

Section 7

Transmission/Transaxle

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Manual Transmission - Medium Duty

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Frame Rail Bracket Bolts and Nuts	22 N.m	16 lb ft
Oil Drain Plug	69 N.m	51 lb ft
Oil Fill Plug	69 N.m	51 lb ft
Set Screw	6 N.m	53 lb in
Shift and Select Cable Nuts	45 N.m	33 lb ft
Transmission and Cable Bracket Bolts	39 N.m	29 lb ft

Lubrication Specifications

Application	Specification	
	Metric	English
API GL5, SAE 90 Multipurpose Oil (Use SAE 80 in Canada)	6.5 liters	6.9 quarts

Diagnostic Information and Procedures

Manual Transmission Diagnosis

Inspect the clutch system and shifting controls for proper operation before you repair the transmission. Ensure that the problem is inside the transmission prior to removing the transmission.

Run the engine at a normal idle with the transmission in neutral and the clutch disengaged. Shift the transmission into reverse and check for a grinding noise. If a grinding noise is heard, check the clutch system and clutch controls for damage or wear. Refer to *Clutch Noisy* or *Clutch Noisy During Engagement*.

If shifting the transmission is restricted, check for dirt, wear, or damage to the shift cables, mounting brackets, and shift cable linkage. Check the shift cable for proper adjustment. Adjust the shift cables if required.

If the clutch system and transmission shifting controls are operational, perform the following diagnosis in order to help locate the transmission problem.

Transmission Jumps Out of Gear

Problem	Action
The shift linkage is improperly adjusted.	Adjust the shift linkage.
The shift fork pads or grooves in the sliding gear are worn excessively.	Overhaul the transmission.
The taper is worn on the clutch gear teeth.	Overhaul the transmission.
The transmission is out of alignment.	Align the transmission.
The shift rod poppet springs are broken.	Overhaul the transmission.
The shift rod poppet springs are worn.	Overhaul the transmission.
The shift rod is bent or out of line.	Overhaul the transmission.

Transmission Jumps Out of Gear (cont'd)

Problem	Action
The shift pad fork pads are not square with the shift rod bore.	Overhaul the transmission.
There is excessive end play in the drive gear, mainshaft, or countershaft.	Overhaul the transmission.
The thrust washers or faces are worn excessively or missing.	Overhaul the transmission.

Transmission Sticking in Gear

Problem	Action
The clutch linkage is improperly adjusted.	Adjust the clutch linkage.
The sliding clutch gears are tight on the sides.	Adjust the clutch system.
Chips are wedged between the spline of the shaft and the gears.	Overhaul the transmission.
There is a misaligned mainshaft of the countershaft.	Overhaul the transmission.

Noisy in the Gears

Problem	Action
The mainshaft rear bearing is worn.	Overhaul the transmission.
The rear bearing is rough, chipped, or tapered.	Overhaul the transmission.
The speedometer gears are worn.	Overhaul the transmission.
There is excessive end play of the mainshaft.	Overhaul the transmission.

Oil Leak Diagnosis

Problem	Action
The oil level is too high.	Adjust the oil level.
The lubricant in the transmission is incorrect.	Replace the transmission oil.
The bolts are loose or missing.	Tighten the loose bolts to the proper torque value. Refer to <i>Fastener Tightening Specifications</i> .
The bearing cap seals are worn.	Overhaul the transmission.
The transmission breather is plugged internally.	Overhaul the transmission.
The seal plugs are loose or missing.	Replace the seal plugs.
The gaskets are worn.	Overhaul the transmission.
There are cracks in the transmission case.	Overhaul the transmission.
The drain or filter plugs are loose.	Tighten the drain or filter plugs to the proper torque. Refer to <i>Fastener Tightening Specifications</i> .
The bearing caps are worn or plugged.	Clean or replace the bearing caps.

Noisy Bearings

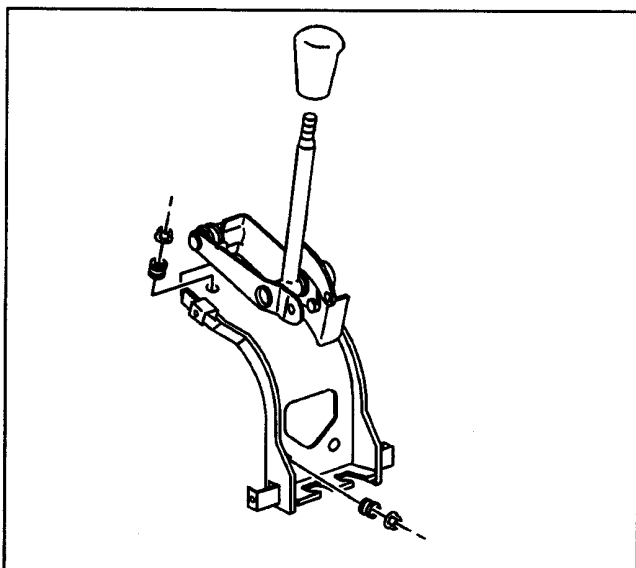
Problem	Action
There is dirt in the transmission oil.	Replace the transmission oil.
The lubricant is incorrect.	Replace the transmission oil.
The oil level is low.	Fill the transmission to the proper oil level.
The bearing retainer is worn or broken.	Overhaul the transmission.
Water or contaminants are in the transmission oil.	Replace the transmission oil.
The engine torque is too high for the transmission.	Adjust the engine torque.
The vehicle is overloaded.	Load the vehicle to the proper load limit.
There is excessive transmission vibration.	Overhaul the transmission.

Noisy in All Gears

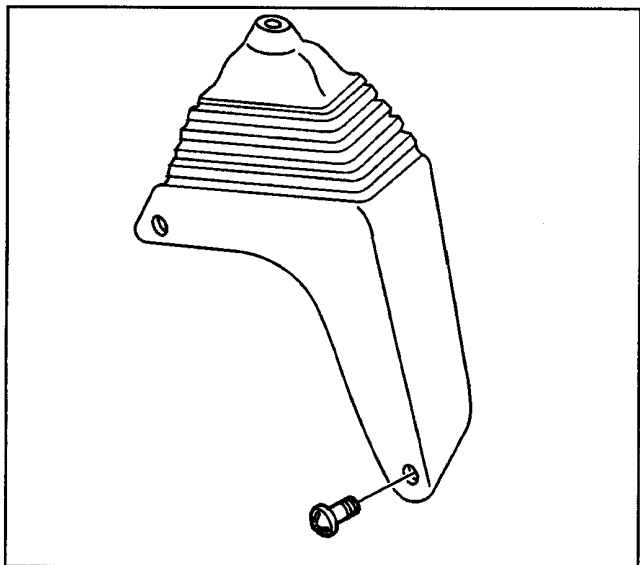
Problem	Action
The gears are chipped or cracked.	Overhaul the transmission.
Free running gears are seizing on the thrust face.	Overhaul the transmission.
There is lack of backlash between mating gears.	Overhaul the transmission.
The floating gears on the mainshaft have seized.	Overhaul the transmission.
There is a lack of transmission oil.	Fill the transmission to the proper oil level.

Noisy in Neutral with Engine Running

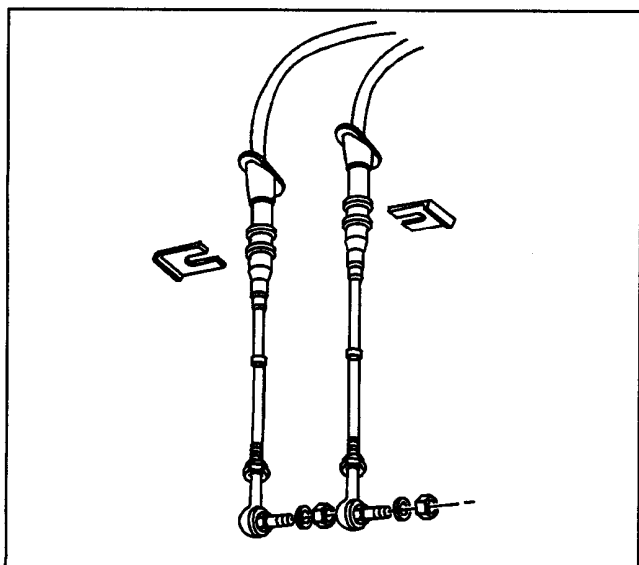
Problem	Action
The transmission is misaligned.	Align the transmission.
The flywheel pilot bearing is worn.	Replace the flywheel pilot bearing.
The countershaft bearing is worn.	Overhaul the transmission.
There is excessive end-play in the countershaft.	Overhaul the transmission.
There is excessive end-play in the idler gear.	Overhaul the transmission.
The reverse idler gear is worn.	Overhaul the transmission.
The countershaft is worn.	Overhaul the transmission.
The clutch linkage is adjusted incorrectly.	Overhaul the transmission.
The mainshaft pilot bearing is worn.	Overhaul the transmission.
The gear tooth contact surface is scuffed.	Overhaul the transmission.
There is a lack of transmission oil.	Fill the transmission to the proper oil level.
The transmission oil is the wrong grade.	Replace the transmission oil.



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Repair Instructions

Shift Cable Replacement

Removal Procedure

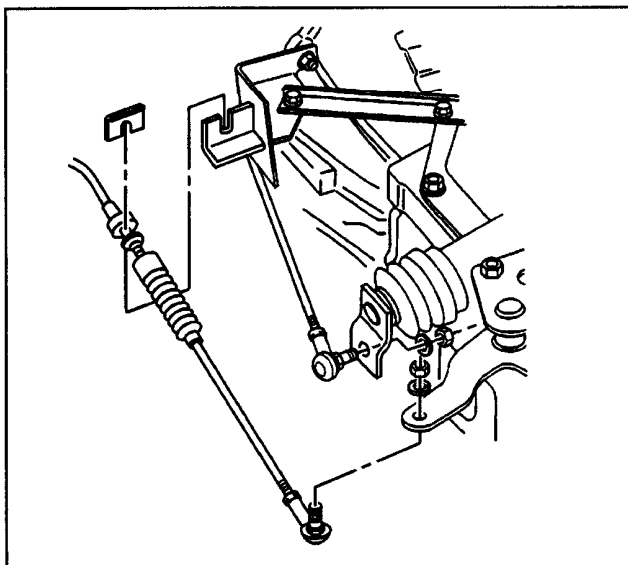
Important:

- Block all of the wheels on the vehicle prior to starting this procedure.
- Apply the park brake.
- Ensure that the shift control lever is in the Neutral position prior to removing the shift cables.

1. Remove the shift knob from the shift control lever.
2. Remove the four screws securing the shift boot to the shift control.
3. Remove the following fasteners securing the shift and select cables to the shift control:
 - The two nuts
 - The washers
 - The clips
4. Remove the two nuts and the washers securing the shift control to the panel.
5. Remove the shift and select cables from the panel.

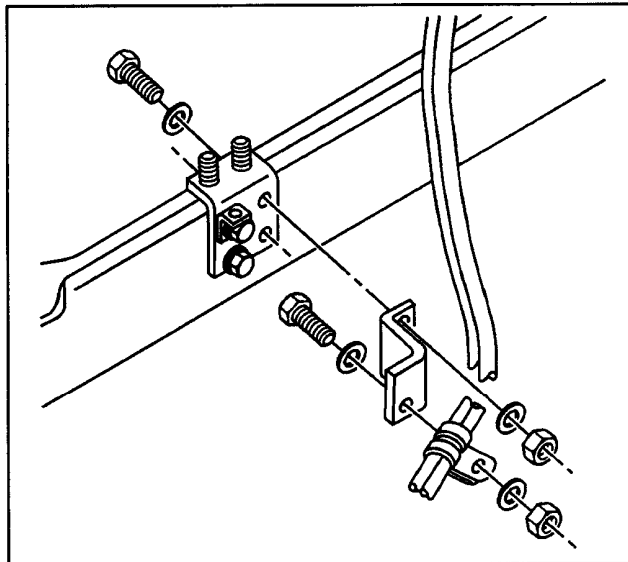
6. Remove the fasteners securing the shift and select cables to the transmission control lever and clutch control lever as follows:

- The two nuts
- The washers
- The clip



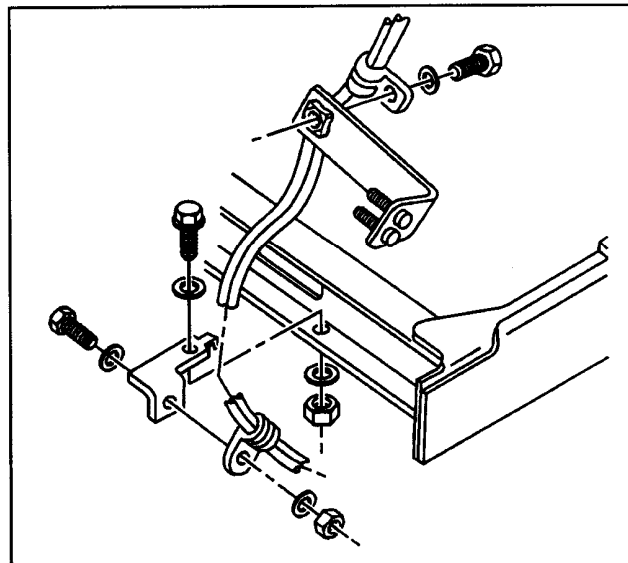
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7. Remove the bolts and the nuts that secure the shift and select cables to the frame rail brackets.

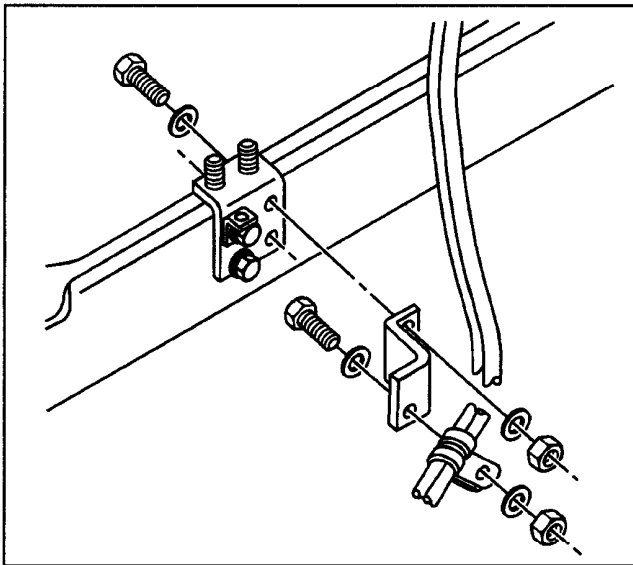


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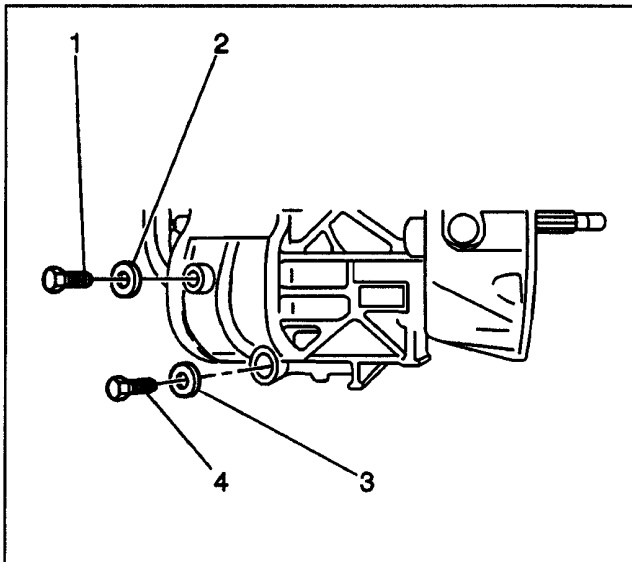
8. Remove the bolts and nuts securing the shift and select cables to the frame rail brackets. Note the routing of the shift and select cables.



