



Fuller® Transmission

Service Manual

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Warnings and Cautions

Warnings & Cautions

WARNING:



Follow the specified procedures in the indicated order to avoid personal injury

Note: Additional relevant information not covered in the service procedure.

WARNING: Before starting a vehicle:

- Sit in the driver's seat
- Place shift lever in neutral
- Set the parking brake

WARNING: Before working on a vehicle or leaving the cab with engine running:

- Place shift lever in neutral
- Set the parking brake
- Block the wheels

WARNING: When parking the vehicle or leaving the cab:

- Place shift lever in neutral
- Set the parking brake

CAUTION:



CAUTION: Follow the specified procedures in the indicated order to avoid equipment malfunction or damage.

CAUTION: Do not release the parking brake or attempt to select a gear until the air pressure is at the correct level.

CAUTION: To avoid damage to the transmission during towing:

- Place shift lever in neutral
- Lift the drive wheels off of the ground or disconnect the driveline

CAUTION: Do not operate the vehicle if alternator lamp is lit or if gauges indicate low voltage.

Purpose and Scope of Manual

This manual is designed to provide information necessary to service and repair the Eaton Fuller transmissions listed on the front.

How to use this Manual

The service procedures have been divided into two sections: In-Vehicle Service Procedures and Transmission Overhaul Procedures—Bench Service. In-Vehicle Service Procedures contain procedures that can be performed while the transmission is still installed in the vehicle. Transmission Overhaul Procedures contain procedures that are performed after the transmission has been removed from the vehicle.

Overview for In Vehicle Service Procedures

In-Vehicle Service Procedures for Removal and Installation give the steps necessary to complete each repair in the vehicle. They also show "Procedures to complete first", which are steps that are required before completing the current procedure (Removal) or steps to complete after performing the current procedure (Installation).

Overview for Bench Service Procedures

Transmission Overhaul Procedures-Bench Service starts with a transmission that is completely assembled and then removes each part and disassembles it. The removal and disassembly procedures first list the "Procedures to complete first", which are sections in Transmission Overhaul Procedures-Bench Service that must be completed prior to starting the current removal, or disassembly procedure.

Installation starts with a empty case and assembles and installs each component. Installation procedures do not list "Procedures to complete first", since this varies with the repair performed.

Disassemble Precautions

It is assumed in the detailed assembly instructions that the lubricant has been drained from the transmission, the necessary linkage and vehicle air lines disconnected and the transmission has been removed from vehicle chassis. Removal of the gear shift lever housing assembly (or remote control assembly) is included in the detailed instructions (How to Remove the Gear Shift Lever). This assembly **MUST** be detached from the shift bar housing before the transmission can be removed.

Follow closely each procedure in the detailed instructions, make use of the text, illustrations, and photographs provided.
Assemblies

- When disassembling the various assemblies, such as the mainshaft, countershafts, and shift bar housing, lay all parts on a clean bench in the same sequence as removed. This procedure will simplify assembly and reduce the possibility of losing parts.

Bearings

- Carefully wash and lubricate all usable bearings as removed and protectively wrap until ready for use. Remove bearings planned to be reused with pullers designed for this purpose.

Cleanliness

- Provide a clean place to work. It is important that no dirt or foreign material enters the unit during repairs. Dirt is an abrasive and can damage bearings. It is always a good practice to clean the outside of the unit before starting the planned disassembly.

Introduction

Input Shaft

- The input shaft can be removed from the transmission without removing the countershafts, mainshaft, or main drive gear. Special procedures are required and provided in this manual.

Snap Rings

- Remove snap rings with pliers designed for this purpose. Snap rings removed in this manner can be reused, if they are not sprung or loose.

Note: Spiral snap rings on the reverse idler shaft cannot be reused.

When Using Tools to Move Parts

- Always apply force to shafts, housings, etc., with restraint. Movement of some parts is restricted. Never apply force to parts being installed with a driver after they stop solidly. The use of soft hammers, soft bars, and mauls for all disassembly work is recommended.

Inspection Precautions

Before assembling the transmission, check each part carefully for abnormal or excessive wear and damage to determine reuse or replacement. When replacement is necessary, use only genuine Eaton® Transmission parts to assure continued performance and extended life from your unit.

Since the cost of a new part is generally a small fraction of the total cost of downtime and labor, avoid reusing a questionable part which could lead to additional repairs and expense soon after assembly. To aid in determining the reuse or replacement of any transmission part, consideration should also be given to the unit's history, mileage, application, etc.

Recommended inspection procedures are provided in the following checklist.

Bearings

- Wash all bearings in clean solvent. Check balls, rollers, and raceways for pitting, discoloration, and spalled areas. Replace bearings that are pitted, discolored, spalled, or damaged during disassembly.
- Lubricate bearings that are not pitted, discolored, or spalled and check for axial and radial clearances.
- Replace bearings with excessive clearances.
- Check bearing fit. Bearing inner races should be tight to shaft; outer races slightly tight to slightly loose in case bore. If the bearing spins freely in the bore the case should be replaced.

Bearing Covers

- Check covers for wear from thrust of adjacent bearing. Replace covers damaged from thrust of bearing outer race.
- Check cover bores for wear. Replace those worn or oversized.

Clutch Release Parts

- Check clutch release parts. Replace yokes worn at cam surfaces and bearing carrier worn at contact pads.
- Check pedal shafts. Replace those worn at bushing surfaces.

Gears

- Check gear teeth for frosting and pitting. Frosting of gear teeth faces presents no threat of transmission failure. Often in continued operation of the unit, frosted gears "heal" and do not progress to the pitting stage. In most cases, gears with light to moderate pitted teeth have considerable gear life remaining and can be reused, but gears in the advanced stage of pitting should be replaced.

- Check for gears with clutching teeth abnormally worn, tapered, or reduced in length from clashing during shifting. Replace gears found in any of these conditions.
- Check axial clearance of gears.

Gray Iron Parts

- Check all gray iron parts for cracks and breaks. Replace parts found to be damaged.

Oil Return Threads and Seals

- Check oil return threads on the input shaft. If return action of threads has been damaged, replace the input shaft.
- Check oil seal in rear bearing cover. If sealing action of lip has been destroyed, or operating on a worn sealing surface replace the seal.

O-Rings

- Check all o-rings for cracks or distortion. Replace if worn.

Reverse Idler Gear Assemblies

- Check for excessive wear from action of roller bearings.

Shift Bar Housing Assembly

- Check for wear on shift yokes and block at pads and lever slot. Replace excessively worn parts.
- Check yokes for correct alignment. Replace sprung yokes.
- Check lockscrew in yoke and blocks. Tighten and rewire those found loose.
- If housing has been disassembled, check neutral notches of shift bars for wear from interlock balls.

Sliding Clutches

- Check all shift yokes and yoke slots in sliding clutches for extreme wear or discoloration from heat.
- Check engaging teeth of sliding clutches for partial engagement pattern due to snubbing or gear clashing wear.

Splines

- Check splines on all shafts for abnormal wear. If sliding clutch gears, companion flange, or clutch hub has wear marks in the spline sides, replace the specific shaft effected.

Synchronizer

- Check synchronizer for burrs, uneven and excessive wear at contact surface, and metal particles imbedded in friction material
- Check blocker pins for excessive wear or looseness.
- Check synchronizer contact surfaces on the synchronizer cups for wear.

Washers

- Check surfaces of all washers. Washers scored or reduced in thickness should be replaced.

Assembly Precautions

Make sure that case interiors and housings are clean. It is important that dirt and other foreign materials are kept out of the transmission during assembly. Dirt is an abrasive and can damage polished surfaces of bearings and washers. Use certain precautions, as listed below, during assembly.

Bearings

Introduction

- Use a flange-end bearing driver for bearing installation. These special drivers apply equal force to both the inner and outer races, preventing damage to balls/rollers and races while maintaining correct bearing alignment with bore and shaft. Avoid using a tubular or sleeve-type driver, whenever possible, as force is applied to only one of the bearing races.

Capscrews

- To prevent oil leakage and loosening, use Eaton/Fuller sealant #71205 on all capscrews.

Gaskets

- Use new gaskets throughout the transmission as it is being rebuilt. Make sure all gaskets are installed. An omission of any gasket can result in oil leakage or misalignment of bearing covers.

Initial Lubrication

- Coat all limit washers and shaft splines with Lubricant during assembly to prevent scoring and galling of such parts.

O-Rings

- Lubricate all O-rings with silicon lubricant.

Universal Joint Companion Flange or Yoke

- Pull the companion flange or yoke tightly into place with the output shaft retaining capscrews using 100-110 N.m (74-81 lbs. ft.) of torque. Make sure the speedometer drive gear or a replacement spacer of the same width has been installed. Failure to pull the companion flange or yoke tightly into place can result in damage to the mainshaft rear bearing.

Note: Auxiliary mainshaft end yoke retaining cap screw threaded holes have Spiralock™ threads inserted. This is a special thread pitch and no thread damage restoration should be attempted by using a conventional metric thread pitch tap.



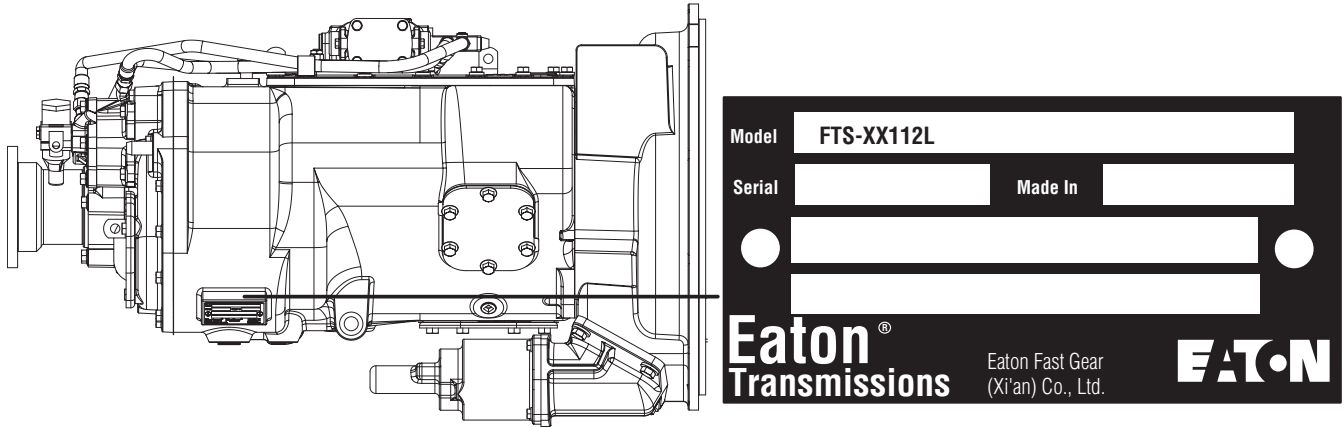
See the appropriate Illustrated Parts Lists (specified by model series) to ensure that proper parts are used during assembly of the transmission.

Serial Tag Information and Model Nomenclature

Transmission model designation and other transmission identification information are stamped on the serial tag. To identify the transmission model and serial number, locate the tag on the transmission and then locate the numbers as shown. The figure below shows the tag which is located on the transmission.

When calling for service assistance or parts, have the model and serial numbers handy.

Do not remove or destroy the transmission identification tag!



Transmission Tag and Location

Model Number

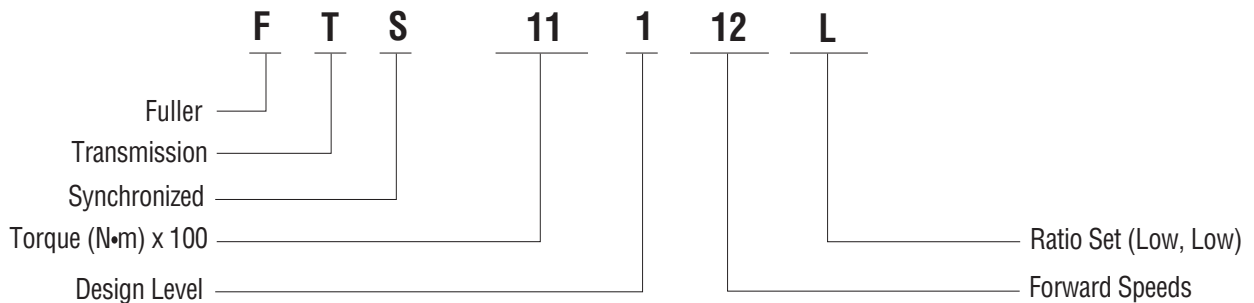
The model number gives basic information about the transmission and is explained below.

Serial Number

The serial number is the sequential identification number of the transmission. Before calling for service assistance, write the number down as it may be needed.

Bill of material or Customer number

This number may be located below the model and serial numbers. It is a reference number used by Eaton®.



Preventive Maintenance Inspection

Preventive Maintenance Inspection

Everyday there are countless vehicles operating over the highways with transmissions in such a neglected mechanical condition, they can be referred to as failures looking for a place to break down. They lack a proper and organized preventive maintenance program.

Preventive maintenance is a general term which applies to all procedures necessary to have maximum life and satisfactory service at the lowest possible cost, short of removing and repairing the unit.

A number of conditions contrary to good preventive maintenance can generally be pointed to when inspecting a failed transmission. Taking a few minutes every so many hours or miles to do a few simple checks could help avoid eventual breakdown or reduce the repair cost. If the transmission is not cared for, it will breakdown.

1. **Air System and Connections**

- Check for leaks, worn air lines, loose connections and capscrews.

2. **Clutch Housing Mounting**

- Check all capscrews of clutch housing flange for looseness.

3. **Clutch Release Bearing**

- Remove hand hole cover and check radial and axial clearance in release bearing.
- Check relative position of thrust surface of release bearing with thrust sleeve on push-type clutches.

4. **Clutch Pedal Shaft and Bores**

- Pry upward on shafts to check wear.
- If excessive movement is found, remove clutch release mechanism and check bushings on bores and wear on shafts. See OEM literature.

5. **Lubricant**

- Change at specified service intervals.
- Use only the types and grades as recommended. See "Lubrication Specifications."

6. **Filler and Drain Plugs**

- Remove filler plugs and check level of lubricant at specified intervals. Tighten fill and drain plugs securely.

7. **Capscrews and Gaskets**

- For applicable models, check all capscrews, especially those on PTO covers and rear bearing covers for looseness which would cause oil leakage.
- Check PTO opening and rear bearing covers for oil leakage due to faulty gasket.

8. **Gear Shift Lever**

- Check for looseness and free play in housing.

Checks With Drive Line Dropped

9. **Universal Joint Companion Flange or Yoke Retaining Cap Screws**

- Check for tightness. Tighten to recommended torque.

10. **Output Shaft**

- Pry upward against output shaft to check radial clearance in mainshaft rear bearing.

Checks With Universal Joint Companion Flange or Yoke Removed

Note: If necessary, use solvent and shop rag to clean sealing surface of companion flange or yoke. Do not use crocus cloth, emery paper, or other abrasive materials that will damage surface finish.

11. Splines on Output Shaft

- Check for wear from movement and chucking action of the universal joint companion flange or yoke.

12. Mainshaft Rear Bearing Cover

- Check oil seal for wear.

Lubrication

Eaton Lubrication Philosophy

In promoting component reliability and longevity, proper lubrication is the key to a sound and effective maintenance program. Without effective lubricants at proper levels, remaining maintenance procedures will not keep components functional.

Synthetic lubricants have proven to be superior to petroleum products and represent opportunities to promote superior products and bottom line operating performance while significantly extending component service life and reliability.

Eaton does recognize that some areas in the world can not obtain good quality synthetic lubricants. Therefore, there are recommendations for mineral based lubricants. Note that the drain interval is significantly shorter with the mineral based lubricant verses the synthetic lubricants.

Not using the required lubricant will result in degraded performance and shortened life of the product. Refer to Eaton Lubrication Manual (TCMT0021) for the latest information regarding lubrication requirements.

Proper Lubrication

Proper lubrication procedures are key to a good all-around maintenance program. If the improper lubricant is used or if the lubricant level is ignored, general maintenance will not keep the transmission running properly or assure long transmission life.

To ensure a proper lubricant maintenance program, follow these steps:

- Maintain lubricant level and inspect regularly.
- Follow maintenance interval chart.
- Use the correct grade and type of lubricant.
- Buy lubricant from an approved dealer.

Warnings and Cautions

- Before working on a vehicle, place transmission in neutral, set brakes, and block wheels.
- Do not introduce additives and/or friction modifiers. Additives of any kind added later to the oil can results in unpredictable consequences. No liability of any kind will be accepted by Eaton for any damage resulting from the use of such additives.
- Do not mix lubricants of different grades.
- Do not mix synthetic and mineral lubricants in the same transmission. When switching between types of lubricants, all areas of each affected component must be thoroughly drained.
- Use clean containers when transferring lubricant from the bulk storage to the transmission. Containers used for anti-freeze or water should be cleaned prior to use.
- Do not re-use lubricant.
- Failure to use the required lubricant will affect the transmission performance and the warranty coverage.
- SAE 15W-40 viscosity grades are not allowed in Eaton transmissions.

Operating Temperatures

Transmissions must not be operated at temperatures above 121°C [250°F]. Operation at temperatures above 121°C [250°F] causes loaded gear tooth temperatures to exceed 177°C [350°F] which will ultimately destroy the heat treatment of the gears.

The following conditions in any combination can cause operating temperatures over 121°C [250°F].

- Operating consistently at high loads / slower speeds
- High ambient temperatures
- Restricted air flow around transmission
- Exhaust system too close to the transmission
- High horsepower operation
- Use of engine retarder

Transmission Lubricant Specifications

Eaton Recommends the Use of Eaton Roadranger Lubricants.

Roadranger SAE 50 Synthetic Lubricant or Eaton PS-164 rev 7 is the only approved synthetic lubricant.

A list of approved lubricants and suppliers can be found at www.roadranger.com in the supplier Lubricant Manual (TCMT0020)

Product	Lubricant Type	Specification	Change Interval Linehaul Applications	Change Interval Vocational Applications
FTS-XX108LL (10 speed) FTS-XX112L (13 speed)	Synthetic	Eaton PS-164 rev7 (SAE 50)	800,000 km [500,000 mi] or 5 years	290,000 km [180,000 mi] or 3 years
FTS-XX108LL (10 speed) FTS-XX112L (13 speed)	Mineral	MIL-PRF-2104H (SAE 50)	100,000 km [62,000 mi] or 1 year	50,000 km [31,000 mi] or 1 year
	Mineral	CAT TO-4 (SAE 40 or SAE 50)	100,000 km [62,000 mi] or 1 year	50,000 km [31,000 mi] or 1 year
	Mineral	API CF-4 (SAE 40 or SAE 50)	100,000 km [62,000 mi] or 1 year	50,000 km [31,000 mi] or 1 year

Lubrication

Transmission Oil Level

Note: Before checking oil level, engine must be idling in neutral for at least 2 minutes and lubricant temperature must be between 15.5degC and 48.8degC [60degF and 120degF].

Approximate Transmission Lube Capacity:

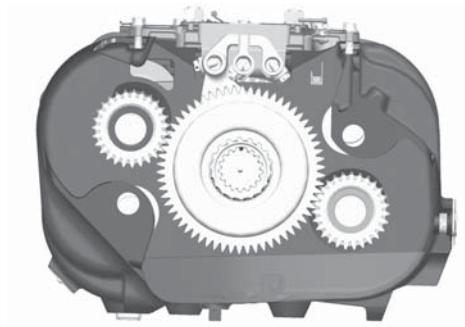
- 8LL - 15 Liters
- 12L - 17 Liters

Check the lubricant level by using the fill hole located on the right side of the transmission.

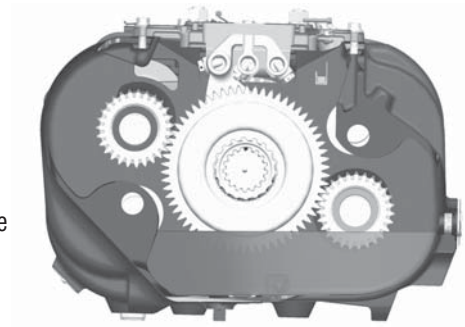
Check fluid levels and inspect for leaks at regular PM maintenance intervals (not to exceed 19,000 km [12,000 mi]) for Line Haul applications or 50 hours for Vocational applications.

1. Place vehicle on level ground
2. Turn engine off
3. Remove fill hole plug
4. Lubricant must be level with the hole (see pictures below)
5. Clean and reinstall the fill hole plug and torque to recommended torque value.

Make sure that the transmission lubricant is level with the bottom of the fill opening. Being able to reach the lubricant with your finger does not indicate that the lubricant is at the proper level.



Improper Oil Level



Proper Oil Level

Vehicle Application Definitions

Line Haul (On-highway)

- High mileage operation (over 100,000 km [62,000 mi] per year)
- On-highway or good to excellent concrete or asphalt
- More than 48 Km [30 miles] between starting and stopping
- 4x2, 6x2, 6x4 tractor/trailer combinations and straight trucks
- Check fluid levels and inspect for leaks every 19,000 Km [12,000 miles]

Vocational (Off-highway)

Vocational service applications are those which require components to be consistently operated at heavy loads, in contaminated environments or on steep grades.

- Low mileage operation (under 100,000 km [62,000 mi] per year)
- Off-highway or areas of unstable or loose unimproved road surfaces
- Less than 48 Km [30 miles] between starting and stopping
- Heavy-Duty, off-road or specialized application type vehicles
- Check fluid levels and inspect for leaks every 50 hours

Recommended Tools

Tool Specifications

Some repair procedures pictured in this manual show the use of specialized tools. Their actual use is recommended as they make transmission repair easier, faster, and prevent costly damage to critical parts.

For the most part, ordinary mechanic's tools such as socket wrenches, screwdrivers, etc., and other standard shop items such as a press, mauls and soft bars are the only tools needed to successfully disassemble and reassemble any Eaton® transmission.

The following tables list and describe the typical tools required to properly service this model transmission above and beyond the necessary basic wrenches, sockets, screwdrivers, and prybars.

General Tools

The following tools are available from several tool manufacturers such as Snap-On, OTC, and many others.

TOOL	PURPOSE
0-340N.m (0-250 lbs. ft.) 12.7 mm (1/2") drive Torque Wrench	General torquing of fasteners (Typically 20-108 N•m (15-80 lbs. ft.))
	Torquing of output nut to
0-11.3 N•m (0 - 100 lbs. in.) 9.52mm (3/8") drive Torque Wrench	General torquing of fasteners
	To remove the output yoke/flange nut
Large Brass Drift	Used to protect shafts and bearings during removal
Large Dead Blow Hammer or Maul	To provide force for shaft and bearing removal
0-12 BAR (0-175 PSI) (2) Air Pressure Gauges 0-10.34 BAR (0-150 PSI)	To troubleshoot and verify correct operation of air system

The following special tools are designed for this Eaton® transmission. The addresses and phone numbers of the tool suppliers are listed after the table. This list is provided as a convenience to our customers. These tools are manufactured by independent companies with no relationship to Eaton®. Eaton® does not warrant the fit or function of the listed tools. To obtain the tools, contact the tool supplier directly.

Special Tools

TOOL	PURPOSE	Eaton Tool Number	OTC Tool Number	Snap-On Tool Number	Especifer Tool Number
Auxiliary Section Hanger	To support, or hang, the auxiliary section in the horizontal position.		J-49302		
Bearing Puller	To remove front countershaft rearbearings.	T-100255-H snap ring used with OTC puller assembly	313579 rods, 42542 bar, and 5051 puller clamp (used with T-100255-H snap ring)		E007011
Crow's Foot	To remove slip fit bearings			1650 Snap-On	
Bearing Driver	To install the front countershaft rear bearings and auxiliary countershaft front bearings	T-18042-96			
Countershaft Support Tools	To support and locate the front section countershafts during bearing removal and installation	T-22247			
Bearing Driver	To install input bearing on input shaft and to install the auxiliary countershaft rear bearings	T-100255-G			
Bearing Driver	To install the front section front countershaft bearings	T-18042-94			E001038 and E0010005
Snap ring Pliers	To remove and install snap rings			SRP4 Snap-On	
Output Installation/Removal Kit	To remove and install the output bearing cover oil seal	K-3651			
Auxiliary Section Removal Adapter Plate	To attach transmission jack to auxiliary section for auxiliary section removal in chassis.		49611	(Used with OTC transmission jack P/N 5019.)	
Mainshaft Hook J-Hooks	To assist in lifting of mainshaft from front section.	T-100255-B			
Bearing Race Puller	To remove the auxiliary countershaft front race			CJ950 with OTC 4254 bar, and 310552 rods	E012007

Recommended Tools

TOOL	PURPOSE	Eaton Tool Number	OTC Tool Number	Snap-On Tool Number	Especifer Tool Number
Bearing Race Puller	To remove the auxiliary countershaft rear race			CJ951 with press	
Shift Bar Housing Removal T-Bar	To remove the Shift Bar housing	T-100255-C			
Countershaft Retaining Strap	To hold the front countershafts	T-100255-D			E009003
Synchronizer Plate	To hold the synchronizer in the neutral position for assembly and disassembly	T-100255-F			

Shop Equipment

20 Ton capacity press	To press countershaft gears from countershaft
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Tools Unique to Especifer ind. e com. de ferramentas Ltda.

Tool	Purpose	Especifer Tool Number
Bearing Driver	To install front section rear countershaft bearing	E001037 & E001038
Bearing Driver	To install rear section tapered bearing cup	E0010006
Bearing Driver	To install auxiliary countershaft cup in rear of maincase	E001032 & E001038
Bearing Driver	To install input shaft bearing	E001033
Bearing Driver	To install auxiliary countershaft bearings	E001038 & E001034
Bearing Driver	To install rear mainshaft tapered bearing	E010004
Bearing Extractor	To remove auxiliary driver gear bearing	E012003
Bearing Extractor	To remove front countershaft front bearings	E007008
Bearing Extractor	To remove input shaft bearing	E012002 & E007009
Bearing Extractor	To remove auxiliary countershaft bearings	E007007
Bearing Extractor	To remove the auxiliary mainshaft tapered bearing from the shaft	E012002 & E0070010
Shaft Installer	To install reverse idler gear shaft	E001036
Shaft Extractor	To remove reverse idler gear shaft	E003003
Seal Installer	To install rear bearing cover oil seal	E001035
Auxiliary Fixture	To support the auxiliary section upright on a flat surface	E009004
Housing Extractor	To separate the auxiliary mainshaft from the auxiliary housing	E012002 & E012005

Contact Information

Especifer ind. e com. de ferramentas Ltda.
 Alamanda Júpiter - 98
 Bairro Vitória Martine
 Indaiatuba
 CEP 13347 - 627
 Ph: 55 19 39369797
 07:30 - 17:00 Monday - Friday
www.especifer.com.br

Torque Specifications

Torque Specifications

Description	Torque Value N•m and lbs. ft.	Thread Size	Additional Comments
Rear Support Studs	81 N•m [60 lbs. ft.]	M16x2.0	Driven Until Bottomed
Rear Support Stud Nuts	244-271 N•m [180-200 lbs. ft.]	M16x1.5	
Clutch Housing Studs	81 N•m [60 lbs. ft.]	M16x2.0	Driven Until Bottomed
Clutch Housing Nuts	244-271 N•m [180-200 lbs. ft.]	M16x1.5	
Clutch Housing Capscrews	97-108 N•m [72-80 lbs. ft.]	M12x1.75	
Clutch Housing Hand Hole Cover Capscrews	27-31 N•m [20-23 lbs. ft.]	M8x1.25	
Booster Adapter Capscrews	97-108 N•m [72-80 lbs. ft.]	M12x1.75	
Clutch Booster Capscrews	27-31 N•m [20-23 lbs. ft.]	M8x1.25	
Front Bearing Cover Capscrews	54-61 N•m [40-45 lbs. ft.]	M10x1.5	
Countershaft Front Bearing Retainer Capscrews	122-162 N•m [90-120 lbs. ft.]	M16x1.5	
Shift Bar Housing Capscrews	54-61 N•m [40-45 lbs. ft.]	M10x1.5	
Shift Yoke/Block Tapered Lockscrews	54-61 N•m [40-45 lbs. ft.]	M12x1.25	
Reverse Plunger Plug		M18x1.5	After installing plunger and spring, tighten plug and back off .25-.50 turns. Stake thread in hole.
6-Bolt PTO Cover Capscrews	54-61 N•m [40-45 lbs. ft.]	M10x1.5	
8-Bolt PTO Cover Capscrews	77-88 N•m [57-65 lbs. ft.]	M12x1.75	
Range Cylinder Capscrews	54-61 N•m [40-45 lbs. ft.]	M10x1.5	
Range Cylinder Cover Capscrews	54-61 N•m [40-45 lbs. ft.]	M10x1.5	
Range Piston Nut	95-115 N•m [70-85 lbs. ft.]	M16x1.5	
Speedo Adapter/Plug	48-67 N•m [35-50 lbs. ft.]	M22x1.5	
Mainshaft Rear Bearing Cover Capscrews	54-61 N•m [40-45 lbs. ft.]	M10x1.5	
Auxiliary Countershaft Rear Bearing Cover Capscrews	54-61 N•m [40-45 lbs. ft.]	M10x1.5	
Rear Housing Capscrews	54-61 N•m [40-45 lbs. ft.]	M10x1.5	
Filter/Regulator Capscrews	12-14 N•m [9-10 lbs. ft.]	M6x1.0	
Auxiliary Drive Gear Bearing Retainer Capscrews	54-61 N•m [40-45 lbs. ft.]	M10x1.5	
Oil Fill Plug	47-68 N•m [35-50 lbs. ft.]	M27x2.0	

Torque Specifications

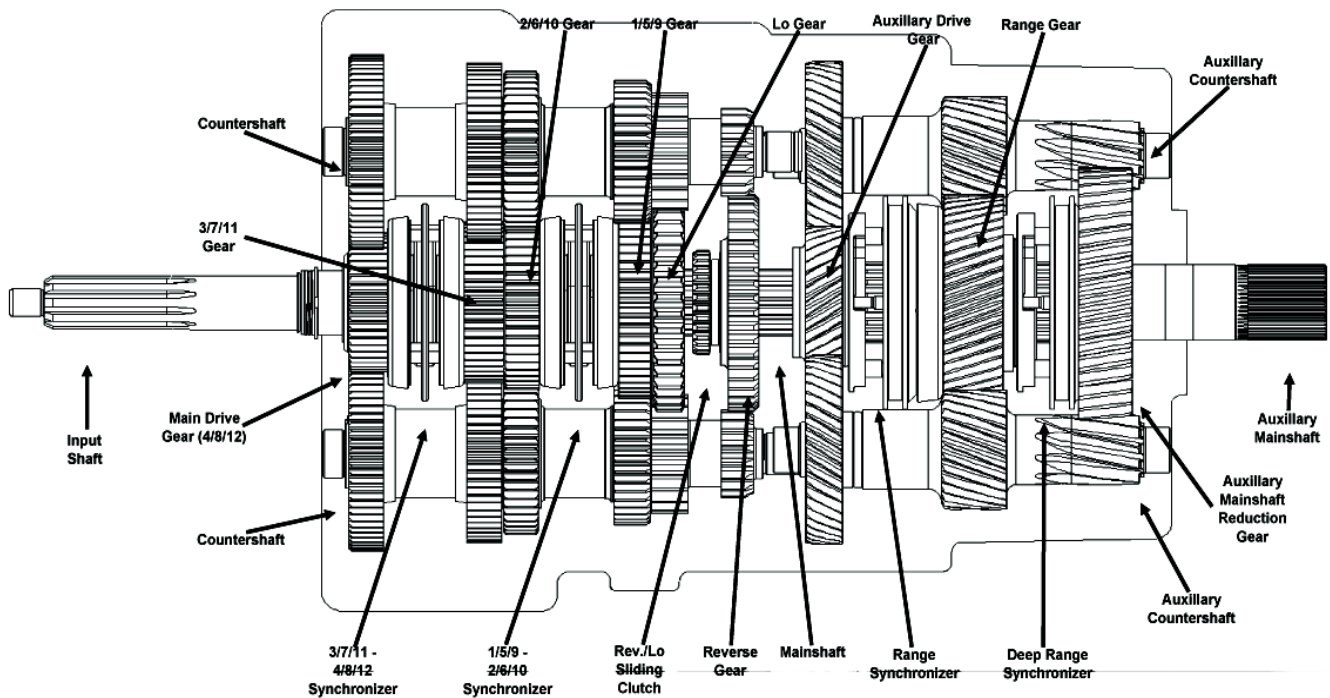
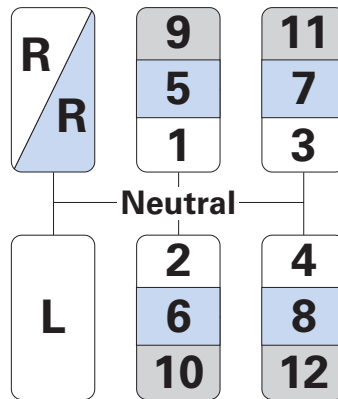
Description	Torque Value N•m and lbs. ft.	Thread Size	Additional Comments
Oil Drain Plug	47-68 N•m [35-50 lbs. ft.]	M27x2.0	
Thermocouple Plug	54-67 N•m [40-45 lbs. ft.]	.500-14 NPTF	
LRC Studs	54 N•m [40 lbs. ft.]	M10x1.5	Drive Until Bottomed
LRC Conical Nuts	54-61 N•m [40-45 lbs. ft.]	M10x1.0	
LRC Jam Nuts	34-47 N•m [25-35 lbs. ft.]	M10x1.0	
Air Fittings	9.5-13.6 N•m [84-120 lb. in.]	.125-27 NPTF	
Range Switch	20-27 N•m [15-20 lbs. ft.]	M18	
Neutral Switch	20-27 N•m [15-20 lbs. ft.]	M18	
Reverse Switch	20-27 N•m [15-20 lbs. ft.]	M14	
Output Shaft Retaining Capcscrews	100-110 N•m [74-81 lbs. ft.]	M-12 x 1.25	Spiralock threads™, no thread adhesive necessary

Power Flow

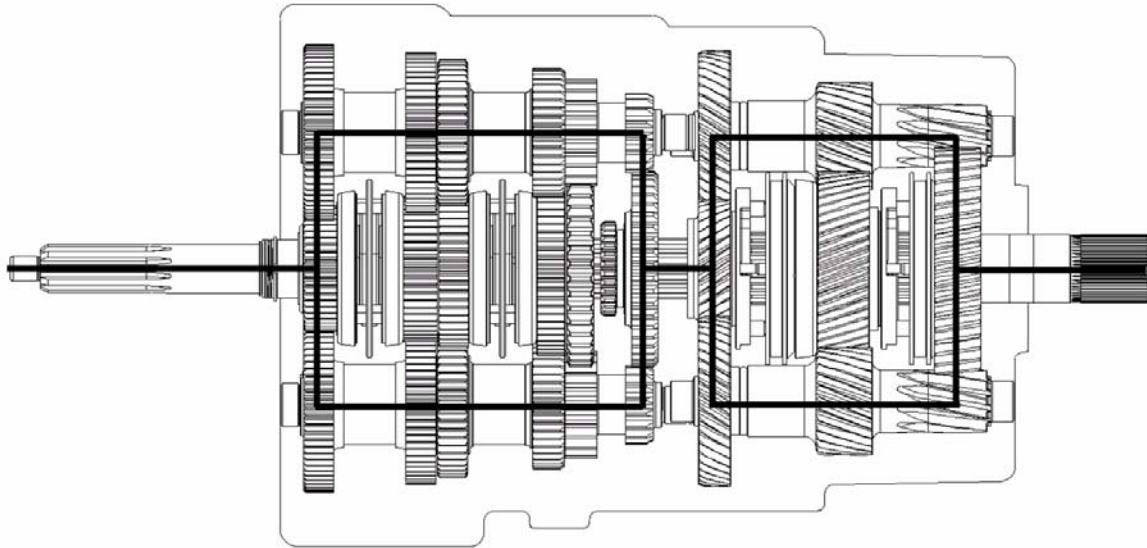
Power Flow Diagrams

An understanding of the engine's power flow through a transmission in each particular gear will assist the technician in troubleshooting and servicing a transmission.

Shift Pattern



Power Flow - Reverse Gear



Reverse Gear

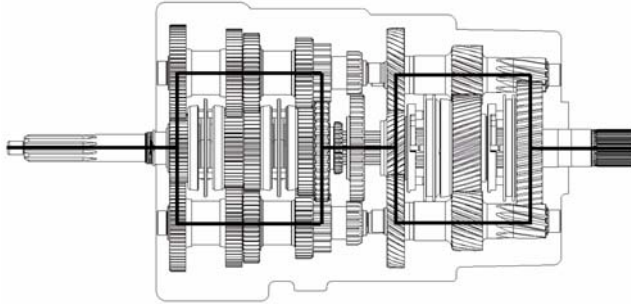
Rev/Low Sliding Clutch Position - Reverse gear (rearward)

Range Synchronizer Position - Low Range (rearward)

Deep Range Synchronizer Position - Deep Range (rearward)

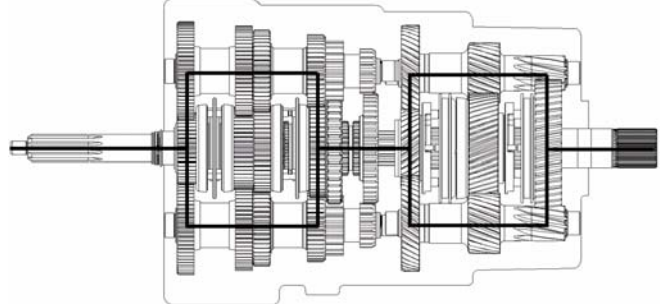
Power Flow

13-Speed



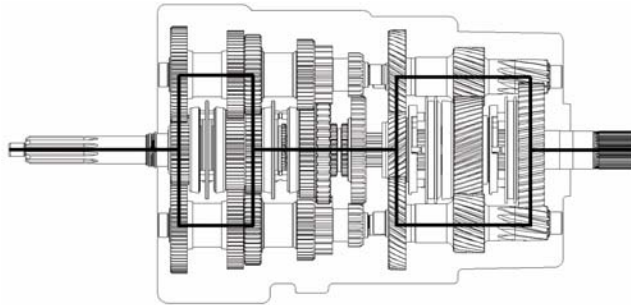
LO Gear

*Rev/Low Sliding Clutch Position - Low gear (forward)Range
Synchronizer Position - Low Range (rearward)
Deep Range Synchronizer Position - Deep Range (rearward)*



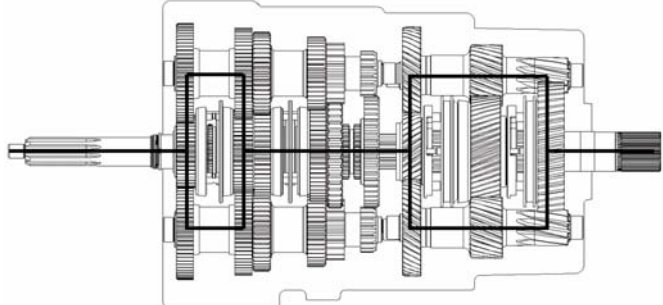
1st Gear

*1/5/9 - 2/6/10 Synchronizer Position - 1st gear (rearward)
Range Synchronizer Position - Low Range (rearward)
Deep Range Synchronizer Position - Deep Range (rearward)*



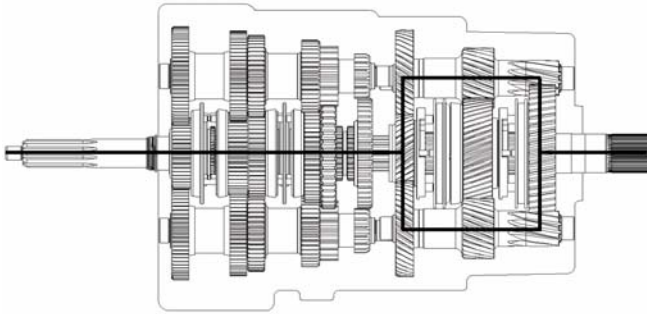
2nd Gear

*1/5/9 - 2/6/10 Synchronizer Position - 2nd gear (forward)
Range Synchronizer Position - Low Range (rearward)
Deep Range Synchronizer Position - Deep Range (rearward)*



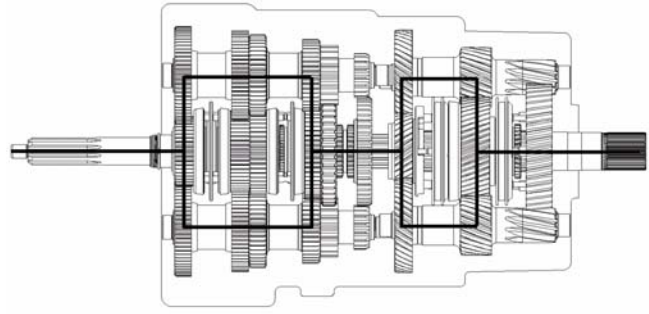
3rd Gear

*3/7/11 - 4/8/12 Synchronizer Position - 3rd gear (rearward)
Range Synchronizer Position - Low Range (rearward)
Deep Range Synchronizer Position - Deep Range (rearward)*



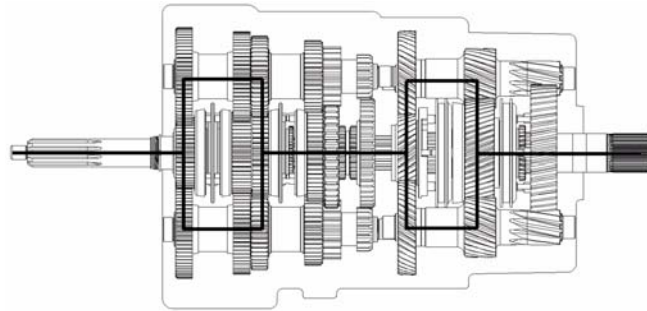
4th Gear

3/7/11 - 4/8/12 Synchronizer Position - 4th gear (forward)
 Range Synchronizer Position - Low Range (rearward)
 Deep Range Synchronizer Position - Deep Range (rearward)



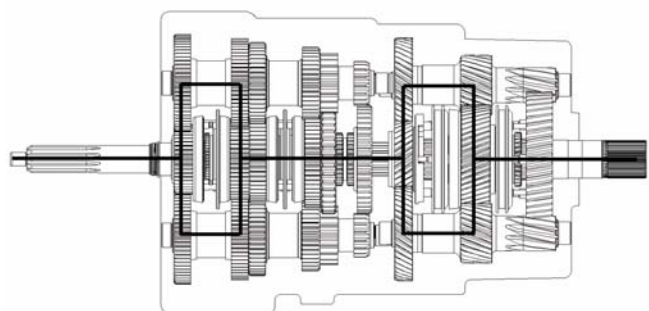
5th Gear

1/5/9 - 2/6/10 Synchronizer Position - 5th gear (rearward)
 Range Synchronizer Position - Low Range (rearward)
 Deep Range Synchronizer Position - Low Range (forward)



6th Gear

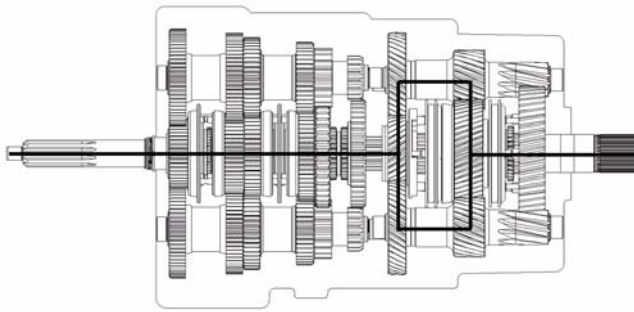
1/5/9 - 2/6/10 Synchronizer Position - 6th gear (forward)
 Range Synchronizer Position - Low Range (rearward)
 Deep Range Synchronizer Position - Low Range (forward)



7th Gear

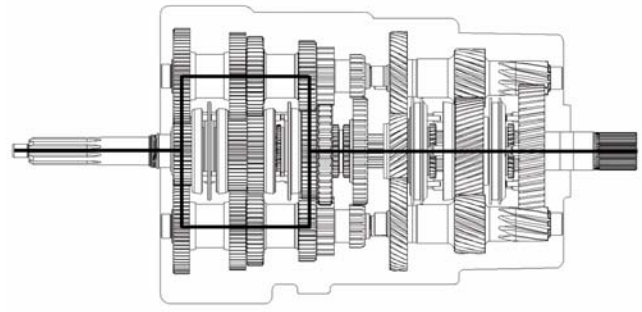
3/7/11 - 4/8/12 Synchronizer Position - 7th gear (rearward)
 Range Synchronizer Position - Low Range (rearward)
 Deep Range Synchronizer Position - Low Range (forward)

Power Flow



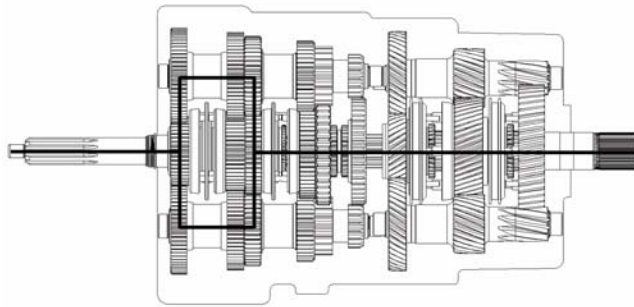
8th Gear

*3/7/11 - 4/8/12 Synchronizer Position - 8th gear (forward)
Range Synchronizer Position - Low Range (rearward)
Deep Range Synchronizer Position - Low Range (forward)*



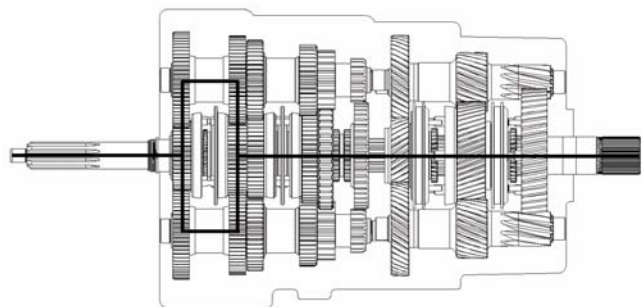
9th Gear

*1/5/9 - 2/6/10 Synchronizer Position - 9th gear (rearward)
Range Synchronizer Position - High Range (forward)
Deep Range Synchronizer Position - Low Range (forward)*



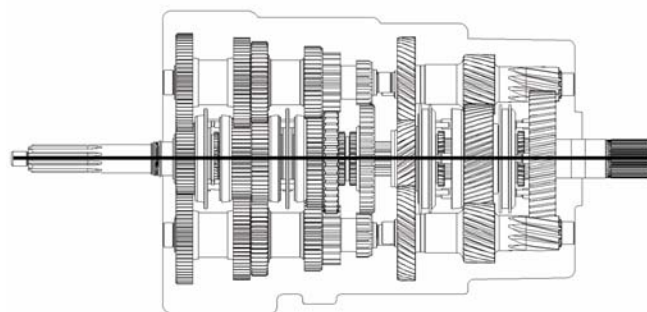
10th Gear

*1/5/9 - 2/6/10 Synchronizer Position - 10th gear (forward)
Range Synchronizer Position - High Range (forward)
Deep Range Synchronizer Position - Low Range (forward)*



11th Gear

*3/7/11 - 4/8/12 Synchronizer Position - 11th gear (rearward)
Range Synchronizer Position - High Range (forward)
Deep Range Synchronizer Position - Low Range (forward)*



12th Gear (Direct Drive)

3/7/11 - 4/8/12 Synchronizer Position - 12th gear (forward)

Range Synchronizer Position - High Range (forward)

Deep Range Synchronizer Position - Low Range (forward)

Timing

Timing Procedures

Special Instructions

It is essential that both countershaft assemblies of the front and auxiliary sections are "timed." This assures proper tooth contact is made between mainshaft gears seeking to center on the mainshaft during torque transfer and mating countershaft gears that distribute the load evenly. If not properly timed, serious damage to the transmission is likely to result from unequal tooth contact causing the mainshaft gears to climb out of equilibrium.

