



Eaton® Fuller® Medium-Duty Clutches

Roadranger®

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Service Manual

Eaton® Fuller® Medium-Duty Clutches

CLSM0100

March 2011

Solo® Medium-Duty

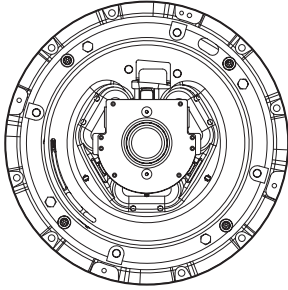
UltraShift™ MD DM Clutch

Stamped Angle Spring Clutch

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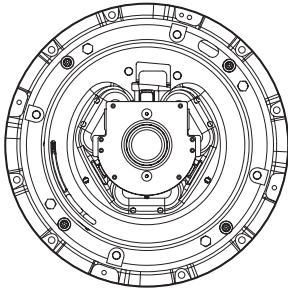
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Solo® Medium-Duty 14" Clutch

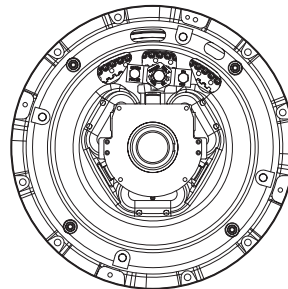
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Warnings and Cautions

Repair Warnings

The major cause of clutch failure is excessive heat. Excessive heat generated between the flywheel, driven discs, intermediate plate and pressure plate can cause the metal to flow and the material to be destroyed. If this occurs, the clutch can burst which can cause property damage, serious bodily injury or death. In order to prevent clutch failure resulting from excessive heat:

1. Do not exceed recommended vehicle loads.
2. The clutch should only be used for the recommended applications.
3. Drivers should be properly trained in starting, shifting and operation of the clutch.
4. Drivers should report erratic clutch operation as soon as possible to permit maintenance personnel to inspect, adjust or lubricate as required.
5. Mechanics must be familiar with proper clutch adjustment, linkage adjustment, lubrication and other maintenance troubleshooting procedures outlined in the Failure Analysis Guide.

When disassembling various assemblies, lay all parts on a clean bench in the same sequence as removed to simplify and reduce the possibility of losing parts.

Since the cost of a new part is generally a small fraction of the cost of downtime and labor, avoid reusing a questionable part that could lead to additional repairs and expense.

Use of other than recommended tools, parts, and instructions listed in this manual may place the safety of the service technician or vehicle driver in jeopardy.

The removal and installation procedure described for each component may vary for your vehicle.

 **IMPORTANT**

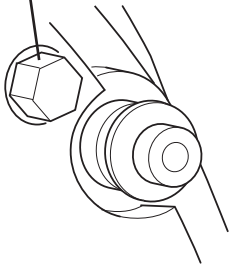
For Solo only, install shipping bolts before removing clutch.

For service information and assistance, call the Roadranger Help Desk at 1-800-826-HELP (4357) (Mexico: 01-800-826-HELP (4357)). You may also find more information about Eaton Fuller Clutches at www.Roadranger.com.

Every effort has been made to ensure the accuracy of the information contained in this manual. However, Eaton Corporation makes no warranty, expressed or implied, based on the information provided.

Out of Vehicle Resetting Procedure

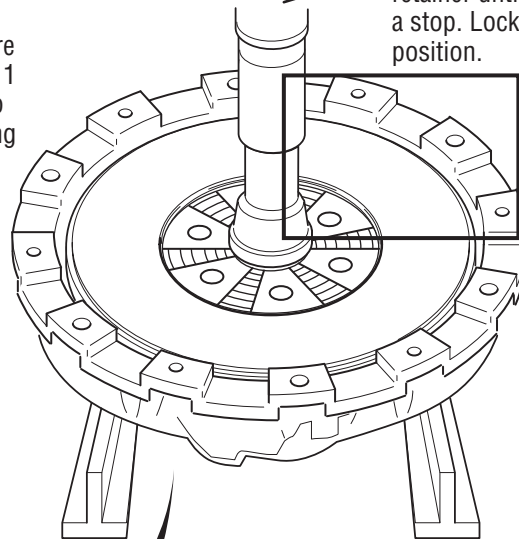
- 1 Remove the four (4) shipping bolts if they have been installed



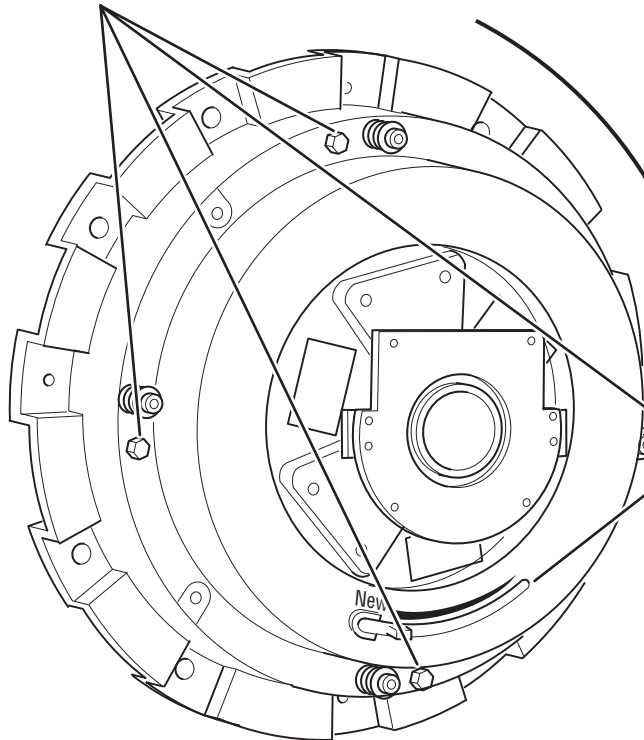
- 2 Support the clutch in an arbor press with the bearing facing down.

Note: Make sure there is at least 1 inch of space to allow the bearing to move down and to provide access to the shipping bolts.

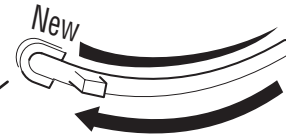
- 3 Center the ram and press downward on the retainer until it comes to a stop. Lock the ram in position.



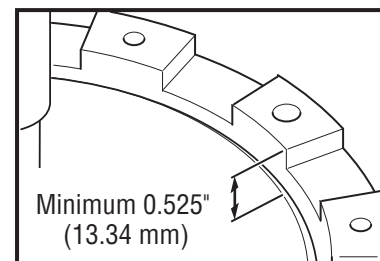
Shipping Bolts



- 4 Slide the wear indicator tab to the "NEW" position and hold it in place with a magnet



- 5 Install four (4) shipping bolts (3/8" x 16 x 1 1/4" UNC, hex head). Progressively tighten (no air wrenches) the four (4) shipping bolts (criss-cross pattern) until the face of the pressure plate is minimum 0.525" (13.34 mm) below the mounting surface.



- 6 Reinstall the clutch using the original installation instructions.

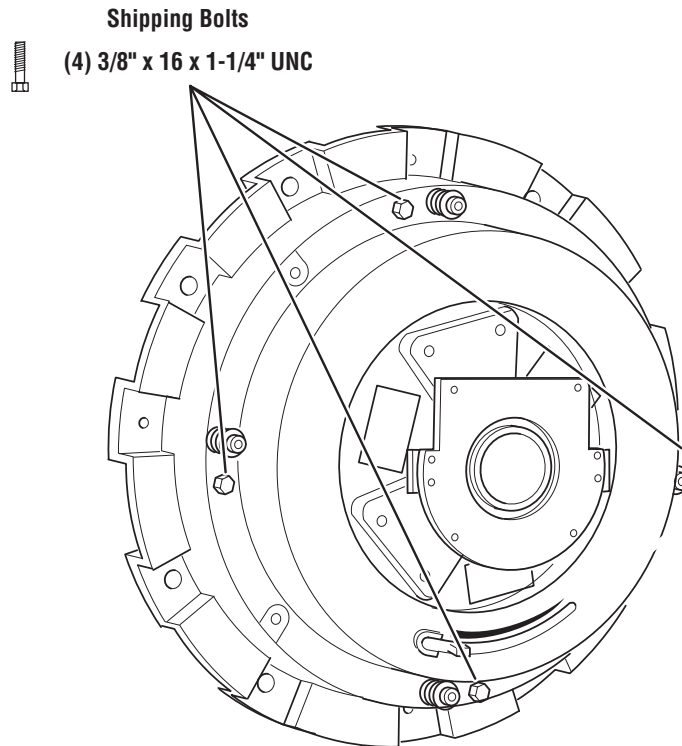
Note: This important step will reset the pressure plate spacers and allow the clutch to release after reinstallation

Clutch Removal Procedure

(If clutch is to be reinstalled and transmission is still in vehicle)

Caution: Note the position of the wear indicating tab on the clutch. If the tab is near the "REPLACE" position, the clutch should be replaced.

1. Locate four (4) 3/8" x 16 x 1 1/4" UNC, hex head machine screws. Install them in the 4 cover holes and turn them finger-tight.



2. Support the Clutch during the removal of the 8 mounting bolts.
3. Remove the clutch from the flywheel.

Note: Mark the proper position of the discs and intermediate plate (for reinstallation).

4. Reinstall the clutch using the original installation instructions for Eaton Solo Medium Duty Clutches or you can reach the nearest Eaton® Roadranger® Sales and Service office by calling 1-800-826-HELP (4357) from anywhere in North America 24 hours a day.

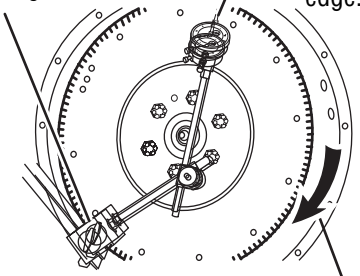
Solo® Medium-Duty 14" Clutch Installation

Measure Engine Flywheel Housing and Flywheel

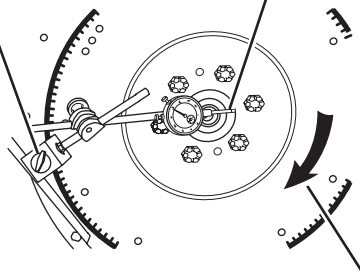
Engine flywheel housing and flywheel must meet these specifications or there will be premature clutch failure. Remove and replace old pilot bearing per engine manufacturer instructions. All gauge contact surfaces must be clean and dry. Clean flywheel surfaces of all grease, oil, and rust preventatives. Failure to perform this function can affect the performance of the clutch.

Use a dial indicator and check the following:

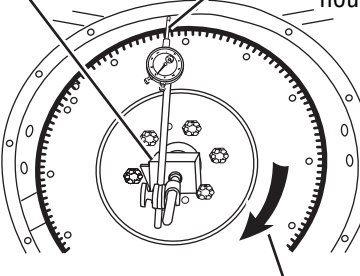
Flywheel Face Runout

- 1 Secure dial indicator base to flywheel housing face.
 - 2 Put gauge finger in contact with flywheel face near the outer edge.
 - 3 Rotate flywheel one revolution. Maximum runout is .007" (.18 mm).
- 

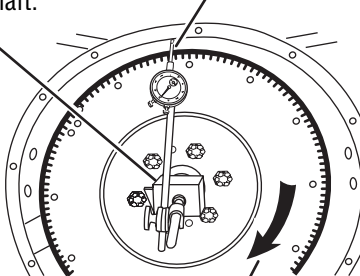
Pilot Bearing Bore Runout

- 1 Secure dial indicator base to flywheel housing face.
 - 2 Position gauge finger so that it contacts pilot bearing bore.
 - 3 Rotate flywheel one revolution. Maximum runout is .005" (.13 mm).
- 

Flywheel Housing I.D. Runout

- 1 Secure dial indicator base to crankshaft.
 - 2 Put gauge finger against flywheel housing pilot I.D.
 - 3 Rotate flywheel one revolution. Maximum runout is .008" (.20 mm).
- 

Flywheel Housing Face Runout

- 1 Secure dial indicator base to crankshaft.
 - 2 Put gauge finger against flywheel housing pilot I.D.
 - 3 Rotate flywheel one revolution. Maximum runout is .008" (.20 mm).
- 

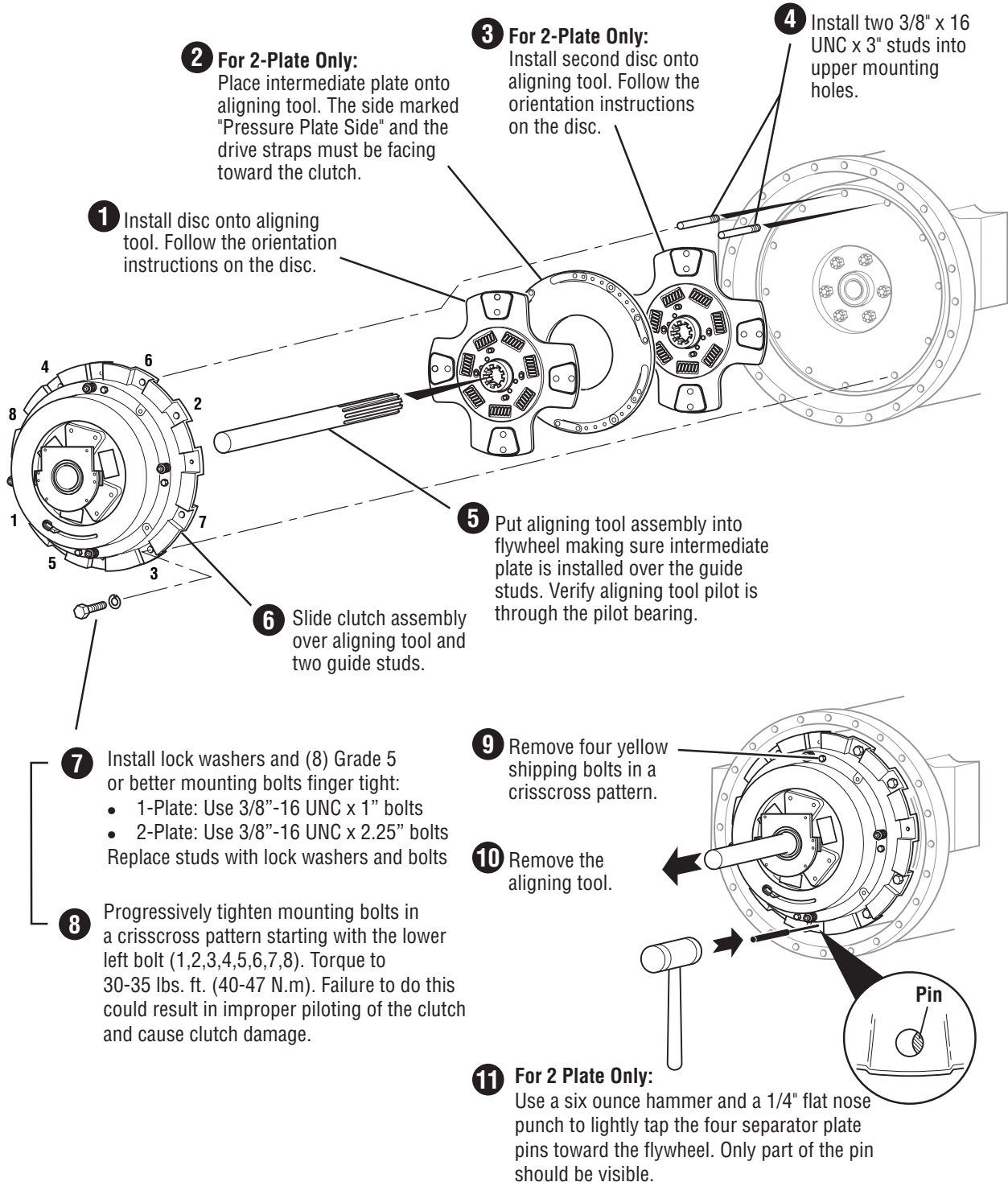
Install Clutch to Flywheel

IMPORTANT

Use the Eaton Fuller Medium-Duty Clutch Selector Guide (CLSL-1310) to make sure you have the right clutch!

