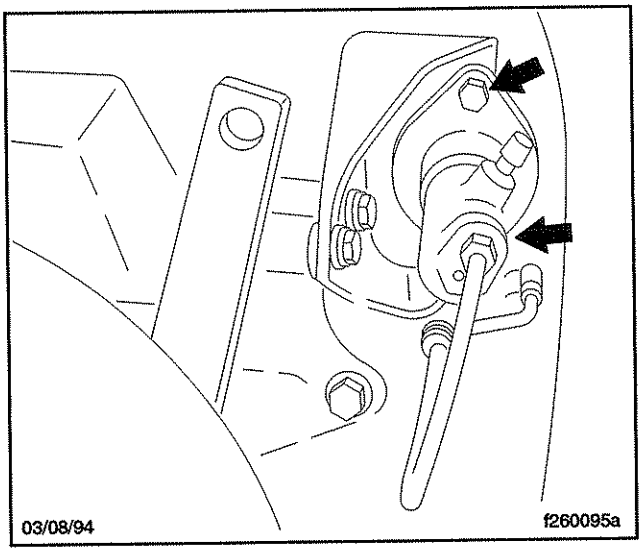


Fig. 1

   - 2.2 Install the mounting capscrews and nuts. Tighten them 41 N·m (30 lbf·ft).

⚠ CAUTION

CAUTION: Do not push the slave cylinder piston more than 65 mm (2-1/2 inches) into the cylinder, or the piston seal will be damaged by the bleed hole.

   - 2.3 Connect the hydraulic line to the slave cylinder. Tighten the hydraulic line fitting 18 to 24 N·m (13 to 18 lbf·ft).

3. Adjust the slave cylinder plunger rod.

   NOTE: The dimensions below apply only to new push-type clutches and correctly adjusted pull-type clutches.

   - 3.1 Turn the plunger rod, moving it in or out of the clevis yoke, to obtain the correct distance between the cylinder mounting surface and the step on the plunger rod shaft. **See Fig. 3** and **Fig. 4.**
     - On a push-type clutch for vehicles built before May 1, 1992, that distance is 44 mm (about 1-3/4 inches): On vehicles built from May 1, 1992, that distance is 62 mm (about 2-1/2 inches).
     - On a pull-type clutch for vehicles with a synchronized transmission, that distance is 44 mm (about 1-3/4 inches): On vehicles with a nonsynchronized transmission, the

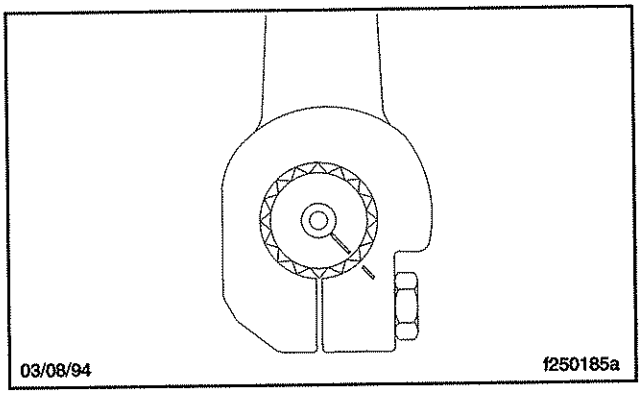


Fig. 2, Index Marks Aligned

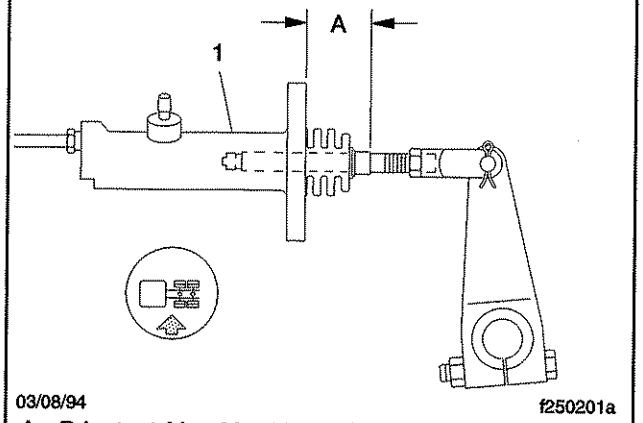
Slave Cylinder Removal and Installation

distance is 82 mm (about 3-7/32 inches).

3.2 Tighten the jam nut.

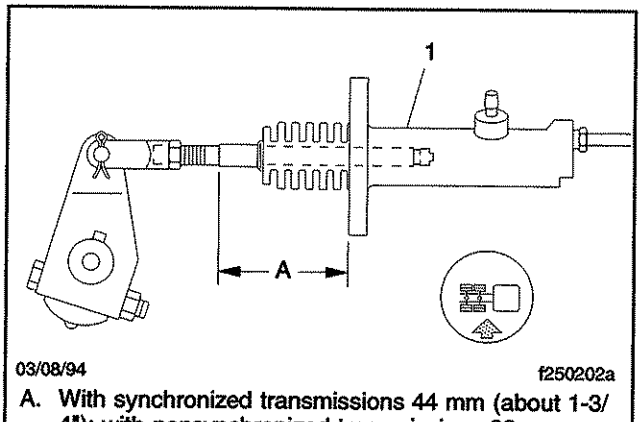
4. Check the alignment of the slave cylinder.

4.1 Carefully detach the rubber boot from the slave cylinder, and push it forward to allow a clear view of the plunger rod where it enters the cylinder bore.



A. Prior to 1 May 92– 44 mm (about 1-3/4"); From 1 May 92– 62 mm (about 2-1/2")
1. Slave Cylinder

Fig. 3, Slave Cylinder Adjustment (Push–Type Clutch)



A. With synchronized transmissions 44 mm (about 1-3/4"); with nonsynchronized transmissions 82 mm (about 3-7/32")
1. Slave Cylinder

Fig. 4, Slave Cylinder Adjustment (Pull–Type Clutch)

4.2 Place the slave cylinder alignment tool (part number 02-12245-000) over the plunger rod with the flange end of the tool away from the cylinder. Gently slide the tool towards the open end of the cylinder bore, and if possible, insert it into the cylinder bore until the flange of the tool is firmly seated against the end of the cylinder. If there is resistance, lightly press and rotate the tool until it slides into the cylinder. **See Fig. 5.** If the tool can be rotated 360 degrees around the plunger rod, the cylinder and rod are aligned as well as is possible. No other alignment is needed. Remove the tool. Install the rubber boot and make sure that the small end of the boot is located in the groove of the plunger rod and that the other end is seated properly on the slave cylinder flange. Fill and bleed the clutch hydraulic system. **See Subject 140** for instructions.

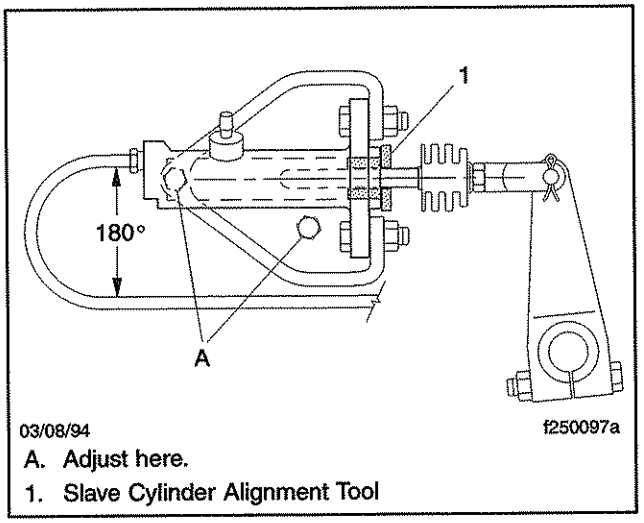
Otherwise, if the tool can't be rotated 360 degrees around the plunger rod, the cylinder and rod require further alignment. With the tool seated, it can be seen in which direction the rod and or cylinder need to be adjusted. Center the rod horizontally if required. Vehicles with synchronized transmissions (slave cylinder on the right) and non-synchronized transmissions (slave cylinder on the left) can be adjusted for horizontal alignment.

4.3 Scribe or paint a line on the clutch release shaft at the edge of the clutch release lever opposite the direction the lever must be moved. This is in order to mark the original location of the lever on the shaft for later reference.

4.4 Loosen the pinch bolt securing the lever to the shaft, and slide the lever until the plunger rod is centered in the cylinder bore. When the rod is centered, the tool will seat against the end of the cylinder with the slot vertical. Tighten the pinch bolt 34 to 42 N·m (25 to 31 lbf·ft), being careful not to move the lever. Check to ensure that the plunger rod is still approximately centered in the cylinder.

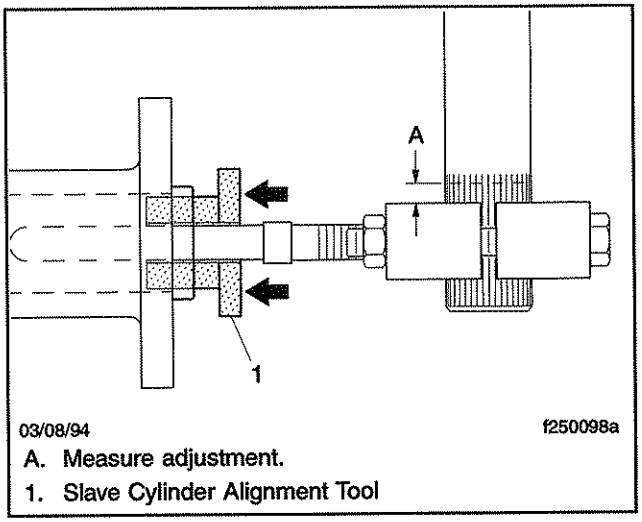
4.5 Using the mark on the shaft as reference, measure the distance the lever was moved

Slave Cylinder Removal and Installation



A. Adjust here.
1. Slave Cylinder Alignment Tool

Fig. 5



A. Measure adjustment.
1. Slave Cylinder Alignment Tool

Fig. 6

to align the plunger rod. **See Fig. 6.** If the lever was moved 5 mm (0.2 inch) or more, the rod was probably cocking the piston, and future cylinder leakage is likely. Replace the cylinder.

5. This step applies only to vehicles with synchronized transmissions (slave cylinder on the right). Center the rod vertically, if required.

   5.1 Loosen the two fasteners that mount the slave cylinder bracket to the transmission. **See Fig. 5.**

   5.2 Move the mounting bracket up or down until the plunger rod is centered vertically in the cylinder, and the tool will rotate 360 degrees around the plunger rod while pressed against the end of the cylinder; then tighten the two mounting fasteners 34 to 42 N·m (25 to 31 lbf·ft). Check alignment with the alignment tool. Readjust if necessary.

   NOTE: The slave cylinder alignment tool is designed to be used during production, or in cases of realignment such as this. The need for readjustment does not necessarily mean that the previous setting was out of specification.

6. When the plunger rod is correctly aligned, and the slave cylinder has been replaced if necessary, carefully install the rubber boot on the cylinder. Ensure that the small end of the boot is located in the groove of the plunger rod and that the other end is seated properly on the slave cylinder flange.

7. Fill and bleed the clutch hydraulic system. **See Subject 140** for instructions.

Clutch Hydraulic System Filling and Bleeding

Filling and Bleeding Using a Pressurized Bleeding Unit

IMPORTANT: If a clutch with internal adjustments is installed on the vehicle, make sure those adjustments are correct before adjusting the plunger rod. Refer to the applicable clutch section in this group for instructions. Also, make sure the slave cylinder plunger rod is properly adjusted. For instructions, refer to **Subject 120.**

⚠ WARNING

WARNING: Hydraulic 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 hydraulic fluid or bleeding hydraulic lines. If you get hydraulic fluid on your skin, wash it off as soon as possible.

⚠ CAUTION

CAUTION: Do not spill hydraulic brake fluid on the cab paint. Clean it off immediately if any is spilled. Hydraulic brake fluid can damage paint.

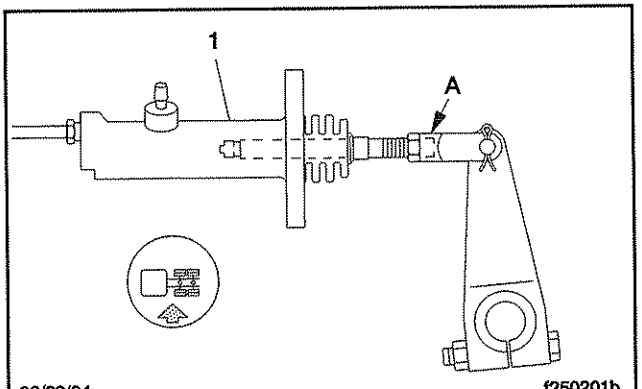
1. Apply the parking brake and chock the tires.
2. Remove the cap from the clutch hydraulic fluid reservoir. Make sure that the reservoir is at least two-thirds full.

NOTE: A pressure bleeding unit (J29532) and a bleeder adaptor (J35798) for the fluid reservoir are available through Kent-Moore Tools and may be used to complete the following procedure. To order these parts, call Kent-Moore at 1-800-328-6657.