Timing is a simple procedure of marking the appropriate teeth of a gear set prior to installation and placing them in proper mesh while in the transmission. In the front section, it is necessary to time only the drive gear set. And depending on the model, only the LO range, deep reduction, or splitter gear set is timed in the auxiliary section.

Procedure - Front Section

1. **Marking countershaft drive gear teeth:** Prior to placing each countershaft assembly into the case, clearly mark the tooth located directly over the drive gear keyway as shown. This tooth is stamped with an "O" to aid identification.

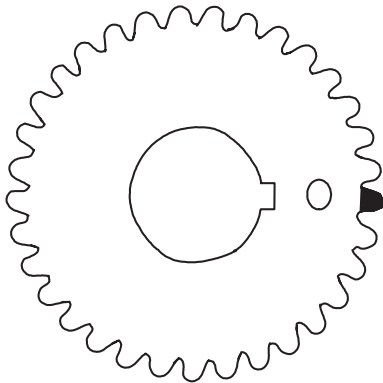


Figure 2

2. **Marking main drive gear teeth:** Mark any two adjacent teeth on the main drive gear.

Mark the two adjacent teeth located directly opposite the first set marked on the main drive gear. As shown to the left, there should be an equal number of unmarked gear teeth on each side between the marked sets.

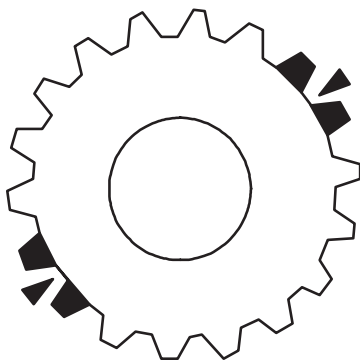
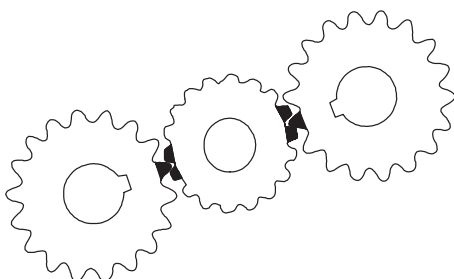


Figure 3

3. **Meshing marked countershaft drive gear teeth with marked main drive gear teeth:** After placing the mainshaft assembly into the case, the countershaft bearings are installed to complete installation of the countershaft assemblies.

When installing the bearings on the left countershaft, mesh the countershaft drive gear marked tooth with either set of main drive gear two marked teeth.

Repeat the procedure when installing the bearings on the right countershaft, make use of the remaining set of main drive gear two marked teeth to time assembly.



Procedure - Time the Auxiliary Section

1. Mark a tooth on the reduction gear with a highly visible paint, preferably a yellow or white.



2. Mark a second tooth 180 degrees away from the first. (Ensure the marks are in the correct position by counting the teeth between them. You should have exactly the same number of teeth on the Reduction gear between the marked teeth).

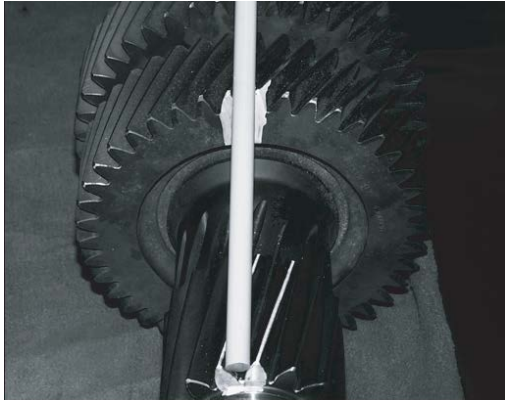


3. Locate the two stamped "O's" on the Countershaft Reduction gears and mark both teeth with a highly visible paint, preferably a yellow or white.

FR and RT Stamp Position



Timing



Left



Right



4. Use a round file or bar to properly align from the marked teeth on the Auxiliary Countershaft to the Auxiliary Splitter gear. When the bar is lined up with the root, between the correct teeth, you will notice it's parallel with the Auxiliary Countershaft. Mark both the teeth with a highly visible paint.

Example of correct alignment:

Bar in correct position parallel with the countershaft, and between the marked Splitter gear and Reduction gear teeth.

Examples of Left or Right Misalignment.

Example showing correct view of Reduction gear timed to Countershaft gears on the bench.

5. Lay the Splitter gear on a flat surface and mark it similar to steps 1 and 2 of this procedure. **(Make sure the teeth are painted on both faces of the Splitter gear front and rear).**
6. Install the Reduction gear and Outputshaft assembly into the Auxiliary case. Then, install the Auxiliary Countershafts and Splitter gear. **(Countershaft retaining straps must be used to hold the Auxiliary Countershafts in place until the Auxiliary section is fully installed. Failure to use the straps could result in the Auxiliary section moving out of time).**

Example of Splitter gear timed to the Auxiliary Countershafts



7. To ensure the timing is correct, check that the marked tooth on the Splitter gear is between the two marked teeth on the Auxiliary Countershaft gears as shown in the illustrations below.



In-Vehicle Service Procedure

How to Remove 1/4" I.D. Air Hoses

Special Instructions

 WARNING

Drain air pressure from vehicle air system before removing air lines to prevent injury.

Important: Label and record air line(s) and hose(s) location prior to removal.

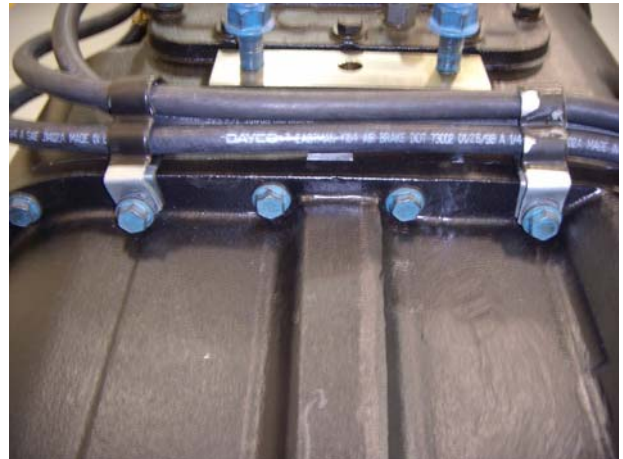
Important: For the 1/4" i.d. air hose(s), remove swivel end of air hose first.

Special Tools

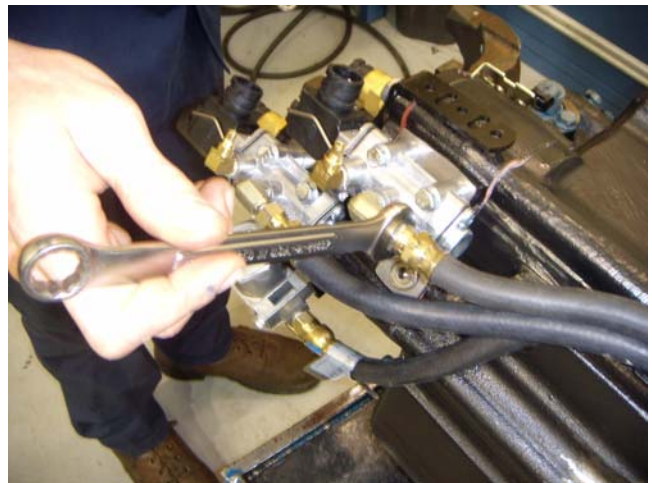
Typical service tools

Procedure -

1. Remove all air hose retaining ties and brackets if needed.



2. Locate swivel coupler end of air hose and remove.



3. Locate and remove fixed end of air hose and remove.
4. Inspect air fittings and remove if damaged.

How to Install the 1/4" I.D. Air Hoses

Special Instructions

For the 1/4" i.d. air hoses, install the fixed coupler end first.

Special Tools

- Typical service tools

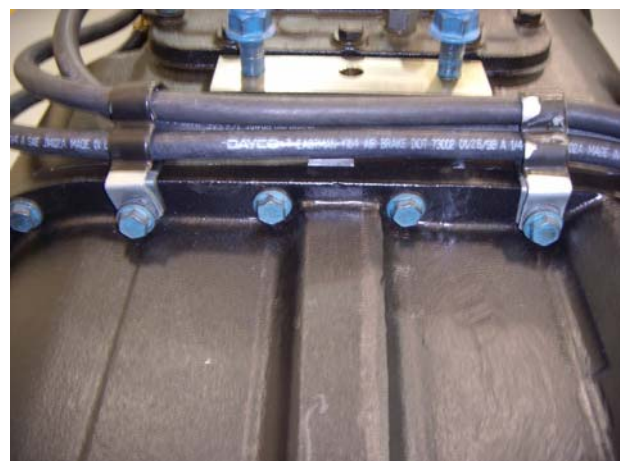
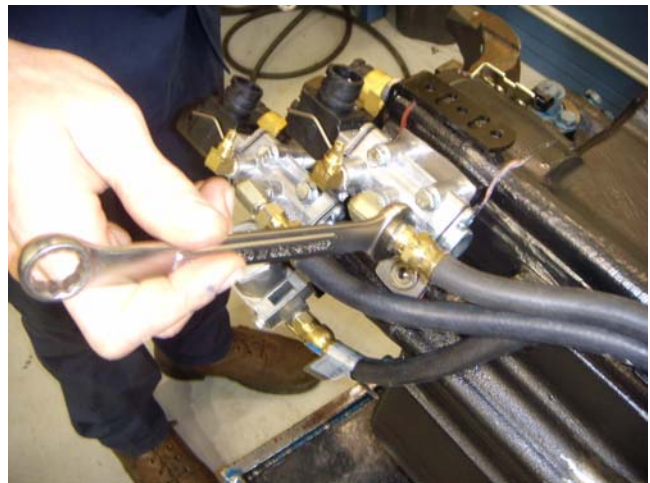
Procedure -

1. Apply Eaton/Fuller thread sealant #71205 or equivalent to threads.
2. Install and tighten fixed coupler end first, then install and tighten swivel end. FTS-XX912L 1/4" I.D. Air Line location references:
 - a. Install 38" 1/4" I.D. air line onto exhaust valve port #2 and connect opposite end to deep range solenoid valve.
 - b. Install 36" 1/4" I.D. air line from exhaust valve port #2 "T" fitting and connect opposite end to range solenoid valve.
 - c. Install 40" 1/4" I.D. air line form port #3 of exhaust valve and connect opposite end to air filter regulator supply port.

Note: Air line lengths may vary upon application.

Note: See Air System Overview section of manual for further reference if needed.

3. Replace all airline brackets if needed and retaining ties. Capscrews of the air line retaining clamps on rear of auxiliary case should be torqued to 54-61 N-m [40-45 lbs. ft.].



In-Vehicle Service Procedure

How to Remove 5/32" (4mm) Push-To-Connect Air Lines and Fittings

Special Instructions

⚠ WARNING

Drain air pressure from vehicle air system before removing air lines to prevent injury.

⚠ CAUTION

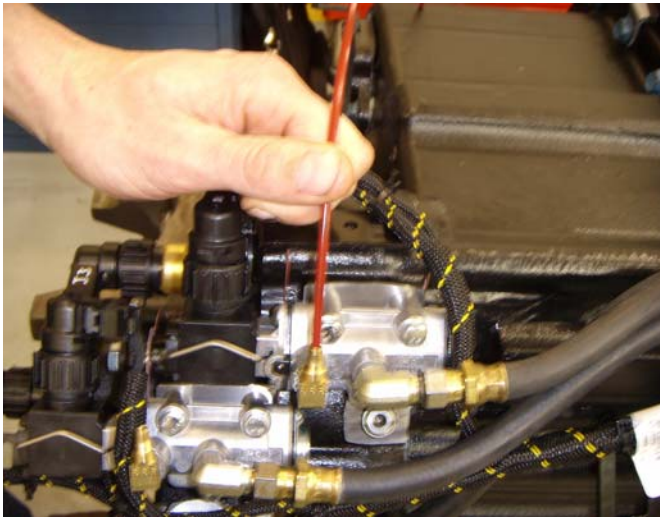
Make sure only 5/32" (4mm) air lines are used with push-to-connect fittings. Using sizes other than 5/32" (4mm) can cause air leaks or damage to fittings.

IMPORTANT: Label and record air line and hose location prior to removal.

Special Tools

- Eaton service toolkit K-2394 is recommended for push-to-connect fittings. The kit contains the release tool and tubing cutter.

Procedure -



1. Use the air line release tool K-2394 to press the release sleeve down while pulling the air line from the fitting.
2. Inspect the fitting for damage or wear. Remove and replace as needed.

How to Install 5/32" (4mm) Push-To-Connect Air Lines and Fittings

Special Instructions

⚠ WARNING

Drain air pressure from vehicle air system before removing air lines to prevent injury.

⚠ CAUTION

Make sure only 5/32" (4mm) air lines are used with push-to-connect fittings. Using sizes other than 5/32" (4mm) can cause air leaks or damage to fittings.

Special Tools

- Eaton service toolkit K-2394 is recommended for push-to-connect fittings. The kit contains the release tool and tubing cutter.

Procedure -

1. Check fitting threads for thread sealant. If no sealant is present, apply Eaton/Fuller thread sealant #71205 or equivalent to fitting threads.
2. Install the fitting.
3. Inspect air line for burrs or deformities. If necessary, trim the air line using a sharp razor blade or air line cutting tool from kit K-2394. The cut must be smooth and square. If tubing end is deformed or burred, the internal O-ring in the fitting may be damaged when the air line is inserted.
4. Push the air line into the fitting. It should insert approximately $\frac{3}{4}$ ". If it does not insert far enough or is difficult to insert, the fitting may be damaged and should be replaced. After inserting, give the air line a slight tug to make sure the air line locks in place. If line does not lock in place, replace the fitting.
5. Pressurize the air system and check for leaks.



In-Vehicle Service Procedures

How to Remove the Air Filter Regulator

Special Instructions

⚠ WARNING

Drain the air pressure from the vehicle air system before removing the air filter lines to prevent injury.

Special Tools

- Typical service tools

Procedure -

1. Remove air lines from the air filter / regulator.
2. Remove the two mounting capscrews that retain the air filter / regulator and remove it from the auxiliary case.
3. Remove sealing o-rings and discard.



How to Install the Air Filter Regulator

Special Instructions

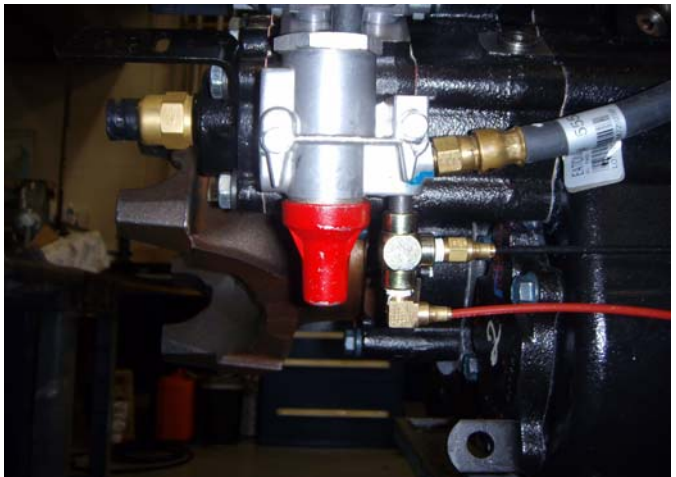
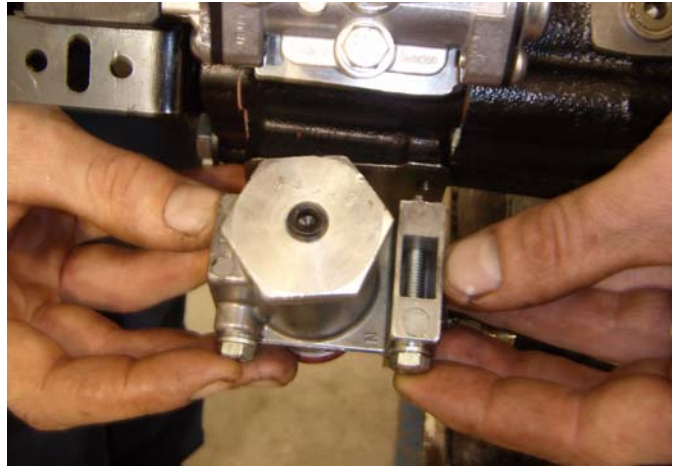
Important: The air filter/regulator has two sealing o-rings located between the filter/regulator and the range cylinder cover.

Special Tools

- Typical service tools

Procedure -

1. Apply Eaton/Fuller sealant #71205 or equivalent to the two retaining capscrews.
2. Insert the two sealing o-rings onto the air/filter regulator using Eaton Fuller Silicone lubricant P/N 71206 or equivalent.
3. Position air filter/regulator to the mounting surface. Install and torque both capscrews to 12-14 N·m [9-10 lbs. ft.].



In-Vehicle Service Procedures

How to Remove the Deep Range and / or Range Solenoid Valve(s)

Special Instructions

⚠ WARNING

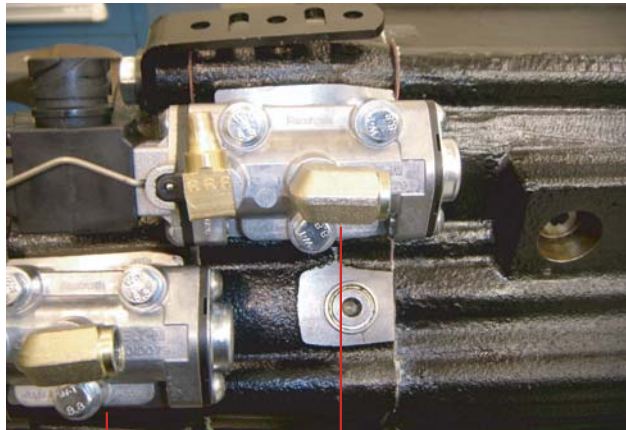
Drain the air pressure from the vehicle air system before removing the air filter lines to prevent injury.

Special Tools

- Typical service tools

Procedure -

1. Remove the three mounting capscrews that attach the deep range and/or range solenoid valve to the auxiliary housing.
2. Lift and remove the valve from the housing.
3. Remove sealing o-rings and discard



Deep Range

Range

How to Install the Deep Range and / or Range Solenoid Valve(s)

Special Instructions

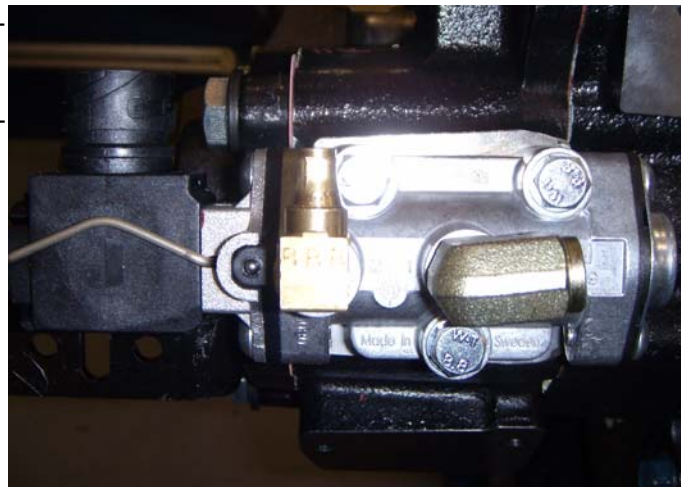
Important: Both solenoid valves have two o-rings located between the valves and the cylinder housings.

Special Tools

- Typical service tools

Procedure -

1. Apply Eaton/Fuller sealant #71205 or equivalent to the three retaining capscrews
2. Apply Eaton Fuller Silicone lubricant P/N 71206 or equivalent to the sealing o-rings and insert onto solenoid valve(s).
3. Install deep range and/or solenoid and torque the three capscrews to 12-14 N·m [9-10 lbs. ft.].



In-Vehicle Service Procedures

How to Remove the High-Speed Downshift System Transmission Harness

Special Instructions

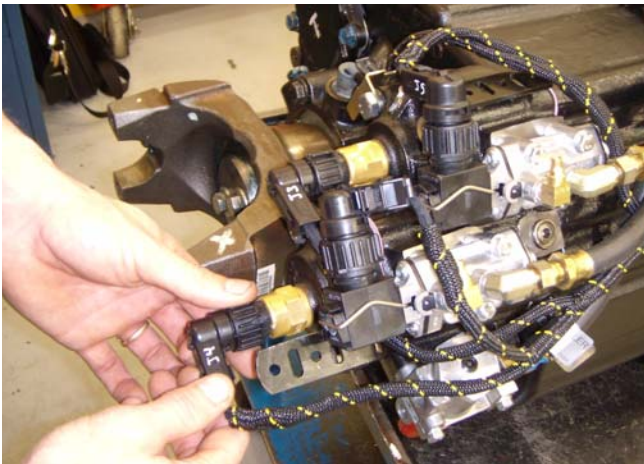
CAUTION

The battery negative must be disconnected prior to unhooking the Electronic Control Unit (ECU).
Do not allow contamination to enter into the ECU connector pins or transmission harness connector.

Special Tools

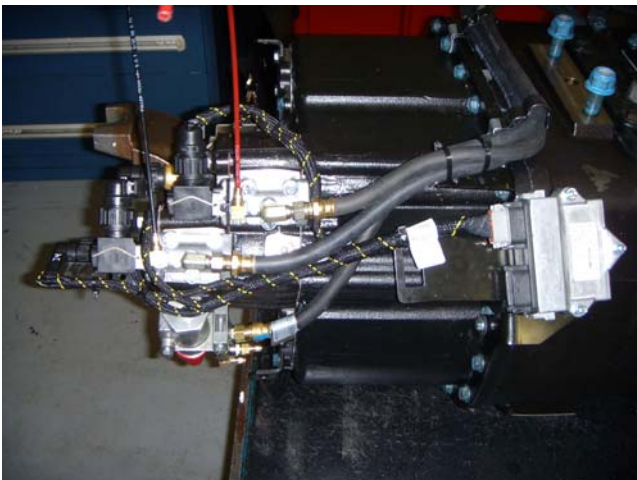
- Typical service tools

Procedure -



1. Remove all retaining ties.
2. Disconnect the transmission harness connector at the ECU, output shaft speed sensor, deep range and range solenoids, and switches. Remove transmission harness.

Note: Mark or tag connection points for reassembly references if needed.



How to Install the High-Speed Downshift System Transmission Harness

Special Instructions

CAUTION

The battery negative must be disconnected prior to unhooking the ECU.
Do not allow contamination into the ECU pins or transmission harness connector.

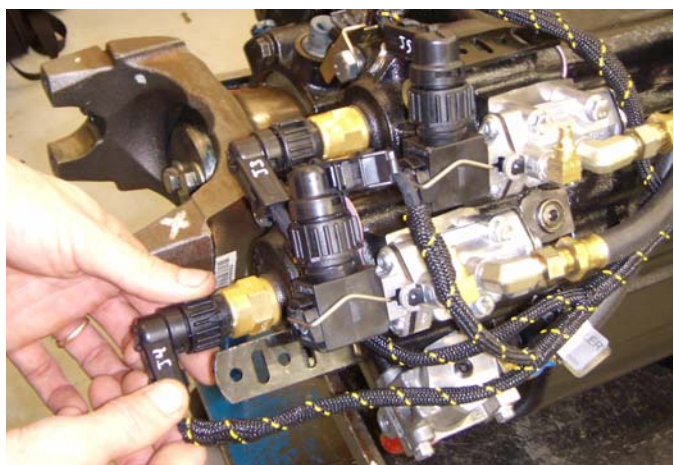
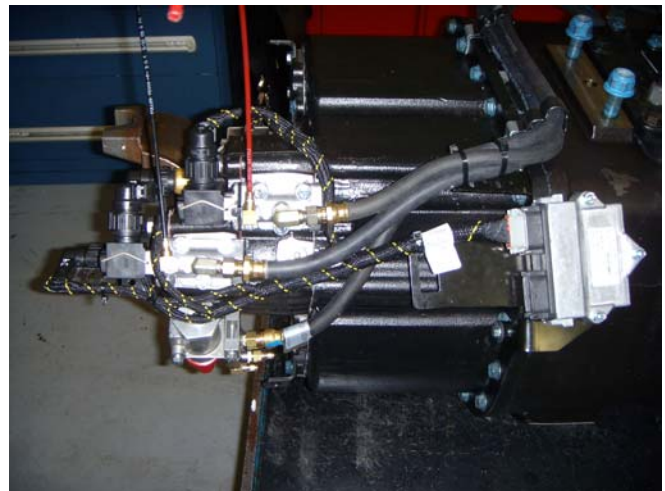
Special Tools

- Typical service tools

Procedure -

1. Apply Nyogel lubricant P/N 5564527 to all female connection pin locations.
2. Plug transmission wiring harness into ECU.
3. Route harness according to layout and connect both range switches, solenoids, and speed sensor
4. Fasten retaining ties to secure harness at harness retention points.

Note: Use wiring schematic from troubleshooting guide, TRTS4400, to ensure proper harness connections if needed.



In-Vehicle Service Procedures

How to Remove the ECU

Special Instructions

CAUTION

The battery negative must be disconnected prior to unhooking the ECU.
Do not allow contamination into the ECU pins or transmission harness connector.

Special Tools

- Typical service tools

Procedure -

1. Remove the transmission harness and interface connectors from ECU.
2. Remove ECU from the bracket by removing three retaining capscrews.
3. If needed, remove the three ECU mounting bracket retaining capscrews and remove bracket.



How to Install the ECU

Special Instructions

CAUTION

The battery negative must be disconnected prior to unhooking the ECU.
Do not allow contamination into the ECU pins or harness connectors.

Special Tools

- Typical service tools

Procedure -

1. If needed, install the ECU mounting bracket and torque three retaining capscrews to 12-14 N·m [9-10 lbs. ft.].
2. Install ECU onto bracket and torque the three retaining capscrews to 12-14 N·m [9-10 lbs. ft.].
3. Apply Nyogel lubricant P/N 5564527 to all female connection pin locations and reattach the transmission and interface harness connectors.



In-Vehicle Service Procedures

How to Remove the Output Shaft Speed Sensor

Special Instructions

None

Special Tools

- Typical service tools



Procedure -

1. Disconnect wiring harness from the output shaft speed sensor.
2. Remove the sensor retaining capscrew.
3. Remove the sensor and o-ring from the rear bearing cover.



How to Install the Output Shaft Speed Sensor

Special Instructions

Important: Clean the mounting surfaces on the housing and remove any burrs or sharp edges.

Important: Apply anti seize or equivalent compound to speed sensor journal only. Remove any compound that gets on end of sensor. This may affect sensor function if not cleaned off.

Special Tools

- Typical service tools

Procedure -

1. Apply anti seize or equivalent compound to journal of sensor.
2. Install output shaft speed sensor into rear bearing cover.
3. Install retaining cap screw and torque to 27-31 N-m [20-23 lbs. ft.].
4. Apply Nyogel lubricant P/N 5564527 to speed sensor connector and reattach connector to speed sensor.



In-Vehicle Service Procedures

How to Remove the Neutral Switch

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

1. Remove Neutral Switch electrical connector.
2. Loosen and remove the neutral switch from the Shift Bar Housing.

Note: This picture shows an optional Neutral Switch Plug.



How to Install the Neutral Switch

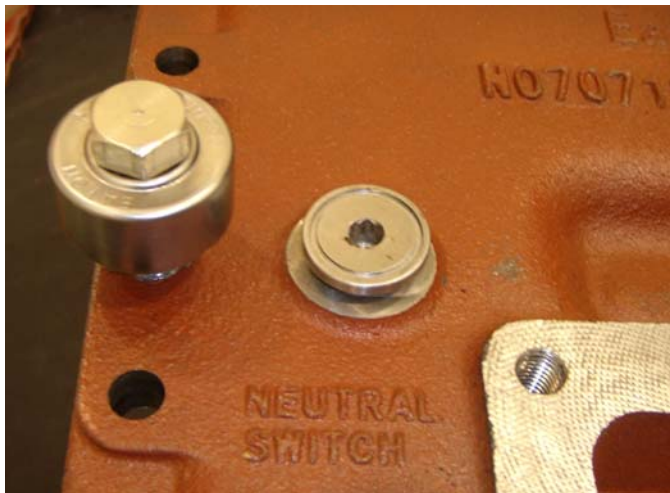
Special Instructions

None

Special Tools

- Typical service tools

Procedure -



1. Install Neutral switch and gasket into shift bar housing location marked "neutral switch" and torque to 20.3-27.1 N·m [180-240 lbs. in.].
2. Apply Nyogel lubricant P/N 5564527 to neutral switch connector plug and insert electrical connector

Note: Make sure the washer is installed on the switch before tightening it to the shift bar housing.

Note: This picture shows an optional Neutral Switch Plug.

In-Vehicle Service Procedures

How to Remove the Reverse Switch

Special Instructions

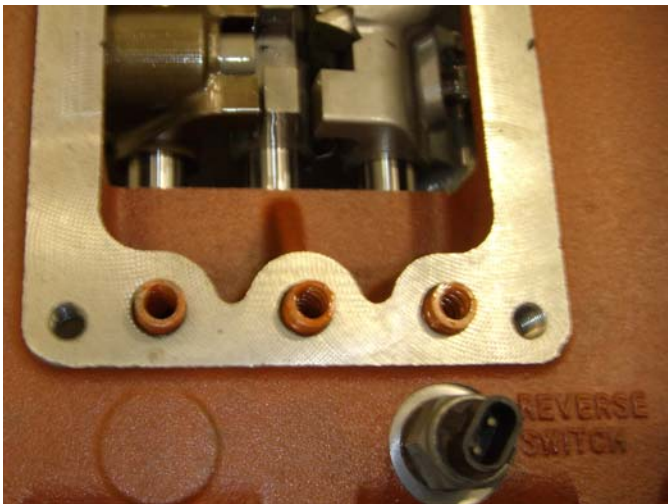
None

Special Tools

- Typical service tools

Procedure -

1. Remove Reverse Switch electrical connector.
2. Loosen and remove the Reverse Switch from the Shift Bar Housing.



How to Install the Reverse Switch

Special Instructions

None

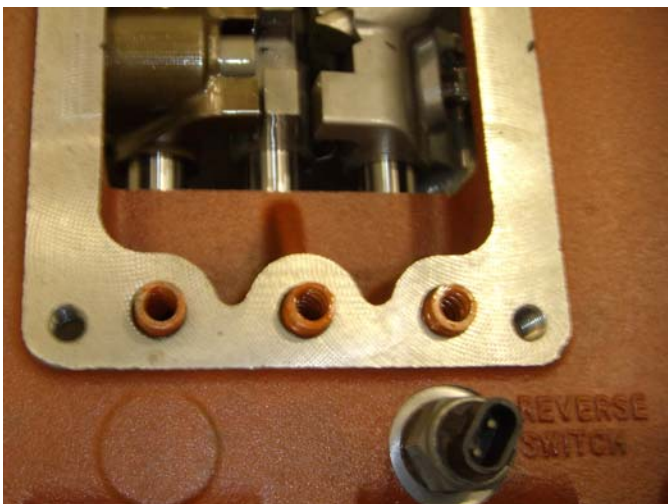
Special Tools

- Typical service tools

Procedure -

1. Install reverse switch and gasket onto shift bar housing in location marked "reverse switch" and torque to 20.3-27.1 N·m [180-240 lbs. in.].
2. Apply Nyogel lubricant P/N 5564527 to reverse switch connector plug and install electrical connection.

Note: Make sure the washer is installed on the switch before tightening it to the shift bar housing.



In-Vehicle Service Procedures

How to Remove the Range Exhaust Valve Assembly

Special Instructions

None

Special Tools

- Typical service tools



Procedure -

1. If needed, remove air lines from exhaust valve. See "Airhose Removal" section for reference.
2. Loosen and remove both retaining capscrews.
3. Remove the exhaust valve, spring and plunger from side of transmission case.

Note: Air hoses can stay fastened to the exhaust valve if only servicing the shift bar housing.

How to Install the Range Exhaust Valve Assembly

Special Instructions

None

Special Tools

- Typical service tools



Procedure -

1. Install range shift interlock exhaust valve spring, plunger and exhaust valve onto side of transmission.
2. Apply Eaton Fuller Silicone lubricant P/N 71206 or equivalent to the sealing o-ring and install o-ring onto mounting flange of exhaust valve.
3. Apply Eaton/Fuller #71205 liquid thread sealant to cap-screws and torque capscrews to 12-14 N·m [9-10 lbs. ft.].
4. If needed, install air hoses onto exhaust valve. See "Air Hose Installation" section for reference.

In-Vehicle Service Procedures

How to Remove the Remote Shift Control

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

1. Remove OEM shift linkage.
2. Remove retaining capscrews at all four locations.
3. Remove the shift control.
4. Clean all gasket material from the gasket surfaces.



How to Install the Remote Shift Control

Special Instructions

None

Special Tools

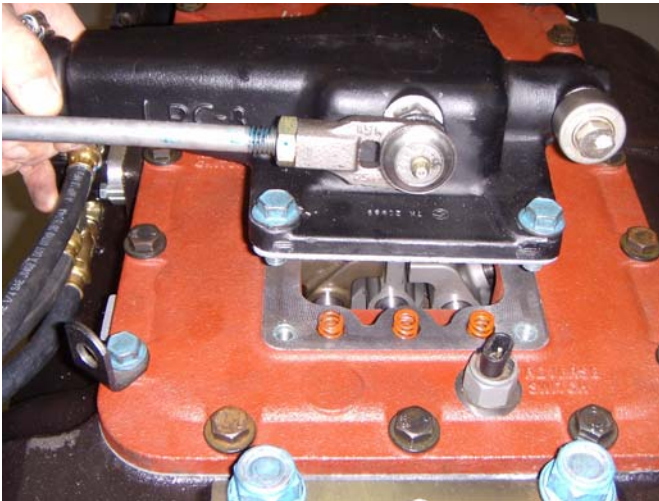
- Typical service tools

Procedure -

1. Install a new gasket on shift bar housing opening.
2. Install the remote shift control. Apply Eaton/Fuller #71205 liquid thread sealant and torque the four retaining capscrews to 54-61 N·m [40-45 lbs. ft.].

Note: Ensure shift finger is aligned to shift blocks.

3. Reinstall OEM shift linkage.



In-Vehicle Service Procedures

How to Remove the Deep Range and / or Range Switches

Special Instructions

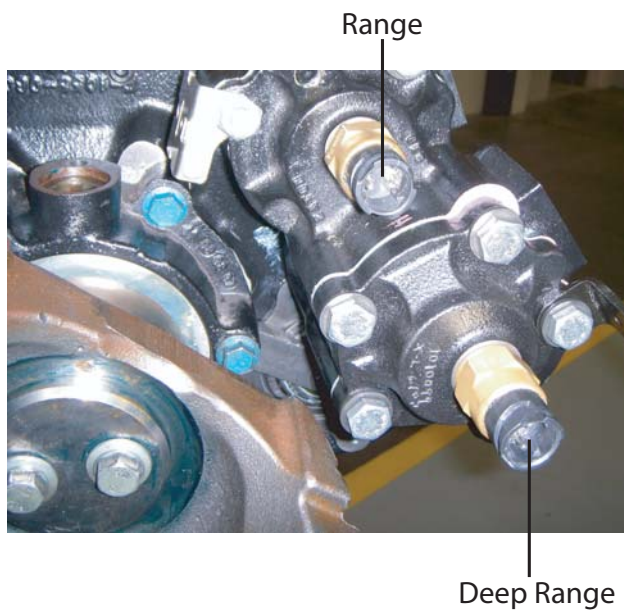
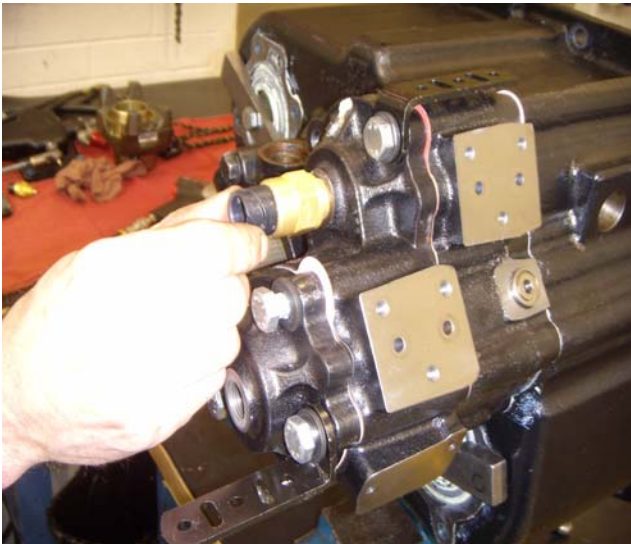
None

Special Tools

- Typical service tools

Procedure -

1. Disconnect wire harness from switch(s).
2. Remove Deep Range and/or Range switch(s) and gasket(s) from range cylinder cover(s).



How to Install the Deep Range and / or Range Switches

Special Instructions

None

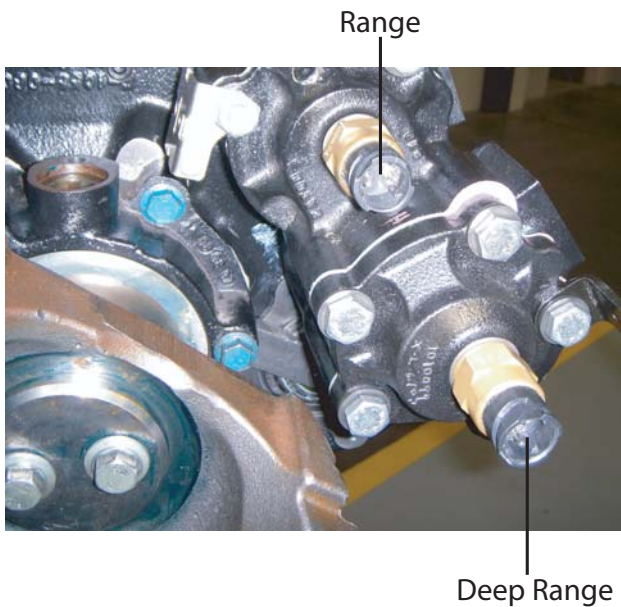
Special Tools

- Typical service tools

Procedure -

1. Install Deep Range and/or Range switch(s) with gasket(s) into the rear cylinder cover(s) and torque switch 20-27 N·m [15-20 lbs. ft.].
2. Apply Nyogel lubricant P/N 5564527 and reconnect wire harness to switch(s).

Shift System



In-Vehicle Service Procedures

How to Remove the Deep Range and Range Pistons and O-Rings

Special Instructions

⚠ WARNING

Drain air pressure from vehicle air system before removing cylinder covers to prevent injury.

Important: Do not use an impact to remove deep range of range piston nuts due to possible damage to the yoke bars threads.

Special Tools

- Typical service tools

Procedure -

1. Disconnect wiring harness connectors from Deep Range and Range switches. Remove Deep Range and/or Range switch(s) and gasket(s) from range cylinder cover(s).
2. Remove the detent plugs, springs and balls from the deep range and range yoke bar locations.



3. Remove the 5 retaining capscrews from the deep range cylinder cover.

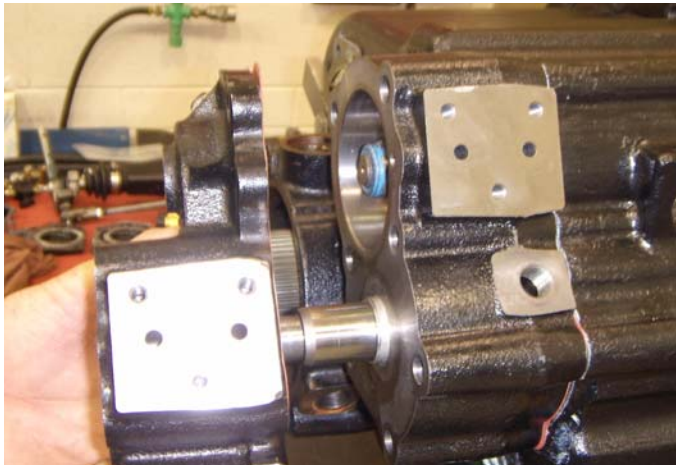


In-Vehicle Service Procedures

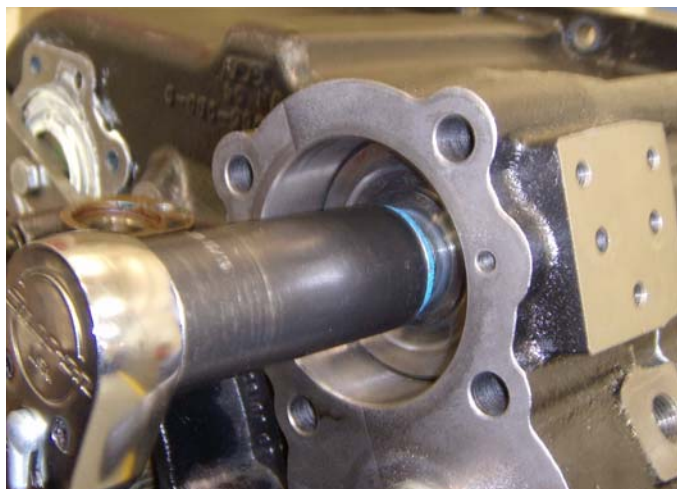
4. Remove the deep range piston retaining nut by hand tool only.



5. Remove last cap screw from the deep range cylinder housing and then remove cylinder housing. May have to slightly tap on the deep range yoke bar with a soft maul to remove yoke bar from piston.



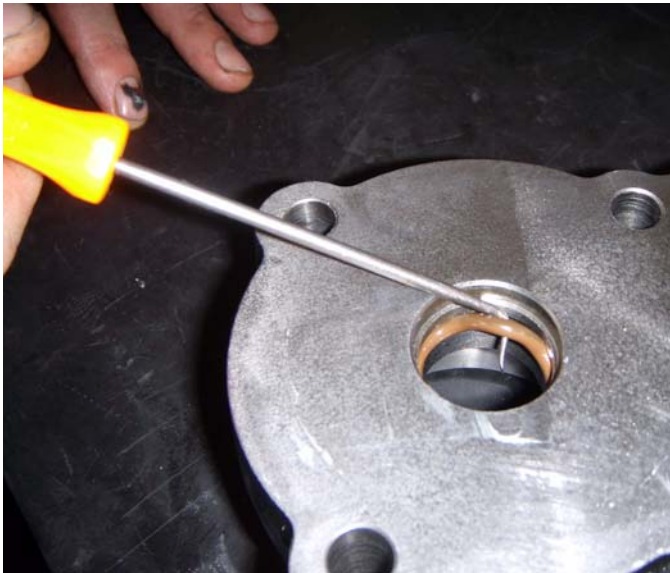
6. Remove range cylinder piston retaining nut and remove cylinder housing. May have to slightly tap on the range yoke bar with a soft maul to remove yoke bar from piston.



In-Vehicle Service Procedures



7. Remove o-ring from the deep range housing.



8. Remove o-ring from the range housing.

In-Vehicle Service Procedures

9. Remove outer and inner o-rings from the deep range and range pistons.



10. If needed, remove bushings from deep range/range cylinder housings if worn.



11. Clean all gaskets from range housings and auxiliary section housing.

In-Vehicle Service Procedures

How to Install the Deep Range and Range Pistons and O-Rings

Special Instructions

Important: Apply Eaton/Fuller silicone lubricant to all shift cylinder assembly O-rings so a film covers the entire surface.

Special Tools

- Typical service tools

Procedure -

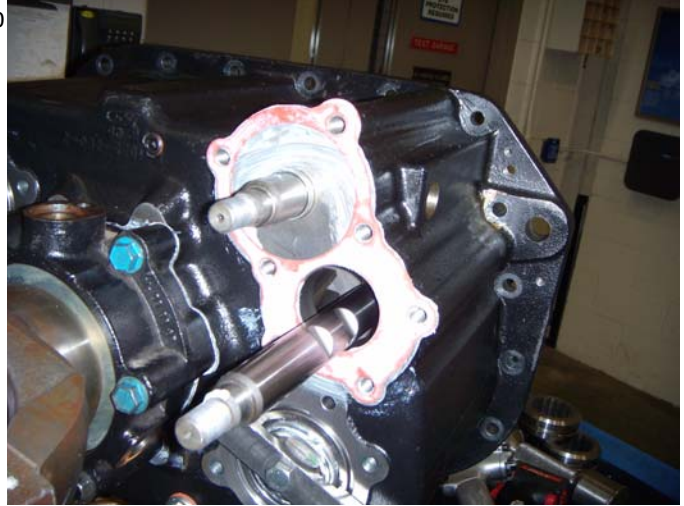
1. If needed, install deep range/range cylinder housing bushings.



2. Install o-ring into range housing using Eaton Fuller Silicone lubricant P/N 71206 or equivalent.



3. Install gasket on rear of auxiliary section housing for range cylinder housing and install range cylinder housing onto auxiliary section.



4. Apply Eaton Fuller Silicone lubricant P/N 71206 or equivalent onto the piston bore and piston o-rings. Apply new o-rings to inner and outer of range piston and then insert range piston into range cylinder.



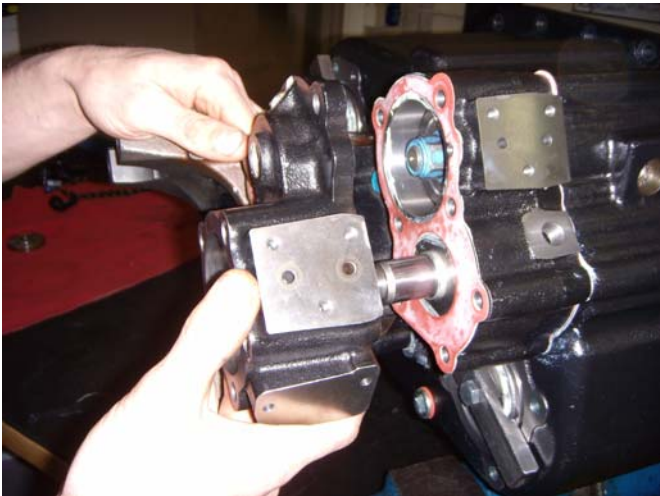
5. Install range piston hex nut and torque to 95-115 N.m [70-85 lbs. ft.].



In-Vehicle Service Procedures



6. Install o-ring into deep range cylinder housing and apply Eaton Fuller Silicone lubricant P/N 71206 or equivalent.



7. Install deep range cylinder housing and cap screws hand tight.

Note: Transmission harness brackets get installed onto top two cap screw locations.



8. Install both inner and outer o-rings onto deep range piston and apply Eaton Fuller Silicone lubricant P/N 71206 or equivalent onto the piston bore and piston o-rings.