CAUTION

An assembled clutch can weigh up to 120 lbs. (54 kg). Avoid the risk of injury. Use proper equipment when lifting a clutch.



Install Transmission

Check Transmission For Wear

Replace any worn components.

Transmission Bearing Retainer Cap

A worn/rough bearing retainer cap may cause the clutch brake to wear prematurely.

Cross Shaft and Bushings

Excessive wear at these points can cause side loading on the sleeve bushing, bushing failures and yoke bridge contact with the clutch when the pedal is down.

Input Shaft Splines

Any wear on the splines will prevent the driven discs from sliding freely, causing poor clutch release (clutch drag). Slide discs full length of shaft to check for twisted shaft splines.

Release Yoke

Worn fingers can cause bushing wear and yoke interference when the pedal is down.

Input Shaft

Wear (roughness) can reduce sleeve bushing life and cause it to come out.

Clutch Brake

Replace if equipped.

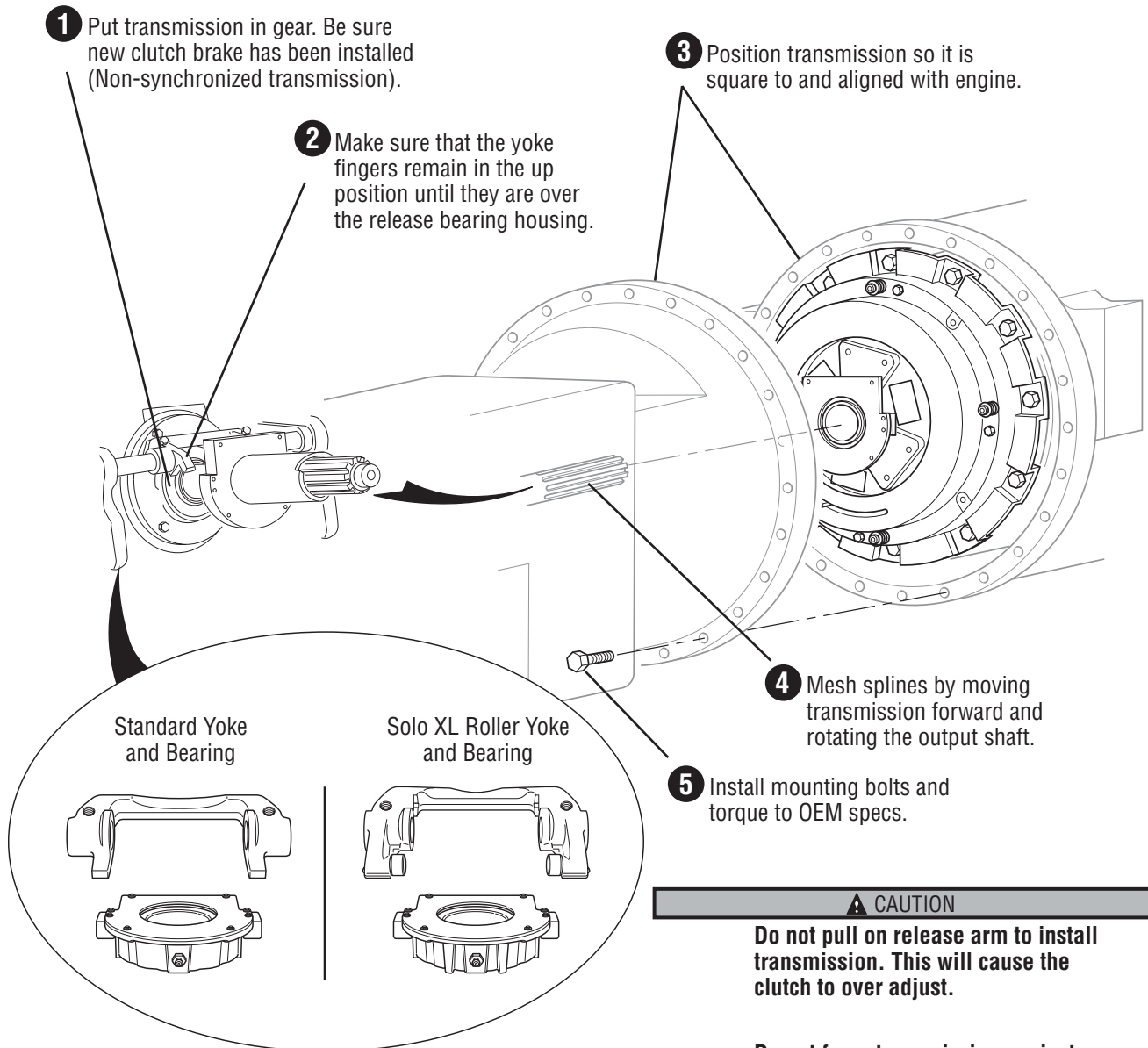
CAUTION

Do not excessively force the transmission into the clutch assembly or engine housing. This will cause damage to the splines of the rear disc hub that is not warrantable. If the discs do not slide freely in the input shaft, investigate the cause of the problem and make any necessary changes. If the discs do not slide freely, the clutch will not release and the transmission will grind going into gear.

Do not use the cross-shaft release lever (or a pipe over it) to pull the transmission into its final position. Pulling the bearing too far during installation can cause an overstroke causing the release bearing to move closer to the transmission (less than .490"). Follow the Out of Vehicle Resetting Procedure on page 1.

Do not let the transmission drop or hang unsupported in the driven discs. This can bend the discs and the clutch will not release causing damage that is not warrantable.

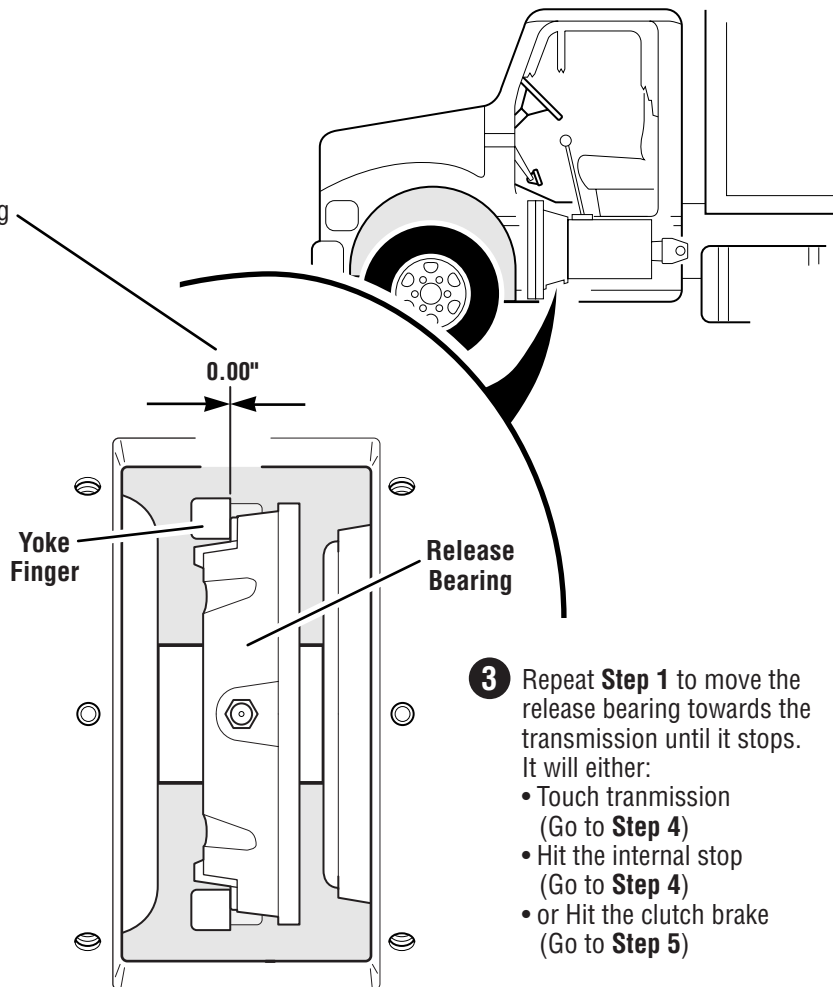
Fasten Transmission to Flywheel Housing



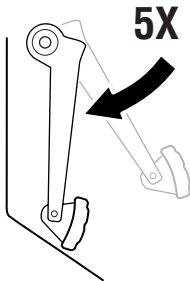
Set-up (Mechanical Linkage Only)

Note: For trucks with hydraulic linkage, see page 35.

- 1** Adjust the clutch linkage until the yoke fingers contact the release bearing (zero free-play in cab).



- 2** Press the pedal to the floor up to 5 times, this:
 - Moves release bearing slightly closer to the transmission
 - Gains free-play in cab



- 3** Repeat **Step 1** to move the release bearing towards the transmission until it stops. It will either:
 - Touch transmission (Go to **Step 4**)
 - Hit the internal stop (Go to **Step 4**)
 - or Hit the clutch brake (Go to **Step 5**)

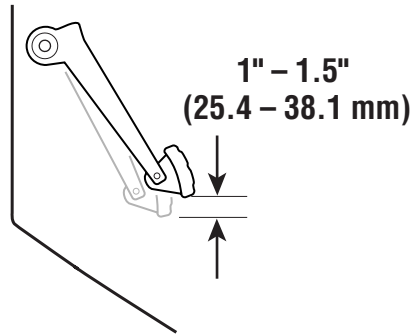
Adjust Linkage (Mechanical Linkage Only)

Note: For trucks with hydraulic linkage, see page 35.

Vehicles WITHOUT clutch brake

(Vehicles with clutch brake, proceed to Steps 5–8)

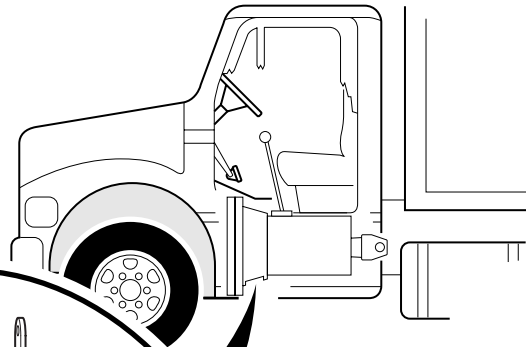
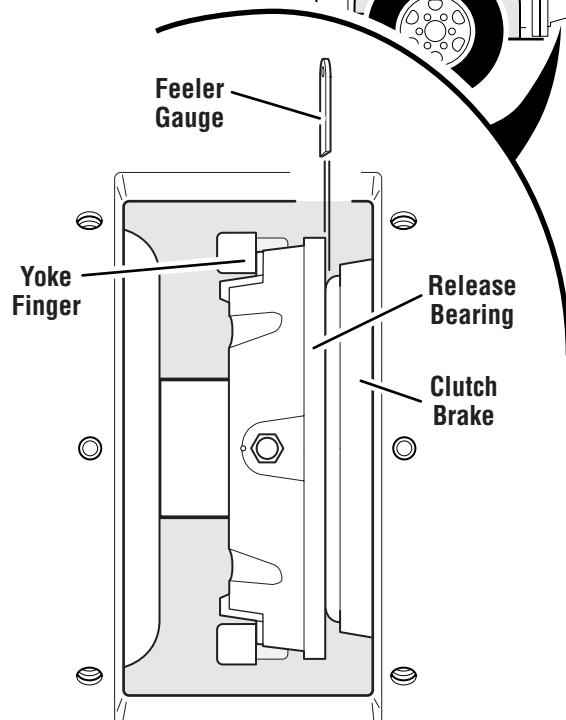
- 4** Adjust linkage to get 1" – 1.5" (25.4 – 38.1 mm) of free-play. Go to **Step 8**.



Vehicles WITH clutch brake:

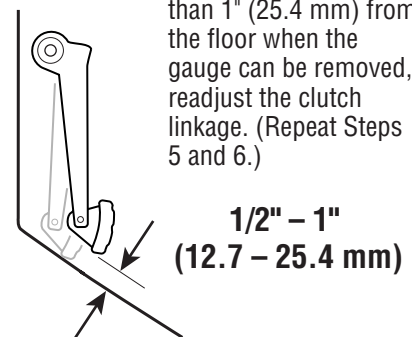
- 5** Insert .010" (.25 mm) feeler gauge between the release bearing and the clutch brake. Press the pedal down to clamp the gauge.

- If the gauge does not clamp, return to **Step 1** and readjust the clutch linkage.



- 6** Slowly let up on the pedal and check the pedal position at the moment the gauge can be removed.

- If the pedal is less than 1/2" (12.7 mm) or more than 1" (25.4 mm) from the floor when the gauge can be removed, readjust the clutch linkage. (Repeat Steps 5 and 6.)

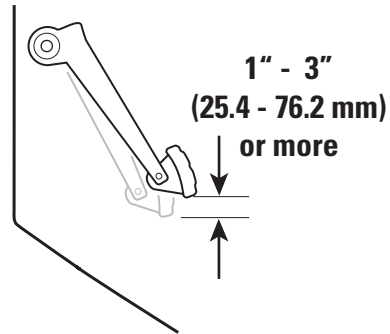


Verify Free-Play (Mechanical Linkage Only)

Note: For trucks with hydraulic linkage, see page 35.

Vehicles WITH clutch brake (continued)

- 7** Measure the free-play in the cab. The correct distance is 1" – 3" (25.4 – 76.2 mm).
 - If the free-play distance is not 1" – 3" (25.4 – 76.2 mm), go to **Step 8** and change the free-play.
- 8** Verify that there is free-play in the cab. If not, the truck linkage is not providing enough stroke, consult OEM truck manufacturer manual for free-play dimension.



⚠ IMPORTANT

DO NOT RESET CLUTCH. Do not change free-play by readjusting the clutch linkage.

Lubricate

NOTE: All clutches use a lithium complex base grease with a minimum of 325°F (163°C) operating range meeting N.L.G.I. grade 2 or 3 specs.

NOTE: Apply ample grease that is visibly exiting the opening and contacts the transmission shaft. This will lube the clutch brake and bushing when the pedal is pressed.

For additional lubrication information, see TCMT0021.

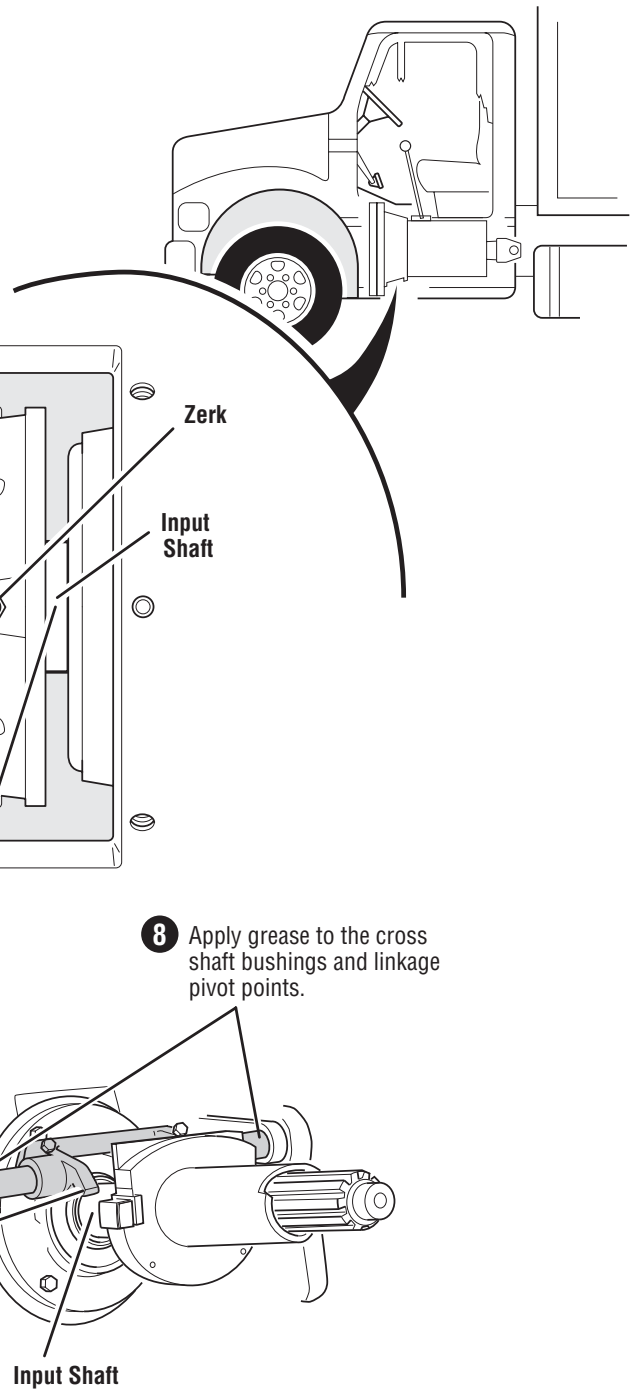
CAUTION

Failure to properly lubricate the bearing/bushing will result in bearing and bushing failures.

