



Heavy-Duty Clutches

Roadranger®

More time on the road®

Service Manual

CLSM0200

January 2012

Solo Advantage®

Easy Pedal Advantage®

Value Clutch™

UltraShift™ DM

UltraShift PLUS ECA Clutch

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.

For Solo and Heavy-Duty ECA clutches only, install shipping bolts before removing clutch assembly from the flywheel.

IMPORTANT

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 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.

Warnings and Cautions

Repair Warnings	i
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Solo Advantage™ Self-Adjusting Clutches

Remove Clutch	1
Install Solo Advantage HD 15.5" Clutch ...	2
Measure Engine Flywheel Housing and Flywheel	2
Install Clutch to Flywheel	3
Install Transmission	5
Set-up	7
Troubleshooting for Solo Advantage HD 15.5" Clutches	10
Symptom-Driven Diagnostics	10
Too Much Free Pedal or Too Much Clutch Brake	1
Not Enough Free Pedal or No Clutch Brake	12
Resetting Procedures	13
In-Vehicle Reset Procedure	13
In-Vehicle Resetting Procedure Using the Solo Advantage Clutch Reset Tool. .	14
Verify Clutch Brake Squeeze	15
Out-of-Vehicle Reset Procedure for HD ECA or Solo Advantage Clutches	16

Easy Pedal Advantage™ Manual Adjust Clutches

Install Easy Pedal Advantage & ValueClutch .	17
Install Clutch to Flywheel	18
Install 15.5" Clutch to Flywheel	18
Install Transmission	20
Set-Up	22

UltraShift DM Heavy Duty Clutch

Remove Clutch	26
UltraShift DM Clutch Install Clutch to Flywheel	28
Install Transmission	29
Heavy-Duty UltraShift Clutch Recalibration .	30

ECA Clutch

Remove Clutch	32
Opening the ECA Clutch	32
15.5" Heavy-Duty ECA Clutch Installation .	35
Install Clutch to Flywheel	36
Install Transmission	37
Lubricate	39
ECA Clutch Adjustment	40
Grease Interval Count Reset	42

ServiceRanger Procedure	42
Operator Triggered Procedure	44
ECA Clutch In-Vehicle Resetting Procedure .	45
Opening the ECA Clutch	45

Low Capacity Inertia Brake

Wear Life Measurement	48
Transmission Removed	48
Transmission in Chassis	48

Hydraulic Linkage

Verify Linkage System Stroke	49
Master Cylinder Installation	49
Transmission Installation	50
Hose Assembly	51

Solo Advantage Lube Hose Assembly With Hydraulic Linkage

Installation Process	52
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General Clutch Information

Function of a Clutch	54
Neutral Idle Rattle	54
Self-Adjusting Clutches	55
Clutch Disc Friction Material	56
Clutch Slippage	56
Clutch Torque Capacity	56
Clutch Wear	56
Cover Assembly	56
Driven Disc	57
Facings	57
Intermediate Plate	57
Positive Separator Pin™	57
6-Position Kwik-Adjust®	57
Clutch Brakes	57

Factors that Effect Clutch Performance

When to Inspect the Clutch	59
----------------------------------	----

Preventative Maintenance Overview

Inspection for Clutch Life	59
Designing a Clutch for a Specific Application	59
Preventive Maintenance Overview	60
Lubrication	60
Recommended Lubrication	60
Lubrication Interval	60

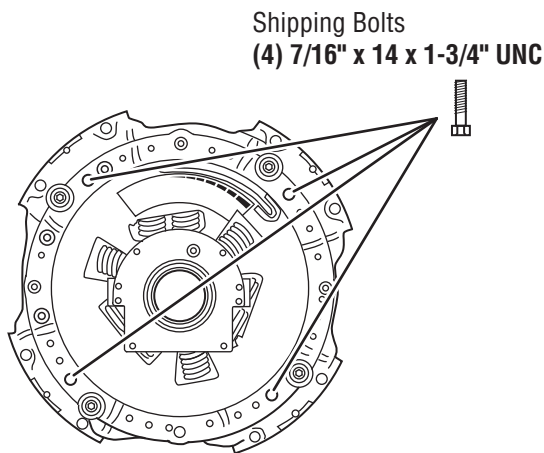
Remove Clutch

(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 4 shipping bolts (7/16" x 14 x 1 3/4" UNC, hex head). Install them in the 4 cover holes hand tight then turn one full turn.



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).

IMPORTANT

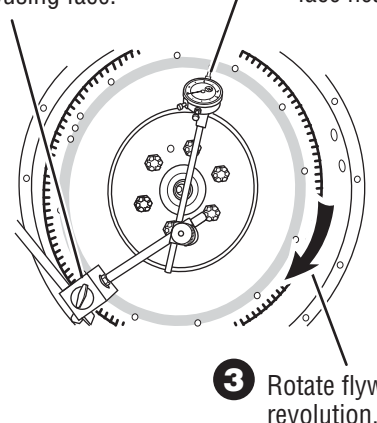
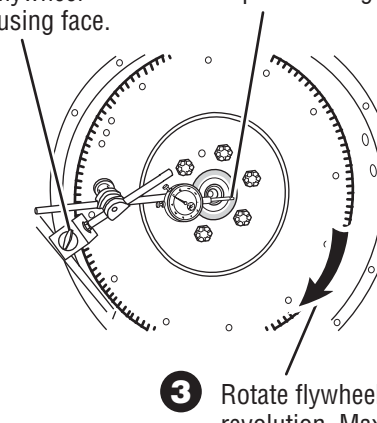
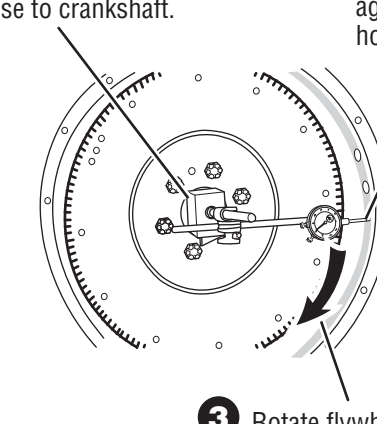
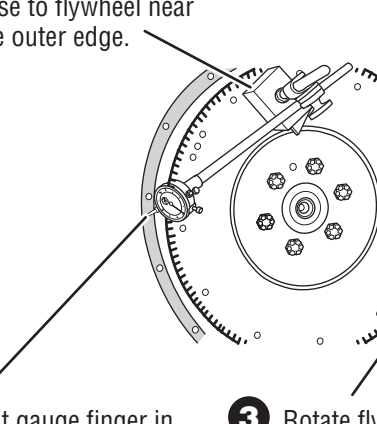
This step will hold the pressure plate separator pins in proper position so the clutch can be reused and will release after reinstalling.

Install Solo Advantage Heavy-Duty 15.5" Clutch

Measure Engine Flywheel Housing and Flywheel

Engine flywheel housing and flywheel must meet these specifications or it may result in 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 0.008" (0.20 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 0.005" (0.13 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 0.008" (0.20 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 0.008" (0.20 mm). 

Solo Advantage Self-Adjusting Clutches

Install Clutch to Flywheel

▲ IMPORTANT

Use the Eaton Clutch Selector Guide (CLSL1511) to make sure you have the right clutch.

Note: When installing clutch to flywheel, position the wear indicator at the bottom of flywheel to ease future clutch servicing.

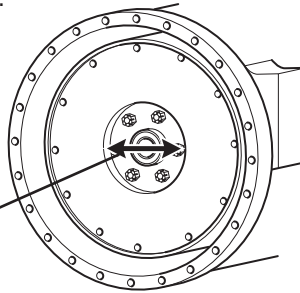
▲ WARNING

An assembled clutch weighs about 150 lbs (68 kg). Avoid the risk of injury. Use proper equipment when lifting a clutch.

- 1** Measure the flywheel bore. Use the Eaton Clutch Selector Guide to verify that the damper will fit into the flywheel bore.

7.0" (8-spring)
8.5" (10-spring)
10.0" (7-spring and Mack 9-spring)

Note: Mack 9-spring for Mack and Volvo engines 2007 and newer only.



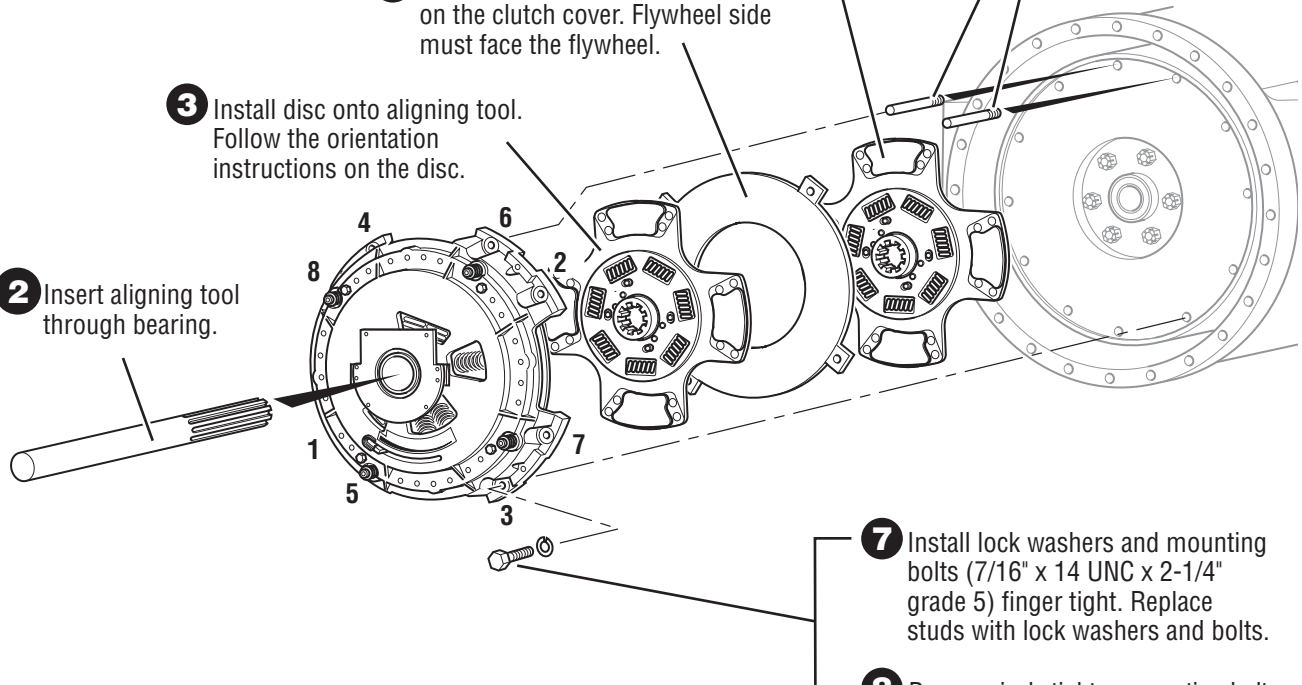
- 6** Install two 7/16" x 14 UNC x 5" studs into upper mounting holes. Install assembled clutch.

- 5** Install second disc onto aligning tool. Follow the orientation instructions on the disc.

- 4** Install intermediate plate into slots on the clutch cover. Flywheel side must face the flywheel.

- 3** Install disc onto aligning tool. Follow the orientation instructions on the disc.

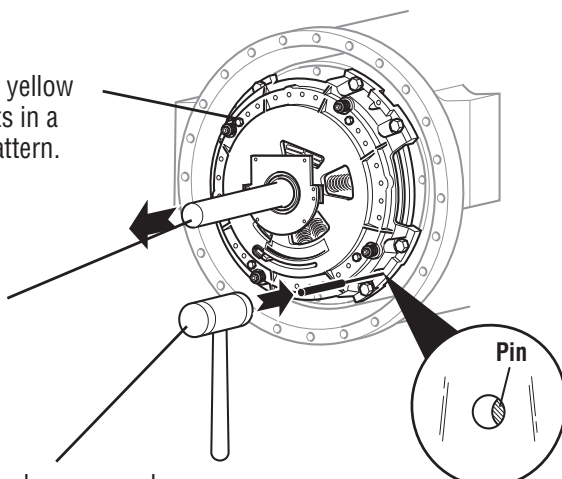
- 2** Insert aligning tool through bearing.



- 7** Install lock washers and mounting bolts (7/16" x 14 UNC x 2-1/4" grade 5) finger tight. Replace studs with lock washers and bolts.

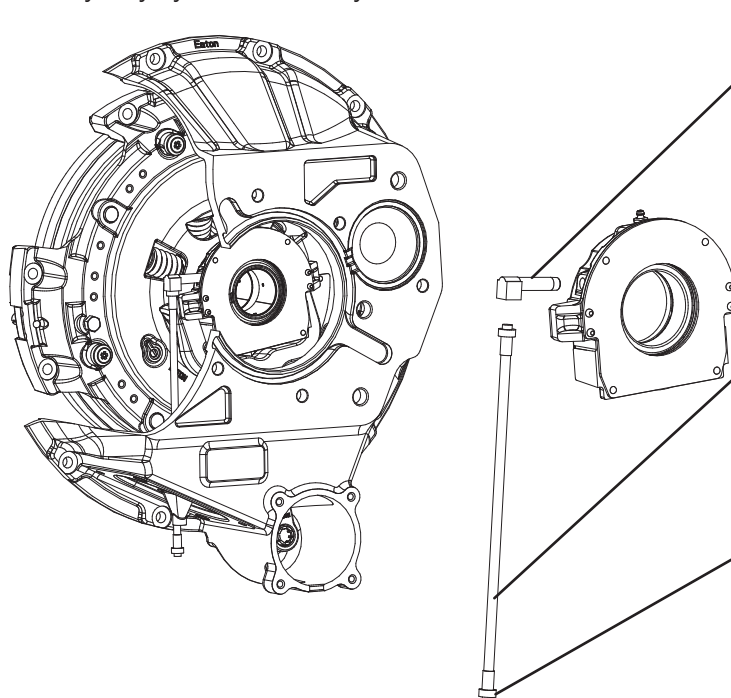
- 8** Progressively tighten mounting bolts in a crisscross pattern starting with the lower left bolt (1, 2, 3, 4, 5, 6, 7, 8). Torque to 40-50 lb-ft (54-68 N•m). Failure to do this could result in improper piloting of the clutch and cause clutch damage.

Solo Advantage Self-Adjusting Clutches

- 9** Remove four yellow shipping bolts in a crisscross pattern.
- 10** Remove the aligning tool.
- 11** Use a six ounce hammer and a 1/4" flat nose punch to lightly tap the four separator plate pins toward the flywheel. Only part of the pin should be visible. If installing Solo Advantage Clutch, proceed to **Step 12**.
- 
- The diagram shows a top-down view of the clutch assembly. Four yellow shipping bolts are being removed in a crisscross pattern. An aligning tool is being removed. A circular inset shows a close-up of a pin being moved toward the flywheel.

Install HD Solo Advantage Lube Hose Attachment

Note: The example shown is of a Lube Hose Attachment for a heavy-duty Hydraulic release system.

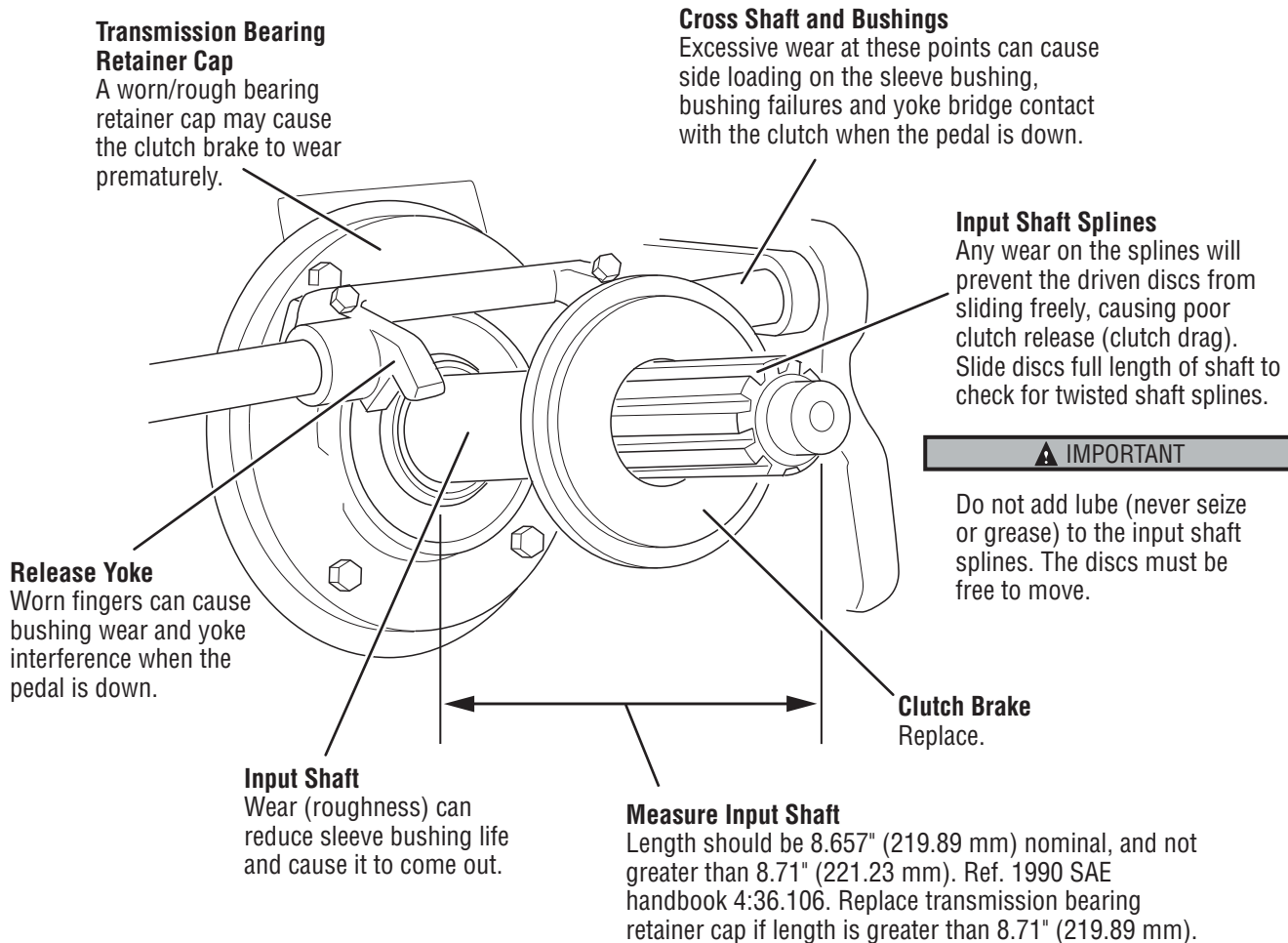
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- The diagram shows a side view of the clutch assembly with the lube hose attachment installed. A separate view shows the attachment being tightened onto the grease port.
- 12** Install brass fitting into grease port on left side of release bearing housing using Weatherhead socket. Tighten hand tight and continue to turn until the opening of the fitting is facing toward the 6 o'clock position.
- 13** Install lube hose into brass fitting and tighten until hand tight, then turn an additional 2 turns.
- 14** Lubricate release bearing until grease purges from release bearing housing. Use NLGI grade 2 or 3 Lithium complex grease. Reference Eaton lubrication manual TCMT0021 for specific instructions.

Note: A-8173 hand hole cover with grommet is required with HD Solo Advantage clutch used with hydraulic release system.

Install Transmission

Check Transmission for Wear

Replace any worn components.



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 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.

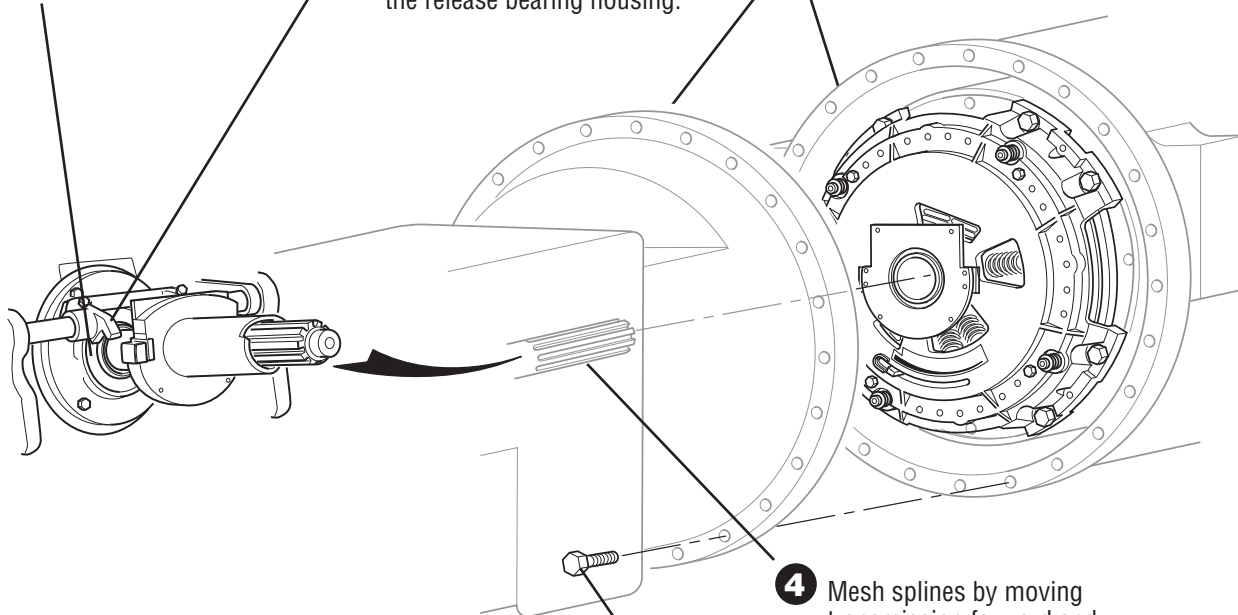
Do not use the cross-shaft release lever (or a pipe over it) to pull the transmission into its final position. Pulling the bearing too far during installation can cause an overstroke causing the release bearing to move closer to the transmission (less than 0.490") with this condition. Follow the Out of Vehicle Resetting Procedure on **page 1**.