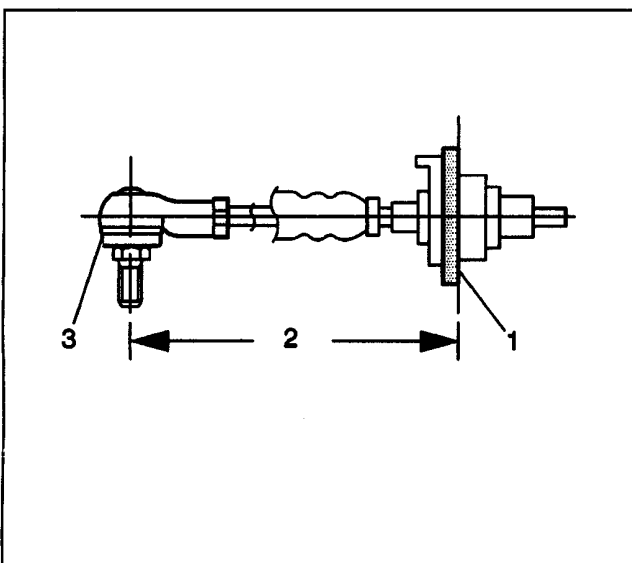
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Installation Procedure

1. Install the bolts and nuts securing the shift and select cables to the frame rail brackets.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the bolts and nuts securing the shift and select cables to the frame rail brackets.

Tighten

Tighten the frame rail bracket bolts and nuts to 22 N.m (16 lb ft).

3. Route the shift and select cables through the panels.

4. Install the two nuts and washers securing the shift control to the panel.

Tighten

Tighten the shift control panel nuts to 22 N.m (16 lb ft).

5. Install the following fasteners securing the shift and select cables to the shift control:

Tighten

Tighten the shift and select cable nuts to 45 N.m (33 lb ft).

- The two nuts
- The washers
- The clips

6. Install the four screws securing the shift boot to the shift control.

7. Install the shift knob to the shift control lever.

8. Adjust the shift and select control cables. Refer to *Shift Cable Adjustment*.

Shift Cable Adjustment

Important:

- The shift control cable attaches to the transmission control lever.
- The select control cable attaches to the select bell crank lever.

1. Remove the nut and washer securing the shift cable or the select control cable from the transmission control lever or the transmission select bell crank lever if applicable.
2. Ensure that the transmission select and shift levers are in the mechanical neutral position.
3. Turn the adjustment nut at the end (1) of the shift or select cable in order to obtain the proper rear side of bracket (3) to control lever distance.

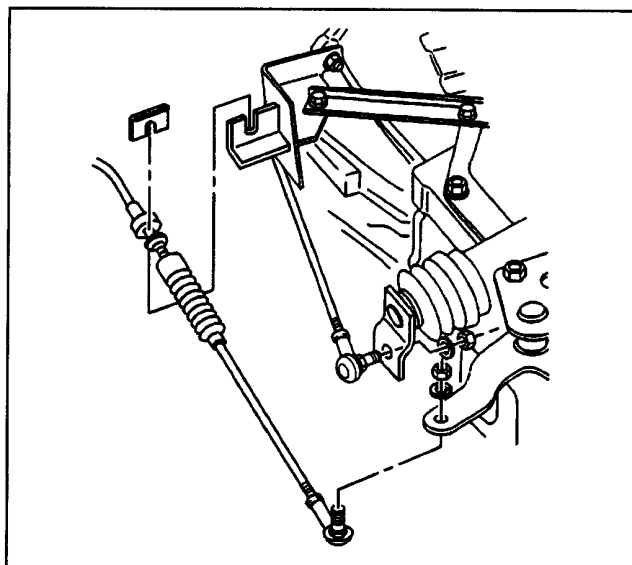
Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the nuts, the washers, and the clip securing the shift and/or select cable(s) to the transmission control lever and/or the select bell crank lever.

Tighten

Tighten the shift and select cable nuts to 45 N.m 33 lb ft).

5. Start the engine and check for proper shift operation.

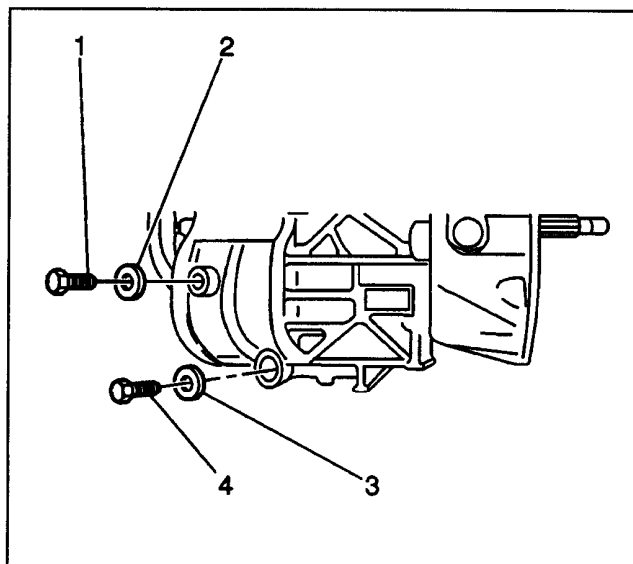


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Transmission Oil Change Procedure

Removal Procedure

1. Clean the area around the drain and fill plugs.
2. Remove the oil fill plug (1) and the seal (2) from the transmission case. Discard the seal.
3. Position a container under the oil drain hole to catch the transmission oil.
4. Remove the oil drain plug (3) and the seal (4) from the transmission case. Discard the seal.



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Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the oil drain plug (3) and a new seal (4) into the transmission case.

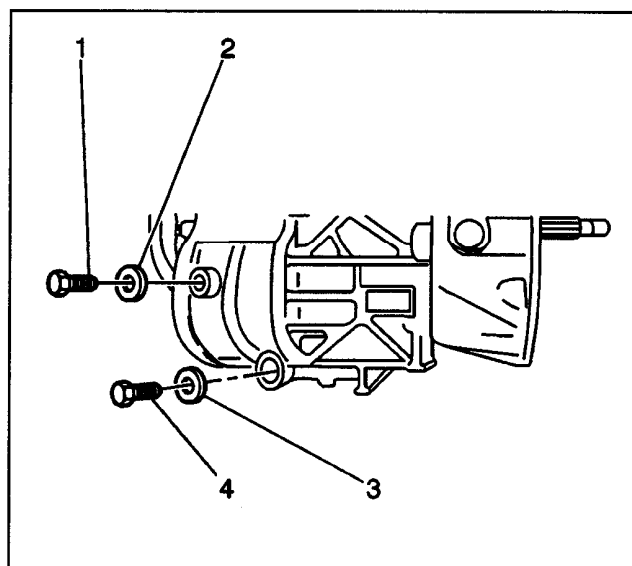
Tighten

Tighten the oil drain plug to 69 N.m (51 lb ft).

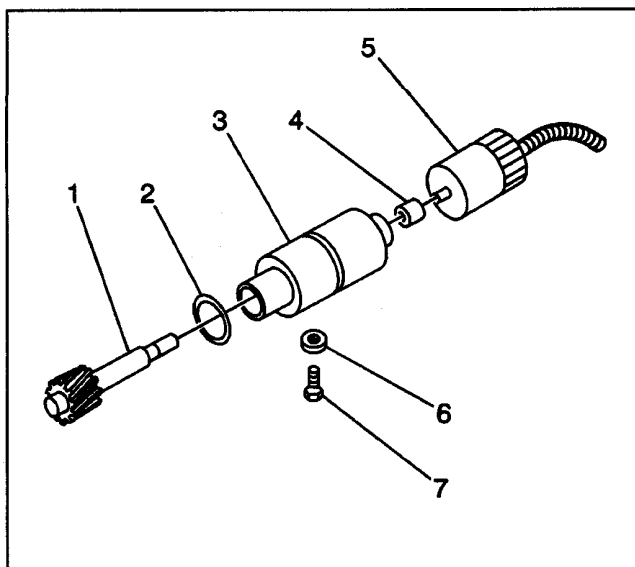
2. Fill the transmission to the level of the oil fill plug hole with transmission oil. Refer to *Lubrication Specifications*.
3. Install the oil fill plug (1) and a new seal (2) to the transmission case.

Tighten

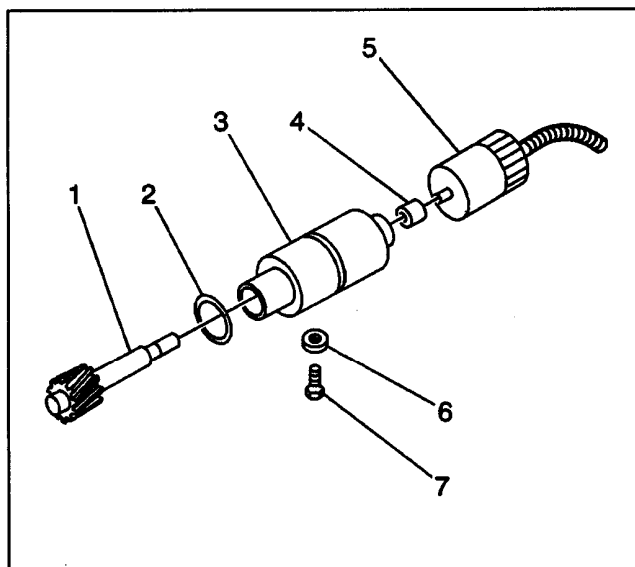
Tighten the oil fill plug to 69 N.m (51 lb ft).



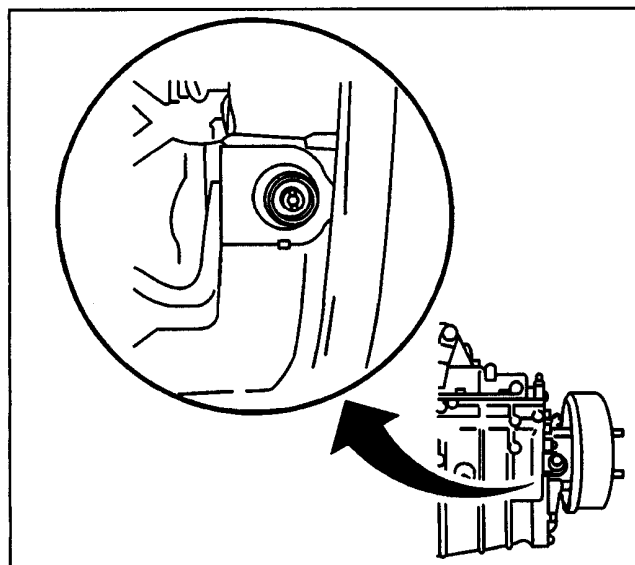
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Speedometer Driven Gear Replacement

Removal Procedure

Tools Required

J 35833 Speedometer Driven Gear Bushing Remover

1. Remove the speed sensor (5) and speed sensor seal (4) from the speedometer driven gear bushing.
Discard the speed sensor seal.
2. Remove the bushing set screw (7) and washer (6) from the speedometer driven gear bushing (3).
3. Use the *J 35833* in order to remove the speedometer driven gear bushing (3) from the transmission case.
4. Remove the speedometer driven gear seal from the transmission case.
Discard the speedometer driven gear seal (2).
5. Remove the speedometer driven gear (1) from the transmission.

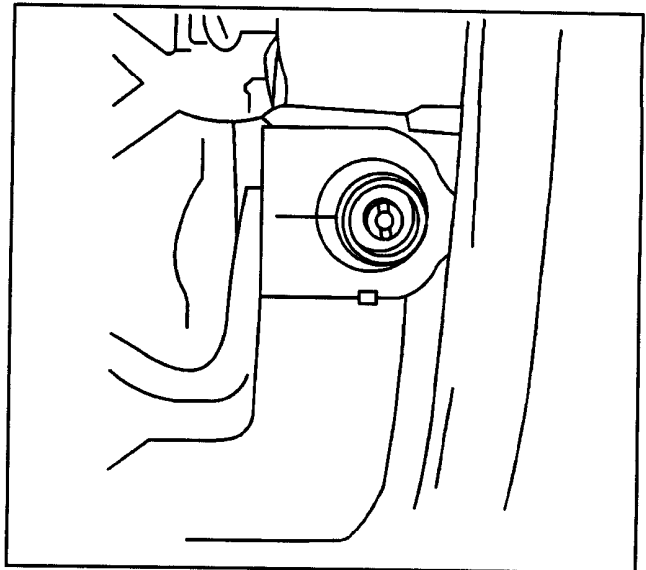
Installation Procedure

1. Install the speedometer driven gear (1) to the transmission.
2. Install a new speedometer driven gear seal (2) to the transmission case.
3. Install the speedometer driven gear bushing (3) to the transmission case.
4. Install the bushing set screw (7) and the washer (6) to the speedometer driven gear bushing.
5. Install the speed sensor (5) and a new speed sensor seal (4) to the speedometer driven gear bushing.

Speedometer Driven Gear Backlash Adjustment

1. Remove the speedometer driven gear from the transmission. Refer to *Speedometer Driven Gear Replacement*.
2. Position the speedometer driven gear and the speedometer driven gear bushing into the transmission case rear cover.
3. Rotate the bushing in the direction toward the front of the vehicle until there is no backlash between the speedometer driven gear and the transmission drive gear.

4. Mark the bushing and transmission case rear cover.

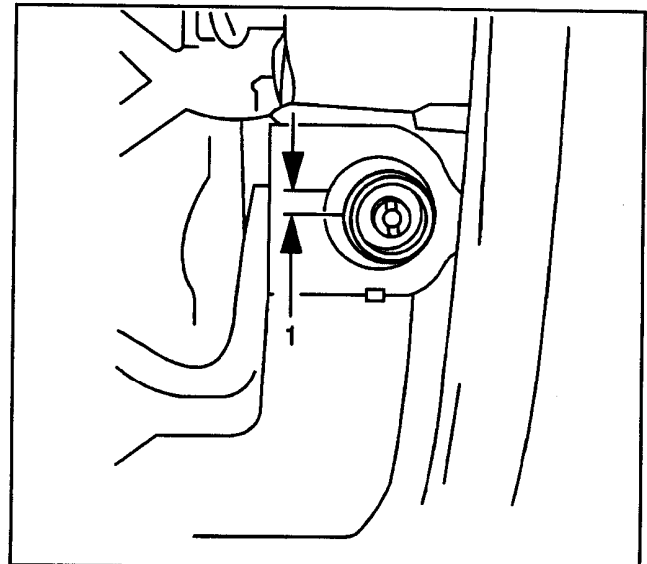


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5. Rotate the bushing in the reverse direction (1) by the measurement shown in the Reverse Direction Distance Table.