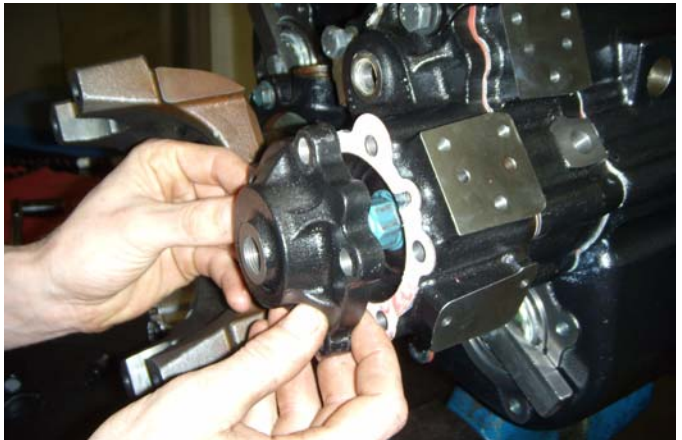
In-Vehicle Service Procedures

9. Insert deep range piston onto the deep range shift yoke bar and torque hex nut to 95-115 N·m [70-85 lbs. ft.].



10. Install deep range cylinder cover gasket, cover and cap-screws. Torque all capscrews to 54-61 N·m [40-45 lbs. ft.].

Note: Transmission harness bracket must be placed at the 3 o'clock cap screw position.



11. Install the detent plugs, springs and balls into the deep range and range yoke bar locations. Torque 20-27 N·m (15-20 lbs. ft.)



12. Using Nyogel lubricant P/N 5564527, reinstall transmission harness connectors onto both range switches.

In-Vehicle Service Procedures

How to Remove the Shift Bar Housing

Special Instructions

None

Special Tools

- Typical service tools.

Procedure -

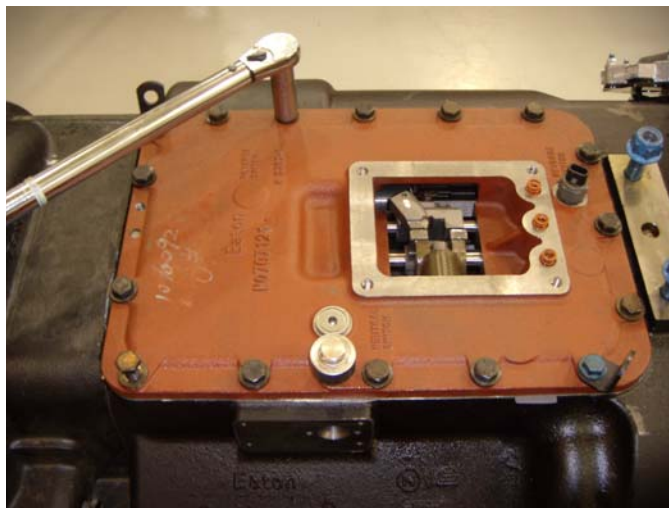
1. Use compressed air to clean any loose dirt or debris from top of transmission.
2. Procedure to complete first: How to Remove the Remote Shift Control.
3. Remove three shift detent springs and the balls from the shift bar housing.

Note: A magnet is helpful in the removal of the detent balls.



4. Remove the 16 shift bar housing retaining capscrews and lifting brackets.

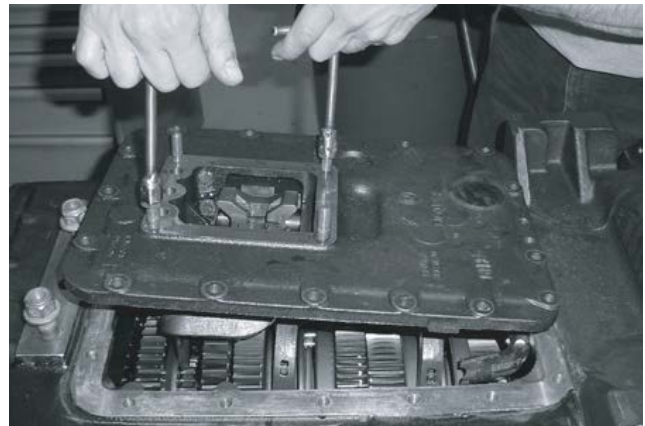
Note: Note location of lifting brackets before removal.



5. Break loose shift bar housing using a shift bar housing retaining capscrew in the shift bar housing pusher threaded hole location and screw in cap screw. Use a wrench only until shift bar housing is dislodged from dowel pin.



6. Remove shift bar housing.



7. Remove the gasket and clean the gasket surfaces.

Note: Do not drop any debris into the transmission while the shift bar housing is removed.

In-Vehicle Service Procedures

How to Install the Shift Bar Housing

Special Instructions

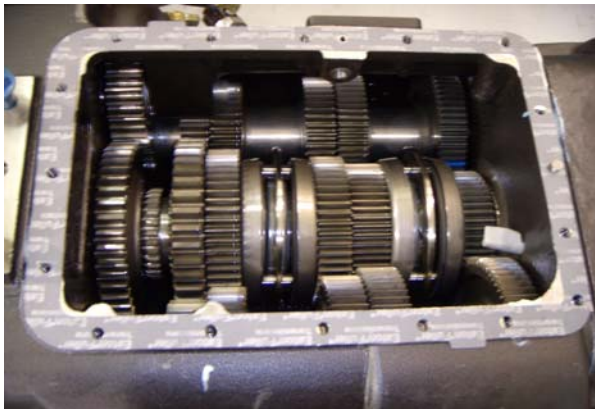
None

Special Tools

- Typical service tools.

Procedure -

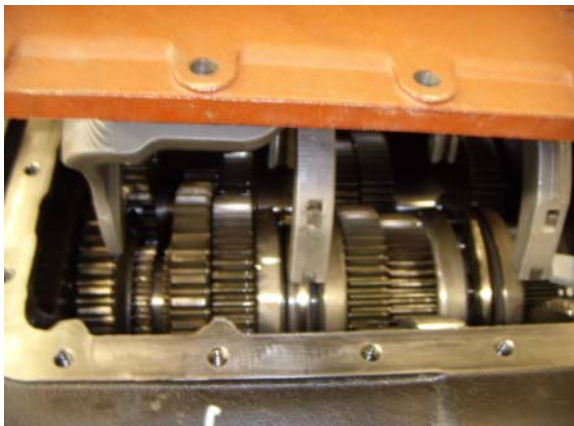
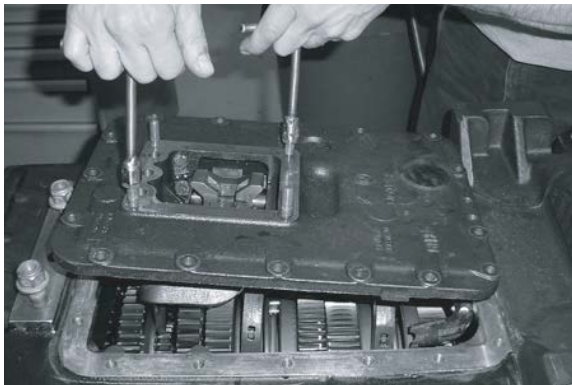
1. Install a new shift bar housing gasket onto transmission main case.



2. Install shift bar housing onto transmission.

Note: Make sure shift bar housing shift blocks are located to neutral and all main case synchronizers and reverse sliding clutch are located to neutral.

Note: Make sure to align the shift bar housing with the dowel pin in the case.

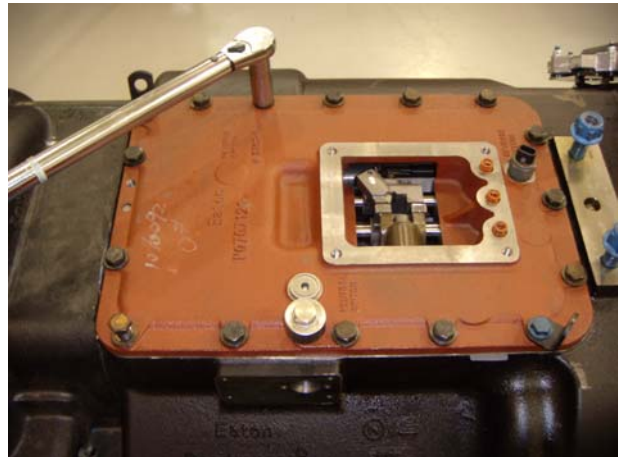


In-Vehicle Service Procedures

3. Install all 16 shift bar housing capscrews and torque to 54-61 N·m [40-45 lbs. ft.].

Note: Ensure lifting brackets are placed in the correct positions.

Note: All shift bar housing capscrews are of the same length.



4. Install the three detent springs and balls.



5. Reinstall the remote shift control. Reference "How to Install the Remote Shift Control" section of the service manual.

In-Vehicle Service Procedures

How to Remove the Output Yoke / Flange and Retaining Capscrews

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

1. Remove drive shaft from transmission. Reference OEM removal guidelines.
2. Remove the end yoke retaining capscrews and washer from auxiliary mainshaft.
3. Remove the end yoke/flange.



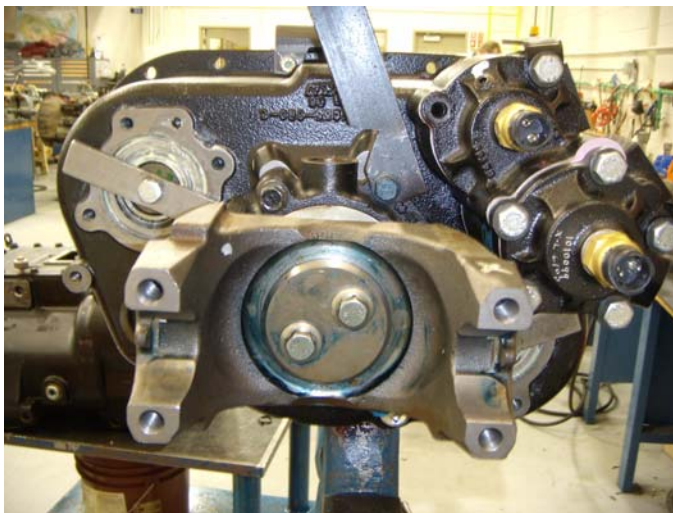
How to Install the Output Yoke / Flange and Retaining Capscrews

Special Instructions

None

Special Tools

- Typical service tools



Procedure -

1. Install end yoke, retaining washer, and capscrews. Apply Eaton/Fuller #71205 liquid thread sealant to capscrews and then tighten both retaining capscrews to specified torque rating 100-110 N·m [74-81lbs. ft.].

Note: Auxiliary mainshaft end yoke retaining cap screw threaded holes have Spirallock™ threads inserted. This is a special thread pitch and no thread damage restoration should be attempted by using a conventional metric thread pitch tap.

⚠ WARNING

Use only Eaton/Fuller #71205 liquid thread sealant or liquid equivalent on the yoke retaining capscrews. Do not use any type of thread locking tape on the end yoke retaining capscrews. This may cause the capscrews threads to strip and cause the end yoke to loosen.

2. Reinstall driveshaft per OEM guidelines.

In-Vehicle Service Procedures

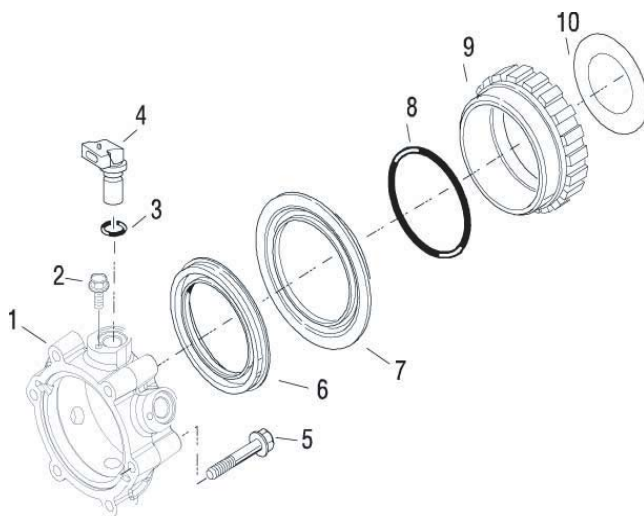
How to Remove the Auxiliary Mainshaft Oil Seal

Special Instructions

None

Special Tools

- Typical service tools



Procedure -

1. Procedures to complete first:
 - Reference OEM removal guidelines for removing drive shaft
 - How to Remove the End Yoke/Flange and retaining cap-screws
 - How to Remove the Speed Sensor

Note: Do not gouge rear bearing bore during seal removal.

Note: The seal will be damaged on removal and will require a new seal.

2. Remove the speedometer rotor, dust shield, and o-ring.
3. Pry the seal out using a large screwdriver or pry bar in the metal groove of the seal.
4. Remove the seal slinger from the speedometer rotor using a brass drift and hammer.
5. Inspect all parts of the seal surface for wear, scratches, burrs, or other damage.

Note: If the sensor is a thread in type, note the number of threads expose so the sensor can be reinstalled to the same depth. If the sensor is a push in type, remove the hold down capscrew and pull the sensor out of the bore.

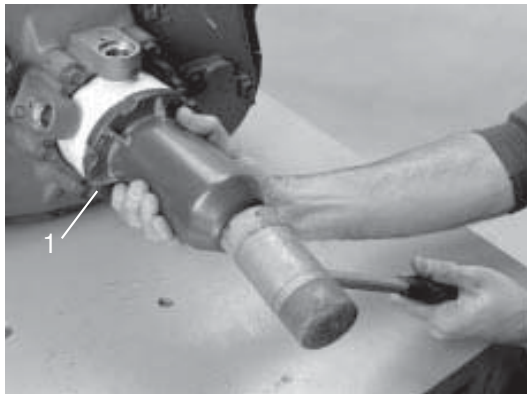
How to Install the Auxiliary Mainshaft Oil Seal

Special Instructions

None

Special Tools

- Seal Driver - see "Recommended Tools" section for further information.



Procedure -

1. Place a seal on the oil seal driver, and drive the new seal into the rear bearing cover. The seal is fully installed when the flange on the seal is flush with the shoulder in the bore.

2. Install the new slinger on the speedometer rotor / seal sleeve using a slinger driver.

3. If previously removed, install the o-ring over the output shaft.

Note: To avoid creating oil leaks, make sure the speedometer rotor / seal sleeve is free from contaminants.

4. Install the speedometer rotor / seal sleeve over the output shaft and install the speedometer sensors.
5. Install the output yoke over the output shaft. The yoke should slide on and stop before contacting the speedometer rotor. As the output shaft fastener is installed the output yoke will contact the speedometer rotor.

In-Vehicle Service Procedures

How to Remove the Auxiliary Section

Special Instructions

Drain transmission lube.

Special Tools

- Transmission jack with transmission adapter - Reference "Recommended Tools" section for further information.
- E009003 countershaft retaining straps.



Procedure -

1. Remove driveshaft per OEM guidelines.
2. Drain transmission lube.
3. Remove auxiliary section bearing covers and shims. Install counter shaft retaining straps.

Note: Mark bearing covers and shims to ensure proper positioning for reinstallation.

4. Remove the 19 auxiliary housing retaining capscrews and slightly separate the auxiliary case from main case to allow clearance for the transmission adapter to be installed.



Note: Threaded capscrew holes are located in the dowel pin areas of the auxiliary section housing to aid in the separation of the gasket joint. Insert 2 auxiliary housing retaining capscrews into the threaded holes and tighten evenly until the gasket joint separates.

Note: If necessary, to aid in removal, remove the main case to auxiliary housing alignment dowel pins by using a soft maul and punch.

5. Remove all gasket material from gasket surfaces.



In-Vehicle Service Procedures

How to Install the Auxiliary Section

Special Instructions

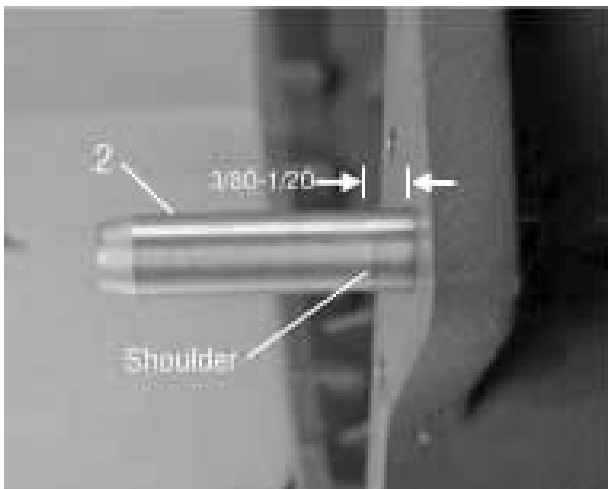
None

Special Tools

- Transmission jack with transmission adapter - Reference "Recommended Tools" section for further information.
- E009003 countershaft retaining straps

Procedure -

1. Need to engage range yoke to the rearward position in auxiliary section and engage front box into any gear for installation of auxiliary section.
2. Tighten countershaft retaining strap capscrews until the countershafts are supported firmly.



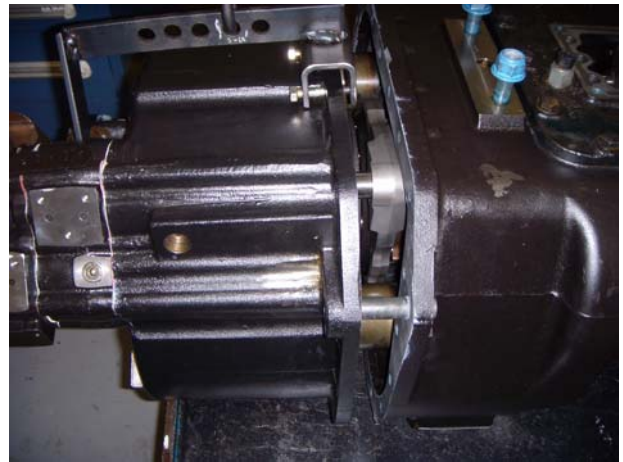
3. If needed, install dowel pins into the main case so that 3/8" or 1/2" of the shoulder is exposed or pin is flush with front of case ear.

In-Vehicle Service Procedures

4. Apply gasket to rear of transmission main case.



5. Align auxiliary section into place and align onto the dowel pins. Slide auxiliary section onto dowel pins and remove the transmission adapter.



6. Slide auxiliary section on the rest of way until both housings mate with each other.

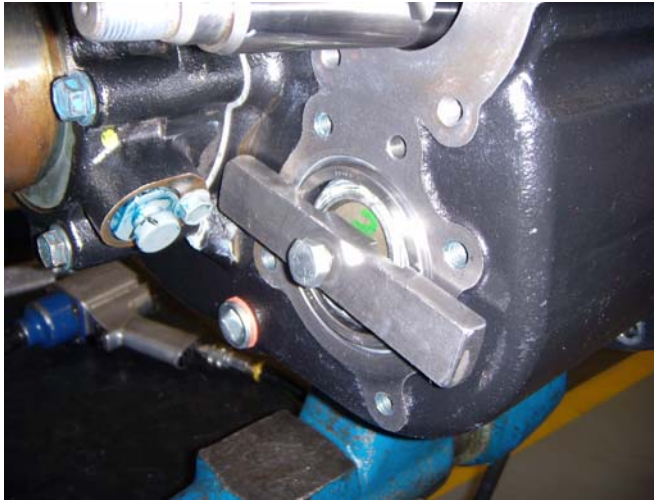
Note: rotation of the end yoke may be necessary to engage gear teeth for housings to properly mate.

7. Install the 19 auxiliary section capscrews and torque to 54-61 N-m [40-45 lbs. ft.].

Note: locate air line brackets to the correct locations.



In-Vehicle Service Procedures



8. Remove countershaft bearing straps and ensure bearing cones are seated in place. Initiate countershaft bearing shimming procedure.



9. Install rear countershaft bearing cover gaskets, covers, with the designated shim determined during the shimming procedure and torque covers to 54-61 N-m [40-45 lbs. ft.].

Note: Reference "Shim Procedure" section for further details.

Note: Ensure input shaft and output shaft of transmission rotates before further assembly.

10. Reinstall driveshaft to OEM guidelines.
11. Refill transmission lube.

How to Remove 1/4" I.D. Air Hoses

Special Instructions

Important: Label and record air line(s) and hose(s) location prior to removal.

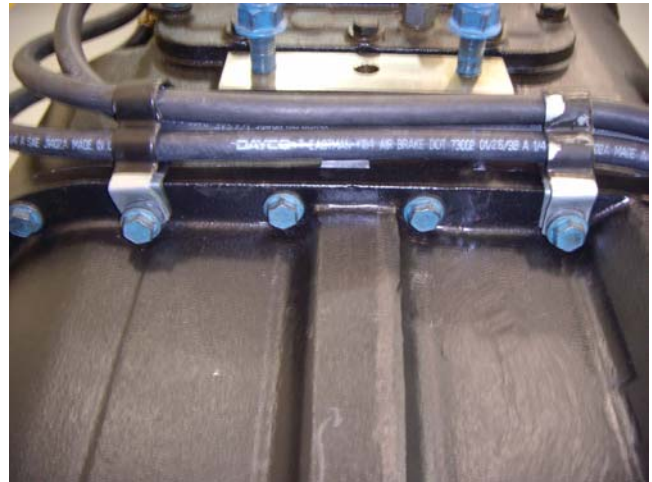
Important: For the 1/4" i.d. air hose(s), remove swivel end of air hose first.

Special Tools

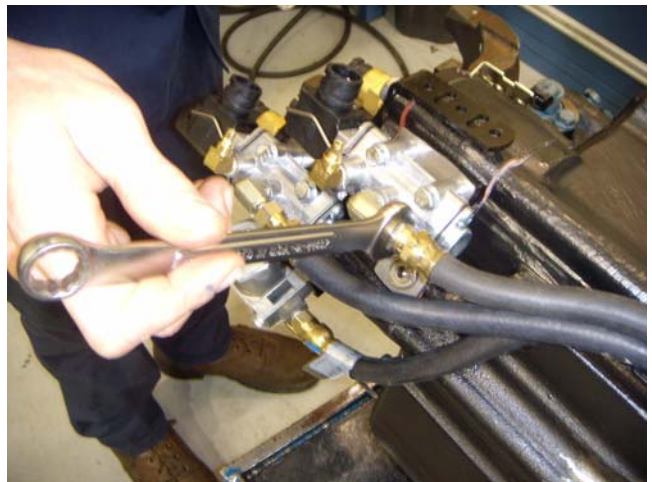
Typical service tools

Procedure -

1. Remove all air hose retaining ties and brackets if needed.



2. Locate swivel coupler end of air hose and remove.



3. Locate and remove fixed end of air hose and remove.
4. Inspect air fittings and remove if damaged.

Transmission Overhaul Procedure - Bench Service

How to Remove 5/32" (4mm) Push-To-Connect Air Lines and Fittings

Special Instructions

CAUTION

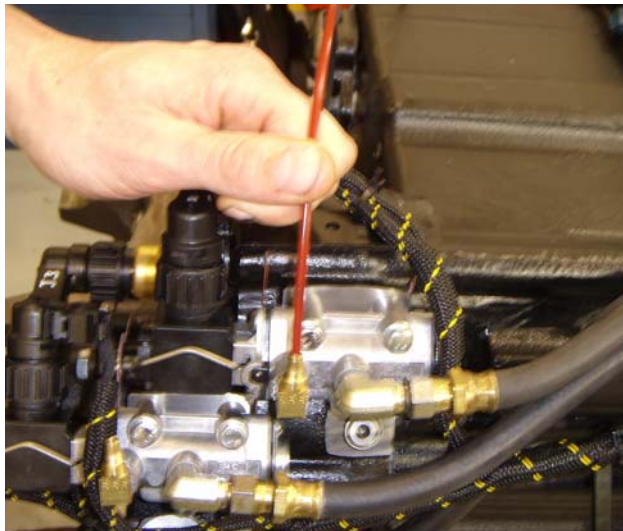
Make sure only 5/32" (4mm) air lines are used with push-to-connect fittings. Using sizes other than 5/32" (4mm) can cause air leaks or damage to fittings.

IMPORTANT: Label and record air line and hose location prior to removal.

Special Tools

- Eaton service toolkit K-2394 is recommended for push-to-connect fittings. The kit contains the release tool and tubing cutter.

Procedure -



1. Use the air line release tool K-2394 to press the release sleeve down while pulling the air line from the fitting.
2. Inspect the fitting for damage or wear. Remove and replace as needed.

How to Remove the Air Filter Regulator

Special Instructions

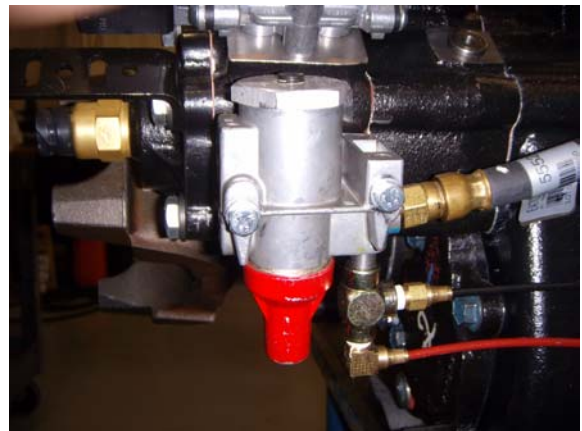
None.

Special Tools

- Typical service tools

Procedure -

1. Remove air lines from the air filter / regulator.
2. Remove the two mounting capscrews that retain the air filter / regulator and remove it from the auxiliary case.
3. Remove sealing o-rings and discard.



In-Vehicle Service Procedures

How to Remove the Deep Range and / or Range Solenoid Valve(s)

Special Instructions

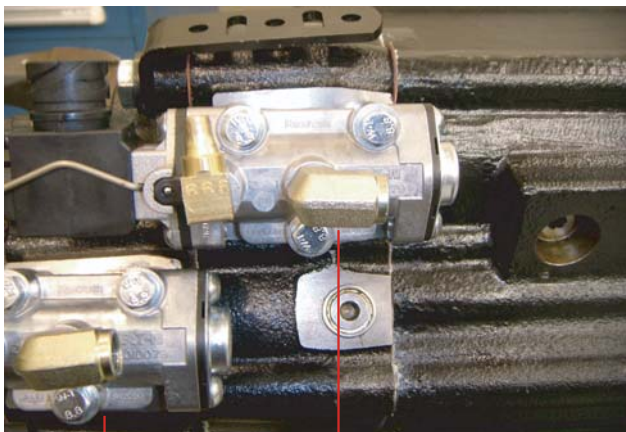
None

Special Tools

- Typical service tools

Procedure -

1. Remove the three mounting capscrews that attach the deep range and/or range solenoid valve to the auxiliary housing.
2. Lift and remove the valve from the housing.
3. Remove sealing o-rings and discard



Deep Range

Range

Transmission Overhaul Procedure - Bench Service

How to Install the Deep Range and / or Range Solenoid Valve(s)

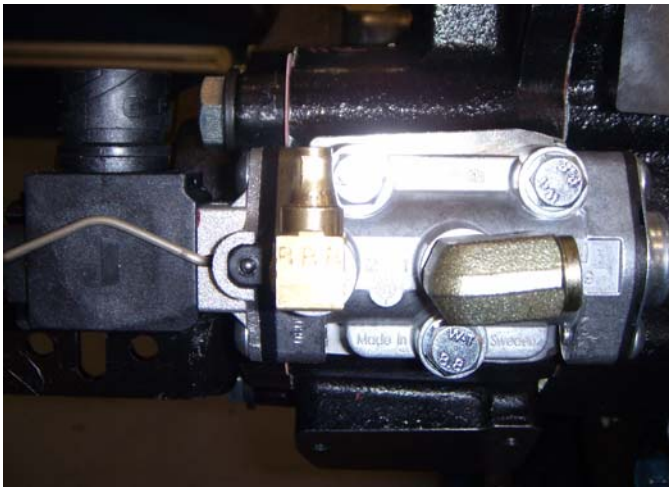
Special Instructions

Important: Both solenoid valves have two o-rings located between the valves and the cylinder housings.

Special Tools

- Typical service tools

Procedure -



1. Apply Eaton/Fuller sealant #71205 or equivalent to the three retaining capscrews
2. Apply Eaton Fuller Silicone lubricant P/N 71206 or equivalent to the sealing o-rings and insert onto solenoid valve(s).
3. Install deep range and/or solenoid and torque the three capscrews to 12-14 N·m [9-10 lbs. ft.].

Transmission Overhaul Procedure - Bench Service

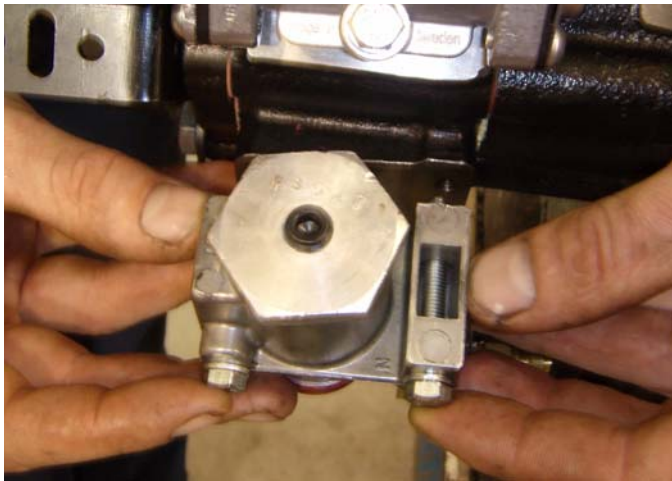
How to Install the Air Filter Regulator

Special Instructions

Important: The air filter/regulator has two sealing o-rings located between the filter/regulator and the range cylinder cover.

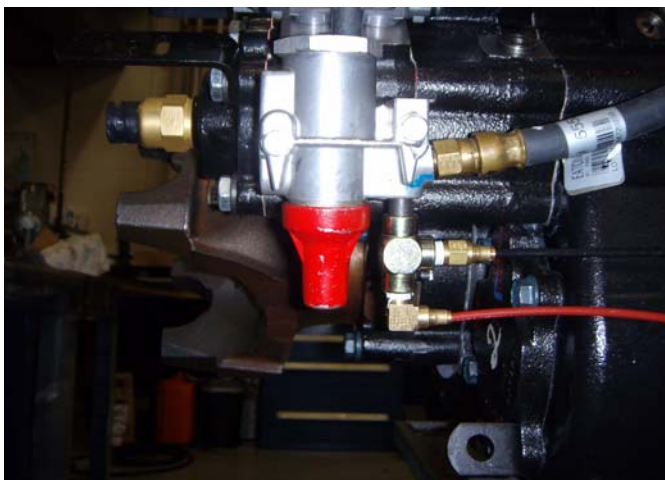
Special Tools

- Typical service tools



Procedure -

1. Apply Eaton/Fuller sealant #71205 or equivalent to the two retaining capscrews.
2. Insert the two sealing o-rings onto the air/filter regulator using Eaton Fuller Silicone lubricant P/N 71206 or equivalent.
3. Position air filter/regulator to the mounting surface. Install and torque both capscrews to 12-14 N·m [9-10 lbs. ft.].



Transmission Overhaul Procedure - Bench Service

How to Install 5/32" (4mm) Push-To-Connect Air Lines and Fittings

Special Instructions

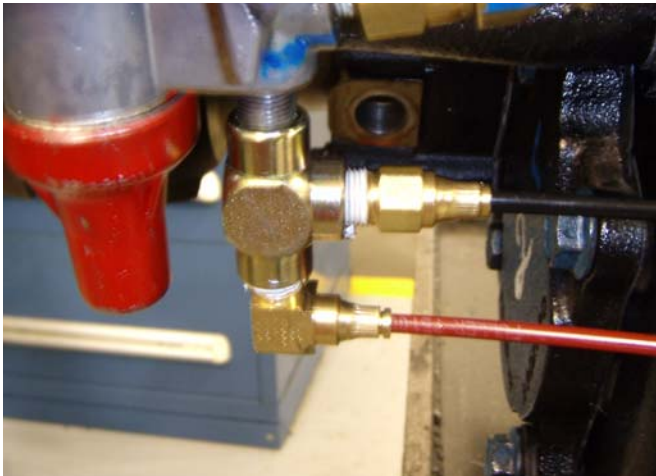
CAUTION

Make sure only 5/32" (4mm) air lines are used with push-to-connect fittings. Using sizes other than 5/32" (4mm) can cause air leaks or damage to fittings.

Special Tools

- Eaton service toolkit K-2394 is recommended for push-to-connect fittings. The kit contains the release tool and tubing cutter.

Procedure -



1. Check fitting threads for thread sealant. If no sealant is present, apply Eaton/Fuller thread sealant #71205 or equivalent to fitting threads.
2. Install the fitting.
3. Inspect air line for burrs or deformities. If necessary, trim the air line using a sharp razor blade or air line cutting tool from kit K-2394. The cut must be smooth and square. If tubing end is deformed or burred, the internal O-ring in the fitting may be damaged when the air line is inserted.
4. Push the air line into the fitting. It should insert approximately $\frac{3}{4}$ ". If it does not insert far enough or is difficult to insert, the fitting may be damaged and should be replaced. After inserting, give the air line a slight tug to make sure the air line locks in place. If line does not lock in place, replace the fitting.
5. Pressurize the air system and check for leaks.

Transmission Overhaul Procedure - Bench Service

How to Install the 1/4" I.D. Air Hoses

Special Instructions

For the 1/4" i.d. air hoses, install the fixed coupler end first.

Special Tools

- Typical service tools

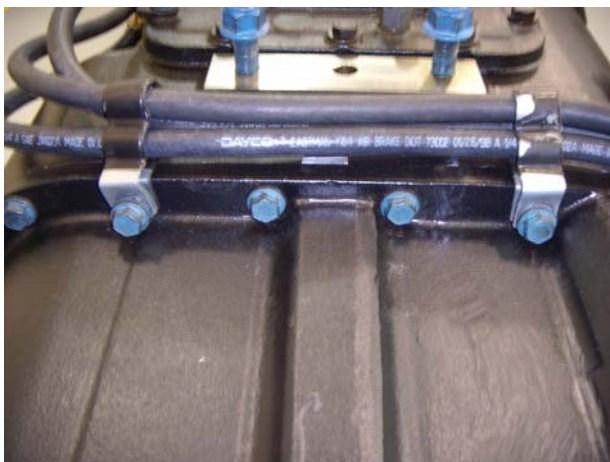
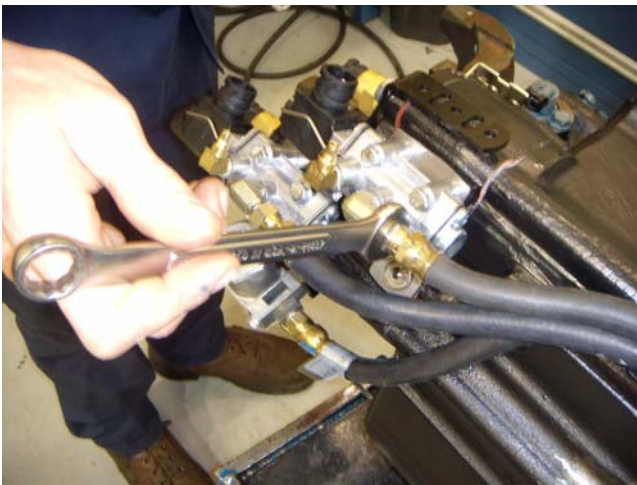
Procedure -

1. Apply Eaton/Fuller thread sealant #71205 or equivalent to threads.
2. Install and tighten fixed coupler end first, then install and tighten swivel end. RTS-11912L 1/4" I.D. Air Line location references:
 - a. Install 38" 1/4" I.D. air line onto exhaust valve port #2 and connect opposite end to deep range solenoid valve.
 - b. Install 36" 1/4" I.D. air line from exhaust valve port #2 "T" fitting and connect opposite end to range solenoid valve.
 - c. Install 40" 1/4" I.D. air line form port #3 of exhaust valve and connect opposite end to air filter regulator supply port.

Note: Air line lengths may vary upon application.

Note: See Air System Overview section of manual for further reference if needed.

3. Replace all airline brackets if needed and retaining ties. Capscrews of the air line retaining clamps on rear of auxiliary case should be torqued to 54-61 N-m [40-45 lbs. ft.].



Transmission Overhaul Procedure - Bench Service

How to Remove the High-Speed Downshift System Transmission Harness

Special Instructions

CAUTION

Do not allow contamination to enter into the ECU connector pins or transmission harness connector.

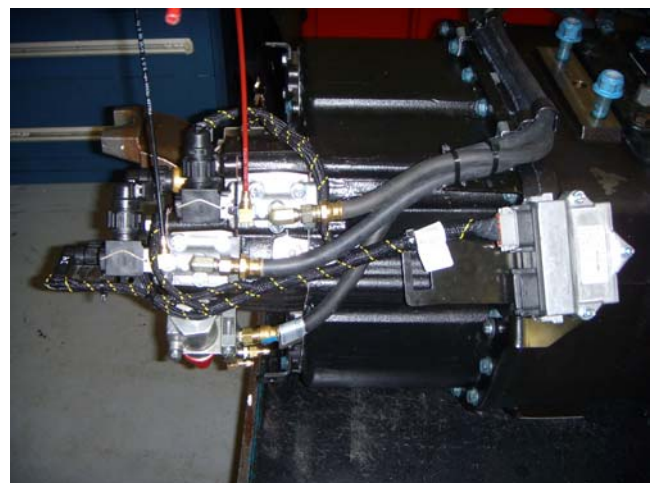
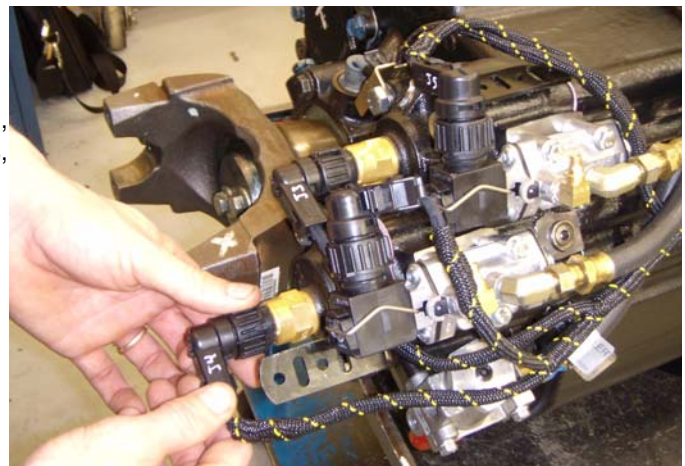
Special Tools

- Typical service tools

Procedure -

1. Remove all retaining ties.
2. Disconnect the transmission harness connector at the ECU, output shaft speed sensor, deep range and range solenoids, and switches. Remove transmission harness.

Note: Mark or tag connection points for reassembly references if needed.



How to Remove the Output Shaft Speed Sensor

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

1. Disconnect wiring harness from the output shaft speed sensor.
2. Remove the sensor retaining capscrew.
3. Remove the sensor and o-ring from the rear bearing cover.



Transmission Overhaul Procedure - Bench Service

How to Install the Output Shaft Speed Sensor

Special Instructions

Important: Clean the mounting surfaces on the housing and remove any burrs or sharp edges.

Important: Apply anti seize or equivalent compound to speed sensor journal only. Remove any compound that gets on end of sensor. This may affect sensor function if not cleaned off.

Special Tools

- Typical service tools

Procedure -

1. Apply anti seize or equivalent compound to journal of sensor.
2. Install output shaft speed sensor into rear bearing.
3. Install retaining cap screw and torque to 27-31 N-m [20-23 lbs. ft.].
4. Apply Nyogel lubricant P/N 5564527 to speed sensor connector and reattach connector to speed sensor.



Transmission Overhaul Procedure - Bench Service

How to Install the ECU

Special Instructions

CAUTION

Do not allow contamination into the ECU pins or transmission harness connectors.

Special Tools

- Typical service tools



Procedure -

1. If needed, install the ECU mounting bracket and torque three retaining capscrews to 12-14 N·m [9-10 lbs. ft.].
2. Install ECU onto bracket and torque the three retaining capscrews to 12-14 N·m [9-10 lbs. ft.].
3. Apply Nyogel lubricant P/N 5564527 to all female connection pin locations and reattach the transmission and interface harness connectors.

Transmission Overhaul Procedure - Bench Service

How to Install the High-Speed Downshift System Transmission Harness

Special Instructions

CAUTION

Do not allow contamination into the ECU pins or transmission harness connectors.

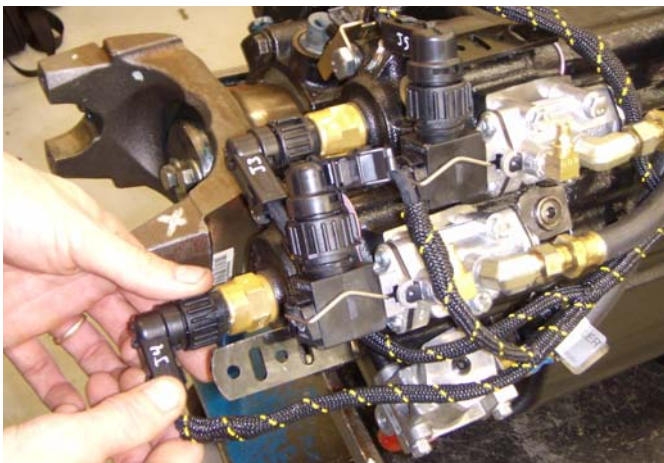
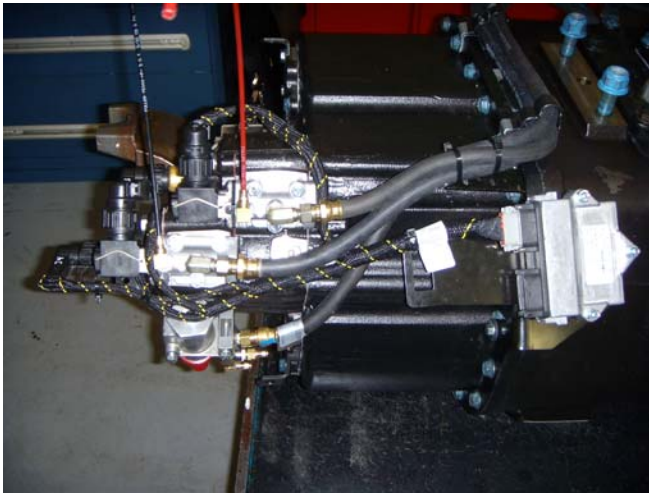
Special Tools

- Typical service tools

Procedure -

1. Apply Nyogel lubricant P/N 5564527 to all female connection pin locations.
2. Plug transmission wiring harness into ECU.
3. Route harness according to layout and connect both range switches, solenoids, and speed sensor
4. Fasten retaining ties to secure harness at harness retention points.

Note: Use wiring schematic from troubleshooting guide, TRTS4400, to ensure proper harness connections if needed.



How to Remove the Neutral Switch

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

1. Remove Neutral Switch electrical connector.
2. Loosen and remove the neutral switch from the Shift Bar Housing.

Note: This picture shows an optional Neutral Switch Plug.



Transmission Overhaul Procedure - Bench Service

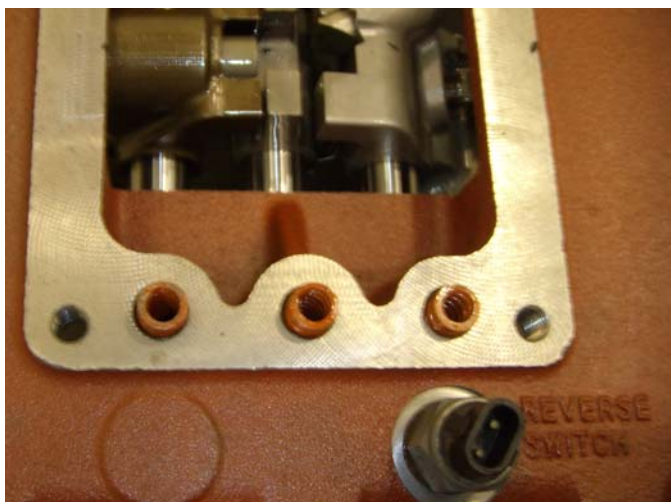
How to Remove the Reverse Switch

Special Instructions

None

Special Tools

- Typical service tools



Procedure -

1. Remove Reverse Switch electrical connector.
2. Loosen and remove the Reverse Switch from the Shift Bar Housing.

Transmission Overhaul Procedure - Bench Service

How to Remove the Range Exhaust Valve Assembly

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

1. If needed, remove air lines from exhaust valve. See "Airhose Removal" section for reference.
2. Loosen and remove both retaining capscrews.
3. Remove the exhaust valve, spring and plunger from side of transmission case.

Note: Air hoses can stay fastened to the exhaust valve if only servicing the shift bar housing.



Transmission Overhaul Procedure - Bench Service

How to Remove the Remote Shift Control

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

1. Remove OEM shift linkage.
2. Remove retaining capscrews at all four locations.
3. Remove the shift control.
4. Clean all gasket material from the gasket surfaces.



Transmission Overhaul Procedure - Bench Service

How to Disassemble the Remote Shift Control

Special Instructions

None

Special Tools

Typical service tools

Procedure -

1. Procedures to complete first:
 - How to remove remote shift control.
2. Place the remote shift control in a vise with brass jaws or a protective device to prevent damage to the gasket surface.



3. Remove the linkage pivot stud retaining castle nut, retaining cotter pin, and then remove the castle nut.

Note: Be sure to note which hole is being used to secure the linkage control pivot stud.



Transmission Overhaul Procedure - Bench Service



4. Using a soft maul, dislodge the linkage pivot stud from the linkage pivot arm.



5. Loosen the linkage control rod retaining stud on the remote shift control housing then unscrew the stud and remove the linkage control rod.



6. Mark the orientation of the shift arm to the shift shaft with tool makers dye then loosen the shift arm pinch bolt and remove the shift arm.

Transmission Overhaul Procedure - Bench Service

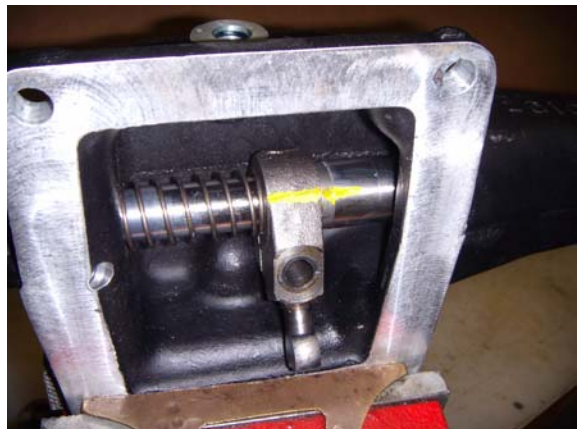
7. Loosen the shift-boot sealing clamp and remove the shift-boot and clamp.



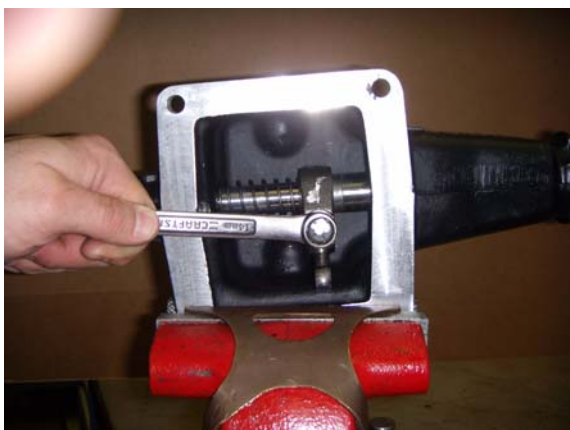
8. If needed, loosen and remove the transmission breather from the remote shift control housing.



9. Mark the orientation of the shift finger to the shift shaft.



Transmission Overhaul Procedure - Bench Service



10. Loosen and remove the shift finger pinch bolt.



11. Remove the shift shaft from the remote shift control housing.

Note: You may have to slightly tap on the shift finger with a soft maul to dislodge the shift finger from the shift rail splines.