7 Apply grease to input shaft and yoke fingers.

8 Apply grease to the cross shaft bushings and linkage pivot points.

Input Shaft

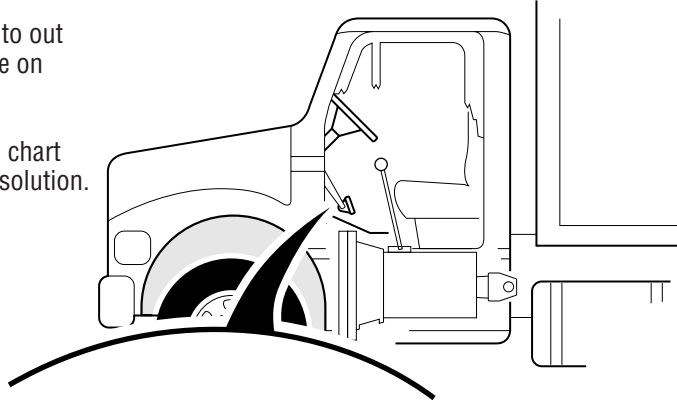


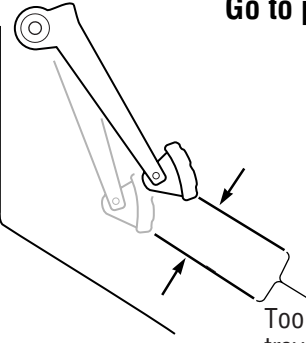
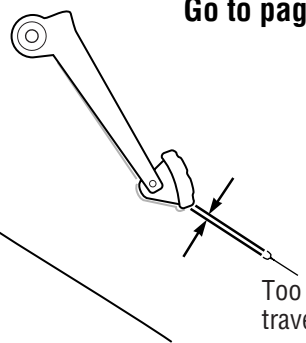
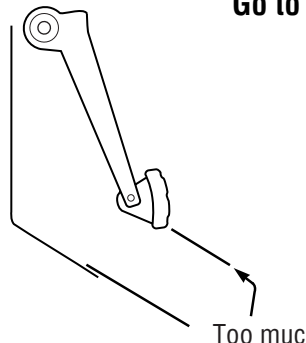
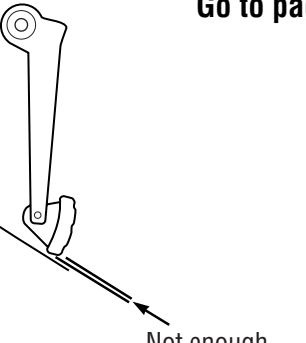
Solo® Medium-Duty 14" Clutch Troubleshooting

Symptom-Driven Diagnostics

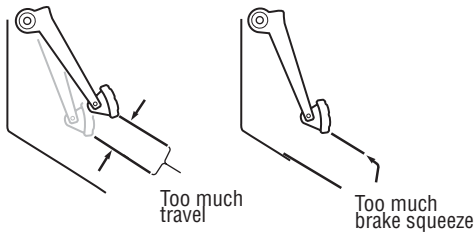
If clutch is out of vehicle, go to out of vehicle resetting procedure on page 1.

Based on your symptom, the chart will direct you to the correct solution.



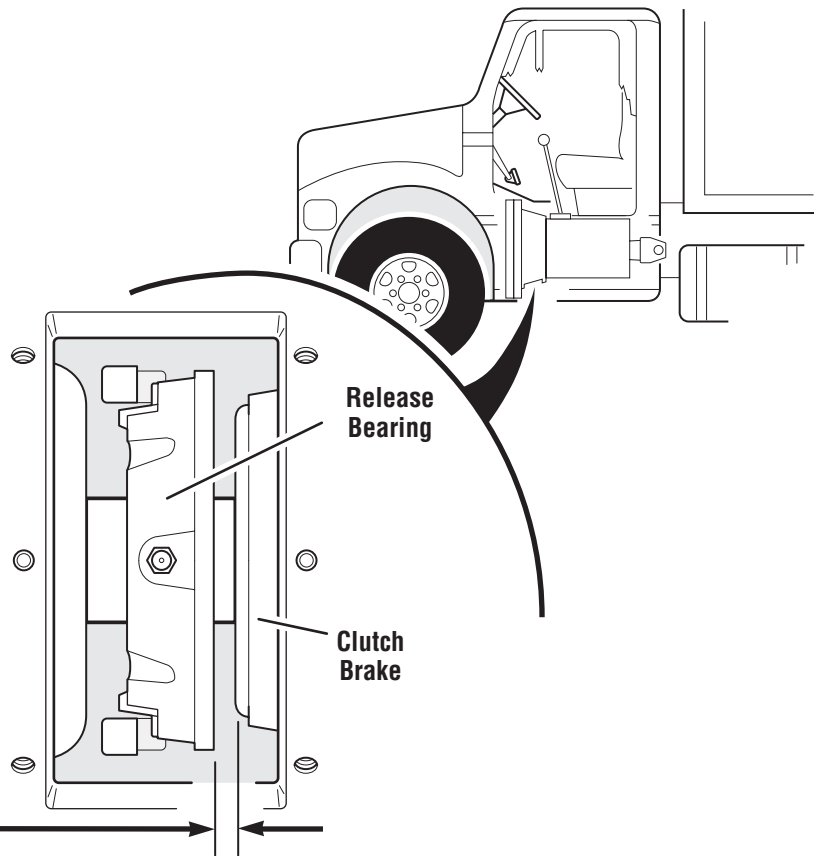
<p>✓ Too Much Free Pedal: Go to page 12</p>  <p>Too much travel</p> <p>Pedal travels too far before engaging clutch. Clutch does not disengage.</p>	<p>✓ Not Enough Free Pedal: Go to page 14</p>  <p>Too little travel</p> <p>Pedal travels too little before engaging the clutch.</p>
<p>✓ Too Much Clutch Brake: Go to page 12</p>  <p>Too much brake squeeze</p>	<p>✓ No Clutch Brake: Go to page 14</p>  <p>Not enough brake squeeze</p>

Too Much Free Pedal or Too Much Clutch Brake



Note: Before measuring the distance between the release bearing and clutch brake depress clutch pedal to remove free pedal in the cab.

- 1** Measure distance between release bearing and clutch brake.
- 2** Use chart to find solution.

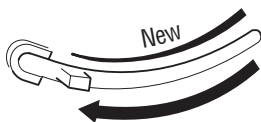


Measurement	Status	Solution
<input checked="" type="checkbox"/> If distance is correct .490" - .560" (12.45 - 14.22 mm)	Clutch is set up correctly	Problem exists with truck linkage. Repair according to OEM specifications. Hydraulic Linkage: Go to page 35
<input checked="" type="checkbox"/> If distance is Less than .490" (12.45 mm)	Clutch is not set up correctly	If clutch was factory installed and was never removed or if clutch was removed from engine and reinstalled. Go to page 13 If new/reman clutch was installed and it never operated properly, check wear tab position. If tab at NEW position, disc installed incorrectly. Go to page 4, Steps 1 and 3 If the shipping bolts have been removed. Go to page 4, Step 9 If tab not at NEW position, the bearing may have been pulled during installation causing an overadjust. Go to page 1

In Vehicle Resetting Procedure

- 1** Have assistant hold clutch pedal down.

- 2** While pedal is held down, move wear tab to the left (Good) position.



NOTE: If the cam does not move, loosen transmission and install 1/2" spacers between the clutch housing and engine housing to increase stroke.

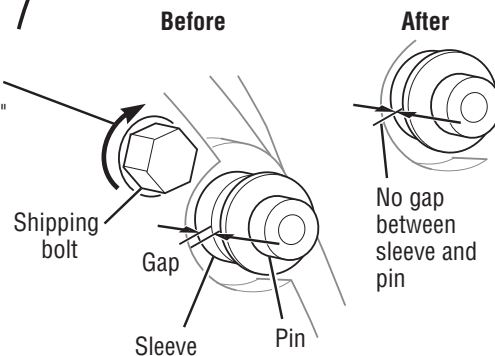
- With spacers in place, follow steps 1-3 in this procedure.
- Remove spacers and torque transmission mounting bolts.
- Continue process starting at Step 4.

Go to Page 14.

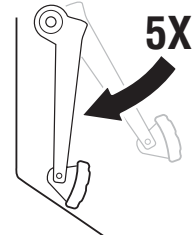
- 3** Let up on pedal. DO NOT push pedal down again or wear tab will return to the wrong position.



- 4** Install and tighten 4 shipping bolts (7/16" x 14 x 1-3/4 UNC) until they quit turning.



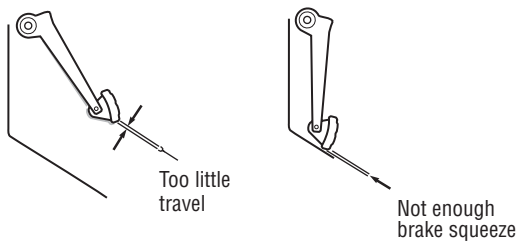
- 6** Push pedal down and squeeze clutch brake 5 times to reposition bearing.



- 5** Remove shipping bolts.

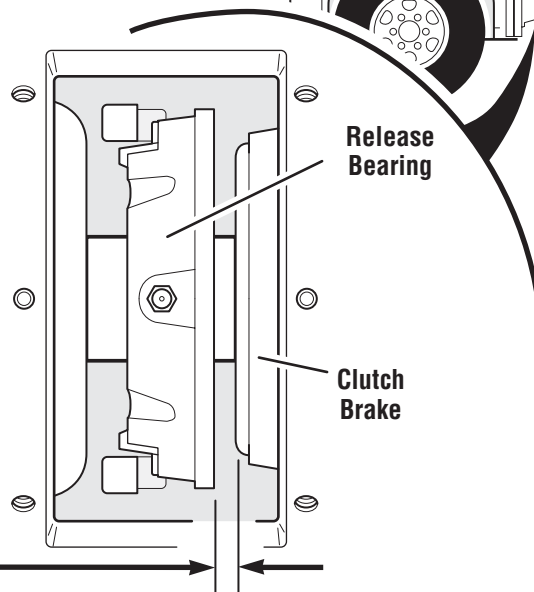
NOTE: This will remove the gap between the sleeve and the pin.

Not Enough Free Pedal or No Clutch Brake



Note: Before measuring the distance between the release bearing and clutch brake depress clutch pedal to remove free pedal in the cab.

- 1** Measure distance between release bearing and clutch brake.
- 2** Use chart to find solution.



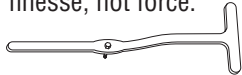
Measurement	Status	Solution
<input checked="" type="checkbox"/> If distance is correct .490" - .560" (12.45 - 14.22 mm)	→ Clutch is set up correctly	Problem exists with truck linkage. Repair according to OEM specifications. Hydraulic Linkage: Go to page 35
<input checked="" type="checkbox"/> If distance is More than .560" (14.22 mm)	→ Clutch is not set up correctly	If clutch was factory installed and was never removed, Go to page 15 (Seized Cam / Cam Spring)
		If clutch was removed from engine and reinstalled, Go to page 13 (In Vehicle Resetting Procedure)
		If new/reman clutch was installed and it never operated properly, Go to page 7 (Setup)

Seized Cam / Cam Spring

Loosen Cam

- 1 Have an assistant hold clutch pedal down.

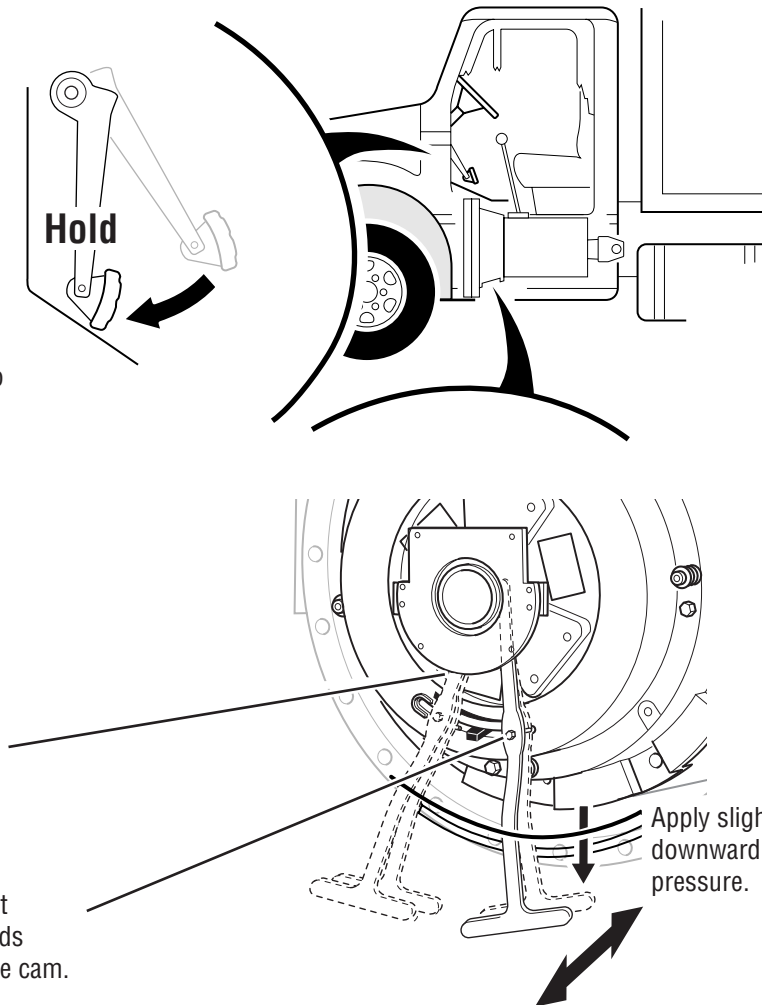
NOTE: Use the Seized Cam Adjustment Tool to free a seized cam and return the clutch to its normal function. Use finesse, not force.



Tool Part Code:
CLPI-SOLOTOOL

- 2 Insert end of tool through access panel opening and under bearing.

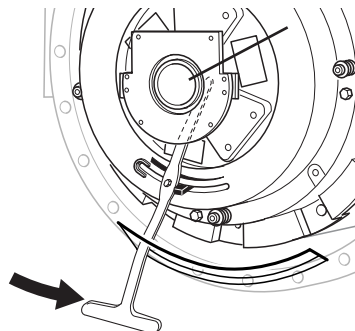
- 3 Position tool so that threaded bolt extends down into slot in the cam.



- 4 Use the tool to move the cam toward the right or "Replace" position:

If the cam moves easily:

- Move it back to the left to verify spring tension will pull it back to the right. If it will not return to the right, the cam spring may be broken.