Notice: The backlash between the gears will be in the specified range 0.1-0.3 mm (0.138-0.157 in) after performing this procedure.

6. Using a marker pin, mark a set screw hole boring position on the bushing through the rear case set screw mounting hole.
 7. Remove the bushing and speedometer driven gear from the transmission rear case.
 8. Drill a set screw access hole into the bushing. Drill one 4.5 mm (0.177 in) hole 3.5—4.0 mm (0.138—0.157 in) depth into the bushing.
 9. Install the following components into the transmission rear case:
 - The speedometer driven gear
 - The speedometer driven gear seal
 - The speedometer driven gear bushing
 10. Align the access hole in the bushing with the set screw hole.
- Notice:** Refer to *Fastener Notice* in Cautions and Notices.



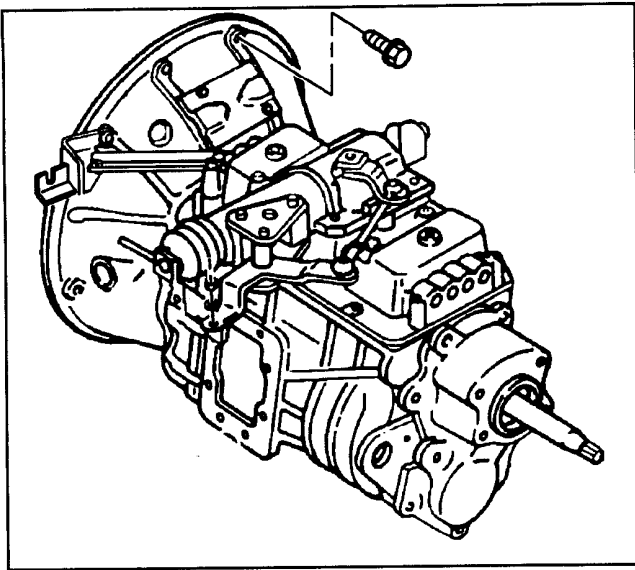
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11. Install the set screw and washer.

Tighten

Tighten the set screw to 6 N·m (53 lb in).

12. Install a new speed sensor seal and seal sensor.



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Transmission Replacement

Removal Procedure

1. Block all of the vehicle wheels.
2. Remove the transmission oil from the transmission. Refer to *Transmission Oil Change Procedure*.
3. Remove the propeller shaft. Refer to the following procedures:
 - *One-Piece Propeller Shaft Replacement (Full Yoke/229)*
 - *One-Piece Propeller Shaft Replacement (Full Yoke/305)*
 - *One-Piece Propeller Shaft Replacement (Half Yoke/229)*
 - *One-Piece Propeller Shaft Replacement (Half Yoke/305)*
 - *One-Piece Propeller Shaft Replacement (Outboard Slip/229)*
 - *One-Piece Propeller Shaft Replacement (Outboard Slip/305)*
 - *Two-Piece Propeller Shaft Replacement (Inboard Slip Joint and Flange)*
 - *Three-Piece Propeller Shaft Replacement (Center Bearing, Full Yoke)*
4. Remove the clutch slave cylinder. Refer to *Clutch in Transmission*.
5. Remove the power take off drive shaft, if installed.
6. Remove the parking brake cable and bracket. Refer to *Parking Brake Cable Replacement*.
7. Remove the shift and select cable at the transmission. Refer to *Shift Cable Replacement*.
8. Remove the wiring harness connectors and the wiring harness.
9. Remove the speed sensor and seal from the speedometer driven gear bushing.

Important:

- Support the transmission with a cradle type jack prior to removing the transmission mounting bolts.
 - If a cradle type jack is not used, chain the transmission to the jack that you use.
 - Pull the transmission straight back on the clutch splines in order to avoid damage to the clutch system.
 - Do not let the transmission hang on the clutch splines when removing the transmission from the engine.
10. Remove the bolts that secure the transmission and cable brackets to the engine.

Installation Procedure**Important:**

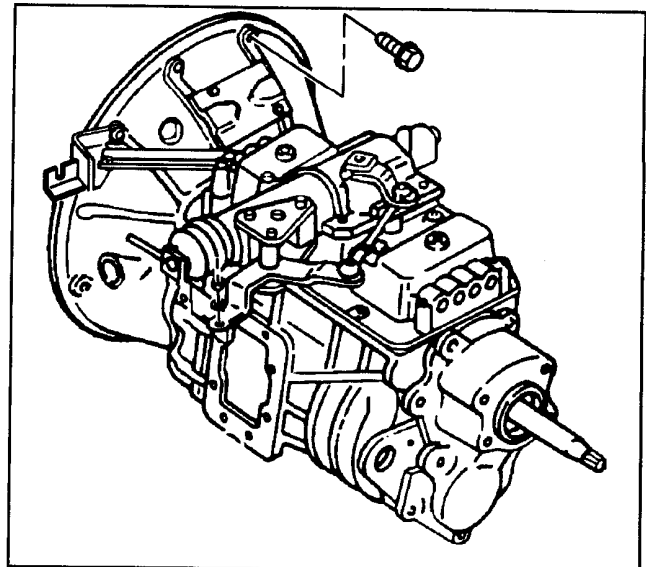
- Support the transmission with a cradle type jack prior to lifting the transmission.
- Do not let the transmission hang on the clutch splines when removing the transmission from the engine.

1. Align the transmission with the engine.
2. Align the direct gear shaft splines with the clutch hub splines.
3. Install the bolts that secure the transmission and the cable brackets to the engine.

Tighten

Tighten the transmission and cable bracket bolts to 39 N.m (29 lb ft).

4. Install the speed sensor and seal to the speedometer driven gear bushing.
5. Install the wiring harness connectors and the wiring harness.
6. Install the shift and select cable at the transmission. Refer to *Shift Cable Replacement*.
7. Install the parking brake cable and bracket. Refer to *Parking Brake Cable Replacement* in *Parking Brake*.
8. Install the power take off drive shaft, if necessary.
9. Install the clutch slave cylinder. Refer to *Clutch in Transmission*.
10. Install the propeller shaft. Refer to the following procedures:
 - *One-Piece Propeller Shaft Replacement (Full Yoke/229)*
 - *One-Piece Propeller Shaft Replacement (Full Yoke/305)*
 - *One-Piece Propeller Shaft Replacement (Half Yoke/229)*
 - *One-Piece Propeller Shaft Replacement (Half Yoke/305)*
 - *One-Piece Propeller Shaft Replacement (Outboard Slip/229)*
 - *One-Piece Propeller Shaft Replacement (Outboard Slip/305)*
 - *Two-Piece Propeller Shaft Replacement (Inboard Slip Joint and Flange)*
 - *Three-Piece Propeller Shaft Replacement (Center Bearing, Full Yoke)*
11. Fill the transmission with transmission oil. Refer to *Transmission Oil Change Procedure*.
12. Start the engine and check for the transmission operation.



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Description and Operation**Transmission Description and Operation**

The six speed (MLD6Q) transmission has a constant mesh first and reverse gear. The remaining gears are synchronized. Shifting is done with a remote shift controlm connected to two cables that operate a shift quadrant mounted on the top of the transmission. The transmission is equipped with a drive that can be connected to a power takeoff system.

Overhaul Information

For the overhaul of the MLD6Q manual transmissions, refer to Manual Transmission Overhaul.

Automatic Transmission - Allison

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Auxiliary Oil Cooler Top Support Bolts	30 N.m	22 lb ft
Auxiliary Oil Cooler Bottom Support to Radiator Support Bolts	30 N.m	22 lb ft
Auxiliary Oil Cooler Top Support to Radiator Support Bolts	30 N.m	22 lb ft
Flywheel to Flexplate Bolts	56 N.m	41 lb ft
Modulator Clip Bolt	20 N.m	15 lb ft
Modulator Cable to Support Bracket Bolts	9 N.m	80 lb ft
Modulator Cable Nut	12 N.m	106 lb in
Oil Cooler Line Engine Block Bracket Bolts	30 N.m	22 lb ft
Oil Cooler Line Nuts to Auxiliary Oil Cooler	30 N.m	22 lb ft
Oil Cooler Line Nuts to Radiator	30 N.m	22 lb ft
Oil Cooler Line Nuts to Transmission Connectors	25 N.m	18 lb ft
Oil Cooler Line Transmission Case Bracket Bolts	30 N.m	22 lb ft
Oil Level Indicator Tube to Engine Bracket Bolt	55 N.m	41 lb ft
Oil Level Indicator Tube to Transmission Nut	130 N.m	96 lb ft
Transmission to Engine Bolts	55 N.m	41 lb ft

Fluid Capacity Specifications

Application	Specification	
	Metric	English
Allison AT 545 Use DEXRON® III Automatic Transmission Oil.	14 LITER	14.8 quarts

Diagnostic Information and Procedures

Shift Speed Too High

Problem	Action
The governor valve is stuck.	Clean or replace the governor screen and/or the governor.
The modulation is delayed.	Adjust the modulator. Refer to <i>Transmission Modulator Cable Adjustment</i> .
The mechanical actuator cable is kinked, broken, or not properly adjusted.	Replace, adjust, or repair the cable.
The mechanical actuator is obstructed.	Replace the actuator.
The shift signal valve adjustment is too high.	Adjust the shift points.
The valves are sticking.	Replace or rebuild the control valve assembly.
The modulation is improper.	Inspect the modulator valve and the modulator body.

Shift Speed Too Low

Problem	Action
The governor spring is weak or missing.	Replace the governor.
The mechanical actuator is kinked, broken, or not properly adjusted.	Replace, adjust, or repair the cable.
The adjustment of the shift signal valve spring is too loose.	Tighten the spring adjusting ring to the specification.
The modulator valve is stuck open.	Check the spring adjustment.
The modulator valve is stuck open.	Replace the modulator. Refer to <i>Transmission Modulator Replacement</i> .

Low Main Pressure in All Ranges

Problem	Action
The oil level is low.	Add oil in order to acquire the proper oil level. Refer to <i>Transmission Oil Checking Procedure</i> .
The external filter is clogged.	Replace the external filter. Refer to <i>External Transmission Oil Filter Replacement</i> .
The seal ring on the intake tube is leaking or missing.	Install a new seal ring onto the top end of the intake tube.
The main pressure regulator valve spring is weak.	Replace the spring.
The control valve body is leaking.	Replace or rebuild the valve body assembly.
The valves of the trimmer relays and main pressure regulator are sticking.	Replace or rebuild the valve body assembly.
The input charging pump is worn or damaged.	Replace or rebuild the pump.
The priority valve is missing.	Replace the missing valve.

Low Main Pressure in First Gear

Possible Cause	Action
The first range circuit is leaking in the control valve body.	Replace or rebuild the control valve body.
The first clutch piston seals are leaking excessively.	1. Overhaul the transmission. 2. Replace the seals.

Intermittent Buzzing Noise

Problem	Action
The oil level is low.	Add oil in order to acquire the proper oil level. Refer to <i>Transmission Oil Checking Procedure</i> .
Air is leaking at the intake tube due to a damaged O-ring.	Replace the intake tube seal and filter.
The oil pan filter is clogged.	Replace the oil pan filter. Refer to <i>Transmission Oil Pan and Filter Replacement</i> .
The oil is aerated.	Make sure the oil level is correct. Refer to <i>Transmission Oil Checking Procedure</i> .
The external oil filter is damaged.	Replace the external oil filter. Refer to <i>External Transmission Oil Filter Replacement</i> .

Excessive Creep in First and Reverse Gears

Problem	Action
The engine idle speed is set too high.	Adjust the idle speed. Refer to Idle Speed Adjustment in Diesel Fuel Injection.
The shift cable is disconnected.	Connect the shift cable end. Refer to <i>Shift Cable Replacement</i> .

Low Lubrication Pressure

Problem	Action
The oil level is low.	Add oil in order to acquire the proper oil level. Refer to <i>Transmission Oil Checking Procedure</i> .
The engine idle speed is too low.	Refer to Idle Speed Adjustment.
The oil cooler lines are restricted or leaking.	1. Check the lines for kinks or leaks. 2. Reroute or replace the lines as necessary. Refer to <i>Transmission Oil Cooler Line Replacement</i> .
The transmission is excessively leaking oil internally.	Overhaul the transmission.

Fluid Leaking into Converter Housing

Problem	Action
The rear oil seal of the engine crankshaft is leaking.	Refer to Crankshaft Rear Oil Seal Replacement in Engine Mechanical.
The metal-cased, lip-type seal at the front of the input charging pump is leaking.	Replace the pump seal.
The seal around the outer diameter of the oil pump is leaking.	Replace the outer diameter pump seal.
The cranked weld in the torque converter assembly is leaking.	Repair or replace the converter assembly.
The torque converter pump hub at the seal area is worn.	Replace the torque converter pump hub.

Transmission Overheats in All Ranges

Problem	Action
The cooler lines are restricted.	1. Remove the restrictions. 2. Clean or replace the lines as necessary. Refer to <i>Transmission Oil Cooler Line Replacement</i>.
The torque converter has broken parts.	Repair or replace the converter assembly.
The oil is aerated.	Check the following parts: • The seal ring at the intake tube • The input charging pump
Internal leakage is slowing the oil cooling flow.	Overhaul the transmission.

High Stall Speed

Problem	Action
The oil level is low.	Add oil in order to attain the proper fluid level. Refer to <i>Transmission Oil Checking Procedure</i> .
The clutch pressure is low.	Test the pressure.
The forward clutch slips.	Rebuild the forward clutch.
The first clutch slips.	Rebuild the first clutch.
The fourth clutch (reverse) is slipping.	Rebuild the fourth clutch.

Low Stall Speed

Problem	Action
The engine is not performing efficiently, possibly because of plugged or restricted injectors or high altitude conditions.	Refer to Engine Controls.
The converter parts are broken.	Replace or rebuild the converter assembly.
The vehicle stalls at speeds of 50 percent of normal, which implies a freewheeling stator.	Replace or rebuild the converter assembly.

Rough Shifting

Problem	Action
The governor valve is stuck.	Clean or replace the governor screen and/or the governor.
The valve spring of the vacuum modulator is not properly adjusted, or the vacuum hose is kinked or leaking.	Check the spring adjustment.
The mechanical actuator cable is kinked, broken, or not properly adjusted.	Replace, adjust, or repair the cable.
The mechanical actuator is obstructed.	1. Check the actuator. 2. Replace the actuator if necessary.
The modulator is inoperative.	Replace the modulator. Refer to <i>Transmission Modulator Replacement</i> .
The trimmer valve is sticking, or has a broken spring.	Replace or rebuild the control valve body assembly.
The control valve is sticking.	Replace or rebuild the control valve body assembly.

Rough Shifting (cont'd)

Problem	Action
The modulator valve is sticking.	1. Clean the valve. 2. Check the vacuum modulator. 3. Adjust the spring.
The engine idle speed in neutral to drive is too fast.	Adjust the engine idle screw. Refer to <i>Idle Speed Adjustment in Engine Controls</i> .
The selector linkage is out of adjustment.	Adjust the shift cable. Refer to <i>Shift Cable Adjustment</i> .