3. Prepare the pressure bleeding unit for use according to the manufacturer's instructions. Use DOT #3 hydraulic brake fluid. Also, allow some fluid to run through the pressure unit hose to remove air from the hose. Pressurize the unit to 207 kPa (30 psi).
4. Connect the pressure bleeding unit to the reservoir.
5. Connect a clear drain line to the slave cylinder bleed valve.

IMPORTANT: The slave cylinder may not be mounted in a horizontal position. If it isn't, remove the slave cylinder and hold it in a horizontal position to completely purge all air from the cylinder.

6. Fully depress the clutch pedal and block it in this position.
7. Open the slave cylinder bleed valve; then, open the valve on the bleeder unit. Observe the flow of hydraulic fluid through the slave cylinder drain line. When no bubbles appear in the fluid, close the valve on the slave cylinder. Then, close the valve at the bleeding unit.
8. Move the slave cylinder plunger rod 13 mm (1/2 inch) in and out several times until a firm resistance is felt, or until no bubbles appear in the reservoir. **See Fig. 1.**
9. Disconnect the bleeding unit, and install the cap on the slave cylinder bleeder valve.
10. Check the fluid level in the reservoir. If necessary, add or remove hydraulic fluid to bring the fluid level to the MAX line. Install the reservoir cap.
11. Depress the clutch pedal a few times. There should be resistance over the full pedal stroke.
12. Check the clutch function.
    - 12.1 Make sure that the parking brake is still set.
    - 12.2 Fully depress the clutch and hold it in this position.
    - 12.3 With the transmission in neutral, start the engine.



A. Move the plunger rod in and out about 13 mm (1/2 inch).
1. Slave Cylinder

Fig. 1

Clutch Hydraulic System Filling and Bleeding

12.4 Shift the transmission through the gears. All gears must engage easily.

12.5 Keep the clutch pedal fully depressed, the engine running, and the transmission in gear.

12.6 If the clutch begins to engage within approximately three minutes, the system is not working properly. Shut down the engine. Repeat the filling/bleeding procedure.

NOTE: If the clutch system still is not working properly, check the master and slave cylinder operation.

13. Check the entire system for leaks. Tighten connections if necessary. Check the fluid level in the reservoir again.

14. Remove the chocks from the tires.

Clutch Linkage Adjustment

NOTE: Clutch linkage adjustment may be necessary if the master cylinder or slave cylinder is being replaced. It is not necessary after replacing the clutch. Also, there is no linkage adjustment on used push-type clutches. On push-type clutches, the adjustment procedure below applies only to the original installation.

Adjustment

NOTE: If a clutch with internal adjustments is installed on the vehicle, make sure those adjustments are correct before checking the clutch linkage. If internal adjustment is needed, refer to the applicable clutch section in this group.

1. If the master cylinder is being replaced, check the master cylinder plunger rod adjustment.

   1.1 If adjustment is needed, and before attaching the master cylinder, loosen the plunger rod jam nut.

⚠ CAUTION

CAUTION: Adjust the plunger rod to extend 38.5 mm (about 1-1/2 inches) beyond the outside surface of the firewall. If the rod extends too far, the piston seals will be damaged when the piston travels too far in the master cylinder bore. In addition, the clutch will not self-adjust because the opening to the clutch fluid reservoir will be blocked. If the rod doesn't extend far enough, there will be play at the clutch pedal.

   NOTE: There is normally no play with a hydraulic clutch.

   1.2 Adjust the plunger rod by turning it in or out of the clevis yoke until it extends 38.5 mm (about 1-1/2 inches) beyond the outside surface of the firewall. **See Fig. 1.**

   1.3 Tighten the jam nut.

   1.4 Install the master cylinder. For instructions, **refer to Subject 100.**

2. If the slave cylinder is being replaced, check the slave cylinder plunger rod adjustment.

   2.1 Make sure that the index marks on the clutch release lever and the release shaft are aligned. **See Fig. 2.**

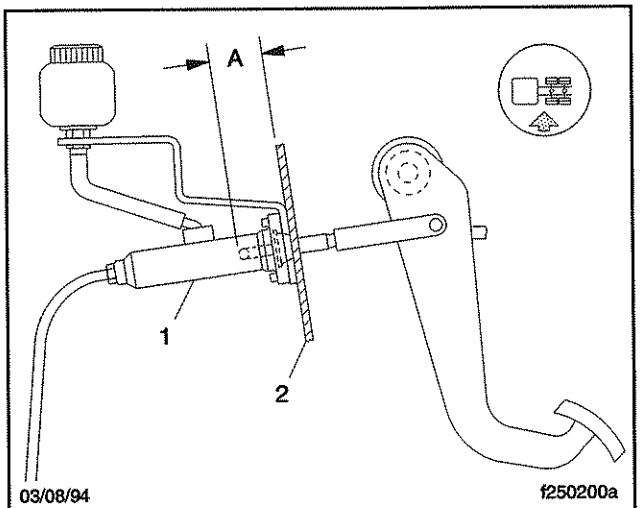
   2.2 Install the slave cylinder. **Refer to Subject 120** for instructions.

⚠ CAUTION

CAUTION: Do not push the slave cylinder piston more than 65 mm (2-1/2 inches) into the cylinder, orthe piston seal will be damaged by the bleed hole.

   2.3 If adjustment is needed, adjust the slave cylinder plunger rod by turning it in or out of the clevis yoke to obtain the correct distance between the cylinder mounting surface and the step on the plunger rod shaft. **See Fig. 3** and **Fig. 4.**

   - On a push-type clutch for vehicles built before May 1, 1992, that distance is 44 mm (about 1-3/4 inches): On vehicles built from May 1, 1992, that distance is 62 mm (about 2-1/2 inches).
   - On a pull-type clutch for vehicles with a synchronized transmission, that distance is 44 mm (about 1-3/4 inches): On vehicles with a nonsynchronized transmission, the



A. 38.5 mm (about 1-1/2") beyond firewall outside surface
1. Master Cylinder
2. Firewall

Fig. 1, Plunger Adjustment

Clutch Linkage Adjustment

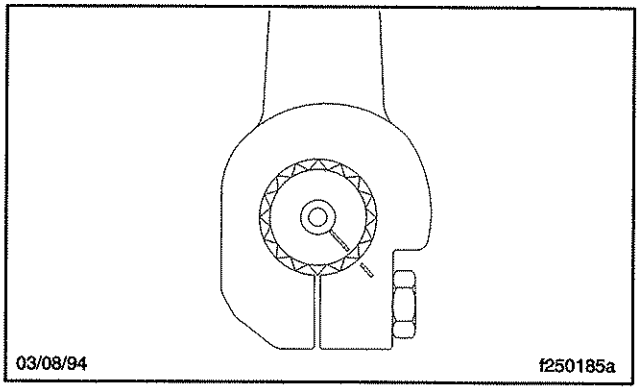
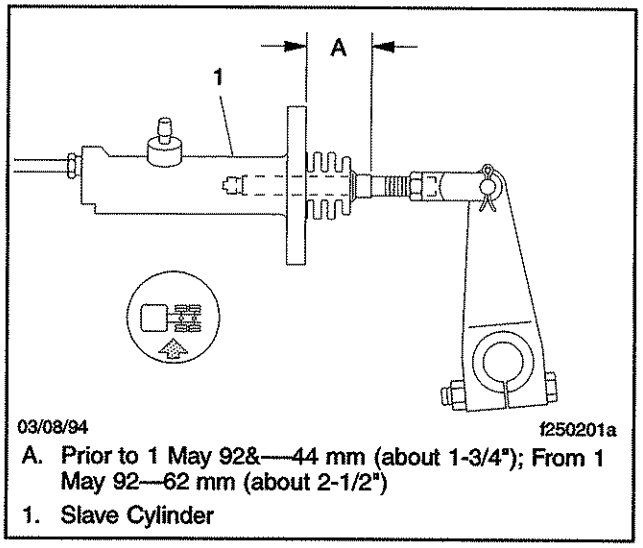


Fig. 2, Index Marks Aligned

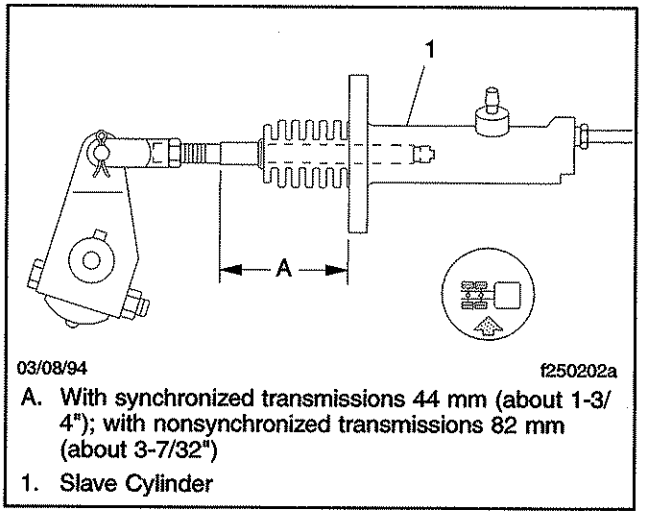
distance is 82 mm (about 3-7/32 inches).

2.4 Tighten the jam nut.



A. Prior to 1 May 92&—44 mm (about 1-3/4"); From 1 May 92—62 mm (about 2-1/2")
1. Slave Cylinder

Fig. 3, Slave Cylinder Adjustment (Push-Type Clutch)



A. With synchronized transmissions 44 mm (about 1-3/4"); with nonsynchronized transmissions 82 mm (about 3-7/32")
1. Slave Cylinder

Fig. 4, Slave Cylinder Adjustment (Pull-Type Clutch)

Contents

Subject	Subject Number
General Description	050
Service Operations	
Clutch Adjustments	100
Clutch Removal, Inspection, and Installation	110
Specifications	400

General Description (See Fig. 1)

Valeo clutches installed in Freightliner Business Class vehicles are available in 14-inch and 16-inch models. They are single-plate, diaphragm spring, pull-type clutches. A dampened driven disc is standard. The lining is a "cerametallic" material.

See **Specifications, 400** for additional information.

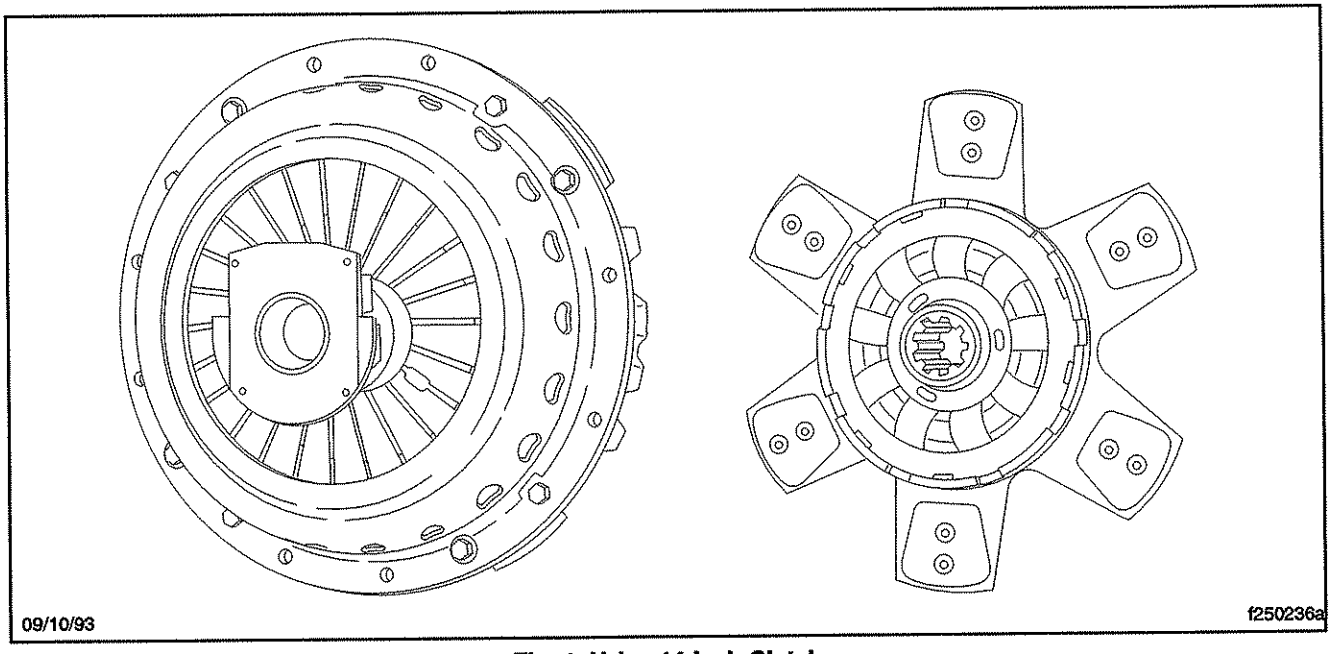


Fig. 1, Valeo 14-Inch Clutch

Special Tools

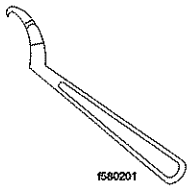
Special Tools				
Quantity Needed	Tool	Description	Manufacturer	Part Number
2	 f580201	Adjustable Hook Spanner Wrench	Kent-Moore	J4749

Table 1, Special Tools

Clutch Adjustments

Valeo clutches require two adjustments: release bearing clearance (this distance must be 12.7 to 14.3 mm (1/2 to 9/16 inch) and (on mechanical clutch linkage systems only) clutch free-travel (this distance must be 2.7 to 3.7 mm (0.105 to 0.145 inch). See **Fig. 1**.