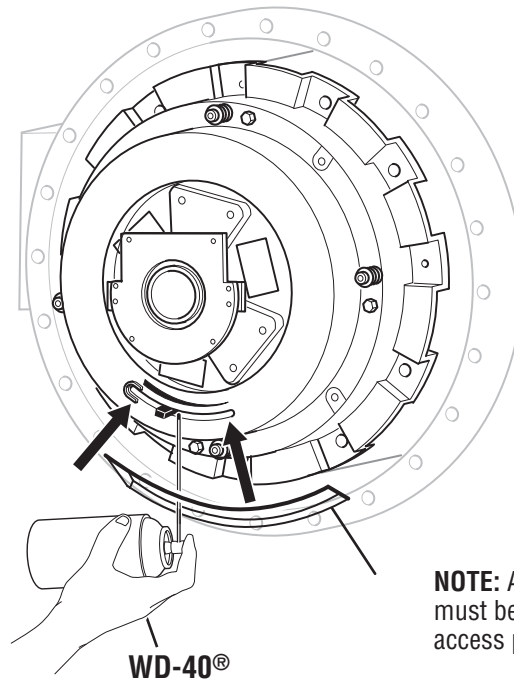
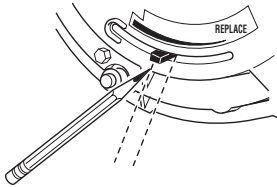
If the cam is stuck:

- Do not force the cam toward the engine. Instead, use sideways pressure to the right and lightly pull the tool away from the engine to separate the top cam from the bottom cam.
- When the cam moves slightly to the right, let up on the pedal. Verify there has been an increase in free pedal and that the bearing has moved closer to the transmission. (If equipped with a clutch brake, measurement should be .490" - .560" [12.45 - 14.22 mm].)
- If the cam is still seized:

Seized Cam

- 5** Spray WD-40 into cam slot and all three spring perches.
- Do not substitute another penetrant for WD-40. WD-40 is safe to use with cam material.
 - Make sure there is full penetration of liquid into cam.
 - Rotate engine to access all three locations.

- 6** Mark cam tab position. This mark will later serve as an indicator for cam adjustment.



NOTE: All adjustments must be done through access panel opening.

To reach other locations, rotate flywheel.

- 7** If cam is still seized:
- Repeat WD-40 spray at all three spring perches.
 - Let up and push down on clutch pedal.
 - When clutch pedal is down, jiggle the tool in the cam slots to apply pressure in all directions.

NOTE: The Seized Cam Tool should not be used for normal adjustments. Follow the Setup procedure on page 6.

UltraShift™ MD DM Clutch

Remove Clutch

⚠ WARNING

An assembled clutch weighs about 100 lbs. (45 kg). Avoid the risk of injury. Use proper equipment when lifting a clutch.

- 1** Prior to removing the transmission, rotate the engine until one of the jack screw locations can be viewed through the clutch housing inspection opening.

- 2** Using a piece of 5/16" x 18 UNC x 3" threaded rod (jack screw), install two nuts on one end and lock them together. This will allow you to turn the jack screw in and out of the cover assembly.

- 3** Install the jack screw into one of the four holes located adjacent to the clutch mounting bolts. This forces the pressure plate forward clamping the disc, holding it in place.

⚠ CAUTION

Do not overtighten the jack screw. Tightening more than 9 lbs. ft. can cause permanent clutch damage.

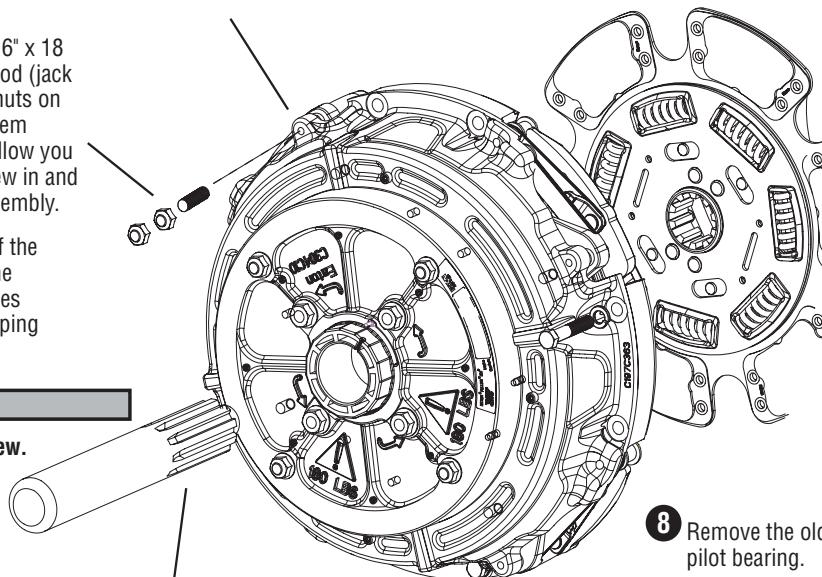
- 4** Remove the transmission, supporting its weight to prevent damage to the clutch disc.

- 5** Insert alignment shaft and clutch jack.

- 6** Remove the jack screw.

- 7** Unbolt the clutch from the flywheel and slide the clutch away from the flywheel.

- 8** Remove the old pilot bearing.

**⚠ WARNING**

An assembled clutch weighs about 100 lbs. (45 kg). Avoid the risk of injury. Use proper equipment when lifting a clutch.

⚠ CAUTION

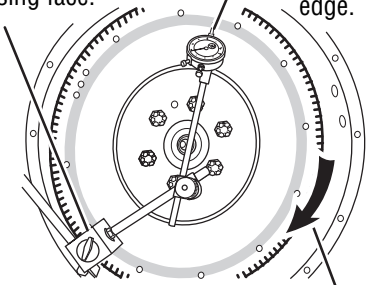
When removing the clutch, the flywheel side disc can fall off of the alignment shaft, permanently damaging the driven disc.

Measure Engine Flywheel Housing and Flywheel

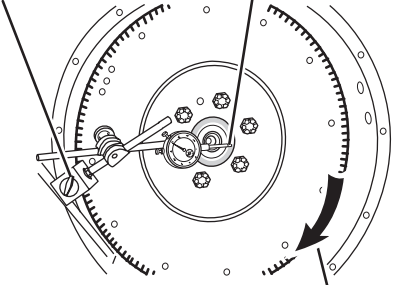
Engine flywheel housing and flywheel must meet these specifications or there will be premature clutch failure. Remove and replace old pilot bearing per engine manufacturer instructions. All gauge contact surfaces must be clean and dry. Clean flywheel surfaces of all grease, oil, and rust preventatives. Failure to perform this function can affect the performance of the clutch.

Use a dial indicator and check the following:

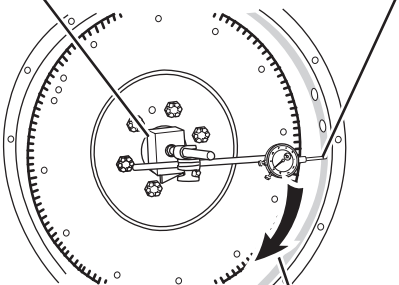
Flywheel Face Runout

- 1 Secure dial indicator base to flywheel housing face.
 - 2 Put gauge finger in contact with flywheel face near the outer edge.
 - 3 Rotate flywheel one revolution. Maximum runout is .007 (.78 mm)
- 

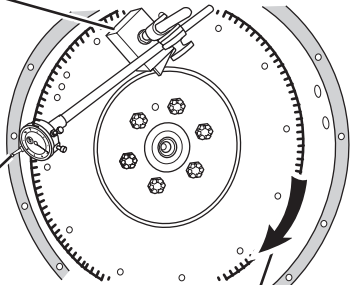
Pilot Bearing Bore Runout

- 1 Secure dial indicator base to flywheel housing face.
 - 2 Position gauge finger so that it contacts pilot bearing bore.
 - 3 Rotate flywheel one revolution. Maximum runout is .005" (.13 mm)
- 

Flywheel Housing I.D. Runout

- 1 Secure dial indicator base to crankshaft.
 - 2 Put gauge finger against flywheel housing pilot I.D.
 - 3 Rotate flywheel one revolution. Maximum runout is .008" (.20 mm).
- 

Flywheel Housing Face Runout

- 1 Secure dial indicator base to flywheel near the outer edge.
 - 2 Put gauge finger in contact with face of flywheel housing.
 - 3 Rotate flywheel one revolution. Maximum runout is .008" (.20 mm).
- 

Install Clutch to Flywheel

⚠ WARNING

An assembled clutch weighs about 100 lbs. (45 kg). Avoid the risk of injury. Use proper equipment when lifting a clutch.

1 Install new pilot bearing.

2 Measure the flywheel bore to verify that the damper will fit into the flywheel bore.

3 Insert aligning tool through DM Clutch.

10.0" (8-spring)

4 Install two 3/8" - 16 UNC x 5" studs into upper mounting holes. Using clutch jack or other lifting device, install assembled clutch.

5 Install lock washers and (8) Grade 5 or better mounting bolts finger tight:

- 1-Plate: Use 3/8"-16 UNC x 1" bolts
- 2-Plate: Use 3/8"-16 UNC x 2.25" bolts

Replace studs with lock washers and bolts

9 Remove the aligning tool.

8 Install the jack screw into one of the four holes located adjacent to the clutch mounting bolts. This forces the pressure plate forward clamping the disc, holding it in place. Be sure the hole chosen as at the 6 o'clock position to allow for removal after the transmission is installed.

7 Using a piece of 5/16" x 18 UNC x 3" threaded rod (jack screw), install two nuts on one end and lock them together. This will allow you to turn the jack screw in and out of the cover assembly.

6 Progressively tighten mounting bolts in a crisscross pattern starting with the lower left bolt (1,2,3,4,5,6,7,8). Torque to 30-35 lb-ft (40-47 Nm). Failure to do this could result in improper piloting of the clutch and cause clutch damage.

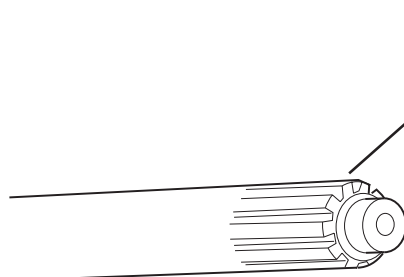
⚠ CAUTION

Do not overtighten the jack screw. Tightening more than 9 lbs. ft. can cause permanent clutch damage.

Install Transmission

Check Transmission for Wear

Replace any worn components.



- 1 Any wear on the splines will prevent the driven discs from sliding freely, causing poor clutch release (clutch drag.) Slide disc full length of shaft to check for twisted shaft splines.

⚠ IMPORTANT

Do not add lube to the input shaft splines (Never seize or grease). The discs must be free to slide.

Fasten Transmission to Flywheel Housing

- 1 Position transmission so it is square to and aligned with engine.
- 2 Mesh splines by moving transmission forward and rotating the input shaft. Do not use excessive force. Do not let the transmission hang unsupported in the discs.
- 3 Install mounting bolts and torque to OEM specs.
- 4 Remove the jack screw.
- 5 Reconnect UltraShift wiring harness.

⚠ WARNING

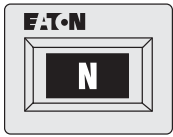
Do not let the transmission drop or hang unsupported in the driven disc. This can cause the disc to become distorted and the clutch to not release.

⚠ CAUTION

Do not use excessive force. If it does not enter freely, investigate the cause of problem and make any necessary changes.

MD Ultrashift Clutch Recalibration

1. Turn key on.
2. Verify a solid "N" is on the gear display.

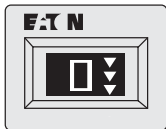


3. Start engine.
4. Increase engine RPM above 1500. This will unlock the clutch. Failure to do this will set a clutch disengagement code and the code and transmission will not go into gear.

Note: Programmable VSS Tamper Resistance options or other artificial engine speed limits which prevent reaching the required 1500 RPM may prevent proper disengagement of the clutch locking device after initial installation. These options may need to be disabled until after the clutch-locking device is disengaged.

Note: If ServiceRanger is available, proceed to Step 12.

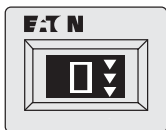
5. Start with the system powered down, the vehicle stationary, and the engine not running.
6. Key on and allow the system to completely power up but do not start the engine.
7. Select "LOW" mode on the shift controller (UltraShift system will begin to emit an audible tone).
8. Select an upshift once (UltraShift gear display will display a "0" with down arrows and discontinue the tone indicating "Special Functions" mode is activated).



9. Once in Special Functions mode, select one additional upshift (UltraShift gear display will display a "1" with up arrows indicating UltraShift Touch Point Resent is selected.)



10. After the "1" is displayed, depress the throttle pedal to the floor and hold for 3-5 seconds (the gear display will change back to a "0" with down arrows indicating the routine has been successfully completed).



11. Key off or select any mode and the UltraShift system returns to normal operation.
12. Save clutch data / Recalibrate clutch with ServiceRanger.

Gen 3

- Using ServiceRanger, select "Advanced Product Function" button.
- Select UltraShift transmission model (Gen 3) from menu tree in the upper left.
- Select the VPA/SnapShot Utility and launch the function.
- Read the APF description and select "Next."
- Enter the vehicle info and select "Next."
- Select "VPA" from the dropdown "Data Source" field.
- Enter an output file name and location using Browse Button or use default filename and location shown.

Note: If the default filename and location is used, the VPA data file will be saved to the ServiceRangerData folder in the VPA sub-folder on the C:\drive.

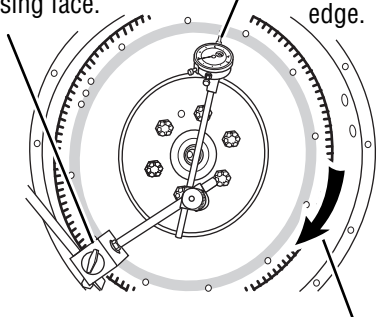
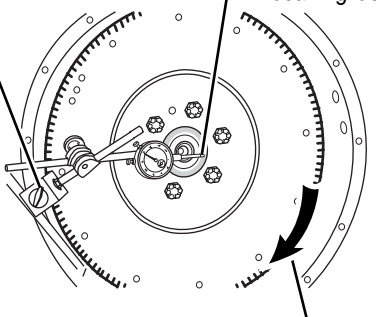
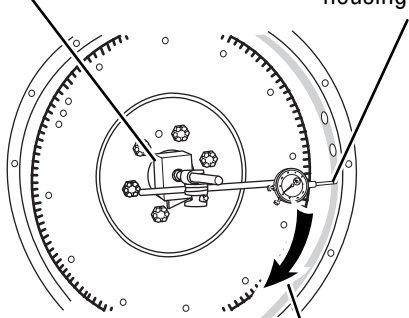
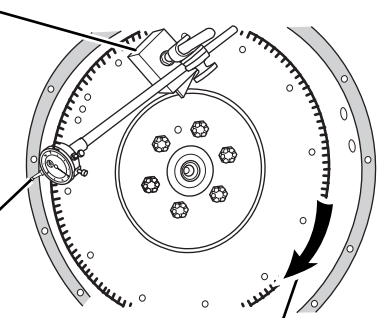
- Select the "start transer" button to download data from transmission controller and then select "Next."
- The output file can now be viewed, select "Finish."
- Select "Clear Clutch Data" button to clear data from transmission controller.
- If successful proceed to next step, if unsuccessful exit function and re-enter. Contact Roadranger Call Center 1-800-826-4357 for help.
- Select the "Calibrate Clutch" button to calibrate new clutch and the select "Finish" when complete.

Stamped Angle Spring Clutch

Measure Engine Flywheel Housing and Flywheel

Engine flywheel housing and flywheel must meet these specifications or there will be premature clutch failure. Remove and replace old pilot bearing per engine manufacturer instructions. All gauge contact surfaces must be clean and dry. Clean flywheel surfaces of all grease, oil, and rust preventatives. Failure to perform this function can affect the performance of the clutch.