Note: Adjust the linkage until pushing the pedal down moves the bearing against the clutch brake. Let up on the pedal and measure the distance between the bearing and clutch brake (distance should be 0.490"-0.560").

Solo Advantage Self-Adjusting Clutches

Fasten Transmission to Flywheel Housing

- 1** Put transmission in gear. Make sure new clutch brake has been installed.
- 2** Make sure that the yoke fingers remain in the up position until they are over the release bearing housing.
- 3** Position transmission so it is square to and aligned with engine.



⚠ CAUTION

Do not pull on release arm to install transmission. This will cause the clutch to over adjust.

Do not force transmission against clutch with yoke fingers in the UP position. This will break the cast webbing of the clutch causing damage that is not warrantable.

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

⚠ IMPORTANT

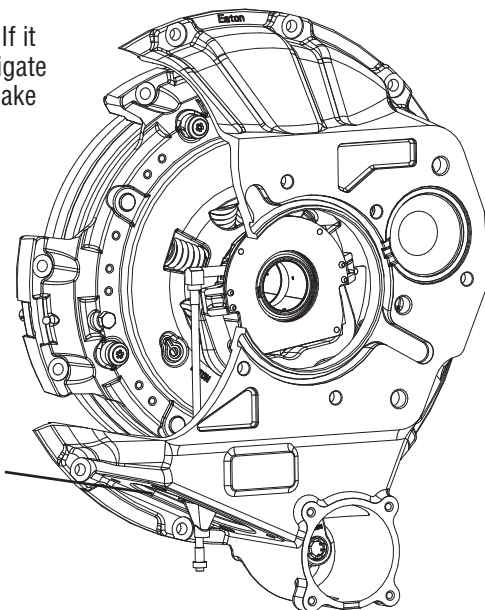
Do not add lube (never seize or grease) to the input shaft splines. The discs must be free to move.

- 4** Mesh splines by moving transmission forward and rotating the output shaft.
- 5** Install mounting bolts and torque to OEM specs. If installing Solo Advantage clutch, proceed to **Step 6**.

⚠ WARNING

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

- 6** Install hand hold cover A-8173 with grommet positioned toward rear of hand hold opening in the clutch housing. Secure the hand hole cover with two 5/16" x 18 x 1/2" long bolts.



- 7** Insert plug into hole in the upper left side of the clutch housing where the horizontal lube hose is utilized. (Image not shown)

Note: If the lube hose assembly should need servicing it can be replaced without removal of the transmission.

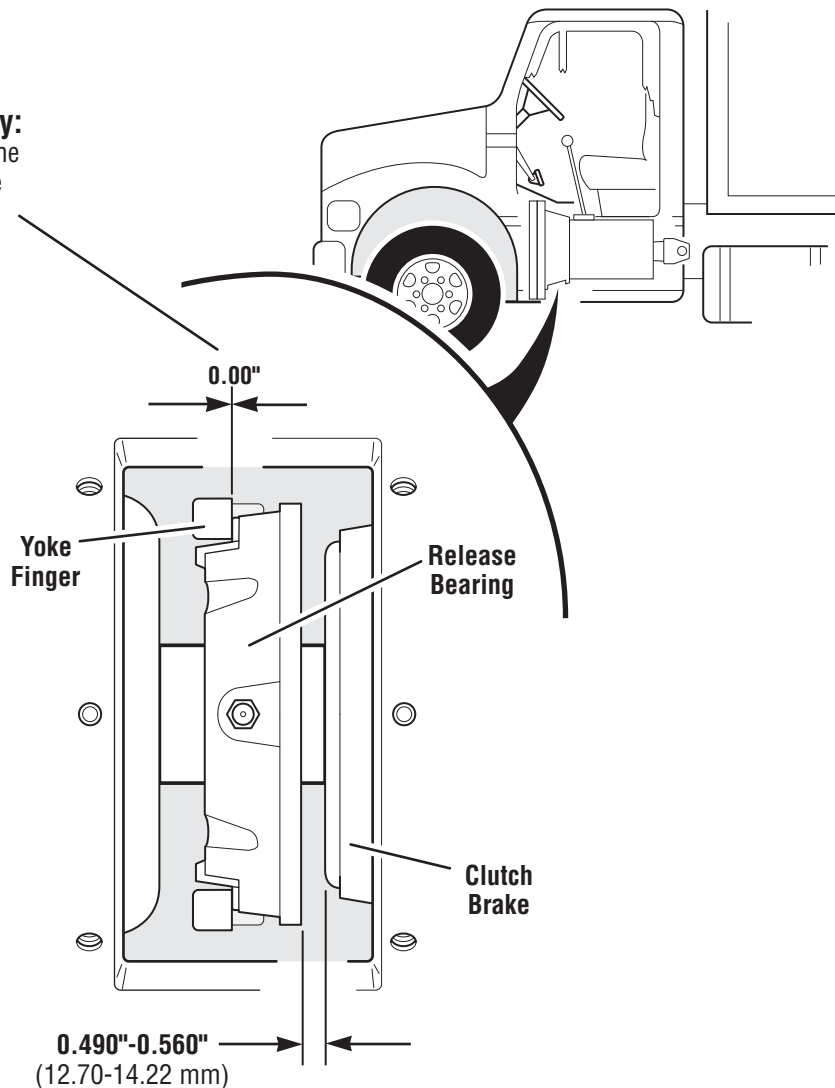
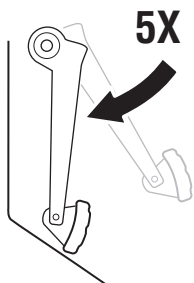
Set-up

Adjust Clutch Linkage

- 1 Hydraulic Linkages:**
Skip to **Step 2**.

Mechanical Linkages Only:
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** With the pedal up, measure the distance between the release bearing and the clutch brake. The correct distance should be 0.490"-0.560" (12.70-14.22 mm):
 - If the distance is more the 0.560" (14.22 mm), return to **Step 1** and readjust the clutch linkage.
 - If the distance is less the 0.490" (12.70 mm), see Solo Advantage Heavy-Duty 15.5" Clutch Troubleshooting. Go to **page 10**.

Verify Clutch Brake Squeeze

⚠ WARNING

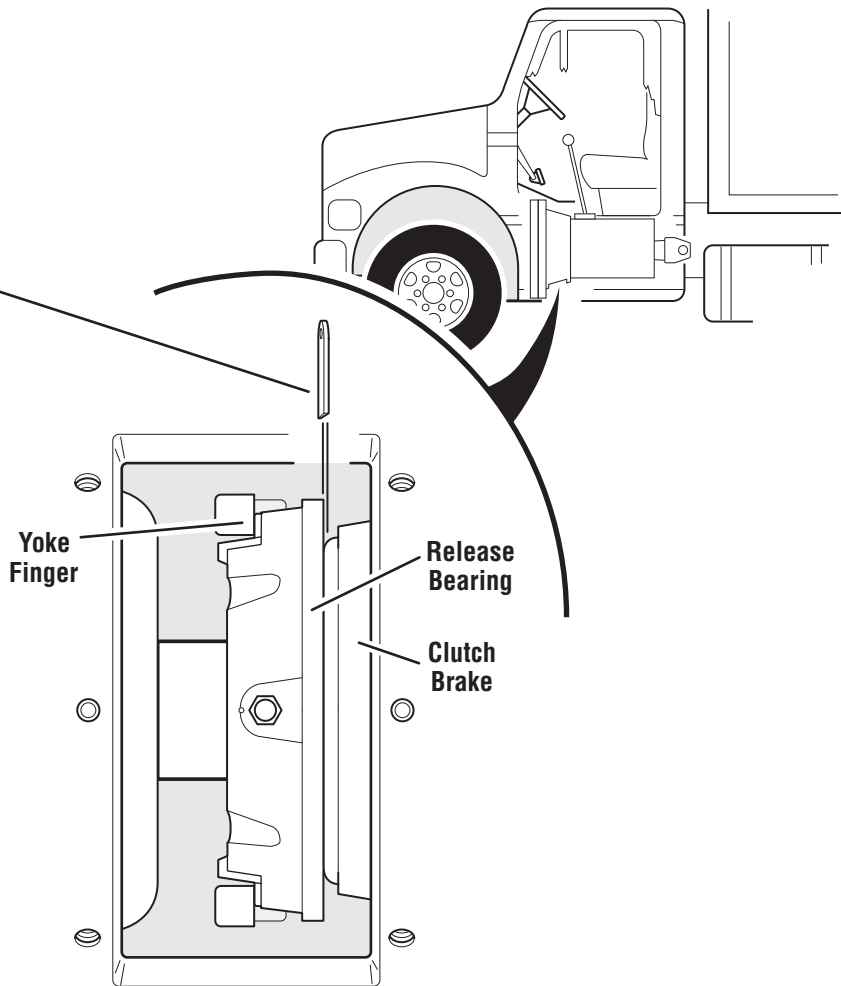
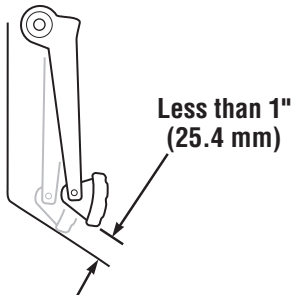
Use a gauge long enough to keep hands away from moving parts.

- 4** Have an assistant insert 0.010" (0.25 mm) feeler gauge between the release bearing and the clutch brake.

Press the pedal down to the floor to reclamp the gauge:

- If the gauge does not clamp, readjust the truck linkage and move yoke fingers 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. Return to **Step 4**.



Verify Free-Play

- 6** Verify there is free-play in the cab. If not, the truck linkage is not providing enough stroke, consult OEM manual for free-play dimension. For Solo clutches, proceed to **Step 8**. For Solo Advantage clutches, proceed to **Step 9**.

⚠ IMPORTANT

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

Solo Advantage Self-Adjusting Clutches

Lubricate

Note: All clutches use a Lithium complex grease with a minimum of 325°F (163°C) operating range meeting NLGI grade 2 or 3 specs.

For additional lubrication information, see TCMT0021.

⚠ CAUTION

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

- 7** 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.

- 8** Apply grease to input shaft and yoke fingers.

- 9** Apply grease to the cross shaft bushings and linkage pivot points.

Input Shaft

Zerk

Input Shaft

⚠ IMPORTANT

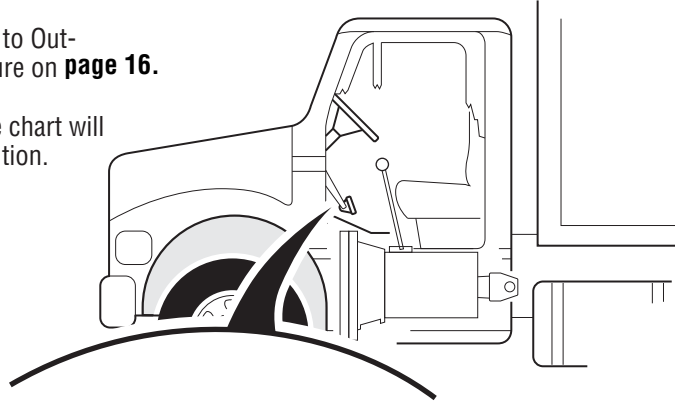
Do not add lube (never seize or grease) to the input shaft splines. The disc must be free to move.

Troubleshooting for Solo Advantage Heavy-Duty 15.5" Clutches

Symptom-Driven Diagnostics

If clutch is out of vehicle, go to Out-of-Vehicle Resetting Procedure on **page 16**.

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



☒ **Too Much Free Pedal:**

A diagram of the clutch pedal linkage. The pedal is shown in a retracted position. A double-headed arrow indicates the distance from the pedal's rest position to the point where it begins to engage the clutch. The text "Too much travel" is next to the arrow.

Too much travel

Pedal travels too far before engaging the clutch. Clutch does not disengage.
Go to page 11.

☒ **Not Enough Free Pedal:**

A diagram of the clutch pedal linkage. The pedal is shown in a retracted position. A double-headed arrow indicates the distance from the pedal's rest position to the point where it begins to engage the clutch. The text "Not enough travel" is next to the arrow.

Not enough travel

Pedal travels too little before engaging the clutch.
Go to page 12.

☒ **Too Much Clutch Brake:**

A diagram of the clutch pedal linkage. The pedal is shown in a retracted position. A double-headed arrow indicates the distance from the pedal's rest position to the point where it begins to engage the clutch. The text "Too much brake squeeze" is next to the arrow.

Too much brake squeeze

Go to page 11.

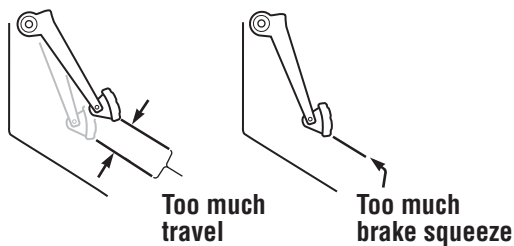
☒ **No Clutch Brake:**

A diagram of the clutch pedal linkage. The pedal is shown in a retracted position. A double-headed arrow indicates the distance from the pedal's rest position to the point where it begins to engage the clutch. The text "Not enough brake squeeze" is next to the arrow.

Not enough brake squeeze

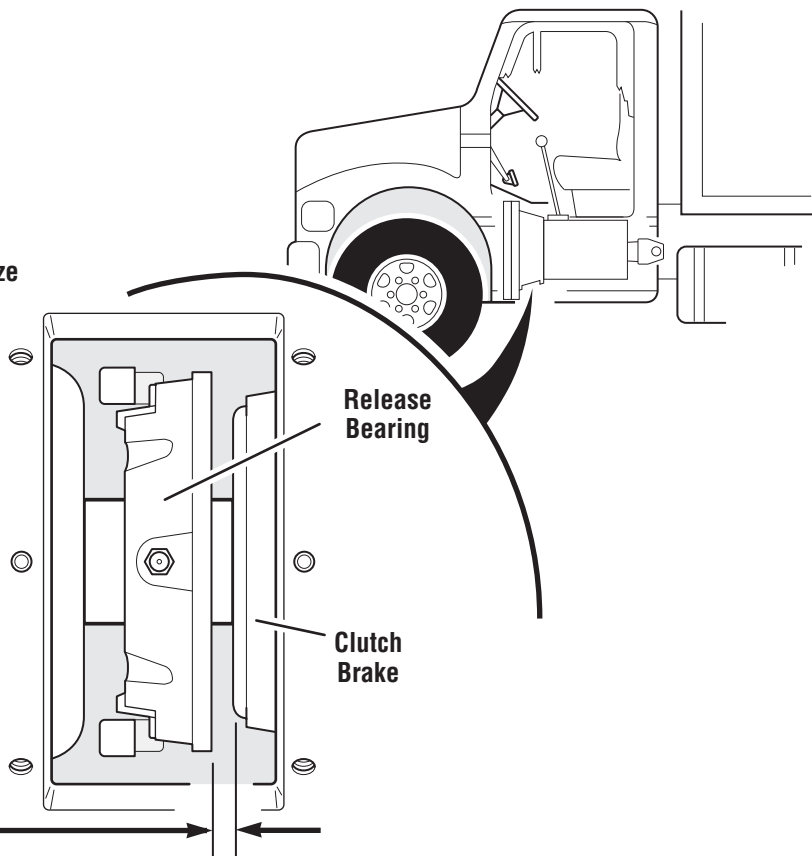
Go to page 12.

Too Much Free Pedal or Too Much Clutch Brake



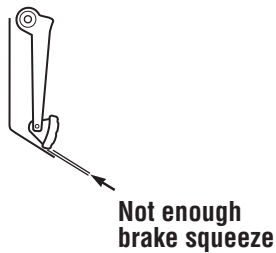
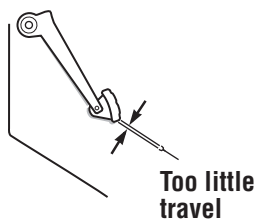
Note: Before measuring the distance between the release bearing and clutch brake depress clutch pedal to remove free pedal in the cab.

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



Measurement	Status	Solution
☒ If distance is correct 0.490"-0.560" (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 49.
☒ If distance is Less than 0.490" (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 GOOD position: • Disc is installed incorrectly Go to page 3, Step 4 and 5. • Damper is too large for the flywheel opening Go to page 3, Step 1. If tab not at GOOD position, the bearing may have been pulled during installation, causing an overadjust. Go to page 16.

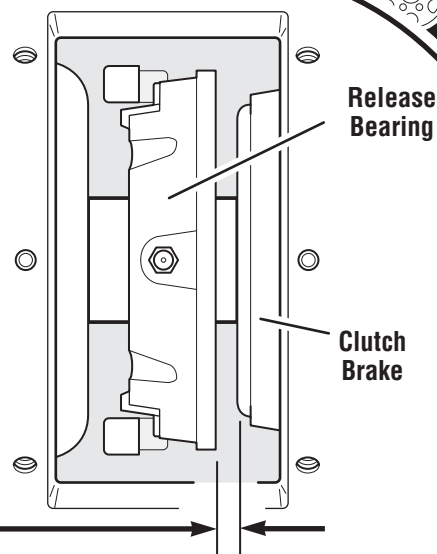
Not Enough Free Pedal or No Clutch Brake



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
☒ If distance is correct 0.490"-0.560" (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 49.
☒ If distance is More than 0.560" (14.22 mm)	Clutch is not set up correctly	If clutch was factory installed and was never removed, Mechanical Linkage: Go to page 14. Hydraulic Linkage: Go to page 49.
		If clutch was removed from engine and reinstalled, (Setup) Go to page 7.
		If new/reman clutch was installed and it never operated properly, (Setup) Go to page 7.

Resetting Procedures

In-Vehicle Reset 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.

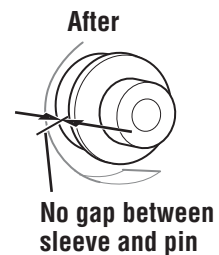
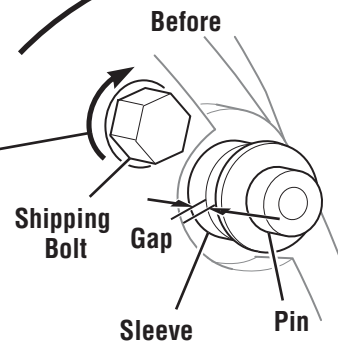
- With spacers in place, follow **Steps 1-3** in this procedure.
- Remove spacers and torque transmission mounting bolts.
- Continue process starting at **Step 4**.

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

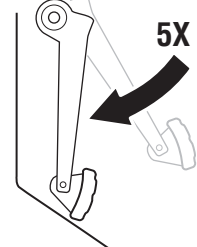


- 4 Install and tighten 4 shipping bolts (7/16" x 14 x 1-3/4 UNC) until they quit turning.

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



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



- 5 Remove shipping bolts.

In-Vehicle Resetting Procedure Using the Solo Advantage Clutch Reset Tool



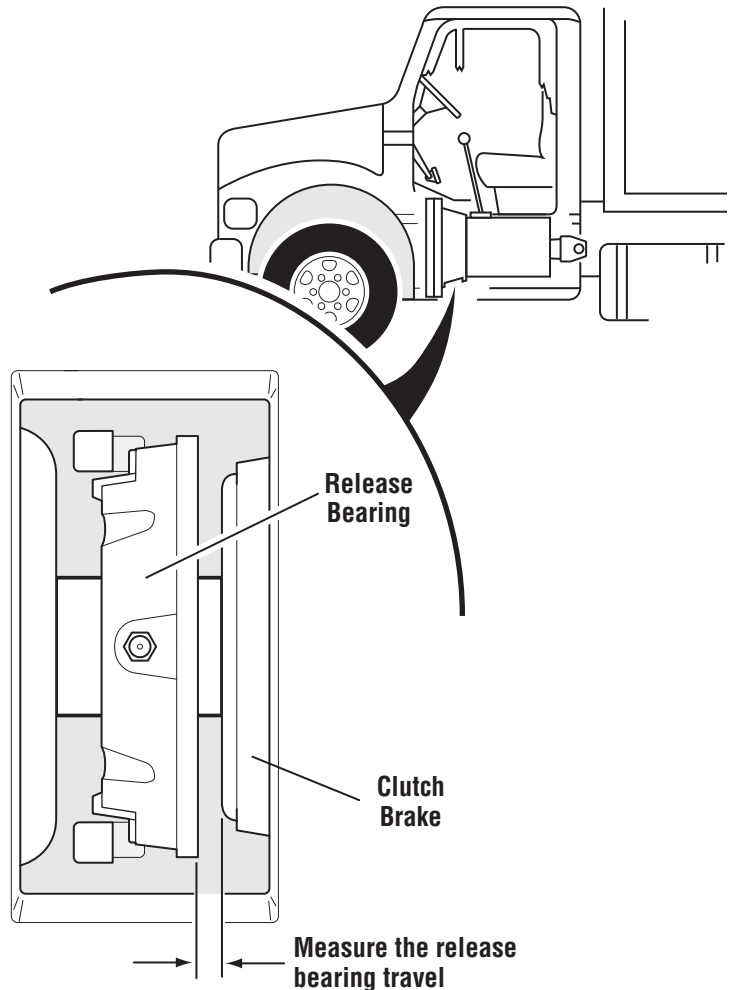
Tool Part Code:

RR1005CL

K-Line 1-800-824-5546

- 1** Determine if the release bearing travel is correct. Measure the distance between the clutch brake and the release bearing with the clutch pedal up. If the measurement is between 0.490" and 0.590", the Solo has set itself correctly.