12. Remove the shift finger and spring from the remote shift control housing.

Transmission Overhaul Procedure - Bench Service

13. If needed, remove the seal from the remote shift control housing.



14. If needed, remove the shift rail expansion plug by driving it out of the housing with a soft bar and maul.



15. If needed, remove the shift rail bushings from the remote shift control housing using a soft maul and bushing driver.



Transmission Overhaul Procedure - Bench Service

How to Remove the Shift Bar Housing

Special Instructions

None

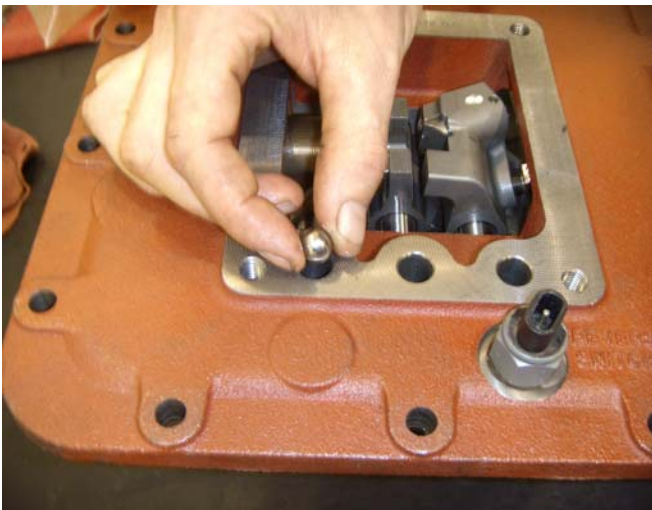
Special Tools

- Typical Service Tools

Procedure -

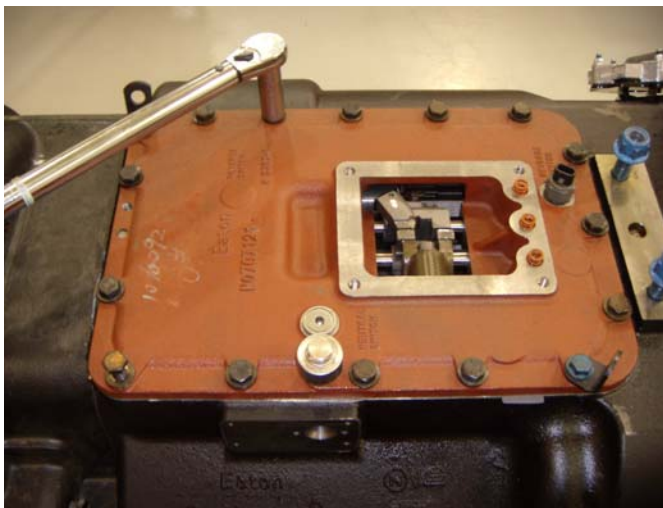
1. Use compressed air to clean any loose dirt or debris from top of transmission.
2. Procedure to complete first: How to Remove the Remote Shift Control.
3. Remove three shift detent springs and the balls from the shift bar housing.

Note: A magnet is helpful in the removal of the detent balls.



4. Remove the 16 shift bar housing retaining capscrews and lifting brackets.

Note: Note location of lifting brackets before removal.

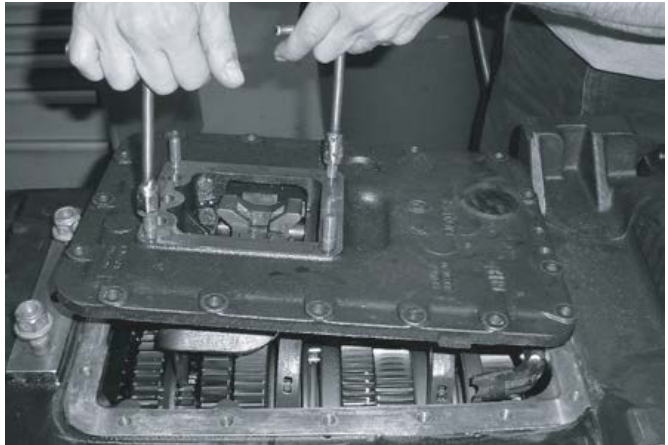


Transmission Overhaul Procedure - Bench Service

5. Break loose shift bar housing using a shift bar housing retaining capscrew in the shift bar housing pusher threaded hole location and screw in capscrew. Use a wrench only until shift bar housing is dislodged from dowel pin.



6. Remove shift bar housing.



7. Remove the gasket and clean the gasket surfaces.

Note: Do not drop any debris into the transmission while the shift bar housing is removed.

Transmission Overhaul Procedure - Bench Service

How to Disassemble the Shift Bar Housing

Special Instructions

None

Special Tools

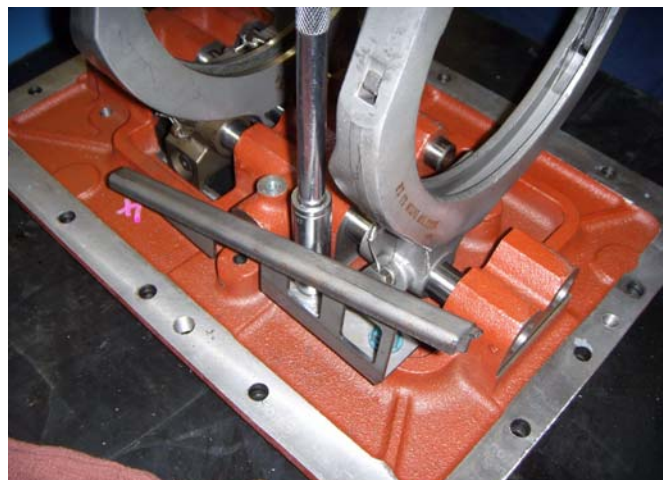
Toolmaker's dye

Procedure -

1. Procedures to complete first:
 - How to remove the Neutral Switch
 - How to remove the Reverse Switch
 - How to remove the Range Exhaust Valve Assembly
 - How to remove the Remote Shift Control
 - How to remove the Shift Bar Housing
2. If needed, remove oil breather from top of shift bar housing.



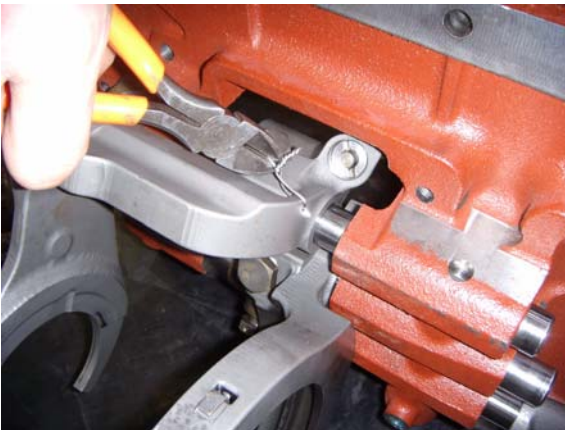
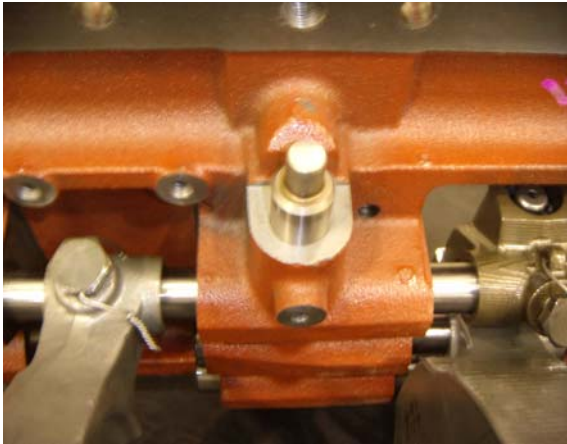
3. Turn over the SBH and remove the oil trough retaining cap-screws and oil trough.



Transmission Overhaul Procedure - Bench Service



4. Remove cap screw for range interlock plunger and remove plunger from shift bar housing.



5. Cut and remove safety wire from all shift yoke and shift block retaining cap screws.

Note: If needed, mark shift yokes, shift blocks, and shift rails with tool maker's dye to ensure proper re-assembly.

Transmission Overhaul Procedure - Bench Service

6. Remove cap screw from Low/Reverse shift yoke and slide shift rail out of shift bar housing.

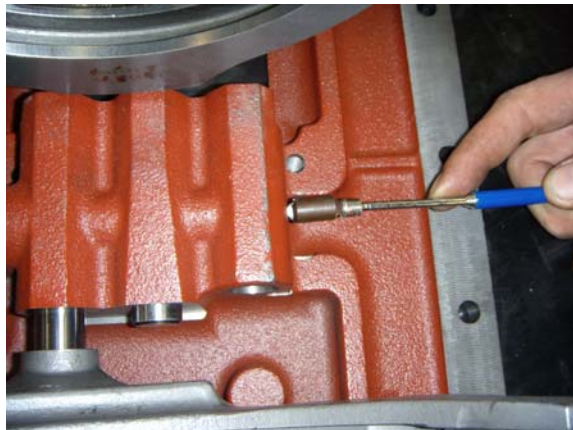
Note: If shift rail will not slide out, ensure 1/2 and 3/4 shift rails are in neutral position.



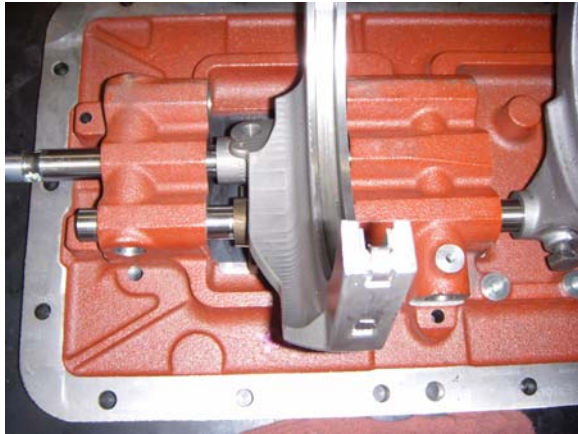
7. If needed, remove reverse shift detent spring and plunger from yoke.



8. Remove shift rail interlock ball and range interlock pin from the shift bar housing.



Transmission Overhaul Procedure - Bench Service

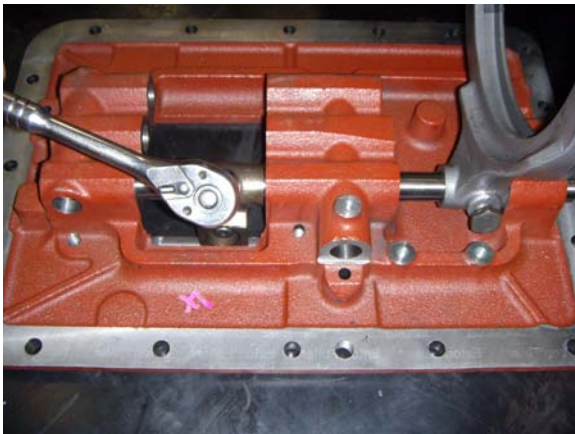


9. Remove capscrew from 1/2 shift yoke and remove shift rail from shift bar housing.

Note: If shift rail will not slide out ensure 3/4 shift rail is in neutral position.



10. Extract range interlock pin and shift rail interlock pin from 1/2 shift rail.



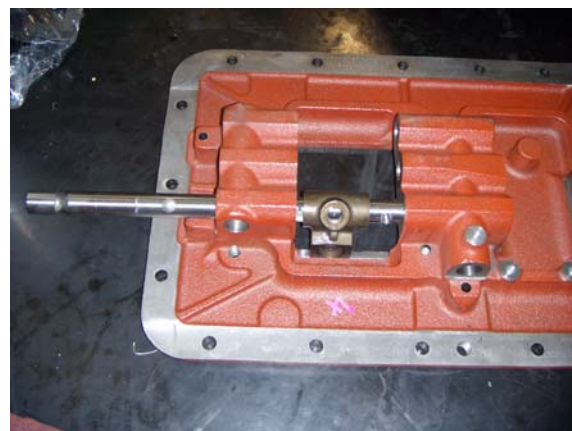
11. Remove shift rail interlock ball and range interlock pin from the shift bar housing.

Transmission Overhaul Procedure - Bench Service

12. Remove cap screws from 3/4 shift yoke and shift block.



13. Remove shift rail from shift bar housing. Extract range interlock pin from shift rail.



14. If needed, remove detent from 4/5 shift block.



Transmission Overhaul Procedure - Bench Service



15. Inspect all shift yoke pads for wear and replace if worn.

16. Inspect and clean all shift bar housing parts, replace any worn parts.

Bench Service Procedures

How to Remove the Deep Range and / or Range Switches

Special Instructions

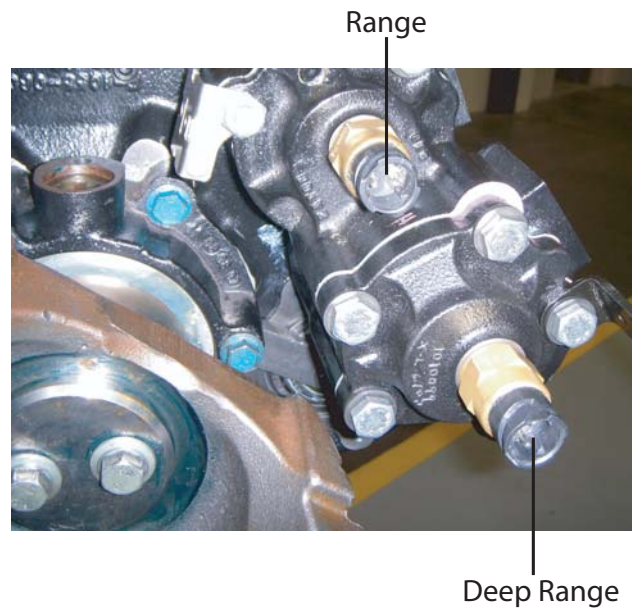
None

Special Tools

- Typical service tools

Procedure -

1. Disconnect wire harness from switch(s).
2. Remove Deep Range and/or Range switch(s) and gasket(s) from range cylinder cover(s).



Transmission Overhaul Procedure-Bench Service

How to Remove the Deep Range and/or Range Pistons and O-Rings

Special Instructions

Important: Do not use an impact to remove deep range of range piston nuts due to possible damage to the yoke bars threads.

Special Tools

- Typical service tools

Procedure -

1. Remove the detent plugs, springs and balls from the deep range and range yoke bar locations.
2. Remove the 5 retaining capscrews from the deep range cylinder cover.

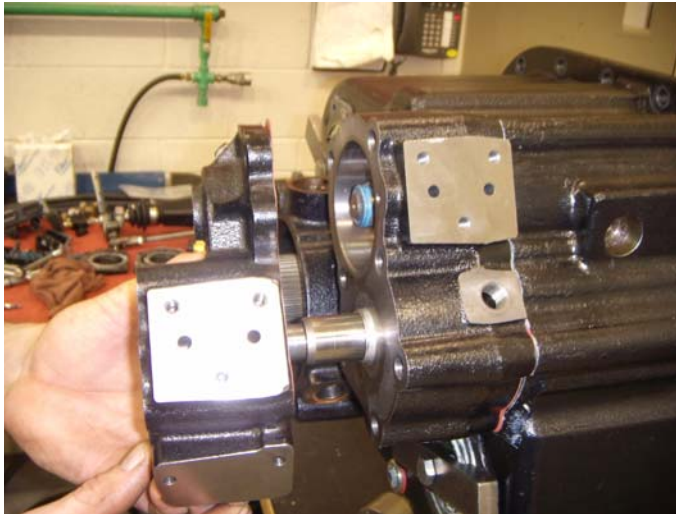


Transmission Overhaul Procedure-Bench Service

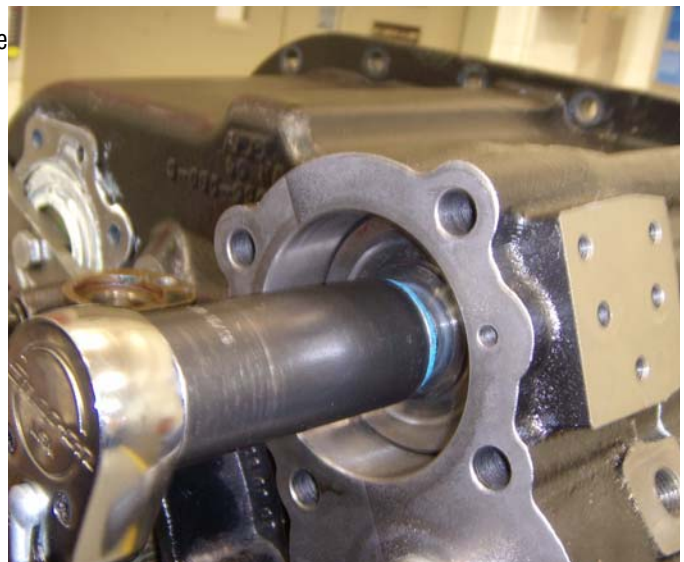
3. Remove the deep range piston retaining nut by hand tool only.



4. Remove last cap screw from the deep range cylinder housing and then remove cylinder housing. May have to slightly tap on the deep range yoke bar with a soft maul to remove yoke bar from piston.



5. Remove range cylinder piston retaining nut and remove cylinder housing. May have to slightly tap on the range yoke bar with a soft maul to remove yoke bar from piston.



Transmission Overhaul Procedure-Bench Service



6. Remove o-ring from the deep range housing.



7. Remove o-ring from the range housing.

Transmission Overhaul Procedure-Bench Service

8. Remove outer and inner o-rings from the deep range and range pistons.



9. If needed, remove yoke bar bushings from deep range/range cylinder housings with soft punch and maul if worn.



10. Clean all gaskets from range housings and auxiliary section housing.

Transmission Overhaul Procedure - Bench Service

How to Install the Deep Range and Range Pistons and O-Rings

Special Instructions

Important: Apply Eaton/Fuller silicone lubricant to all shift cylinder assembly O-rings so a film covers the entire surface.

Special Tools

- Typical service tools

Procedure -

1. If needed, install deep range/range cylinder housing bushings.



2. Install o-ring into range housing using Eaton Fuller Silicone lubricant P/N 71206 or equivalent.



Transmission Overhaul Procedure - Bench Service

3. Install gasket on rear of auxiliary section housing for range cylinder housing and install range cylinder housing onto auxiliary section.



4. Apply Eaton Fuller Silicone lubricant P/N 71206 or equivalent onto the piston bore and piston o-rings. Apply new o-rings to inner and outer of range piston and then insert range piston into range cylinder.



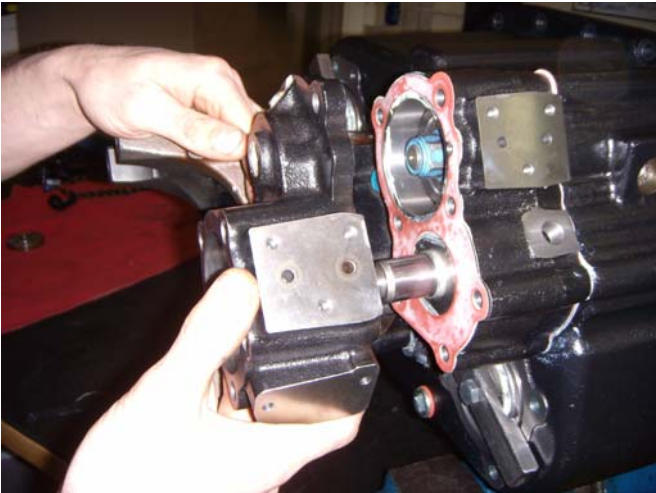
5. Install range piston hex nut and torque to 95-115 N·m [70-85 lbs. ft.].



Transmission Overhaul Procedure - Bench Service



6. Install o-ring into deep range cylinder housing and apply Eaton Fuller Silicone lubricant P/N 71206 or equivalent.



7. Install deep range cylinder housing and cap screws hand tight.

Note: Transmission harness brackets get installed onto top two cap screw locations.



8. Install both inner and outer o-rings onto deep range piston and apply Eaton Fuller Silicone lubricant P/N 71206 or equivalent onto the piston bore and piston o-rings.

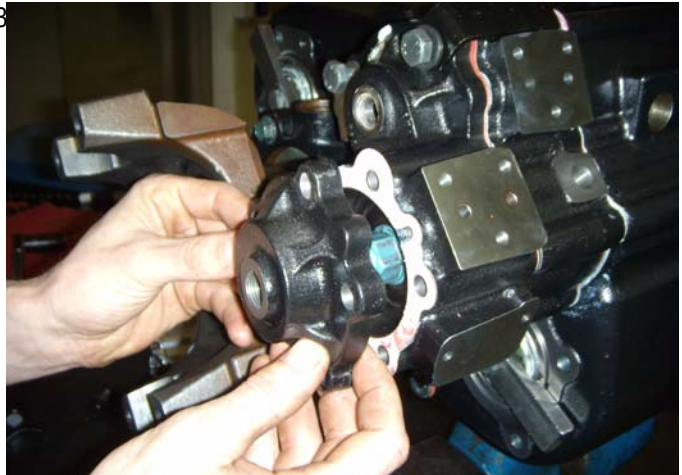
Transmission Overhaul Procedure - Bench Service

9. Insert deep range piston onto the deep range shift yoke bar and torque hex nut to 95-115 N·m [70-85 lbs. ft.].



10. Install deep range cylinder cover gasket, cover and capscrews. Torque all capscrews to 54-61 N·m [40-45 lbs. ft.].

Note: Transmission harness bracket must be placed at the 3 o'clock cap screw position.



11. Install the detent plugs, springs and balls into the deep range and range yoke bar locations. Torque 20-27 N·m (15-20 lbs. ft.)



12. Using Nyogel lubricant P/N 5564527, reinstall transmission harness connectors onto both range switches.

Transmission Overhaul Procedure - Bench Service

How to Install the Deep Range and / or Range Switches

Special Instructions

None

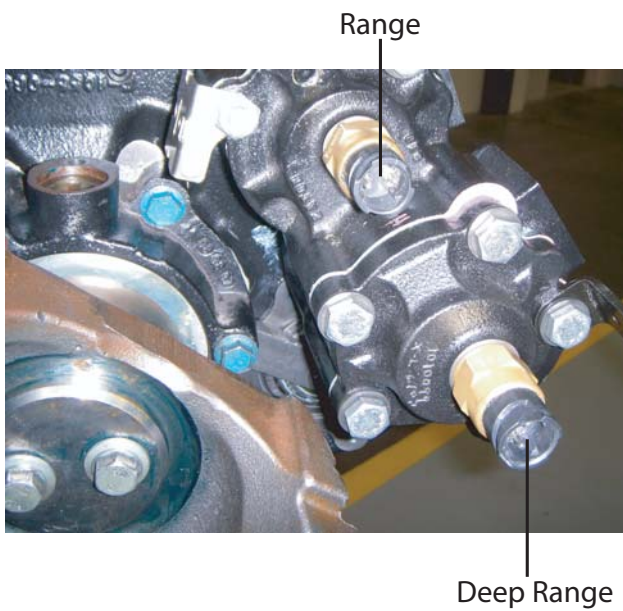
Special Tools

- Typical service tools

Procedure -

1. Install Deep Range and/or Range switch(s) with gasket(s) into the rear cylinder cover(s) and torque switch 20-27 N·m [15-20 lbs. ft.].
2. Apply Nyogel lubricant P/N 5564527 and reconnect wire harness to switch(s).

Shift System



Transmission Overhaul Procedure - Bench Service

How to Assemble the Shift Bar Housing

Special Instructions

Important: Lubricate shift rails and install range interlock pin using lubricant for retention, so the pin does not dislodge from shift rail during assembly.

Special Tools

Typical service tools



Procedure -

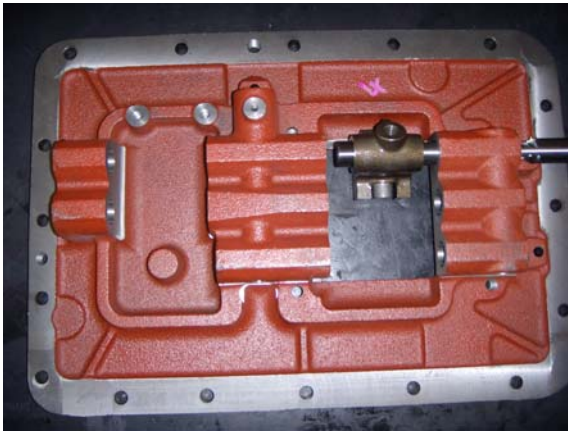
1. Lubricate 3/4 shift rail and install range interlock pin using lubricant for retention so the pin does not dislodge from shift rail during assembly.
2. Partially install shift rail into shift bar housing.



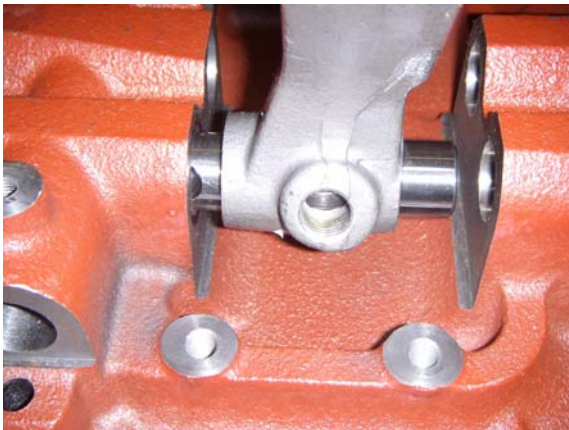
Transmission Overhaul Procedure - Bench Service



3. If needed, assemble 3/4 shift block detent assembly.



4. Insert shift block into shift bar housing and slowly slide shift rail into shift block and into center shaft rail support.

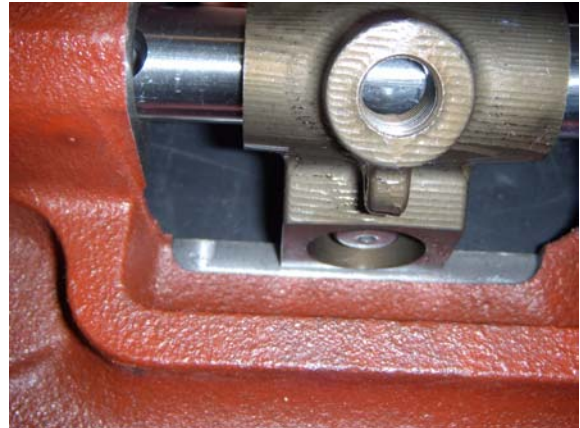


5. Insert 3/4 shift yoke into position and slide shift rail into and through yoke, then into front shift rail support.

Note: All shift yokes have orientation identifiers of "Front" on the face of the yoke. The shift bar housing also has a "Front" identifier near the front mounting flange. The yokes should face the "Front" identifier of the shift bar housing when assembled.

Transmission Overhaul Procedure - Bench Service

6. Align 3/4 shift yoke with yoke cap screw opening and shift rail cavity and insert capscrews hand tighten. Align 3/4 shift block cap screw opening with shift rail cavity and insert cap screw and hand tighten.



7. Insert range interlock pin into shift bar housing, ensure the pin goes into the proper location and rests against the 3/4 shift rail.



8. Insert shift rail interlock ball into shift bar housing cavity and ensure it rests against the 3/4 shift rail with shift rail in neutral position.



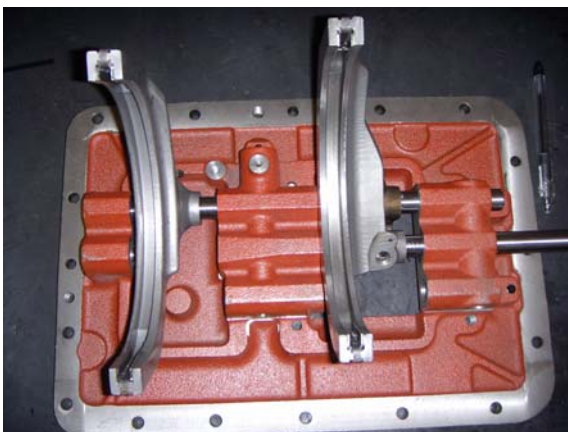
Transmission Overhaul Procedure - Bench Service



9. Apply lubricant to 1/2 shift rail and insert shift rail interlock pin and range interlock pin into shift rail using a light grease to retain pins during assembly.



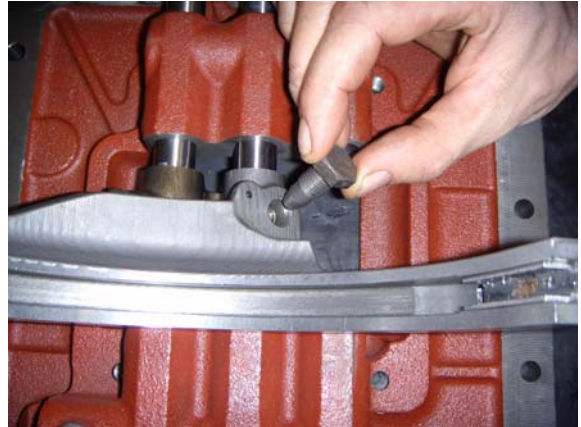
10. Insert 1/2 rail partially into center shift rail support, make sure that the 3/4 shift rail is in the neutral position so the shift rail interlock ball is seated into the 3/4 shift rail detent groove.



11. Install 1/2 shift yoke and slide 1/2 shift rail into yoke and shift rail support.

Transmission Overhaul Procedure - Bench Service

12. Align 1/2 shift yoke cap screw opening with 1/2 shift rail cavity and install retaining capscrews and hand tighten.



13. Install shift rail interlock pin into the shift rail support (center) of the shift bar housing and make sure it rests in position against the 1/2 shift rail.



14. Install shift rail interlock ball into shift rail support and make sure it rests against 1/2 shift rail. Ensure 1/2 shift rail is in the neutral position.



Transmission Overhaul Procedure - Bench Service



15. Lube Low/Reverse shift rail and install rail into shift rail support and ensure that the 1/2 and the 3/4 shift rails are in neutral position so the shift rail can be slid thru the shift rail support.



16. If needed, assemble the Low/Reverse yoke shift detent.

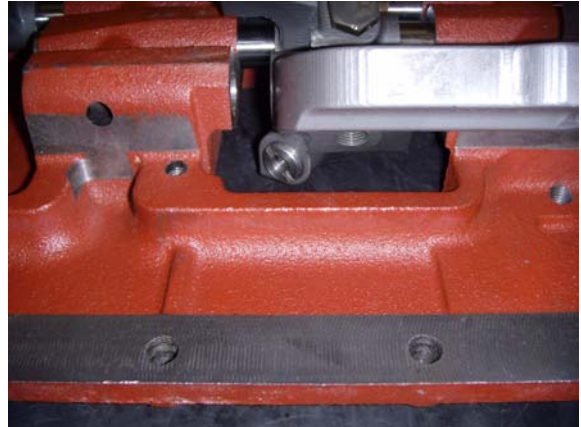


17. Install the Low/Reverse shift yoke and slide the shift rail into the Low/Reverse shift yoke.

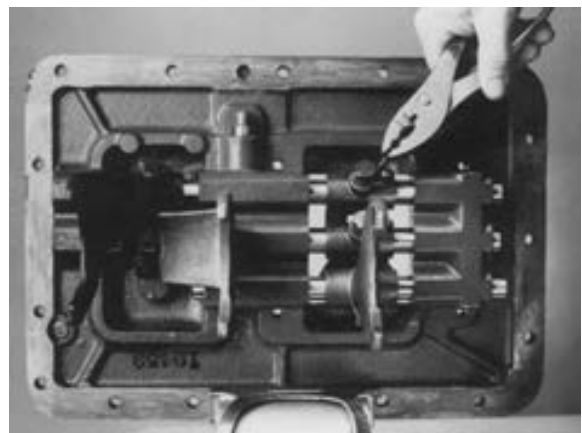
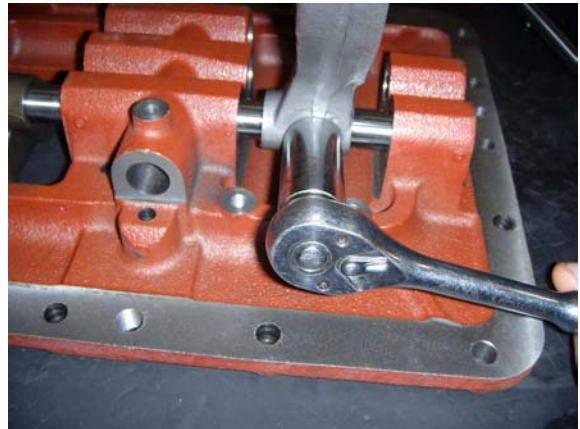
Transmission Overhaul Procedure - Bench Service

18. Align Low/Reverse shift yoke cap screw opening with shift rail cavity and install the retaining cap screw hand tight.

Note: Test shift rail interlock system to make sure that any two shift rails can not be engaged at the same time. If any two shift rails can be engaged into a gear position at the same time, repeat previous steps.



19. Torque all shift yoke retaining capscrews to 54-61 N.m (40-45 lbs. ft.) and safety wire all capscrews to shift rails/yokes and secure safety wire.



Transmission Overhaul Procedure - Bench Service



20. Install range interlock plunger into side of shift bar housing and install plunger retaining cap screw into shift bar housing. Apply Eaton/Fuller #71205 liquid thread sealant and torque to 12-14 N.m (9-10 lbs. ft.).



21. Install oil trough and capscrews. Apply Eaton/Fuller #71205 liquid thread sealant and torque cap screws to 27-31 N.m (20-23 lbs. ft.).



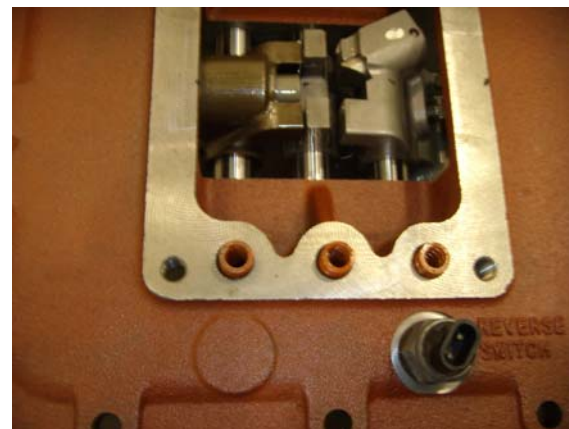
22. If needed, install oil breather into shift bar housing next to neutral switch location and torque to 20.3-27.1 N.m (180-240 lbs. in.)

Transmission Overhaul Procedure - Bench Service

23. If needed, install Neutral switch or plug into shift bar housing location marked "neutral switch" and torque to 20.3-27.1 N.m (180-240 lbs. in.).



24. If needed, install reverse switch plug/switch into shift bar housing in location marked "reverse switch" and torque to 20.3-27.1 N.m (180-240 lbs. in.).



Transmission Overhaul Procedure - Bench Service

How to Install the Shift Bar Housing

Special Instructions

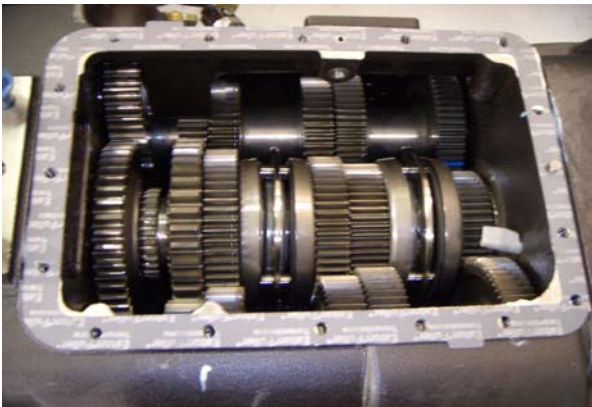
None

Special Tools

- Typical service tools.

Procedure -

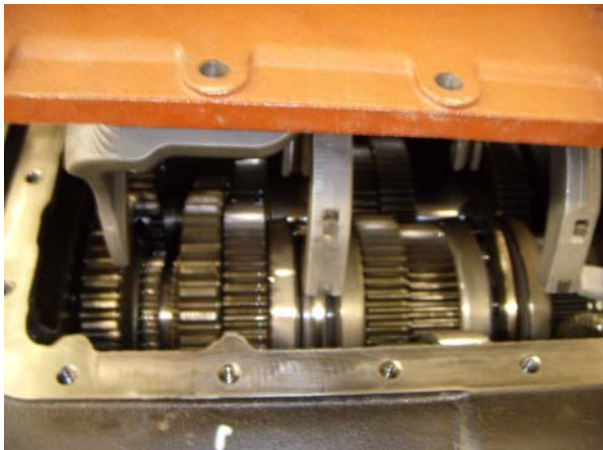
1. Install a new shift bar housing gasket onto transmission main case.



2. Install shift bar housing onto transmission.

Note: Make sure shift bar housing shift blocks are located to neutral and all main case synchronizers and reverse sliding clutch are located to neutral.

Note: Make sure to align the shift bar housing with the dowel pin in the case.

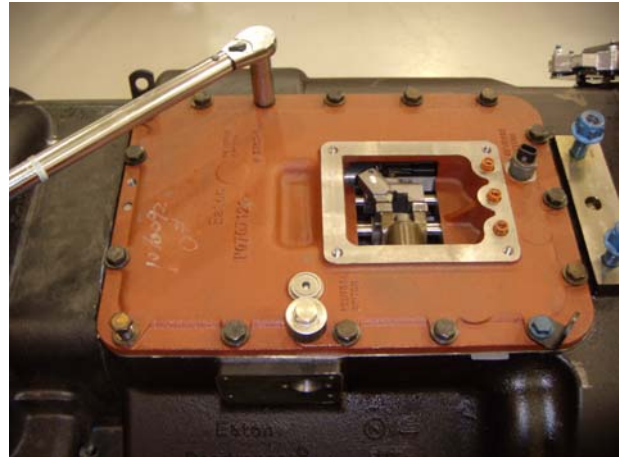


Transmission Overhaul Procedure - Bench Service

3. Install all 16 shift bar housing capscrews and torque to 54-61 N·m [40-45 lbs. ft.].

Note: Ensure lifting brackets are placed in the correct positions.

Note: All shift bar housing capscrews are of the same length.



4. Install the three detent springs and balls.



5. Reinstall the remote shift control. Reference "How to Install the Remote Shift Control" section of the service manual.

Transmission Overhaul Procedure - Bench Service

How to Assemble the Remote Shift Control

Special Instructions

None

Special Tools

Typical service tools

Procedure -

1. If needed, reinstall the shift rail bushings with a soft maul and bushing driver.

Note: Drive outer bushing in until flush with housing. Drive inner bushing in until flush with bore opening inside of housing.



2. Reinstall the shift rail expansion plug with a soft bar and maul.

Note: Drive in until fully seated against inner bore of housing.



Transmission Overhaul Procedure - Bench Service

3. If needed, reinstall the remote shift control seal by using a soft bar and seal installation tool.



4. Install the shift shaft into housing, and install the shift finger and spring onto the shift shaft as you slide the shift shaft into place. Slide the shift finger onto the splines of the shift shaft.

Note: Be sure to properly align the orientation marks of the shift shaft and shift finger.



5. Apply Eaton/Fuller sealant #71205 or equivalent to the shift finger pinch bolt and install the pinch bolt and torque to 48 - 61 N•m (35 - 45 ft. lbs.)



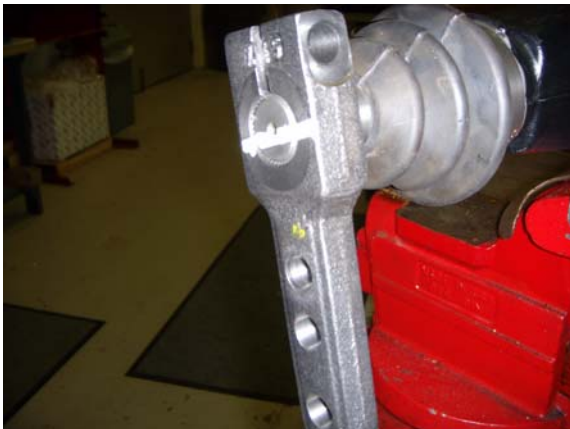
Transmission Overhaul Procedure - Bench Service



6. If needed, apply Eaton/Fuller sealant #71205 or equivalent to the transmission breather and install the breather to the remote shift control housing and torque to 25 - 30 N•m (18 - 22 ft. lbs.).



7. Install the shift-boot and sealing clamp. Position the boot and clamp and then tighten the clamp.



8. Align orientation marks and install shift arm to the shift shaft. Apply Eaton/Fuller sealant #71205 or equivalent to the pinch bolt and torque the pinch bolt to 48 - 61 N•m (35 - 45 ft. lbs.).

Transmission Overhaul Procedure - Bench Service

9. Apply Eaton/Fuller sealant #71205 pr equivalent to the retaining stud of the linkage control rod and install the linkage control rod to the Remote Shift Control housing and torque retaining stud to 61 - 74 N•m (45 - 55 ft. lbs)



10. Insert the linkage pivot stud into the linkage pivot arm hole.

Note: Ensure that the stud is inserted into the same hole of the shift arm in which it was removed.



11. Install the linkage pivot stud retaining castle nut and torque to 41 N•m (30 ft. lbs.) min., align to next pin hole, do not back off nut to achieve pin hole alignment. Ensure the hole in the linkage pivot stud lines up with a recess in the castle nut.



Transmission Overhaul Procedure - Bench Service



12. Install the linkage pivot stud retaining castle nut cotter pin.

Transmission Overhaul Procedure - Bench Service

How to Install the Remote Shift Control

Special Instructions

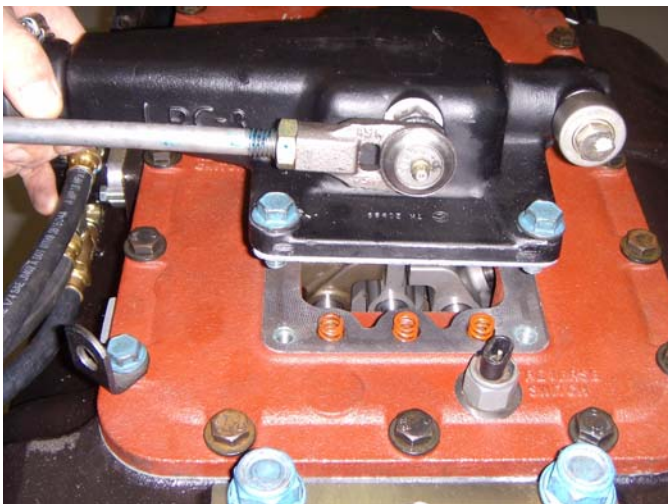
None

Special Tools

- Typical service tools

Procedure -

1. Install a new gasket on shift bar housing opening.
2. Install the remote shift control. Apply Eaton/Fuller #71205 liquid thread sealant and torque the four retaining capscrews to 54-61 N·m [40-45 lbs. ft.].
3. Reinstall OEM shift linkage.



Transmission Overhaul Procedure - Bench Service

How to Install the Range Exhaust Valve Assembly

Special Instructions

None

Special Tools

- Typical service tools



Procedure -

1. Install range shift interlock exhaust valve spring, plunger and exhaust valve onto side of transmission.
2. Apply Eaton Fuller Silicone lubricant P/N 71206 or equivalent to the sealing o-ring and install o-ring onto mounting flange of exhaust valve.
3. Apply Eaton/Fuller #71205 liquid thread sealant to cap-screws and torque capscrews to 12-14 N·m [9-10 lbs. ft.].
4. If needed, install air hoses onto exhaust valve. See "Air Hose Installation" section for reference.

Transmission Overhaul Procedure - Bench Service

How to Install the Reverse Switch

Special Instructions

None

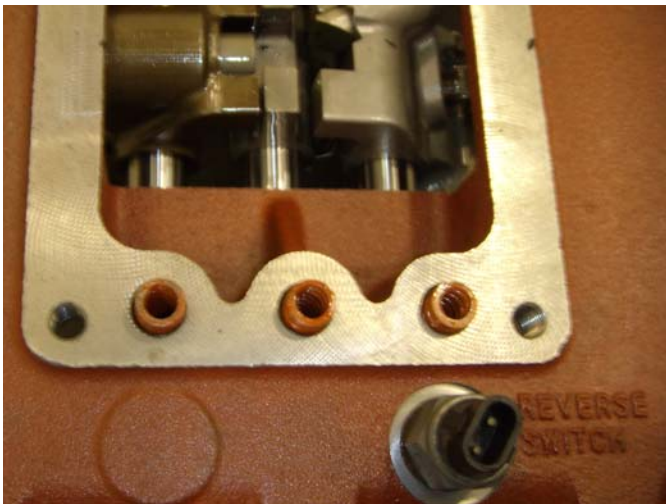
Special Tools

- Typical service tools

Procedure -

1. Install reverse switch and gasket onto shift bar housing in location marked "reverse switch" and torque to 20.3-27.1 N·m [180-240 lbs. in.].
2. Apply Nyogel lubricant P/N 5564527 to reverse switch connector plug and install electrical connection.

Note: Make sure the washer is installed on the switch before tightening it to the shift bar housing.



How to Install the Neutral Switch

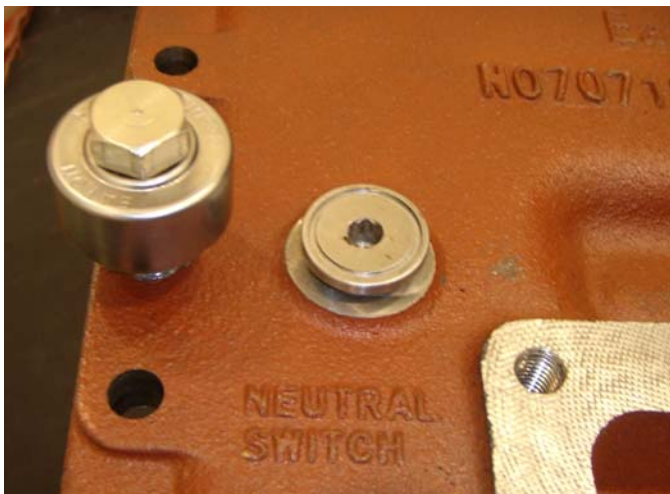
Special Instructions

None

Special Tools

- Typical service tools

Procedure -



1. Install Neutral switch and gasket into shift bar housing location marked "neutral switch" and torque to 20.3-27.1 N·m [180-240 lbs. in.].
2. Apply Nyogel lubricant P/N 5564527 to neutral switch connector plug and insert electrical connector

Note: Make sure the washer is installed on the switch before tightening it to the shift bar housing.

Note: This picture shows an optional Neutral Switch Plug.

Transmission Overhaul Procedures-Bench Service

How to Remove the Boosted Actuator and Adapter Housing

Special Instructions

The air line must be disconnected if removing an air over hydraulic boosted actuator.

The hydraulic line does not need to be disconnected for the removal and installation of the actuator and actuator housing.

⚠ WARNING

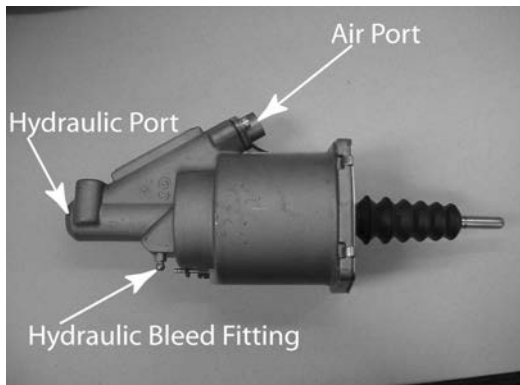
The air system must be bleed prior to removing any air lines to prevent possible injury.

⚠ CAUTION

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

Special Tools

- Typical service tools



Procedure -

1. The air line must be disconnected from the boosted actuator prior to removing the assembly.

Note: It is not necessary to remove the hydraulic line. Removing the hydraulic line will allow air to enter the system, requiring the system to be bled.