Use a dial indicator and check the following:

<p>Flywheel Face Runout</p> <ol style="list-style-type: none"> 1 Secure dial indicator base to flywheel housing face. 2 Put gauge finger in contact with flywheel face near the outer edge. 3 Rotate flywheel one revolution. Maximum runout is .007" (.18 mm). 	<p>Pilot Bearing Bore Runout</p> <ol style="list-style-type: none"> 1 Secure dial indicator base to flywheel housing face. 2 Position gauge finger so that it contacts pilot bearing bore. 3 Rotate flywheel one revolution. Maximum runout is .005" (.13 mm). 
<p>Flywheel Housing I.D. Runout</p> <ol style="list-style-type: none"> 1 Secure dial indicator base to crankshaft. 2 Put gauge finger against flywheel housing pilot I.D. 3 Rotate flywheel one revolution. Maximum runout is .008" (.20 mm). 	<p>Flywheel Housing Face Runout</p> <ol style="list-style-type: none"> 1 Secure dial indicator base to flywheel near the outer edge. 2 Put gauge finger in contact with face of flywheel housing. 3 Rotate flywheel one revolution. Maximum runout is .008" (.20 mm). 

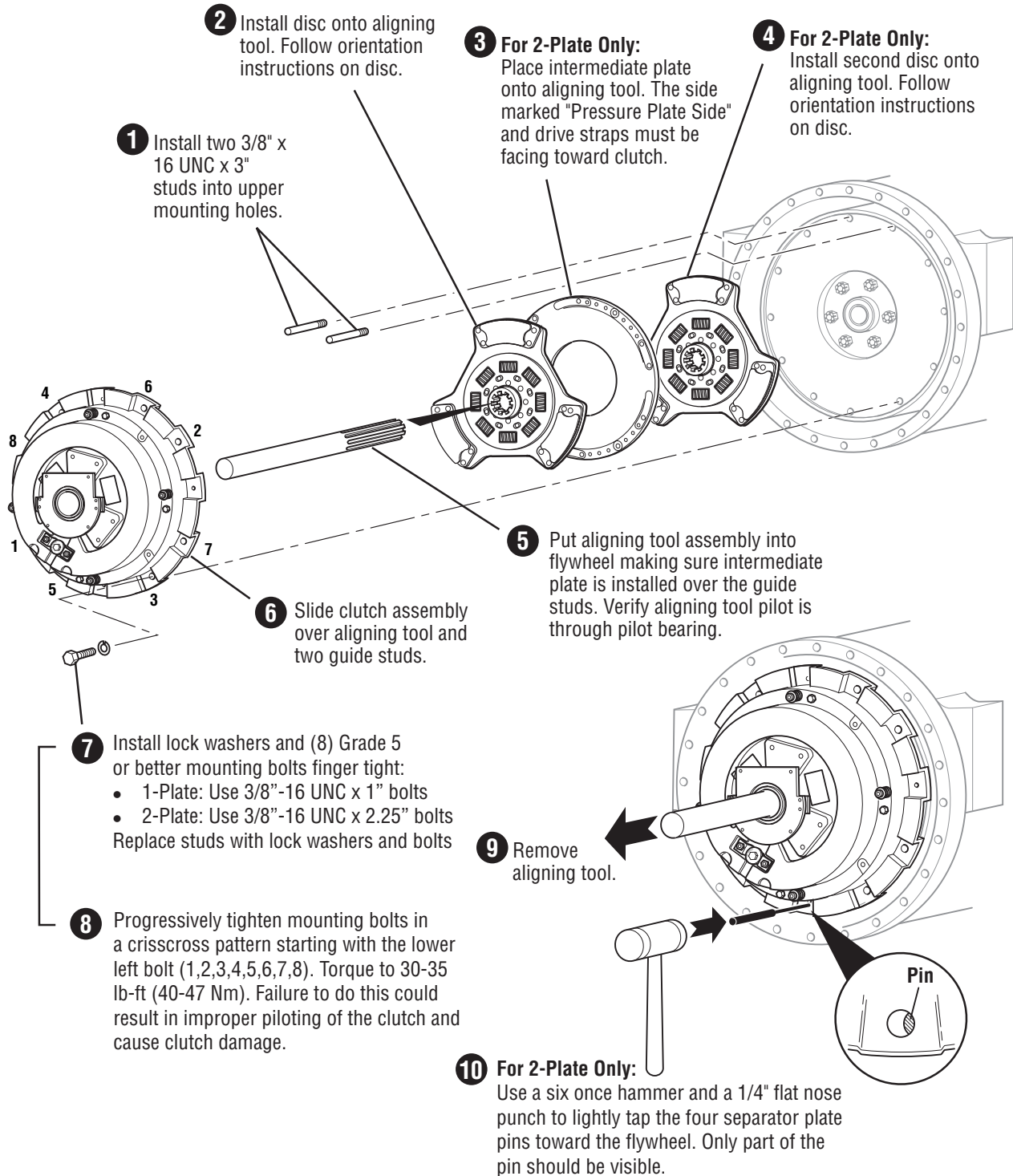
Install Clutch to Flywheel

IMPORTANT

Use Eaton Fuller Medium-Duty Clutch Selector Guide (CLSL-1310) to make sure you have the right clutch!

CAUTION

An assembled clutch can weigh up to 120 lbs. (54 kg). Avoid risk of injury. Use proper equipment when lifting a clutch.



Install Transmission

Check Transmission For Wear

Replace any worn components.

Transmission Bearing Retainer Cap

A worn/rough bearing retainer cap may cause the clutch brake to wear prematurely.

Cross Shaft And Bushings

Excessive wear at these points can cause side loading on the sleeve bushing, bushing failures and yoke bridge contact with the clutch when the pedal is down.

Input Shaft Splines

Any wear on the splines will prevent the driven discs from sliding freely, causing poor clutch release (clutch drag). Slide discs full length of shaft to check for twisted shaft splines.

Release Yoke

Worn fingers can cause bushing wear and yoke interference when the pedal is down.

Input Shaft

Wear (roughness) can reduce sleeve bushing life and cause it to come out.

Clutch Brake

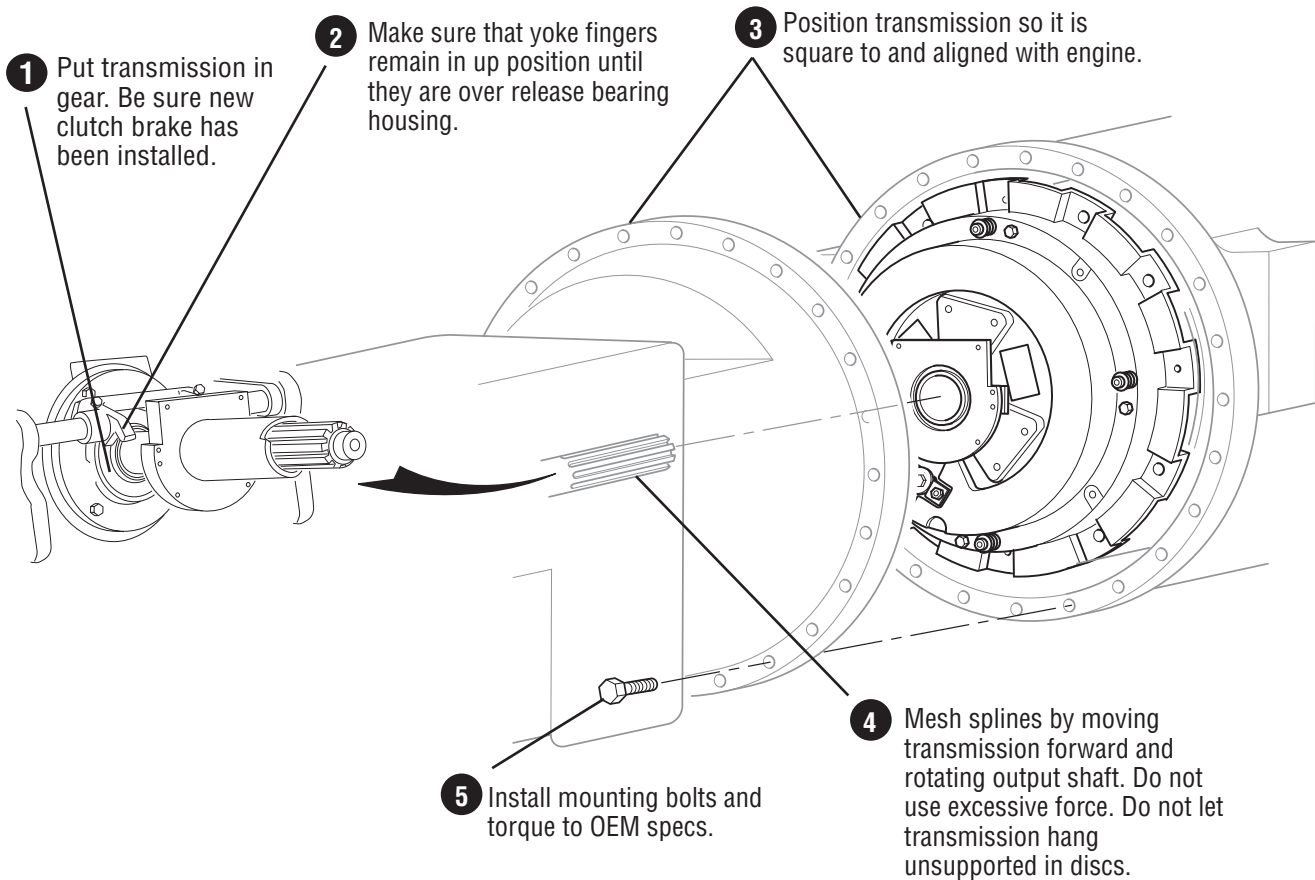
Replace if equipped.

CAUTION

Do not let the transmission drop or hang unsupported in the driven discs. This can bend the discs and the clutch will not release causing damage that is not warrantable.

Do not excessively force the transmission into the clutch assembly or engine housing. This will cause damage to the splines of the rear disc hub that is not warrantable. If the discs do not slide freely in the input shaft, investigate the cause of the problem and make any necessary changes. If the discs do not slide freely, the clutch will not release and the transmission will grind going into gear.

Fasten Transmission to Flywheel Housing



NOTE: If you have a hydraulic linkage, go to **page 35**.

Set-up (No Clutch Brake)

For clutches with clutch brake, see page 31.

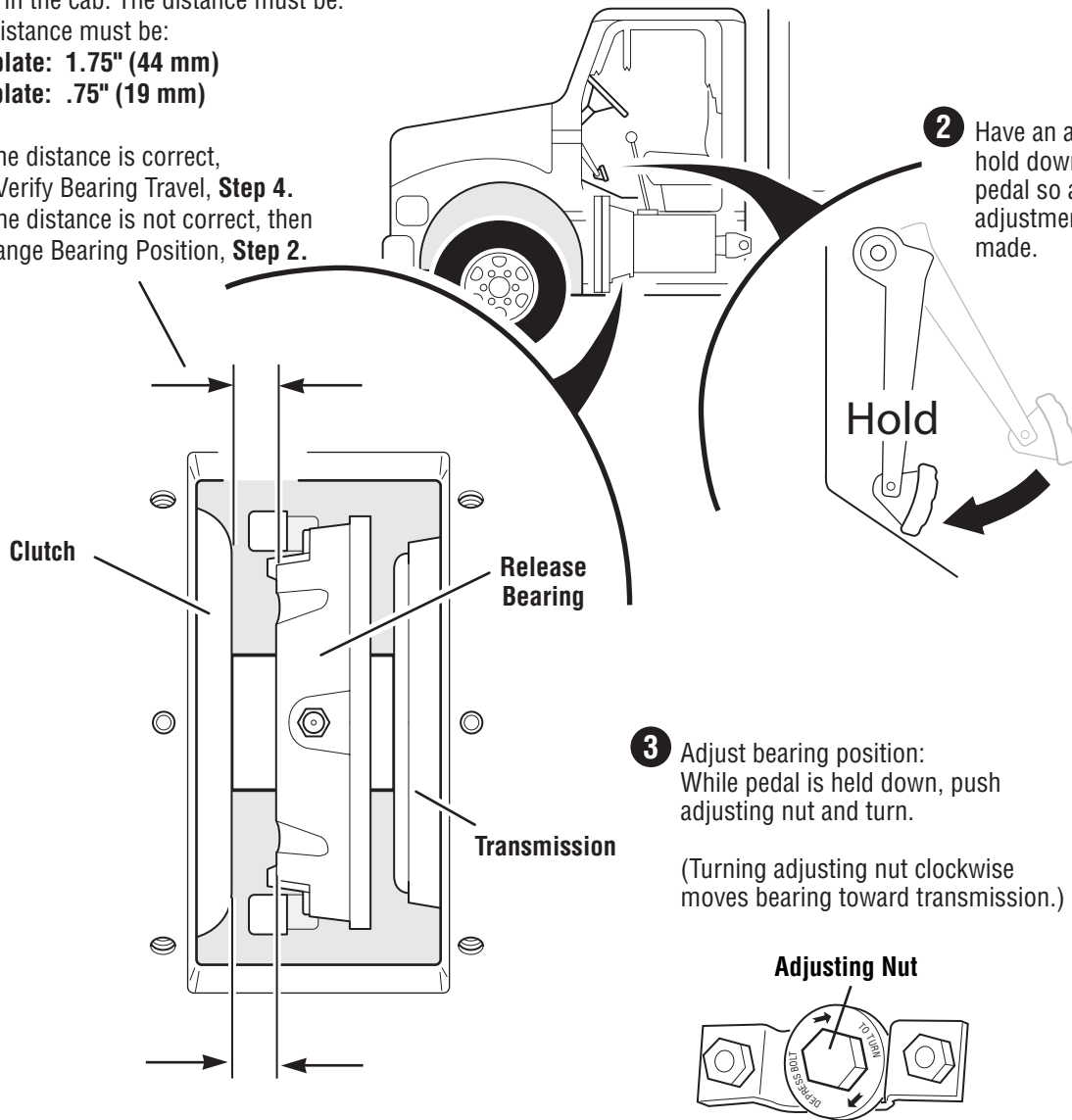
Adjust Bearing Position

- 1** Before measuring the distance between the release bearing and the clutch, depress the clutch pedal to remove free pedal in the cab. The distance must be:

The distance must be:
One plate: 1.75" (44 mm)

Two plate: .75" (19 mm)

- If the distance is correct, then Verify Bearing Travel, **Step 4.**
- If the distance is not correct, then Change Bearing Position, **Step 2.**



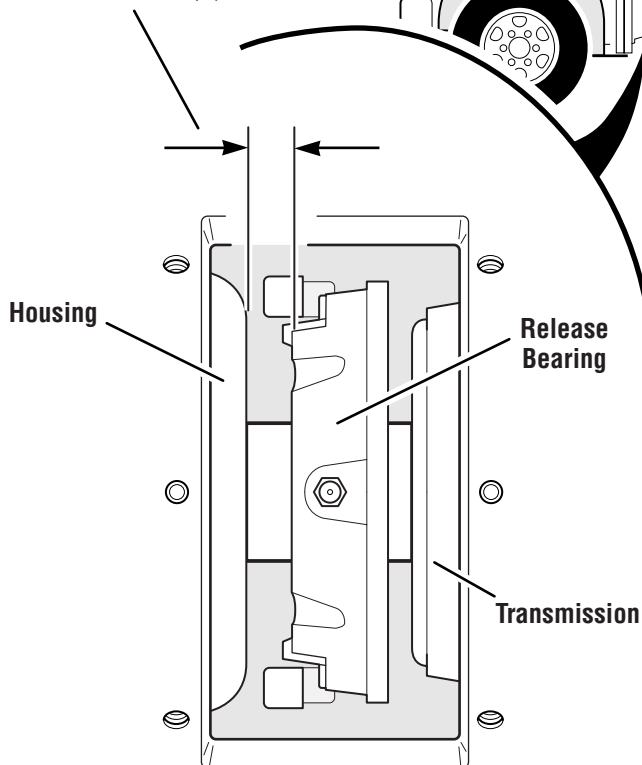
- 2** Have an assistant hold down clutch pedal so an internal adjustment can be made.