HYDRAULIC CLUTCH CONTROL SYSTEM

1. Using Kent-Moore tool J4749, loosen the locknut ring (**Fig. 1**). Then, rotate the sleeve with the adjuster ring to the specified release bearing clearance.

   With non-synchronized transmissions equipped with a clutch brake, release bearing clearance is 1/2 to 9/16 inch (12.7 to 14.3 mm). See **Fig. 1**.

   With non-synchronized transmissions and no clutch brake, release bearing clearance is 3/4 inch (19 mm).

2. Using Kent-Moore tool J4749, tighten the locknut ring against the release bearing coupler. Tighten the locknut 35 to 40 lbf·ft (47 to 61 N·m).

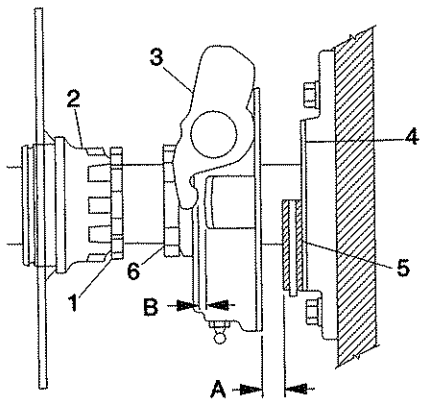
MECHANICAL LINKAGE CLUTCH CONTROL SYSTEM

IMPORTANT: An inspection tool A02–12419 (available through the PDCs) can be used to check the distance between the release bearing and the clutch brake. See **Fig. 2**. 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.

1. If using tool A02–12419 to check the distance between the release bearing and the clutch brake, position the tool so that the legs straddle the transmission input shaft. Check the gap with both ends of the tool as follows:

   1.1 Insert the blue 0.56-inch (14.3-mm) end. If it fits loosely the gap is too wide and adjustment is needed. Go to the next step.

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



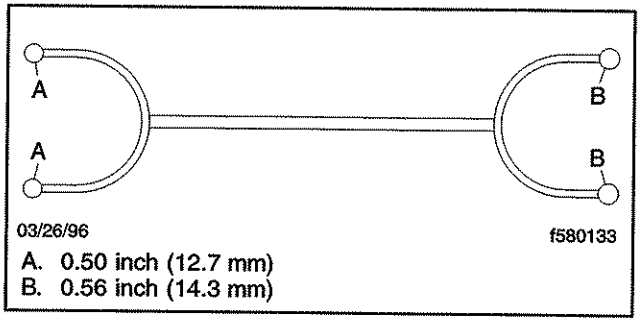
09/10/93 f250250a

A. 1/2 to 9/16 inch (12.7 to 14.3 mm) With Clutch Brake
B. 0.105 to 0.145 inch (2.7 to 3.7 mm)

1. Locknut Ring
2. Release Bearing Coupler
3. Release Yoke
4. Bearing Cover
5. Bearing Pad
6. Adjuster Ring

Fig. 1, Clutch Adjustment Measurements

Clutch Adjustments



A. 0.50 inch (12.7 mm)
B. 0.56 inch (14.3 mm)

Fig. 2, Inspection Tool A02-12419

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.

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

2. Disconnect the external linkage to allow free movement of the release yoke.
3. Using two spanner wrenches (Kent-Moore J4749), loosen the release bearing locknut. Thread the locknut back toward the transmission a small distance to ensure that it will not interfere with the adjustment procedure.
4. Rotate the sleeve with the adjuster ring to the specified release bearing clearance.
5. Using the two spanner wrenches, place one on the notches of the release bearing coupler and the other on the release bearing locknut. Use the first wrench to prevent the coupler from rotating while using the second wrench to tighten the locknut against the coupler as a jamnut.
6. Tighten the locknut ring against the release bearing coupler by placing the two wrenches in notches that will result in the two wrench handles diverging slightly from one another. Then both handles can be grasped with one hand and squeezed closely together.

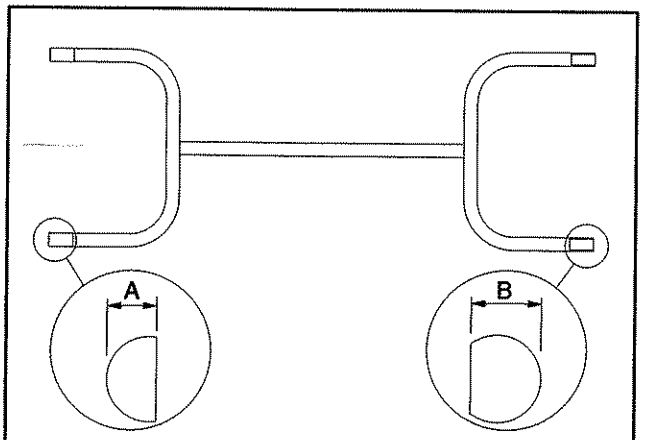
IMPORTANT: An inspection tool A02–12254 (available through the PDCs) can be used to check the distance between the release bearing and the release fork (free travel). See **Fig. 3**. The legs on one end of the tool have green tape on them and are 0.105 inch (2.7 mm) thick; the legs on the other end have blue tape on them and are 0.145 inch (3.7 mm) thick.

7. If using tool A02–12254 to check the distance between the release bearing and the release fork, position the tool so it straddles the fork to ensure that there won't be any misalignment. Check the distance with both ends of the tool as follows:

7.1 Insert the blue 3.7-mm (0.145-inch) end. If it fits loosely the gap is too wide and adjustment is needed. Connect the external linkage, then go to the section on clutch linkage adjustment in this group.

7.2 If the blue 3.7-mm (0.145-inch) end can't be inserted in the gap, then try to insert the green 2.7-mm (0.105-inch) end. If the green end of the tool fits, snug or loose, then no adjustment is needed.

7.3 If the green end of the tool can't be inserted in the gap, adjustment is needed. Connect the external linkage, then perform a clutch linkage adjustment. For instructions, see **Section 25.02.**



A. 2.7 mm (0.105 inch)
B. 3.7 mm (0.145 inch)

Fig. 3, Inspection Tool A02-12254

Clutch Removal, Inspection, and Installation

Removal

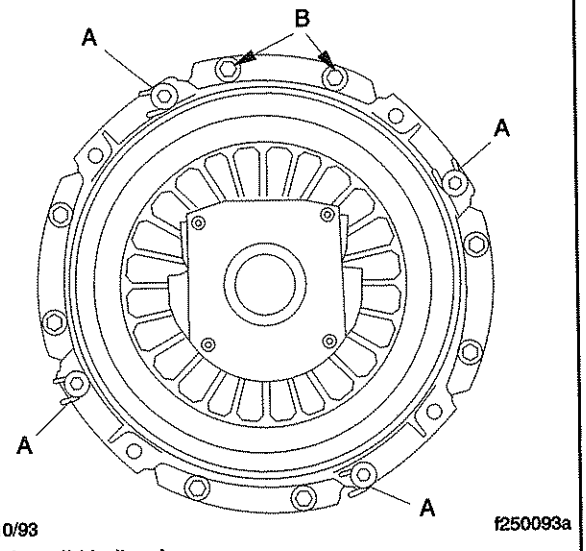
1. Remove the transmission. Follow the procedures in **Group 26** of this manual.

⚠ CAUTION

CAUTION: Do not let the transmission drop, and do not let the transmission hang unsupported by the input shaft in the pilot bearing. Taking these precautions will prevent damage to the clutch assembly and the pilot bearing.

2. Remove the clutch brake (if equipped) from the transmission input shaft.
3. To facilitate clutch removal and installation, Valeo clutches employ four U-clips to hold the pressure plate toward the clutch. Install the four U-clips. See **Fig. 1**.
4. Install a clutch alignment tool through the clutch and into the flywheel pilot bearing to support the clutch assembly during removal.

NOTE: If an alignment tool is not available, use an input shaft from a manual transmission. Remove the gear from the end of the input shaft.



A. Install U-clips here.
B. Install guide pins here.

Fig. 1, 14-Inch and 16-Inch Clutches

5. Remove the top two capscrews from the pressure plate assembly as indicated in **Fig. 1**. Install guide pins in the two holes. If guide pins are not available, they may be made by removing the heads from two capscrews.
6. Remove the remaining capscrews which secure the cover assembly to the flywheel.

⚠ WARNING

WARNING: The cover assembly is heavy and should be removed only with a lifting device. If the assembly is lifted improperly or dropped, it could cause serious personal injury.

7. Lift the pressure plate, release bearing, and clutch assembly over the alignment tool and guide pins.
8. Whenever the clutch assembly is serviced or the engine is removed, the pilot bearing in the flywheel should be removed and replaced. Use an appropriate internal puller and a slide hammer to remove the pilot bearing. Install the new pilot bearing with an appropriate driver.

Inspection

1. Inspect the release fork, the cross shaft, and the shaft bushings. Inspect the transmission input shaft splines. Minor scratches may be removed with emery cloth. Replace any damaged or excessively worn parts.
2. Inspect the flywheel for heat spots, warpage, scoring, or cracks around the bolt holes. If necessary, machine or replace the flywheel.
3. Inspect the pressure plate friction surface for wear or damage. If the plate is cracked, replace it. Heat marks are normally found on a pressure plate after operation. These marks can usually be removed with emery cloth. If you cannot remove heat marks with emery cloth, replace the pressure plate.
4. Inspect the pilot bearing. Although the pilot bearing should be replaced whenever the clutch is removed, any excessive wear or damage to the pilot bearing could indicate other problems which should be remedied.

Clutch Removal, Inspection, and Installation

5. Inspect the clutch release linkage, the shafts, and the yoke for wear or binding. Make any necessary repairs.
6. If a clutch brake is installed, inspect the clutch brake wear surface on the transmission. Replace the transmission front bearing cover if necessary.

Installation

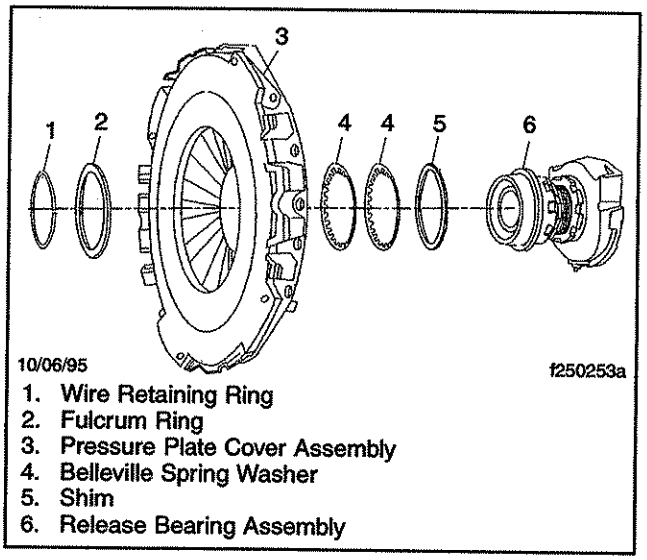
NOTE: If you are installing components which have been in operation, do the inspection procedure in this subject before installing the clutch.

1. Lubricate the bore in the crankshaft for the pilot bearing with the specified lubricant. Do not over-lubricate. Excess lubricant can contaminate the disc and cause the clutch to slip.

   Using an appropriate driver, install the pilot bearing. Refer to the engine manufacturer's service manual for instructions.
2. Install guide pins in the top two bolt holes of the flywheel. If guide pins are not available, make them by removing the heads from two capscrews.
3. If necessary, install the release bearing assembly on the pressure plate. See **Fig. 2** for assembly.

   3.1 Be sure that the Belleville spring fingers are toward the shim, and that the rounded face of the fulcrum ring is toward the diaphragm fingers of the pressure plate.

   3.2 Install the fulcrum ring and the wire retaining ring on the end of the release bearing coupler. Be sure that the wire retaining ring is fully seated in its groove. See **Fig. 3**.
4. Position the clutch alignment tool in the clutch disc so the flat side of the disc marked *FLYWHEEL SIDE* will face the flywheel. Insert the alignment tool into the pilot bearing.