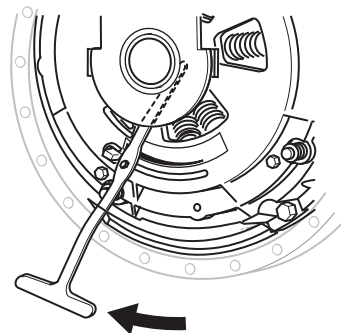
Note: Yoke gap only applies to mechanical linkage. Most hydraulic linkages operate without yoke gap.
- 2** If the release bearing travel is less than 0.490" the Solo must be reset. A common cause of this is the transmission was pulled in with the release arm during clutch installation.
- 3** Rotate the engine so that the cam tab can be reached through the transmission inspection opening.



- 4** Push the clutch pedal to the floor. While the clutch pedal is pushed to the floor have someone push the cam tab to the new position using finger pressure or the Solo tool. Once the cam tab is pushed to the new position you can release the clutch pedal.

Note: If the cam tab does not move, there is not enough release bearing travel to allow the cams to separate. In this case, loosen the transmission and install 1/2" spacers between the flywheel housing and bell housing.

With the spacers in place push the clutch pedal to the floor while someone pushes the cam tab to the new position. Once the tab is in the new position release the clutch pedal and remove the spacers. Torque the transmission mounting bolts.



Solo Advantage Self-Adjusting Clutches

- 5** Install (4) shipping bolts and progressively tighten by hand until they bottom out. Rotate the engine to access all 4 bolts:

- 15 1/2" Solo use 7/16 x 14 UNC x 1 3/4"
- Stamped 14" Solo use 3/8 x 16 UNC x 1 1/4"

Note: This will reset the pressure plate separator pins and allow the clutch to release after installation.

- 6** Remove the (4) shipping bolts. The release bearing and sleeve will move forward towards the engine when the bolts are removed. The Solo is now in the new position.

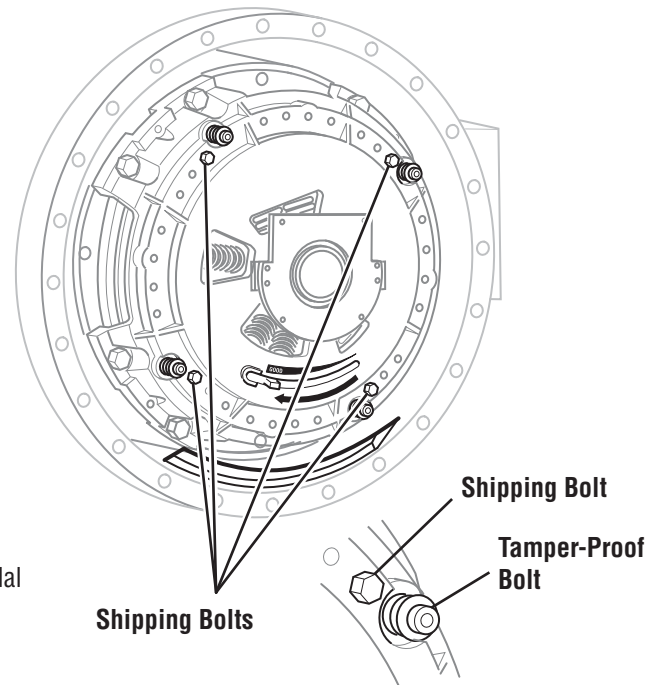
- 7** With the free pedal removed push the clutch pedal down at least 5 times. Make sure the clutch release bearing contacts the clutch brake.

While you engage and release the clutch the cab free pedal will increase. This indicates the Solo is adjusting to the environment.

- 8** Measure the distance between the clutch brake and the release bearing. It should be between 0.490" and 0.590".

- 9** If the release bearing travel is still greater than 0.590" between the clutch brake and the release bearing, repeat **Steps 7 and 8**.

- 10** Adjust the clutch linkage to achieve 1/8" clearance between the release yoke and the release bearing. Verify proper clutch brake squeeze.



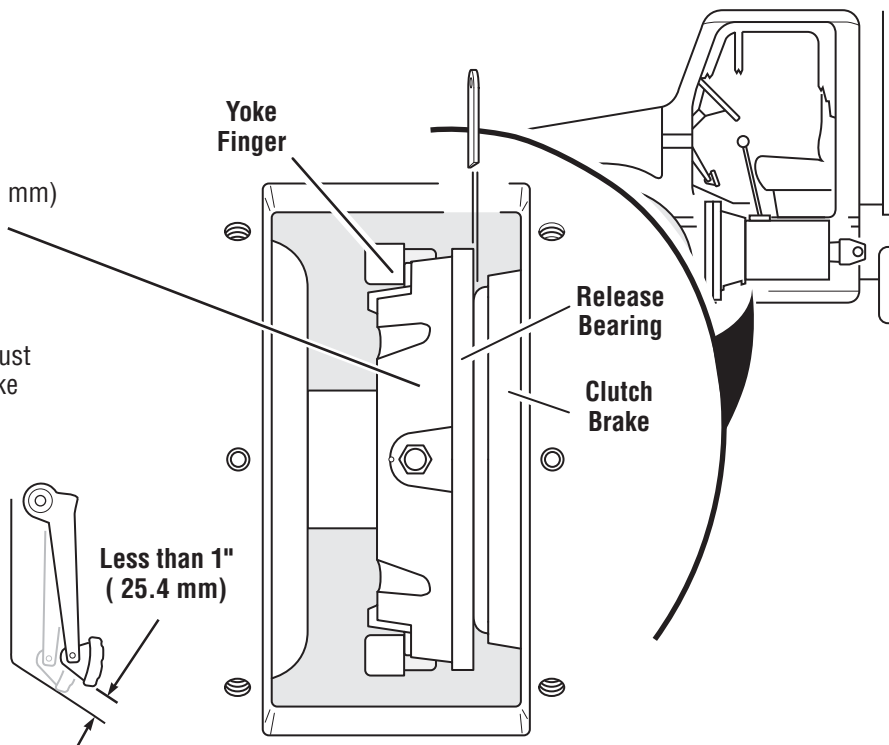
Verify Clutch Brake Squeeze

⚠ WARNING

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

- 1** Have an assistant insert 0.010" (0.25 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.

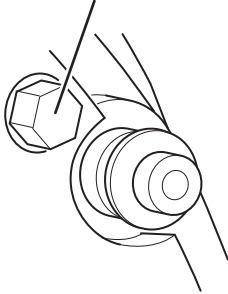
- 2** Slowly let up on the pedal and measure the pedal position at the moment the gauge can be removed:
- If pedal is more than 1" (25.4 mm) from the floor, readjust the truck linkage to move the yoke fingers further from the release bearing. Repeat **Step 1**.



Solo Advantage Self-Adjusting Clutches

Out-of-Vehicle Reset Procedure for Heavy-Duty ECA or Solo Advantage Clutches

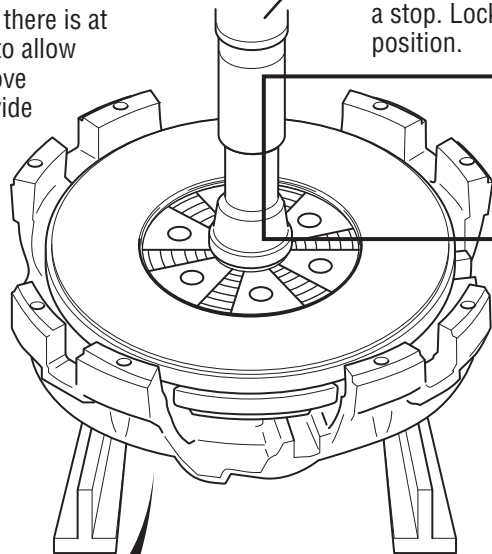
- 1 Remove the 4 shipping bolts if they have been installed.



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

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

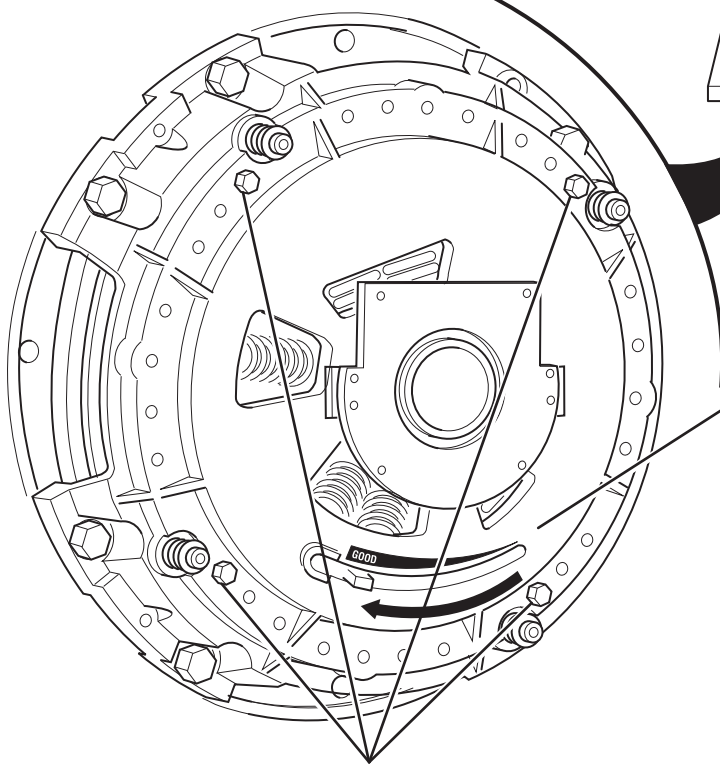
- 3 Center the ram and press downward on the retainer until it comes to a stop. Lock the ram in position.



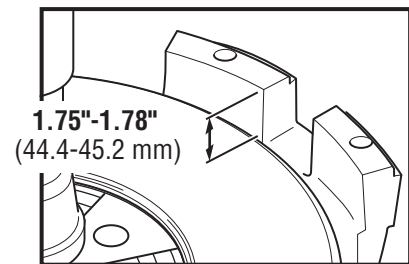
- 4 Slide the wear indicator tab to the "GOOD" position and hold it in place with a magnet



- 5 Install 4 shipping bolts (7/16" x 14 x 1-3/4" UNC, hex head). Progressively tighten (no air wrenches) the 4 shipping bolts (crisscross pattern) until the face of the pressure plate is 1.75"-1.78" (44.4-45.2 mm) below the mounting surface.



Shipping Bolts



- 6 Reinstall the clutch using the original installation instructions.

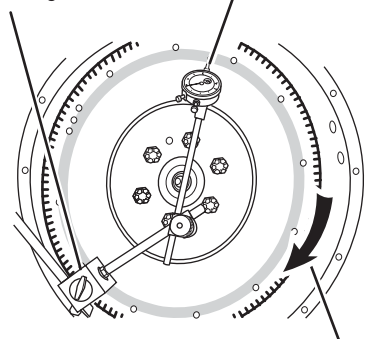
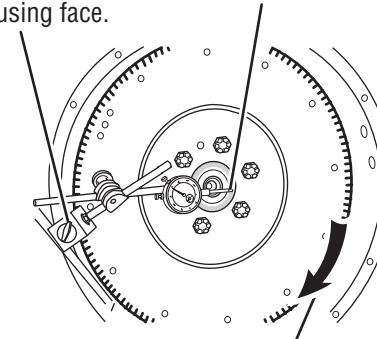
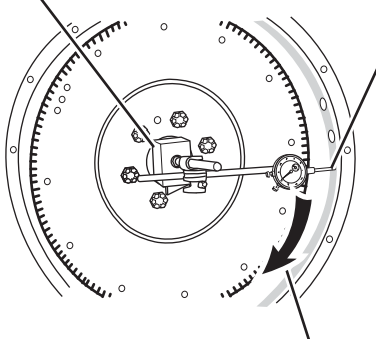
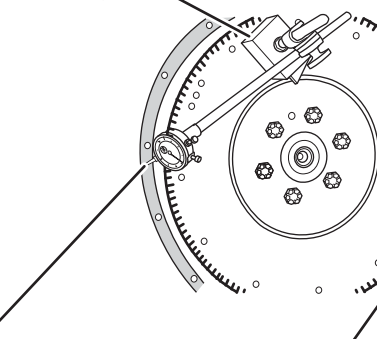
Note: This important step will reset the pressure plate separator pins and allow the clutch to release after reinstallation.

Install Easy Pedal Advantage and ValueClutch

Measure Engine Flywheel Housing and Flywheel

Engine flywheel housing and flywheel must meet these specifications or may result in a 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 0.008" (0.20 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 0.005" (0.13 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 0.008" (0.20 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 0.008" (0.20 mm). 

Install Clutch to Flywheel

Install 15.5" Clutch to Flywheel (Easy Pedal Shown)

▲ IMPORTANT

Use the Eaton Clutch Selector Guide (CLSL1511) to make sure you have the right clutch.

Note: When installing clutch to flywheel, position the adjuster at the bottom of flywheel to ease future clutch servicing.

▲ WARNING

An assembled clutch weighs about 150 lbs (68 kg). Avoid the risk of injury. Use proper equipment when lifting a clutch.

Note: Easy Pedal or manual adjust clutch assemblies not recommended for use with hydraulic release systems.

- 1 Measure the flywheel bore. Use the Eaton Clutch Selector Guide to verify that the damper will fit into the flywheel bore.

7.0" (8-spring)
8.5" (10-spring)
10.0" (7-spring and Mack 9-spring)

Note: Mack 9-spring for Mack and Volvo engines 2007 and newer only.

- 5 Install second disc onto aligning tool. Follow the orientation instructions on the disc.

- 4 Install intermediate plate into slots on the clutch cover. Flywheel Side must face the flywheel.

- 3 Install disc onto aligning tool. Follow the orientation instructions on the disc.

- 2 Insert aligning tool through bearing.

- 6 Install two 7/16" x 14 UNC x 5" studs into upper mounting holes. Install assembled clutch.

- 7 Install lock washers and mounting bolts (7/16" x 14 UNC x 2-1/4" grade 5) finger tight. Replace studs with lock washers and bolts.

- 9 Verify bearing position is 3/8"-5/8" (9.5-15.9 mm) from cover.

- 10 Remove the aligning tool. Be sure shipping blocks are removed.

- 11 Use a six ounce hammer and a 1/4" flat nose punch to lightly tap the four separator plate pins toward the flywheel (New EP Only). Reman and Value clutches do not have pins. Only part of the pin should be visible.

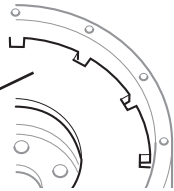
- 8 Progressively tighten mounting bolts in a crisscross pattern starting with the lower left bolt (1, 2, 3, 4, 5, 6, 7, 8). Torque to 40-50 lb-ft (54-68 N•m). Failure to do this could result in improper piloting of the clutch and cause clutch damage.

Easy Pedal Advantage Manual Adjust Clutches

Install 14" Clutch to Flywheel

- 1 Ensure the correct flywheel depth is 2-15/16".

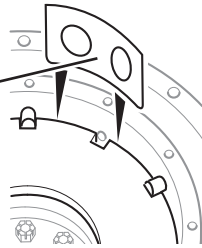
- 2 Put front disc into flywheel. Flywheel side must be toward engine. Use new slots to put intermediate plate on pins.



Super-duty clutch only:

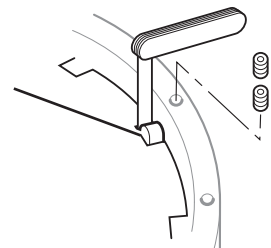
- 3 Install three equally spaced anti-rattle springs.

Note: Check orientation on anti-rattle springs before installing.

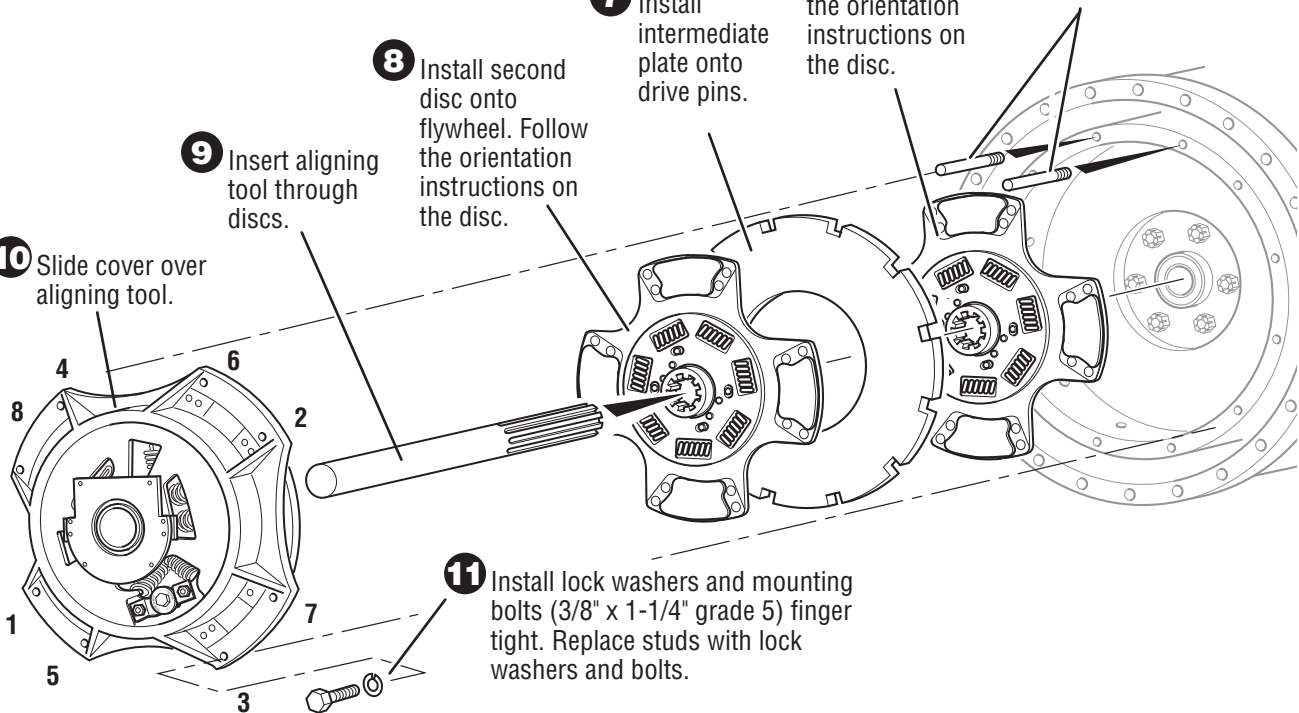


- 4 Turn intermediate plate left. Use 0.006" feeler gauge to check left pin clearance on all 6 drive pins.

Note: Remove two set screws. Straighten pins to increase clearance and reinstall set screws. Do not file slots.