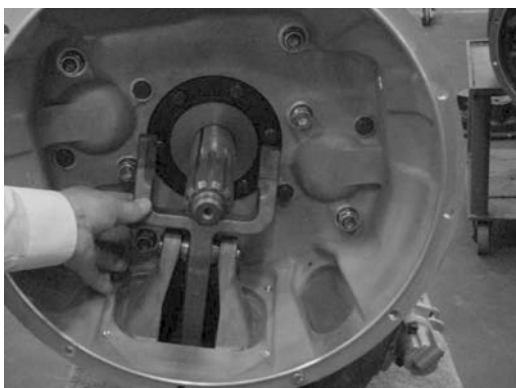
2. Remove the four capscrews from the boosted actuator.
3. Apply force to remove the actuator rod from the clutch slave fork.
4. Pull the boosted actuator back and remove it from the actuator housing.

Transmission Overhaul Procedures-Bench Service

5. Remove the four capscrews holding the actuator housing to the clutch housing.



6. Lower the actuator housing and remove it from the clutch housing.



Transmission Overhaul Procedures-Bench Service

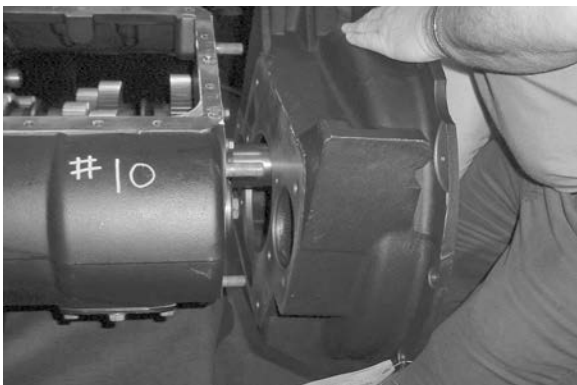
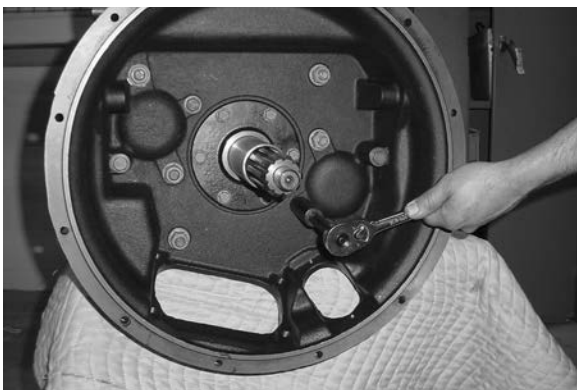
How to Remove the Clutch Housing

Special Instructions

The clutch release mechanism must be removed.

Special Tools

- Typical service tools



Procedure -

1. Procedures to complete first:
 - How to Remove the Clutch Actuator
2. From inside the clutch housing remove the nuts and washers.
3. From inside the clutch housing remove the capscrews.
4. Jar clutch housing to break the gasket seal.
5. Pull the clutch housing from the studs and transmission case.
6. Remove the gasket and clean all mounting surfaces of gasket material.

How to Install the Boosted Actuator and Adapter Housing

Special Instructions

The air line should remain disconnected until the boosted actuator and boosted actuator housing are assembled.

 CAUTION

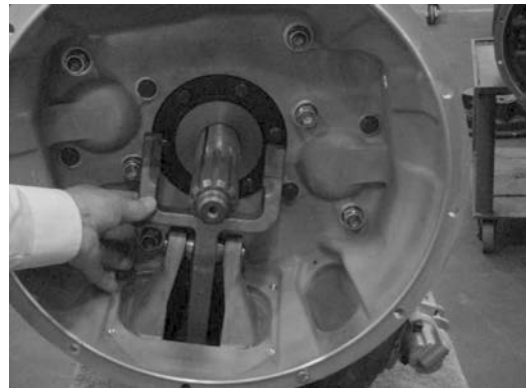
Do not press or disengage clutch pedal when slave cylinder or clutch servo is removed

Special Tools

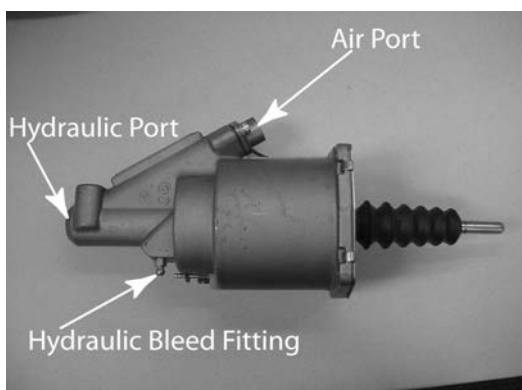
- Typical service tools

Procedure -

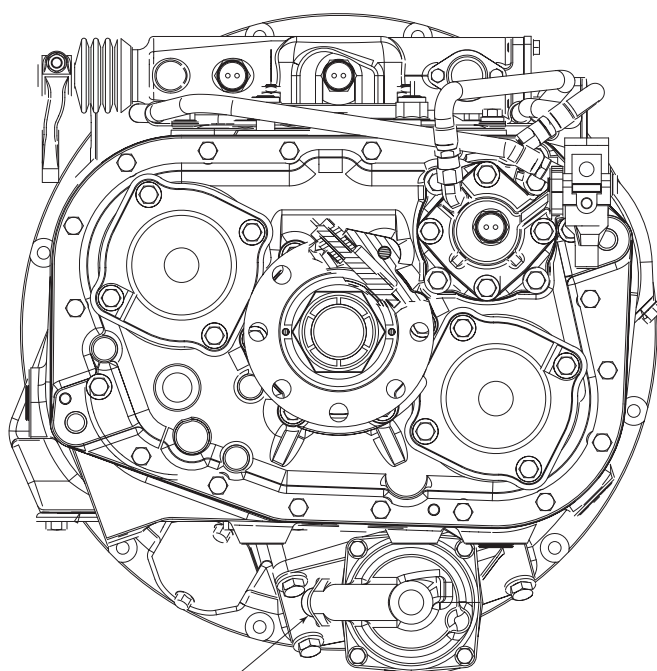
1. Lift boosted actuator housing up through the clutch housing opening.
2. Tighten the four capscrews for the actuator housing to 97-108 N•m (72-80 lbs. ft.).



Transmission Overhaul Procedures-Bench Service



3. Slide boosted actuator into the back of the actuator housing and snap the push-rod into the clutch release fork.



Air Port at a 90 degree angle to the bottom of the maincase

4. Make sure the actuator is oriented with the air port being being horizontal with the clutch housing.
5. Install the four capscrews holding the boosted to the actuator housing and tighten to 19 N•m (14 lbs. ft.).
6. Install the air line to the boosted actuator.

How to Install the Clutch Housing

Special Instructions

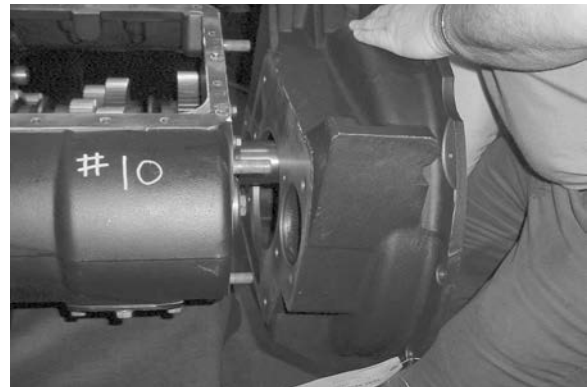
None

Special Tools

- Typical service tools

Procedure -

1. Place a new gasket on the clutch housing mounting surface and install the housing.
2. Install the nuts with washers or lock washers on the studs, tighten to 244-271 N•m (180-200 lbs. ft.).
3. Install the capscrews with lock washers, tighten to 97-108 N•m (72-80 lbs. ft.).



Transmission Overhaul Procedure - Bench Service

How to Remove the Output Yoke / Flange and Retaining Capscrews

Special Instructions

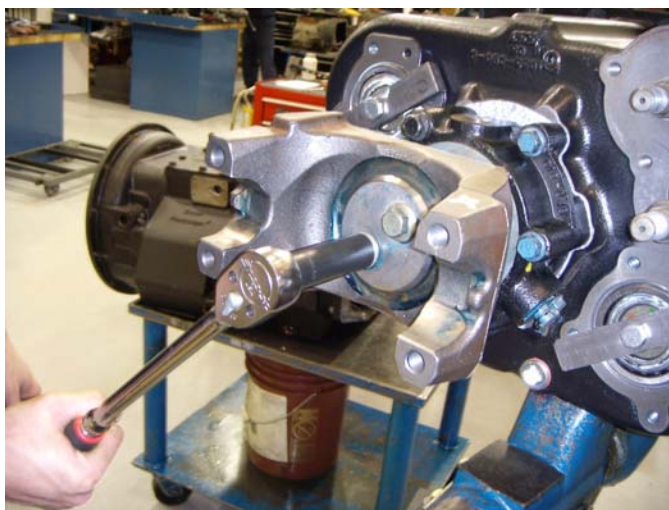
None

Special Tools

- Typical service tools

Procedure -

1. Remove drive shaft from transmission. Reference OEM removal guidelines.
2. Remove the end yoke retaining capscrews and washer from auxiliary mainshaft.
3. Remove the end yoke/flange.



Transmission Overhaul Procedure - Bench Service

How to Remove the Auxiliary Section

Special Instructions

Important: Ensure transmission lube has been drained prior to Auxiliary Section removal.

Important: Auxiliary countershaft retaining straps may be installed to hold countershafts in place. You can make retaining straps from 3" x 1" bar stock. Auxiliary section can be removed without straps, use caution.

Special Tools

An approved lifting device and an approved lifting chain

J-49302 Lifting bracket

E009003 Auxiliary countershaft retaining straps

Procedure -

1. Remove auxiliary section bearing covers and shims. Install E009003 counter shaft retaining straps.

Note: Mark bearing covers and shims to ensure proper positioning for reinstallation.

2. Remove the 19 auxiliary case retaining capscrews and slightly separate the auxiliary case from the main case to allow clearance for J-49302 lifting bracket to be installed.



Transmission Overhaul Procedure - Bench Service

Note: Threaded capscrew holes are located in the dowel pin areas of the auxiliary section housing to aid in the separation of the gasket joint. Insert 2 auxiliary housing retaining capscrews into the threaded holes and tighten evenly until the gasket joint separates.



3. Remove left upper most range cylinder cover retaining cap screw and harness bracket. Remove right upper most rear bearing cover retaining cap screw and install J-49302 lifting bracket. Remove the auxiliary section case from the main transmission using the proper lifting equipment.

Note: If necessary, to aid in removal, remove main to auxiliary case alignment dowel pins by using a soft maul and punch.

4. Clean all parts and remove all gasket material from gasket surfaces and inspect all parts according to service manual specifications.



Transmission Overhaul Procedure - Bench Service

How to Remove the Rear Bearing Cover and Speedometer Rotor

Special Instructions

None

Special Tools

Typical service tools

Procedure -

1. Procedures to complete first:
 - How to remove the Speed Sensor.
 - How to remove the End Yoke/Flange and Nut.
2. Remove the speedometer rotor with dust shield and the o-ring.



3. Remove the six Output Bearing Cover capscrews then remove the Rear Bearing Cover with gasket.

Note: Mark orientation of bearing cover prior to removal.



Transmission Overhaul Procedure - Bench Service

How to Disassemble the Speedometer Rotor and Dust Shield

Special Instructions

None

Special Tools

See "Recommended Tools" section for further information.

Procedure -

1. Procedures to complete first:
 - How to remove the Output Bearing Cover and Slinger with Sleeve
 - How to remove the Speed Sensor.
 - How to remove the End Yoke/Flange and retaining capscrews
2. Place the speedometer rotor assembly on a flat surface and insert the dust shield driver.
3. Drive the dust shield off the ledge of the speedometer rotor and remove.



How to Remove the Auxiliary Mainshaft Oil Seal

Special Instructions

None

Special Tools

Typical service tools

Procedure -

1. Procedures to complete first:
 - How to remove the Output Bearing Cover and Slinger with Sleeve
 - How to remove the Speed Sensor.
 - How to remove the End Yoke/Flange and Nut.
2. Use a punch to remove the seal by driving it out from the back flange of the cover.

Note: Do not gouge rear bearing bore during seal removal.

Note: The seal will be damaged on removal and require a new seal.



Transmission Overhaul Procedure - Bench Service

How to Remove the Auxiliary Countershaft Assembly

Special Instructions

Important: For ease of disassembly, mount the auxiliary section upright in a vise, using brass jaws.

Important: As the countershaft straps are removed, the countershafts can fall from the auxiliary case.

Special Tools

Vise with brass jaws or wood blocks

Item E00700 and E012007: Bearing Pullers

Soft bar and maul

Auxiliary countershaft retaining straps

Procedure -

1. Loosen counter shaft retaining straps slightly and use soft maul to move auxiliary mainshaft forward (From the end yoke end) in order to remove auxiliary countershafts.

Note: May have to progressively loosen countershaft retaining straps during this process in order to gain enough clearance to remove countershafts.

2. Remove strap from upper countershaft and remove upper countershaft. Mark countershaft with the location that it was removed from.



Transmission Overhaul Procedure - Bench Service



3. Remove strap from lower countershaft and remove countershaft. Mark countershaft with location that it was removed from.



4. If needed, remove auxiliary countershaft bearings from both countershaft assemblies using countershaft tapered bearing extractor P/N E007007.



5. If needed, remove auxiliary countershaft bearing cones from main case of transmission using the E012007, countershaft rolling bearing extractor.

Transmission Overhaul Procedure - Bench Service

6. If needed, remove auxiliary countershaft bearing cups from auxiliary case by using a soft bar and maul.



Transmission Overhaul Procedure - Bench Service

How to Remove and Disassemble the Auxiliary Main Shaft Assembly

Special Instructions

Important: When using the soft bar and maul on the output shaft, be careful not to damage the threads.

Important: When removing the rear bearing cover, the rear bearing cone drops from the housing bore.

Important: For ease of disassembly, mount the auxiliary section upright in a vise using brass jaws.

Special Tools

Vise with brass jaws or wood blocks

Soft bar and maul

Shop Press



Procedure -

1. Remove range synchronizer and yoke bar from auxiliary housing and then remove synchronizer assembly from range yoke. Inspect range yoke pads for wear.

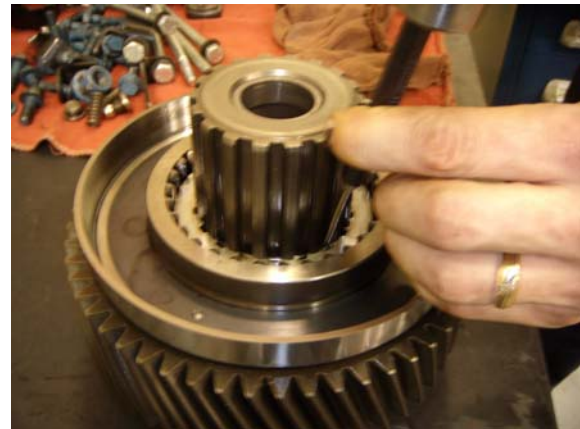
Note: No area of yoke pad should be worn to less than .400" thickness.

Transmission Overhaul Procedure - Bench Service

2. Remove range mainshaft retaining nut, washer and dowel pin from end of auxiliary mainshaft and then remove the range mainshaft reduction gear assembly.



3. Disassemble range mainshaft reduction gear assembly by removing both range mainshaft retaining pins from the range gear hub by using a 1/8" straight punch and small soft maul.



4. Rotate the range mainshaft gear retaining washer until the washer can be removed from the shaft and then remove range gear. If worn, remove bushings from range gear hub with a soft bar and maul from each end of the range gear hub.

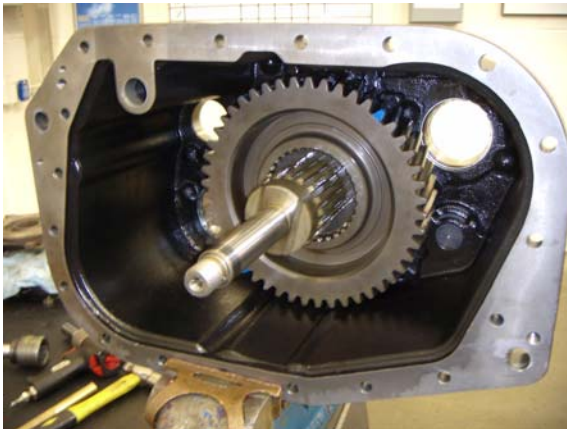


Transmission Overhaul Procedure - Bench Service



5. Remove deep range yoke and synchronizer and then remove deep range synchronizer from yoke and inspect yoke pads for wear.

Note: No area of yoke pad should be worn to less than .400" thickness.



6. Remove auxiliary mainshaft from auxiliary case section by slightly tapping on auxiliary mainshaft with a soft maul to dislodge it from auxiliary mainshaft from rear bearing.



7. Remove the bearing spacer from aux mainshaft.

Transmission Overhaul Procedure - Bench Service

8. Use the reduction gear front face as a base and press the output shaft through the bearing and gear using a shop press. This frees the bearing, reduction gear, and washers for removal.



9. Remove the auxiliary main shaft gear stepped washer, reduction gear, and flat washer from the shaft.



10. Remove the six rear bearing cover capscrews and remove the rear bearing cover and then remove the seal from the rear bearing, Reference "How to Remove the Auxiliary Main-shaft Oil Seal" section.

Note: Mark orientation of bearing cover prior to removal.



Transmission Overhaul Procedure - Bench Service



11. Remove auxiliary mainshaft bearing cup from auxiliary case by using a soft maul and punch.



12. If needed, remove the range yoke bar bushings from the auxiliary case with a soft bar and maul or soft bar and soft hammer.

Transmission Overhaul Procedures-Bench Service

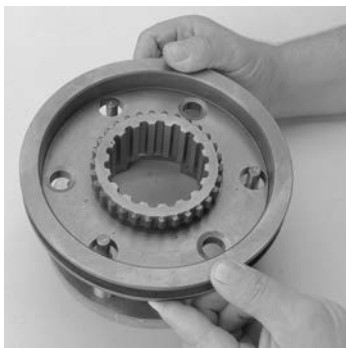
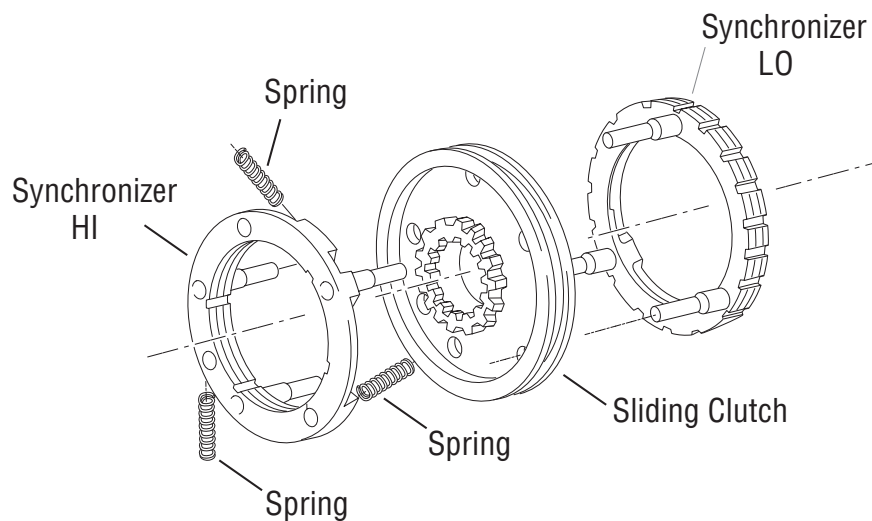
How to Disassemble the Synchronizer Assembly

Special Instructions

Place the synchronizer assembly on a clean, flat surface. Cover the synchronizer assembly with a shop rag to prevent losing the three (3) springs under pressure from the HI range synchronizer pin locations.

Special Tools

- Typical service tools



Procedure -

1. Place the larger LO range synchronizer ring on the bench.
2. Cover the synchronizer with a shop rag to contain the springs.
3. Grab both sides of the HI range synchronizer and pull.
4. From the synchronizer ring LO range pins, remove the sliding clutch.

Transmission Overhaul Procedure - Bench Service

How to Remove the Thru-Shaft PTO Expansion Plug and Aux Case Drain Plug

Special Instructions

None

Special Tools

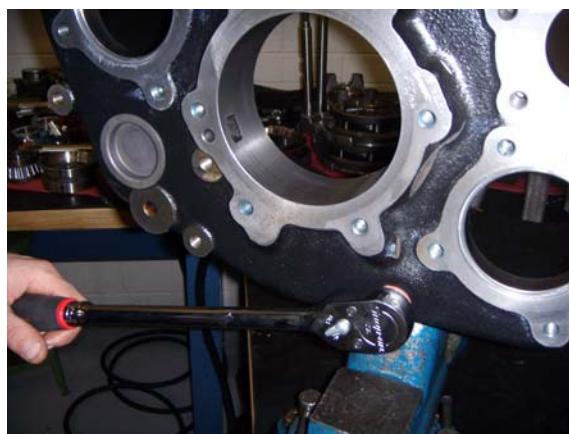
Soft bar and maul

Procedure -

1. If needed, remove PTO thru shaft expansion plug from auxiliary housing with a soft bar and soft hammer or maul.



2. If needed, remove auxiliary case drain plug using a 1/2" square drive ratchet.



Transmission Overhaul Procedure - Bench Service

How to Install the Thru-Shaft PTO Expansion Plug and Aux Case Drain Plug

Special Instructions

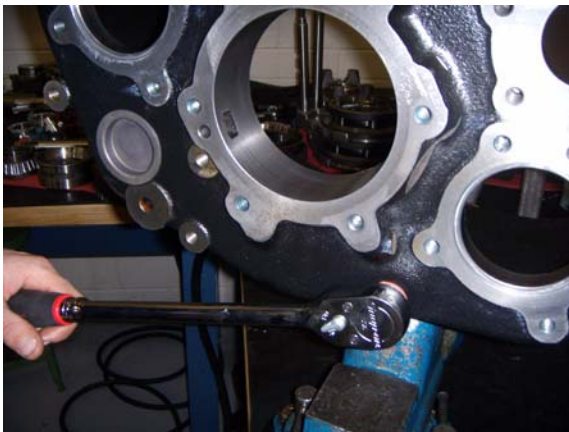
None

Special Tools

Plug/Bushing driver

Procedure -

1. If needed, install auxiliary case drain plug with Eaton/Fuller #71205 liquid thread sealant. Using a 1/2" square drive, torque wrench to 47-68 N.m (35-50 lbs. ft.).



2. If needed, install PTO thru shaft expansion plug with appropriate plug/bushing installation tool and maul.



How to Assemble the Synchronizer Assembly

Special Instructions

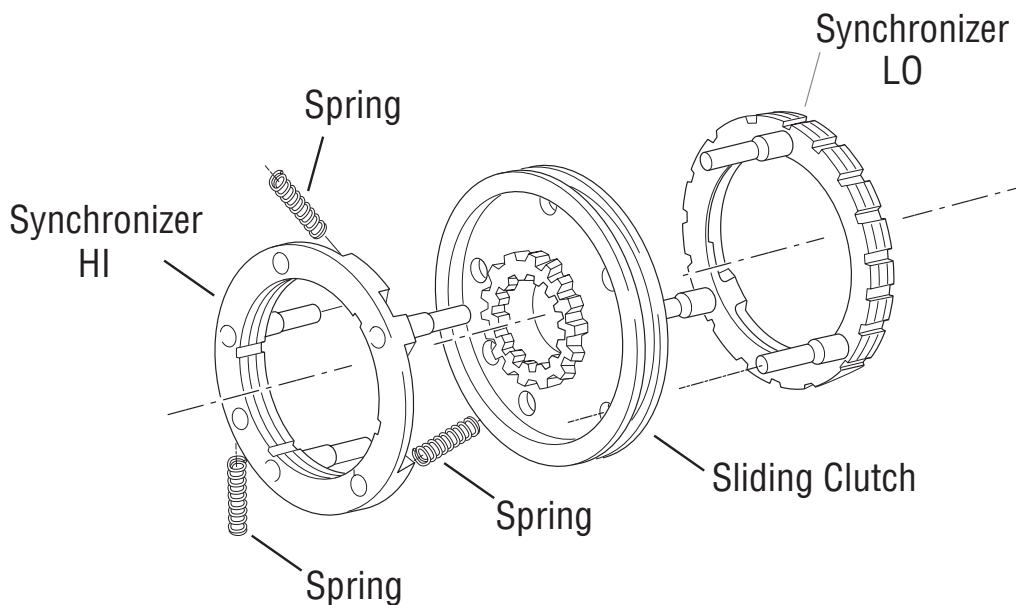
Assembly should be done on a clean, flat surface slightly lower than your waist.

Pins on the LO range synchronizer must line up with the chamfered holes on the sliding clutch bottom.

When compressing the HI range synchronizer springs cover with a shop rag. In the event compression is not achieved the first time, this prevents the springs from leaving the bench area.

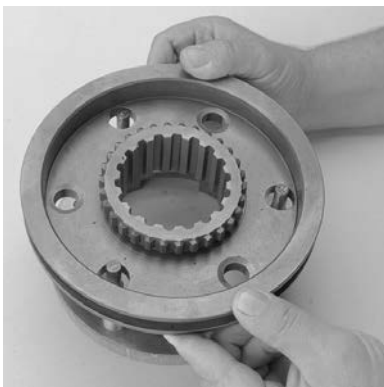
Special Tools

- Typical service tools



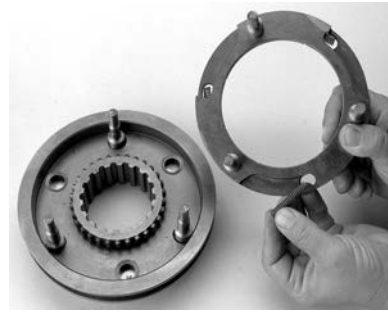
Procedure -

1. On the bench place the larger LO range synchronizer ring face down with pins up.
2. With the sliding clutch recessed side up, place the sliding clutch on the LO range synchronizer pins.

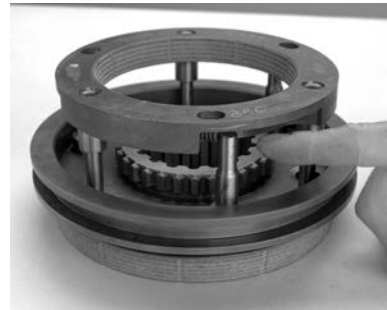


Transmission Overhaul Procedures-Bench Service

3. In the HI range synchronizer bores, install the three (3) springs.



4. Place the HI range synchronizer ring over the LO range synchronizer ring. Rotate the HI range synchronizer until the springs are seated against the pins.



5. Cover the assembly with a shop rag.
6. Apply downward pressure to the HI range synchronizer ring while twisting counterclockwise. This compresses the springs to fully seat HI range on the LO range synchronizer. This should be done with a rapid twist and push motion.

Note: Make sure there are three springs and they are fully compressed.

Note: Make sure you can move the sliding clutch from HI to LO range and back.



Transmission Overhaul Procedure - Bench Service

How to Assemble and Install the Auxiliary Main Shaft Assembly

Special Instructions

Important: Output shaft stack up should be done on a clean, flat surface.

Important: When heating the bearings, do not heat above 275° F (136° C).

Special Tools

Heat lamp, Bearing Heater, Shop Press, or hot plate and oil

See "Recommended Tools" section for seal installation tools.

Toolmaker's dye

Procedure -

1. Use soft maul or soft hammer to tap auxiliary mainshaft bearing cup into auxiliary case.



2. With toolmaker's dye, mark two teeth of the deep range gear 180° opposite of each other. Refer to "Timing" section of manual for more information.



Transmission Overhaul Procedure - Bench Service

3. Install the auxiliary main shaft gear flat washer, deep range gear, and stepped washer onto the auxiliary mainshaft.



4. Heat the auxiliary mainshaft bearing or use a shop press and properly sized bearing adapter to install bearing onto auxiliary mainshaft until fully seated to step washer.



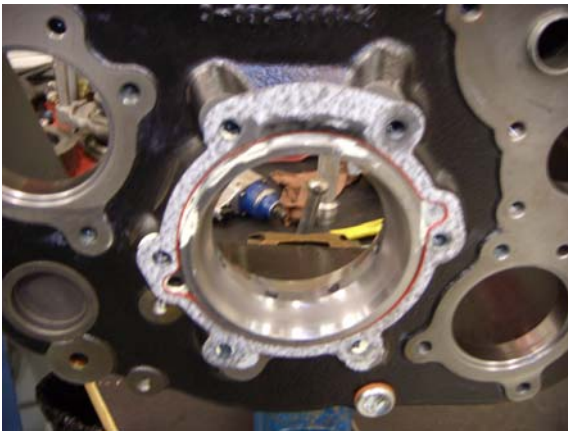
5. Insert auxiliary mainshaft assembly into auxiliary case and install auxiliary mainshaft rear bearing onto shaft and tap bearing with a soft bar and maul as far as possible.



Transmission Overhaul Procedure - Bench Service

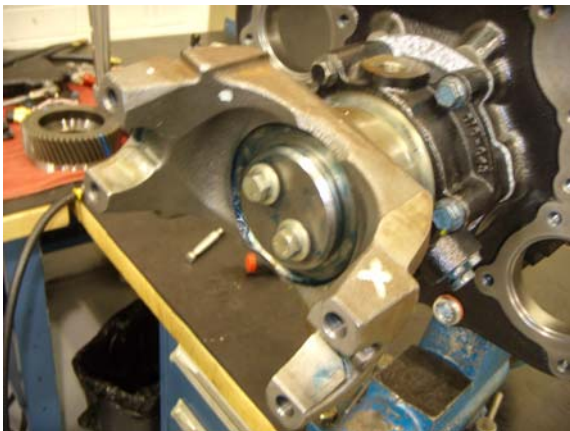


6. Install auxiliary mainshaft rear seal into rear bearing cover using the proper seal driver. If needed, reference "How to Install Auxiliary Mainshaft Oil Seal" section.



7. Install rear bearing cover gasket and cover with the six retaining capscrews and torque to 54-61 N.m (40-45 lbs. ft.)

Note: Make sure that rear bearing is orientated to the correct position.



8. Install speedometer rotor seal ring, speedometer rotor/dust shield, end yoke assembly just enough to hold auxiliary mainshaft into place.

Transmission Overhaul Procedure - Bench Service

9. Install assembled synchronizer onto deep range shift yoke with small diameter synchronizer ring facing outward and install shift yoke / synchronizer assembly onto auxiliary mainshaft.

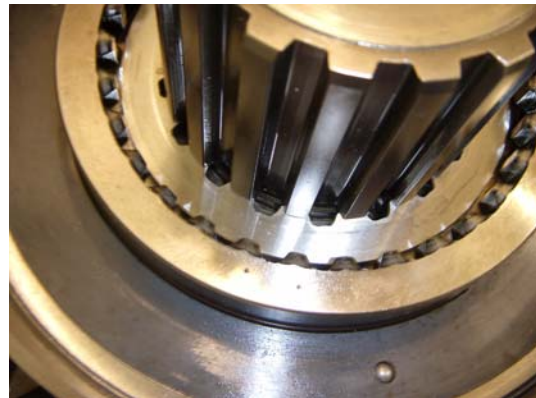


10. With toolmaker's dye, mark two teeth of the range gear 180° opposite of each other. Refer to "Timing" section for more information.



11. Install range mainshaft reduction gear onto range gear hub. Then install slotted washer onto shaft and position into gear then rotate washer into alignment with the range main shaft splines. Gently turn over assembly and drive washer retaining pins until bottomed out below gear surface with a soft bar and maul.

Note: If pins are above gear surface, check for proper alignment of slotted washer.



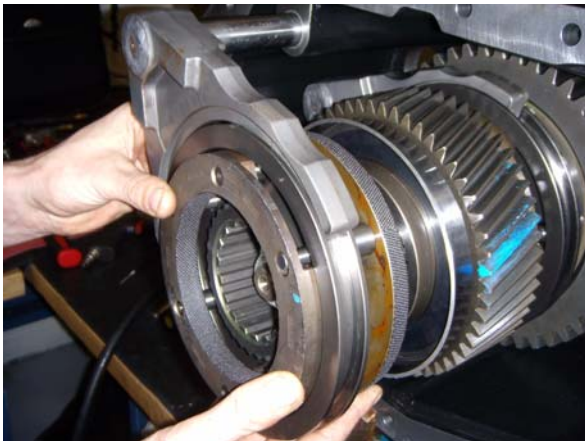
Transmission Overhaul Procedure - Bench Service



12. If needed, install bushing into range gear hub assembly using a soft punch bar.



13. Install range mainshaft reduction gear assembly onto auxiliary mainshaft with range mainshaft facing forward. Install range mainshaft dowel pin, washer, and hex nut onto auxiliary mainshaft with Eaton/Fuller #71205 liquid thread sealant and torque nut to 244-284 N.m (180-210 lbs. ft.).



14. If needed, install bushings into range yoke bore of auxiliary case.
15. Insert assembled range synchronizer onto range shift yoke with small diameter synchronizer ring facing forward and install range synchronizer and yoke assembly into auxiliary case.

Transmission Overhaul Procedure - Bench Service

How to Install the Auxiliary Countershaft Assembly

Special Instructions

None

Special Tools

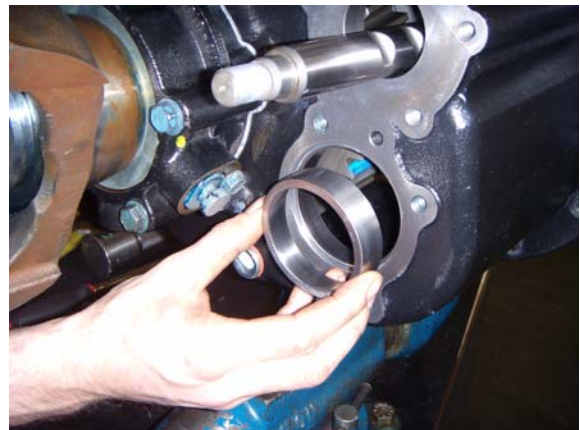
Countershaft retaining straps: E009003

Soft maul

Toolmaker's dye

Procedure -

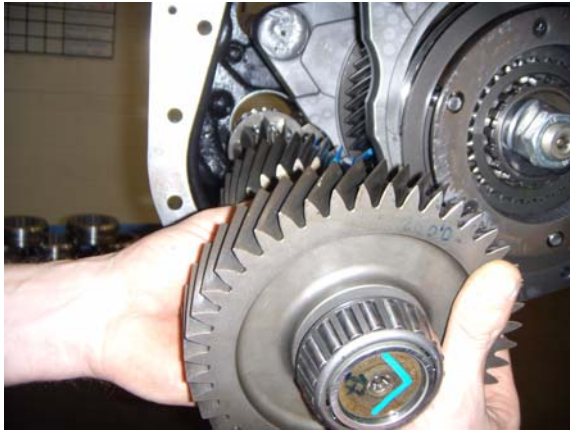
1. If needed, install rear countershaft bearing cups into bores of auxiliary case using a soft maul.



2. If needed, install washers and bearings onto both auxiliary countershafts and mark the countershaft gears at the designated timing mark with toolmaker's dye. Refer to "Timing" section for more information.



Transmission Overhaul Procedure - Bench Service



3. Install lower auxiliary countershaft while aligning timing marks of the countershaft to the deep range and range main shaft reduction gears. Once in alignment install strap onto rear of countershaft to hold into position.



4. Install upper countershaft while aligning timing marks of the countershaft to the deep range and range main shaft reduction gears. Once in alignment install strap onto rear of countershaft to hold into position.



5. Tighten retaining straps down until countershafts are secured firmly and recheck countershaft timing to deep range and range gears to ensure alignment.

Transmission Overhaul Procedure - Bench Service

How to Install the Auxiliary Mainshaft Oil Seal

Special Instructions

None

Special Tools

See "Recommended Tools" section for further information.

Procedure -

1. Use the seal driver from the K-3651 to install the seal in the output bearing cover.

Note: The oil seal should be flush with the machined surface of the bearing cover.

Note: A small amount of oil on the outside surface will ease the installation and help prevent seal damage or misalignment.



How to Assemble the Speedometer Rotor and Dust Shield

Special Instructions

None

Special Tools

See "Recommended Tools" section for further information.

Procedure -

1. Place the speedometer rotor with the large diameter face down on a flat surface and rest the dust shield on the ridge.
2. Use the dust shield driver to install the dust shield until it is flush with the speedometer rotor surface.



Transmission Overhaul Procedure - Bench Service

How to Install the Rear Bearing Cover and Speedometer Rotor

Special Instructions

None

Special Tools

Typical service tools

Procedure -

1. Items to complete first:
 - How to install the Auxiliary Mainshaft Oil Seal
 - How to Assemble the Speedometer Rotor.
2. Install the Output Bearing Cover with gasket and torque the six retaining to 54-61 N.m (40-45 lbs. ft.)

Note: Ensure rear bearing cover is located to the correct position.



3. If previously removed, install the speedometer rotor o-ring over the output shaft and then install the speedometer rotor over the output shaft. Next, install the outer dust shield.

Note: To avoid creating oil leaks, make sure the speedometer rotor and dust shield are free from contaminants.

4. Go to "How to Install End Yoke / Flange Retaining Cap-screws"" for further information.



Transmission Overhaul Procedure - Bench Service

How to Install the Auxiliary Section

Special Instructions

None

Special Tools

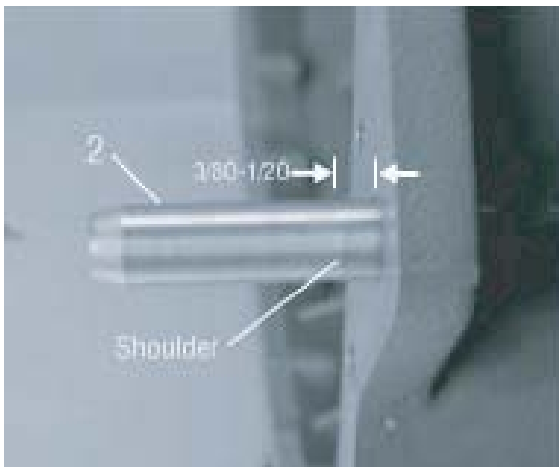
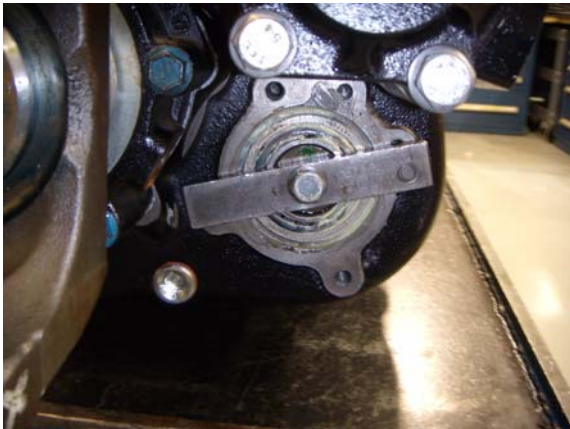
An approved lifting device and an approved lifting chain

J-49302 lifting bracket

E009003 Countershaft support tools

Procedure -

1. Need to move range yoke to rearward position for installation of auxiliary section and then install J-49302 Lifting bracket.
2. Tighten countershaft retaining strap capscrews until the countershafts are supported firmly.



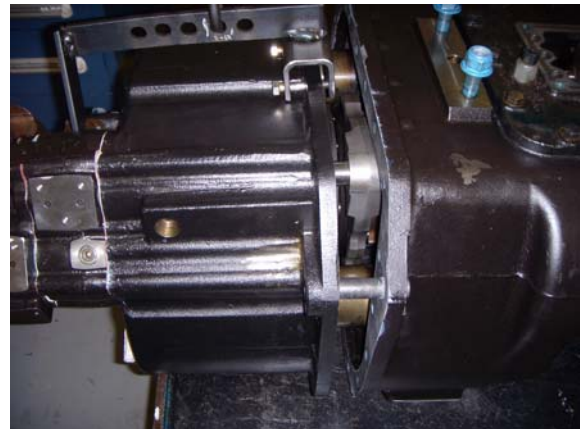
3. If needed, install dowel pins into the main case so that 3/8" to 1/2" of the shoulder is exposed or pin is flush with front of case ear.

Transmission Overhaul Procedure - Bench Service

4. Apply gasket to rear of transmission main case.



5. Lower auxiliary section into place and align onto the dowel pins. Slide auxiliary section onto dowel pins and remove lifting bracket.

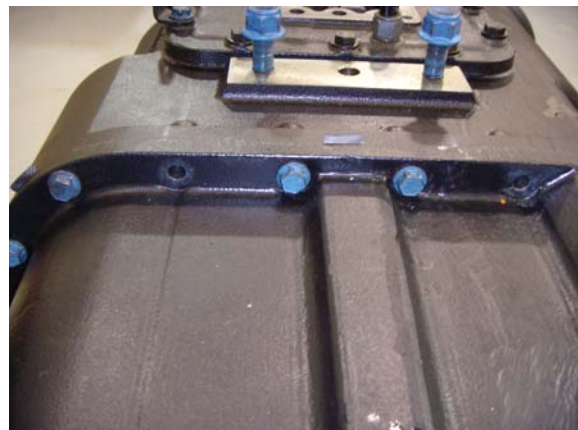


6. Slide auxiliary section on the rest of the way until both housings mate with each other.

Note: Rotation of end yoke may be necessary to engage gear teeth for housings to properly mate.

7. Install the 19 auxiliary section capscrews and torque to 54-61 N.m (40-45 lbs. ft.).

Note: Locate air line brackets to the correct locations.



Transmission Overhaul Procedure - Bench Service



8. Remove countershaft bearing straps and ensure bearing cones are seated in place. Initiate countershaft bearing shimming procedure.



9. Install rear countershaft bearing cover gaskets, covers, with the designated shim determined during the shimming procedure and torque covers to 54-61 N.m (40-45 lbs. ft.).

Note: Ensure input shaft and output shaft of transmission rotates before further assembly.

Transmission Overhaul Procedure - Bench Service

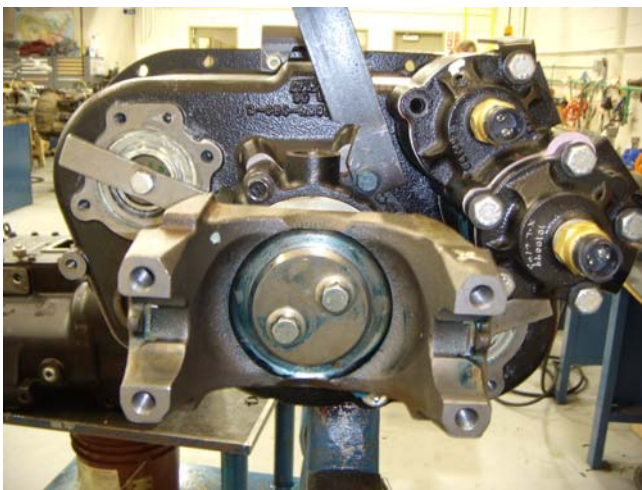
How to Install the Output Yoke / Flange and Retaining Capscrews

Special Instructions

None

Special Tools

- Typical service tools



Procedure -

1. Install end yoke, retaining washer, and capscrews. Apply Eaton/Fuller #71205 liquid thread sealant to capscrews and then tighten both retaining capscrews to specified torque rating 100-110 N·m [74-81lbs. ft.].

Note: Auxiliary mainshaft end yoke retaining cap screw threaded holes have Spiralock™ threads inserted. This is a special thread pitch and no thread damage restoration should be attempted by using a conventional metric thread pitch tap.

WARNING

Use only Eaton/Fuller #71205 liquid thread sealant or liquid equivalent on the yoke retaining capscrews. Do not use any type of thread locking tape on the end yoke retaining capscrews. This may cause the capscrews threads to strip and cause the end yoke to loosen.

2. Reinstall driveshaft per OEM guidelines.

How to Remove the Auxiliary Drive Gear Assembly

Special Instructions

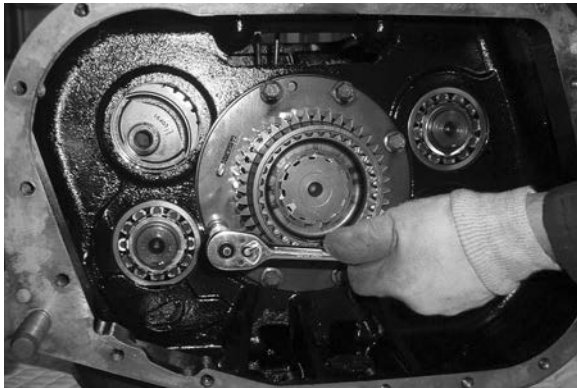
None

Special Tools

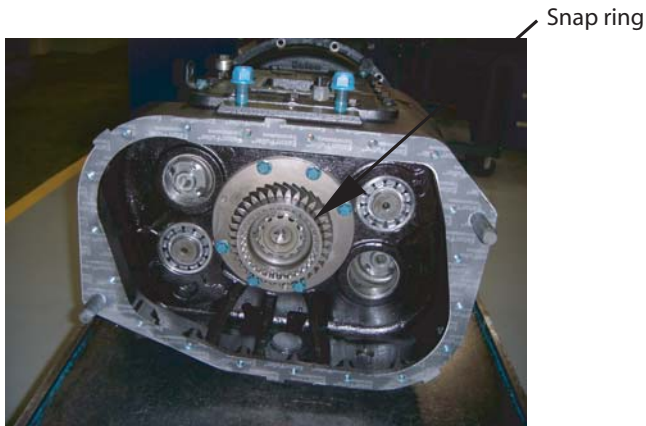
- Crows Foot Prybar
- Snap ring Pliers

Procedure -

1. Procedures to complete first:
 - How to Remove the Air Lines
 - How to Remove the Auxiliary Section
2. Remove the capscrews from the bearing retainer.