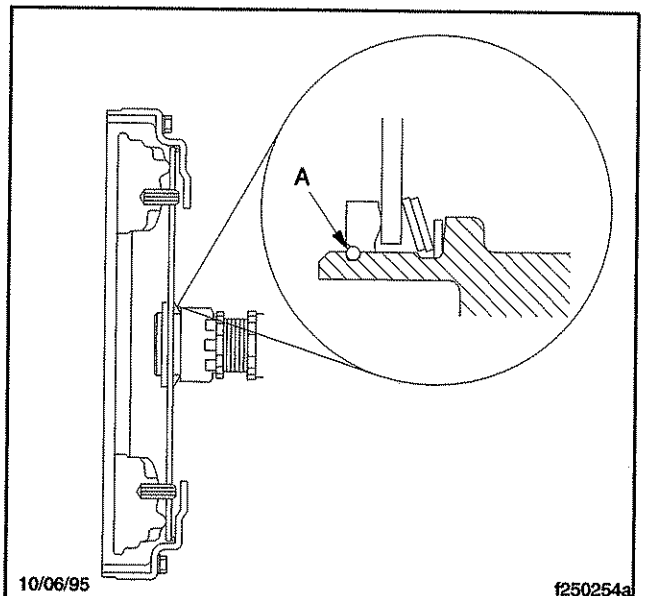
1. Wire Retaining Ring
2. Fulcrum Ring
3. Pressure Plate Cover Assembly
4. Belleville Spring Washer
5. Shim
6. Release Bearing Assembly

Fig. 2, Install the Release Bearing Assembly

⚠ WARNING

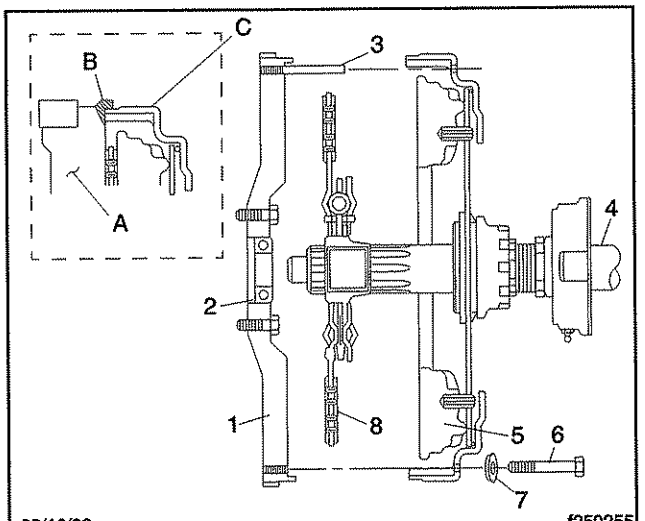
WARNING: The cover assembly is heavy and should be installed only with a lifting device. If the assembly is lifted improperly or dropped, it could cause serious personal injury.

5. Install the pressure plate assembly over the alignment tool and the guide pins. See **Fig. 4**.
6. Install the mounting capscrews finger-tight in the cover assembly.



A. Make sure the retaining ring is fully seated in the groove.

Fig. 3, Seat the Wire Retaining Ring



A. Flywheel
B. Raised Step
C. Pressure Plate Assembly

1. Flywheel
2. Pilot Bearing
3. Guide Pin
4. Alignment Tool
5. Pressure Plate Assembly
6. Capscrew
7. Washer
8. Clutch Disc

Fig. 4, Pressure Plate Installation, 16-Inch Clutches

For 16-inch clutches, be sure the pressure plate cover fits inside the raised step of the flywheel. Refer to the detail in **Fig. 4**.

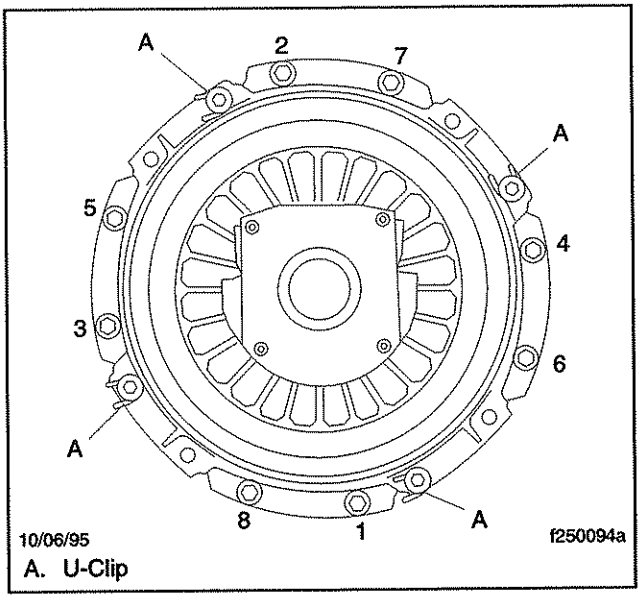
Remove the two guide pins, and install the remaining two capscrews.

IMPORTANT: Use hardened washers and grade 8 capscrews. Be sure the capscrews are the correct length. Capscrews which are too short will strip; capscrews which are too long will damage the flywheel and may break off under engine torque.

7. Tighten the capscrews one turn at a time until they are snug. Then, tighten the capscrews as specified below. Follow the tightening sequence in **Fig. 5**.
   - 14-Inch Clutches: 47 to 54 N·m (35 to 40 lbf·ft).
   - 16-Inch Clutches: 54 to 61 N·m (40 to 45 lbf·ft).
8. Remove the four wire U-clips (**Fig. 5**). Remove the clutch alignment tool.
9. Install the transmission. Follow the procedures in **Group 26** of this manual.

⚠ CAUTION

CAUTION: Do not let the transmission drop, and do not let the transmission hang unsupported by the input shaft in the pilot bearing bore in the flywheel. Taking these precautions will prevent damage to the clutch assembly and the pilot bearing. If excessive force is required to install the transmission into the flywheel housing, investigate the cause and make necessary corrections.



A. U-Clip

Fig. 5, 14-Inch and 16-Inch Clutch

Designation	Definition
EV	Eaton Valeo
115	x 10 = Maximum torque capacity in lbf.ft
16	Clutch size in inches

Table 1, Model Nomenclature

Weight and Torque Ratings				
Model	**Total Weight kg (lbs)**	**Torque Rating N.m (lbf.ft)**	**Housing**	**Flywheel**
14-Inch				
EV06514	28 (62)	881 (650)	SAE #2	14-Inch Flat
EV08814	28 (62)	1193 (880)		
EV10514	30 (66)	1424 (1050)		
16-Inch				
EV11516	39 (87)	1559 (1150)	SAE #2	16-Inch Flat
EV12516	41 (91)	1250 (1695)		
EV14016	41 (91)	1898 (1400)		

Table 2, Weight and Torque Ratings

Cover Assembly Torque Values		
Description	**Clutch**	**Torque N.m (lbf.ft)**
Cover Assembly Capscrews (grade 8)	14-Inch	47–54 (35–40)
	16-Inch	54–61 (40–45)

Table 3, Cover Assembly Torque Values

Adjustment Values	
Description	**Adjustment mm (inch)**
Release Yoke Finger to Bearing Pad Clearance	3 (1/8)
Clutch Pedal Free Travel (minimum)	19 (3/4)
Release Travel Clearance: Non-Synchronized Transmission With Clutch Brake	13 (1/2)

Table 4, Adjustment Values

Specifications

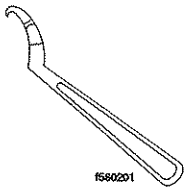
Special Tools			
Tool	**Description**	**Manufacturer**	**Part Number**
 f580201	Adjustable Hook Spaner Wrench	Kent-Moore Tools Kent-Moore Tool Division, 28784 Little Mack, Roseville, MI 48066	J4749

Table 5, Special Tools

Contents

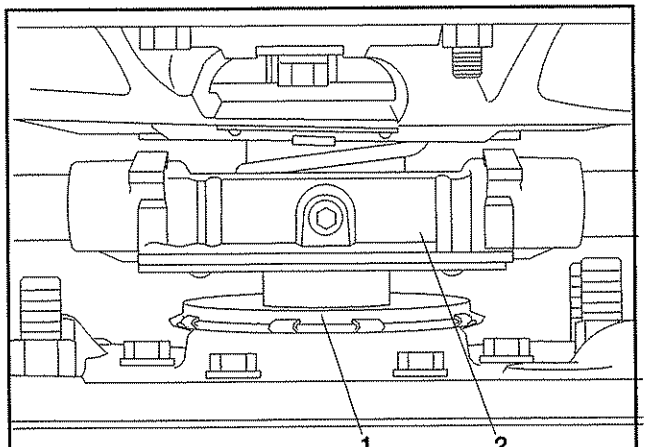
Subject	Subject Number
General Information	050
Service Operations	
One-Piece Clutch Brake Replacement	100
Replacement of a One-Piece Clutch Brake with a Two-Piece Clutch Brake	110
Two-Piece Clutch Brake Replacement	120
Troubleshooting	300

General Description

When the vehicle is stationary, a clutch brake permits shifting into first gear or reverse gear without severe gear clash.

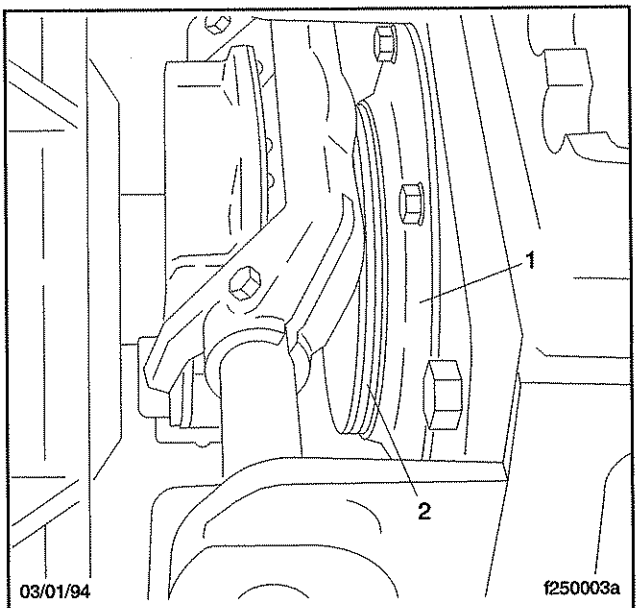
Clutch brake engagement occurs approximately during the last 1 to 1-1/4 inches (25 to 33 mm) of downward pedal travel. The clutch brake is between the release-bearing housing (see **Fig. 1**) and the transmission bearing cap, and is engaged by tangs to the transmission input shaft. When the pedal is fully depressed, the clutch brake is squeezed between the release-bearing housing and the transmission bearing cap (see **Fig. 2**), stopping the rotation of the main drive gear.

The clutch brake may be a disc-type or a torque-limiting type. In addition, the clutch brake may be either a one-piece or two-piece design. To prevent overloads to it, the torque-limiting clutch brake is designed to slip when loads of 20 to 25 lbf·ft (27 to 34 N·m) are reached. Clutch brakes are not designed for upshifting.



1. Clutch Brake
2. Release Bearing

Fig. 1, Clutch Brake and Release Bearing



1. Transmission Input Shaft Bearing Cap
2. Clutch Brake Discs and Washer

Fig. 2, Clutch Brake and Bearing Cap

One-Piece Clutch Brake Replacement

Replacement

1. Shut down the engine, set the parking brake, and chock the tires.
2. Tilt the hood.
3. Drain the air tanks.
4. Disconnect the batteries.
5. Place the transmission in gear.
6. Remove the shift tower from the top of the transmission. See **Group 26** in this manual for instructions.
7. Disconnect the driveline from the rear of the transmission. See **Group 41** in this manual for instructions.
8. Disconnect the midship bearing. See **Group 41** in this manual for instructions. Pull the driveshaft aside and position it out of the way.
9. Remove the fuel tank compression brace. See **Group 47** in this manual for instructions.
10. Disconnect the clutch rod from the clutch release lever. See **Section 25.02** in this group for instructions.
11. Disconnect the transmission wiring.
12. Disconnect the transmission air lines.
13. Remove the auxiliary air tank, if so equipped.
14. Remove the transmission oil cooler and set it aside, out of the way.

IMPORTANT: Do not disconnect the oil cooler lines.

15. Place a transmission jack in position below the transmission. Adjust the jack to support the transmission.
16. Secure the transmission to the jack.
17. Remove the flywheel housing-to-clutch housing bolts. See **Group 26** in this manual for instructions.

⚠ CAUTION

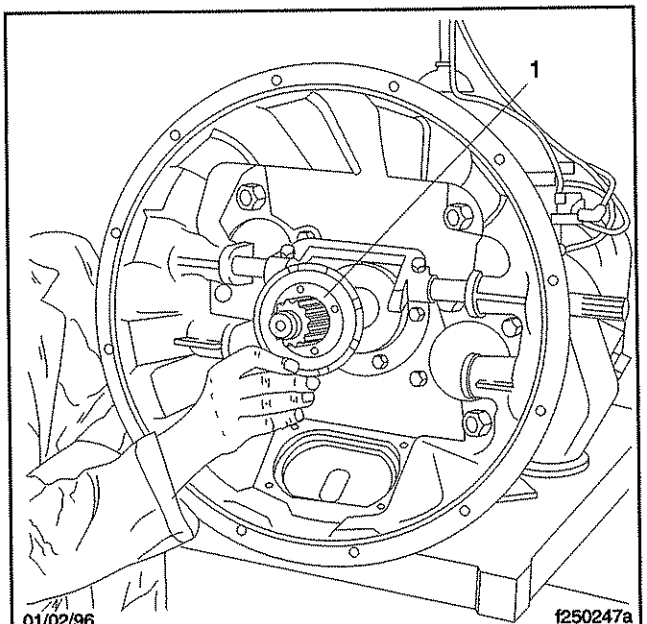
Do not let the rear of the transmission drop, and do not let the transmission hang unsupported in the splined hubs of the clutch discs. Taking these precautions will prevent bending and distortion of the clutch discs.