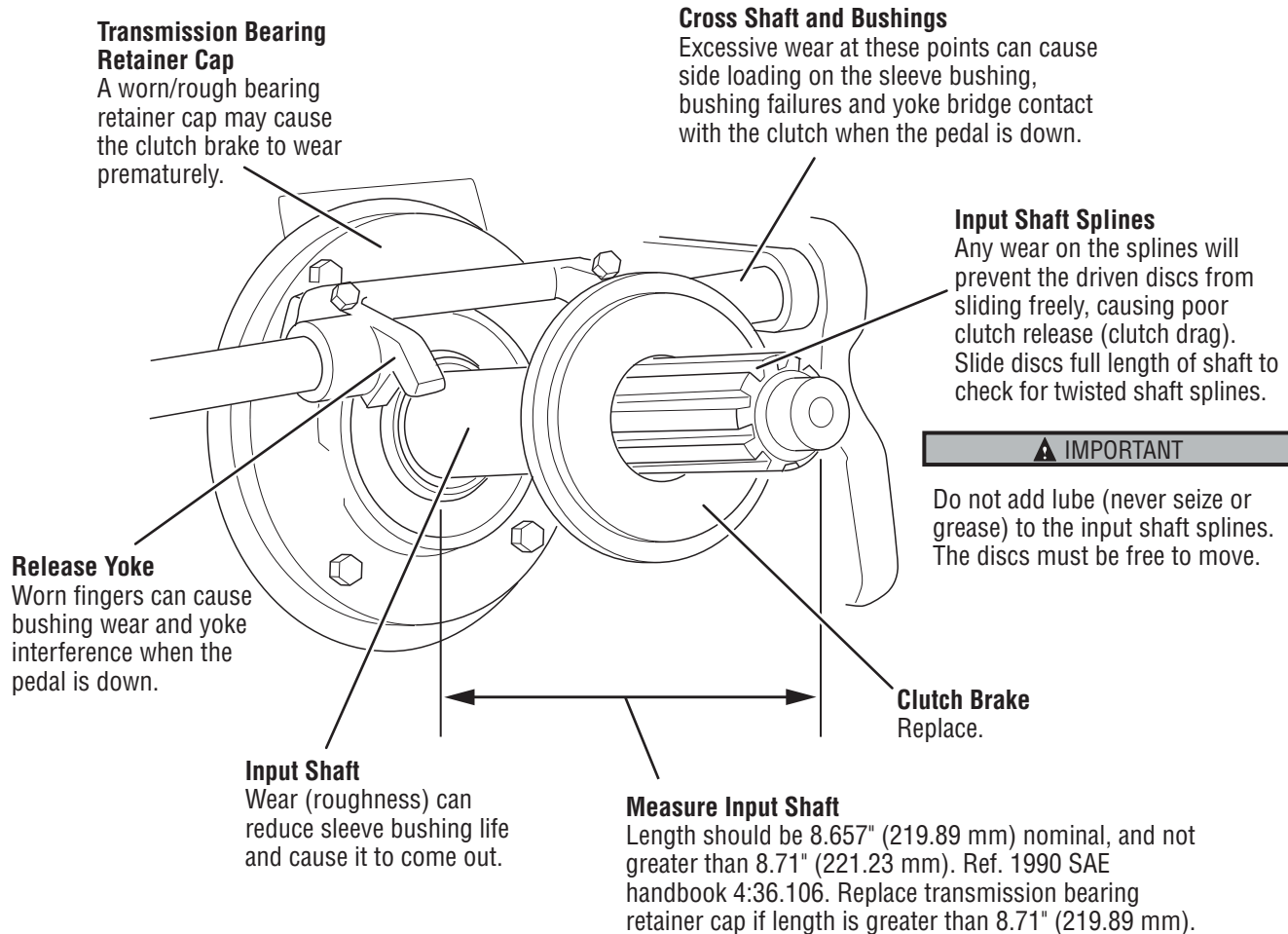
- 5 Install two 3/8" x 2-1/2" studs into upper mounting holes.
- 6 Install disc into flywheel. Follow the orientation instructions on the disc.
- 7 Install intermediate plate onto drive pins.
- 8 Install second disc onto flywheel. Follow the orientation instructions on the disc.
- 9 Insert aligning tool through discs.
- 10 Slide cover over aligning tool.
- 11 Install lock washers and mounting bolts (3/8" x 1-1/4" grade 5) finger tight. Replace studs with lock washers and bolts.
- 12 Progressively tighten mounting bolts in a crisscross pattern starting with the lower left bolt (1, 2, 3, 4, 5, 6, 7, 8). Torque to 25-35 lb-ft (34-47 N•m). Failure to do this could result in improper piloting of the clutch and cause clutch damage.
- 13 Remove the aligning tool. Be sure shipping blocks are removed.



Install Transmission

Check Transmission For Wear

Replace any worn components.



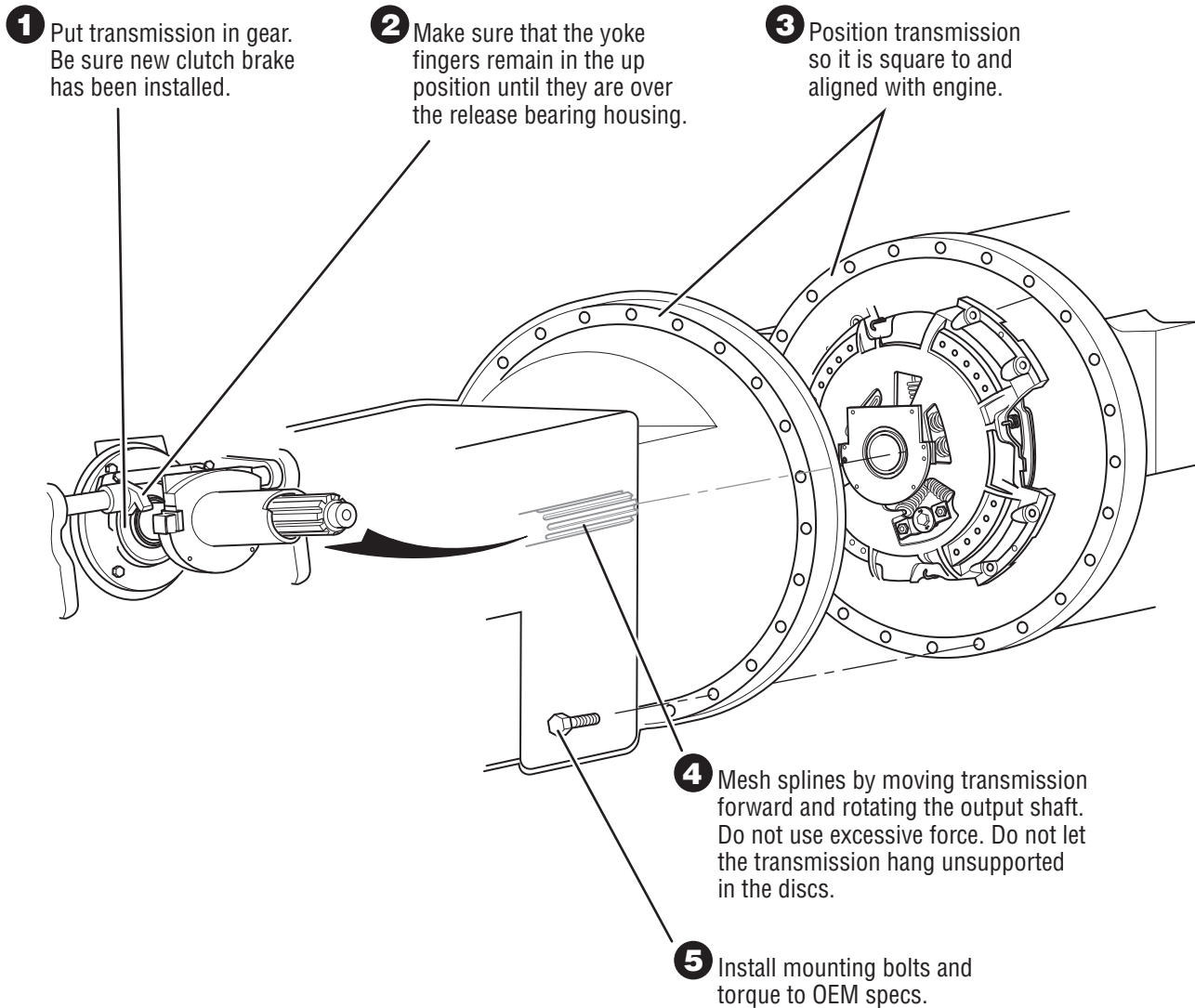
CAUTION

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 on 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

Transmission installation and clutch set-up procedures are the same for the 14" and 15.5" clutch.



⚠ WARNING

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

⚠ IMPORTANT

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

⚠ CAUTION

Do not force transmission against clutch with yoke fingers in the up position. This will break the cast webbing of the clutch causing damage that is not warrantable.

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

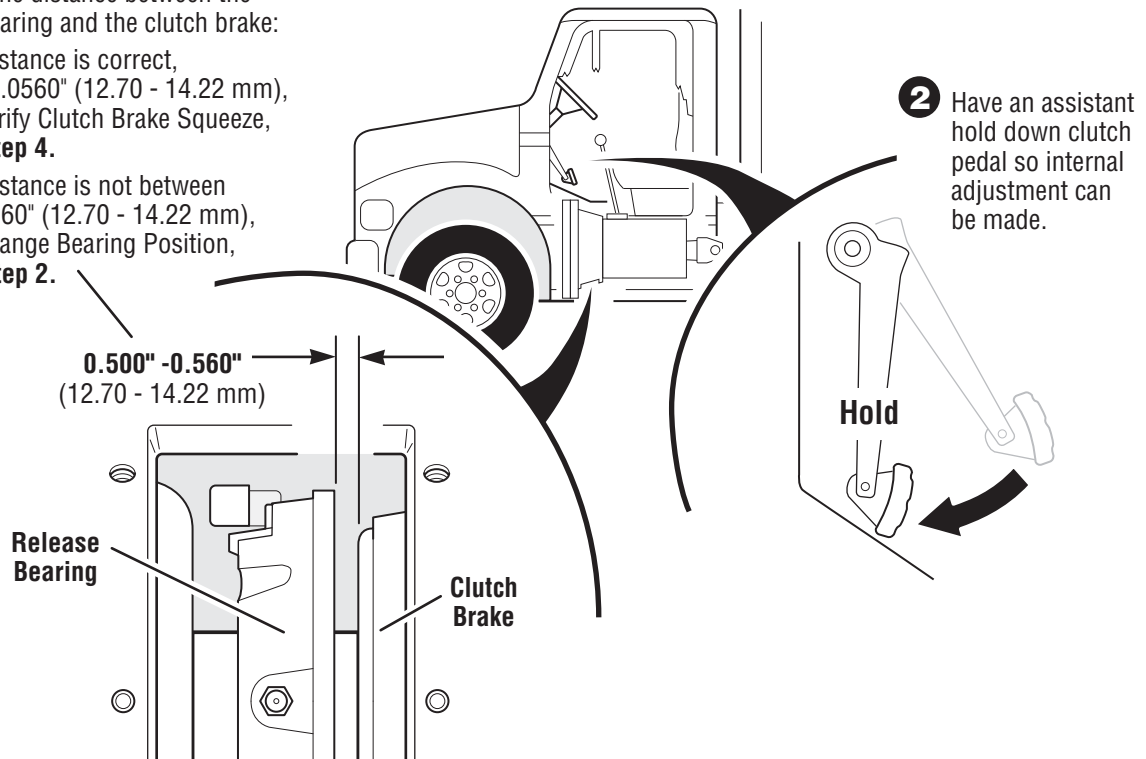
Set-Up

Adjust Bearing Position

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

1 Measure the distance between the release bearing and the clutch brake:

- If the distance is correct, 0.500" - 0.560" (12.70 - 14.22 mm), then Verify Clutch Brake Squeeze, go to **Step 4**.
- If the distance is not between 0.500" - 0.560" (12.70 - 14.22 mm), then Change Bearing Position, go to **Step 2**.



3 Adjust bearing position:

Easy-Pedal & Easy Pedal Advantage Only:	Value Clutch Only:
While pedal is held down, push adjusting nut and turn: • If measurement was more than 0.560" (14.22 mm), turn adjusting nut clockwise. • If measurement was less than 0.500" (12.77 mm), turn adjusting nut counterclockwise. Adjusting Nut Part Number 125489	While pedal is held down, remove lockstrap and move adjusting lug: • If measurement was more than 0.560" (14.22 mm), move adjusting lug to the left (shown). • If measurement was less than 0.500" (12.77 mm), move adjusting lug to the right. Adjusting Lug Lockstrap

Verify Clutch Brake Squeeze

⚠ WARNING

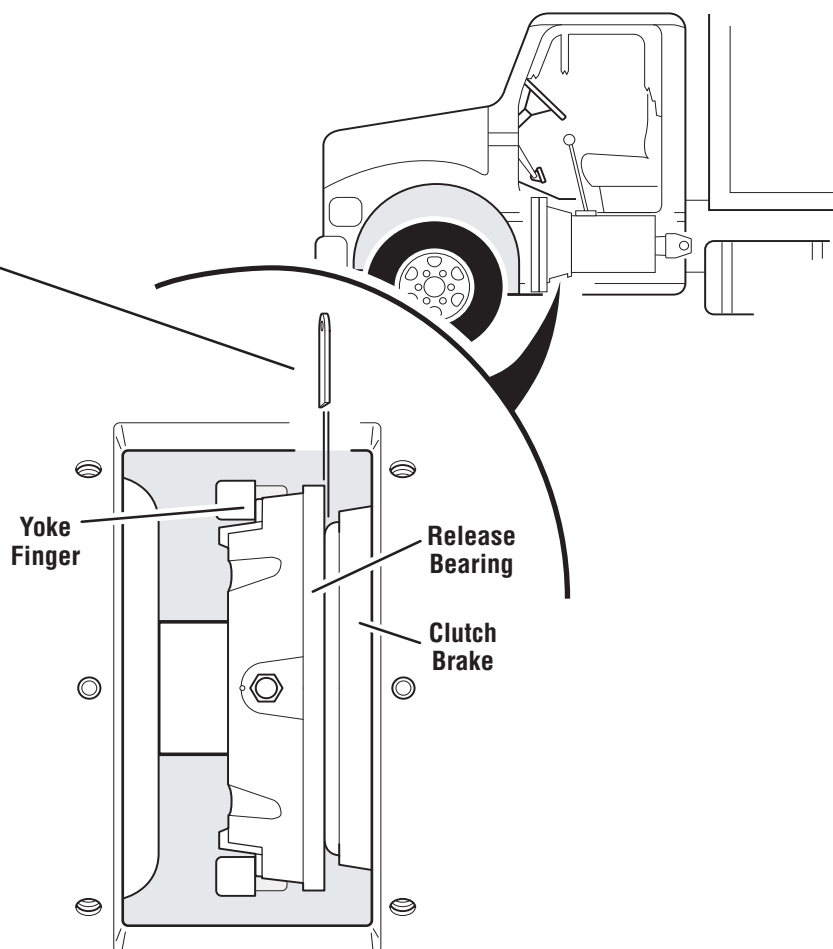
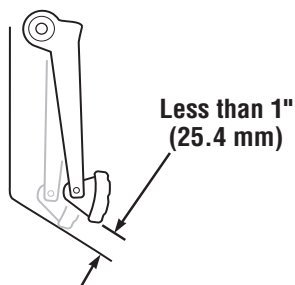
Use a gauge long enough to keep hands away from moving parts.

- 4** Have an assistant insert 0.010" (0.25 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**.



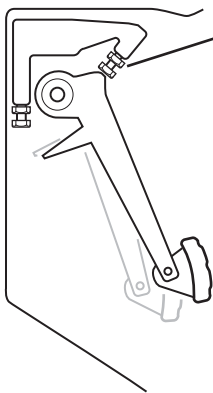
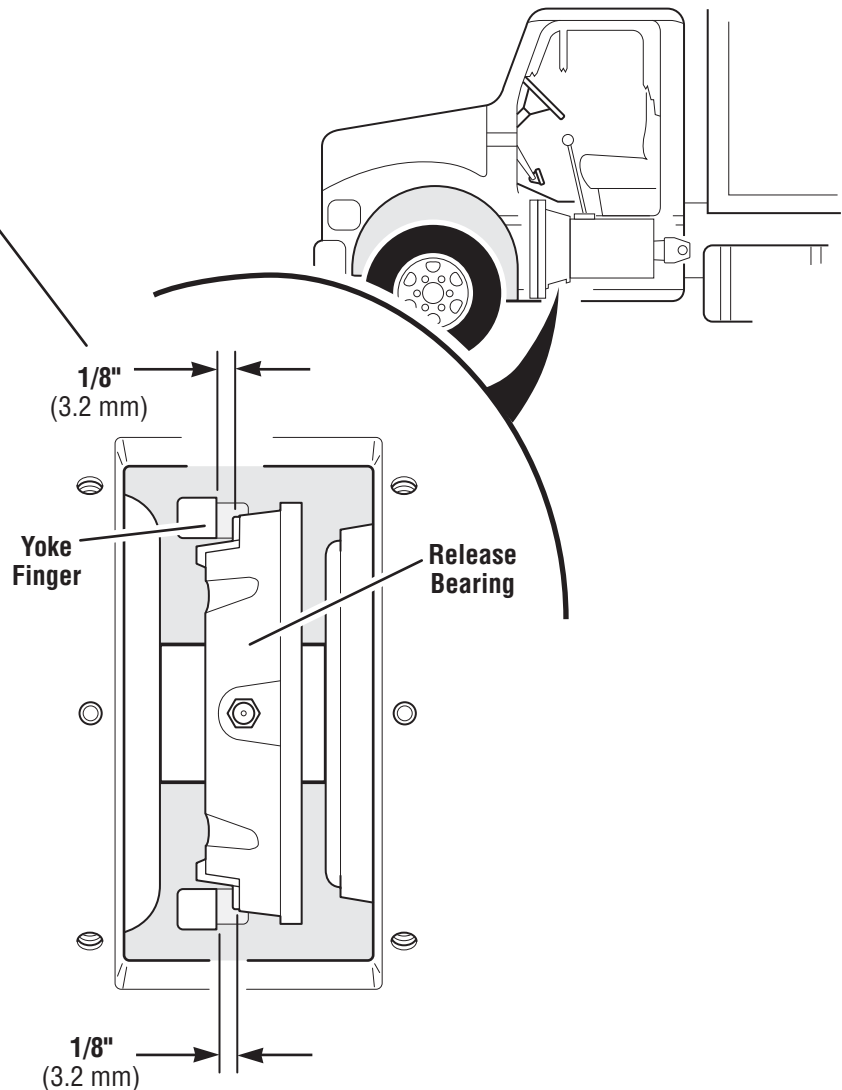
Verify Free-Play

- 6** Measure the distance between yoke tips and bearing wear pads simultaneously. This distance should be $\frac{1}{8}$ " (3.2 mm). If distance is not $\frac{1}{8}$ " (3.2 mm), go to **Step 7**.

⚠ IMPORTANT

Do not change bearing position.

Note: $\frac{1}{8}$ " (3.2 mm) distance will create free-play in cab. Free-play in cab may be different on different truck makes, models and years.



- 7** The truck linkage should allow for a minimum of 0.685" of yoke finger movement; 0.125" for free-play, 0.500" for the bearing and 0.060" for clutch brake squeeze. If it is necessary to increase the free-play, adjust upper pedal stop to raise or lower the pedal in the cab. If this is not possible, check the OEM parts manual to verify the correct clutch arm was installed at the factory.

⚠ IMPORTANT

Do not change free-play by changing the bearing position. Correct bearing position is 0.500"-0.560" (12.70 - 14.22 mm)

Lubricate

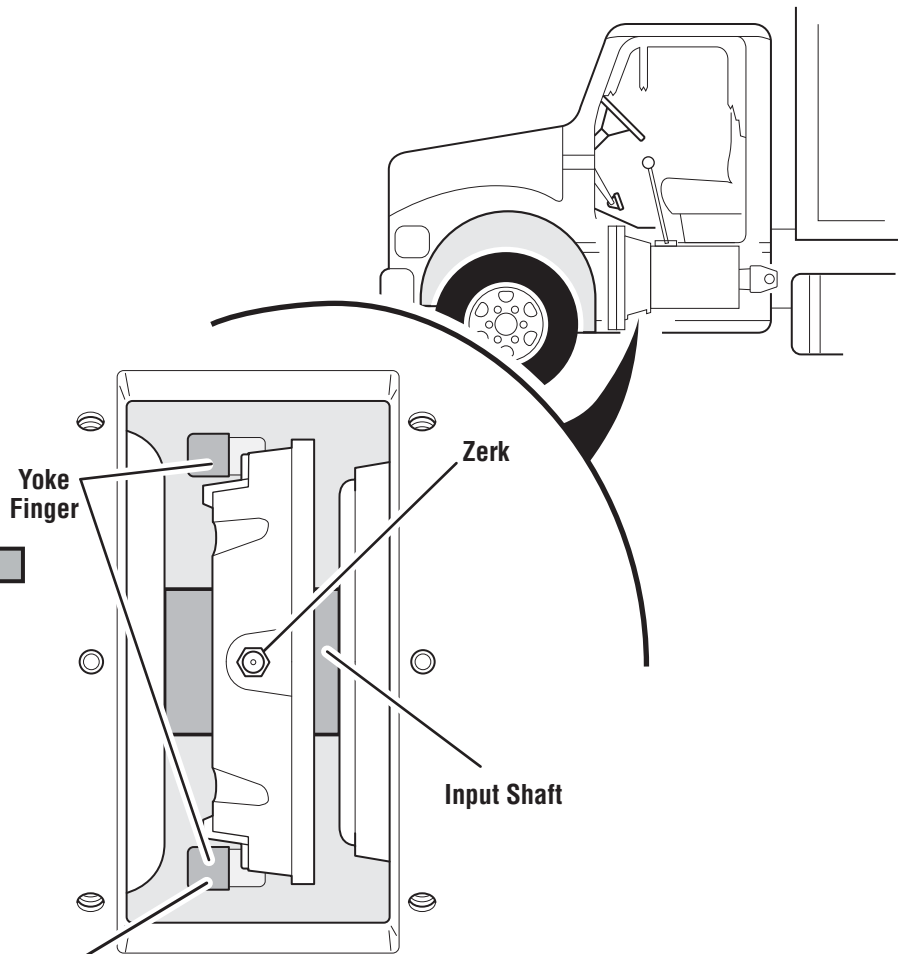
Note: All clutches use a Lithium complex grease with a minimum of 325°F (163°C) operating range meeting NLGI grade 2 or 3 specs.

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.

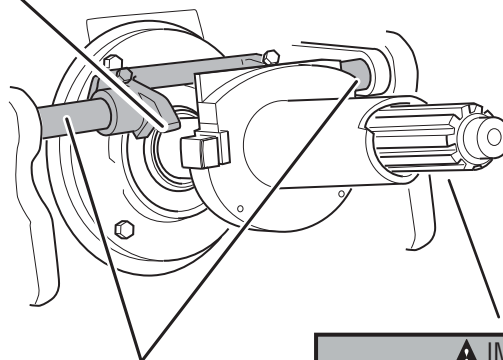
For additional lubrication information, see TCMT0021.

CAUTION

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



- 8** Apply grease to input shaft and yoke fingers.



- 9** Apply grease to the cross shaft bushings and linkage pivot points.

IMPORTANT

Do not add lube (never seize or grease) to the input shaft splines. The disc must be free to move.

UltraShift DM Heavy Duty Clutch

Remove Clutch

⚠ WARNING

An assembled clutch weighs about 182 lbs (82 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 discs and holding them in place.