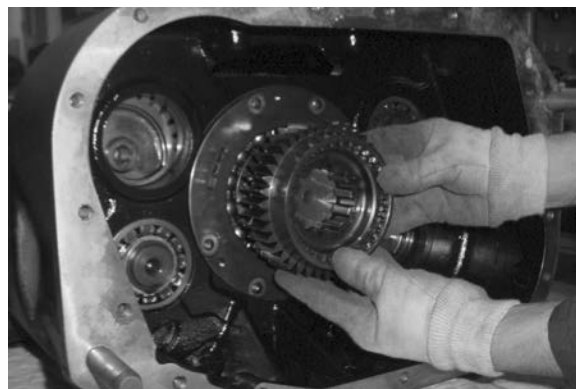


3. Remove the snap ring.

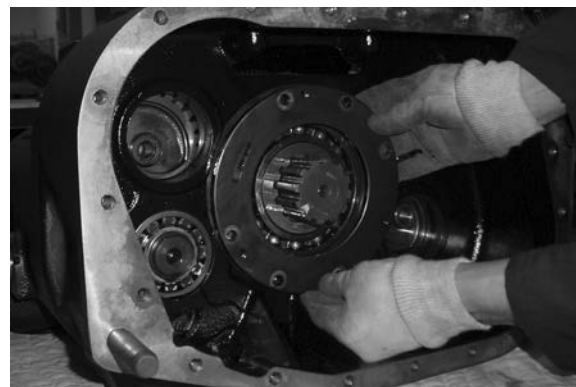


Transmission Overhaul Procedures-Bench Service

4. Remove the auxiliary drive gear.



5. Remove the retainer plate.



6. From inside the case, carefully pry or tap the bearing rearward until the snap ring is exposed.



7. Use a pry bar or crows foot to pry against the bearing snap ring.



Transmission Overhaul Procedures-Bench Service



8. Remove the bearing.



9. Remove the sleeve/spacer from the bearing and inspect for damage or wear.



10. Remove the snap ring from the reverse gear.



11. Remove the spacer from the reverse gear.

Transmission Overhaul Procedures-Bench Service

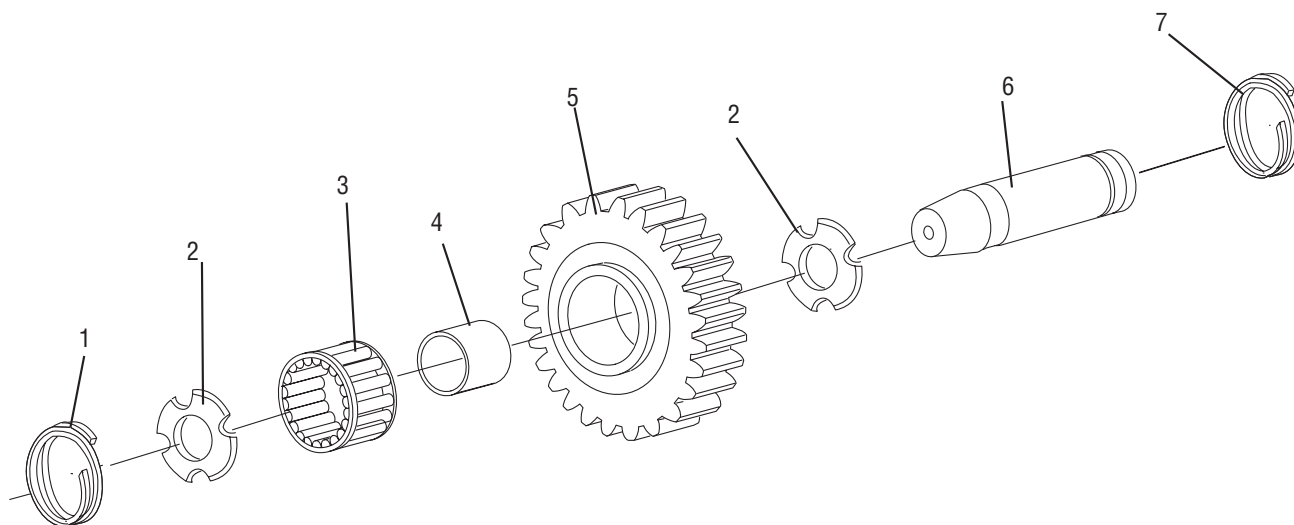
How to Remove the Upper Reverse Idler Assembly

Special Instructions

None

Special Tools

- Slide Hammer



- 1. Snap Ring
- 2. Washer
- 3. Bearing
- 4. Race

- 5. Reverse Idler Gear
- 6. Idler Shaft
- 7. Snap Ring

Transmission Overhaul Procedures-Bench Service

Procedure -

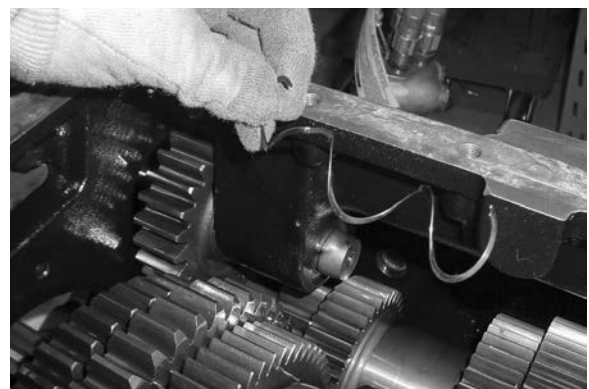
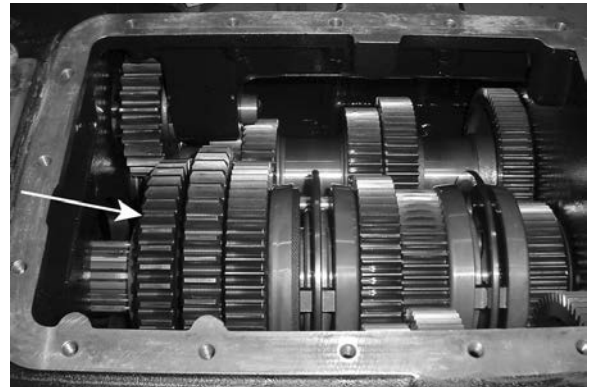
1. Procedures to complete first:
 - How to Remove the Air Lines
 - How to Remove the Remote Shift Control
 - How to Remove the Shift Bar Housing
 - How to Remove the Auxiliary Section
 - How to Remove the Auxiliary Drive Gear Assembly
 - How to Remove the Auxiliary Countershaft Front Bearings

2. Push the reverse gear towards the front of the transmission.

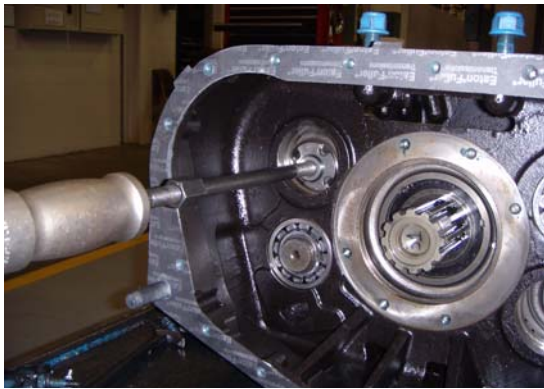
Note: The reverse gear can be moved over the sliding clutch until it comes in contact with the mainshaft LO gear.

3. Remove the reverse idler shaft spiral snap ring on the tapered end of the shaft.

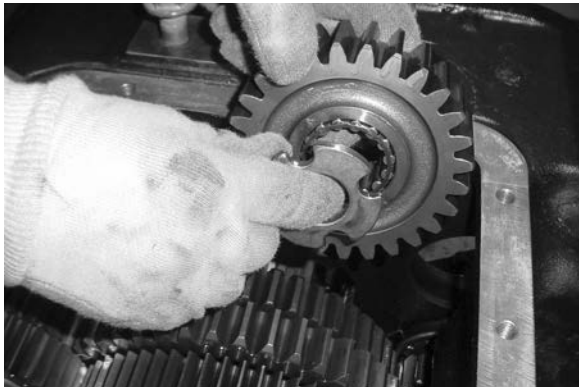
4. The snap ring will be damaged on removal and must be replaced.



Transmission Overhaul Procedures-Bench Service

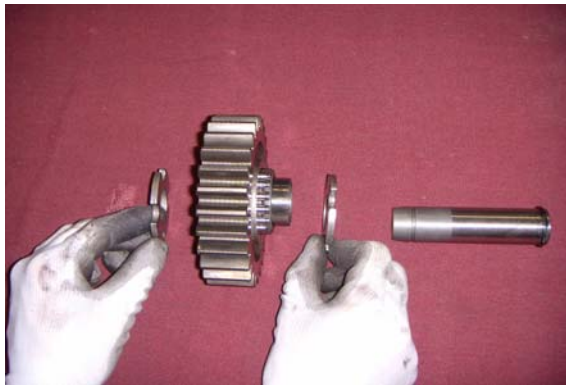


5. Install special tool slide hammer into the back of the reverse idler shaft and remove shaft.



6. Remove the reverse gear and washer as the shaft is pulled out.

Note: Hold pressure on the gear as the idler shaft is removed from the gear to prevent the reverse washer from dropping into the case.



7. Inspect the reverse gear assembly for damage or wear.

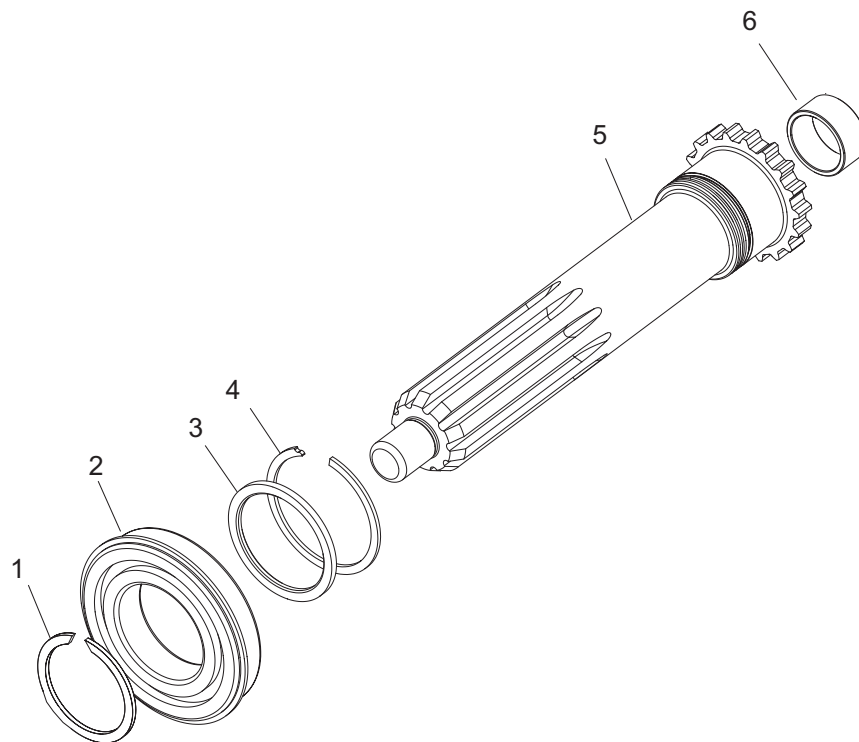
How to Remove the Input Shaft Assembly

Special Instructions

None

Special Tools

- Crows Foot Prybar
- Mainshaft J-hooks
- Snap ring Pliers



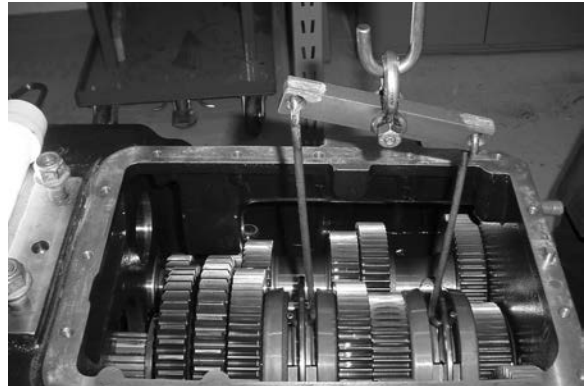
- 1. Snap Ring
- 2. Input Shaft Bearing
- 3. Spacer
- 4. Snap Ring

- 5. Input Shaft
- 6. Bushing

Transmission Overhaul Procedures-Bench Service

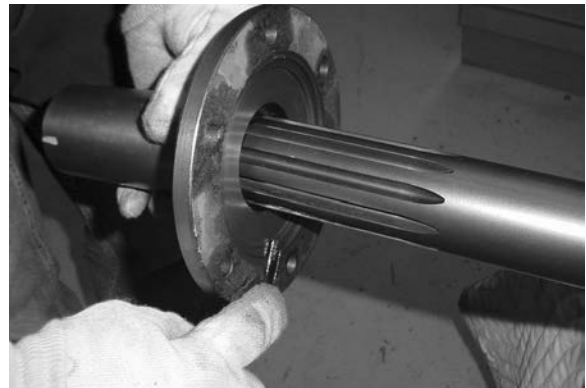
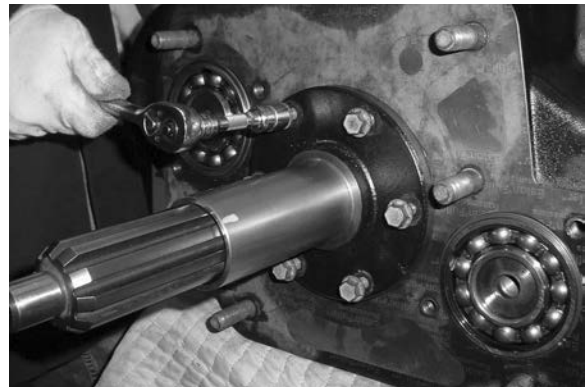
Procedure -

1. If removing just the input shaft without maincase disassembly perform only steps 3-11.
2. Procedures to complete first:
 - How to Remove the Clutch Housing
 - How to Remove the Remote Shift Control
 - How to Remove the Shift Bar Housing
 - How to Remove the Air Lines
3. Support the mainshaft with Mainshaft J-Hooks to hold the mainshaft up and prevent it from binding.
4. Remove the input shaft capscrews.

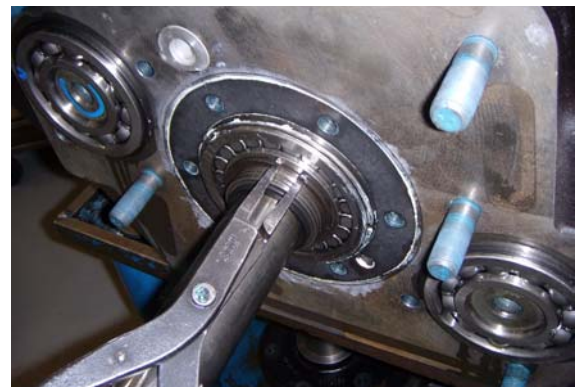


5. Tap the input shaft front bearing cover to break the seal and remove.

Note: Note oil channel passage (as shown) for correct orientation during installation.



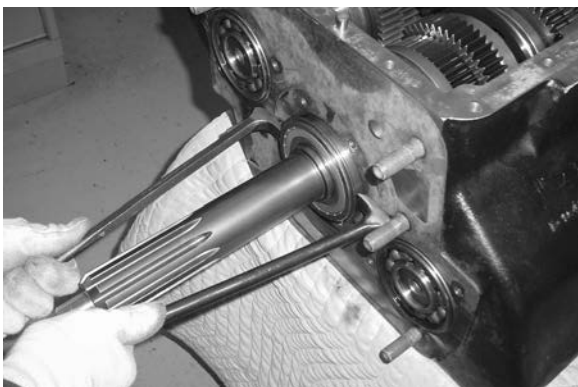
6. Remove the input shaft snap ring.



Transmission Overhaul Procedures-Bench Service



7. Tap input shaft rearward to move the input shaft bearing from the bore.



8. Use crow's foot to pry on the snap ring and work the bearing out of the bore.



9. Remove the spacer.



10. Remove the inner main drive gear snap ring.

Transmission Overhaul Procedures-Bench Service

11. Remove the input shaft.



How to Remove the Upper Countershaft Bearings

Special Instructions

None

Special Tools

- Bearing Puller and snap ring

Procedure -

1. Procedures to complete first:
 - How to Remove the Air Lines
 - How to Remove the Boosted or Hydraulic Actuator or Adapter Housing
 - How to Remove the Auxiliary Drive Gear
 - How to Remove the Remote Shift Control
 - How to Remove the Shift Bar Housing
 - How to Remove the Auxiliary Section
 - How to Remove the Clutch Housing
 - How to Remove the Front Countershaft Bearing Retainers.
 - How to Remove the Input Shaft
2. Remove the snap ring from the rear of the mainbox countershaft.
3. Drive the upper countershaft rearward one to two times then rotate to the lower countershaft.



Transmission Overhaul Procedures-Bench Service

4. Drive the lower countershaft rearward one to two times and go back to the upper countershaft.

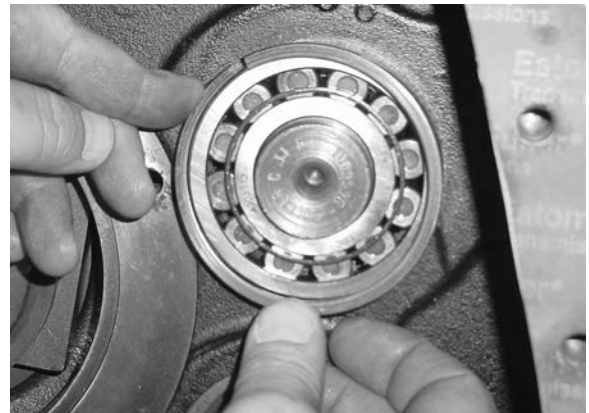
Note: It may be necessary to drive the mainshaft back to prevent damage to the drive gear cup.

 CAUTION

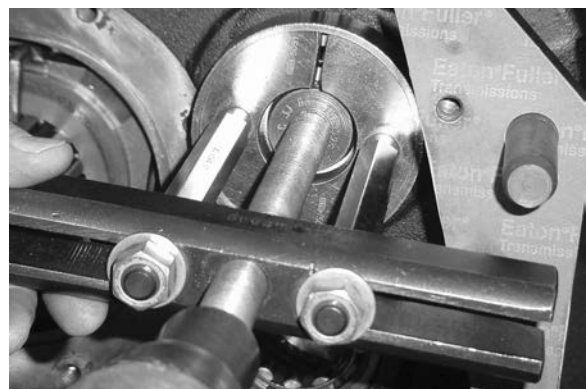
You must rotate between the upper and lower countershafts when driving them rearward. If they are not driven back together damage will occur to the main drive gear cup.



5. Place a snap ring from the tool into the bearing groove on the maincase rear countershaft bearing.



6. Install the bearing puller and remove bearing.
7. Drive the upper countershaft rearward until its out of the bearing. Remove the bearing by hand.



How to Remove the Mainshaft Assembly

Special Instructions

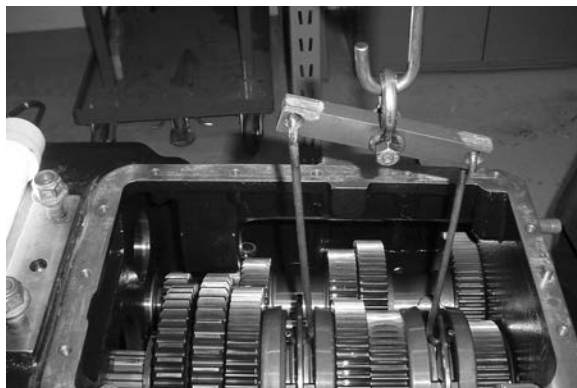
None

Special Tools

- Mainshaft J-Hooks

Procedure -

1. Procedures to complete first:
 - How to Remove the Air Lines
 - How to Remove the Upper Reverse Idler Assembly
 - How to Remove the Boosted or Hydraulic Actuator or Adapter Housing
 - How to Remove the Auxiliary Drive Gear Assembly
 - How to Remove the Remote Shift Control
 - How to Remove the Shift Bar Housing
 - How to Remove the Auxiliary Section
 - How to Remove the Clutch Housing
 - How to Remove the Front Countershaft Bearing Retainers.
 - How to Remove the Input Shaft
 - How to Remove the Upper Countershaft Bearings
2. Install a bar and ring to hold the upper countershaft away from the mainshaft.



3. Make sure the J-hooks are installed and positioned as shown.

Note: J-hooks should be attached to the synchronizer rings.

Transmission Overhaul Procedures-Bench Service

4. Lift the mainshaft from the case.



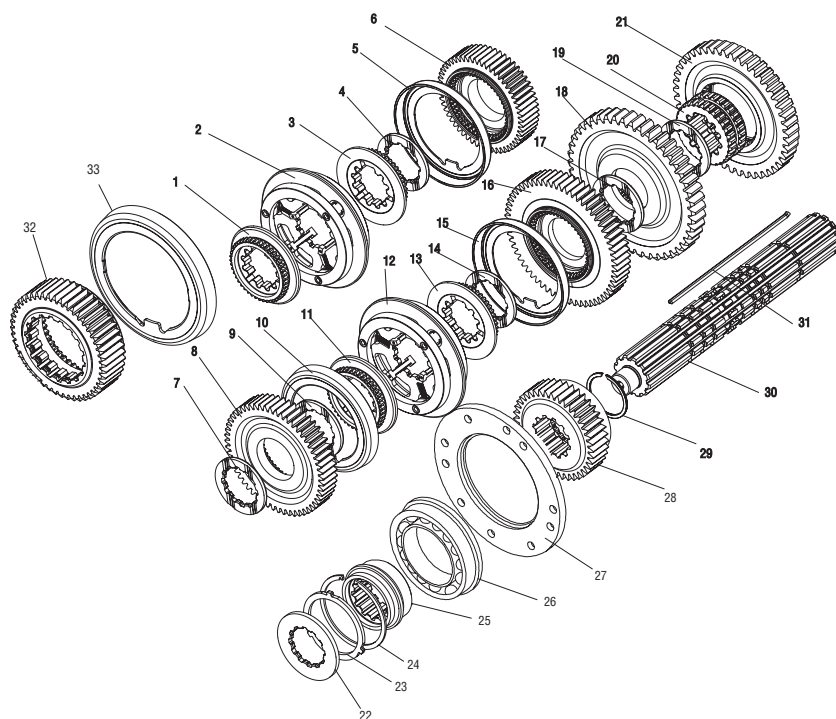
How to Disassemble the Mainshaft Assembly

Special Instructions

None

Special Tools

- Typical service tools



1. Synchronizer Hub
2. Synchronizer Ring
3. Synchronizer Hub
4. Washer
5. 3rd Gear Cup
6. 3rd Gear
7. Washer
8. 2nd Gear
9. Washer
10. 2nd Gear Cup
11. Synchronizer Hub
12. Synchronizer Ring
13. Synchronizer Hub
14. Washer
15. 1st Gear Cup
16. 1st Gear

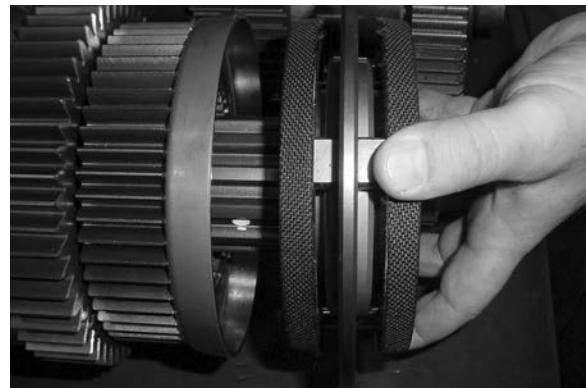
17. Washer
18. LO Gear
19. Washer
20. Sliding Clutch
21. Reverse Gear
22. Washer
23. Spacer
24. Snap Ring
25. Auxiliary Bearing Hub
26. Auxiliary Drive Gear Bearing
27. Auxiliary Bearing Retainer Plate
28. Auxiliary Drive Gear
29. Snap Ring
30. Mainshaft
31. Mainshaft Key
32. Mainshaft Drive Gear
33. Mainshaft Drive Gear Cup

Transmission Overhaul Procedures-Bench Service

Procedure -

1. Procedures to complete first:
 - How to Remove the Air Lines
 - How to Remove the Boosted or Hydraulic Actuator or Adapter Housing
 - How to Remove the Auxiliary Drive Gear
 - How to Remove the Upper Reverse Idler Assembly
 - How to Remove the Remote Shift Control
 - How to Remove the Shift Bar Housing
 - How to Remove the Auxiliary Section
 - How to Remove the Clutch Housing
 - How to Remove the Front Countershaft Bearing Retainers.
 - How to Remove the Input Shaft
 - How to Remove the Upper Countershaft Bearings
 - How to Remove the Mainshaft Assembly
2. Remove the main drive gear retaining strap and remove the gear.
3. Remove the 3/7/11 - 4/8/12 synchronizer.
4. Place a rag in the center of the synchronizer until it is ready to place back on the mainshaft.

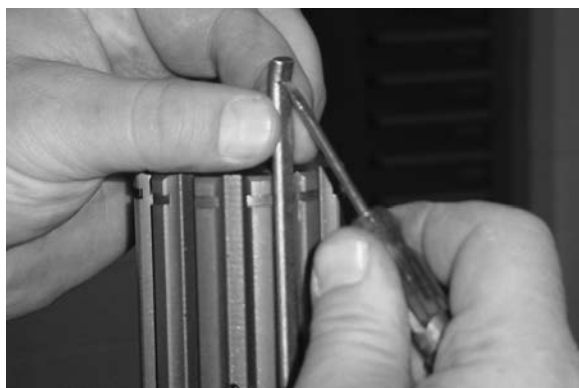
Note: The rag prevents the synchronizer from coming apart when handled.
5. Place the mainshaft in a vise with protective jaws.
6. Mark the keyway location on the top of the mainshaft for re-assembly purposes.



Transmission Overhaul Procedures-Bench Service



7. Mark the keyway location on the bottom of the mainshaft for reassembly purposes.



8. Remove the keyway.



9. Rotate the washer and remove.



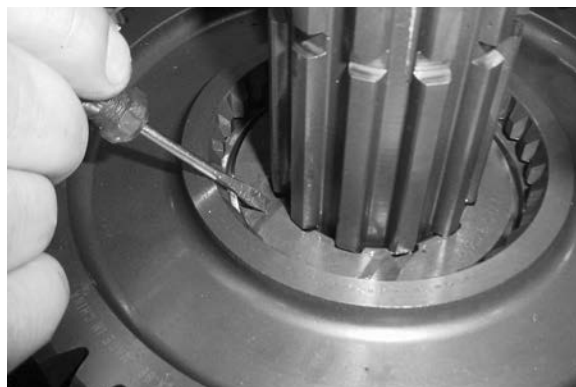
10. Remove the reverse gear.

Transmission Overhaul Procedures-Bench Service

11. Remove the LO/Reverse sliding clutch.



12. Rotate the LO gear washer and remove.



13. Remove LO gear.



14. Remove the 1st gear washer.



Transmission Overhaul Procedures-Bench Service



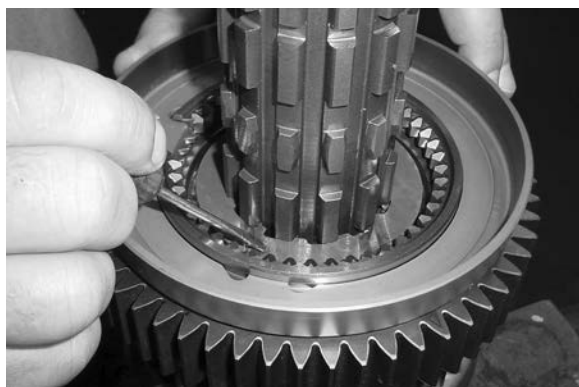
15. Remove 1/5/9 gear.



16. Remove the washer.



17. Remove the 1/5/9 - 2/6/10 synchronizer.



18. Remove the 2nd gear washer.

Transmission Overhaul Procedures-Bench Service

19. Remove 2/6/10 gear.



20. Remove the 3rd gear washer.



21. Remove 3/7/11 gear.



22. Remove the final washer.



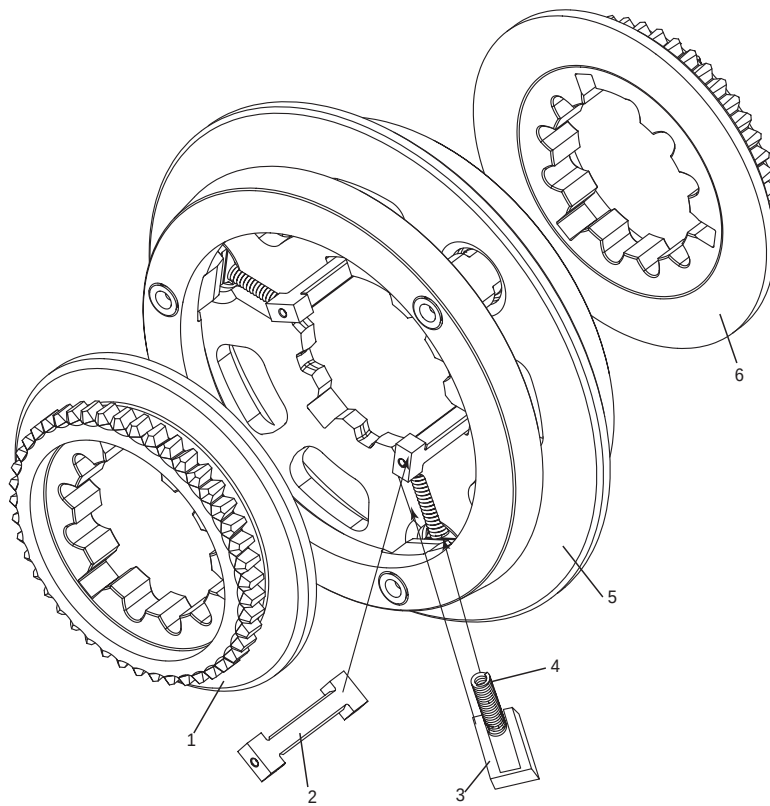
How to Disassemble the Mainshaft Synchronizers

Special Instructions

None

Special Tools

- Synchronizer Plate



- 1. Synchronizer Hub
- 2. Synchronizer Alignment Pegs
- 3. Detent Blocks

- 4. Detent Springs
- 5. Synchronizer Ring
- 6. Synchronizer Hub

Transmission Overhaul Procedures-Bench Service

Procedure -

1. Procedures to complete first:
 - How to Remove the Air Lines
 - How to Remove the Boosted or Hydraulic Clutch Actuator or Adapter Housing
 - How to Remove the Auxiliary Drive Gear
 - How to Remove the Upper Reverse Idler Assembly
 - How to Remove the Remote Shift Control
 - How to Remove the Shift Bar Housing
 - How to Remove the Auxiliary Section
 - How to Remove the Clutch Housing
 - How to Remove the Front Countershaft Bearing Retainers.
 - How to Remove the Input Shaft
 - How to Remove the Upper Countershaft Bearings
 - How to Remove the Mainshaft Assembly
 - How to Disassemble the Mainshaft Assembly
2. Place the tool flat on the bench.

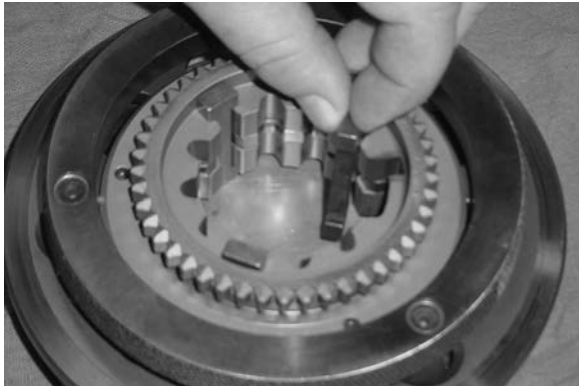


3. Place the synchronizer on the tool.

Note: Install shop rag in center of synchronizer ring to hold the springs and detents in place.



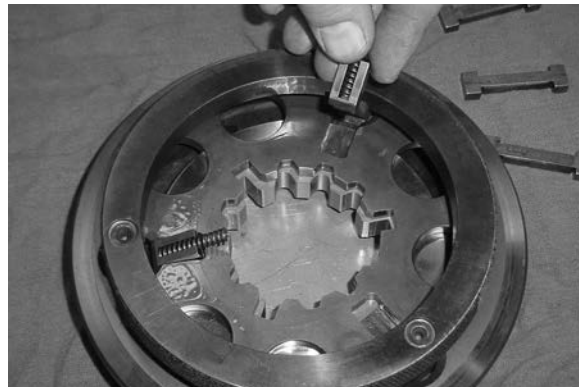
Transmission Overhaul Procedures-Bench Service



4. Remove the synchronizer lugs.



5. Place a rag over the synchronizer and perform a partial shift to unseat the springs. Remove the top clutch hub.



6. Remove the three springs and blocks.



7. Remove the synchronizer ring.

Transmission Overhaul Procedures-Bench Service

How to Remove the Upper Countershaft Assembly

Special Instructions

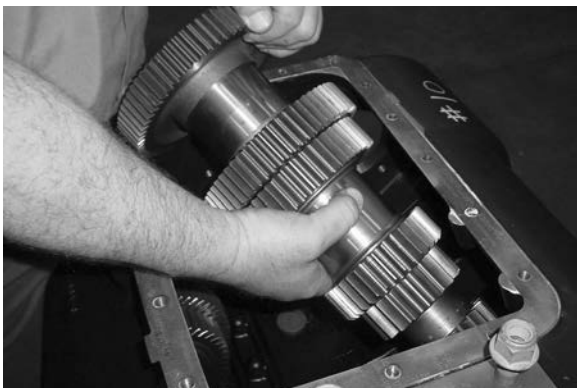
None

Special Tools

- Typical service tools

Procedure -

1. Procedures to complete first:
 - How to Remove the Air Lines
 - How to Remove the Boosted or Hydraulic Actuator or Adapter Housing
 - How to Remove the Auxiliary Drive Gear Assembly
 - How to Remove the Upper Reverse Idler Assembly
 - How to Remove the Remote Shift Control
 - How to Remove the Shift Bar Housing
 - How to Remove the Auxiliary Section
 - How to Remove the Clutch Housing
 - How to Remove the Front Countershaft Bearing Retainers.
 - How to Remove the Input Shaft
 - How to Remove the Upper Countershaft Bearings
 - How to Remove the Mainshaft Assembly
2. Move the upper countershaft assembly to the rear as far as possible.
3. Lift upper countershaft from the case.



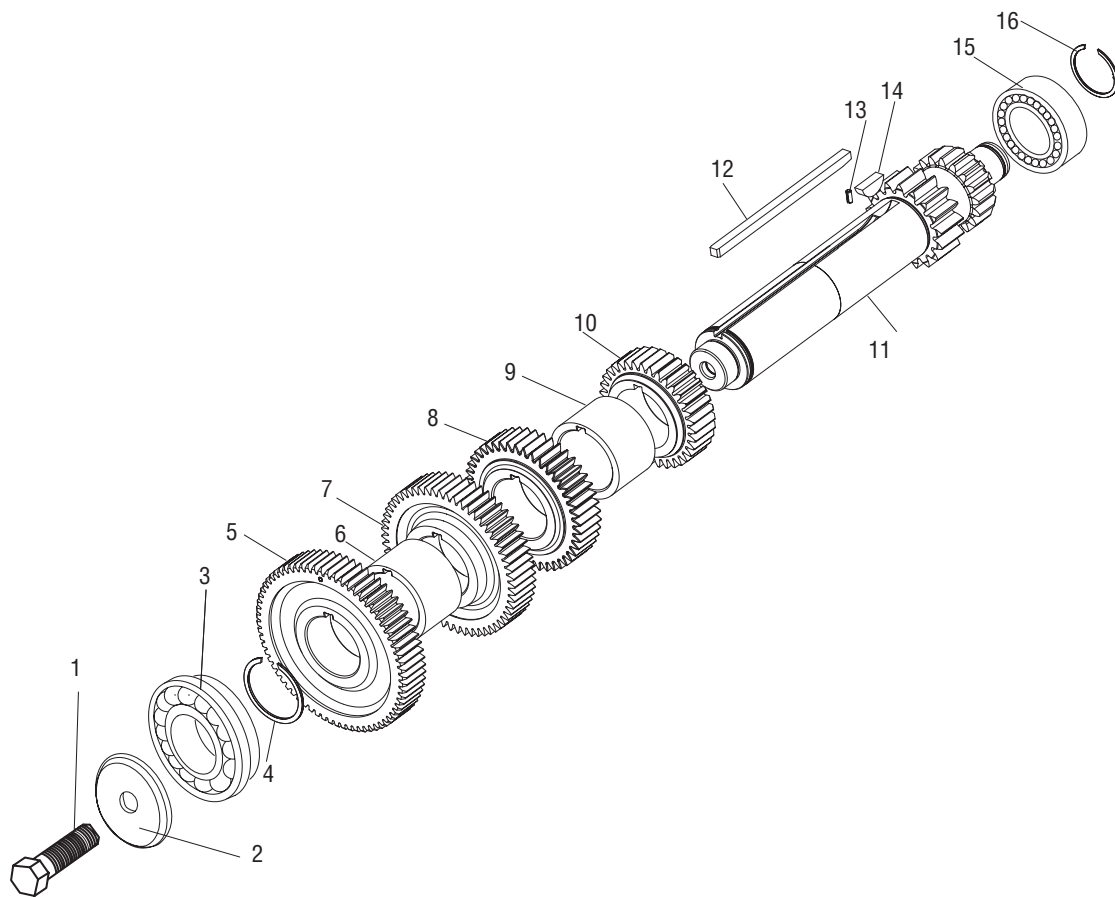
How to Disassemble the Uppper Countershaft Assembly

Special Instructions

None

Special Tools

- Typical service tools



1. Retainer Capscrew

2. Retainer

3. Front Bearing

4. Snap Ring

5. Countershaft Drive Gear

6. Sleeve

7. Countershaft 3rd/PTO Gear

8. Countershaft 2nd Gear

9. Sleeve

10. Countershaft 1st Gear

11. Countershaft

12. Countershaft Key

13. Countershaft Roll Pin

14. Countershaft Woodruff Key

15. Countershaft Rear Bearing

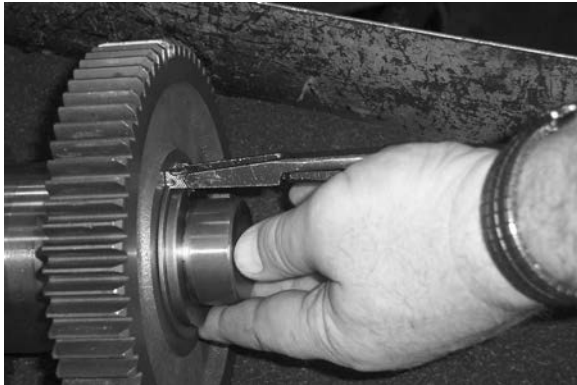
16. Snap Ring

Transmission Overhaul Procedures-Bench Service

Procedure -

- How to Remove the Air Lines
- How to Remove the Boosted or Hydraulic Actuator or Adapter Housing
- How to Remove the Auxiliary Drive Gear Assembly
- How to Remove the Upper Reverse Idler Assembly
- How to Remove the Remote Shift Control
- How to Remove the Shift Bar Housing
- How to Remove the Auxiliary Section
- How to Remove the Clutch Housing
- How to Remove the Front Countershaft Bearing Retainers.
- How to Remove the Input Shaft
- How to Remove the Upper Countershaft Bearings
- How to Remove the Mainshaft Assembly
- How to Remove the Upper Countershaft Assembly

1. Remove the snap ring from the front of the countershaft.



2. Place the countershaft in the press.



3. Press off the countershaft 4th gear using the face of 4th gear as a base.



Transmission Overhaul Procedures-Bench Service

4. Press off 3rd gear and the sleeve.



5. Press off 2nd gear and the sleeve.



6. Press off 1st gear.



Transmission Overhaul Procedures-Bench Service

How to Remove the Lower Countershaft Bearings

Special Instructions

None

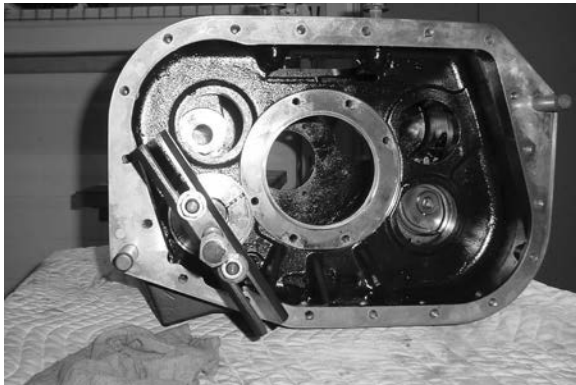
Special Tools

- Bearing Puller and snap ring

Procedure -

- How to Remove the Air Lines
- How to Remove the Boosted or Hydraulic Actuator or Adapter Housing
- How to Remove the Auxiliary Drive Gear Assembly
- How to Remove the Upper Reverse Idler Assembly
- How to Remove the Remote Shift Control
- How to Remove the Shift Bar Housing
- How to Remove the Auxiliary Section
- How to Remove the Clutch Housing
- How to Remove the Front Countershaft Bearing Retainers.
- How to Remove the Input Shaft
- How to Remove the Upper Countershaft Bearings
- How to Remove the Mainshaft Assembly
- How to Remove the Upper Countershaft Assembly

1. Attach the snap ring from the tool to the rear countershaft bearing. Then, attach the bearing puller and remove the bearing.



2. Remove front bearing from case.

Note: If the shaft is still in the bearing, drive it rearward until the bearing can be removed by hand.

How to Remove the Lower Countershaft Assembly

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

- How to Remove the Air Lines
- How to Remove the Boosted or Hydraulic Actuator or Adapter Housing
- How to Remove the Auxiliary Drive Gear Assembly
- How to Remove the Upper Reverse Idler Assembly
- How to Remove the Remote Shift Control
- How to Remove the Shift Bar Housing
- How to Remove the Auxiliary Section
- How to Remove the Clutch Housing
- How to Remove the Front Countershaft Bearing Retainers.
- How to Remove the Input Shaft
- How to Remove the Upper Countershaft Bearings
- How to Remove the Mainshaft Assembly
- How to Remove the Upper Countershaft Assembly
- How to Remove the Lower Countershaft Bearings

1. Move the upper countershaft assembly to the rear as far as possible.
2. Lift the upper countershaft from the case.



Transmission Overhaul Procedures-Bench Service

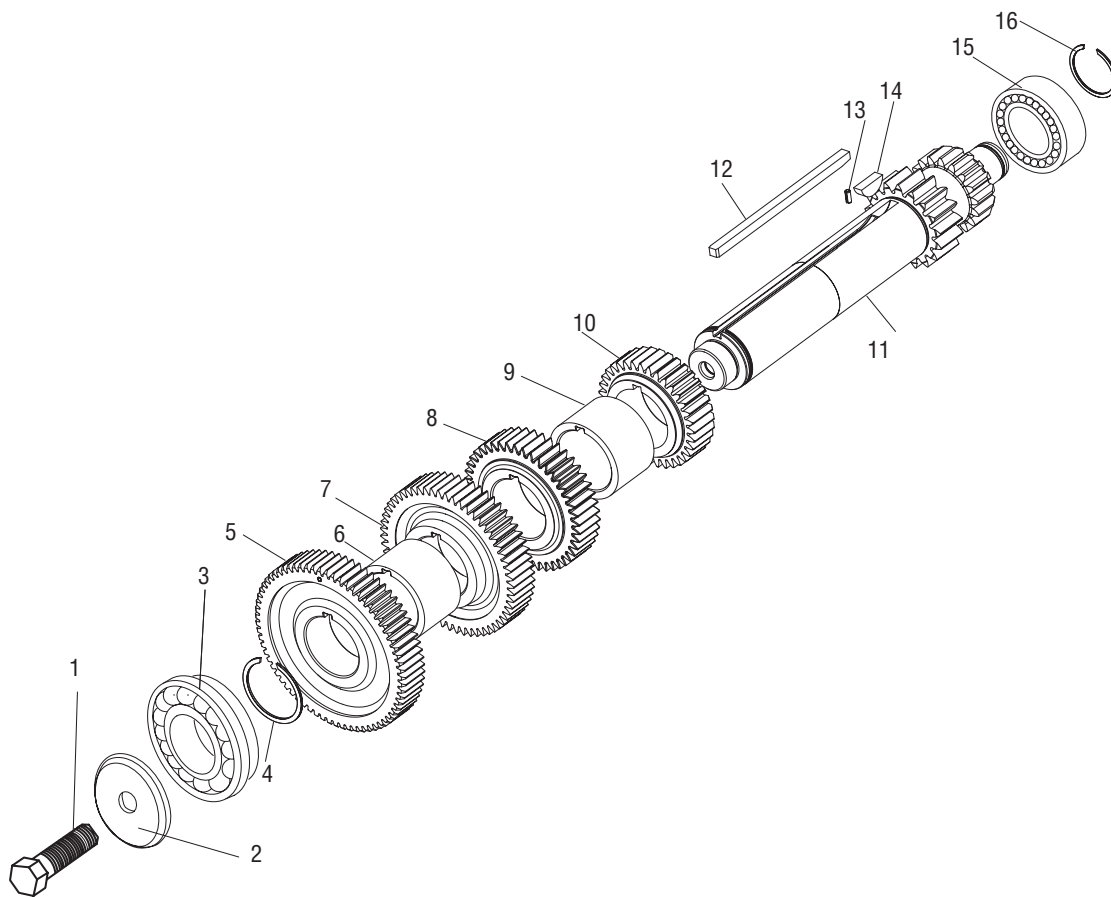
How to Disassemble the Lower Countershaft Assembly

Special Instructions

None

Special Tools

- Typical service tools



1. Retainer Capscrew

2. Retainer

3. Front Bearing

4. Snap Ring

5. Countershaft Drive Gear

6. Sleeve

7. Countershaft 3rd/PTO Gear

8. Countershaft 2nd Gear

9. Sleeve

10. Countershaft 1st Gear

11. Countershaft

12. Countershaft Key

13. Countershaft Roll Pin

14. Countershaft Woodruff Key

15. Countershaft Rear Bearing

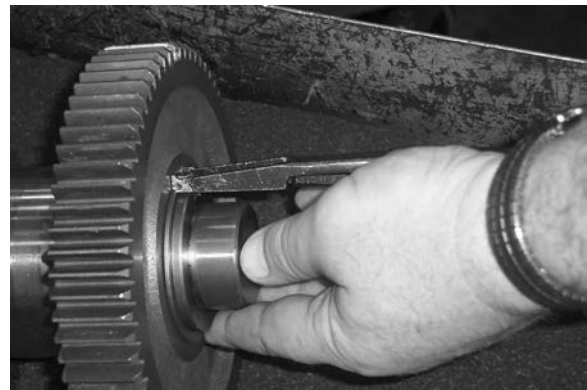
16. Snap Ring

Transmission Overhaul Procedures-Bench Service

Procedure -

- How to Remove the Air Lines
- How to Remove the Boosted or Hydraulic Actuator or Adapter Housing
- How to Remove the Auxiliary Drive Gear Assembly
- How to Remove the Upper Reverse Idler Assembly
- How to Remove the Remote Shift Control
- How to Remove the Shift Bar Housing
- How to Remove the Auxiliary Section
- How to Remove the Clutch Housing
- How to Remove the Front Countershaft Bearing Retainers.
- How to Remove the Input Shaft
- How to Remove the Upper Countershaft Bearings
- How to Remove the Mainshaft Assembly
- How to Remove the Upper Countershaft Assembly
- How to Remove the Lower Countershaft Bearings
- How to Remove the Lower Countershaft Assembly

1. Remove the snap ring from the front of the countershaft.



2. Place the countershaft in the press.



3. Press off the countershaft 4th gear using the face of 4th gear as a base.



Transmission Overhaul Procedures-Bench Service



4. Press off 3rd gear and sleeve.



5. Press off 2nd gear and sleeve.



6. Press off 1st gear.

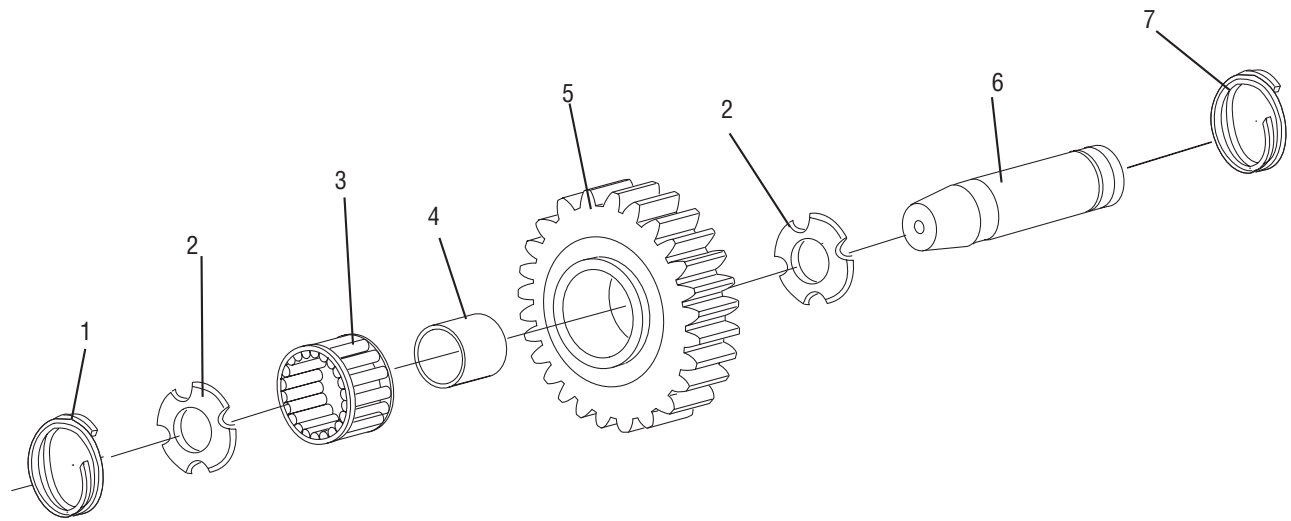
How to Remove the Lower Reverse Idler Assembly

Special Instructions

None

Special Tools

- Slide Hammer



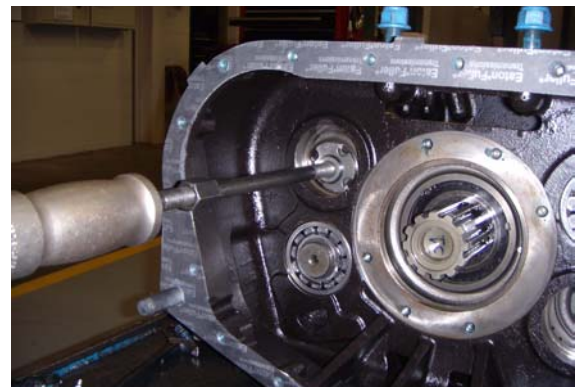
- 1. Snap Ring
- 2. Washer
- 3. Bearing
- 4. Race

- 5. Reverse Idler Gear
- 6. Idler Shaft
- 7. Snap Ring

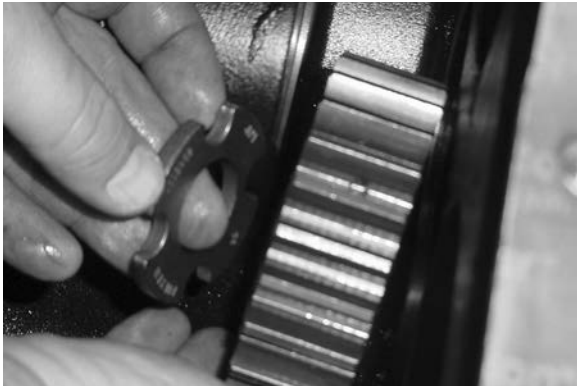
Transmission Overhaul Procedures-Bench Service

Procedure -

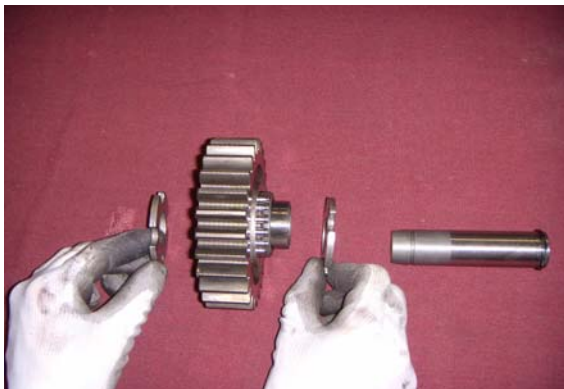
- How to Remove the Air Lines
 - How to Remove the Boosted or Hydraulic Actuator or Adapter Housing
 - How to Remove the Auxiliary Drive Gear Assembly
 - How to Remove the Upper Reverse Idler Assembly
 - How to Remove the Remote Shift Control
 - How to Remove the Shift Bar Housing
 - How to Remove the Auxiliary Section
 - How to Remove the Clutch Housing
 - How to Remove the Front Countershaft Bearing Retainers.
 - How to Remove the Input Shaft
 - How to Remove the Upper Countershaft Bearings
 - How to Remove the Mainshaft Assembly
 - How to Remove the Upper Countershaft Assembly
 - How to Remove the Lower Countershaft Bearings
1. Remove the snap ring from the tapered end of the shaft.
 2. The snap ring will be damaged on removal and can not be reused.
 3. Install the slide hammer into the back of the reverse idler shaft and pull it from the case.