Excessive Slip and Clutch Chatter Only One Range

Problem	Action
The clutch is slipping in one range.	1. Rebuild the specific clutch that is slipping. 2. Replace the piston seals.
Oil is leaking excessively at the piston seals in one range.	Overhaul the clutch and piston assembly.
Oil is leaking in the valve components of one range.	Replace or rebuild the control valve body assembly.
The trimmer valve is stuck open.	1. Replace or rebuild the control valve body assembly. 2. Check the trimmer valve for freedom of movement.
The priority valve is cycling.	Replace or rebuild the control valve body assembly.

Dirty Fluid

Problem	Action
The oil has not been changed at proper intervals.	1. Drain the oil. 2. Replace the oil filter. Refer to <i>Transmission Oil Pan and Filter Replacement</i>. 3. Replace the external oil filter. Refer to <i>External Transmission Oil Filter Replacement</i>. 4. Fill the transmission with new oil.
The heat of the oil is excessive.	Check the cooling system.
The clutch is inoperative.	Overhaul the transmission.
The filter or filter elements are damaged.	Replace the filter or elements. Refer to <i>External Transmission Oil Filter Replacement</i> .
The engine rear oil seal is faulty.	Replace the engine rear oil seal. Refer to <i>Engine Rear Oil Seal Replacement in Engine Mechanical</i> .

Output Shaft Seal Fluid Leak

Problem	Action
The seal at the output flange is missing or faulty.	Install a new seal in the rear of the transmission housing.
The flange is worn at the seal surface.	Replace the flange.

Slips in All Forward Ranges

Problem	Action
The oil level is low.	Add oil in order to obtain the proper oil level. Refer to <i>Transmission Oil Checking Procedure</i> .
The clutch main pressure is low.	Test the pressure.
The forward clutch is slipping.	1. Rebuild the forward clutch. 2. Replace the piston seals.
The seal rings on the front support hub are broken.	Replace the seal rings.

Slips in Fourth and Reverse Gear Only

Problem	Action
The fourth clutch is slipping.	1. Rebuild the clutch. 2. Replace the piston seals.
The trimmer valve is sticking.	1. Replace or rebuild the control valve body assembly. 2. Inspect the trimmer valve.
The seal rings on the center support assembly hub are broken.	Replace the seal rings.
The seal rings of the clutch piston are cut.	Replace the seal rings.
The check balls are not seating in the rotating clutch housings.	Inspect the check balls for contamination and proper operation.

Slips in Reverse and First Gear Only

Problem	Action
The first clutch is slipping.	1. Overhaul the clutch. 2. Replace the piston seals.
The piston seal rings are cut.	Replace the seal rings.
The clutch-apply oil feed tube is loose or leaking.	Reset or replace the feed tube.

Vehicle Moves Forward in Neutral

Problem	Action
The idle speed is incorrect.	Adjust the idle speed. Refer to <i>Idle Speed Adjustment in Engine Controls</i> .
The shift selector linkage is not in adjustment.	Adjust the shift cable. Refer to <i>Shift Cable Adjustment</i> .
The forward clutch has failed and is dragging.	Rebuild the forward clutch.

Vehicle Moves Backward in Neutral

Problem	Action
The shift cable is not in adjustment.	Adjust the shift cable. Refer to <i>Shift Cable Adjustment</i> .
The fourth clutch is inoperative and is dragging.	Rebuild the fourth clutch.
The shift cable is faulty or broken.	Repair or replace the shift cable. Refer to <i>Shift Cable Replacement</i> .
The main pressure is low.	Test the pressure.
The shift selector is not engage at the control valve.	Install or replace the parts that are involved. The parts are found inside the oil pan.
The oil level is low.	Fill to the proper oil level. Refer to <i>Transmission Oil Checking Procedure</i> .

Fluid Out of Fill Tube or Breather

Problem	Action
The oil level indicator is loose.	1. Tighten the cap. 2. Replace the cap as necessary.
The oil level is too high.	Drain the oil in order to acquire the proper oil level. Refer to <i>Transmission Oil Checking Procedure</i> .
The oil level is too low.	Add oil in order to acquire the proper oil level. Refer to <i>Transmission Oil Checking Procedure</i> .
The modulator is faulty.	Replace the modulator. Refer to <i>Transmission Modulator Replacement</i> .
The oil level indicator tube is plugged.	1. Check the fill tube for blockage. 2. Clean the tube as necessary.
The breather is clogged.	Clean or replace the breather.
The transmission oil contains water.	1. Drain the oil. 2. Replace the oil. Refer to <i>Transmission Oil Checking Procedure</i> .
The oil level indicator gasket is worn.	Replace the gasket or the oil level indicator. Refer to <i>Transmission Oil Level Indicator Tube Replacement</i> .
The oil level indicator is improperly marked.	Replace the oil level indicator. Refer to <i>Transmission Oil Level Indicator Tube Replacement</i> .

Oil Leak Diagnosis

The cause of most external leaks can generally be located and repaired with the transmission in the vehicle.

General Method

1. Verify that the leak is transmission oil.
2. Thoroughly clean the suspected leak area.
3. Operate the vehicle for about 15 minutes or until normal operating temperatures are reached.
4. Park the vehicle over clean paper or cardboard.
5. Turn the ignition to the OFF position.
6. Look for oil spots on the paper.
7. Make the necessary repairs.

Powder Method

1. Thoroughly clean the suspected leak area with solvent.
2. Apply an aerosol type powder (foot powder) to the suspected leak area.
3. Operate the vehicle for about 15 minutes or until the normal operating temperatures are reached.
4. Turn the ignition to the OFF position.
5. Inspect the suspected leak area.
6. Trace the leak path through the powder in order to find the source.
7. Make the necessary repairs.

Dye and Black Light Method

1. Follow the manufacturer's recommendation for the amount of dye to be used.
2. Find the leak with a black light.
3. Make the necessary repairs.

Gasket and Seal Checks

Once the leak has been pinpointed and traced back to the source, determine the cause of the leak in order to repair the leak properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. Repair the bent flange before attempting to repair a leak. In order to prevent leakage, correct any of the following conditions.

- Check the gasket areas for the following conditions that may cause a leak:
 - The fluid level or pressure is too high
 - A plugged vent or drain-back holes
 - Improperly tightened fasteners or dirty/damaged threads
 - Warped flanges or warped sealing surfaces
 - Damaged or worn gaskets
 - Cracking or porosity of the component
 - Improper sealant used (where applicable)
- Check the seal areas for the following conditions that may cause a leak:
 - The oil level or pressure is too high
 - A plugged vent or drain-back hole
 - A damaged seal bore (scratched, burred, or nicked)
 - A damaged or worn seal
 - Improper installation
 - Cracks in the component
 - The manual or output shaft surface is scratched, nicked, or missing
 - A loose or worn bearing causing excess seal wear

Possible Points of Oil Leaks

Oil leaks may occur in the following areas:

- The transmission or the transmission oil pan
 - Attaching bolts are not tightened to the correct specification.
 - A gasket is improperly installed or damaged.
 - The oil pan or mounting face is not flat.
- The transmission case
 - The filler tube multi-lip threads are leaking.
 - The governor cover or O-ring is damaged or missing.
 - The filler tube bracket is misaligned.
 - The vehicle speed sensor seal is damaged.
 - The manual shaft seal is damaged.
 - The oil cooler connector fittings are loose or damaged.
 - The propeller shaft oil seal is worn or damaged.
 - The governor cover is leaking.
 - The line pressure pipe plug is loose.
 - The casting is porous.
- The converter end seal
 - The seal lip is cut.
Check the converter hub for damage.
 - The bushing is moved forward.
The bushing is damaged.
 - The garter spring is missing from the seal.
- The converter end
 - The converter leaks in the weld area.
 - The casting in the case of the pump is porous.
- The vent pipe or the fill tube
 - The transmission oil level is too high.
 - Water or coolant is in the oil.
The oil appears milky.
 - The case is porous.
 - The oil level indicator is incorrect.
 - The transmission vent is plugged.
 - The drain back holes are plugged.
 - The oil pump to case gasket, if equipped, is misaligned.

Repair Instructions

Parts Cleaning and Inspection

Service Precautions

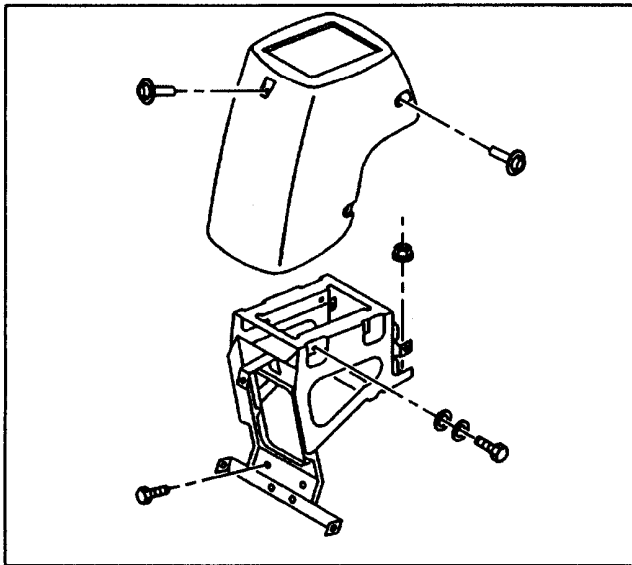
1. Use the following appropriate safety equipment:
 - Safety glasses
 - Safety shoes
 - Gloves
2. Keep the work area clean.
3. Keep the tools clean.
4. Clean the exterior of the transmission before removing any parts.
5. Do not use wipe cloths or rags.
6. Do not use solvents on rubber seals or plastic/Teflon® thrust washers.
7. Blow out all of the passages with compressed air.
8. Clean the small passages with a fine wire.
9. Handle the parts carefully in order to prevent damage.
10. Lubricate all of the internal parts with transmission oil during assembly.
11. When installing screws, bolts, or studs into aluminum, always dip the threads into transmission oil.
12. Always use a torque wrench for the proper torque.
13. Recondition damaged or stripped aluminum threads with thread inserts.
14. Replace all of the gaskets and O-ring seals. Do not use gasket cement or sealers.
15. Replace the plastic/Teflon® thrust washers.
16. Install the plastic/Teflon® thrust washers using the proper seal protector.

Inspection Procedure

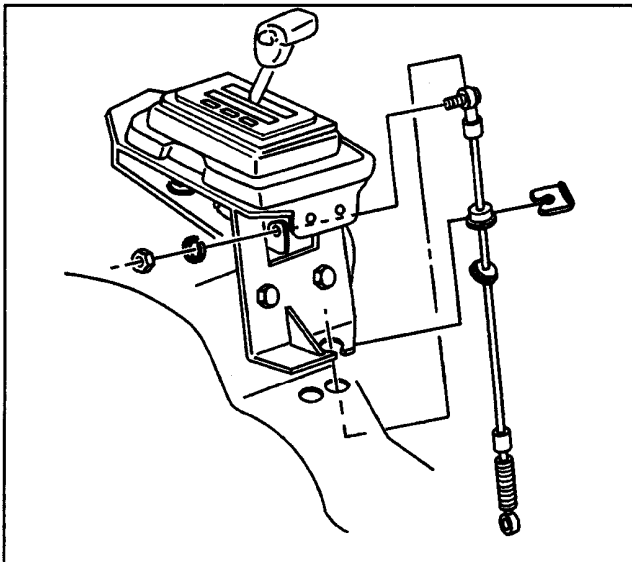
1. Inspect the manual linkage for wear at the pivoting points and bent or broken links and rods.
2. Inspect the following items for nicks, cuts, or damage:
 - The seals
 - The gasket
 - The O-rings
 - The mating surfaces
3. Check the mating surfaces for the following defects:
 - Nicks
 - Cuts
 - Damage
4. Inspect the snap rings for the following conditions:
 - Expansion or compression
 - Distortion
 - Nicks
 - Proper ring-to-groove fit
5. Inspect the bearings and thrust surfaces for the following conditions:
 - Wear
 - Scoring
 - Pitting

Transmission Oil Pan and Filter Replacement

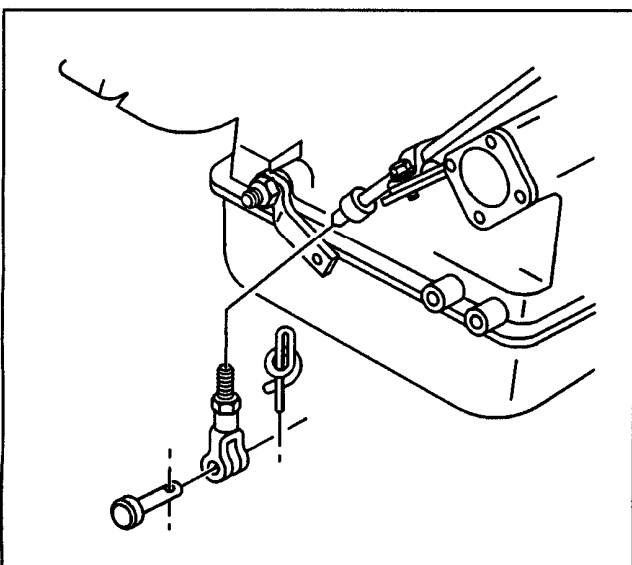
Refer to the Allison SA1241 Service Manual for the oil pan filter replacement.



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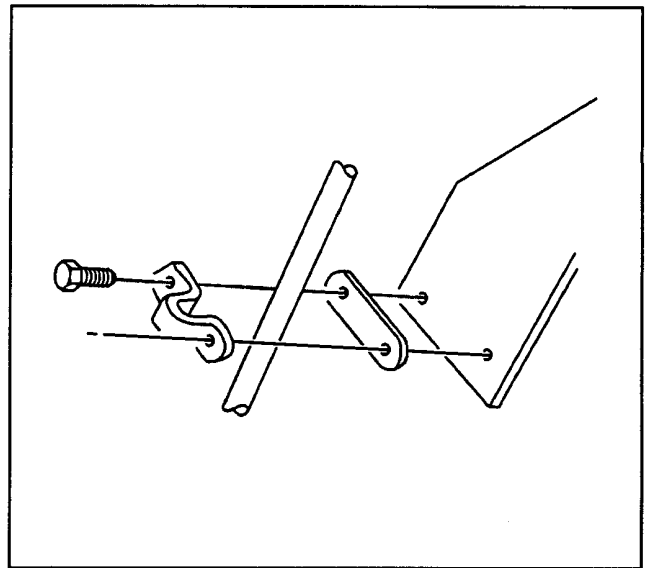
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Shift Cable Replacement

Removal Procedure

1. Remove the plugs and the screws securing the shift control housing to the shift control.
2. Remove the nut, the washer, and the clip securing the shift cable to the shift control.
3. Remove the cotter pin and the clevis pin securing the shift cable to the transmission shift lever.

4. Remove the two screws, the clamp, and the spacer securing the shift cable to the shift cable support bracket.
5. Note the positions of the shift cable frame rail clamps prior to removal.
6. Remove the screws and clamps securing the shift cable to the frame rail.
7. Remove the grommets securing the shift cable to the cab and the frame rail.