⚠ CAUTION

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

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

- 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.

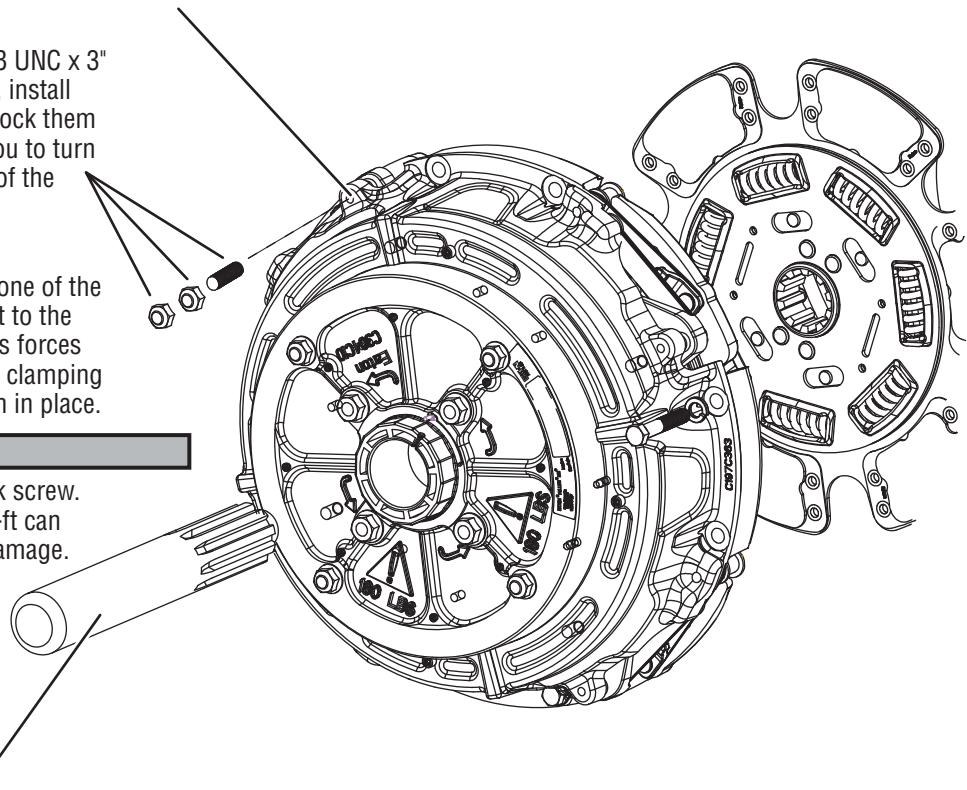
- 8 Remove the old pilot bearing.

⚠ WARNING

An assembled clutch weighs about 182 lbs (82 kg). Avoid the risk of injury. Use proper equipment when lifting a clutch.

⚠ CAUTION

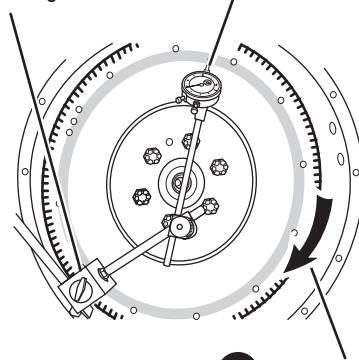
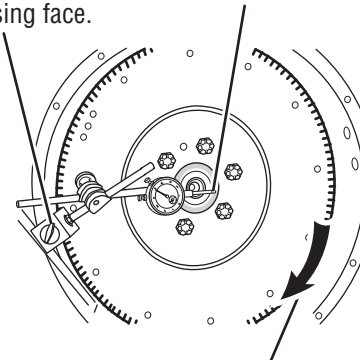
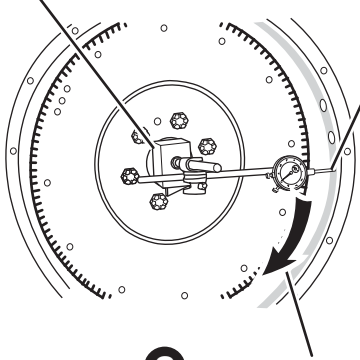
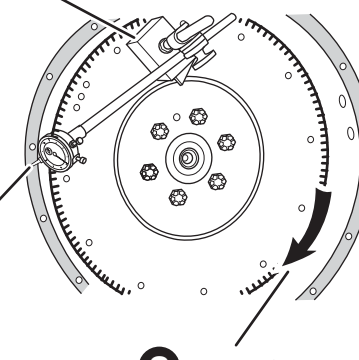
When removing the clutch, the flywheel side disc can fall off of the alignment shaft, permanently damaging the driven disc.



Measure Engine Flywheel Housing and Flywheel

Engine flywheel housing and flywheel must meet these specifications or may result in a 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 0.008" (0.20 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 0.005" (0.13 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 0.008" (0.20 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 0.008" (0.20 mm). 

Remove

UltraShift DM Clutch Install Clutch to Flywheel

Note: If installing a new DM, follow the installation directions that are provided in the box.

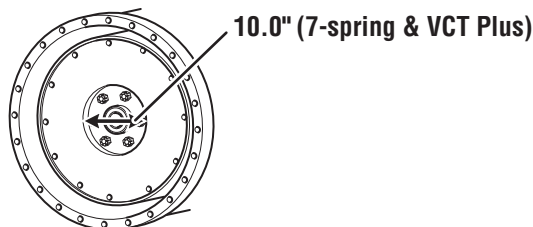
The required alignment tool, part number RR1009CL, can be ordered through K-Line at 1-800-824-5546.

⚠ WARNING

An assembled clutch weighs about 182 lbs (82 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.



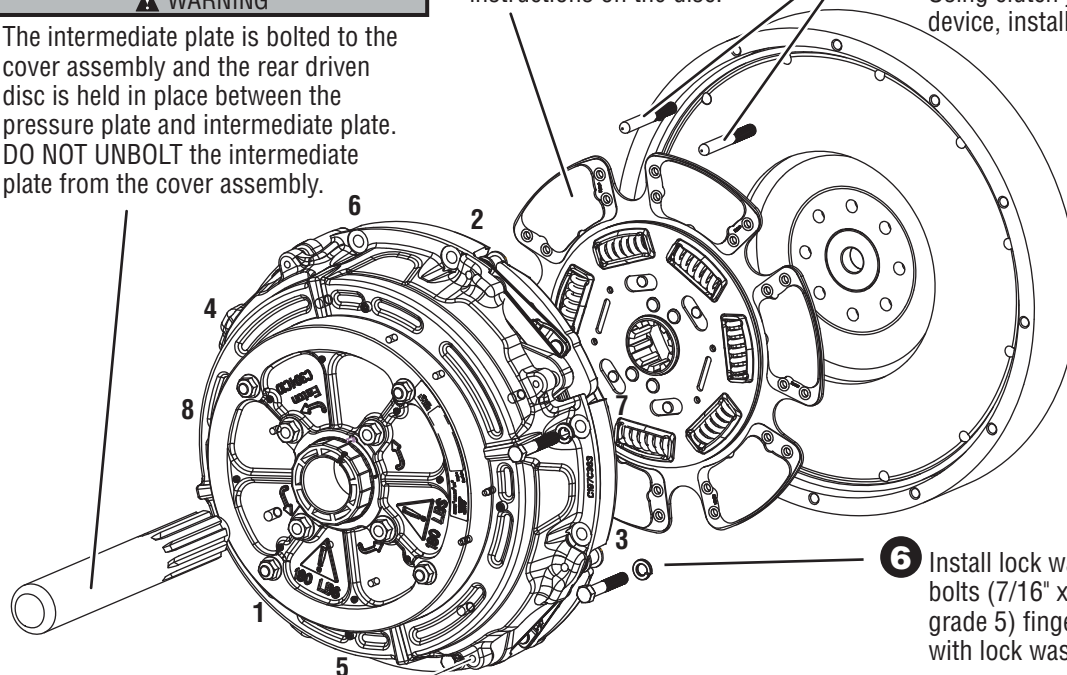
- 3 Insert aligning tool through DM Clutch and rear disc.

⚠ WARNING

The intermediate plate is bolted to the cover assembly and the rear driven disc is held in place between the pressure plate and intermediate plate. **DO NOT UNBOLT** the intermediate plate from the cover assembly.

- 4 Install second disc onto aligning tool. Follow the orientation instructions on the disc.

- 5 Install two 7/16" x 14 UNC x 5" studs into upper mounting holes. Using clutch jack or other lifting device, install assembled clutch.



- 10 Remove the aligning tool.

- 9 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 discs and holding them in place. Be sure the hole chosen is at the 6 o'clock position to allow for removal after the transmission is installed.

- 8 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 Install lock washers and mounting bolts (7/16" x 14 UNC x 2-1/4" grade 5) finger tight. Replace studs with lock washers and bolts.

- 7 Progressively tighten mounting bolts in a crisscross pattern starting with the lower left bolt (1, 2, 3, 4, 5, 6, 7, 8). Torque to 40-50 lb-ft (54-68 N•m). Failure to do this could result in improper piloting of the clutch and cause clutch damage.

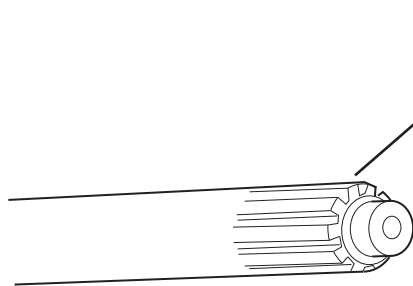
⚠ CAUTION

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

Install Transmission

Check Transmission for Wear

Replace any worn components.



1 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.

⚠ IMPORTANT

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

Fasten Transmission to Flywheel Housing

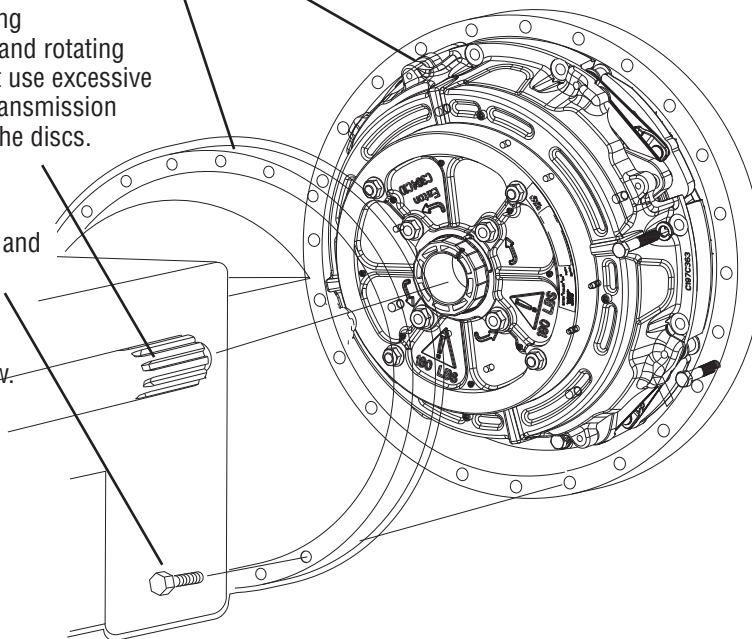
1 Position transmission so it is square to and aligned with engine.

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

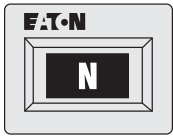
Do not let the transmission drop or hang unsupported in the driven discs. This can cause the discs to become distorted and the clutch to not release.

⚠ CAUTION

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

Heavy-Duty UltraShift Clutch Recalibration

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

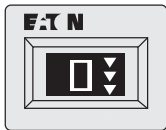


3. Start engine.
4. Increase engine RPM above 1500. This will unlock the clutch. Failure to do this will set a clutch disengagement code and the code and transmission will not go into gear.

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**.

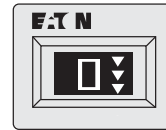
5. Start with the system powered down, the vehicle stationary, and the engine not running.
6. Key on and allow the system to completely power up but do not start the engine.
7. Select “LOW” mode on the shift controller (UltraShift system will begin to emit an audible tone).
8. Select an upshift once (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 2

- Using ServiceRanger, select the “Advanced Product Functions” button located on the main menu.
- Select Eaton AutoShift Gen-2 from the product selection screen.

Note: This screen will only appear if the vehicle is equipped with more than one supported Roadranger product.

- Select Clutch Data from the “Advanced Product Functions” screen.
- Save the clutch data by selecting the “Save Abuse Info to a File” button.

Note: Use the truck VIN as the file name. The data file will be saved to the ServiceRanger folder in the Clutch Data subfolder (e.g. C:\Serviceranger\Clutch Data).

- Reset clutch abuse info by selecting the “Reset Clutch Abuse Info” button.
- Recalibrate the new clutch by selecting the “Calibrate Clutch” button.

Note: Failure to calibrate a newly installed clutch may result in some initial harsh vehicle launches, as the system is required to manually recalibrate.

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 subfolder on the C:\drive.

- Select the “Start Transfer” 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.

Remove Clutch

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.

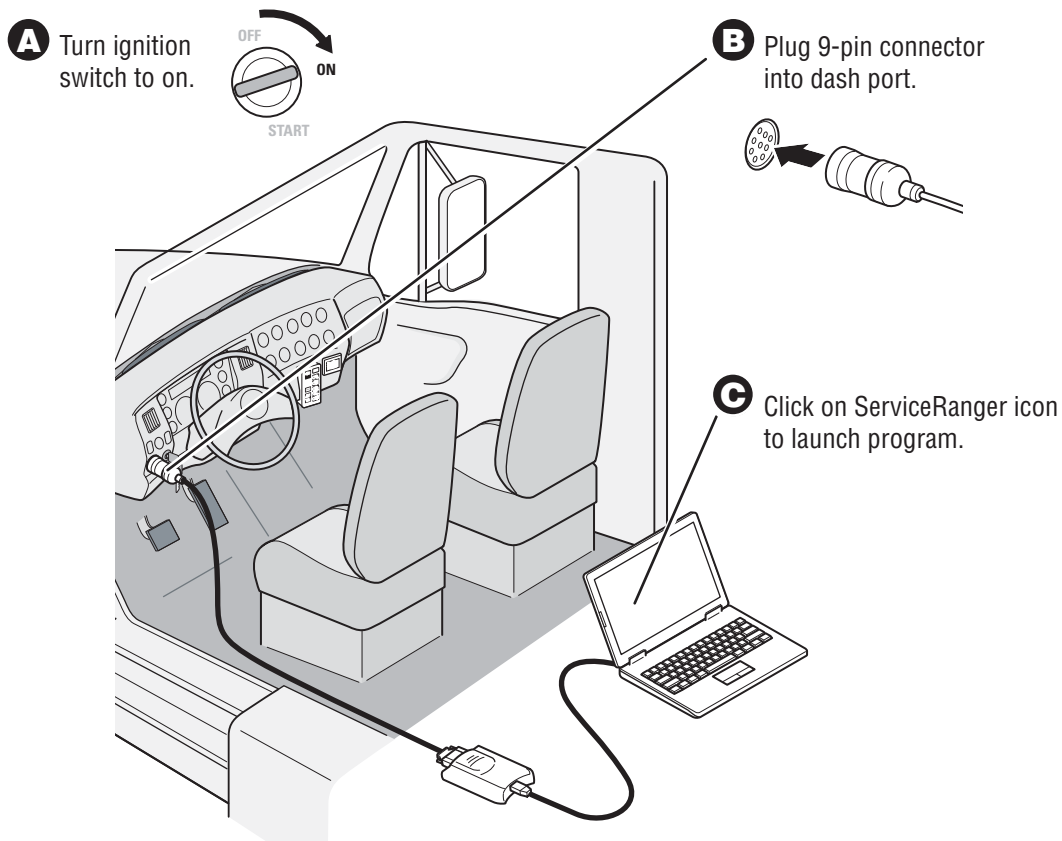
1. Use Eaton Service Ranger Diagnostic Software in order to command the ECA to open the clutch.

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

Opening the ECA Clutch

CAUTION

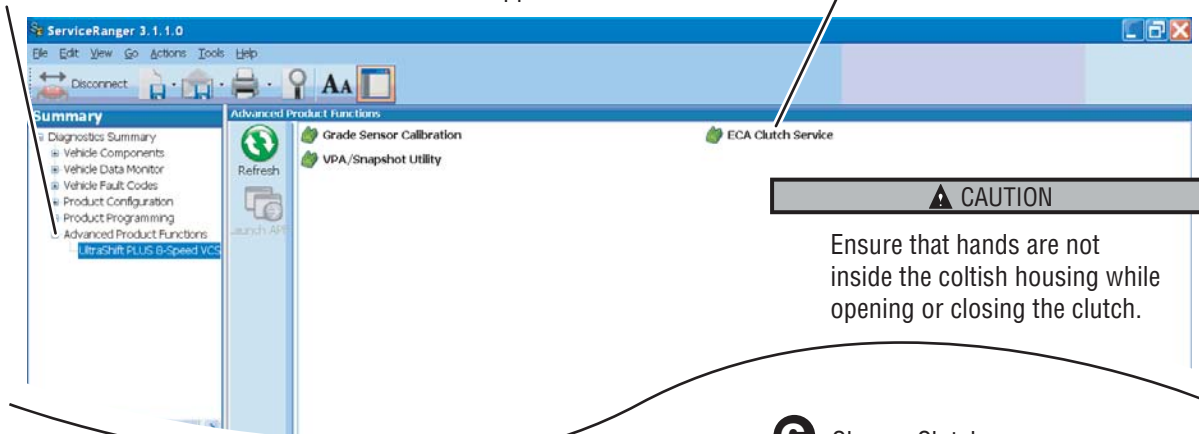
Ensure that hands are not inside the clutch housing while opening or closing the clutch.



- D** Open and expand the Advanced Product Functions tree.

- E** Click on transmission.
Note: Advanced Product Functions appear.

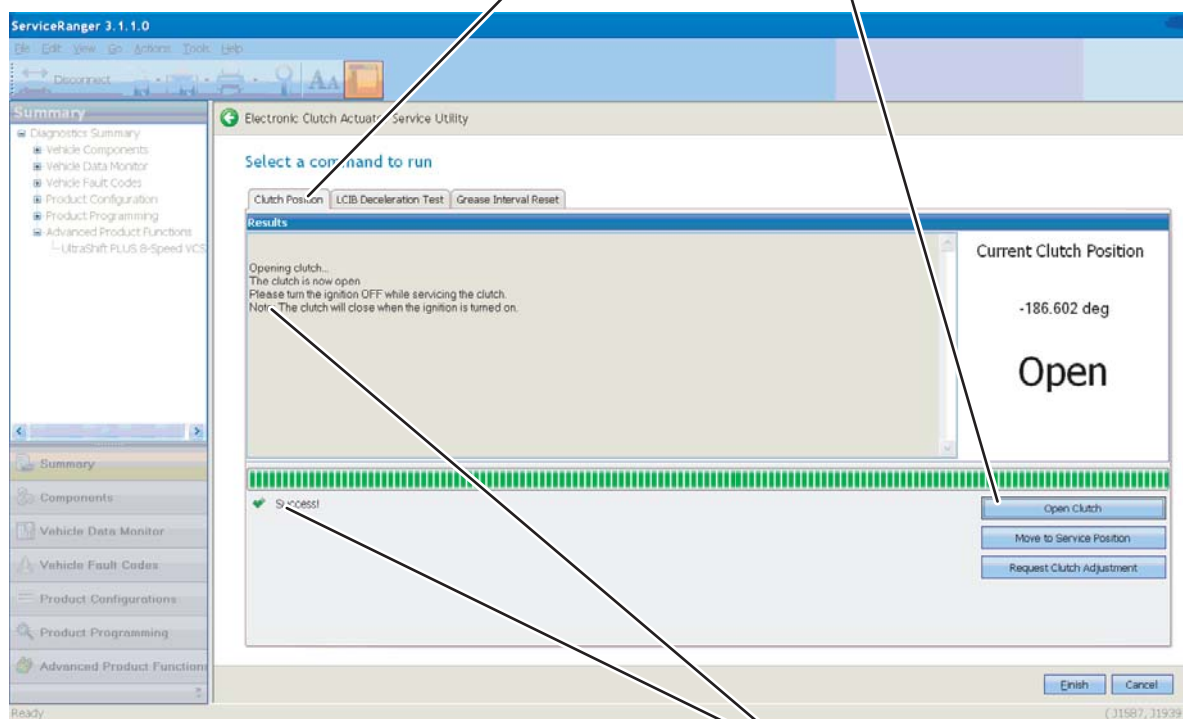
- F** Click on ECA Clutch Service.



- G** Choose Clutch Position tab.

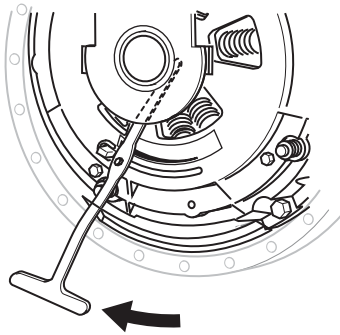
- H** Click Open Clutch button.

Note: ServiceRanger will require engine running in order to open clutch.



- I** Confirm Positive results.

- Slide the wear indicating tab to the left until it is at the "NEW" position.



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

- Without cranking the engine, close the clutch by switching the ignition to ON, and the wear indicating tab will stay in the "NEW" position.