18. Pull the transmission back until the input shaft clears the flywheel.
19. Remove the old clutch brake from the transmission input shaft. See **Fig. 1**.
20. Align the tangs of the new clutch brake with the grooves on the input shaft and slide the clutch brake into position. See **Fig. 2**.

⚠ CAUTION

Use care to avoid springing the drive discs when the transmission is being installed. Do not force the transmission into the clutch or flywheel housing if it does not enter freely. Do not let the transmission drop or hang unsupported in the driven discs. These practices can damage the clutch assembly.

21. Install the transmission. See **Group 26** in this manual for instructions.
22. Remove the transmission jack.
23. Connect the air lines and the transmission wiring.



1. Clutch Brake

Fig. 1, Clutch Brake Removal

One-Piece Clutch Brake Replacement

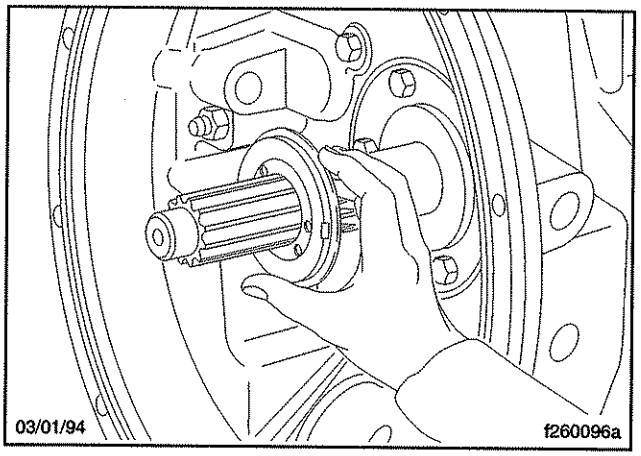


Fig. 2, Clutch Brake Installation

24. Install the fuel tank compression brace. See **Group 47** in this manual for instructions.
25. Install the auxiliary air tank, if so equipped.
26. Install the transmission oil cooler.
27. Install the shift tower on the top of the transmission. See **Group 26** in this manual for instructions.
28. Connect the clutch rod to the clutch release lever. See **Section 25.02** in this group for instructions.
29. Connect the driveline at the rear of the transmission. See **Group 41** in this manual for instructions.
30. Connect the midship bearing. See **Group 41** in this manual for instructions.
31. Ensure that the transmission is out of gear and adjust the clutch. See **Group 25** in this manual for instructions.
32. Connect the batteries.
33. Lower the hood and remove the chocks from the tires.
34. Test drive the vehicle and ensure that the clutch brake and clutch operate properly.

Replacement of a One-Piece Clutch Brake with a Two-Piece Clutch Brake

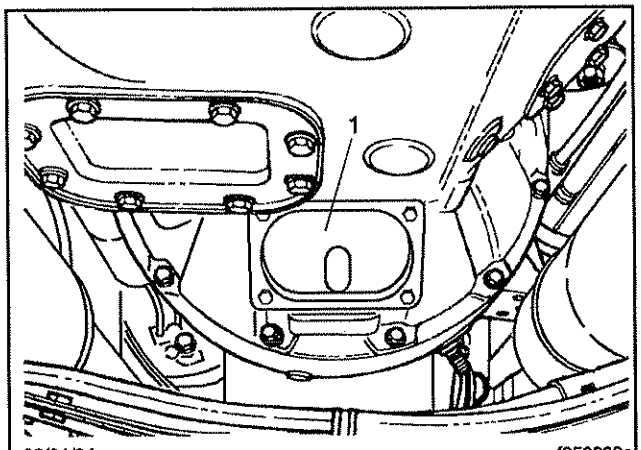
Replacement

1. Shut down the engine, set the parking brake, and chock the tires.
2. Tilt the hood.
3. Remove the four fasteners and the clutch inspection cover. See **Fig. 1**.

⚠ WARNING

Wear safety goggles when cutting off the old clutch brake. If any of the metal parts were to chip, flying pieces of metal could cause eye injury.

4. Using an air chisel, carefully cut off the old clutch brake.
5. Check the orientation and fit of the new two-piece clutch brake halves.
6. Place one half of the new two-piece clutch brake onto the input shaft and rotate it to the top side of the shaft. See **Fig. 2**.
7. Align the lower half with the upper half at the connecting points.
8. Hold both halves together and start the fasteners on both sides.
9. Align the fasteners with the grooves on the input shaft.



03/01/94 f250002a

1. Inspection Cover

Fig. 1, Clutch Inspection Cover

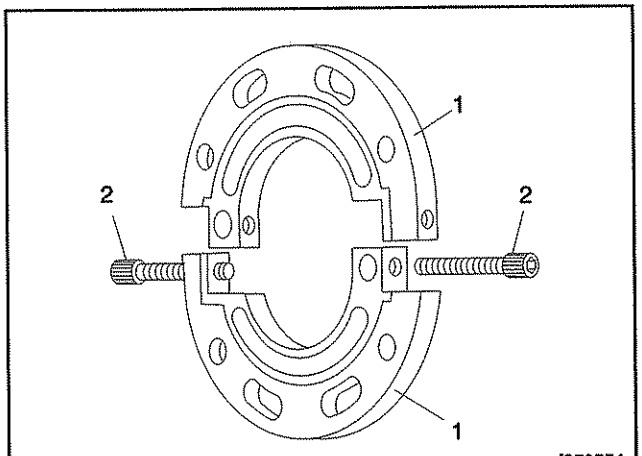
10. Tighten Allen-head fasteners 60 lbf·in (675 N·cm).

NOTE: Other types of two-piece clutch brakes use roll pins for fasteners.

⚠ WARNING

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

11. If the replacement clutch brake uses roll pins, carefully drive in the roll pins equally with a punch and mallet, securing the halves to each other.
12. Install the clutch inspection cover and the four fasteners. Tighten the fasteners securely.
13. Adjust the clutch. See **Group 25** in this manual for instructions.
14. Lower the hood and remove the chocks from the tires.
15. Test drive the vehicle and ensure that the clutch brake and clutch operate properly.



06/02/99 f250554

1. Clutch Brake Half
2. Allen-Head Fastener

Fig. 2, Two-Piece Clutch Brake (Spicer shown)

Two-Piece Clutch Brake Replacement

Replacement

1. Shut down the engine, set the parking brake, and chock the tires.
2. Tilt the hood.
3. Remove the four fasteners and the clutch inspection cover. See **Fig. 1**.

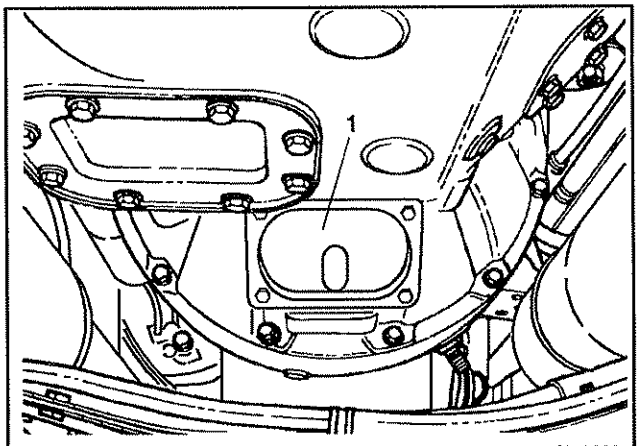
NOTE: Some types of two-piece clutch brakes use roll pins for fasteners.

4. Rotate the input shaft until the Allen-head fasteners or roll pins securing the two clutch brake halves are visible.
5. If the old clutch brake uses Allen-head fasteners, remove the fasteners and remove the two brake halves from the input shaft.

⚠ WARNING

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

6. If the old clutch brake uses roll pins, carefully drive out the pins with a punch and mallet and remove the two brake halves from the input shaft.
7. Check the orientation and fit of the new two-piece clutch brake halves.



1. Inspection Cover

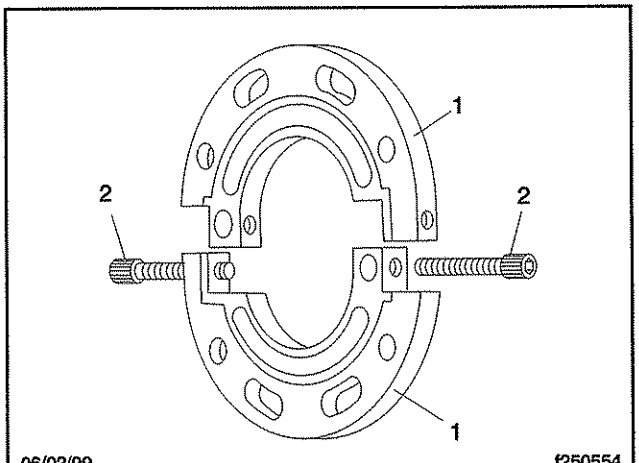
Fig. 1, Clutch Inspection Cover

8. Place one half of the new two-piece clutch brake onto the input shaft and rotate it to the top side of the shaft. See **Fig. 2**.
9. Align the lower half with the upper half at the connecting points.
10. Hold both halves together and start the fasteners on both sides.
11. Align the fasteners with the grooves on the input shaft.
12. Tighten Allen-head fasteners 60 lbf·in (675 N·cm).

⚠ WARNING

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

13. If the replacement clutch brake uses roll pins, carefully drive in the roll pins equally with a punch and mallet, securing the halves to each other.
14. Install the clutch inspection cover and the four fasteners. Tighten the fasteners securely.
15. Adjust the clutch. See **Group 25** in this manual for instructions.
16. Lower the hood and remove the chocks from the tires.



1. Clutch Brake Half
2. Allen-Head Fastener

Fig. 2, Two-Piece Clutch Brake (Spicer shown)

Two-Piece Clutch Brake Replacement

17. Test drive the vehicle and ensure that the clutch brake and clutch operate properly.

Troubleshooting Tables

Problem—Broken Tabs on the Clutch Brake

Problem—Broken Tabs on the Clutch Brake	
Possible Cause	**Remedy**
Vibration.	Inspect the clutch disc hubs; check the installation of the clutch. Make sure dampened discs are used.
The clutch linkage is incorrectly adjusted.	Adjust the clutch linkage. Also, check the installation of the clutch.
The driver used the clutch brake while the vehicle was moving.	Use correct driving technique.
The driver used the clutch to hold the vehicle on a hill when stopped.	Use correct driving technique.

Problem—Poor Clutch Release

Problem—Poor Clutch Release	
Possible Cause	**Remedy**
The clutch brake is damaged and/or not functioning.	Install a new clutch brake.

Contents

Subject	Subject Number
General Information	050
Service Operations	
Reservoir Removal and Installation	100
Master Cylinder Replacement	110
Slave Cylinder Replacement	120
Hydraulic Clutch Removal and Installation	130
Clutch Hydraulic System Filling and Bleeding	140
Release Bearing and Yoke Assembly Replacement	150
Hydraulic Hose Replacement	160
Clutch Switch Replacement	170
Troubleshooting	300
Specifications	400
Special Tools	500

General Information

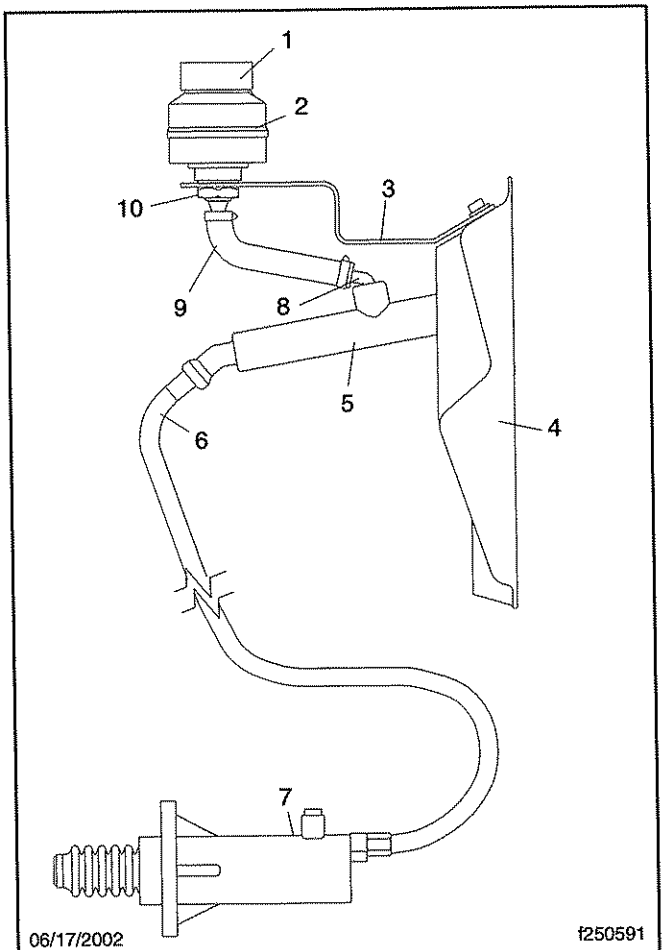
The Sachs hydraulic clutch is a 14.5-inch (365 mm) push-type clutch that is used with the MBT520 and MBT660 medium-duty transmissions. All Mercedes-Benz transmission models require a hydraulic clutch system. For more information on the Mercedes-Benz transmissions, see **Section 26.00**.