Transmission Overhaul Procedures-Bench Service



4. Remove the reverse gear and washer from the case.



5. Inspect the reverse idler assembly for damage or wear.

Transmission Overhaul Procedures-Bench Service

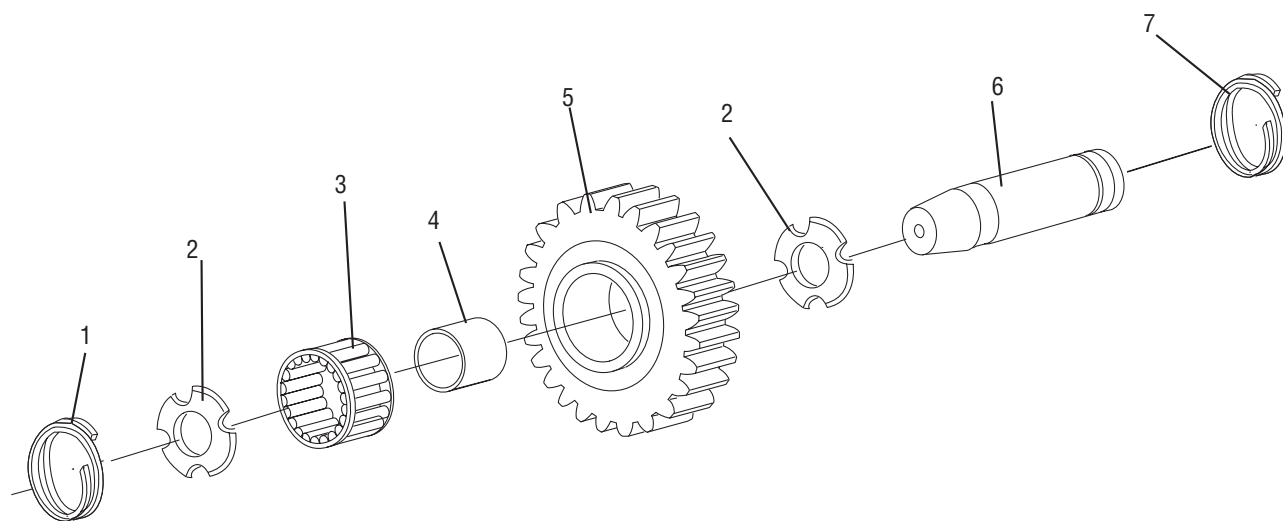
How to Install the Lower Reverse Idler Assembly

Special Instructions

None

Special Tools

- Typical service tools



- 1. Snap Ring
- 2. Washer
- 3. Bearing
- 4. Race

- 5. Reverse Idler Gear
- 6. Idler Shaft
- 7. Snap Ring

Transmission Overhaul Procedures-Bench Service

Procedure -

1. Make sure the reverse gear bearing and race are installed in the gear.

2. Install the gear and washer in the case.

Note: Make sure to place the washer in the front of the reverse idler gear with the writing on the washer facing the clutch housing.

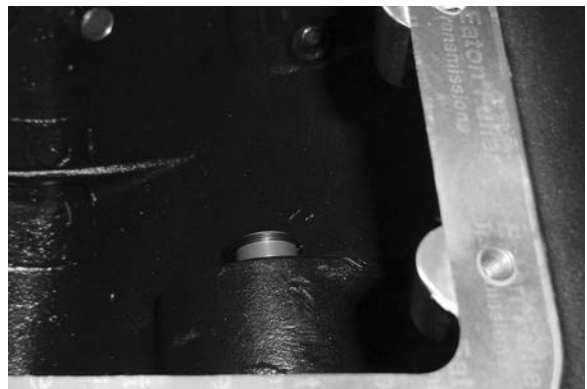
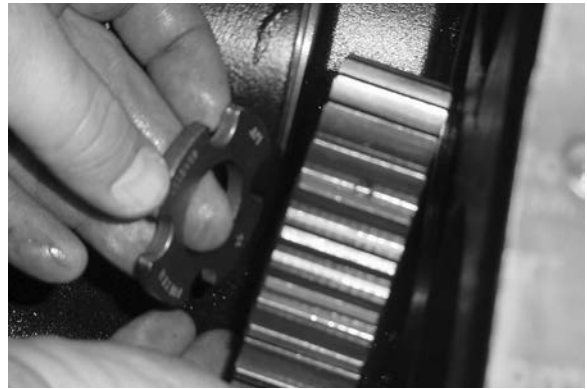
3. If the rear snap ring was removed replace.

4. Hold the reverse gear and washer with one hand and pilot the idler shaft into the gear until it holds the gear and washer from falling. Finish driving the idler shaft into place with a driver.

5. Install the snap ring on the reverse idler shaft tapered end.

6. Install the snap ring on the idler shaft using a 1-1/8" (29 mm) socket. Push the snap ring over the tapered end of the shaft until its fully seated in the groove.

Note: Make sure the snap ring is fully seated in the groove.



Transmission Overhaul Procedures-Bench Service

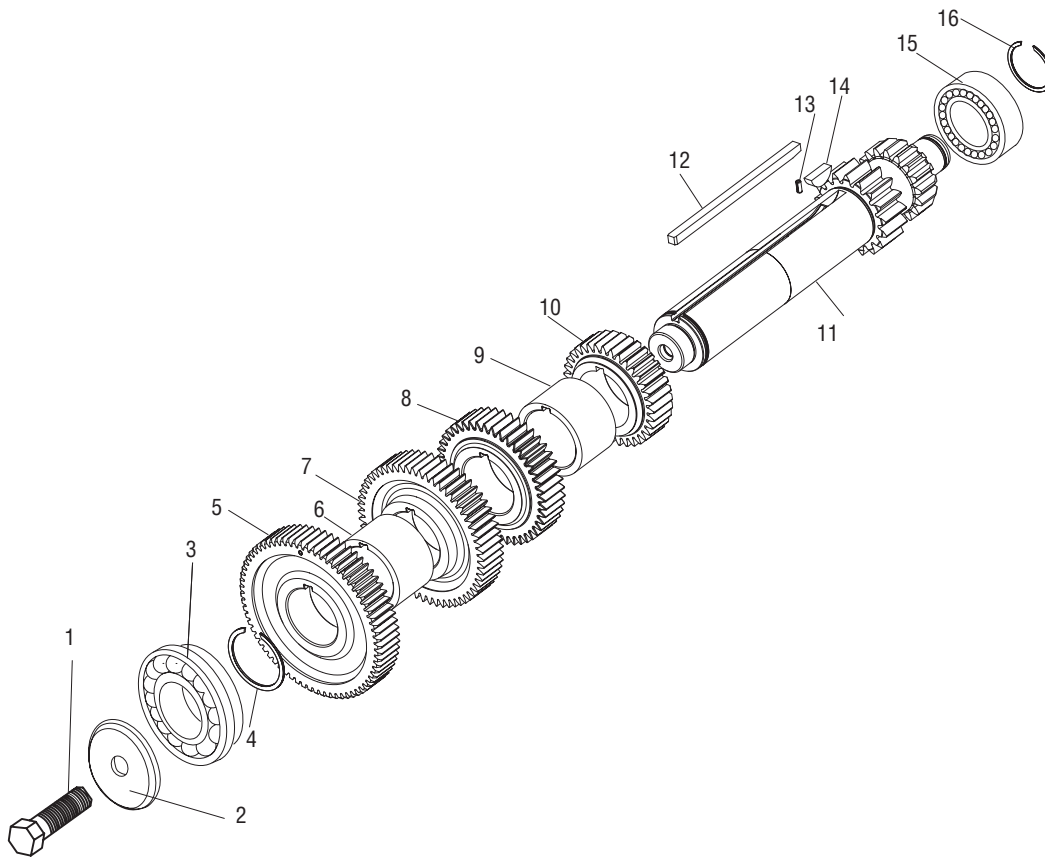
How to Assemble the Upper and Lower Countershafts

Special Instructions

The use of lubricant will ease the assembly, when pressing the gears onto the countershafts.

Special Tools

- Typical service tools



1. Retainer Capscrew

2. Retainer

3. Front Bearing

4. Snap Ring

5. Countershaft Drive Gear

6. Sleeve

7. Countershaft 3rd/PTO Gear

8. Countershaft 2nd Gear

9. Sleeve

10. Countershaft 1st Gear

11. Countershaft

12. Countershaft Key

13. Countershaft Roll Pin

14. Countershaft Woodruff Key

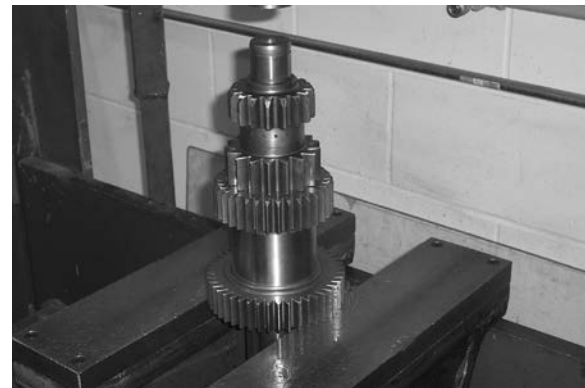
15. Countershaft Rear Bearing

16. Snap Ring

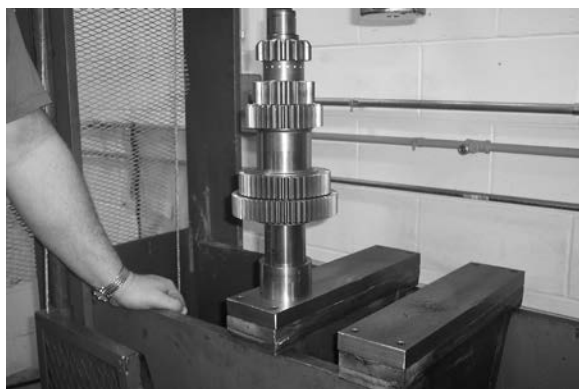
Transmission Overhaul Procedures-Bench Service

Procedure -

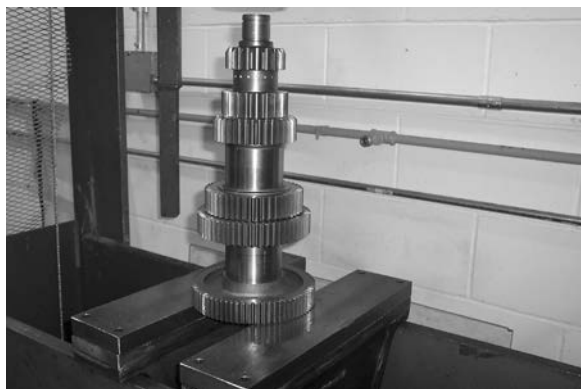
1. If previously removed, install the keys in each countershaft keyway.
2. Align the 1st gear keyway with the countershaft key, and press the gear on the countershaft.
3. Align the 1st gear sleeve keyway with the countershaft key.
4. Align the 2nd speed gear keyway with the countershaft key and press the gear and sleeve on the countershaft.
5. Align the 3rd speed gear keyway with the countershaft key, and press on the countershaft.



Transmission Overhaul Procedures-Bench Service



6. Align the 3rd gear sleeve keyway with the countershaft key.



7. Align the 4th speed gear keyway with the countershaft key, and press the gear and sleeve on the countershaft.



8. Install the snap ring on the front of the countershaft.

How to Install the Lower Countershaft and Bearings

Special Instructions

None

Special Tools

- Countershaft Support Timing Tool
- Front Countershaft Bearing Driver
- Front Countershaft Rear Bearing Driver



Procedure -

1. On the drive gear of the countershaft mark the tooth aligned with the gear keyway. Use a highly visible toolmakers dye like yellow or white.



2. Install the lower countershaft into the case.



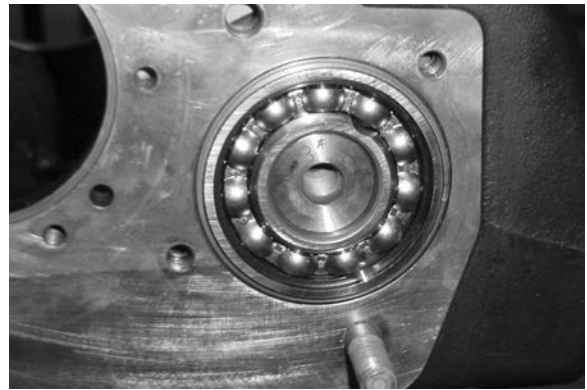
3. Install the tool to support the countershaft rear.

Transmission Overhaul Procedures-Bench Service

4. Install the front countershaft bearing and drive on with the bearing driver.



5. Make sure bearing is flush with the countershaft.

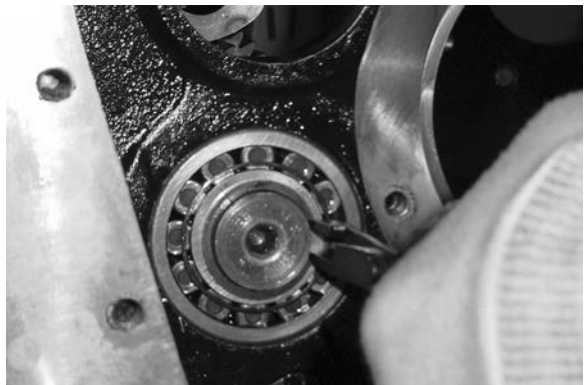


6. Install the bearing and use the tool to drive the rear bearing into place.

Note: The bearing should be recessed into the case slightly.



7. Install the snap ring on the rear of the countershaft.



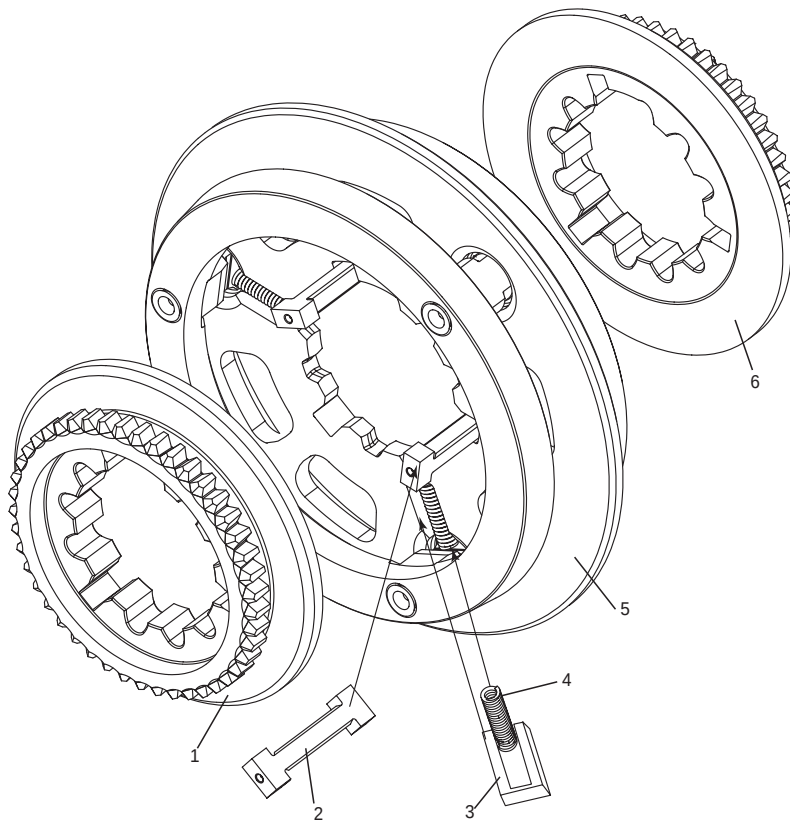
How to Assemble the Mainshaft Synchronizers

Special Instructions

None

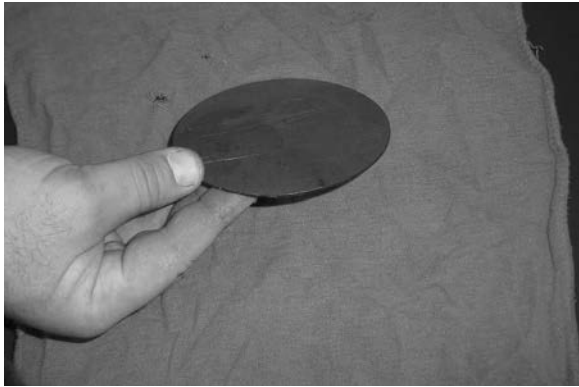
Special Tools

- Synchronizer Plate



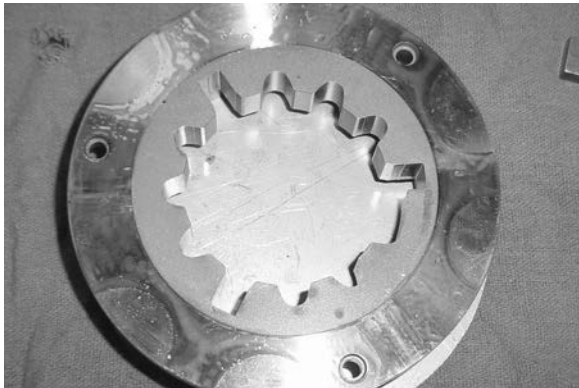
- 1. Synchronizer Hub
- 2. Synchronizer Alignment Pegs
- 3. Detent Blocks

- 4. Detent Springs
- 5. Synchronizer Ring
- 6. Synchronizer Hub



Procedure -

1. Place the tool on a flat surface.



2. Install the lower synchronizer plate on the plate.



3. Install the synchronizer ring onto the plate.



4. Make sure the keyway slot on the synchronizer plate and the synchronizer ring line up.

5. Place the springs in the keys.



6. Install the keys by placing pressure on the end of the spring with a small screwdriver.

Note: Be careful not to lift up on the middle synchronizer ring during assembly because it could dislodge the springs.



7. Place the top plate onto the synchronizer ring.



8. Make sure the keyway on the top synchronizer plate and the synchronizer ring line up.



Transmission Overhaul Procedures-Bench Service



9. Install the synchronizer lugs.



10. Place a shop rag into the center of the synchronizer until its ready to be installed.

Be careful when handling the synchronizer without a rag in the middle. Moving the middle ring will cause the springs to pop out of their place.

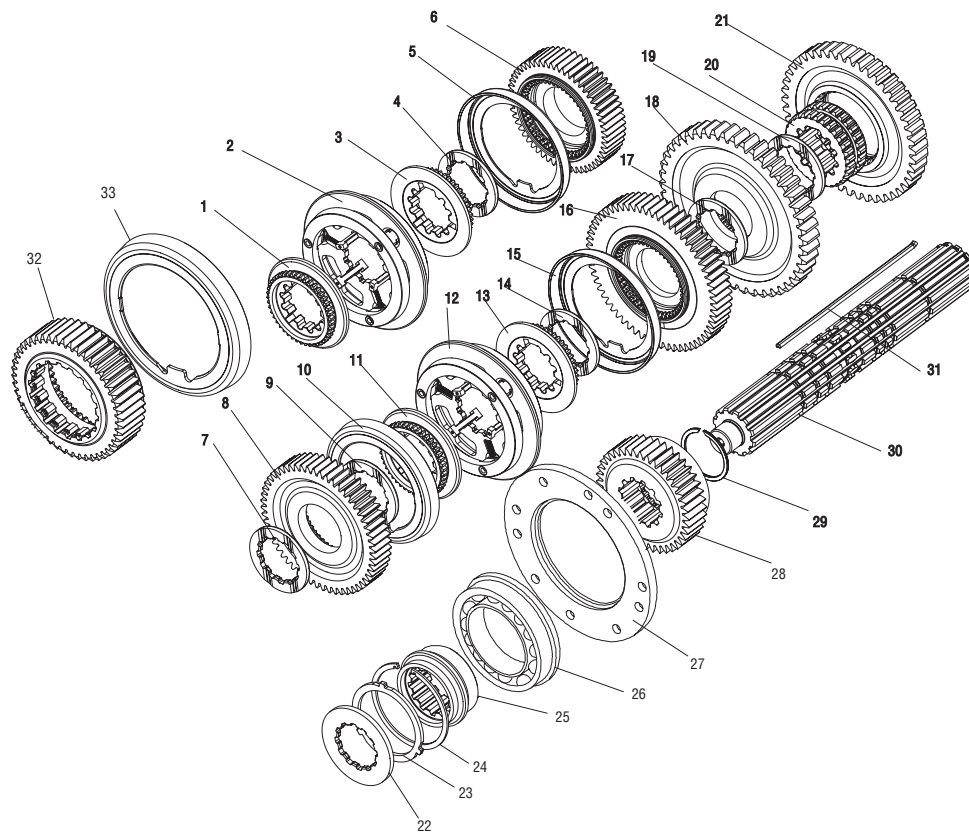
How to Assemble the Mainshaft Assembly

Special Instructions

None

Special Tools

- Typical service tools

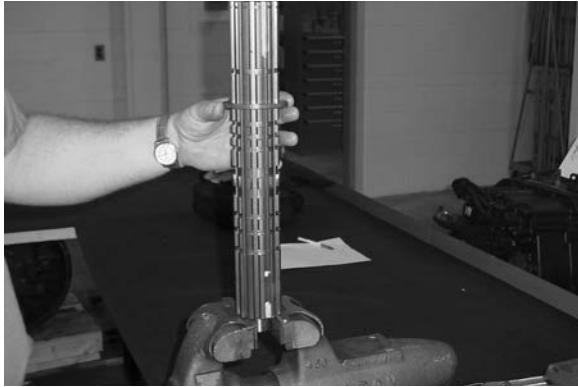


1. Synchronizer Hub
2. Synchronizer Ring
3. Synchronizer Hub
4. Washer
5. 3rd Gear Cup
6. 3rd Gear
7. Washer
8. 2nd Gear
9. Washer
10. 2nd Gear Cup
11. Synchronizer Hub

12. Synchronizer Ring
13. Synchronizer Hub
14. Washer
15. 1st Gear Cup
16. 1st Gear
17. Washer
18. LO Gear
19. Washer
20. Sliding Clutch
21. Reverse Gear
22. Washer

23. Spacer
24. Snap Ring
25. Auxiliary Bearing Hub
26. Auxiliary Drive Gear Bearing
27. Auxiliary Bearing Retainer Plate
28. Auxiliary Drive Gear
29. Snap Ring
30. Mainshaft
31. Mainshaft Key
32. Mainshaft Drive Gear
33. Mainshaft Drive Gear Cup

Transmission Overhaul Procedures-Bench Service

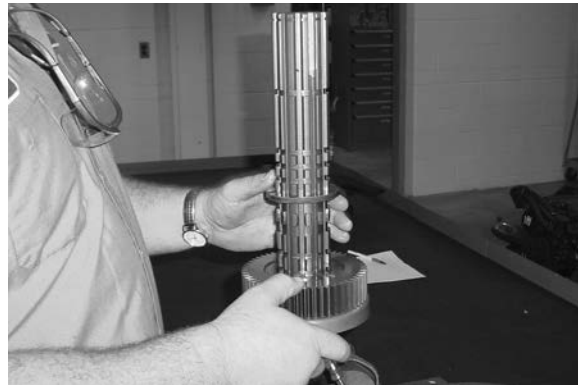


Procedure -

1. With the mainshaft pilot end down, install the washer. Rotate the washer until the splines on the washer and the mainshaft splines align.



2. Install a plastic air line starting from the bottom of the mainshaft keyway and work up to the top as each additional part is placed on the mainshaft.



3. With synchronizer cup facing down, install 3/7/11 gear onto the mainshaft.

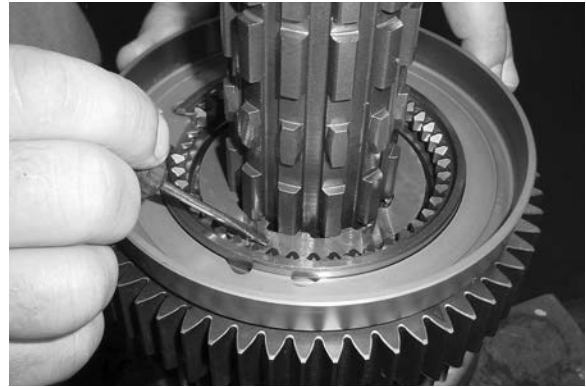


4. Install the flat washer. Rotate the washer until the washer splines and mainshaft splines align.

5. With the synchronizer cup facing up, install 2/6/10 gear onto the mainshaft.

Transmission Overhaul Procedures-Bench Service

6. Position the flat washer against the gear. Rotate the washer until the washer splines and mainshaft splines align.



7. Install the synchronizer onto the mainshaft. Make sure the keyway on the synchronizer and the mainshaft key line up.



8. Install the next washer by the synchronizer. Rotate the washer until the washer splines and mainshaft splines align.



9. Install the 1/5/9 gear with the synchronizer cup facing down onto the mainshaft.



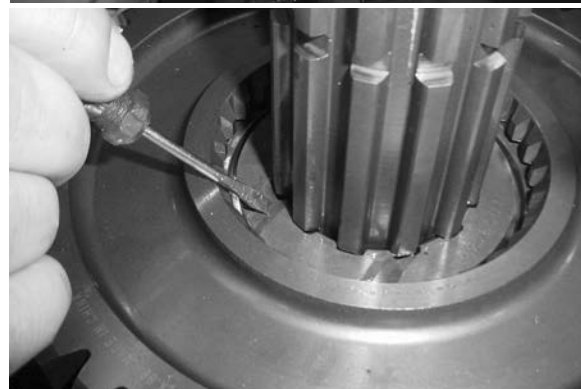
Transmission Overhaul Procedures-Bench Service



10. Install the flat washer. Rotate the washer until the washer splines and mainshaft splines align.



11. Install LO gear onto the mainshaft.



12. Install the flat washer. Rotate the washer until the washer splines and mainshaft splines align.



13. Install the LO/Reverse sliding clutch.

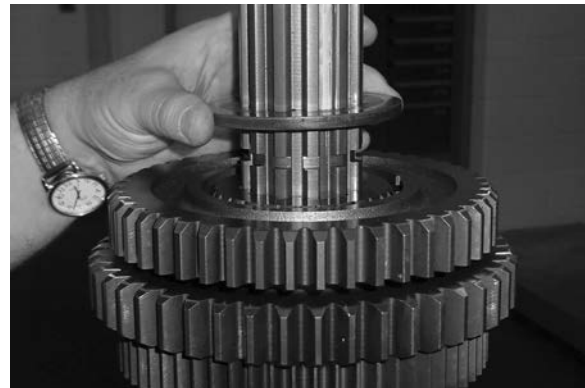
Note: Make sure the reverse gear is installed with the internal clutching teeth facing down.

Transmission Overhaul Procedures-Bench Service

14. Install the reverse gear.



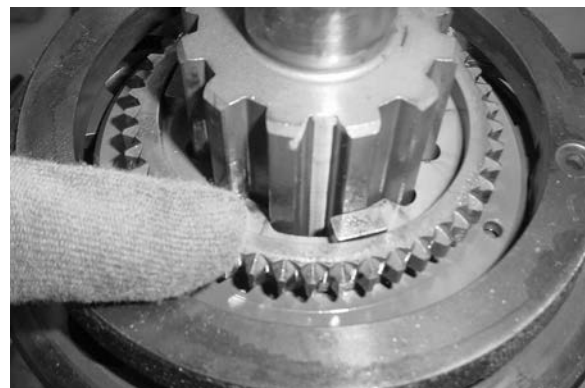
15. Install the flat washer. Rotate the washer until the washer splines and mainshaft splines align.



16. Install the key from the top as the plastic air line is pulled out the bottom.



17. Install the front mainshaft synchronizer.



Transmission Overhaul Procedures-Bench Service



18. Mark two teeth on the main drive gear then mark two teeth directly opposite. Use a visible toolmakers dye with a color like yellow or white.
19. Install the main drive gear onto the mainshaft.

How to Install the Upper Countershaft Assembly

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

1. On the drive gear of the countershaft mark the tooth aligned with the gear keyway. Use a highly visible toolmakers dye like yellow or white.
2. Install the upper countershaft.
3. Place a support (as shown) on the front of the countershaft to hold it away from the center of the case.



Transmission Overhaul Procedures-Bench Service

How to Install and Time the Mainshaft Assembly

Special Instructions

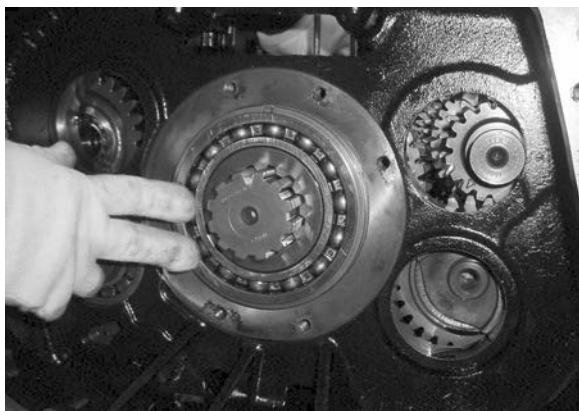
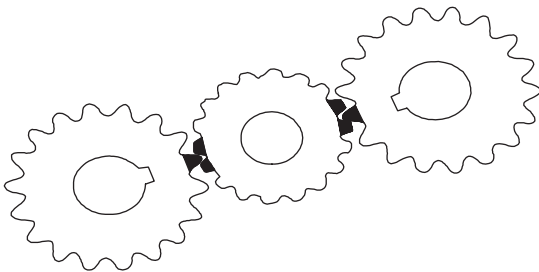
None

Special Tools

- J-Hooks
- Input Bearing Driver



Figure 3



Procedure -

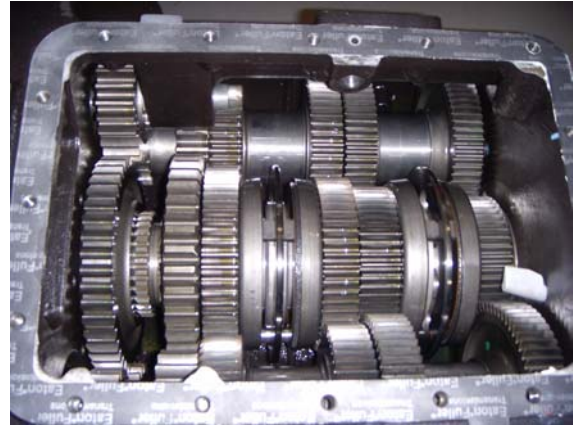
1. Make sure the proper tools are installed before attempting to install the mainshaft.
2. Install the J-hooks onto the mainshaft and lower it into the maincase.

Note: The upper countershaft may need to be held towards the wall, while someone else maneuvers the mainshaft into place.

3. Line the two marked teeth on the main drive gear up with the marked tooth on the countershaft drive gear.
4. Partially install just the auxiliary drive gear bearing to help align the mainshaft for assembly.

Transmission Overhaul Procedures-Bench Service

5. At this time, other components of the front section must be installed before the mainshaft installation and timing can be completed. To complete the mainshaft timing see procedures:
 - a. How to Install the Input Shaft Assembly
 - b. How to Install the Upper Countershaft Bearings.



Transmission Overhaul Procedures-Bench Service

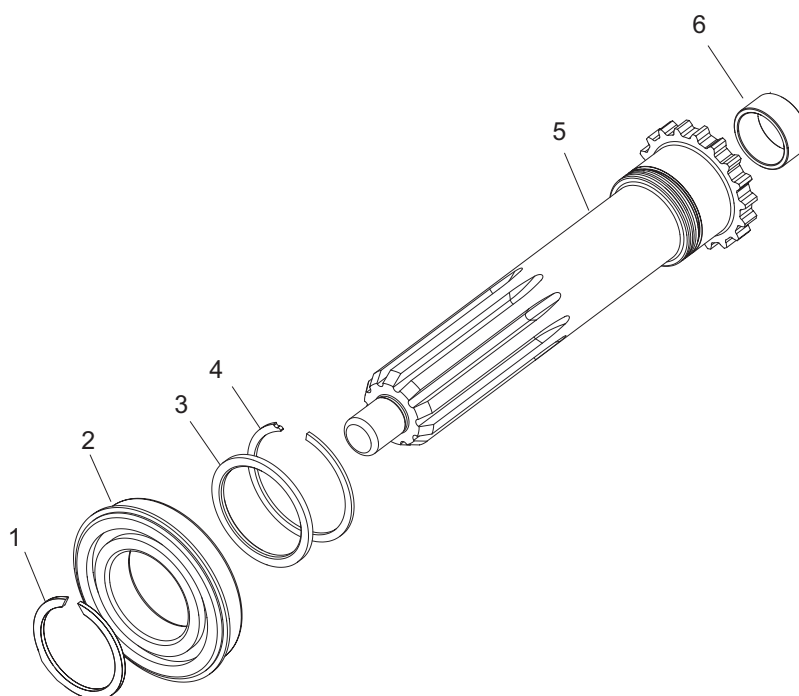
How to Install the Input Shaft Assembly

Special Instructions

None

Special Tools

- Bearing Driver



1. Snap Ring
2. Input Shaft Bearing
3. Spacer

4. Snap Ring
5. Input Shaft
6. Bushing

Transmission Overhaul Procedures-Bench Service

Procedure -

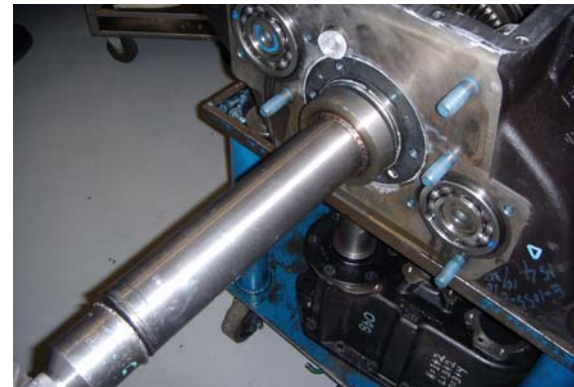
1. Install the input shaft and insert the main drive gear snap ring.



2. Install the input shaft spacer.



3. Install the input bearing with the input bearing driver.



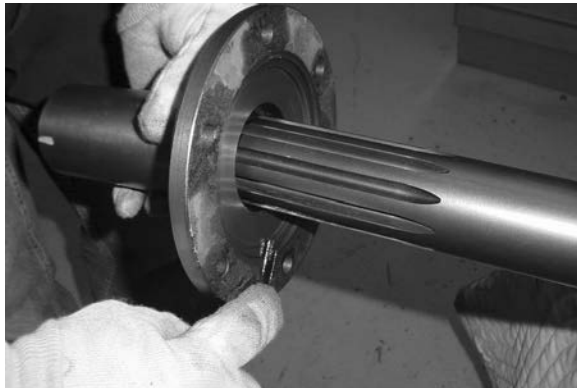
4. Install the snap ring in front of the input bearing.

Note: If the snap ring groove is not accessible hold the input shaft and tap lightly on the input shaft outer bearing race.

5. Align the upper countershaft timing marks with the main drive gear timing marks.
6. Place a new gasket on the bearing cover housing.



Transmission Overhaul Procedures-Bench Service



7. Install the inputshaft bearing cover housing making sure to orient the oil hole on the housing (as shown) with the one on the main case.
8. Install the six capscrews and apply sealant. Tighten to 54-61 N•m (40-45 lbs. ft.).
9. At this time, other components of the front section must be installed before the mainshaft installation and timing can be completed. To finish timing the mainshaft assembly follow:
 - a. How to Install the Upper CounterShaft Bearings

How to Install the Upper Countershaft Bearings

Special Instructions

None

Special Tools

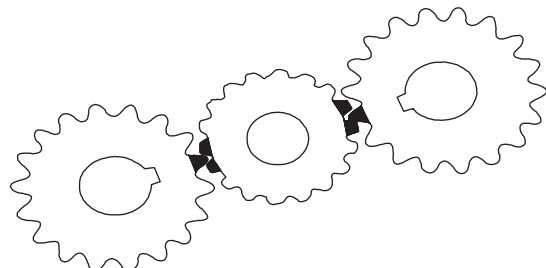
- Countershaft Timing Block
- Front Driver
- Rear Bearing Driver
- Retaining Strap

Procedure -

1. Insert the countershaft support tool to center the shaft in the rear case bore.
2. Use a tool to hold the countershaft up and start the front bearing into the bore.
3. Make sure the timing marks on the main drive gear and the countershaft drive gear line up.



Figure 3



Transmission Overhaul Procedures-Bench Service



4. Use a bearing driver to install the front countershaft bearing.



5. Install the bearing and use a tool to drive the rear bearing into place.

Note: The bearing should be recessed into the case slightly.



6. Install the snap ring onto the rear of the countershaft.

How to Install the Front Countershaft Bearing Retainers

Special Instructions

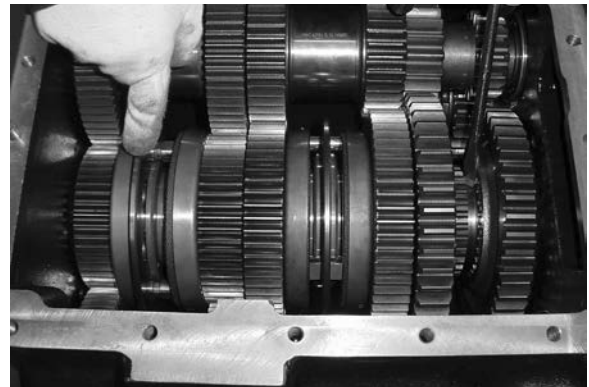
None

Special Tools

- Typical service tools

Procedure -

1. Lock the transmission mainbox into two gears.
2. Install the front countershaft bearing retainers and cap-screws. Tighten to 122-162 N•m (90-120 lbs. ft.).



Transmission Overhaul Procedures-Bench Service

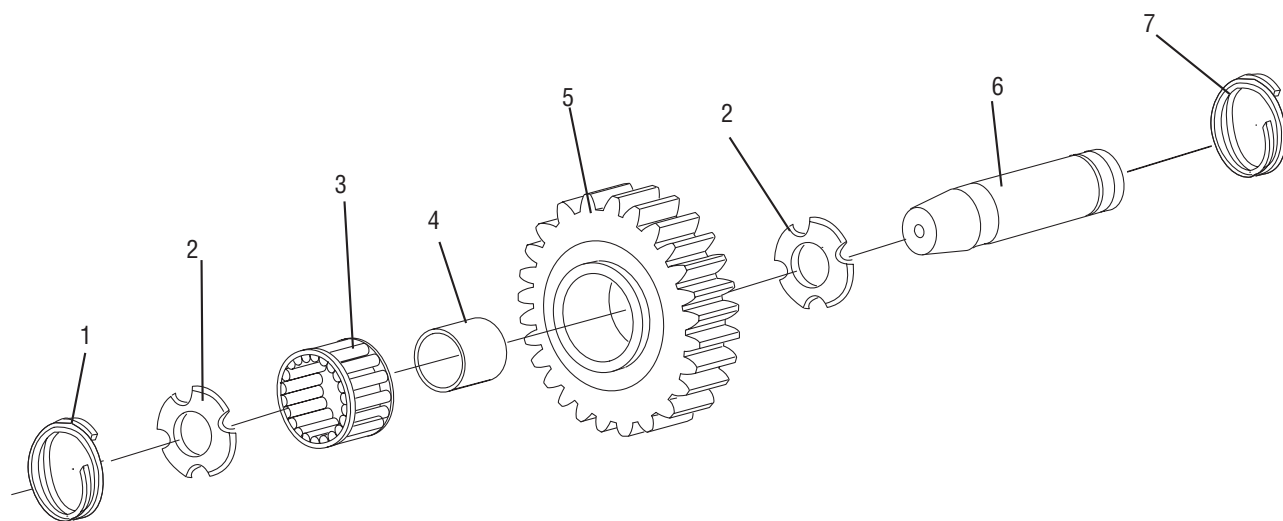
How to Install the Upper Reverse Idler Gear Assembly

Special Instructions

None

Special Tools

- Typical service tools

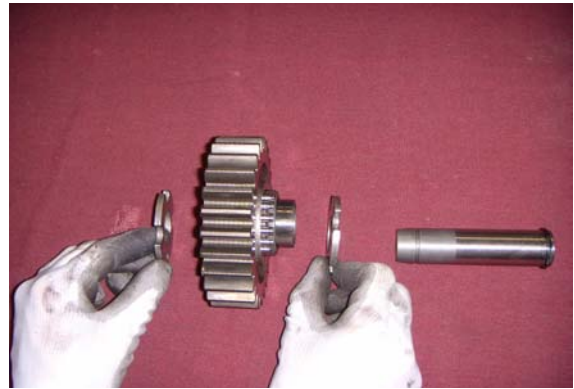


- 1. Snap Ring
- 2. Washer
- 3. Bearing
- 4. Race

- 5. Reverse Idler Gear
- 6. Idler Shaft
- 7. Snap Ring

Procedure -

1. Inspect the reverse idler shaft, race, and bearing for wear or damage and replace if necessary.



2. Insert the washer as shown with the writing facing the front of the transmission.

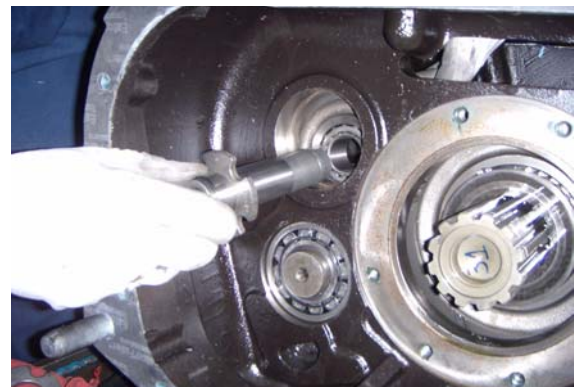
Note: Insert a finger or small screwdriver into the case boss to hold the washer and reverse gear from falling until the idler shaft is partially installed.



3. Inspect the rear snap ring and plate for damage or wear and replace as necessary.



4. Install the reverse idler shaft by hand until it partially pilots into the case bore and holds the gear and reverse idler washer.

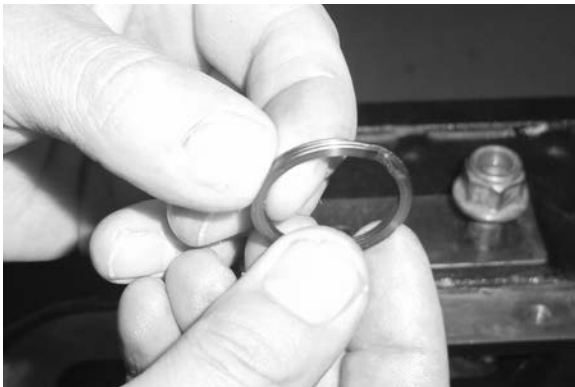


Transmission Overhaul Procedures-Bench Service

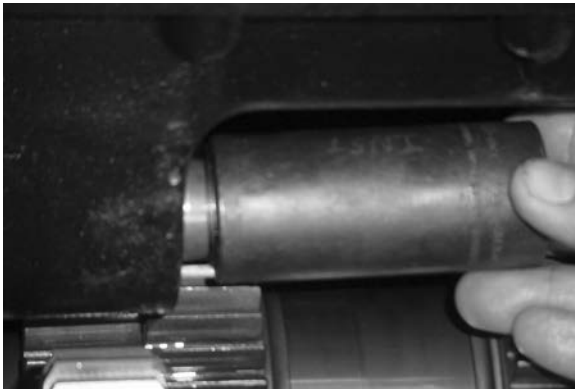


5. Drive the reverse idler shaft into place.

Note: Make sure to drive on the outside surface of the shaft and not inside the tapped hole.