- 3** Adjust bearing position: While pedal is held down, push adjusting nut and turn.

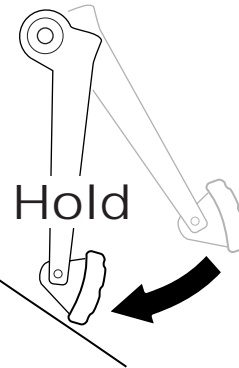
(Turning adjusting nut clockwise moves bearing toward transmission.)

Verify Bearing Travel

- 4** With clutch pedal up, measure the distance between the release bearing and the housing. This is distance (A).



- 5** Have an assistant hold down clutch pedal.

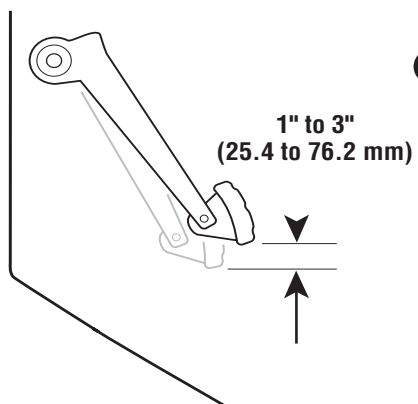


- 6** With clutch pedal down, measure the distance between the release bearing and the housing. This is distance (B).

The total release bearing travel distance (B minus A) for both one plate and two plate must be **.500" to .562" (13 to 14 mm)**.

- If the bearing contacts the transmission before moving .500" to .562" (13 to 14 mm), slightly reduce the "A" dimension to allow more bearing pull.
- If the linkage does not move the bearing .500" (13 mm) or more, adjust the fork fingers slightly closer. The release bearing must move over .500" (13 mm) for the clutch to release.

Verify Free-Play



- 7** Measure clutch pedal free-play in cab. The free-play distance should be **1" to 3" (25.4 to 76.2 mm)**.

Note: If free-play distance is incorrect your linkage may be deficient. Consult OEM truck manufacturer manual for proper free-play dimension.

Lubricate

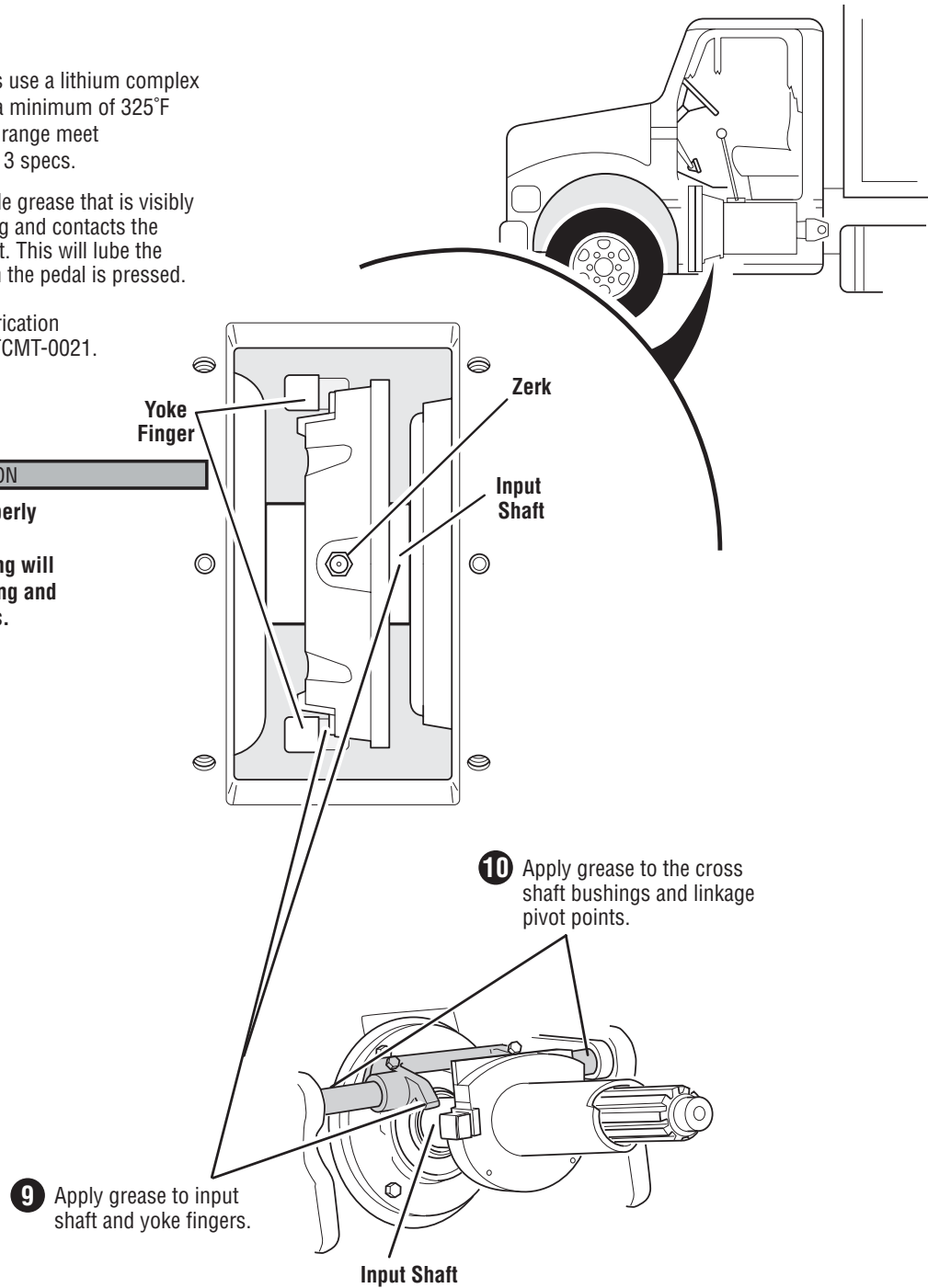
NOTE: All clutches use a lithium complex base grease with a minimum of 325°F (163°C) operating range meet N.L.G.I grade 2 or 3 specs.

NOTE: Apply ample grease that is visibly exiting the opening and contacts the transmission shaft. This will lube the clutch brake when the pedal is pressed.

For additional lubrication information, see TCMT-0021.

CAUTION

Failure to properly lubricate the bearing/bushing will result in bearing and sleeve failures.



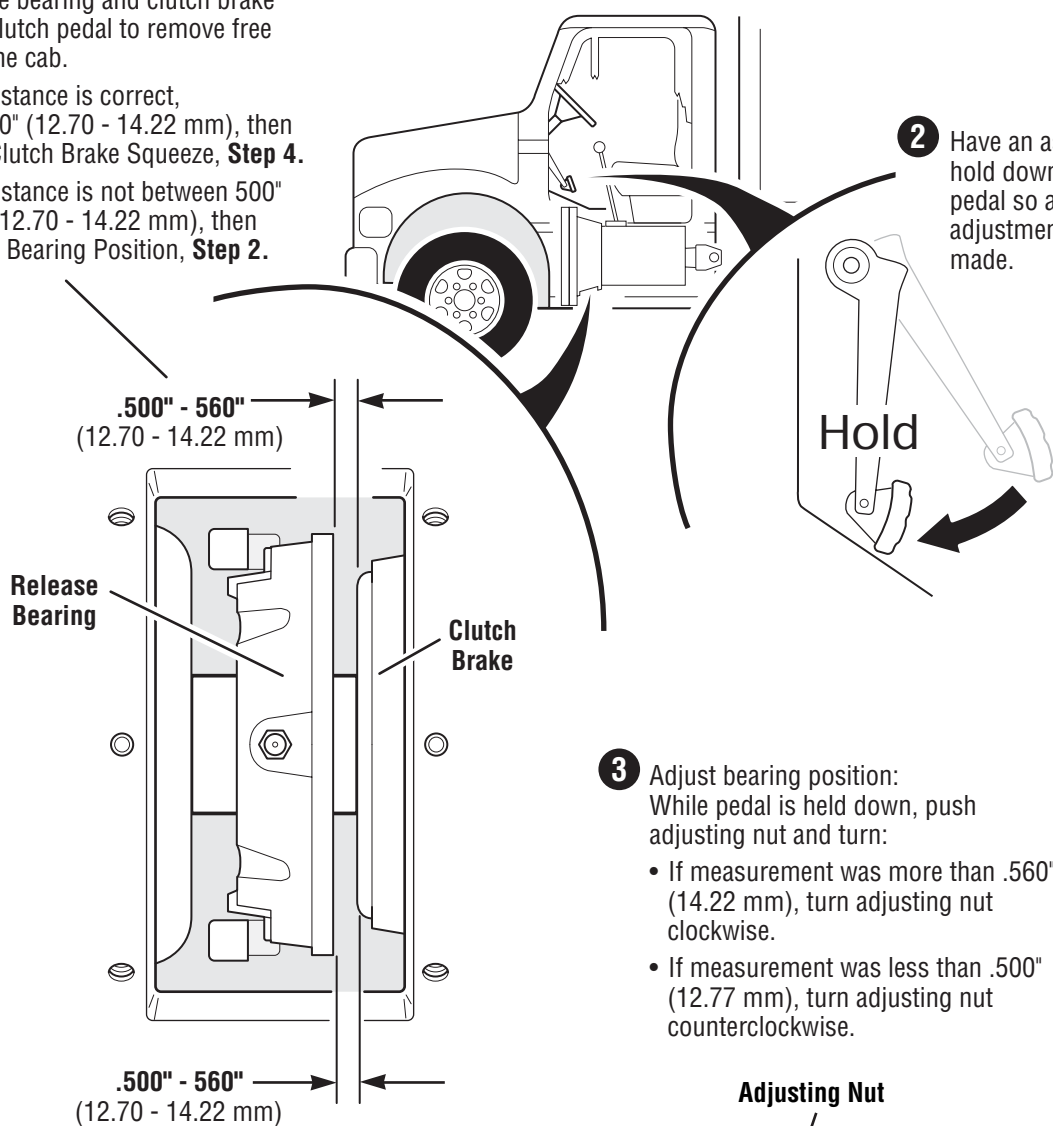
Set-up (with Clutch Brake)

For clutches with no clutch brake, see page 27.

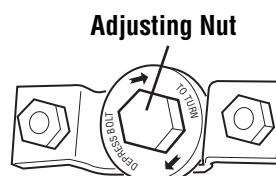
Adjust Bearing Position

1 Before measuring the distance between the release bearing and clutch brake depress clutch pedal to remove free pedal in the cab.

- If the distance is correct, .500" - .560" (12.70 - 14.22 mm), then Verify Clutch Brake Squeeze, **Step 4**.
- If the distance is not between .500" - .560" (12.70 - 14.22 mm), then Change Bearing Position, **Step 2**.



- 3** Adjust bearing position: While pedal is held down, push adjusting nut and turn:
- If measurement was more than .560" (14.22 mm), turn adjusting nut clockwise.
 - If measurement was less than .500" (12.77 mm), turn adjusting nut counterclockwise.



Verify Clutch Brake Squeeze

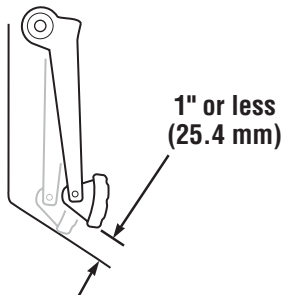
⚠ CAUTION

Use a gauge long enough to keep hands away from moving parts.

- 4** Have an assistant insert .010" (.25 mm) feeler gauge between the release bearing and the clutch brake.
- Press the pedal down to the floor to clamp the gauge:

- If the gauge does not clamp, readjust the truck linkage and move the yoke finger closer to the bearing.

- 5** Slowly let up on the pedal and measure the pedal position at the moment the gauge can be removed:
- If pedal is more than 1" (25.4 mm) from the floor, readjust the truck linkage to move the yoke fingers further from the release bearing. Repeat **Step 4**.



Yoke Finger

Release Bearing

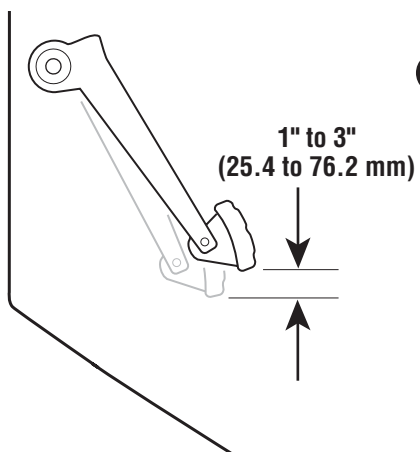
Clutch Brake

NOTE: The truck linkage system must provide enough stroke to allow for free travel, release travel (bearing movement of .500"), and clutch brake squeeze (if equipped).

If all three cannot be achieved, then the truck linkage system is not providing enough stroke to make the clutch work properly. Do not install another clutch, because the problem is with the truck linkage system. (The truck may have been assembled with incorrect linkage components.)

Do not set the release bearing closer to the transmission or clutch brake. If the bearing is not pulled enough the clutch will not release. Do not attempt to force a Solo clutch to move the bearing closer to the transmission. It is designed for .500"-.560" release bearing travel and will only set itself to the correct dimension. An incorrect stroke problem can only be corrected by fixing the truck linkage.

Verify Free-Play



- 6 Measure clutch pedal free-play in cab. The free-play distance should be **1" to 3" (25.4 to 76.2 mm)**.

Note: If free-play distance is incorrect your linkage may be deficient. Consult OEM truck manufacturer manual for proper free-play dimension.

Lubricate

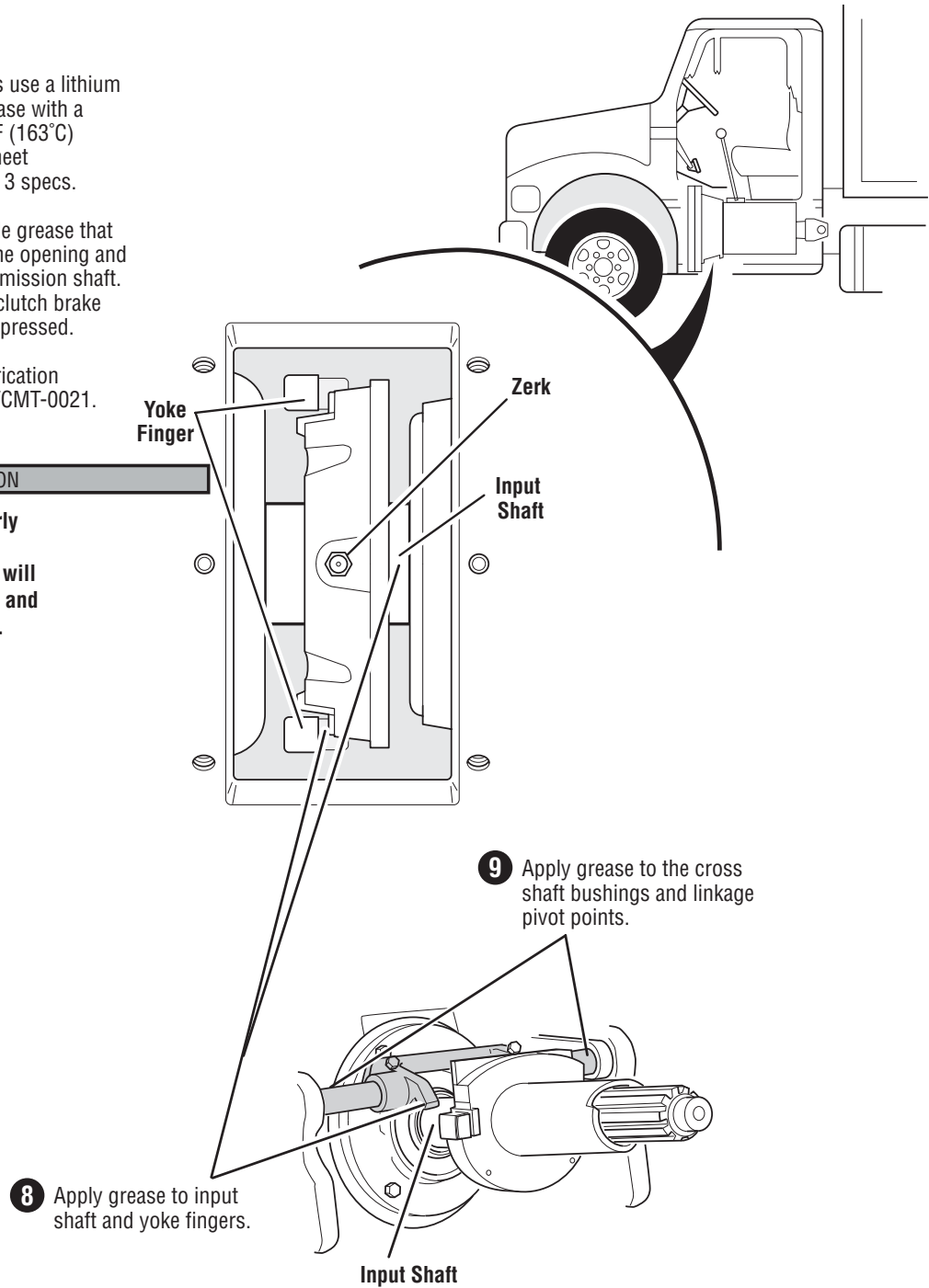
NOTE: All clutches use a lithium complex base grease with a minimum of 325°F (163°C) operating range meet N.L.G.I grade 2 or 3 specs.