The hydraulic clutch control system consists of a fluid reservoir, a master cylinder, various connectors and hoses, and a slave cylinder. See **Fig. 1**.

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.

The hydraulic system is self-adjusting. To bleed the system, see **Subject 140**.



1. Reservoir
2. Reservoir Cap
3. Reservoir Bracket
4. Clutch Support Plate
5. Master Cylinder
6. Hydraulic Hose
7. Slave Cylinder
8. Elbow Connector
9. Reservoir Hose
10. Jam Nut

Fig. 1, Clutch Components

Reservoir Removal and Installation

Removal

⚠ WARNING

Clutch hydraulic fluid (DOT 3 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.
3. Using a flat-head screwdriver, remove the quick-disconnect clamp that attaches the hydraulic hose to the slave cylinder. Retain the clamp for later installation.

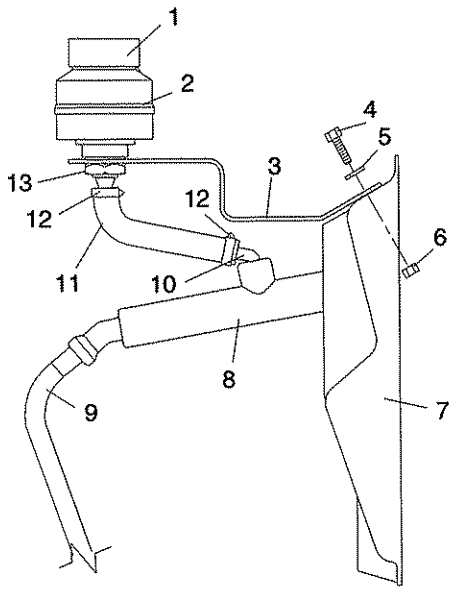
⚠ CAUTION

Do not spill clutch hydraulic fluid (DOT 3 brake fluid) on the cab paint. Clean it off immediately if any is spilled. DOT 3 brake fluid can damage paint.

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 reservoir, not more than 0.3 quarts (0.3 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 reservoir.
   - 4.4 Cover the hose to avoid contamination of the hydraulic fluid.
5. Using a flat-head screwdriver, remove the hose clamp that attaches the reservoir hose to the master cylinder. Retain the clamp for later installation.
6. Remove the two 5/16–24 mounting bolts, washers, and locknuts with nylon inserts attaching the reservoir bracket to the clutch support plate (pie pan). See **Fig. 1**.
7. Remove the reservoir and reservoir bracket from the vehicle.
8. Clamp the reservoir bracket in a vise.
9. Loosen the M18 jam nut attaching the reservoir to the reservoir bracket. Remove the reservoir from the bracket.

Installation

1. Position the reservoir on the bracket, with the bracket still in the vise. Tighten the jam nut 147 lbf·ft (199 N·m).
2. Mount the reservoir bracket on the flange of the clutch support plate, as removed.



02/26/2003 f250601

1. Reservoir Cap
2. Reservoir
3. Reservoir Bracket
4. Bracket Mounting Bolt, 5/16–24
5. Hardened Flatwasher
6. Locknut, 5/16–24
7. Clutch Support Plate
8. Master Cylinder
9. Hydraulic Hose
10. Elbow Connector
11. Reservoir Hose
12. Hose Clamp
13. Jam Nut, M18

Fig. 1, Reservoir and Bracket

Reservoir Removal and Installation

3. With the bracket mounted on the vehicle, remove the vise holding the reservoir and bracket.
4. Install the two bracket mounting bolts and tighten them 13 lbf·ft (18 N·m).
5. Connect the reservoir hose to the master cylinder. Install the clamp, as removed.

⚠ WARNING

Use only approved clutch hydraulic fluid (DOT 3 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 3 hydraulic brake fluid. Flush and bleed the system according to the procedures in **Subject 140**.

NOTE: Make sure clean fluid comes out while bleeding.

7. Check the function of the clutch actuation system according to the procedures under the heading "Clutch Actuation System Check" in **Troubleshooting, 300**.

Replacement

⚠ WARNING

Clutch hydraulic fluid (DOT 3 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. Drain the hydraulic fluid from the entire system. For detailed procedures, see **Subject 100.**
2. Remove the reservoir, following the procedures in **Subject 100.**

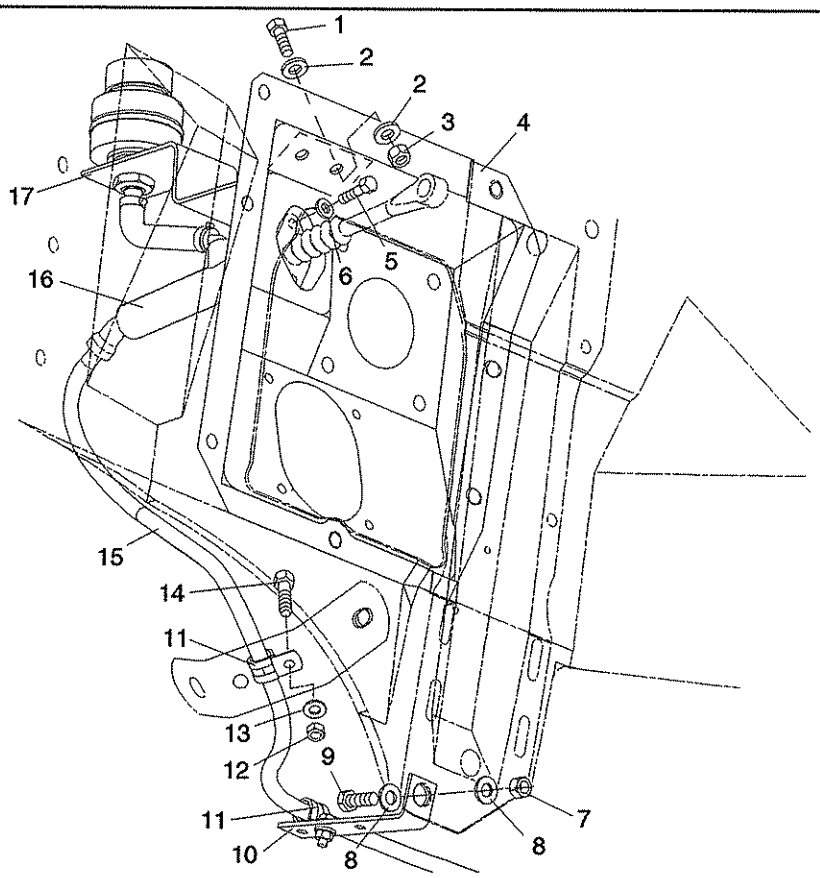
⚠ CAUTION

Do not spill clutch hydraulic fluid (DOT 3 brake fluid) on the cab paint. Clean it off immediately if any is spilled. DOT 3 brake fluid can damage paint.

3. Using a flat-head screwdriver, remove the quick-disconnect clamp that attaches the hydraulic hose to the hose connector on the master cylinder. Retain the clamp for later installation. Remove the hose connector from the opening in the end of the master cylinder. See **Fig. 1.**
4. Remove the two M6 master cylinder capscrews and washers from the holes in the clutch support plate.
5. Slide the clevis on the master cylinder off the clevis pin on the clutch pedal.
6. Remove the old master cylinder from the clutch support plate.
7. Attach the clevis on the new master cylinder to the clevis pin on the clutch pedal.
8. Fasten the new master cylinder to the clutch support plate. Tighten the capscrews 60 lbf·in (680 N·cm).
9. Attach the hose connector and hydraulic hose to the opening in the end of the master cylinder.
10. Moisten the tip of the elbow connector in DOT 3 brake fluid. Insert the moistened tip of the elbow into the opening in the top of the master cylinder.
11. Install the reservoir hose.
12. Install the reservoir, following the procedures in **Subject 100.**

NOTE: Make sure clean fluid comes out while bleeding.

Master Cylinder Replacement



06/20/2002 f250593

1. Reservoir Bracket Mounting Bolt, 5/16–24
2. Steel-Plated Washer, 5/16
3. Locknut, 5/16–24
4. Clutch Support Plate
5. Master Cylinder Capscrew, M6
6. Hardened Flatwasher, M6
7. Locknut, 1/2–13
8. Hardened Flatwasher, 0.53
9. Frontwall Bracket Mounting Bolt, 1/2–13
10. Frontwall Standoff Bracket
11. Cushioned Clamp
12. Locknut, 1/4–20
13. Steel-Plated Washer, 1/4
14. Clamp Mounting Bolt, 1/4–20
15. Hydraulic Hose
16. Master Cylinder
17. Reservoir Bracket

Fig. 1, Clutch Master Cylinder

Replacement

⚠ WARNING

Clutch hydraulic fluid (DOT 3 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.
3. Using a flat-tip screwdriver, remove the quick-disconnect clamp that attaches the hydraulic hose to the slave cylinder. Retain the clamp for later installation.

⚠ WARNING

Never take the slave cylinder apart while it is connected to the hydraulic hose. If the slave cylinder is removed from the bell housing, the metal pushrod inside the cylinder can be released at high speed, causing component damage and serious personal injury.

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

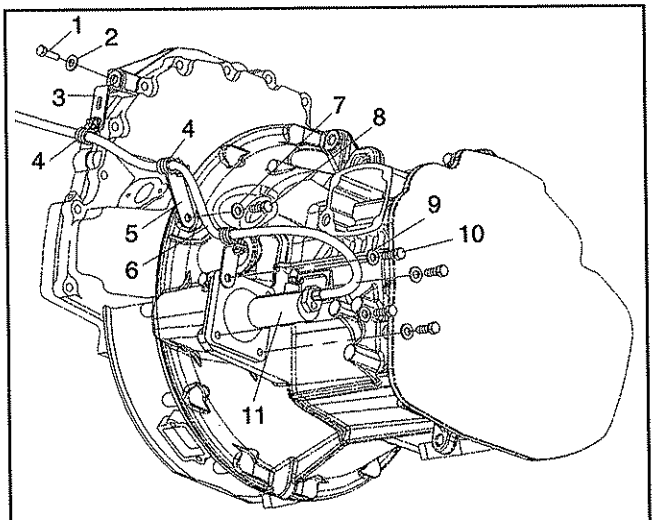
IMPORTANT: Be sure to mount the slave cylinder with the bleed valve on top, as shown in **Fig. 1**.

7. Mount the slave cylinder on the bell housing, as removed.
   - 7.1 Make sure that the pushrod is attached to the clutch fork and inserted into the pushrod bore in the slave cylinder.
   - 7.2 Push the slave cylinder against the bell housing to compress the internal spring.
8. Install the four slave cylinder mounting capscrews and tighten them 13 lbf·ft (18 N·m).
9. Connect the hydraulic hose to the slave cylinder. Install the clamp, as removed.

⚠ WARNING

Use only approved clutch hydraulic fluid (DOT 3 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.

10. Fill the reservoir with approved DOT 3 hydraulic brake fluid. Flush and bleed the system according to the procedures in **Subject 140**.



06/20/2002 f250592

1. Timing Case Mounting Capscrew, M10
2. Hardened Flatwasher, M10
3. Timing Case Standoff Bracket
4. Cushioned Clamp
5. Bell Housing Standoff Bracket
6. Hydraulic Hose
7. Flatwasher, M10
8. Bell Housing-to-Timing Case Mounting Capscrew, M10
9. Flatwasher, M8
10. Slave Cylinder Mounting Capscrew, M8
11. Slave Cylinder

Fig. 1, Clutch Slave Cylinder

Slave Cylinder Replacement

NOTE: Make sure clean fluid comes out while bleeding.

11. Check the function of the clutch actuation system according to the procedures under the heading "Clutch Actuation System Check" in **Troubleshooting, 300.**

Hydraulic Clutch Removal and Installation

Special Tools

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

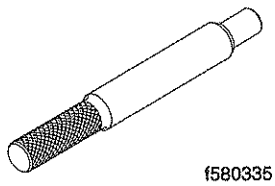
Special Tool			
Tool	**Description**	**Manufacturer**	**Part Number**
 f580335	Clutch Centering Pin	Kent-Moore	J-45719

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, see **Section 26.00**, Subject 110.
2. Remove the cover assembly. See **Fig. 1**. Loosen the capscrews in a star pattern, taking care not to loosen any one capscrew too much before loosening the next one.