6. Use a new spiral snap ring for installation. The snap ring should have no gaps between the rings.



7. Place the new snap ring on the tapered end of the idler shaft. Install a 1 - 1/8" (29 mm) socket on the idler shaft and drive the snap ring into place.



8. Use a screwdriver to assure the snap ring is completely in the groove.

How to Install the Auxiliary Drive Gear Assembly

Special Instructions

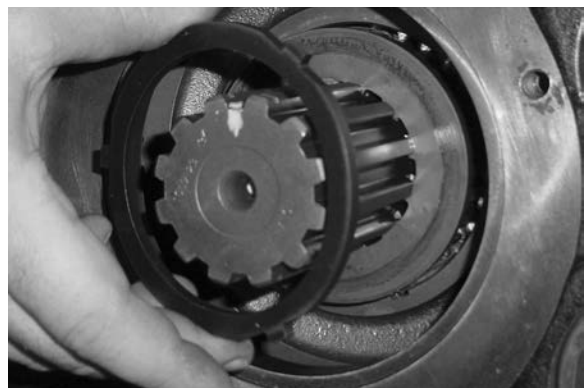
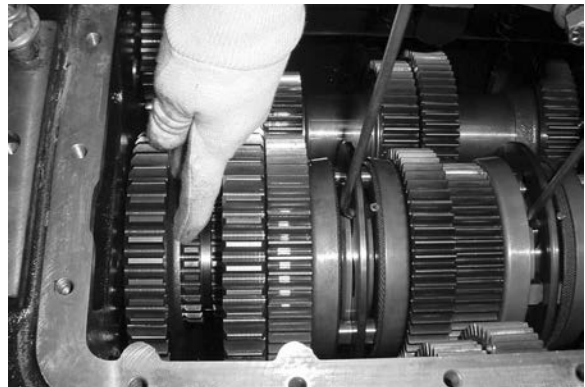
None

Special Tools

- Typical service tools

Procedure -

1. Move the reverse gear into mesh with the reverse idler gears.
2. Install the reverse gear spacer.
3. Install the reverse gear snap ring. Make sure the snap ring is fully seated in the reverse gear.



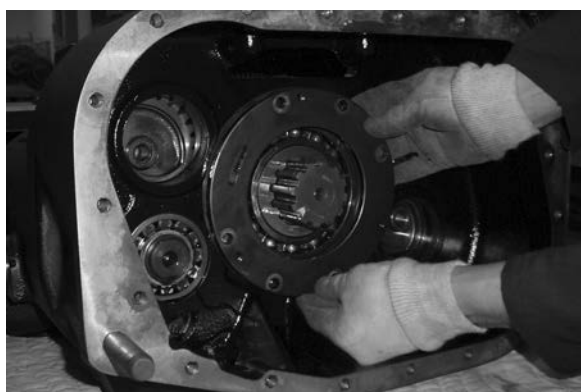
Transmission Overhaul Procedures-Bench Service



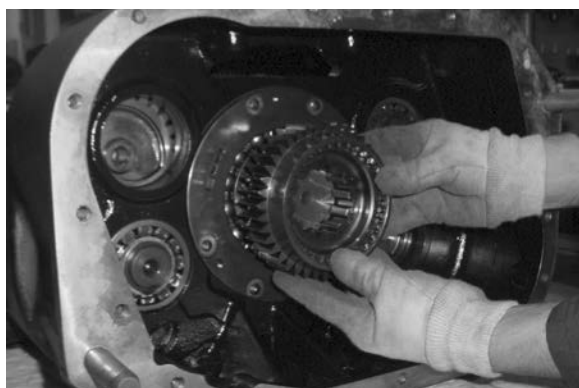
4. Assemble the auxiliary bearing and sleeve.



5. Install the auxiliary bearing.



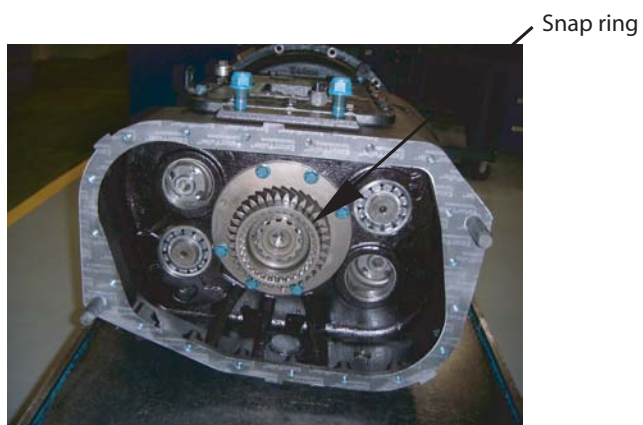
6. Install the auxiliary bearing retainer.



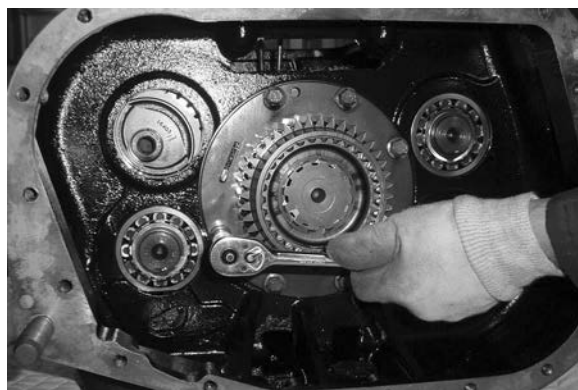
7. Install the auxiliary drive gear.

Transmission Overhaul Procedures-Bench Service

8. Install the auxiliary drive gear snap ring.



9. Install the auxiliary bearing retainer ring capscrews. Tighten to 54-61 N•m (40-45 lbs. ft.).



Transmission Overhaul Procedures-Bench Service

How to Install the Auxiliary Countershaft Front Bearings

Special Instructions

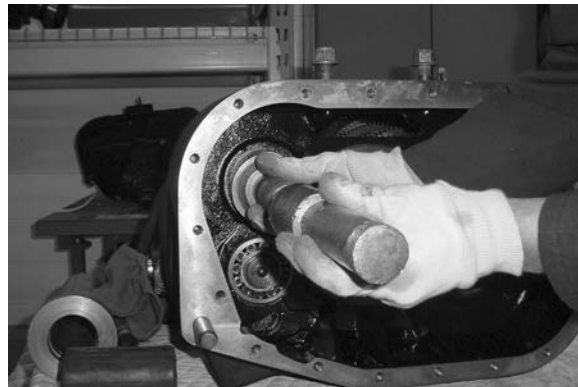
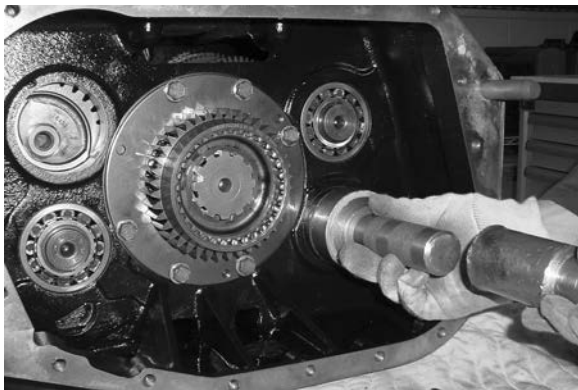
None

Special Tools

- Front Auxiliary Bearing Driver

Procedure -

1. Drive the lower auxiliary countershaft bearing cone in with the tool.
2. Drive the upper auxiliary countershaft bearing cone in with the tool.
3. The bearing cones should be driven until they contact the reverse idler cup, which positions them correctly.



Shim Procedure without a Shim Tool for Tapered Bearings

Special Instructions

The shim procedure can be done in the horizontal or vertical position. The procedure is done the same.



Use genuine Eaton® replacement gaskets for the auxiliary housing and countershaft bearing cover. Do not omit the gaskets. Bearing endplay is influenced by the compressed thickness of the gasket (.011-.012" or .28-.30 mm).

The bearing endplay must be checked and adjusted any time a countershaft, bearing, or housing is replaced. If, during reassembly, the same countershaft, bearings, housing, and shims are reused and kept in the same location, it is not necessary to reset bearing endplay.

The following procedure is used to adjust the endplay for the auxiliary countershaft tapered bearings. By correctly following this procedure, each countershaft will have .001"-.005" (.03-.12 mm) endplay.

Shims must be aligned properly or else the rear bearing cover may be damaged when final torque is applied.

Procedure -

1. The auxiliary countershaft bearing covers or countershaft straps and shims should be removed. Make sure all old gasket material is cleaned from the gasket mounting surfaces on the countershaft bearing covers and the auxiliary housing.
2. Verify that the auxiliary section is in gear. When the output shaft is rotated, the countershafts must also rotate. If not shift the auxiliary into gear by applying shop air to the high range air port on range cylinder to shift into gear.
3. Make sure a 0.100 countershaft rear bearing shim is installed. Be sure the countershaft rear bearing races are seated in the bearing bores.
4. Install two (2) clean 3/8 " x 1" capscrews without washers directly across from each other in each bearing cover. Tapped holes in auxiliary case must be free of thread adhesive.
5. Evenly tighten the capscrews to 7 Lb-in of torque. Do not install the countershaft rear bearing cover gasket. The gap between the bearing cover and the housing surface should be even from side to side.

Note: 7 Lb-in is slightly more than finger tight. Do not over-tighten the capscrews. If the capscrews are too tight, the bearing cover will become distorted.



Transmission Overhaul Procedures-Bench Service



6. Rotate the output shaft 4 times clockwise and 4 times counterclockwise. The rotation will seat and align the rollers in each tapered bearing. Re-torque the capscrews to 7 Lb-in. If the countershafts do not rotate, the range sliding clutch or deep reduction sliding clutch is in neutral. Apply shop compressed air to shift cylinders to shift the sliding clutches into gear.

7. Use a feeler gauge, as close to each capscrew location as possible, and measure the gap between the countershaft rear bearing cover and the auxiliary housing gasket surface. Measure and record the gap at two capscrew locations.

8. Average the two feeler gauge measurements by adding the measurements together and dividing by 2 as shown in Example.

Shim Chart

Gap 1 = .060 ; Gap 2 = .050
Total Gap = .060 + .050 = .110
Average = $110/2 = .055$
Select yellow shim as indicated in the shim chart at the end of this selection.



9. Locate the feeler gauge average measurement in the shim chart to determine the required shim and color code.

Note: The oil pump shim is used when an auxiliary oil pump or PTO is mounted on the countershaft. The oil pump shims have a smaller outside diameter.

10. Remove the countershaft rear bearing cover and gauging shim.
11. Place the selected shim on the rear countershaft bearing race.
12. Position a new gasket on countershaft rear bearing cover mounting surface.
13. Position the countershaft rear bearing cover over the new gasket.
14. Apply Eaton® Fuller® thread sealant #71205 or equivalent to the auxiliary countershaft rear bearing cover capscrews and auxiliary countershaft rear bearing cover.

Transmission Overhaul Procedures-Bench Service

15. Install the auxiliary countershaft rear bearing cover and secure it with the capscrews. Make sure the shim is in the proper location and is not pinched between the cover and the housing. Tighten the capscrews to 40-45 Lb-ft (54-61 Nm).

Note: Use a thick grease to hold the shim in position when installing the cover.

16. Repeat this procedure for the remaining countershaft.

Note: Make sure capscrews are properly torqued.

Note: Make sure the input shaft rotates.



Shim Table

Feeler Gauge Average Gap	Shim Thickness	Standard Shim Part Number	Oil Pump Shim Part Number	Color Code
.072-.075	.033-.034	4302345	4302346	Gold
.69-.0715	.036-.037	21452	21472	Red
.066-.0685	.039-.040	21453	21473	Pink
.063-.0655	.042-.043	21454	21474	Brown
.060-.0625	.045-.046	21455	21475	Tan
.057-.0595	.048-.049	21456	21476	Orange
.054-.0565	.051-.052	21457	21477	Yellow
.051-.0535	.054-.055	21458	21478	Green
.048-.0505	.057-.058	21459	21479	Light Blue
.045-.0475	.060-.061	21460	21480	Lavender
.042-.0445	.063-.064	21461	21481	White
.039-.0415	.066-.067	21684	21686	Black
.036-.0385	.069-.070	21685	21687	Silver

General Troubleshooting

General Troubleshooting Chart

The chart on the following pages contains some of the most common problems that may occur with this transmission along with the most common causes and solutions.

Complaint	Cause	Corrective Action
Noise - Growl / Rumble	Torsional Vibration. [Noise may be most pronounced when transmission is in a “float” (low torque) condition. May also be confined to a particular vehicle speed.]	Check driveline angles for proper u-joint working angles. Check driveline for out of balance or damage. Check u-joints for proper phasing. Check clutch assembly for broken damper springs. Check for inadequate clutch disc damping.
	Transmission bearing or gear failure. [Noise may be most pronounced under hard pull or coast (high torque).]	Check transmission oil for excessive metal particles.
Noise - Growl / Rumble at Idle (Idle Gear Rattle)	Excess engine torsional vibration at idle.	Check for low engine RPM. Check for uneven engine cylinder performance. Check for proper clutch damper operation.
Noise - High Pitched Whine	Gear Noise. Isolate as to axle or transmission noise. If transmission, isolate to specific gear or gears.	Check for worn or defective shift lever isolator. Check for direct cab or bracket contact with transmission (“grounding”). Check for proper driveline u-joint working angles. Check for damaged or worn gearing.

General Troubleshooting Chart (cont)

Complaint	Cause	What to do next
Hard Lever Shifting (Shift lever is hard to gear into or out of gear)	Master clutch dragging.	Check master clutch for proper disengagement. Check master clutch for proper adjustment (both release bearing travel and clutch brake height).
	Shift linkage problem. (Remote shifter)	Check shift linkage or cables for proper adjustment, binding, lubrication, or wear.
	Shift bar housing problem.	Check shift bar housing components for binding, wear, or damage.
	Transmission mainshaft problem.	Check mainshaft for twist. Check sliding clutches for binding, damage, or excessive wear.
	Driver technique.	Driver not familiar or skilled with proper double-clutching technique. Driver contacting the clutch brake during shifts.
Shift Lever Jumpout (Shift lever comes out of gear on rough roads)	Loose or worn engine mounts.	Check engine mounts for damage, wear, or excessive looseness.
	Shift lever problem.	Check shift lever floor boot for binding or stretching. Check shift lever isolator for excessive looseness or wear. Check for excessive offset or overhang on the shift lever. Check for extra equipment or extra weight added to shift lever or knob.
	Worn or broke detent spring or mechanism.	Check for broken detent spring. Check for excessive wear on the detent key of detent plunger. Replace detent spring with heavier spring or add additional spring.
		Check OEM anti-jump out system for failure. If applicable, reference OEM troubleshooting guidelines.

General Troubleshooting

General Troubleshooting Chart (cont)

Complaint	Cause	Corrective Action
Shift Lever Slipout (Transmission comes out of gear under torque)	Internal transmission problem.	Check for excessively worn or damaged sliding clutches or shift yokes.
Transmission goes to neutral (Shift lever doesn't move)	Low air pressure.	Check air regulator pressure.
	Internal transmission problem.	Check for excessively worn or damaged range sliding clutch or yoke.
No range shift or slow range shift (Reference Troubleshooting Guide for model of transmission)	N/A	Reference Troubleshooting Guide for model of transmission.
Grinding Noise on Range Shift	Driver not preselecting range shift.	Instruct driver to preselect range shifts.
	Range synchronizer worn or defective.	Check range synchronizer and mating parts for excessive wear or damage.

Air System Troubleshooting

The symptoms listed below are covered on the following pages. Before beginning any of those troubleshooting procedures, place the transmission in neutral and move the range selection lever from low to high. Listen for any constant air leak from the master control valve, air module base (exhaust), or transmission breather. If a constant leak is heard, go to that particular leak troubleshooting procedure first.

If you do not see the symptom you need to correct, refer to the General Troubleshooting chart.

Symptom

- Constant Air Leak from Master Control Valve
- Air Leak at Deep Reduction Cover Exhaust Port
- Range Shifts with Shift Lever in Gear
- Air Leak from Transmission Breather or Transmission Case is Pressurized

Note: Use the air system troubleshooting procedures for part replacement only if the symptom can be duplicated. If the problem is intermittent, parts that are not defective could be replaced.

Note: During all testing, the vehicle air pressure must be greater than 110 PSI (7.58 bar). If during testing the pressure falls below 110 PSI (7.58 bar), make sure the transmission is in neutral, start engine and let the pressure build to governor cutoff. After the pressure reaches the governor cutoff, continue testing. The pressure is critical if the vehicle is equipped with a vehicle air system pressure protection valve that would shut off the air supply to certain air circuits if the system pressure dropped below a preset level.

Note: A 0-150 PSI (0-10.34 bar) air gauge with a 1/16" and 1/8" male pipe thread fitting attachment is required for some of the test procedures.

⚠ WARNING

Prior to removing any air system components exhaust air from vehicle air system. Failure to exhaust air from the vehicle air system may result in personal injury or damage to parts from the sudden release of air.

Use care when removing the test port pipe plugs. If air pressure is present on the plug, it can become a projectile during removal.

Air System

Symptom - Air leak at master control valve

Normal operation:

A burst of air will be exhausted from the master control valve when moving the range selector from low to high. This is the air being exhausted from the "P" air line.

A burst of air will be exhausted from the master control valve when moving the deep reduction button rearward (shifting out of deep reduction). This is the air being exhausted from the "SP" air line.

Possible causes:

- Incorrectly attached air lines
- Internal leak in exhaust valve
- Internal leak at master control valve
- Internal leak at range valve

	Procedure	Result	What to do next
Step A	Remove lower skirt on master control valve. Check for leaking fitting at the master control valve.	Leak found.	Repair leaking fitting or air line.
		No leak found.	Go to step B.
Step B	Check air lines to make sure all lines are connected to the proper ports on the master control valve. Reversal of "S" and "P" lines will result in a constant leak from the exhaust when high range is selected. Reversal of the H/L and "SP" lines will result in a constant leak when the deep reduction button is rearward.	Air lines are not connected to the proper ports.	Connect lines properly.
		Air lines are connected to proper ports.	Go to step C.
Step C	Move the range selector lever down to Low range. Check for constant air flow from the exhaust "E" port.	Constant air flow from "E" port.	Replace master control valve.
		No air flow from "E" port.	Go to Step D.
Step D	Move the range selector up to high range. Disconnect the small air line connected to the "P" port of the master control valve. Check for air flow from the port and air line.	Constant air is leaking from the "P" port or the "E" port.	Repair or replace the master control valve.
		Air is coming out of the disconnected air line.	1. Verify that the air line is connected to the range solenoid valve. 2. If properly connected reference troubleshooting guide for model of transmission.

	Procedure	Result Air is not leaking from either port or disconnected air line.	What to do next Go to Step E.
Step E	Reattach the air line to the range solenoid valve. Move the range selector down to low range and move the deep reduction button rearward. Disconnect the air line from the "SP" port. Check for air flowing from the SP line.	Air is flowing from the SP line. Air is not flowing from the line.	1. Check to make sure the "SP" line is connected to the deep range solenoid valve. 2. If the line is properly attached, check that the insert valve is properly installed (stem facing outward) and that the insert valve bore is not defective. 3. Replace the insert valve. Repair or replace the master control valve.

Air System

Symptom - Air Leak from Transmission Breather or Transmission Case is Pressurized

Normal Operation:

There should be no measurable air flow from the transmission breather.

Possible causes:

- Leak at range yoke bar O-ring
- Leak at deep reduction yoke bar O-ring

	Procedure	Result	What to do next
Step A	Listen for the air leak with the transmission shifted to both low and high range.	Leak is only in low range.	Remove range cylinder and inspect for damaged range yoke bar, yoke bar O-ring, or range cylinder. Repair as necessary.
		Leak is in both low and high range.	Remove deep reduction cylinder. Inspect for damaged deep reduction yoke bar, O-ring, or cylinder. Repair as necessary.

Symptom: Air leak at deep reduction cylinder cover exhaust port or solenoid valve

Normal operation:

A burst of air will exhaust from this port when shifting into deep reduction (the deep reduction button is moved forward while in low range).

Possible causes:

- Damaged/defective insert valve
- Leak past insert valve external O-rings
- Leak past deep reduction cylinder piston
- Damaged / defective deep range solenoid valve

	Procedure	Result	What to do next
Step A	Check for air leaking at deep range solenoid valve.	Air leaking at valve.	Repair or replace as necessary.
		No air leaking at valve.	Go to step B.
Step B	Remove the deep reduction cylinder cover and piston. Check the piston bore for contamination or damage. Check the piston seals for damage.	Contamination or damage found.	Repair or replace as necessary.

Air System

Symptom - Range shifts with shift lever in gear

Normal Operation:

Range shift should only occur when the shift lever is in neutral. The range selector can be moved up or down while the shift lever is in a gear position, but the shift will not occur until the shift lever is moved to neutral.

Possible Causes:

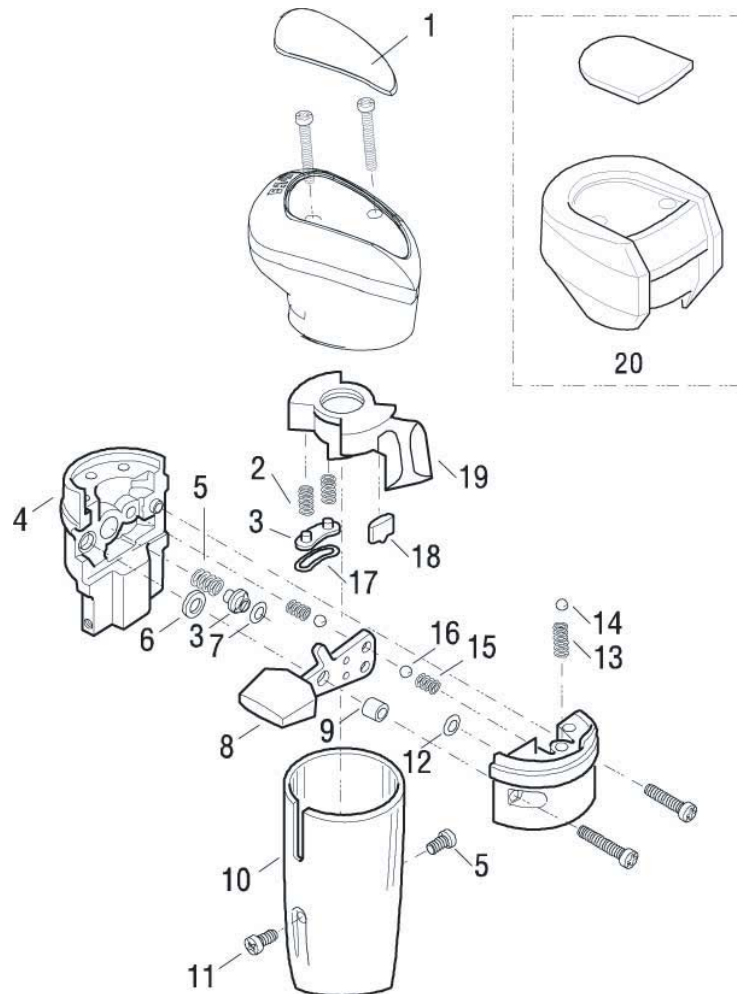
- Worn or missing air valve shaft
- Worn shift rail
- Malfunctioning exhaust valve

Procedure:

If the range has been confirmed to shift with the shift lever in gear, unbolt the exhaust valve from the side of the transmission and push in and hold piston of valve inward and attempt to range shift transmission, this may require two persons to complete. If range shift occurs while piston is held inward, replace exhaust valve. If range shift does not occur confirm that the air valve shaft is present in the shift bar housing. If present remove the shift bar housing assembly and check for worn or damaged air valve shaft, actuating pins, or worn shift rails. Replace parts as necessary.

Master Control Valve

The master control valve contains two switches. 1) The range selector lever on the front of the valve is moved down to select low range. When the range selector is moved up, high range is selected. 2) A "Blue" deep reduction button on the side of the master control valve is moved forward to select deep reduction ratios and moved rearward for remaining ratios. A mechanical interlock prevents moving the deep range button forward when the range lever is in the "up" position.



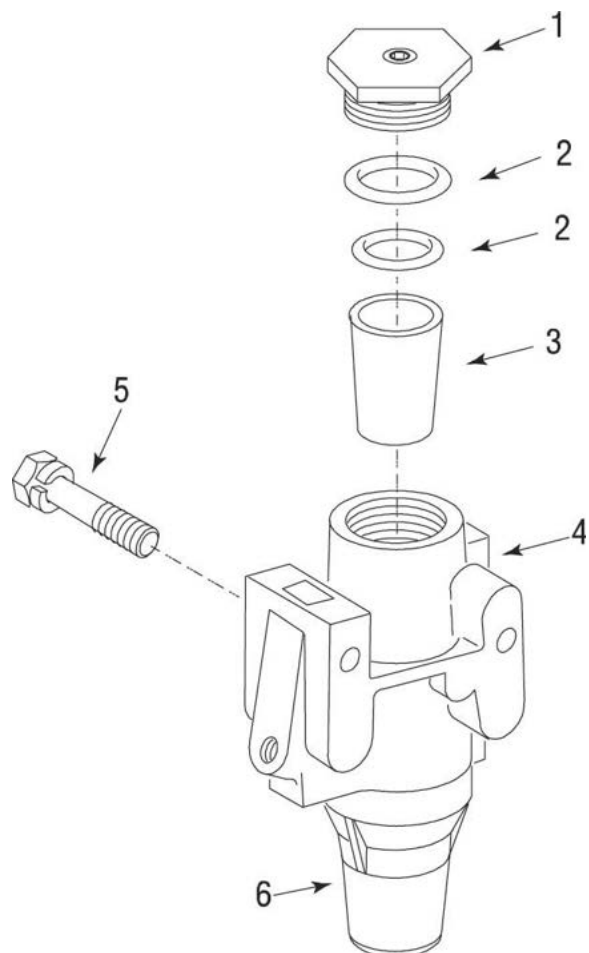
Component Nomenclature and Auxiliary Countershaft Sectional View

- | | |
|-------------------|--------------------------|
| 1. Medallion | 11. Screw |
| 2. Spring | 12. O-Ring |
| 3. Retainer | 13. Spring |
| 4. Housing | 14. 5/32" Ball |
| 5. Spring | 15. Spring |
| 6. Washer | 16. Ball |
| 7. O-Ring | 17. Seal |
| 8. Range Selector | 18. Detent |
| 9. Pin | 19. Splitter Button |
| 10. Cover | 20. Old Style Shift Knob |

Air System Overview

Air Filter/Regulator FTS-XX112L

The filter / regulator assembly filters the vehicle air supply and regulates the pressure to 106-115 PSI (7.34-7.93 bar).

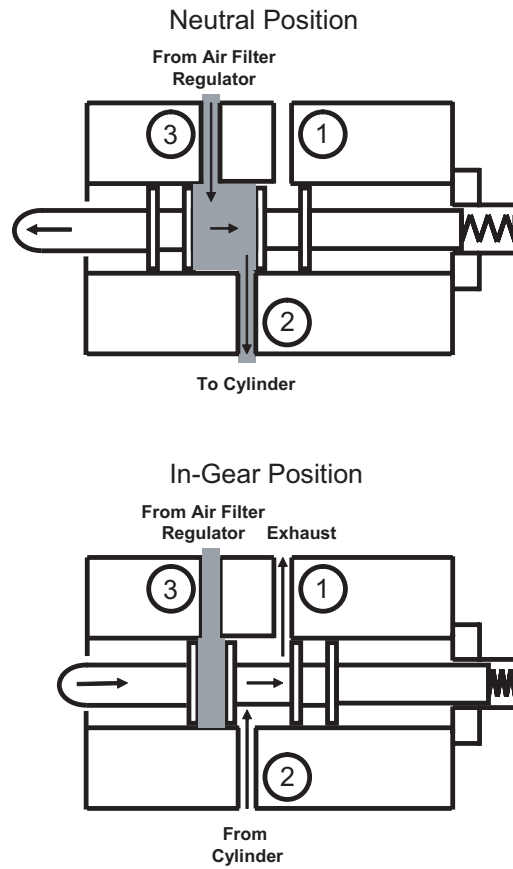


Component Nomenclature and Auxiliary Countershaft Sectional View

- | | |
|-------------------|------------------|
| 1. End Cap | 4. Housing |
| 2. O-Rings | 5. Capscrews |
| 3. Filter Element | 6. Air Regulator |

Exhaust Valve

The exhaust valve controls the supply of air to low and high solenoid valves.



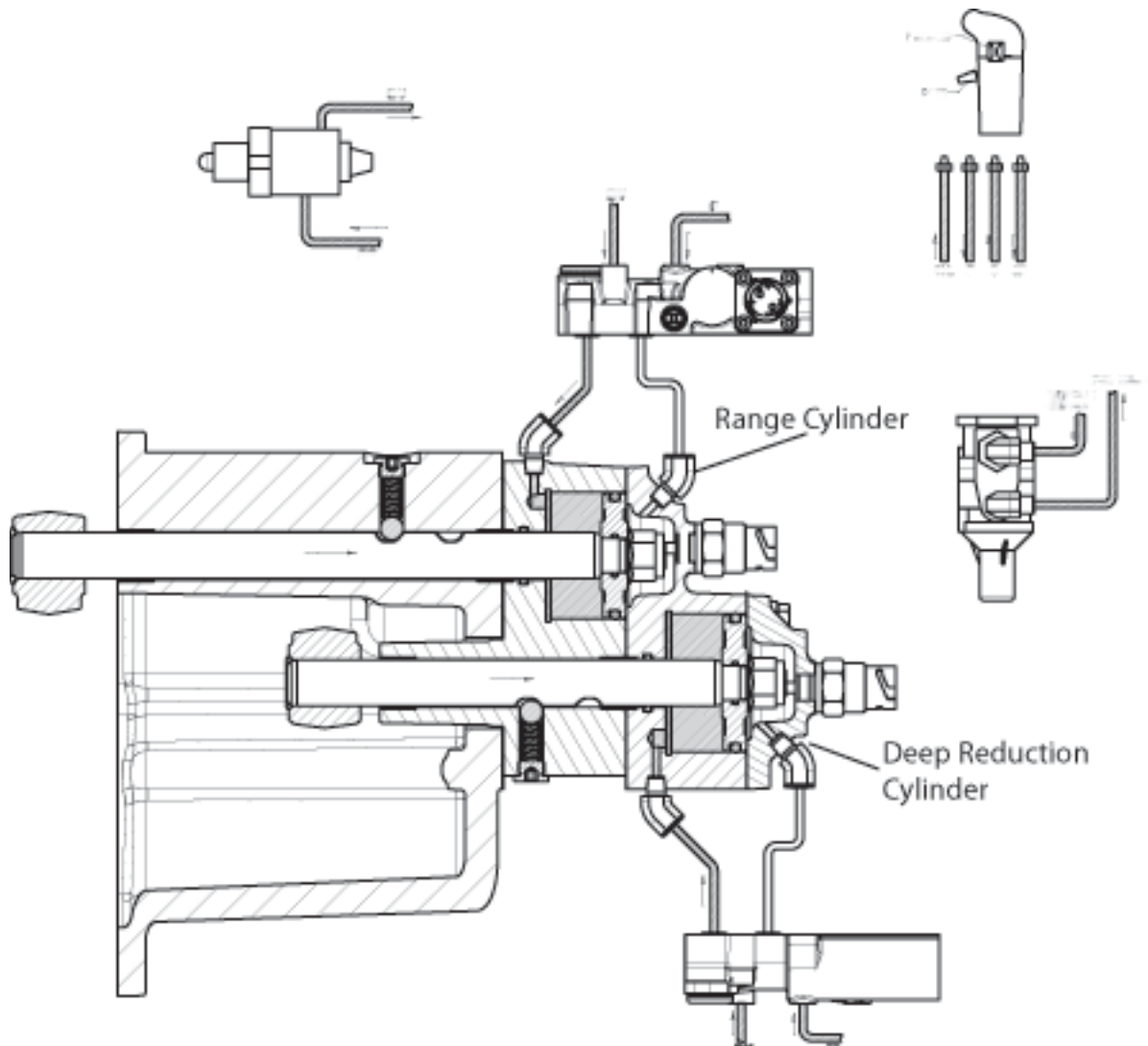
Air System Overview

Range Cylinder

Within the range cylinder is a piston which is fastened to the range yoke bar. Air pressure on the front side of the piston shifts the range synchronizer into low range ratio. Air pressure on the rear of the piston shifts the transmission into deep range ratio.

Deep Reduction Cylinder

The deep reduction cylinder contains a piston and reduction yoke bar. Air pressure on the front side of the piston shifts the transmission into the deep reduction ratio. Air pressure on the rear of the piston shifts the transmission out of deep reduction.

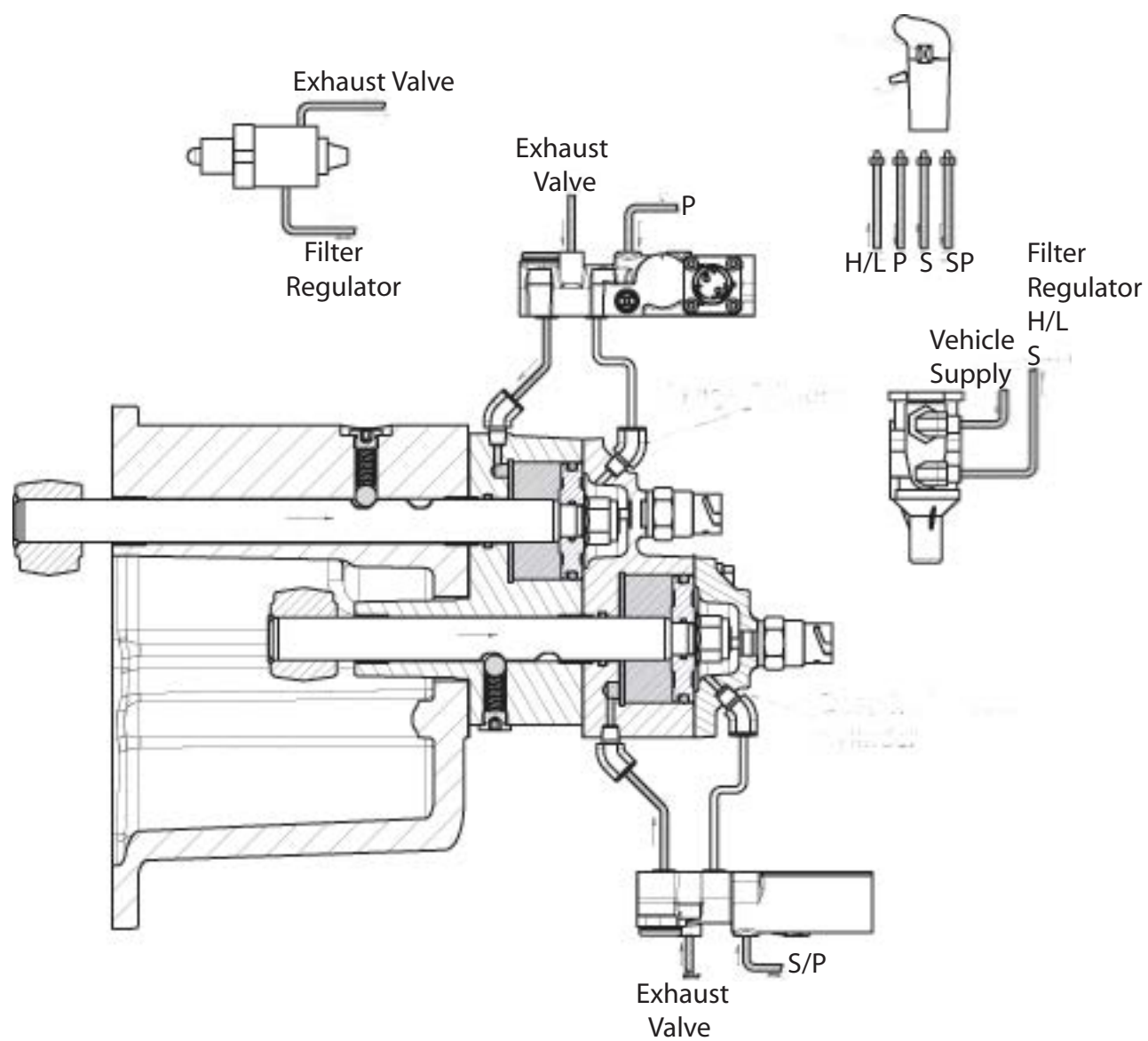


Deep Reduction Range

1. Vehicle supply air 110-130 PSI (7.58-8.96 bar) is supplied to inlet port on filter regulator where it is filtered and regulated to 106-115 PSI (7.34-7.93 bar)
2. Thru a ¼" I.D. air hose, a constant 106-115 PSI (7.34-7.93 bar) regulated air is supplied to the "3" port of the exhaust valve from the filter regulator.
3. Thru 5/32" or 4.0mm line, a constant 106-115 PSI (7.34-7.93 bar) air is also supplied to the "S" and "H/L" port of the master control valve from the filter regulator.
4. The driver selects deep reduction by moving the range selection lever down and the "Blue" deep reduction button to the forward position. This allows constant air supply at the master control valve to enter the "P" (Pilot) and "SP" (Splitter) air lines. This "P" (Pilot) air line connects to the port of the range solenoid valve and the "SP" (Splitter) air line connects to the port of the deep reduction solenoid valve. The pressures on the "P" (Pilot) and "SP" (Splitter) air lines force the spools within the both solenoid valves to move to the deep reduction range positions.
5. Constant supply air at the exhaust valve is supplied thru a ¼" I.D. air hose to the range solenoid valve (shift lever in neutral). This air pressure moves the range piston, range bar, and range synchronizer rearward to shift the transmission into low range.

Air System Overview

Deep Reduction Range

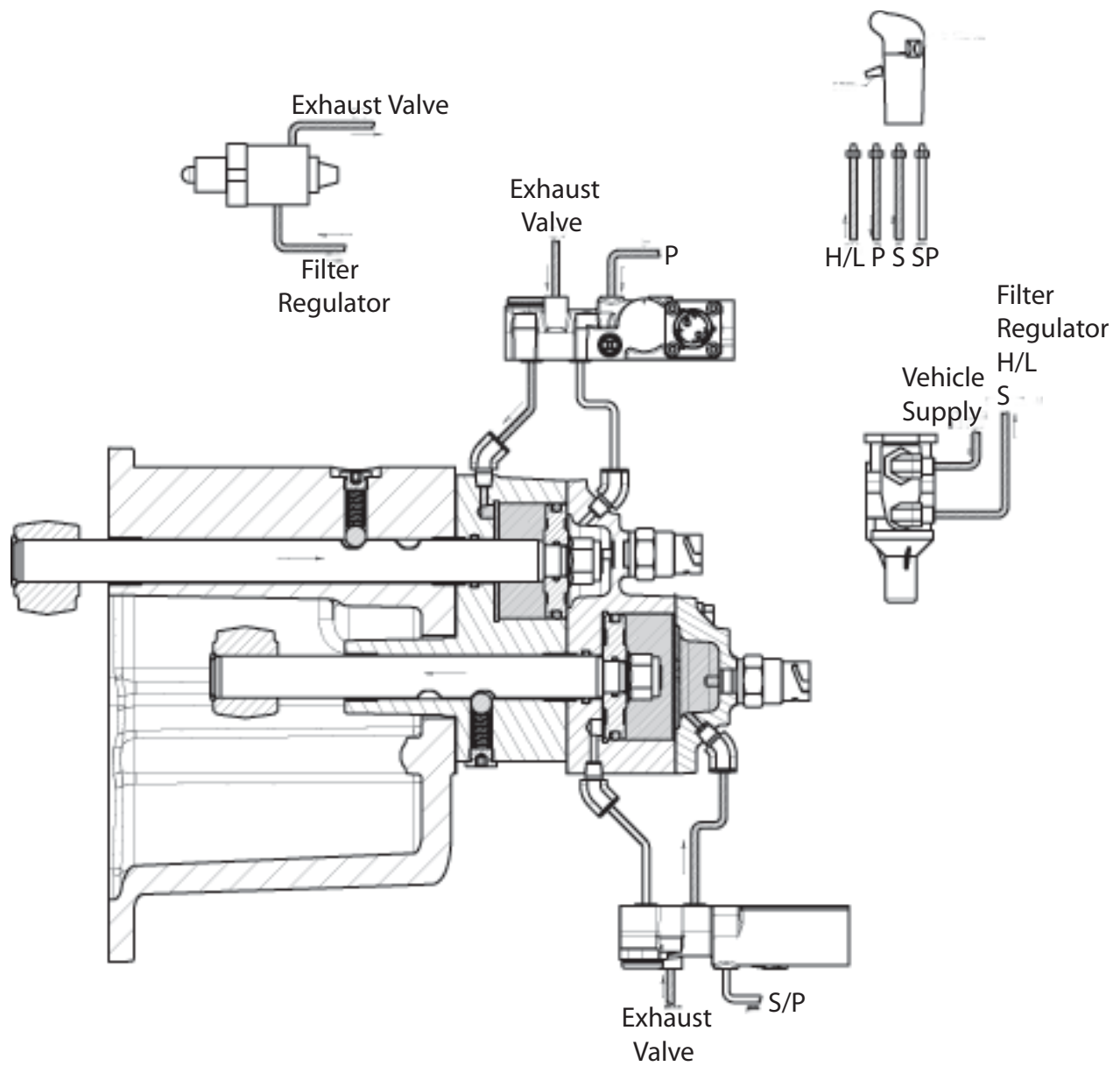


Low Range

1. Vehicle supply air 110-130 PSI (7.58-8.96 bar) is supplied to inlet port on filter regulator where it is filtered and regulated to 106-115 PSI (7.34-7.93 bar)
2. Thru a ¼" I.D. air hose, a constant 106-115 PSI (7.34-7.93 bar) regulated air is supplied to the "3" port of the exhaust valve from the filter regulator.
3. Thru 5/32" or 4.0mm line, a constant 106-115 PSI (7.34-7.93 bar) air is also supplied to the "S" and "H/L" port of the master control valve from the filter regulator.
4. The driver selects low range by moving the range selection lever down. This allows constant air supply at the master control valve to enter the "P" (Pilot) port air line. This "P" (Pilot) air line connects to the port of the range solenoid valve. The pressure on the "P" (Pilot) line causes a valve within the range solenoid spool to move to the low range position.
5. Constant supply air at the exhaust valve is supplied thru a ¼" I.D. air hose to the range solenoid valve (shift lever in neutral). This air pressure moves the range piston, range bar, and range synchronizer rearward to shift the transmission into low range.

Air System Overview

Low Range

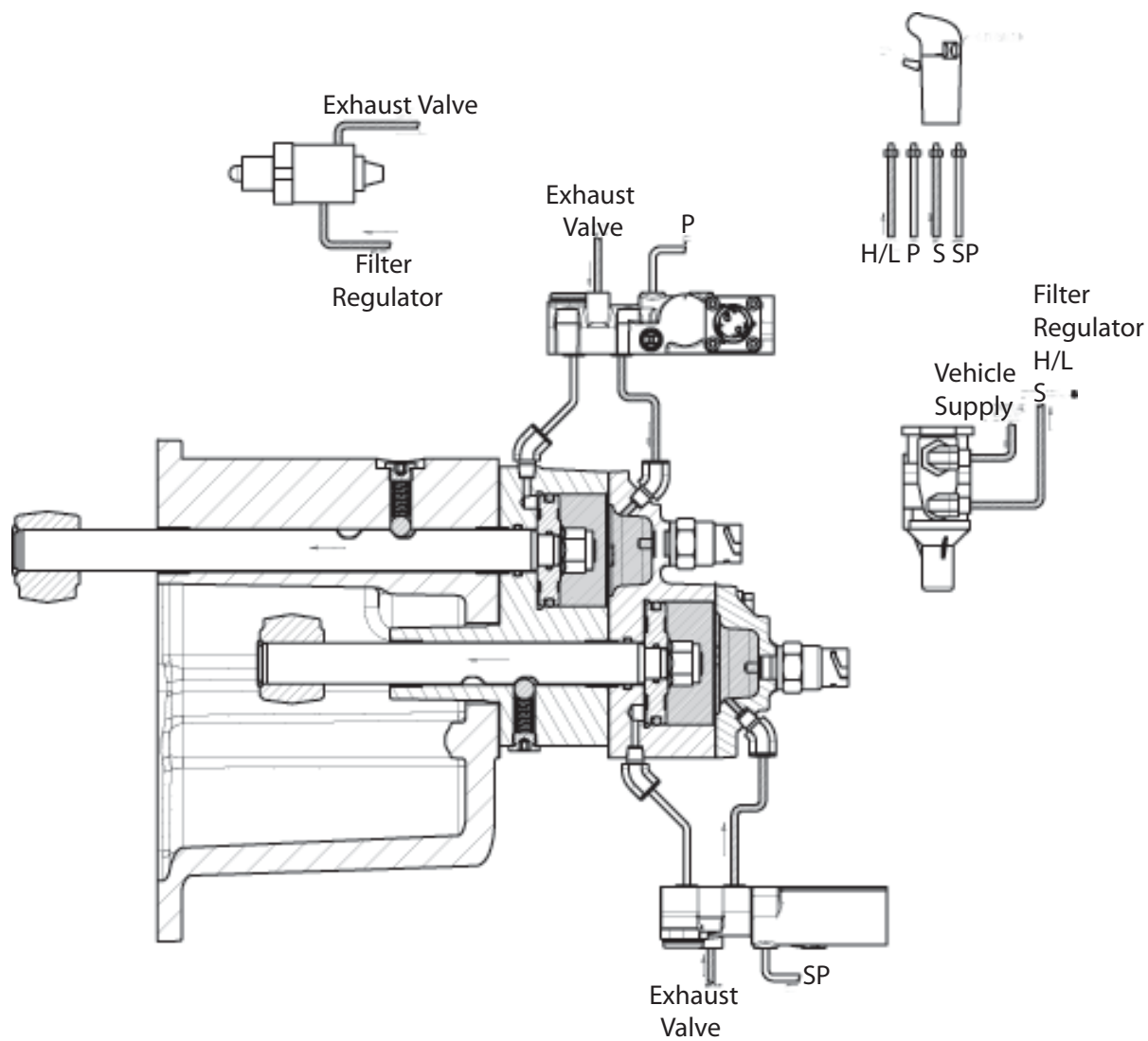


High Range

1. Vehicle supply air 110-130 PSI (7.58-8.96 bar) is supplied to inlet port on filter regulator where it is filtered and regulated to 106-115 PSI (7.34-7.93 bar)
2. Thru a ¼" I.D. air hose, a constant 106-115 PSI (7.34-7.93 bar) regulated air is supplied to the "3" port of the exhaust valve from the filter regulator.
3. Thru 5/32" or 4.0mm line, a constant 106-115 PSI (7.34-7.93 bar) air is also supplied to the "S" and "H/L" port of the master control valve from the filter regulator.
4. The driver selects high range by moving the range piston selection lever up. This shuts off air supply at the "P" line of the master control valve. The air in the "P" line is exhausted via the "E" port of the master control valve. The exhausted air supply on the "P" (Pilot) line causes a spool within the range solenoid valve to move to the high range position.
5. Constant supply air at the exhaust valve is supplied thru a ¼" I.D. air hose to the range solenoid valve (shift lever in neutral). This air pressure moves the range piston, range bar, and range synchronizer forward to shift the transmission into high range.

Air System Overview

High Range



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