CAUTION

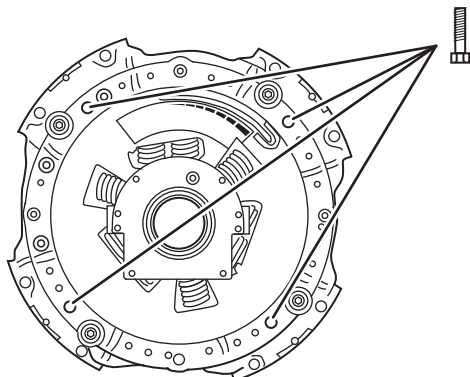
Ensure that hands are not inside the clutch housing when opening or closing the clutch.

- Remove the transmission, supporting its weight to prevent damage to the bearing and discs.
- Locate 4 shipping bolts (7/16" x 14 x 1 3/4" UNC, hex head). Install them in the 4 cover holes hand tight then turn one full turn.

IMPORTANT

This step will hold the pressure plate separator pins in proper position so the clutch can be reused and will release after reinstalling.

Shipping Bolts
(4) 7/16" x 14 x 1-3/4" UNC



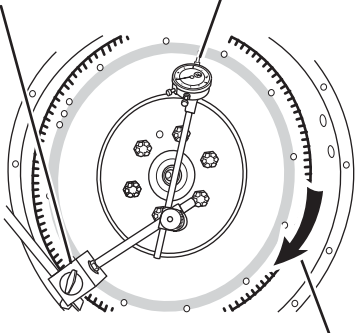
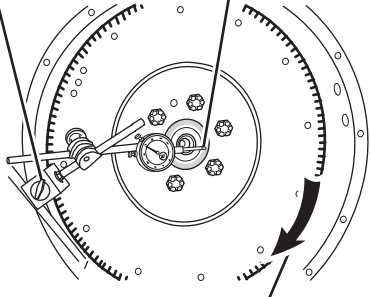
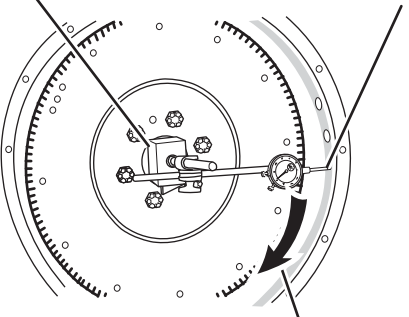
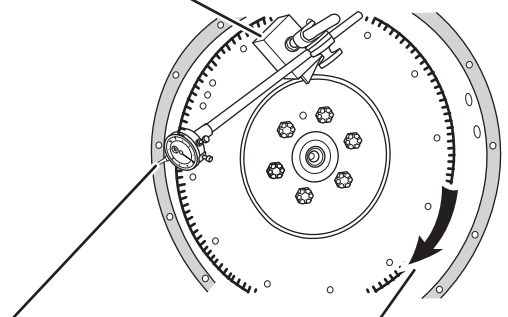
- Support the clutch during the removal of the 8 mounting bolts.
- Remove the clutch from the flywheel.

15.5" Heavy-Duty ECA Clutch Installation

Measure Engine Flywheel Housing and Flywheel

Engine flywheel housing and flywheel must meet these specifications or may result in a 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 0.008" (0.20 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 0.005" (0.13 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 0.008" (0.20 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 0.008" (0.20 mm). 

Install Clutch to Flywheel

Note: The clutch release yoke fingers must be positioned so they clear the release bearing housing when removing and installing the transmission.

- **Preferred method:** Move the release yoke to the service position via ServiceRanger's Advanced Product Functions.
- **Secondary method:** Remove the ECA prior to removing the transmission and then manipulate the fingers by hand.

CAUTION

An assembled clutch weighs about 150 lbs (68 kg). Avoid the risk of injury. Use proper equipment when lifting a clutch.

WARNING

Do not unbolt the intermediate plate from the cover assembly.

Do not use vehicle's transmission to install the ECA clutch, as it can result in damage to the clutch or ECA.

- 1 Insert aligning tool through bearing.
Note: The ECA Clutch alignment tool is a 14-tooth shaft and is 1-3/4" longer than the standard shaft.
- 2 Install second disc onto aligning tool. Follow the orientation instructions on the disc.
- 3 Install two 7/6" x 14 UNC x 5" studs into upper mounting holes. Install assembled clutch.
- 4 Slide the clutch assembly over the guide studs and install six lock washers and mounting bolts (7/16" x 14 UNC x 2 1/4" grade 5) finger tight. Replace studs with remaining two lock washers and bolts.
- 5 Progressively tighten mounting bolts in a crisscross pattern starting with the lower left bolt. Torque to 40–50 lb-ft (54–68 Nm). Failure to do this could result in improper piloting of the clutch and cause clutch damage.
- 6 Remove four yellow shipping bolts in an even 1/4 turn crisscross pattern.
- 7 Remove aligning tool.
- 8 Position the release bearing so the orientation of the lube fitting is in the 4 o'clock position.
- 9 Following transmission installation, perform clutch adjustment. See the "ECA Clutch Adjustment" Section on **page 40**.

Generic graphic

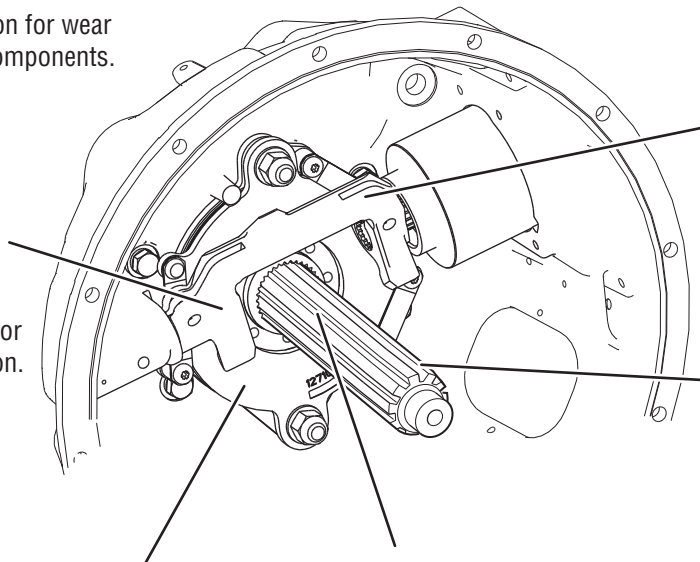
Note: Always perform a clutch adjustment after a clutch replacement.

Install Transmission

Note: Check transmission for wear and replace any worn components.

Release Yoke

Worn rollers can cause bushing wear and yoke interference when the Electronic Clutch Actuator is at the released position.



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 in the release/open position.

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.

Low Capacity Inertia Brake (LCIB)

Eaton requires that you replace the LCIB when replacing the clutch. See Appendix A for LCIB removal and installation instructions.

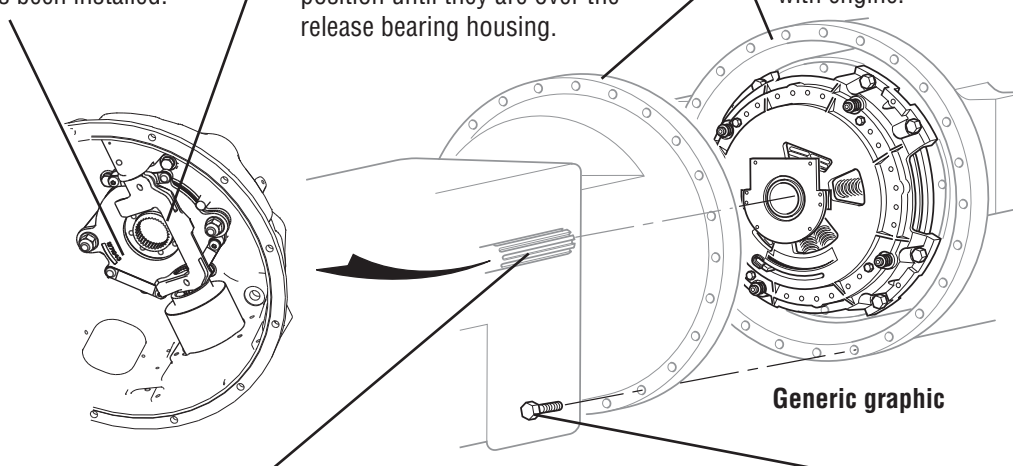
Input Shaft

Wear (roughness) can reduce sleeve bushing life and cause it to become dislodged.

Fasten Transmission to Flywheel Housing

Note: If the ECA has been removed, ensure the yoke fingers remain in the up position. Use the opening vacated by the ECA to rotate the yoke in the up position just before the transmission is going to be aligned.

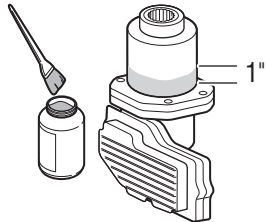
- 1 Put transmission in neutral. Be sure new LCIB has been installed.
- 2 Make sure that the yoke fingers are rolled and remain in the up position until they are over the release bearing housing.
- 3 Position transmission so it is square to and aligned with engine.
- 4 Mesh splines by moving transmission forward and rotating the input shaft. Do not use excessive force. Do not let the transmission hang unsupported in the discs.
- 5 Before installing the mounting bolts the lube tube will have to be reconnected to the clutch housing.
- 6 Install mounting bolts and torque to OEM specs.



Generic graphic

Install Electronic Clutch Actuator (ECA)

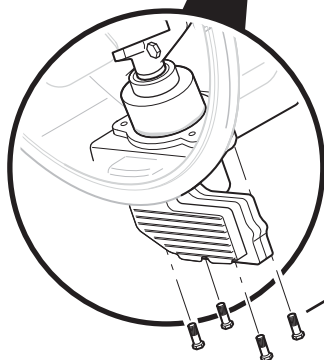
- 1 Apply a 1" band of anti-seize to the barrel of the ECU.



Note: Ensure you rotate the release yoke close to the cast dowel in the clutch housing prior to mating with the cross-shaft. This allows the release yoke to clear the release bearing during installation.

- 2 Install the ECA into the clutch housing bore and align it with the lower cross-shaft.

Note: The ECA will have to be rotated to align with the slot in the clutch housing.



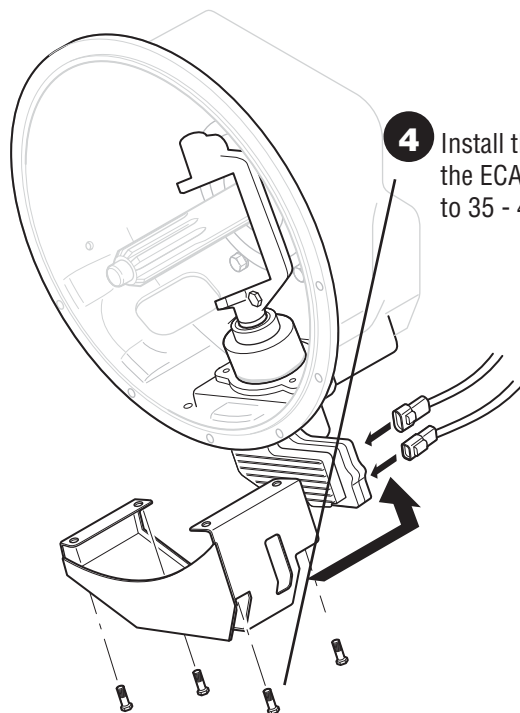
Note: The 4 cap screws for the ECA are longer than the ECA bracket cap screws.

- 3 Install the 4 cap screws from the ECA mounting flange and tighten to 35 - 45 lb-ft (47 - 61 Nm).

- 4 Install the 4 cap screws for the ECA bracket and tighten to 35 - 45 lb-ft (47 - 61 Nm).

- 5 Apply Eaton lubricant (P/N 5564527) to the 8 and 3-way connector terminals and reconnect the connectors to the ECA.

- 6 Reconnect the negative 12-volt battery cable.



Lubricate

1. Open the inspection cover and verify the cross-shaft and release bearing lube tubes are properly attached and functional.

Note: Failed lube lines will prevent grease from reaching the release bearing causing premature clutch release bearing failure.

2. Apply grease through the release bearing lube tube and continue to apply lube to cause enough grease to purge out of the release bearing housing and onto the transmission input shaft.

Note: All clutches use a lithium complex grease with a minimum of 325°F (163°C) operating range meeting NLGI grade 2 or 3 specs.

CAUTION

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

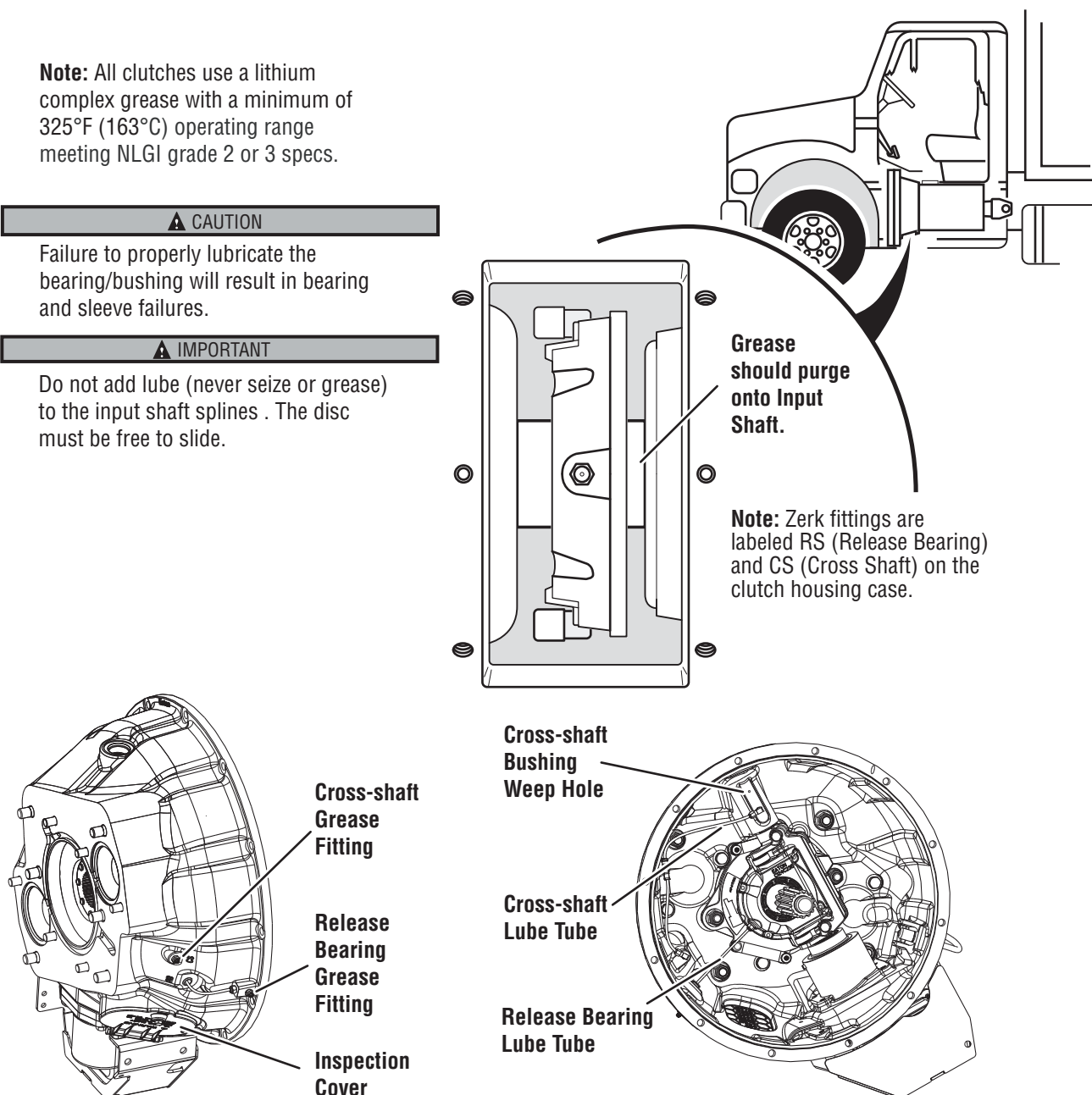
IMPORTANT

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

Note: Do not be concerned if excess grease gets onto the LCIB friction surface, it will not affect the brake's stopping ability.

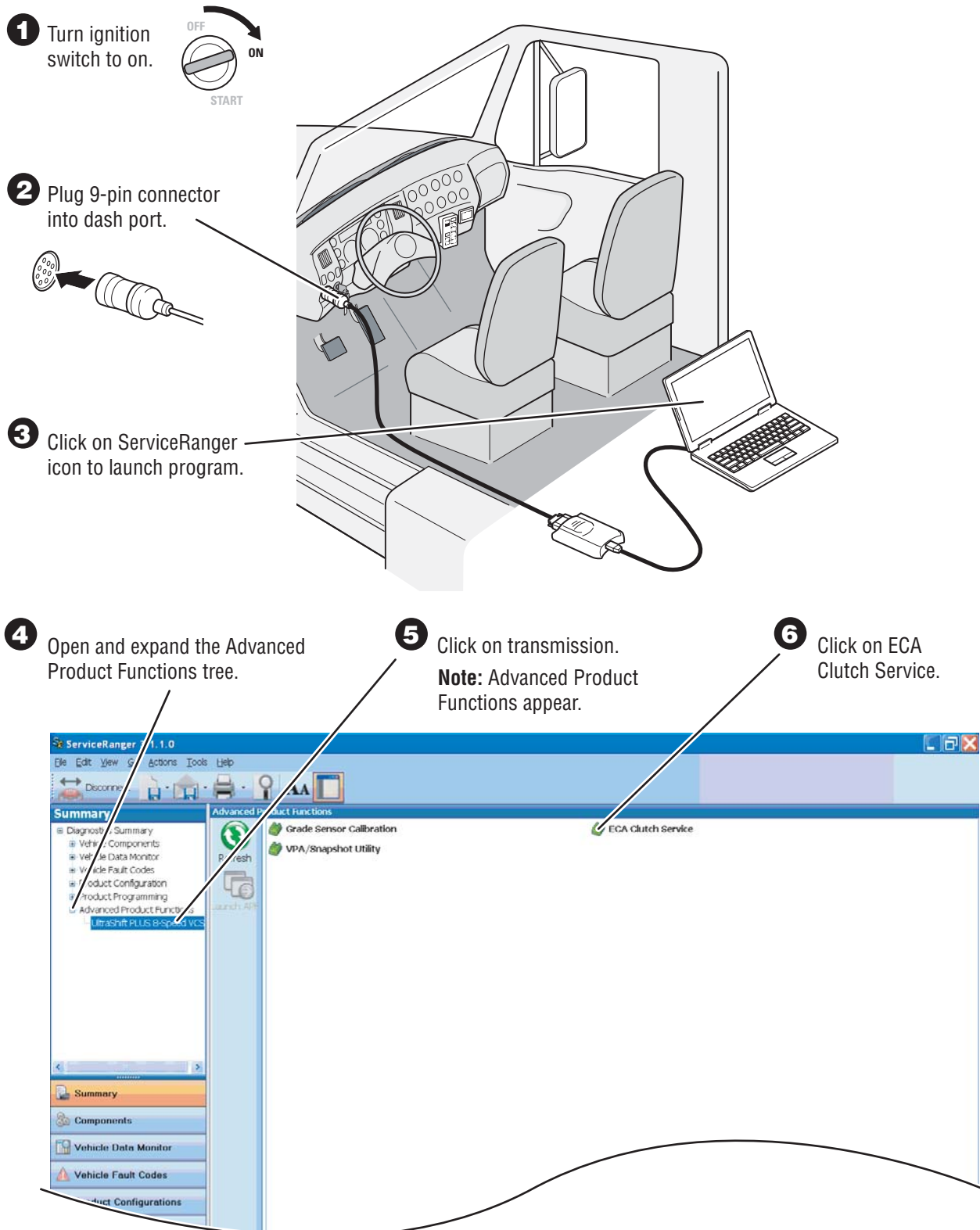
3. Apply grease to the cross-shaft bushing lube tube so that a visual purge can be observed at the cross-shaft bushing weep hole.
4. Reset the grease interval count if the optional automated lube schedule has been activated.

Note: See the "Grease Interval Count Reset" section.