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

3. Remove the clutch disc assembly.

Installation

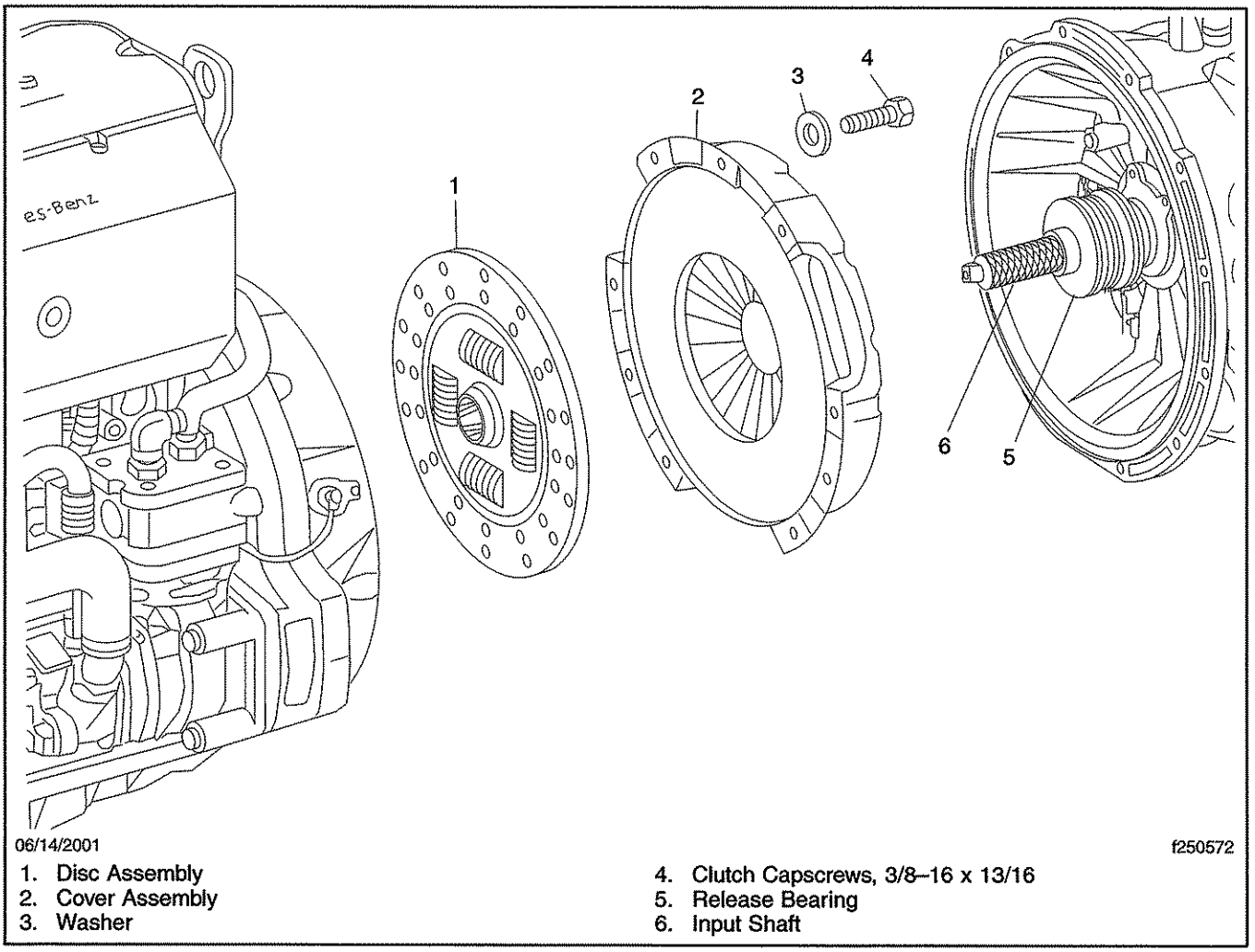
1. Grease the splines of the input shaft and the hub of the disc assembly. Remove any excess grease.

NOTE: Do not grease the guide of the release bearing. The release bearing is made of plastic with an embedded grease.

IMPORTANT: Don't remove the centering pin until the clutch is completely installed.

2. Using the centering pin (**Table 1**), center the disc assembly on the input shaft. See **Fig. 2**.
3. Install the cover assembly.
   - 3.1 Tighten the capscrews progressively in a star pattern. Do not put more tension on one side of the clutch than on the other.
   - 3.2 Tighten the eight clutch capscrews to a final torque of 37 lbf·ft (50 N·m).
4. When all bolts have been tightened, remove the centering pin.
5. Install the transmission on the engine. For instructions, see **Section 26.00**, Subject 110.

Hydraulic Clutch Removal and Installation



1. Disc Assembly
2. Cover Assembly
3. Washer
4. Clutch Capscrews, 3/8–16 x 13/16
5. Release Bearing
6. Input Shaft

Fig. 1, Clutch Assembly

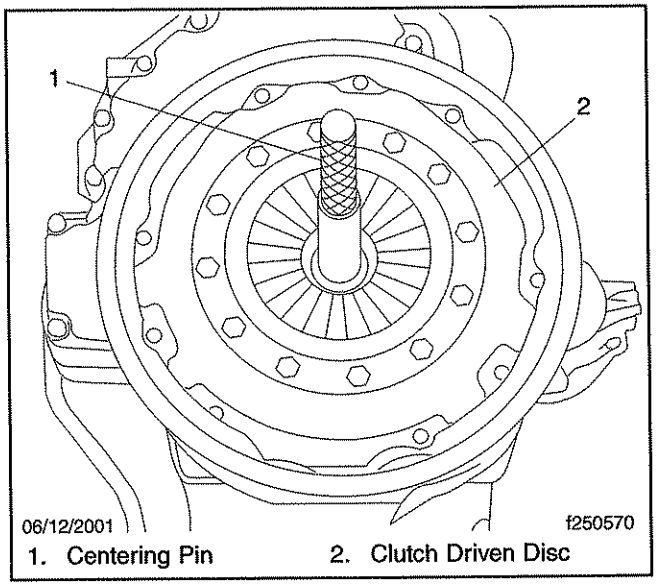


Fig. 2, Centering the Disc

NOTE: Use pressurized bleeding to flush a unit for service. Use manual bleeding if a problem arises during the pressurized bleeding process.

Filling and Bleeding Using a Pressurized Bleeding Unit

1. Apply the parking brake and chock the tires.

⚠ WARNING

Clutch hydraulic fluid (DOT 3 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.

2. Prepare the pressure bleeding equipment according to the manufacturer's instructions. Use DOT 3 brake fluid. Pressurize the bleeder unit to 15 psi (103 kPa).

⚠ WARNING

Use only approved clutch hydraulic fluid (DOT 3 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.

3. Remove the reservoir lid and install the pressure bleed adaptor on the reservoir. See **Fig. 1**.

4. Remove the cap from the bleed valve. Install a transparent drain hose on the bleed valve of the slave cylinder. See **Fig. 2**.

IMPORTANT: The slave cylinder may not be mounted in a horizontal position. If it isn't, remove the slave cylinder and hold it in a horizontal position to completely purge all air from the cylinder.

5. Pressurize the reservoir, filling the system. Open the bleed valve on the bleed tank.

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

6. Press the clutch pedal all the way down and keep it down.

7. Open the slave cylinder bleed valve. Observe the flow of clutch hydraulic fluid through the drain hose. When no bubbles appear in the fluid, close the valve on the slave cylinder. Release the clutch pedal and then close the valve at the bleeder unit.

NOTE: Make sure clean fluid comes out while bleeding.

8. Disconnect the bleeder unit, and install the cap on the slave cylinder bleed valve. Tighten the bleed screw 65 lbf·in (740 N·cm).

9. Check the fluid level in the reservoir. If necessary, add or remove DOT 3 brake fluid to bring the fluid level to the MAX line. Install the reservoir cap.

10. Depress the clutch pedal a few times. There should be resistance over the full pedal stroke.

11. Check the entire system for leaks. Tighten connections if necessary. Check the fluid level in the reservoir again.

12. Remove the chocks from the tires.

Manual Filling and Bleeding

1. Apply the parking brake and chock the tires.

2. Raise the hood.

⚠ WARNING

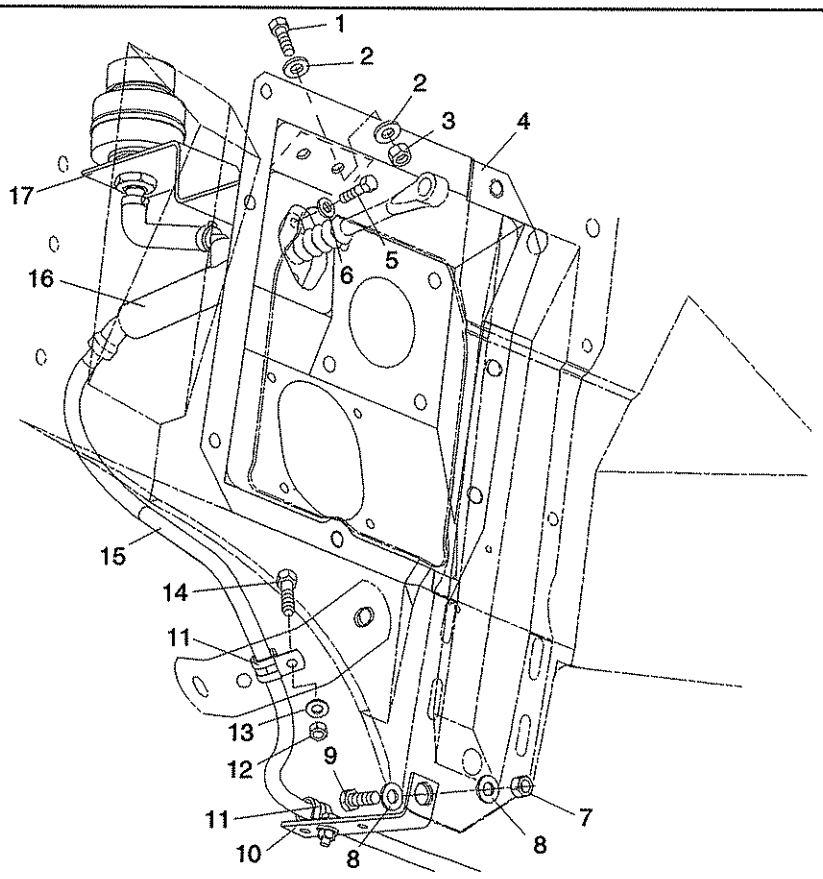
Clutch hydraulic fluid (DOT 3 brake fluid) is hazardous. It may be a skin irritant and can cause blindness if it gets in your eyes. Always wear safety glasses when handling clutch hydraulic fluid or bleeding hydraulic lines. If you get clutch hydraulic fluid on your skin, wash it off as soon as possible.

3. Fill the reservoir with DOT 3 brake fluid. Check periodically throughout the bleed process to make sure that the reservoir remains full.

⚠ WARNING

Use only approved clutch hydraulic fluid (DOT 3 brake fluid). Do not mix different types of brake fluid. The wrong fluid will damage the rubber parts

Clutch Hydraulic System Filling and Bleeding



06/20/2002 f250593

1. Reservoir Bracket Mounting Bolt, 5/16–24
2. Steel-Plated Washer, 5/16
3. Locknut, 5/16–24
4. Clutch Support Plate
5. Master Cylinder Capscrew, M6
6. Hardened Flatwasher, M6
7. Locknut, 1/2–13
8. Hardened Flatwasher, 0.53
9. Frontwall Bracket Mounting Bolt, 1/2–13
10. Frontwall Standoff Bracket
11. Cushioned Clamp
12. Locknut, 1/4–20
13. Steel-Plated Washer, 1/4
14. Clamp Mounting Bolt, 1/4–20
15. Hydraulic Hose
16. Master Cylinder
17. Reservoir Bracket

Fig. 1, Clutch Master Cylinder

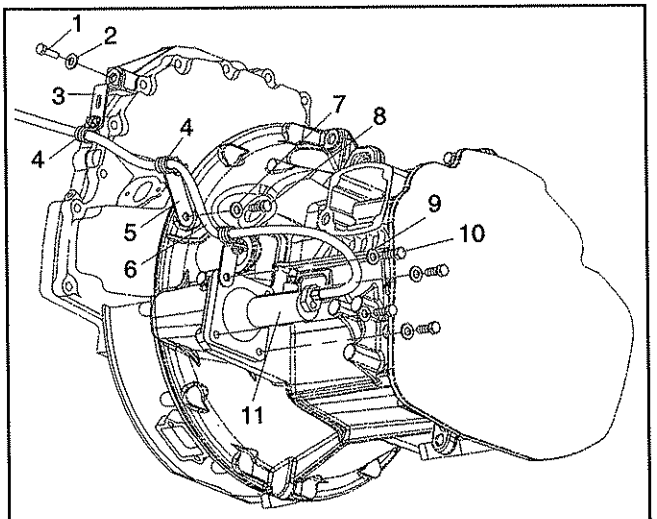
of the system, causing loss of clutch function and the risk of serious personal injury.