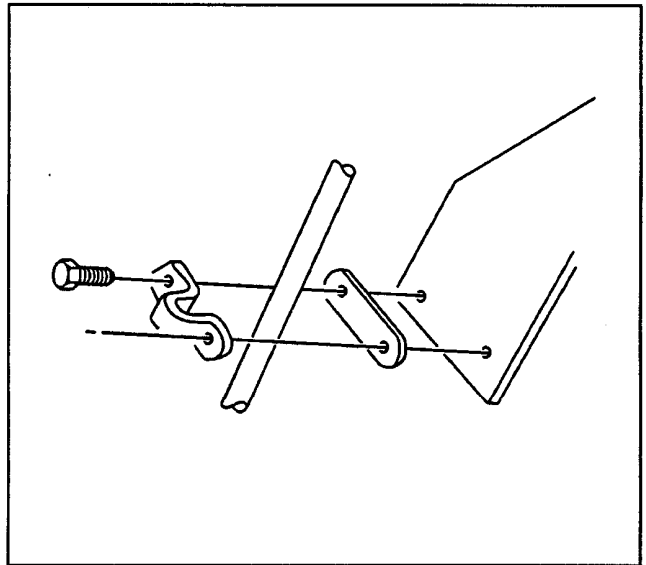


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Installation Procedure

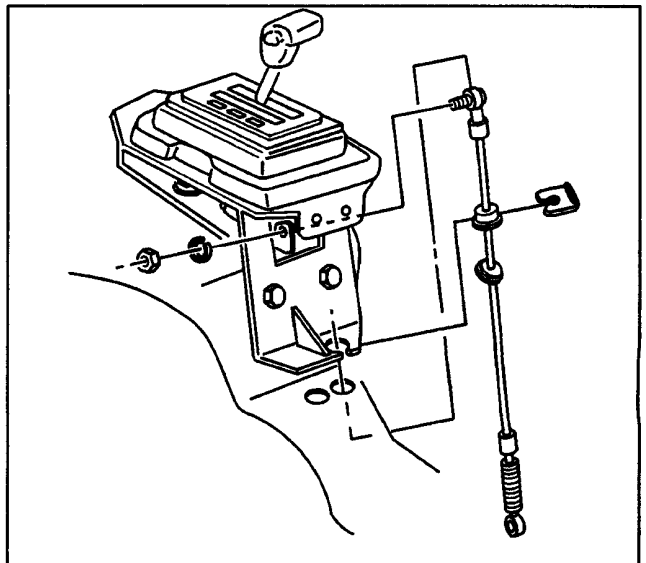
Notice: Ensure the shift control lever and the transmission shift lever are in the mechanical neutral position.

1. Install the screws and the clamps in order to secure the shift cable to the frame rail.
2. Install the two screws, the clamp, and the spacer in order to secure the shift cable to the shift cable support bracket.
3. Adjust the shift cable. Refer to *Shift Cable Adjustment*.

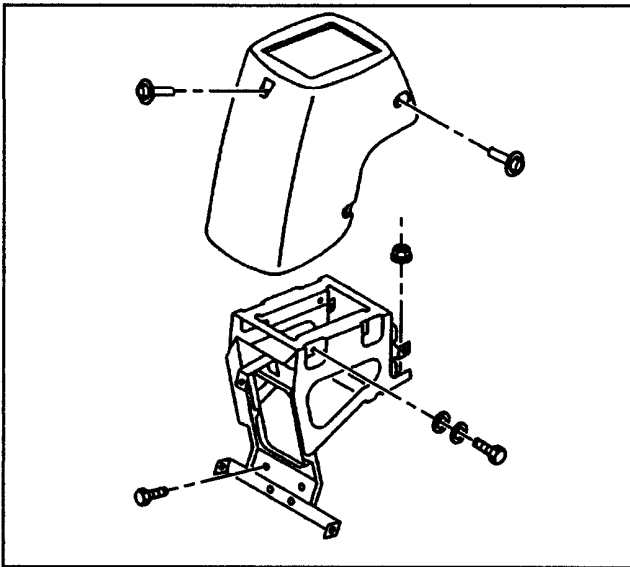


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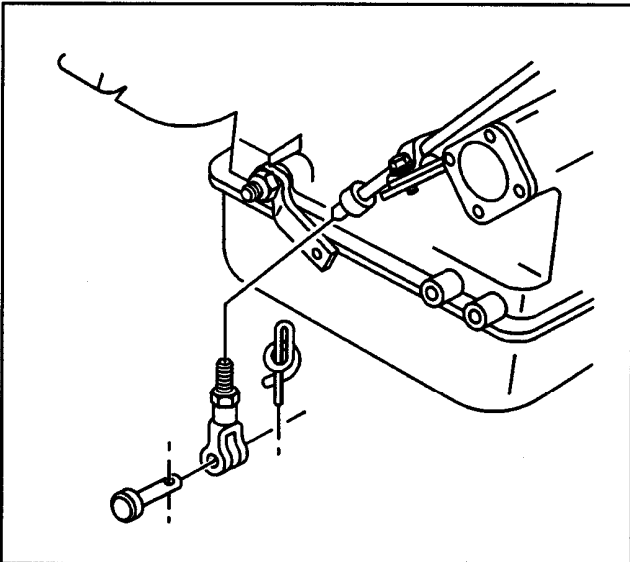
4. Install the nut, the washer, and the clip in order to secure the shift cable to the shift control.



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5. Install the plugs and screws in order to secure the shift control housing to the shift control.

Shift Cable Adjustment

Inspection Procedure

1. Turn the ignition OFF.
2. Block the wheels.
3. Shift the selector lever through each drive range while feeling for full engagement of the transmission.
 - 3.1. Make sure the shift control fully engages all the transmission detent positions in the transmission before the range selector hits a stop.
 - 3.2. Note the position of the selector lever after each shift.
 - 3.3. Make sure the transmission detent R (reverse) does not engage until the selector lever is completely out of the neutral notch.
4. If the selector lever is not properly located or operating, adjust the shift control cable.
 - If you cannot make a satisfactory adjustment, replace the shift cable. Refer to *Shift Cable Replacement*.
 - Before adjusting the shift cable, make sure that all the shift controls are not damaged and operate smoothly.
 - Have an assistant select the required range selector position while you listen for the full engagement of the gears at the transmission shift lever.

Adjustment Procedure

1. Place the range selector against the stop in the R (reverse) position.
2. Disconnect the clevis from the transmission shift lever.
3. Position the transmission shift lever into the mechanical reverse position.
4. Loosen the jam nut at the clevis.

5. Turn the clevis on the threaded cable core until the holes in the clevis align with the hole in transmission shift lever.
6. Install the clevis pin.
 - 6.1. Make sure that the clevis pin enters the holes freely.
 - 6.2. If the clevis pin does not enter the holes freely, adjust the clevis by turning the clevis one half turn in either direction.

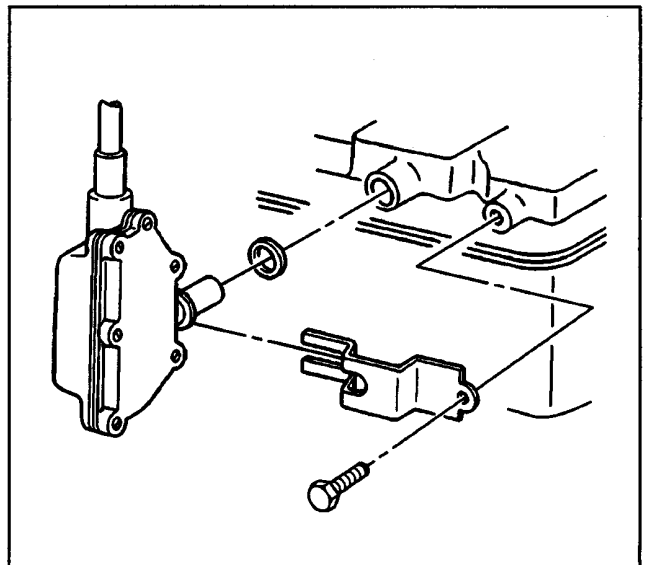
Important: Do not spread the cotter pin.

7. Secure the clevis pin to the transmission shift lever with a new cotter pin.
8. Move the range selector lever in order to check for the detent engagement.
 - 8.1. Make sure the transmission detents fully engage just before the range selector lever hits the stops in the shift control lever.
 - 8.2. Check for the detent engagement in the N (neutral) position.
 - 8.3. Check for the detent engagement in the D (drive) position.
 - 8.4. Check for the detent engagement in the R (reverse) position.
 - 8.5. Check for the detent engagement in all the other range positions.
9. Spread the cotter pin.
10. Tighten the jam nut against the clevis pin.

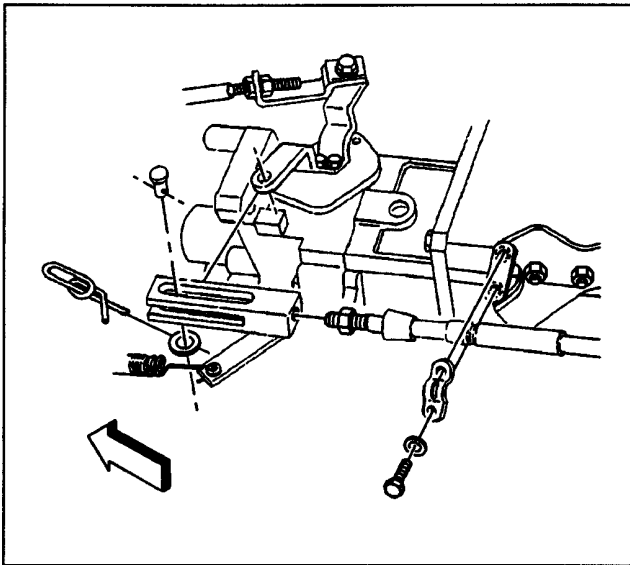
Transmission Modulator Replacement

Removal Procedure

1. Remove the bolt and clip securing the modulator and the O-ring to the transmission.

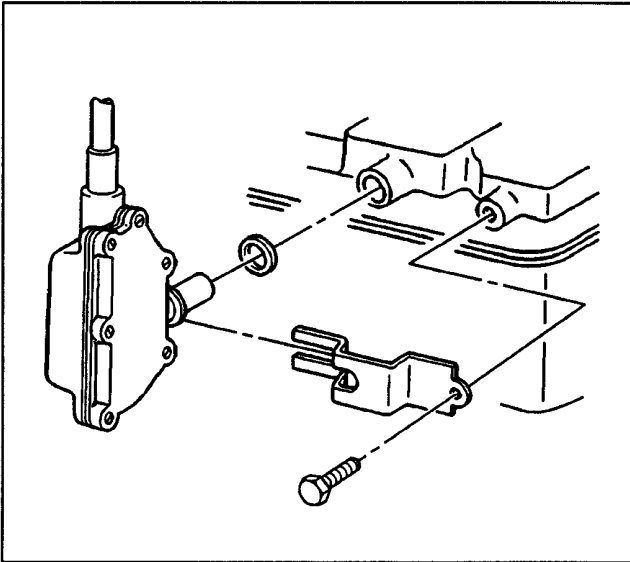


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2. Remove the two bolts and the washers securing the modulator cable to the support bracket.
3. Remove the cotter pin, the washer, and the clevis pin securing the clevis to the engine throttle lever.
4. Remove the clevis from the modulator cable.
5. Remove the modulator cable with the modulator from the vehicle.



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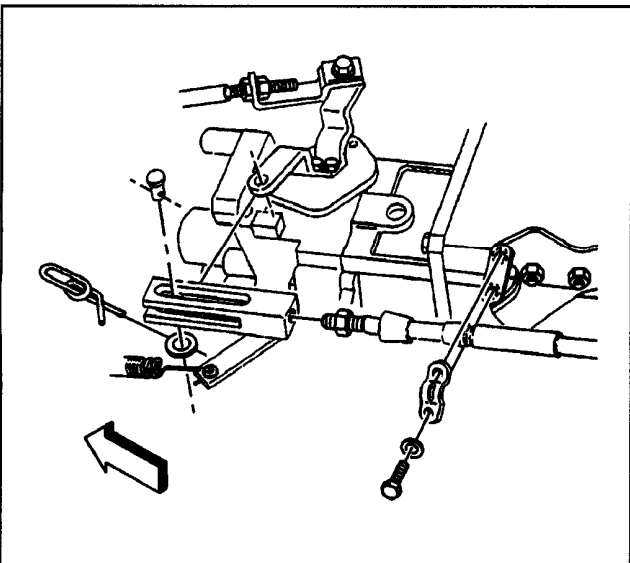
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the bolt and the clip in order to secure the modulator and the O-ring to the transmission.

Tighten

Tighten the bolt to 20 N·m (15 lb ft).



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2. Install the two bolts and the washers in order to secure the modulator cable to the support bracket.

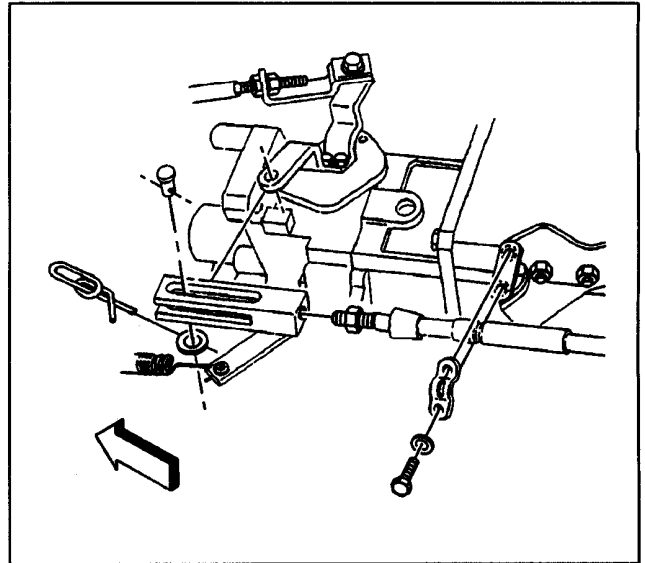
Tighten

Tighten the bolts to 9 N·m (80 lb in).

3. Adjust the modulator cable. Refer to *Transmission Modulator Cable Adjustment*.

Transmission Modulator Cable Adjustment**Removal Procedure**

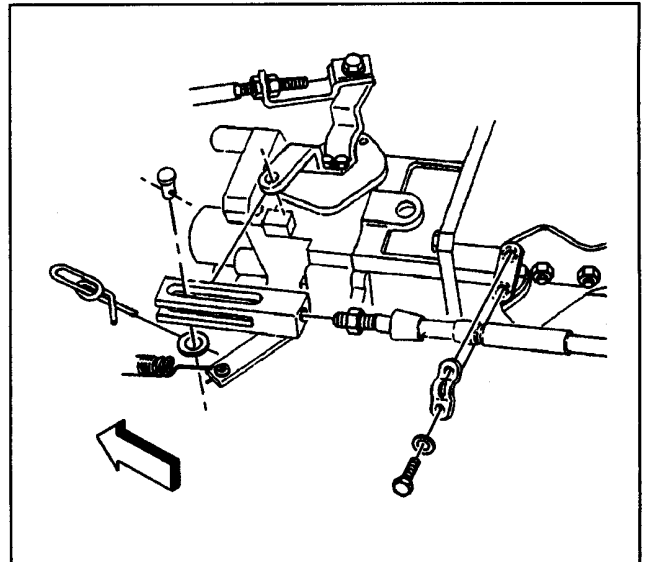
1. Remove the cotter pin, the clevis pin, and the washer securing the clevis to the throttle lever, if necessary.
2. Remove the clevis from the modulator cable, if necessary.