ECA Clutch Adjustment

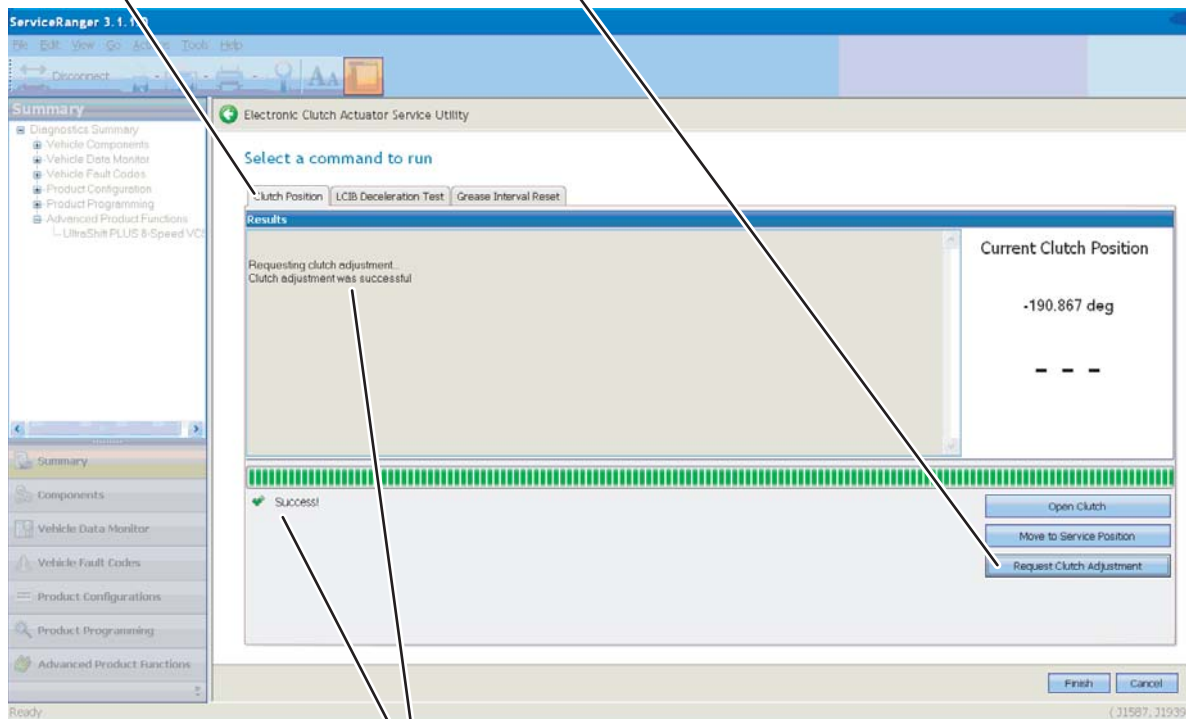
This command signals the ECA to actuate the clutch in order to set the adjustment after an ECA Clutch has been reset or replaced. Fault code 26 or 27 indicate that the clutch may have come out of adjustment. Refer to Troubleshooting Guide TRTS0930 for more fault code detail. A clutch adjustment should always be performed after a clutch replacement.



7 Choose Clutch Position Tab.

8 Click on Request Clutch Adjustment.

Note: ECA will actuate the clutch five times to perform adjustment.



9 Confirm Positive results.

Grease Interval Count Reset

The Heavy-Duty UltraShift PLUS has an optional prognostic feature that notifies the operator when the Clutch Release Bearing needs greasing. This feature can be enabled or disabled via ServiceRanger.

At the appropriate grease interval and shortly after each engine start, “GI” will momentarily appear in the gear display, along with an audible tone. This will continue to occur at each engine start until clutch service has been completed. **Note:** “GI” stands for grease interval and may be misread as “G1” on gear display.

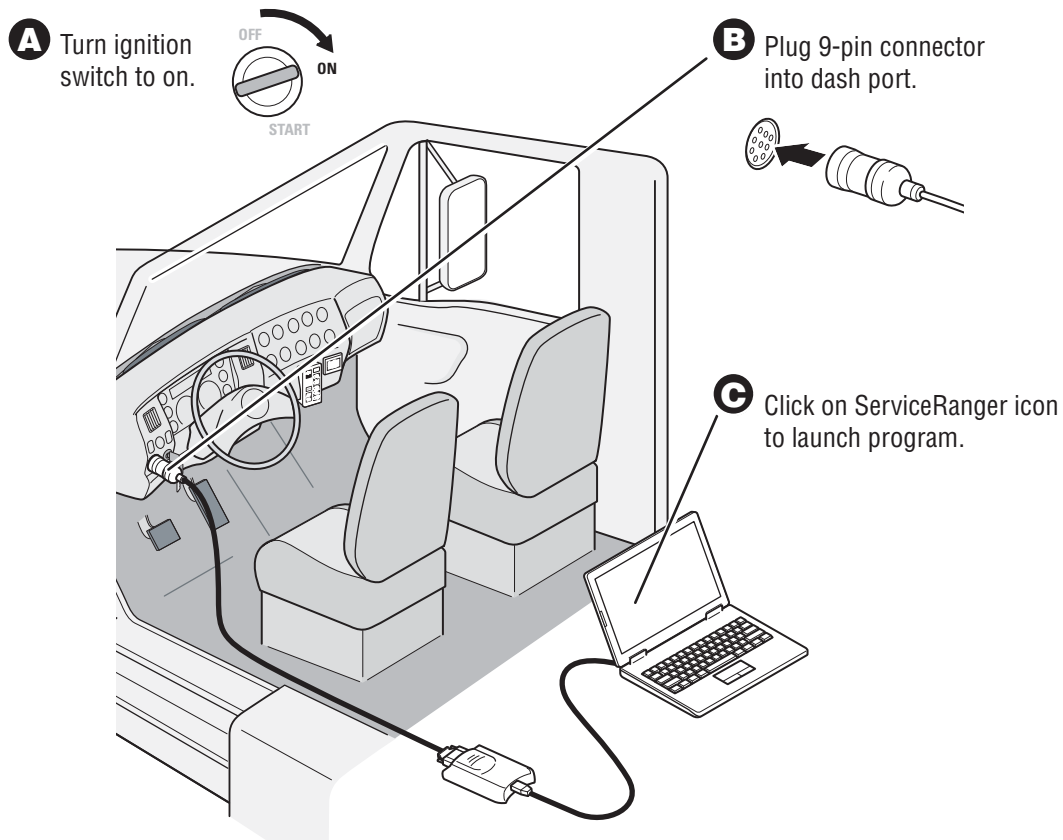
The operator can choose to follow this Automated Lube Schedule or the published lube guidelines in the Lubrication Manual TCMT0021. When enabled, it is highly important to reset the Grease Interval Count every time the release bearing is greased.

The Grease Interval Count can be reset via ServiceRanger or Operator Triggered Special Function.

ServiceRanger Procedure

CAUTION

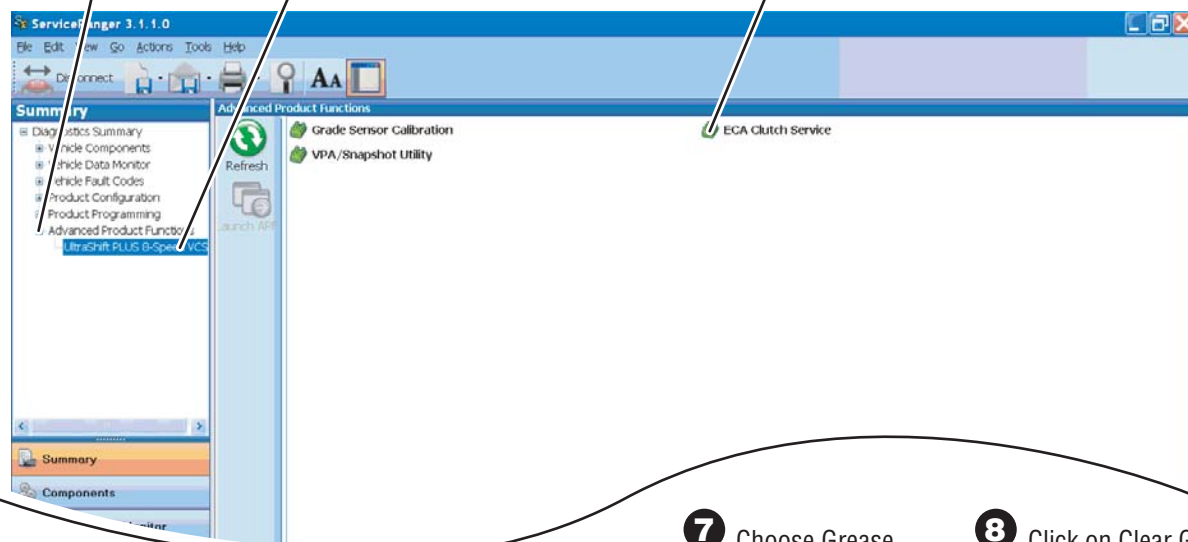
Ensure that hands are not inside the clutch housing while opening or closing the clutch.



4 Open and expand the Advanced Product Functions tree.

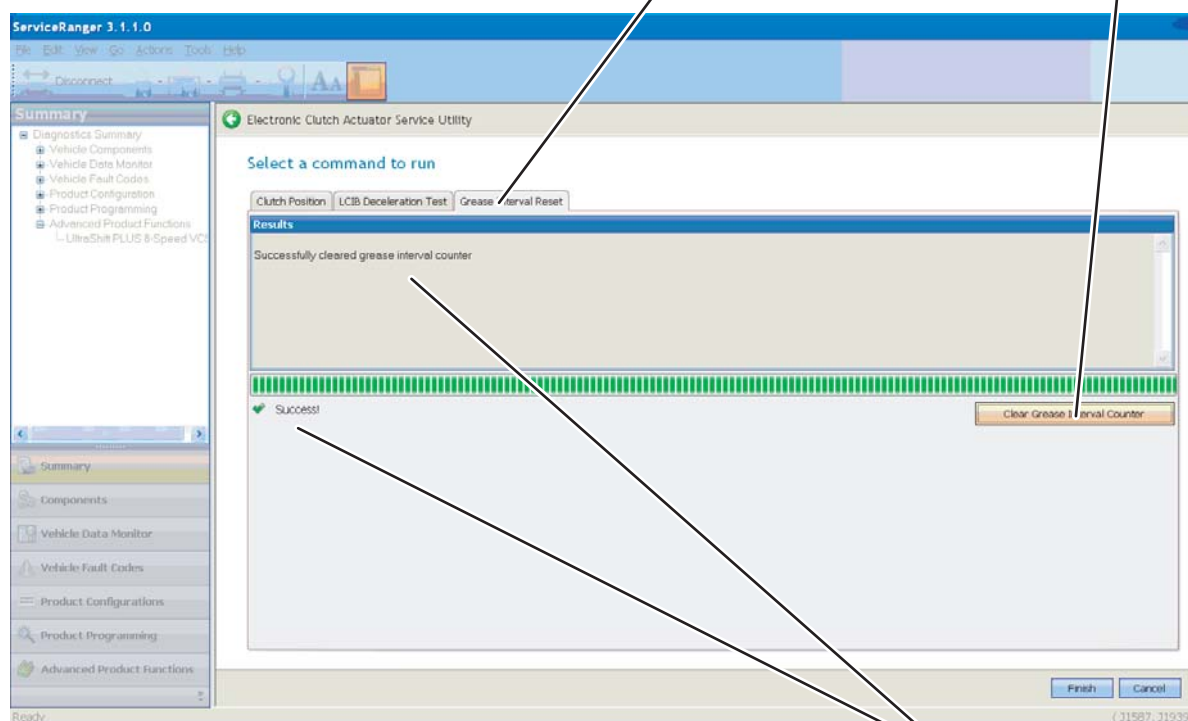
5 Click on transmission.
Note: Advanced Product Functions appear.

6 Click on ECA Clutch Service.



7 Choose Grease Interval Reset tab.

8 Click on Clear Grease Interval Counter.



9 Confirm Positive results.

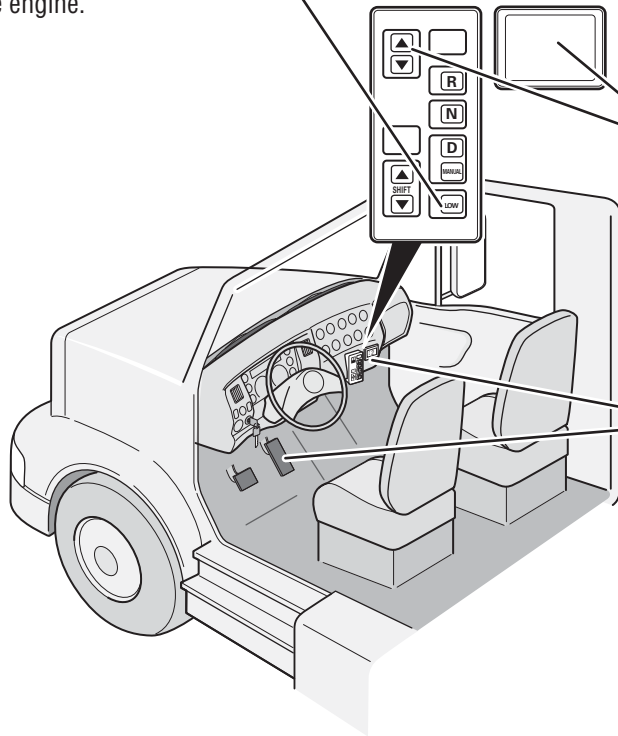
10 Turn ignition switch to off to save reset.

Operator Triggered Procedure

- 1 From the off position, turn ignition to on without cranking the engine.



- 2 Select low mode on the shift device.



- 3 Press the manual up-shift button until the gear display shows "3".



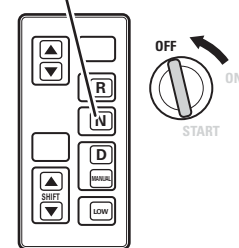
- 4 Press Accelerator to the floor. Gear display will show a down arrow.



- 5 Release the accelerator. Gear display will show a "0".



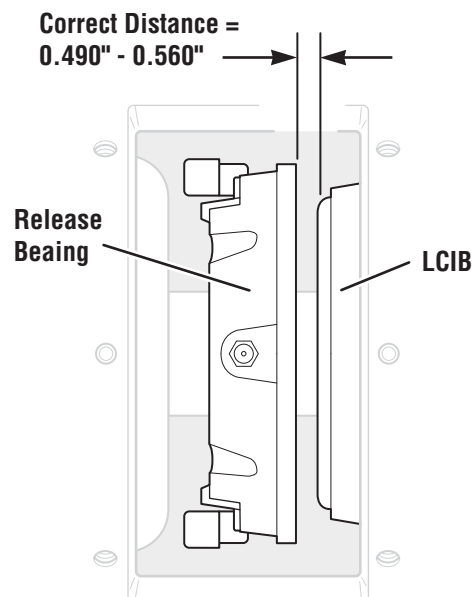
- 6 Select neutral and turn ignition to off in order to save the reset.



ECA Clutch In-Vehicle Resetting Procedure

1. Measure distance between release bearing and Low Capacity Inertia Brake (LCIB):
 - It is necessary to compress the LCIB to a solid condition prior to measuring the distance between the LCIB and the release bearing. A screw driver can be used to compress the LCIB.
 - With the LCIB compressed, proceed in measuring the distance between the release bearing and LCIB. If the measurement is not between 0.490" and 0.560" reset clutch. Go to **Step 2**.
2. Eaton Service Ranger Diagnostic Software is needed to command the ECA to open the clutch.

Note: Keep the ECA Clutch Service Utility open. It will be used again during this process.



Opening the ECA Clutch

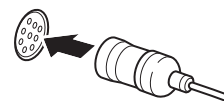
CAUTION

Ensure that hands are not inside the clutch housing while opening or closing the clutch.

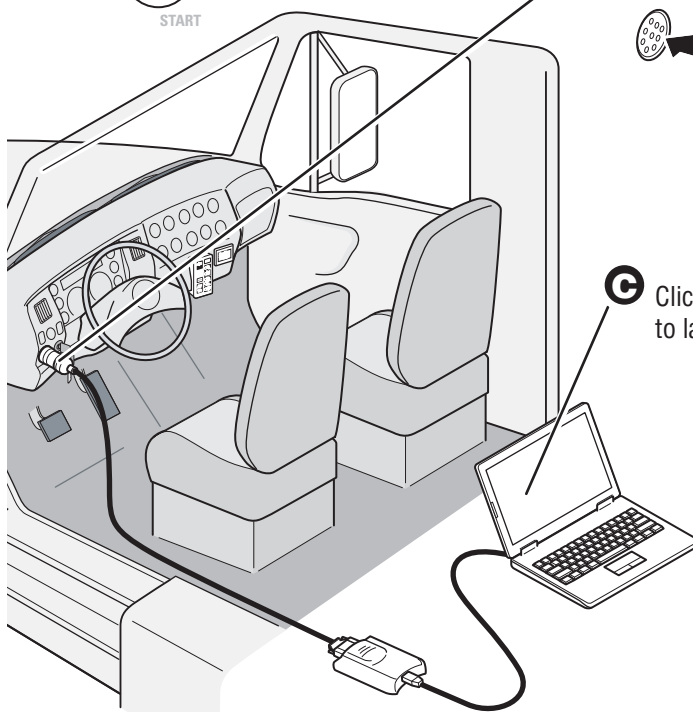
- A** Turn ignition switch to on.



- B** Plug 9-pin connector into dash port.



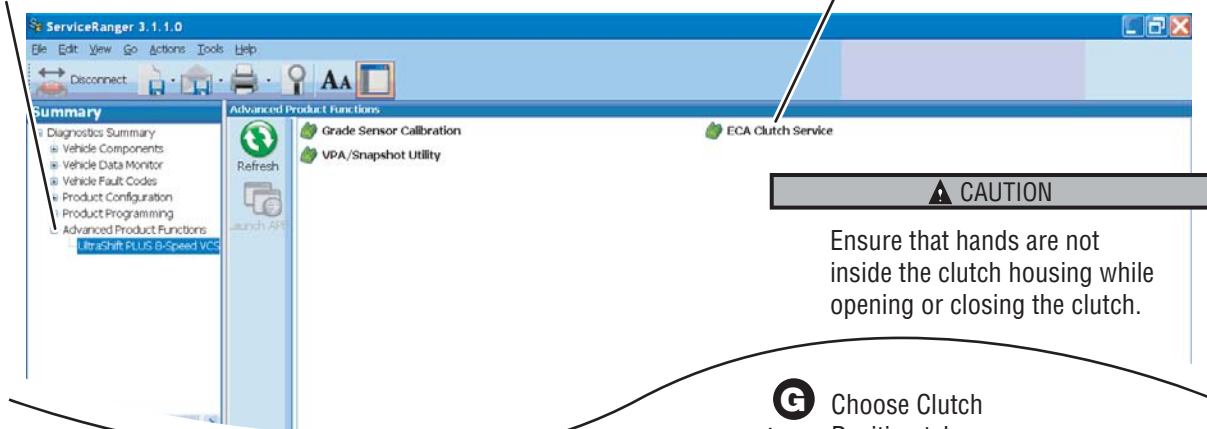
- C** Click on ServiceRanger icon to launch program.



- D** Open and expand the Advanced Product Functions tree.

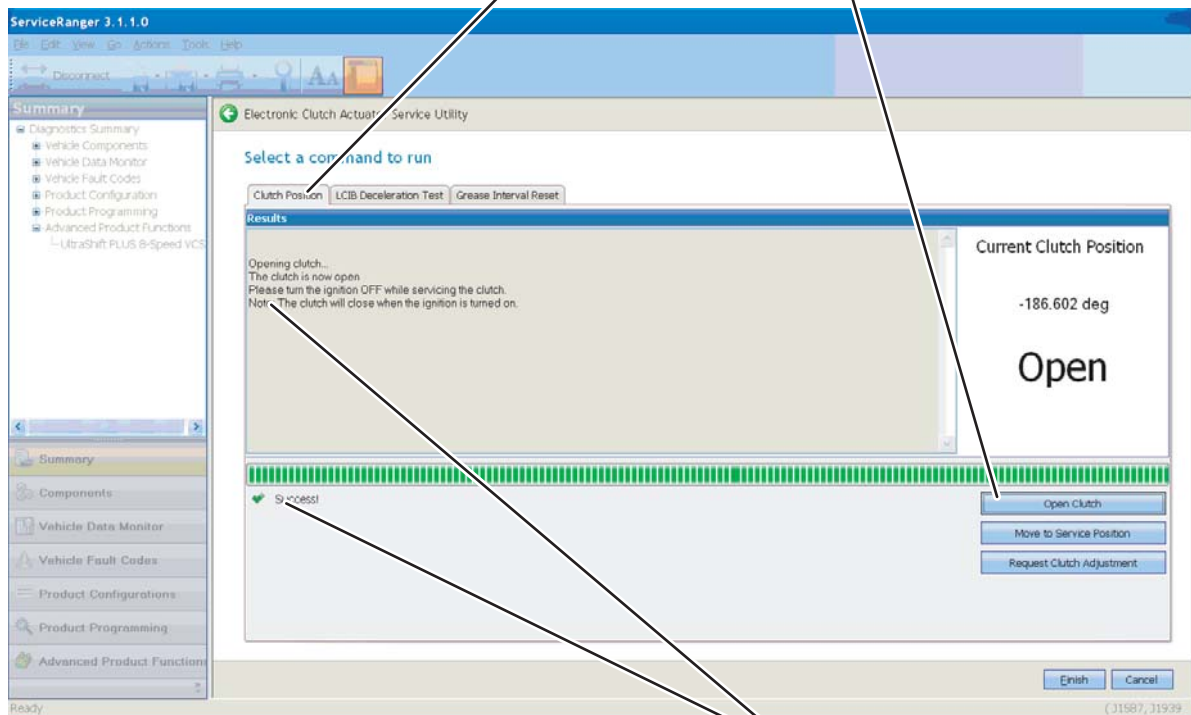
- E** Click on transmission.
Note: Advanced Product Functions appear.

- F** Click on ECA Clutch Service.



- G** Choose Clutch Position tab.

- H** Click Open Clutch button.
Note: ServiceRanger will require engine running in order to open clutch.



- I** Confirm Positive results.

Note: Keep the ECA Clutch Service utility open. It will be used again during this process.