NOTE: Apply ample grease that is visibly exiting the opening and contacts the transmission shaft. This will lube the clutch brake when the pedal is pressed.

For additional lubrication information, see TCMT-0021.

CAUTION

Failure to properly lubricate the bearing/bushing will result in bearing and bushing failures.



Hydraulic Linkage

When the pedal is pushed down, the hydraulic linkage should move the release bearing enough to cause the clutch to adjust the bearing closer to the transmission. The wear indicator should move a little toward the “replace” (right) position. If the clutch will not adjust, the hydraulic system may need repair or correct setup.

Ford Trucks

Ford medium duty trucks use a hydraulic release system that operates with clearance between the fork fingers and the release bearing. The linkage must be adjusted to Ford's specifications to prevent damage to the master cylinder.

Solo Clutches: The hydraulic system must provide enough stroke to cause the clutch to adjust. (approximately .560"). The system must be repaired if not functioning properly.

Stamped Angle Spring: The release bearing position must be properly adjusted and the hydraulic system must provide enough stroke to move the release bearing more than 1/2" of stroke to allow the clutch to function properly. If the bearing is not stroked enough the clutch will not release and the transmission will grind going into gear.

GM/Isuzu Cab Over

Push the pedal down. The hydraulic system must move the bearing .500"-.560" to cause the clutch to adjust. The wear indicator will move slightly toward the “replace” (right) position and the bearing should be approximately .500"-.530" from the transmission when pedal is up.

Freightliner M2 with Hydraulic System

Solo Clutches: Push the pedal down. The hydraulic system must move the bearing .500"-.560" to cause the clutch to adjust. The wear indicator will move slightly toward the “replace” (right) position and the bearing will be closer to the transmission when pedal is up.

Verify Linkage System Stroke

Measure the release bearing position with the pedal up and pedal down to verify bearing travel.

The hydraulic linkage should allow for a minimum of .600" of yoke finger movement: .500"-.560" for clutch release plus additional movement for clutch brake squeeze (if equipped).

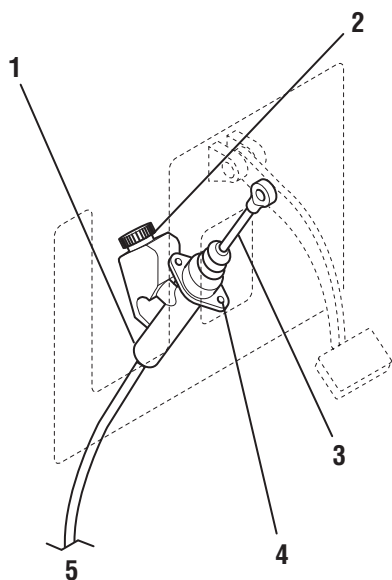
Solo Clutches: If the system does not provide enough movement of the release bearing, the clutch will not adjust and the bearing will move away from the transmission and lose clutch brake squeeze.

Note: If the system is operational, clutch replacement may be necessary. If replacing the clutch, you must adhere to OEM warranty guidelines prior to claim disposition.

Master Cylinder Installation

Master Cylinder

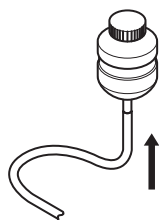
Master cylinder may be mounted at any angle ranging from vertical to horizontal, depending on application.



- 1 - Master cylinder
- 2 - Reservoir
- 3 - Pushrod
- 4 - Bolts (2), M8 x 1.25 mm (torque 20-25 N•m)
- 5 - To booster or slave

Remote Reservoir

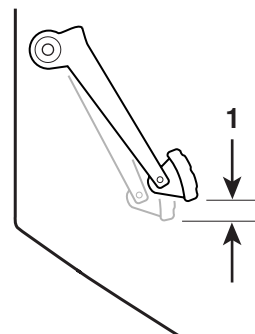
Constant rise in hose from master cylinder to reservoir.



Adjustment

Freeplay

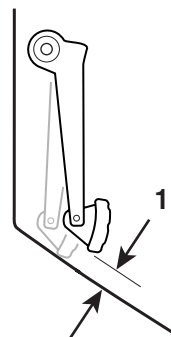
Depending on the application, freeplay can be achieved by adjusting upper pedal stop or by adjusting master cylinder pushrod.



1 - Freeplay 3-8 mm

Clutch Brake Squeeze

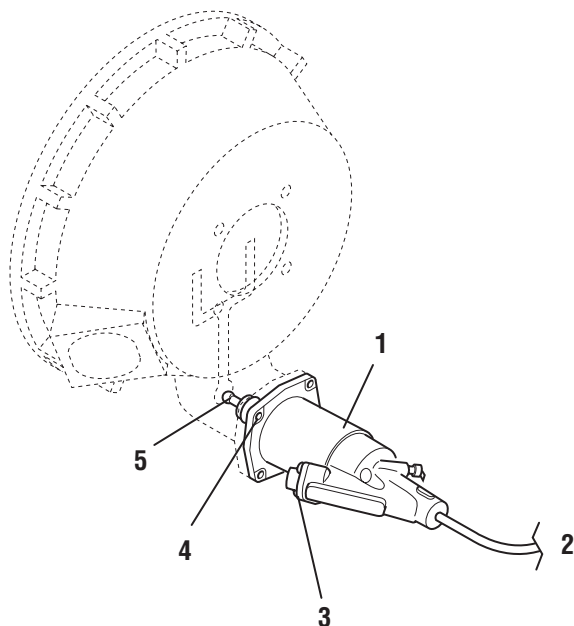
For non-synchronized applications only.



1 - Clutch brake squeeze 13-50 mm

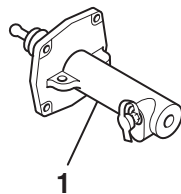
Transmission Installation

Non-Synchronized



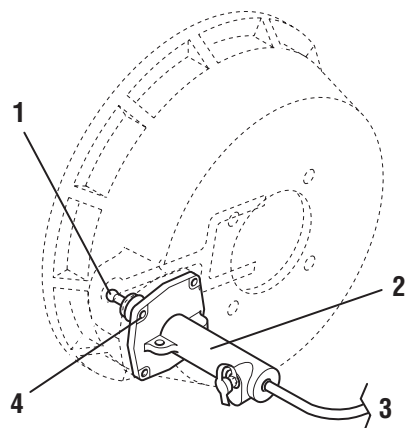
- 1 - Clutch servo
- 2 - To master cylinder
- 3 - Connect air supply 30 psi source; Bolts (4), M16 x 1.5 mm (torque 20-25 N•m)
- 4 - Bolts (2), M8 x 1.25 mm (torque 20-25 N•m)
- 5 - Pushrod

Slave Cylinder



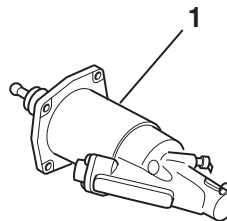
- 1 - Slave cylinder

Synchronized



- 1 - Pushrod
- 2 - Slave cylinder
- 3 - To master cylinder
- 4 - Bolts (4), M8 x 1.25 mm (torque 20-25 N•m)

Clutch Servo



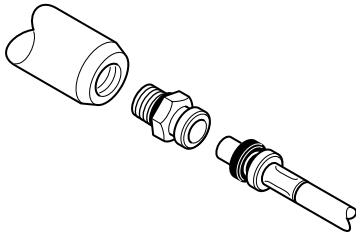
- 1 - Clutch servo

Hose Assembly

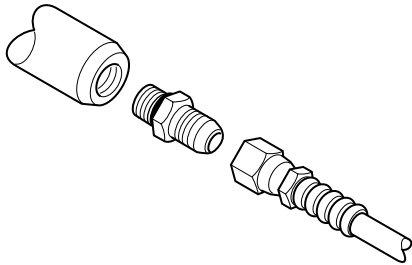
1. Connect hose assembly to master cylinder and slave or booster. Depending on hose type, this is either a threaded connect or snap-to-connect. Torque all connectors to 20-25 N•m.

Note: Make sure there is a constant rise to the master cylinder.

Snap-to-Connect



Threaded Connect



Fill Procedure

Recommended methods are vacuum fill or pressure fill. Refer to OEM procedure.

 **WARNING**

Do not press or disengage clutch pedal when removing slave cylinder or clutch servo.

General Clutch Information

Function of a Clutch

Any modern day clutch, whether designed for an automobile or heavy truck, performs several important tasks allowing for safe and convenient operation of the vehicle.

In a vehicle powertrain, the clutch is the device that interrupts the flow of power from the engine flywheel to the transmission. To start a gasoline or diesel engine, the flywheel must be able to turn freely without propelling the vehicle. By disengaging the clutch, the drivetrain is effectively disconnected from the rotation of the flywheel allowing the engine to start.

Manual transmissions, whether synchronized (synchromesh) or non-synchronized (constant mesh), require an interruption of engine torque to complete a gear change. To make a gear change, the clutch pedal is depressed, breaking torque. This is followed by altering engine speed to more closely match the transmission input shaft (clutch disc) speed. After the proper gear is selected, the clutch pedal is then slowly released. As the clutch disc(s) are compressed, the relative slip speed between the flywheel and the transmission input shaft reaches zero and the clutch is completely engaged and capable of carrying full engine torque. With non-synchronized gearboxes, double clutching (a momentary partial engagement of the clutch made while the transmission is in neutral) is often necessary to allow rotational speeds of gears to become the same and complete the gear change.

With the advent of transmission automation, breaking torque and altering flywheel speed is accomplished via electronic throttle control and engine braking. The clutch pedal is used only when starting the engine, launching the vehicle from a stop, and when the vehicle slows to a stop.

The last function of the clutch is mitigating torsional vibrations. With any in-line, six-cylinder engine there are three (3) distinct power pulses occurring during each revolution of the flywheel. With each firing of a cylinder, the flywheel speeds up then slows down, very quickly, resulting in a torsional vibration. This vibration can damage drivetrain components in short order if left uncontrolled. The coil springs in a driven disc damper absorb much of the vibration. The resonant (generally the least expensive drivetrain component) is considered the “fuse” of the system. Failure of a clutch damper section is usually an indication of a serious torsional vibration systems problem or shock loading due to driver abuse.

Clutches are assemblies made up of many different components utilizing many different types of materials. This section

describes the major components which make up a complete Eaton Fuller Clutch installation.

The following are the major components used to make up a clutch installation:

- Cover Assembly (contains pressure plate)
- Intermediate Plate – (only in 2-plate clutches)
- Driven Disc(s)
- Clutch Brake

Neutral Idle Rattle

Neutral idle rattle is a system issue. It occurs when the engine is idling with the transmission in neutral and the clutch pedal in the up position. As the engine idles, the firing pulses cause the flywheel to oscillate as it is rotating. This oscillation is transmitted through the input shaft and into the transmission gearing. This oscillation causes the transmission gears to impact one another resulting in a sometimes objectionable noise. While this noise is an annoyance, it is in no way damaging to the transmission and other components.

In the past, free travel dampers have been used to overcome this phenomenon. As systems have changed, in terms of mass, inertia, and fuel injection pressures, free travel has become a less effective means of control.

Free travel, simply stated, is the free left or right rotation of the driven disc hub before engaging the clutch damper. This first stage isolates some of the flywheel oscillation energy and prevents or reduces the idle rattle.

Pre-damper technology is now available in some medium- and heavy-duty clutch applications and performs the same function as the free travel. By adding a dampened first stage, it is more effective at limiting neutral idle rattle. Generally, the pre-damper springs are very small and softer in rate than the main damper springs.

In diagnosing neutral idle rattle complaints, first try to fully depress the clutch pedal. This will disconnect the engine from the transmission. Secondly, try raising the engine idle speed with the clutch pedal up. This may smooth out the engine firing and may reduce, or eliminate, the noise.

If you have neutral idle rattle, determine what clutch is installed in the vehicle. It may already have a pre-damper clutch in it. If it is already equipped with a pre-damper clutch, then there is no benefit to changing the clutch.

Solo™ Clutches

The Eaton Fuller Solo is the industry's first adjustment-free clutch. With every push of the pedal, Solo's innovative wear-adjusting technology senses for wear and makes any adjustments necessary.

Why There is No Need to Adjust Eaton Fuller Solo™ Clutches

If the Solo Clutch is properly installed and the linkage is set-up properly, the Solo Clutch should never need internal or external adjusting.

The Solo Clutch automatically keeps the proper release bearing position and clutch free pedal position with two opposing cams. As the Solo Clutch wears, the cams separate from each other keeping the proper release bearing position. This in turn maintains the proper clutch free pedal position.

How it Works

Eaton Fuller Solo's wear-adjusting technology comes from two sliding cams. With every push of the pedal, the clutch senses for wear and makes any adjustments necessary. The cams rotate to maintain the proper adjustment throughout the life of the clutch. On top of the upper cam, a clutch wear indicating tab mirrors the cams' movement to let you know when it's time to replace the clutch. The result of Solo's constant adjustment is greater longevity and a reduction in maintenance and labor costs.

Clutch Disc Dampening Characteristics

A key function of a clutch is to mitigate naturally occurring vibrations of the engine flywheel from reaching the transmission and the other components further down the drivetrain. This is accomplished by employing torsional spring dampers to the clutch pack. These springs take the form of coil springs, configured inside the clutch disc, that compress with the application of torque. The torque path through the damper begins at the friction interface at the facings, proceeds to the steel carrier disc and moves into the disc reinforcing plates where the springs are located. The springs are compressed, transmitting force to the spring covers which are rigidly attached to the hub. Torsional rate is defined as the amount of torque required per degree of center hub rotation. There are three basic categories of torsional rates for clutch dampers: rigid, standard, soft.

Rigid and Clutch Discs - Rigid discs and clutch discs with no spring package whatsoever, act as a nearly direct link from the engine flywheel to the transmission and offer no protection against torsional vibration. Their use should be limited to older mechanically-fueled engines where clutch replacement cost is paramount over long component life. Rigid clutch discs are never used in new OEM applications.