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Adjustment Procedure

1. Install the clevis to the modulator cable.
2. Install the threads of the modulator cable into the clevis to a 20 mm (0.8 in) thread engagement.
3. With the engine OFF, position the throttle lever to the wide open position.
4. Position the clevis over the throttle lever mounting hole.
5. Position the clevis pin through the clevis and the throttle lever.
 - 5.1. Make sure the distance between the clevis pin and the end of the clevis slot away from the cable is between 1–2 mm (0.04–0.08 in).
 - 5.2. If the clearance is not between 1–2 mm (0.04–0.08 in), thread the modulator cable into or out of the clevis in order to acquire the correct clearance.



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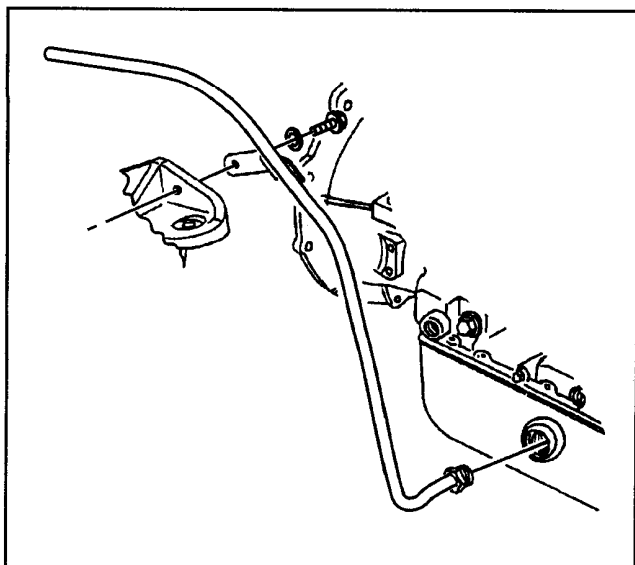
Notice: Refer to *Fastener Notice* in Cautions and Notices.

6. Secure the modulator cable nut to the clevis.

Tighten

Tighten the modulator cable nut to 12 N·m (106 lb in).

7. Secure the clevis pin to the clevis with the washer and the cotter pin.
8. Move the throttle lever from the wide open throttle position to the idle position three or four times.
9. Position the throttle lever in the wide open position.
10. Make sure that the clearance between the clevis pin and the end of the clevis slot away from the cable is between 1–2 mm (0.04–0.08 in).
11. Repeat the procedure, if necessary, in order to acquire the correct clearance.

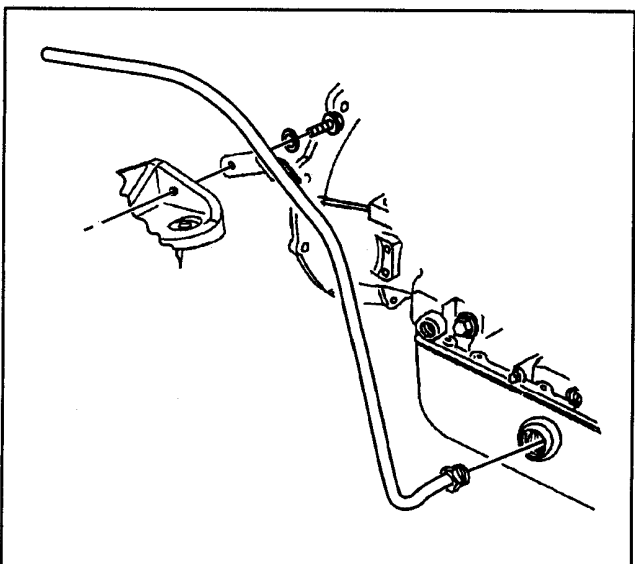


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Transmission Oil Level Indicator Tube Replacement

Removal Procedure

1. Remove the oil level indicator.
2. Remove the bolt and the washer securing the oil level indicator tube to the engine bracket.
3. Place a container under the transmission oil pan in order to catch the draining oil.
4. Remove the nut securing the oil level indicator tube to the transmission oil pan.



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Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the nut in order to secure the oil level indicator tube to the transmission oil pan.

Tighten

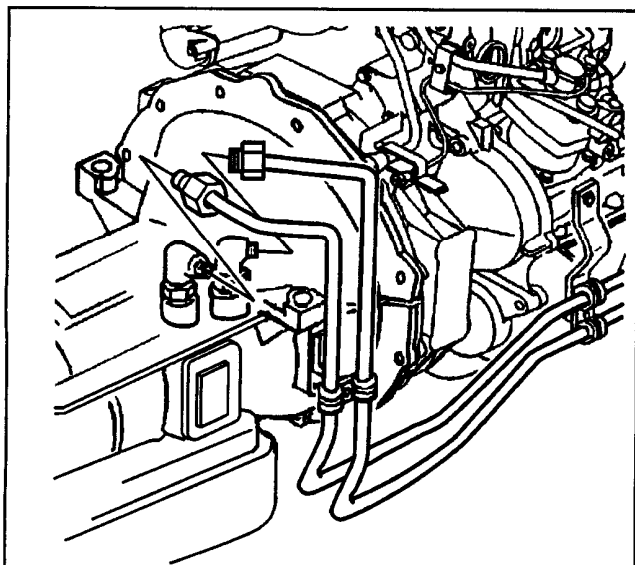
Tighten the nut to 130 N.m (96 lb ft).

2. Install the bolt and washer in order to secure the oil level indicator tube to the engine bracket.

Tighten

Tighten the bolt to 55 N.m (41 lb ft).

3. Install the oil level indicator.
4. Check the transmission oil level. Add oil as necessary. Refer to *Transmission Oil Checking Procedure*.



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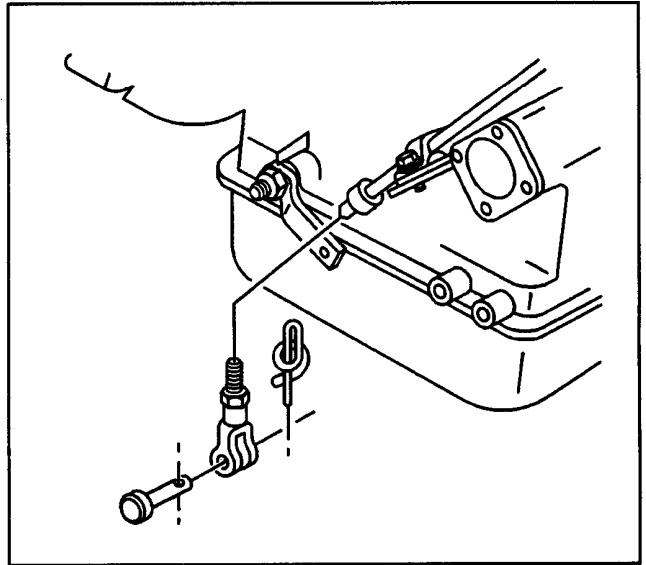
Transmission Replacement

Removal Procedure

Caution: Refer to *Battery Disconnect Caution* in Cautions and Notices.

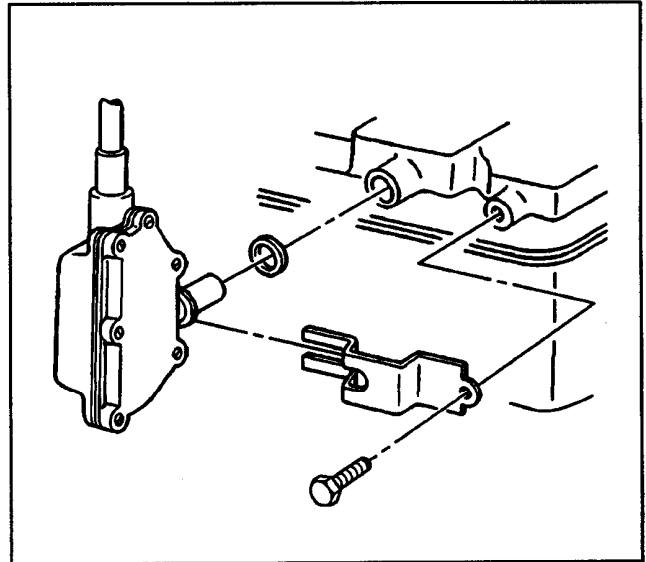
1. Disconnect the negative battery cable.
2. Raise the vehicle.
3. Disconnect the exhaust pipes. Refer to Exhaust Pipe Replacement in Engine Exhaust.
4. Remove the transmission oil level indicator tube. Refer to *Transmission Oil Level Indicator Tube Replacement*.
5. Drain the transmission oil.
6. Cover the transmission oil pan opening in order to prevent the entry of foreign material.
7. Disconnect the oil cooler lines from the transmission case. Refer to *Transmission Oil Cooler Line Replacement*.

8. Disconnect the shift cable from the transmission. Refer to *Shift Cable Replacement*.



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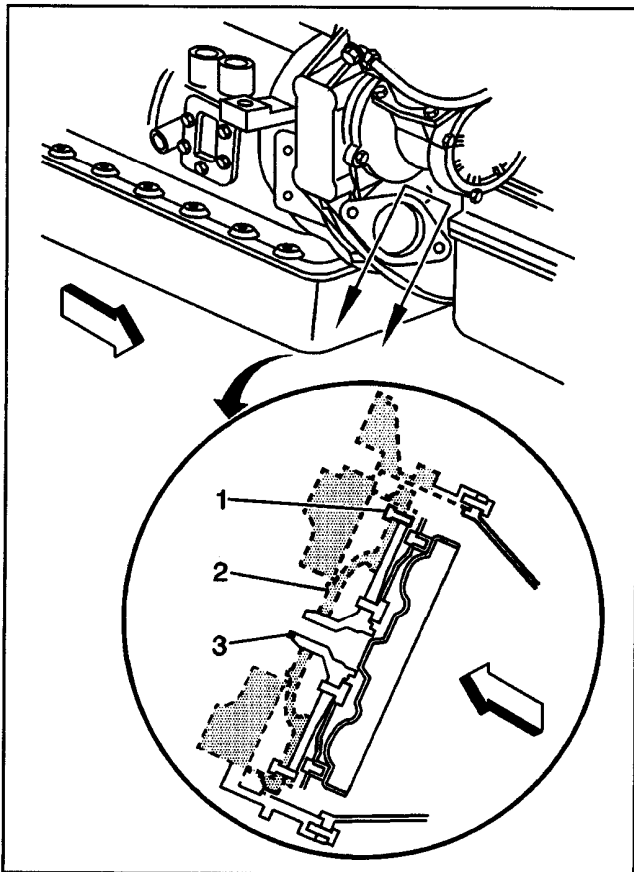
9. Remove the modulator from the transmission. Refer to *Transmission Modulator Replacement*.
10. Disconnect the wiring harness connectors from the transmission.
11. Remove the starter. Refer to *Starter Motor Replacement* in Engine Electrical.
12. Disconnect the propeller shaft from the transmission. Refer to the appropriate procedure:
- One-piece propeller shafts:
 - *One-Piece Propeller Shaft Replacement (Full Yoke/229)*
 - *One-Piece Propeller Shaft Replacement (Full Yoke/305)*
 - *One-Piece Propeller Shaft Replacement (Half Yoke/229)*
 - *One-Piece Propeller Shaft Replacement (Half Yoke/305)*
 - *One-Piece Propeller Shaft Replacement (Outboard Slip/229)*
 - *One-Piece Propeller Shaft Replacement (Outboard Slip/305)*
 - *Two-Piece Propeller Shaft Replacement (Inboard Slip Joint and Flange)*
 - *Three-Piece Propeller Shaft Replacement (Center Bearing, Full Yoke)*
13. Disconnect the park brake cable from the park brake. Refer to *Park Brake Cable Replacement* in Park Brake.



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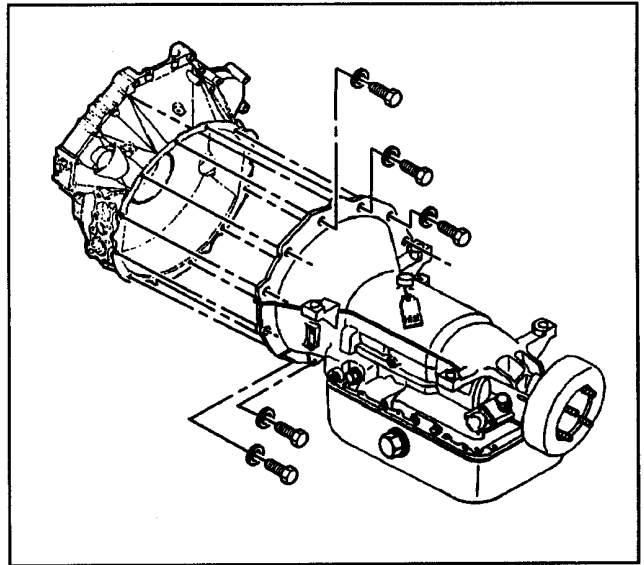
Notice: Carefully inspect the transmission and the surrounding areas to be sure no lines, hoses or wires will interfere with the transmission removal. In order to avoid damage to the transmission or the torque converter, support the transmission with a dolly jack. Do not let the torque converter fall.

14. Support the transmission with a transmission dolly that can hold a load of at least 349 kg (750 lb).
 - 14.1. Position the dolly so that the transmission oil pan will not support the weight of the transmission.
 - 14.2. Fasten a safety chain over the top of the transmission and on both sides of the dolly.
 - 14.3. Cushion the transmission in order to prevent cracks or tears to the transmission housing.
15. Remove the flywheel (2) from the flexplate (3).
 - 15.1. Remove the flywheel access cover.
 - 15.2. Using a pry bar, turn the flexplate (3) in order to align the flexplate to flywheel bolts (1) with the access hole.
 - 15.3. Remove the flexplate to flywheel bolts (1).
 - 15.4. Mark the flywheel (2) and flexplate alignment (3).



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16. Remove the transmission to engine bolts.
17. Move the transmission back from the engine.
18. Lower the transmission.
19. Remove the park brake from the transmission.
Refer to Park Brake.



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Installation Procedure

Notice: Carefully inspect the transmission and the surrounding area to be sure no lines, hoses or wires will interfere with the transmission installation. When raising and moving the transmission, do not let the torque converter slip off the shaft. The transmission or torque converter can be damaged.

Important: Do not install the transmission without installing the park brake.