3 Turn ignition switch to off.

4 Position Reset Tool:

- Through the access panel
- Under the release bearing
- With threaded bolt in cam slot

5 Use tool to move cam to Good position.



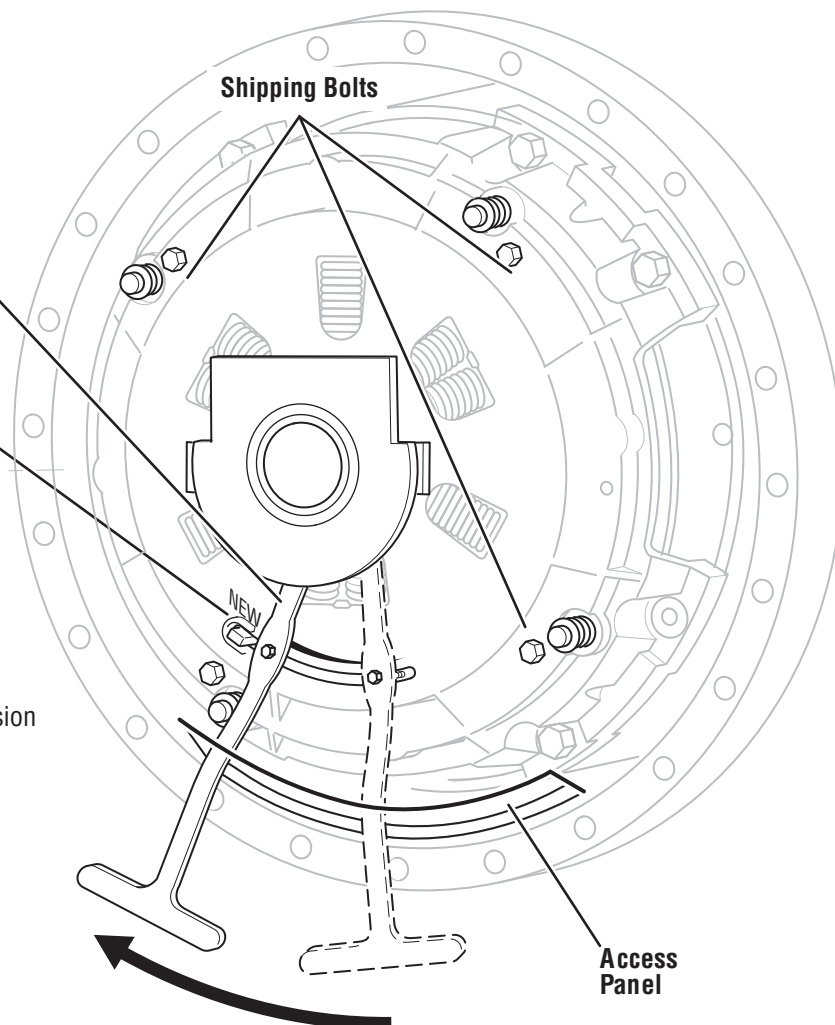
Note: If the cam does not move, loosen transmission and install 1/2" spacers between clutch housing and engine housing to increase stroke.

- With spacers in place, follow **Steps 2 through 6** in this procedure.
- Remove spacers and torque transmission mounting bolts.
- Continue process starting at **Step 7**.

6 Without cranking the engine, close the clutch by switching the ignition to ON.

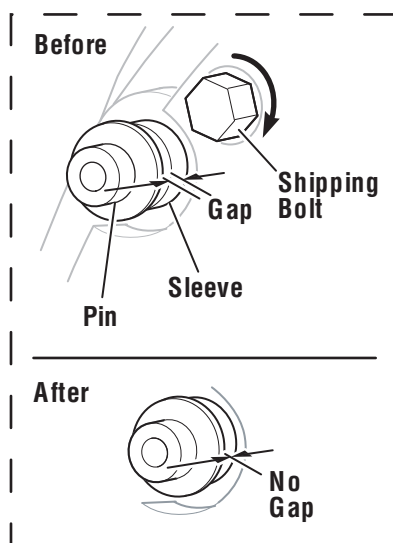
CAUTION

Ensure that hands are not inside the clutch housing when opening or closing the clutch.



7 Install and tighten 4 shipping bolts (7/16" x 14 x 1-3/4 UNC) to remove gap between sleeve and pin.

8 Remove the 4 shipping bolts in a crisscross pattern a 1/4 turn at a time.



9 In the ECA Clutch Service utility, select the Request Clutch Adjustment command, and follow ServiceRanger instructions.

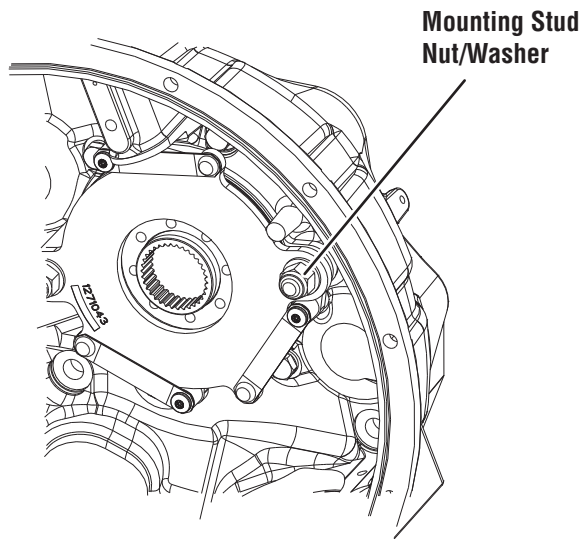
Note: The Request Clutch Adjustment command will automatically initiate the ECA to open and close the clutch, causing a clutch adjustment to take place.

10 Verify reset. Go to **Step 1**.

Low Capacity Inertia Brake Wear Life Measurement

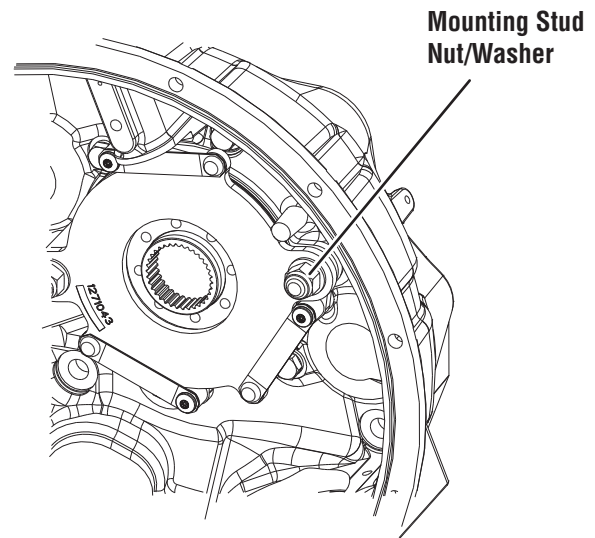
Transmission Removed

1. Compress down the Low Capacity Inertia Brake (LCIB) by hand.
2. Using a shim or a feeler/thickness gauge, measure the gap between the mounting stud nut/washer and the front of the LCIB, caused when the LCIB is compressed.
3. Using calipers, measure the thickness of the feeler gauge:
 - If the gap between mounting stud nut/washer and front of LCIB is 0.140" or less, then there is approximately 50% wear life remaining.
 - If the gap between mounting stud and front of LCIB is 0.220" or greater, then LCIB should be replaced soon.



Transmission in Chassis

1. Open inspection cover.
2. Through the inspection cover opening, lightly compress down the Low Capacity Inertia Brake (LCIB) using an appropriate tool to avoid damaging the LCIB.
3. With your other hand, use a shim or a feeler gauge to measure the gap between the mounting stud nut/washer and the front of the LCIB, caused when the LCIB is compressed.
4. Using calipers, measure the thickness of the feeler gauge:
 - If the gap between mounting stud nut/washer and front of LCIB is 0.140" or less, then there is approximately 50% wear life remaining.
 - If the gap between mounting stud and front of LCIB is 0.220" or greater, then LCIB should be replaced soon.
5. After measurements have been taken, close inspection cover.



Hydraulic Linkage

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 0.600" of yoke finger movement: 0.500"-0.560" for clutch release plus additional movement for clutch brake squeeze.

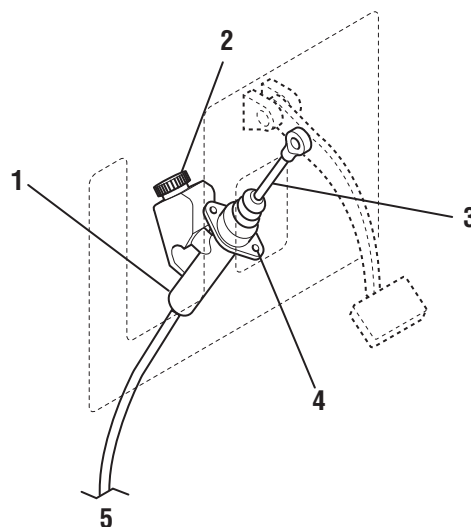
If the system does not provide enough movement of the release bearing, the clutch will not adjust and the bearing will move away from the transmission and lose clutch brake squeeze.

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

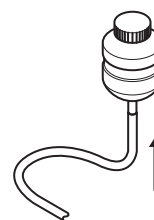
Master cylinder may be mounted at any angle ranging from vertical to horizontal, depending on application.



- 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

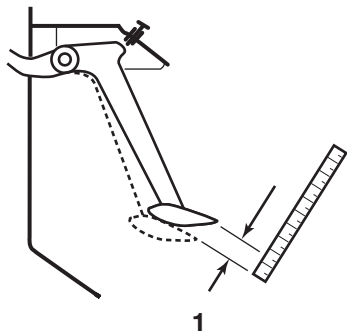
Constant rise in hose from master cylinder to reservoir.



Adjustment

Freeplay

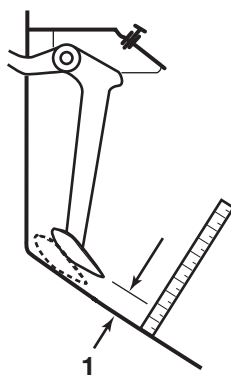
Depending on the application, freeplay can be achieved by adjusting upper pedal stop or by adjusting master cylinder pushrod.



1 - Freeplay 3-8 mm

Clutch Brake Squeeze

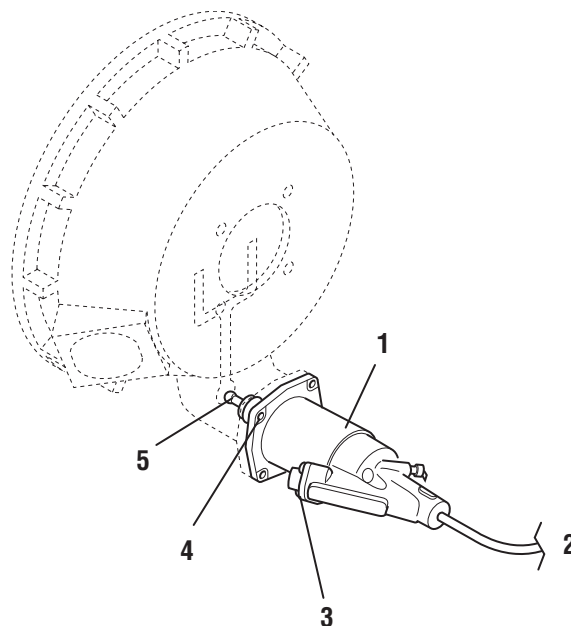
For non-synchronized applications only.



1 - Clutch brake squeeze 13-50 mm

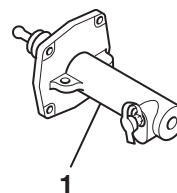
Transmission Installation

Non-Synchronized



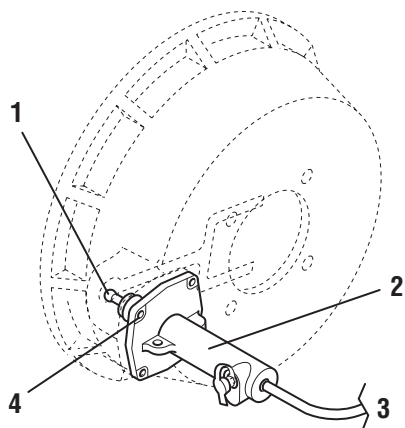
- 1 - Clutch servo
- 2 - To master cylinder
- 3 - Connect air supply 30 psi source; Bolts (4), M16 x 1.5 mm (torque 20-25 N•m)
- 4 - Bolts (2), M8 x 1.25 mm (torque 20-25 N•m)
- 5 - Pushrod

Slave Cylinder



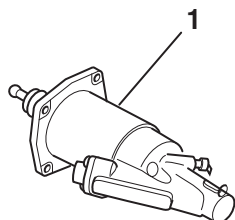
1 - Slave cylinder

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



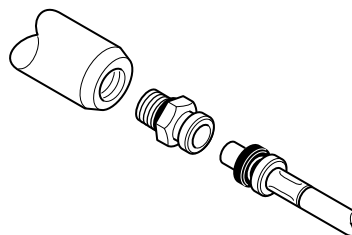
- 1 - Clutch servo

Hose Assembly

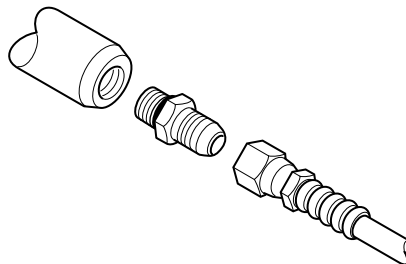
1. Connect hose assembly to master cylinder and slave or booster. Depending on hose type, this is either a threaded connect or snap-to-connect. Torque all connectors to 20-25 N•m.

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.

CAUTION

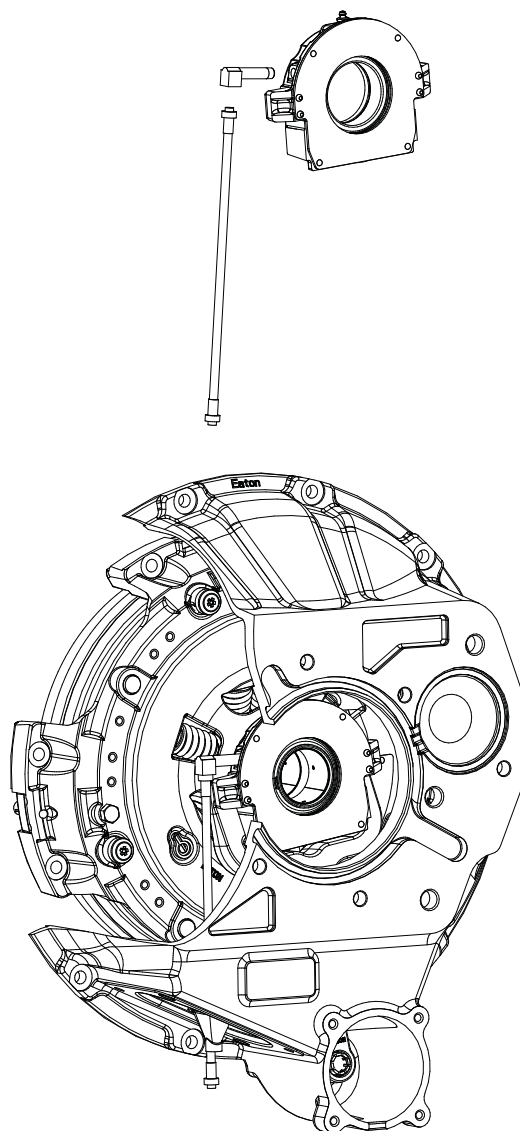
Do not press or disengage clutch pedal when removing slave cylinder or clutch servo.

Solo Advantage Lube Hose Assembly With Hydraulic Linkage

Installation Process

1. Install brass fitting into grease port on left side of release bearing housing using Weatherhead socket. Tighten hand tight and continue to turn until the opening of the fitting is facing toward the 6 o'clock position
2. Install lube hose into brass fitting and tighten until hand tight, then turn an additional 2 turns.
3. Lubricate release bearing until grease purges from release bearing housing. Use NLGI #2 or #3 Lithium complex grease. Reference Eaton lubrication manual TCMT0021 for specific instructions.
4. Install hand hole cover A-8173 with grommet biased towards transmission in the clutch housing. Secure the hand hold cover with two 5/16 x 18 x 1/2 inch long bolts.
5. Insert plug into hole in upper left side of the clutch housing where the horizontal lube hose is utilized.

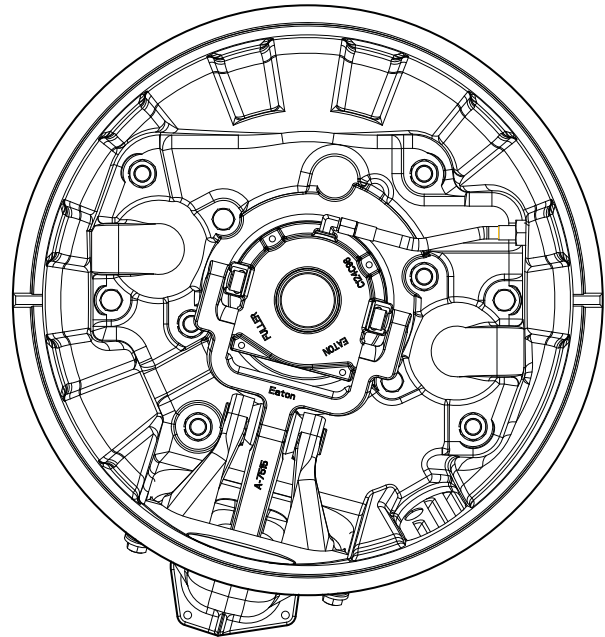
Note: If the lube hose assembly should need servicing it can be replaced without removal of transmission.



Parts Required:

- 1 - K-4050 Lube hose assembly kit
(includes brass fitting, lube hose, and plug)
- 2 - A-8173 Hand hold cover with grommet

1. Fitting is assembled to hose hand tight. Attach the brass fitting to the release bearing housing hand tight and turn fitting until opening of fitting is at the 9 o'clock position when facing the engine. Install the hose into fitting until hand tight and turn 1/6 turn. Refer to diagram.
2. Transmission installation; remove the nuts from the brass fitting with the grease zerk. Install the transmission and insert the brass fitting through the hole in the left side of the clutch housing. Reinstall the brass nuts and tighten.
3. Lubricate release bearing until grease purges from release bearing housing. Use NLGI #2 or #3 Lithium complex grease. Reference Eaton lubrication manual TCMT0021 for specific instructions.
4. Install 4305231 hand hole cover to protect the clutch from contamination.



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 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.

Self-Adjusting Clutches

The Eaton 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 Self-Adjusting Clutches

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

The Self-Adjusting Clutch automatically keeps the proper release bearing position and clutch free pedal position with two opposing cams. As the Self-Adjusting 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 Self-Adjusting Clutches 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.

Pre-Dampers - Pre-damper is a feature designed for reducing idle rattle noise in various applications, where torsional vibrations are growing more erratic. That is why Eaton is now introducing the latest option for heavy-duty applications, the VCT Plus PD, where "PD" stands for Pre-Damper. The Pre-Damper consists of seven small springs, surrounding the hub that reduce idle rattle when operating at low torque or engine speed with the transmission in neutral, prior to operation of the primary damper stage.

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 cera-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 lb-ft. (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 Plus) for all vehicles over 1,000 lb-ft.

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

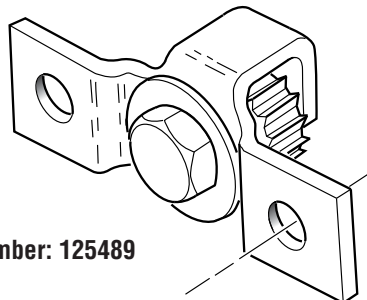
The intermediate plate or center plate, increases the torque capacity of the clutch by providing additional surface area for facing material and torque capacity. The intermediate plate is driven by the clutch cover or by the flywheel on the 14" Easy-Pedal Plus design.

Positive Separator Pin™

Eaton'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'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 adjustor as needed.



Part Number: 125489

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®

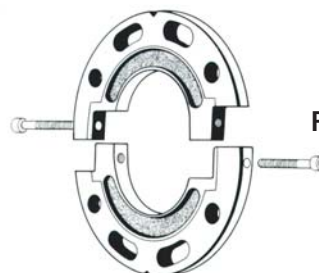
Torque Limiting Clutch Brake

The Eaton 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.



Part Number: 127200

Factors that Effect 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 Self-Adjusting 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 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 = 0.625" (16 mm)

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

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

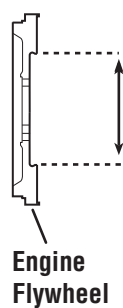
3.5" remaining tab movement

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 three 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. **Check the Flywheel Bore (15.5" Clutch)** - The flywheel environment must be checked to make sure a clutch can be used with it. The bore is important when deciding what type of driven disc to use. The bore must be large enough to allow for a proper fit of the disc. See chart below.



The diagram shows a cross-section of an engine flywheel. A vertical double-headed arrow indicates the measurement of the bore size. The text 'Measure bore size' is placed next to the arrow. The label 'Engine Flywheel' is at the bottom left of the diagram.

	# of Springs	Bore size
8-Spring	7 1/4"	(184.15mm)
10-Spring	8 9/16"	(217.48mm)
7-Spring	9 3/4"	(247.65mm)
9-Spring*	9 3/4"	(247.65mm)

*Mack/Volvo Engine 2007 and newer only

2. **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 $F(f) = uNPr$. 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.
3. **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)

Lube Tube Assembly

The Eaton Lube Tube Assembly enables the release bearings in Eaton 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

Lube Hose Kits/Assemblies for Hydraulic Release System

Kit/Assembly	Description
K-4050	Used with Solo Advantage clutches
A-7857	Used with Non-Solo Advantage™ clutches

Recommended Lubrication



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

For a list of recommended lubricants, see TCMT-0020 or call 1-800-826-HELP (4357).

Lubrication Interval

The DM UltraShift clutch does not require any lubrication or adjustment. There is no clutch linkage associated with this product, therefore there is no linkage adjustment or maintenance requirements.

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

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Roadranger®

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