Standard Dampers - Standard dampers include all 10-spring and most 8-spring types. The springs used in these dampers are approximately 1.5" long and do not offer a large amount of deflection before coil lock takes place. While these dampers were completely adequate for most heavy duty applications several years ago, they are generally incapable of reducing the engine flywheel vibrations developed with slow speed electronically fueled engines. The use of standard dampers in heavy duty applications has virtually ceased in OEM applications. The trend is to use more capable soft-rate dampers.

Soft-Rate Dampers - Soft-rate dampers, like the heavy-duty 7-spring and VCT Plus, offer much better protection against engine flywheel induced torsional vibrations. Their springs are characteristically longer than springs used in standard rate dampers and offer more deflection before coil lock occurs. This larger spring deflection is equated to lower torsional spring rate. With lower torsional rate, the resonant frequency of the complete drivetrain is lowered; usually to a point of a few hundred RPM below normal engine operating range. With the addition of hysteresis or Coulomb dampening (the energy expelled as the damper is exercised), the magnitude of the vibrations is reduced further, adding to the dampers benefit.

Clutch Disc Friction Material

Organic facings, often called "rag" facings, get their name from the high concentration of organic rubber and binder agents that make up their composition. Fiberglass cord (or similar material) is woven into the material matrix and adds burst strength and improves friction and wear properties. Asbestos has not been used in organic friction material since the early 1980's. Organic facings are used without exception in passenger car and light truck applications. This is so because of smooth engagement properties and the relative light torque loads imposed on the clutch. In general, organic friction material lacks in performance in wear rate, coefficient of friction (ability to carry torque), and resistance to fade (abuse tolerance) when compared to ceramic-metallic friction material. The use of organic friction material in heavy vehicles has significantly declined over the past decade. Wear life and its maximum limit to 1,400 ft. lbs. (1892 N•m) of torque in 15.5" clutches are the primary reasons.

Cera-metallic (Ceramic) friction facings are composite material (copper, sand and other friction modifiers and binder agents). The dry raw materials are mixed in bulk, poured into die cavities, compressed, sintered in an controlled atmosphere, then brazed into a steel backer plate to facilitate rivet attachment to the driven disc. Compared to organic friction material, cera-metallics have improved performance in the areas of wear rate, resistance to fade (abuse tolerance), and coefficient of friction (ability to carry torque). It is for this reason that cera-metallics make up the vast majority of OEM builds.

Clutch Slippage

Slippage will cause significant heat build-up and rapid wear of the clutch pack. If the clutch pack temperature raises beyond the facing threshold temperature, the facing may disintegrate. Slippage is the result of loss of clamp load due to lack of adjustment, loading the clutch beyond its design torque rating, or the clutch has reached the end of its design life. With the ability to re-rate an electronic controlled diesel engine, it is quite easy to delivery torque to the clutch beyond its design capacity. Before an engine re-rating is performed, confirm that the clutch and other drivetrain components are capable of carrying the increased torque and power.

Clutch Torque Capacity

It is imperative to understand the factors that influence friction force because this device transmits torque via friction. The fundamental equations that describes friction is:

$$F(f) = uN$$

Where $F(f)$ = Force due to friction

U = Coefficient of friction

N = Load applied to the friction interface

$$T = F(f)r$$

Since torque (T) is equal to force friction $F(f)$ multiplied by the moment arm (R) (distance from application of force to center or rotation) must be known. To exactly calculate the moment arm, the mean radius of a clutch (R), integration must be performed. However, for clutches in the size range offered by Eaton, the calculation can be simplified to:

$$(r) = (ID + OD) / 4$$

Clutch Wear

Clutch wear happens because the clutch discs slip relative to the engine flywheel and the pressure plate surface, and in the case of a two plate clutch, the intermediate plate, during vehicle launch and gear change. As the clutch disc friction material and mating flywheel and pressure plate surfaces wear, the gage thickness of the clutch pack decreases (moving the pressure plate closer to the engine flywheel). This movement of the pressure plate causes the pressure spring(s) to elongate and loose clamping load. If clamping load is allowed to decrease beyond a critical point, the clutch will be unable to carry full engine torque and slip.

Cover Assembly

The cover assembly, constructed of either stamped steel or cast iron, is bolted to the flywheel. It contains the pressure plate, which is fitted to the cover with pressure springs. It also contains the release bearing and levers, which move the pressure plate back and forth, thereby making or breaking contact with the disc assembly.

Driven Disc

Eaton offers a variety of 14" and 15.5" driven disc designs. The selection of driven discs depends on many factors.

Excessive torsional vibration can significantly reduce the life of all drivetrain components. That's why Eaton has engineered soft-rate dampers to reduce critical vibrations in today's electronic, high horsepower engines. Eaton recommends the use of soft-rate dampers (7-spring or VCT) for all vehicles over 1,000 ft. lbs.

Specifically, Eaton offers driven discs with different numbers of springs in the center section of the damper. 7, 8, 9 and 10-spring configurations are available. The proper selection depends on many factors including the engine, flywheel and transmission of the vehicle.

Facings

The disc facings are critical to clutch life and performance because they directly receive the torque of the engine each time the clutch is engaged.

In general, ceramic facings have greater heat tolerance and torque capacity than organic facings. As such, they engage quicker, reduce slippage and deliver longer life.

Organic facings (non-asbestos) are adequate for lower horsepower, on-highway applications. However, Eaton recommends ceramic facings for most applications.

Intermediate Plate

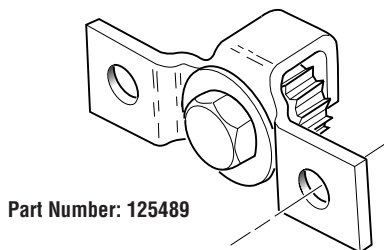
The intermediate plate or center plate, increases the torque capacity of the clutch by providing additional surface area for facing material and torque capacity. The intermediate plate is driven by the clutch cover or by the flywheel on the 14" Easy-Pedal Plus design.

Positive Separator Pin™

Eaton Fuller's Positive Pin Separator improves clutch life and performance by providing cooler operation, smoother engagement and equal plate separation. The pin restricts intermediate plate movement when the clutch is released, giving constant gap on both sides of the plate, therefore, allowing the driven discs to spin freely.

6-Position Kwik-Adjust®

Eaton Fuller's Easy-Pedal Plus® 14" and Easy-Pedal™ 2000 15.5" Clutches feature the Kwik-Adjust component and the easy-to-reach external manual adjustment mechanism that allows for quick adjustment of release bearing travel without the use of special tools or the need to remove any bolts. Using a common box end wrench, simply depress the Kwik-Adjust bolt and turn the standard 6-point hex head adjuster as needed.



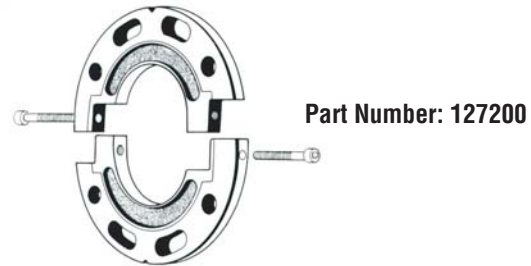
Torque Limiting Clutch Brake

The Eaton Fuller Torque Limiting Clutch Brake has a self-contained torque limiting feature which prevents tang breakage from driver misuse of the clutch brake.

- Part Number 127740: 1.75" spline
- Part Number 127760: 2" spline

Kwik-Konnect® Two-Piece Clutch Brake

The two-piece clutch brake provides cooler operation than competitive clutch brakes. It is designed for service applications, and can be quickly installed without removing the transmission.



Clutch Brakes

Clutch brakes are designed to extend the life of a vehicle's transmission by eliminating damaging gear clash while reducing the effort required to shift into first or reverse from a standstill. Eaton offers two separate clutch brake options.

- Torque Limiting
- Kwik-Konnect®

Factors that Affect Clutch Performance

Excessive slipping is the major cause of clutch failure. Extreme operating temperatures can cause the clutch to fail because the heat generated between the flywheel, driven discs, intermediate plate, and pressure plate is high enough to cause the metal to flow and the friction material to be destroyed.

An improperly adjusted or slipping clutch will produce sufficient heat to rapidly burn up.

There are many factors which have significant impact on clutch life:

- Application (torque capacity)
 - GCW/Weight
 - Number of starts per day
 - Maintenance/Adjustment
1. **Starting the Vehicle in the Proper Gear** - The correct gear will allow you to start the vehicle with your foot off the throttle.
 2. **Gear Shifting Techniques** - Many drivers upshift into the next gear or even skip-shift into a higher gear before the vehicle has reached the proper speed. This type of shifting is almost as damaging as starting off in a gear that is too high, since the engine speed and vehicle speeds are too far apart, requiring the clutch to absorb the speed difference as heat.
 3. **Excessive Vehicle Overload or Overloading the Clutch** - Clutches are designed and recommended for specific vehicle applications and loads. These limitations should not be exceeded. Excessive or extreme overloading is not only damaging to the clutch but to the entire vehicle powertrain as well. If the total gear reduction in the powertrain is not sufficient to handle excessive overloads, the clutch will suffer, since it is forced to pick up the load at a higher speed differential.
 4. **Do Not Ride the Clutch Pedal** - Riding the clutch is very destructive to the clutch since a partial clutch engagement permits slippage and excessive heat. Riding the clutch pedal will also put a constant thrust load on the release bearing, which can thin out the lubricant and also cause excessive wear on the pads. Release bearing failures can often be attributed to this type of operation.
 5. **Do Not Slip the Clutch to Hold the Vehicle on an Incline** - This procedure uses the clutch to do the job normally expected of the wheel brakes. A slipping clutch accumulates heat faster than it can be dissipated, resulting in early failures.
 6. **Do Not Coast with the Clutch Released and Transmission in Gear** - This procedure can cause high driven disc RPM through multiplication of ratios from the final drive and transmission. It can result in "throwing" the facing off the clutch discs. Driven disc speeds of over 10,000 RPM have been encountered in such simple procedures as coasting tractors down an unloading ramp. While an ample safety factor is provided for normal operation, the burst strength of the facing is limited.
 7. **Do Not Engage the Clutch while Coasting** - This procedure can result in tremendous shock loads and possible damage to the clutch, as well as the entire drivetrain.
 8. **Reporting Erratic Clutch Operation Promptly** - Drivers should report erratic clutch operation as soon as possible, to give the maintenance personnel a chance to make the necessary inspection, internal clutch adjustment, linkage adjustment and lubrications, thereby avoiding possible clutch failures and breakdowns while on the road. The importance of free pedal travel (sometimes referred to as a pedal lash) should be brought to the driver's attention as well as the mechanic. This item should be included and commented on daily in the driver's report, since clutch free pedal is the maintenance personnel's guide to the condition of the clutch and the release mechanism.
 9. **Clutch Adjustments** - Manual Adjustment- The importance of proper and timely clutch adjustments and lubrication can not be over stated. Internally adjusting the clutch properly and when needed will keep the clutch components in the proper position and extend the life of the clutch. See the adjustment section for more information.

Solo Adjustment-Free If your truck is equipped with an Eaton Fuller Solo Adjustment-Free Clutch, then the clutch will always be in proper adjustment. Possible lubrication and inspection are needed. See "Inspection and Lubrication".

When to Inspect the Clutch

The clutch should be inspected during the regularly scheduled lubrication intervals as dictated in the Lubrication section or when one of the following occur:

- **Clutch Free Pedal** - If the clutch free pedal is one-half of OEM specifications, not less than one-half inch. During normal clutch use, the release bearing will move toward the fork fingers and reduce "in cab" free pedal.
- **Clutch Is Slipping** - If the clutch is slipping, it may require adjustment. If proper internal (clutch adjuster) and external (clutch linkage) adjustment has been made and the clutch still slips, it is likely worn beyond its useful life and needs replacement.

Inspection for Clutch Life

If your vehicle is equipped with a Eaton Fuller Solo or Solo XL (Extended Lube) Clutch, the clutch is equipped with a clutch wear indicating tab that can be seen through the inspection window. To calculate the expected life of a Solo, apply a paint mark indicating the start point of the clutch wear indicating tab. Record the mileage when this mark was made. After a few months, reinspect the position of the clutch wear indicating tab and record the new mileage. The difference between the two readings can be used to estimate when the clutch will need to be replaced.

For Example:

Starting Mileage = 10,000

After six (6) months mileage = 75,000

Clutch wear indicating tab movement = .625" (16 mm)

75,000-10,000 = 65,000 miles

65,000 miles/.625" = 104,000 miles per inch of tab movement

3.5" remaining tab movement

3.5" remaining tab movement X 104,000 miles per inch of tab movement = 364,000 expected clutch life.

Designing a Clutch for a Specific Application

There are two parts to designing a clutch for a specific application. If the correct clutch is chosen, the truck will have good engagement, protection for the driveline, long clutch life, and minimal loss of torque.

1. **Torque Capacity** - A clutch must be chosen that has a torque capacity that is greater than or equal to the peak torque of the engine. This is very important today when an engine can be easily adjusted electronically to produce greater torque. There are two factors in determining torque capacity. These two factors are friction force and damper capacity.
 - Friction force is a product of the cover assemblies clamp load (also called plate load). This factor was explained in the previous section, and is stated as $F(f) = \mu NPr$. Determining the friction force is important because if this force is not greater than or equal to the peak torque of the engine, the clutch will slip.
 - Damper capacity is what allows the clutch to provide torsional protection for the entire driveline. If the peak engine torque exceeds this capacity, the driveline will be abused. This abuse will cause faster wear and possible destruction of driveline components. Since damper capacity is a product of the springs used in the damper, changing the number and type of springs changes the stiffness of the entire system.
2. **Application** - Service replacement clutches should have the same plate loads, damper and friction material. Substituting from the original could shorten the life of the clutch and drivetrain components.

Preventive Maintenance Overview

To ensure long life and proper operation of the release mechanism of the clutch, it is important to properly lubricate the following areas.

Lubrication

1. **Release Bearing-** The cast iron bearing housing will be equipped with either a standard grease fitting or a lube tube extension. If a lube tube is not present, it is necessary to remove the inspection cover to gain access to the grease fitting. Apply grease until it purges from the rear of the housing. Grease on the clutch brake friction surface and the transmission input shaft will extend the life of the clutch brake and bronze bushings inside the release sleeve.
2. **Release Bearing Wear Pads-** Where the release fork contacts the bearing housing, there are small hardened steel pads. Apply a small amount of grease to the wear pads where the clutch release fork contacts.
3. **Clutch Brake-** The clutch brake friction material is designed to operate with lubricant. While lubricating the release bearing, grease should purge from the housing and contact the clutch brake. This is beneficial for long clutch brake life. If desired, a small amount of grease could be applied to both sides of the clutch brake.
4. **Cross-Shaft Bushings-** Lubricate both the left and the right cross-shaft bushings per OEM recommendations.
5. **Clutch Control Linkage-** Lubricate the clutch linkage bell cranks and pivot pins per OEM recommendations.
6. **Pilot Bearing-** The pilot bearing inside the flywheel is a sealed for life bearing and requires no lubrication. Use a premium pilot bearing to prevent clutch drag and early bearing failures. (C-3, C-4, C-5 Suffix)
7. **Bushing-** Lube must be applied to input shaft between bearing and transmission to prevent bushing from wearing thin and coming out.

Lube Tube Assembly

The Eaton Fuller Lube Tube Assembly enables the release bearings in Eaton Fuller medium and heavy duty clutches to be greased without removing the bell housing inspection cover. The Lube Tube Hose replaces the original zerk fitting on the release bearing and protrudes through the bell housing window.

Lube Tube Lengths

Length in Inches	Part Number
12"	CLT012
9"	CLT009
8"	CLT008
7"	CLT007
6"	CLT006

Recommended Lubrication



Incorrect grease and improper lube procedures will cause bearing failures, bushing wearout, yoke tip and bearing wear pad wear.

Lubrication Interval

For recommended lubrication intervals, see TCMT-0021 or call 1-800-826-HELP (4357).

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