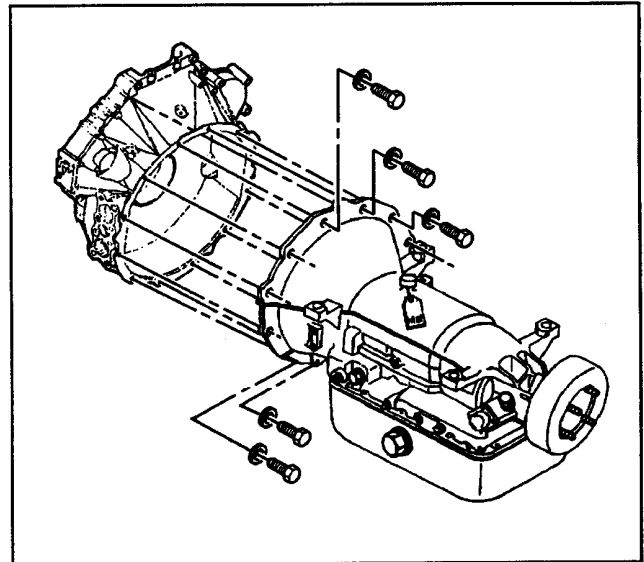
1. Install the park brake to the transmission. Refer to Park Brake Replacement in Park Brake.
2. Raise the vehicle.
3. Raise the transmission.
4. Move the transmission to the engine.
5. Install the transmission to engine.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

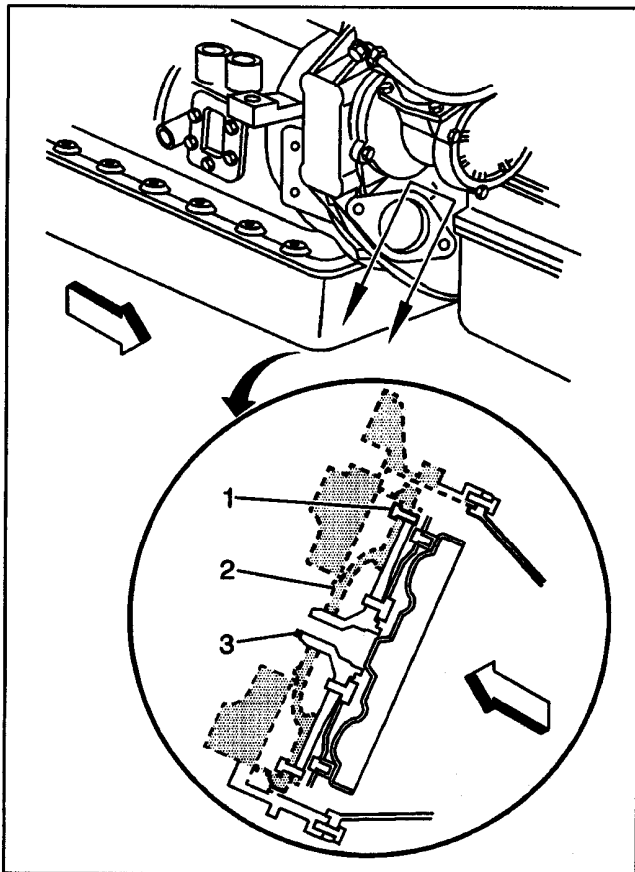
6. Install the transmission to engine bolts.

Tighten

Tighten the bolts to 55 N.m (41 lb ft).



205284



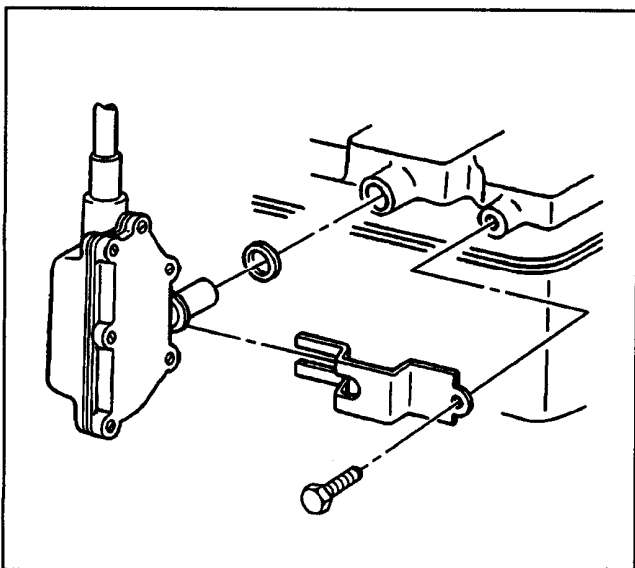
205282

7. Install the flywheel (2) to the flexplate (3).
 - 7.1. Using the alignment marks, align the flywheel (2) and the flexplate (3).
 - 7.2. Using a pry bar, turn the flexplate (3) in order to align the holes for the flexplate to flywheel bolts with the access hole.
 - 7.3. Install the flexplate to flywheel bolts (1) through the access hole.

Tighten

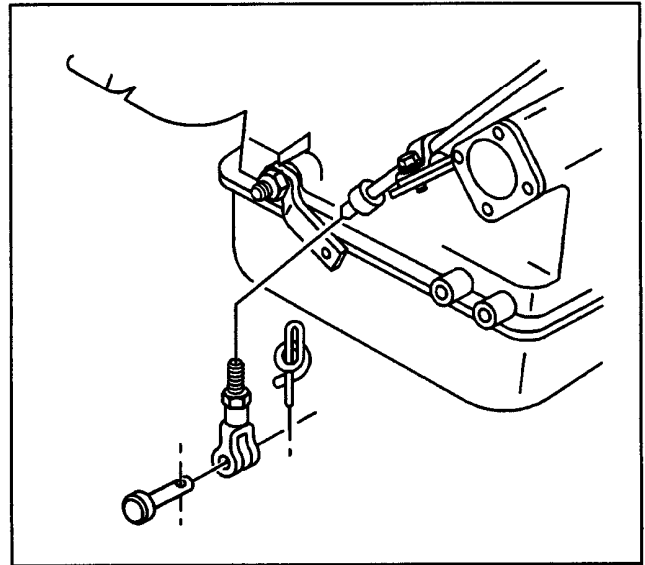
Tighten the bolts to 56 N.m (41 lb ft).

8. Install the flywheel housing access cover.
9. Connect the park brake cable. Refer to Park Brake Cable Replacement in Park Brake.
10. Connect the propeller shaft to the transmission. Refer to the appropriate procedure:
 - One-piece propeller shafts:
 - One-Piece Propeller Shaft Replacement (Full Yoke/229)
 - One-Piece Propeller Shaft Replacement (Full Yoke/305)
 - One-Piece Propeller Shaft Replacement (Half Yoke/229)
 - One-Piece Propeller Shaft Replacement (Half Yoke/305)
 - One-Piece Propeller Shaft Replacement (Outboard Slip/229)
 - One-Piece Propeller Shaft Replacement (Outboard Slip/305)
 - Two-Piece Propeller Shaft Replacement (Inboard Slip Joint and Flange)
 - Three-Piece Propeller Shaft Replacement (Center Bearing, Full Yoke)
11. Install the starter. Refer to Starter Motor Replacement in Engine Electrical.
12. Connect the wiring harness connectors to the transmission.
13. Install the modulator to the transmission. Refer to Transmission Modulator Replacement.



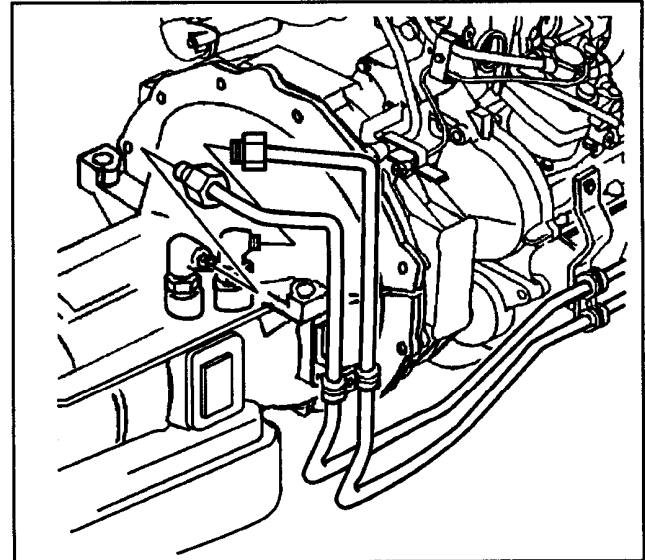
201540

14. Connect the shift cable to the transmission.
Refer to *Shift Cable Replacement*.



205254

15. Connect the oil cooler lines to the transmission case. Refer to *Transmission Oil Cooler Line Replacement*.
16. Install the transmission oil level indicator tube. Refer to *Transmission Oil Level Indicator Tube Replacement*.
17. Connect the exhaust pipes. Refer to *Exhaust Pipe Replacement in Engine Exhaust*.
18. Connect the negative battery cable.
19. Check the transmission oil. Add transmission oil, if necessary. Refer to *Transmission Oil Checking Procedure*.



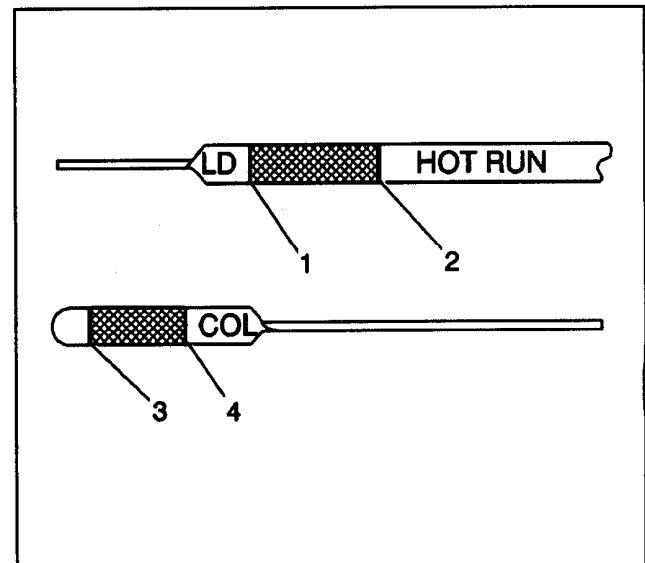
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Transmission Oil Checking Procedure

1. Start the engine.
2. Shift the transmission through all the ranges in order to fill the clutch cavities and oil passages.
3. Shift the transmission to neutral.
4. Idle the engine for at least 1 minute at 1,000–1,200 RPM in order to clear the system of air.
5. Make sure the parking brake is applied.

Notice: When adding oil or checking the oil level, dirt or foreign material must not be allowed to enter the fill tube. Before removing the oil level indicator, clean around the end of the fill tube. Contaminated transmission oil will cause rapid wear and early failure of internal parts.

6. Check the oil while the vehicle is on level ground.



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Cold Oil Check

1. Idle the engine.
2. Make sure the oil temperature is at 16–49 °C (60–120 °F).
3. Remove the oil level indicator from the oil filler tube.
4. Check the oil level.
 - If the oil level registers between the COLD ADD (4) and the COLD FULL (3) bands, the transmission may be safely operated.

Important: Do not overfill the transmission with oil. Refer to *Transmission Oil Checking Procedure*.

- If the level registers at or below the COLD ADD (4) band, add oil in order to bring the oil level to the COLD FULL (3) band. Refer to *Adjusting The Oil Level*.

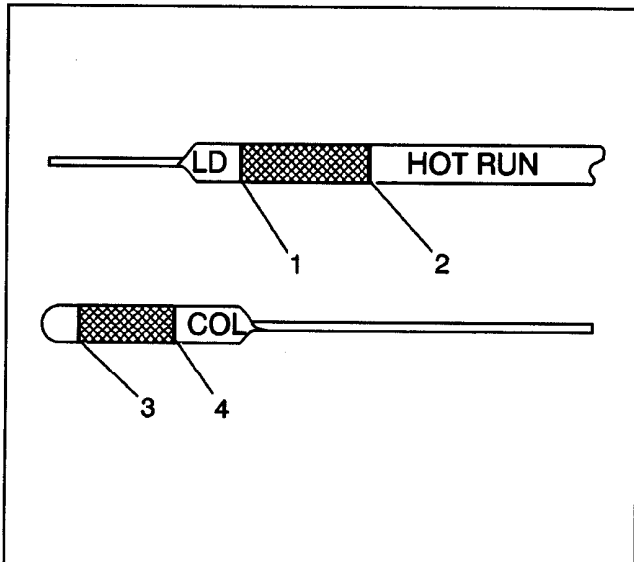
5. Make a hot oil check after the transmission reaches the operating temperature.

Hot Oil Check

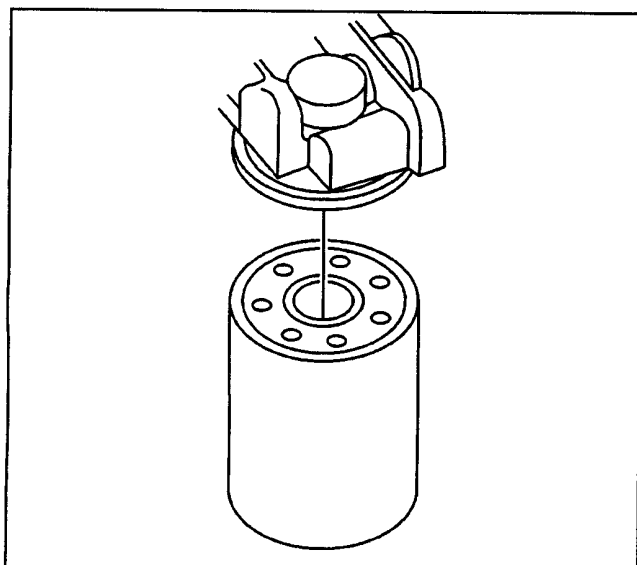
1. Idle the engine.
2. Make sure the oil sump temperature is at 38–49 °C (100–120 °F).
3. Remove the oil level indicator from the oil filler tube.
4. Check the oil level.
 - If the oil level registers between the HOT ADD (1) and the HOT FULL (2) bands, the transmission may be safely operated.

Important: Do not overfill the transmission with oil. Refer to *Fluid Capacity Specifications*.

- If the level registers at or below the HOT ADD (1) band, add oil in order to bring the oil level to the HOT FULL (2) band. Refer to *Adjusting The Oil Level*.



201483



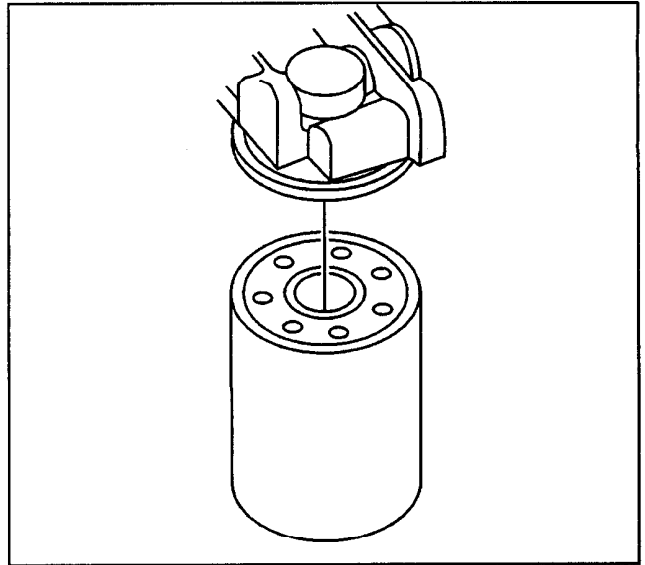
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External Transmission Oil Filter Replacement**Removal Procedure**

1. Locate the external oil filter connected in-line of the transmission oil cooler. The filter is mounted on the right frame rail.
2. Place a container under the oil filter in order to catch any draining oil.
3. Remove the filter from the oil filter cover.