4. Place a wrench on the bleed valve.
5. Remove the cap from the bleed valve. Install a transparent drain hose on the bleed valve of the slave cylinder.
6. Open the bleed valve and allow the fluid to drain into a drain pan or other suitable container.
7. Observe the flow of clutch hydraulic fluid through the drain hose. When no bubbles appear in the fluid, close the bleed valve.

NOTE: The following procedure requires two persons, one to operate the bleed valve and the other to press on the clutch pedal.

8. Bleed the air from the hydraulic clutch system.
   - 8.1 Press the clutch pedal down by hand, using a slow stroke. Stop before the pedal reaches the floor.

Clutch Hydraulic System Filling and Bleeding



06/20/2002 f250592

1. Timing Case Mounting Capscrew, M10
2. Hardened Flatwasher, M10
3. Timing Case Standoff Bracket
4. Cushioned Clamp
5. Bell Housing Standoff Bracket
6. Hydraulic Hose
7. Flatwasher, M10
8. Bell Housing-to-Timing Case Mounting Capscrew, M10
9. Flatwasher, M8
10. Slave Cylinder Mounting Capscrew, M8
11. Slave Cylinder

Fig. 2, Clutch Slave Cylinder

8.2 Open the bleed valve while the other person is pressing down on the pedal.

8.3 Close the bleed valve quickly, before the pedal stroke has ended.

8.4 Slowly return the pedal to the top of its travel.

8.5 With the bleed valve closed, pump the pedal several times slowly.

8.6 Observe the clean fluid in the drain hose for air bubbles. Repeat this procedure as often as necessary, until no bubbles appear in the fluid.

NOTE: Make sure clean fluid comes out while bleeding.

9. Check the function of the clutch actuation system according to the procedures under the heading "Clutch Actuation System Check" in **Troubleshooting, 300.**

10. If the pedal still feels soft or spongy, there may be air in the system.

10.1 Press the pedal halfway down, then quickly jerk the pedal back to the top of its travel. Repeat a few times.

10.2 Repeat the bleed procedure above until the pedal feels firm and responsive.

11. Check the fluid level in the reservoir and add fluid if necessary.

12. Tighten the bleed screw 65 lbf·in (740 N·cm).

13. Remove the chocks from the tires.

Release Bearing and Yoke Assembly Replacement

Replacement

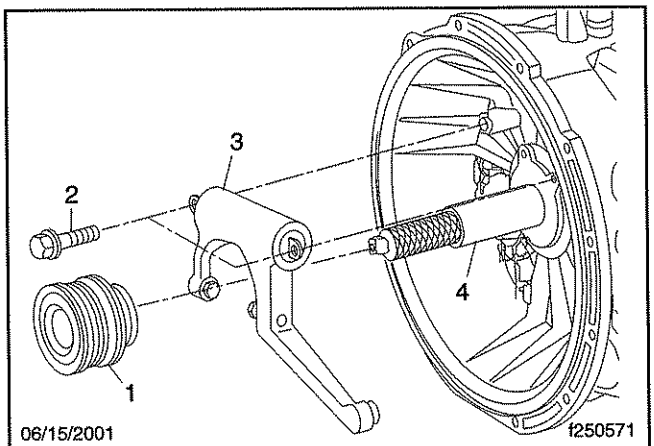
1. Remove the transmission from the engine. For instructions, see **Section 26.00**, Subject 110.
2. Remove the release bearing from the release yoke. See**Fig. 1.**
3. Remove the two capscrews attaching the release yoke to the bell housing. Remove the release yoke from the transmission.
4. Install the release yoke. Tighten the two capscrews 33 lbf·ft (45 N·m).

IMPORTANT: Position the release bearing with the stop pin located at either the top or the bottom.

5. Install the bearing onto the release yoke.

NOTE: Do not grease the guide of the release bearing. The release bearing is made of plastic with an embedded grease.

6. Install the transmission on the engine. For instructions, see **Section 26.00**, Subject 110.



1. Release Bearing
2. Mounting Capscrew
3. Release Yoke
4. Input Shaft

Fig. 1, Release Yoke Assembly

Hydraulic Hose Replacement

Replacement

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

⚠ WARNING

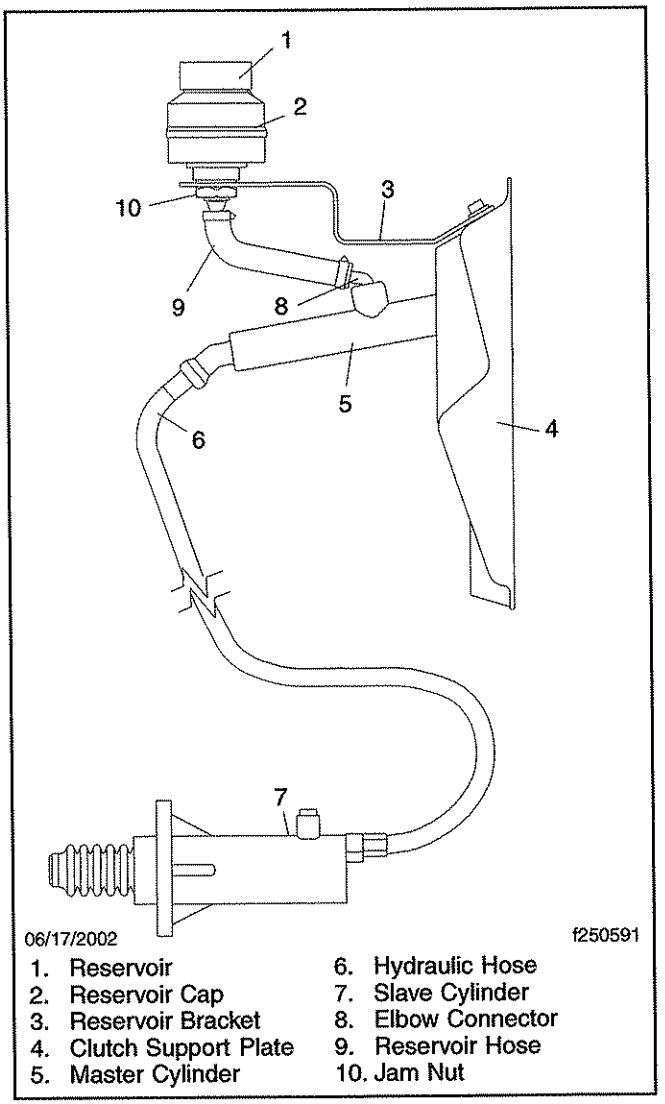
Clutch hydraulic fluid (DOT 3 brake fluid) is hazardous. It may be a skin irritant and can cause blindness if it gets in your eyes. Always wear safety glasses when handling clutch hydraulic fluid or bleeding hydraulic lines. If you get clutch hydraulic fluid on your skin, wash it off as soon as possible.

3. Using a flat-head screwdriver, remove the quick-disconnect clamp that attaches the hydraulic hose to the slave cylinder. Retain the clamp for later installation. See **Fig. 1**.
4. Drain the hydraulic fluid from the entire system. For detailed procedures, see **Subject 100**.
5. Using a flat-tip screwdriver, remove the quick-disconnect clamp that attaches the old hydraulic hose to the hose connector on the master cylinder. Retain the clamp for later installation.
6. Connect the new hydraulic hose to the slave cylinder and the hose connector. Install the clamps, as removed.

⚠ WARNING

Use only approved clutch hydraulic fluid (DOT 3 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.

7. Fill the reservoir with approved DOT 3 hydraulic brake fluid and bleed the system according to the procedures in **Subject 140**.
8. Check the function of the clutch actuation system according to the procedures under the heading "Clutch Actuation System Check" in **Troubleshooting, 300**.

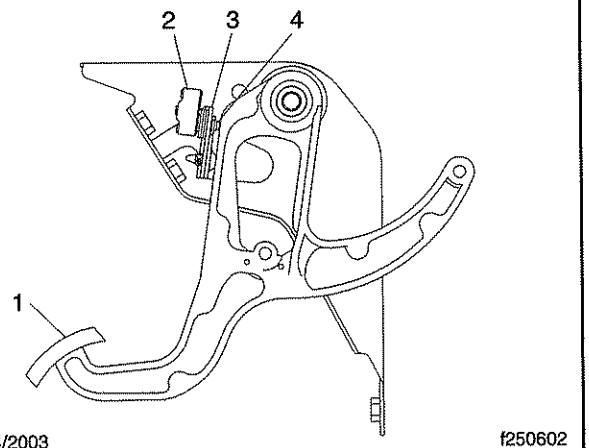


1. Reservoir
2. Reservoir Cap
3. Reservoir Bracket
4. Clutch Support Plate
5. Master Cylinder
6. Hydraulic Hose
7. Slave Cylinder
8. Elbow Connector
9. Reservoir Hose
10. Jam Nut

Fig. 1, Clutch Components

Replacement

1. Disconnect the clutch control switch connector located under the dash just above the clutch pedal.
2. Remove the fasteners holding the switch to the pedal stop bracket. Retain the fasteners for later installation. See **Fig. 1**.
3. Remove the switch assembly from the pedal stop bracket.
4. Mount the new switch assembly on the pedal stop bracket and tighten the 15/32–32 hexnuts.
5. Connect the clutch control electrical connector, and check the function of the clutch actuation system according to the procedures under the heading "Clutch Switch Check" in **Troubleshooting, 300**.



1. Pedal
2. Clutch Switch
3. Pedal Stop Bracket
4. Fasteners

Fig. 1, Clutch Switch Replacement

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 of the hydraulic clutch system, bleed the clutch before restoring the vehicle to service. This will prevent air from remaining in the system.

Clutch Leak Check

⚠ WARNING

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

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.

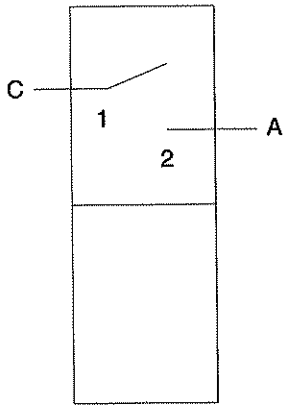
3. Have one person press down on the clutch pedal while the other person checks the clutch hydraulic system for signs of leakage.

Clutch Actuation System Check

1. Shut down the engine.
2. Apply the parking brakes, chock the front and rear tires, and open the hood.
3. Do the "Clutch 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, the engine will start and then stall. Take corrective action using the information under the heading "Troubleshooting Tables."
6. Remove the chocks from the front and rear tires.
7. Test drive the vehicle.
   - 7.1 Check for proper clutch functioning while shifting gears.
   - 7.2 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 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. Do a continuity check between pin A and pin C of the connector. See **Fig. 1.**
   - 4.1 With the pedal not pressed, the circuit should be closed and resistance should be measured.



03/24/2003 f250590a

The switch is normally open, but held closed.

NOTE: Pin "B" is not used.

1. Open Position 2. Closed Position

Fig. 1, Clutch Switch Positions

4.2 With the pedal pressed down about 4 inches (10 cm), the switch should open and no resistance should be measured.

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.	Check clutch function and make any necessary repairs. See the instructions under the heading "Clutch Actuation System Check."
The assist spring is broken.	Replace the clutch pedal.
The pedal assembly is worn or jammed.	Replace the clutch pedal.
The master cylinder has components that are jammed or broken.	Replace the master cylinder. See **Subject 110** for instructions.

Problem–The Clutch Does Not Completely Disengage; Shifting Is Difficult

Problem–The Clutch Does Not Completely Disengage; Shifting Is Difficult	
Possible Cause	**Remedy**
The clutch is worn.	Replace the clutch. See **Subject 130** for instructions.
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.
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 3 brake fluid.

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 cam is damaged.	Replace the clutch pedal.

⚠ 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–The Clutch Pedal Does Not Return

Problem–The Clutch Pedal Does Not Return	
Possible Cause	**Remedy**
The assist spring is broken.	Replace the clutch pedal.

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 clutch 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 54.01** for instructions.

Specifications

For fastener torque values, see **Table 1**.

Torque Values, Hydraulic Clutch				
Description	**Size**	**Grade**	**Torque in lbf.ft (N.m)**	**Torque in lbf.in (N.cm)**
Bleed Screw	—	—	—	65 (740)
Clutch Capscrews	3/8–16	5	37 (50)	—
Master Cylinder Mounting Capscrews	M6	8.8	—	60 (680)
Release Yoke Mounting Capscrews	—	—	33 (45)	—
Reservoir Bracket Jam Nut	M18	—	147 (199)	—
Reservoir Bracket Mounting Bolts	5/16–24	5	13 (18)	—
Slave Cylinder Mounting Capscrews	M8	10.9	13 (18)	—
Standoff Bracket Mounting Capscrews	1/4–20	8	10 (14)	—

Table 1, Torque Values, Sachs Hydraulic Clutch

Special Tools

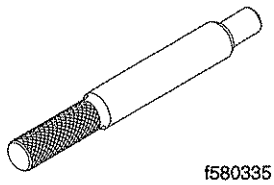
Special Tool			
Tool	**Description**	**Manufacturer**	**Part Number**
 f580335	Clutch Centering Pin	Kent-Moore	J-45719

Table 1, Special Tool for Clutch Removal and Installation