Installation Procedure

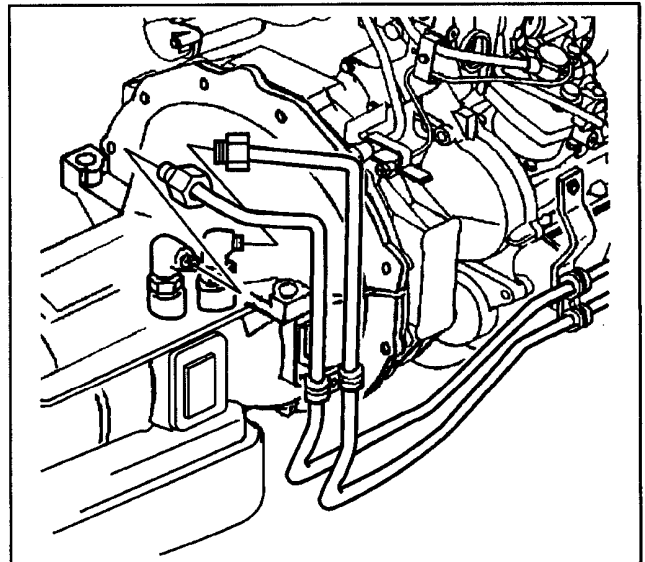
1. Apply a light coat of transmission oil to the filter seal.
2. Install the filter to the oil filter cover.
3. Hand tighten the filter to the oil filter cover.



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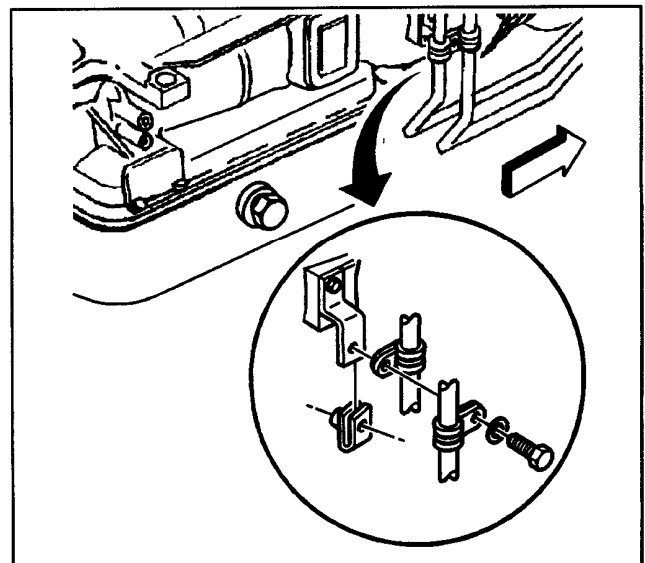
Transmission Oil Cooler Line Replacement**Removal Procedure**

1. Remove the two nuts securing the two oil cooler lines to the transmission oil cooler line connectors.

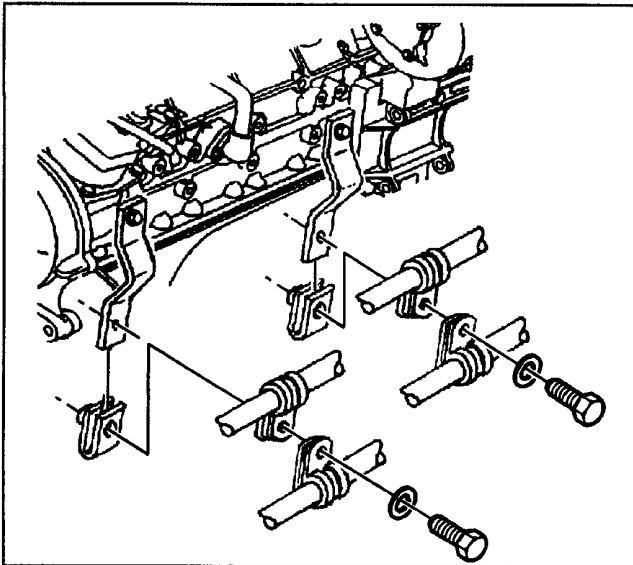


205259

2. Remove the bolt, the washer, and the nut securing the oil cooler line to the transmission case bracket.

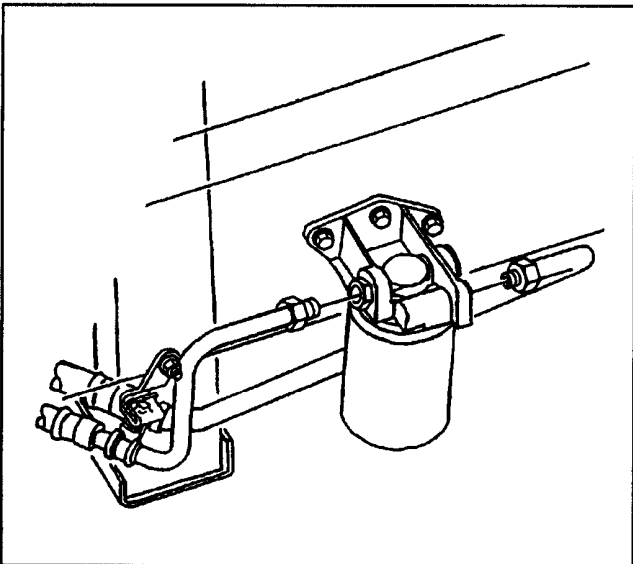


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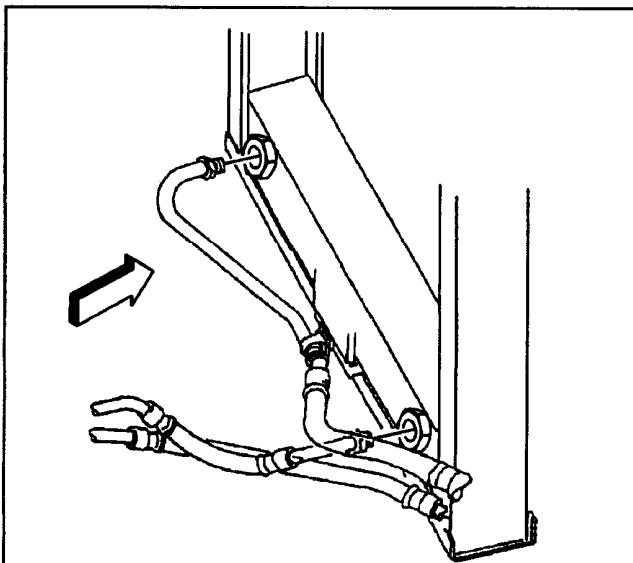
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3. Remove the two bolts, the washers, and the nuts securing the oil cooler lines to the engine block bracket.



205270

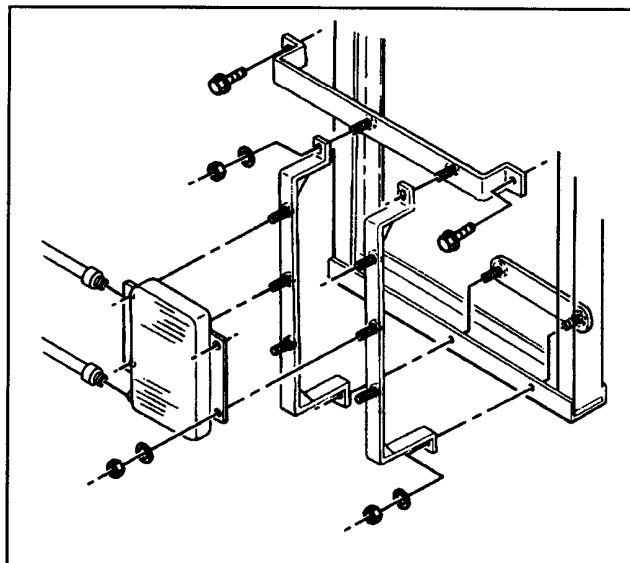
4. Remove the two nuts securing the two oil cooler lines to the transmission oil filter.



205273

5. Disconnect the two oil cooler lines from the radiator.

6. Disconnect the two oil cooler lines from the auxiliary oil cooler.
7. Remove the oil cooler lines from the vehicle.



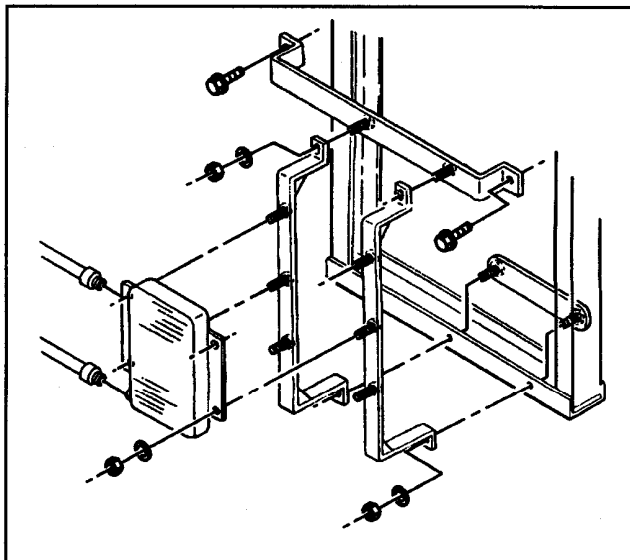
205278

Installation Procedure

1. Install the oil cooler lines to the vehicle.
Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Connect the two oil cooler lines to the auxiliary oil cooler.

Tighten

Tighten the oil cooler lines to 30 N.m (22 lb ft).

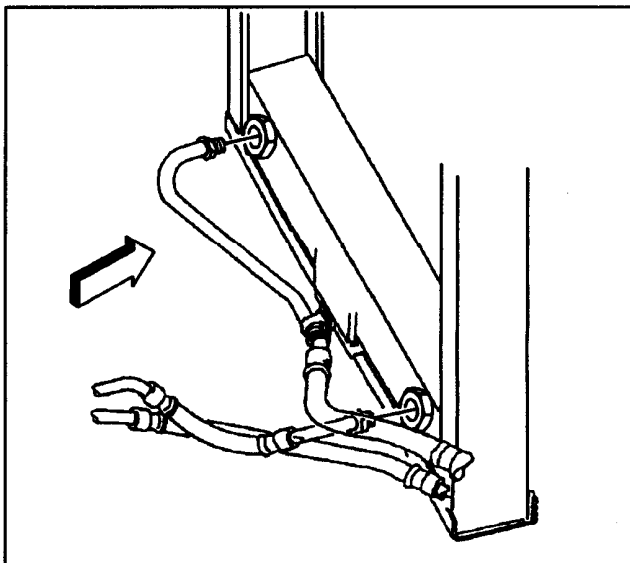


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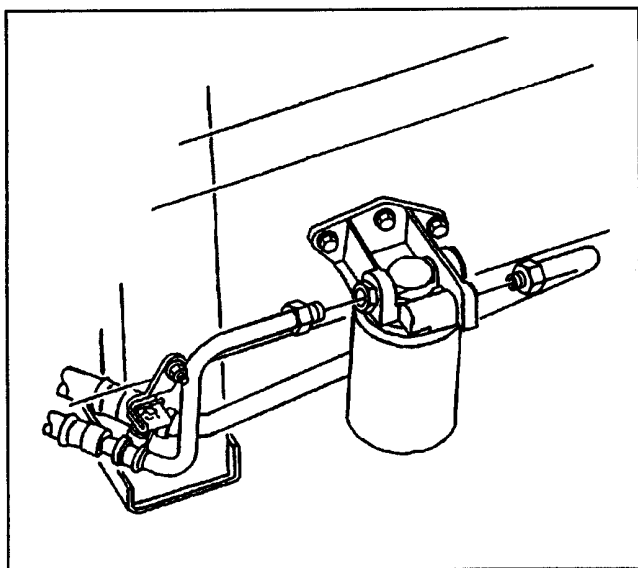
3. Install the two oil cooler lines to the radiator.

Tighten

Tighten the oil cooler lines to 30 N.m (22 lb ft).



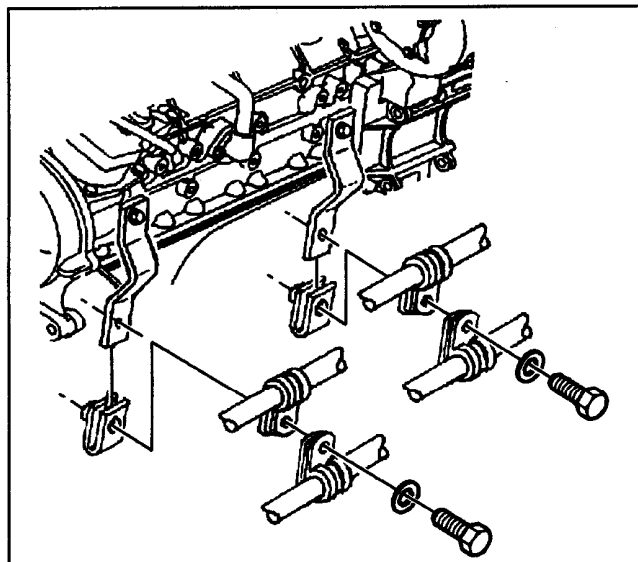
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4. Install the two nuts in order to secure the two oil cooler lines to the transmission oil filter.

Tighten

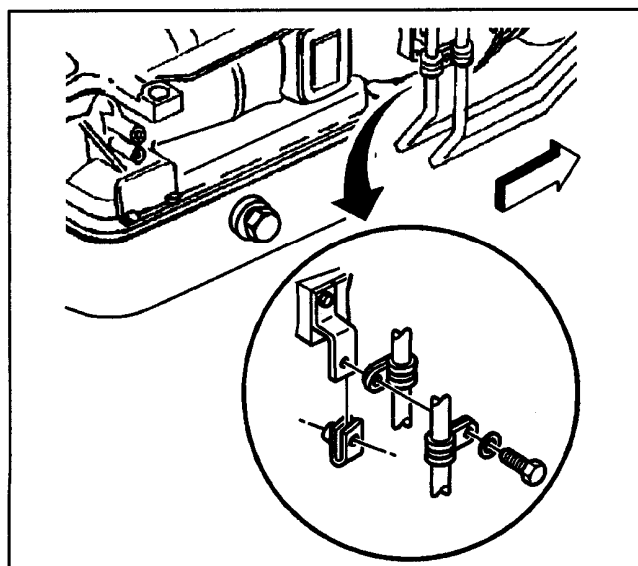
Tighten the nuts to 30 N.m (22 lb ft).



5. Install the two bolts, the washers, and the nuts in order to secure the oil cooler lines to the engine block bracket.

Tighten

Tighten the nuts to 30 N.m (22 lb ft).



6. Install the bolt, the washer, and the nut in order to secure the oil cooler line to the transmission case bracket.

Tighten

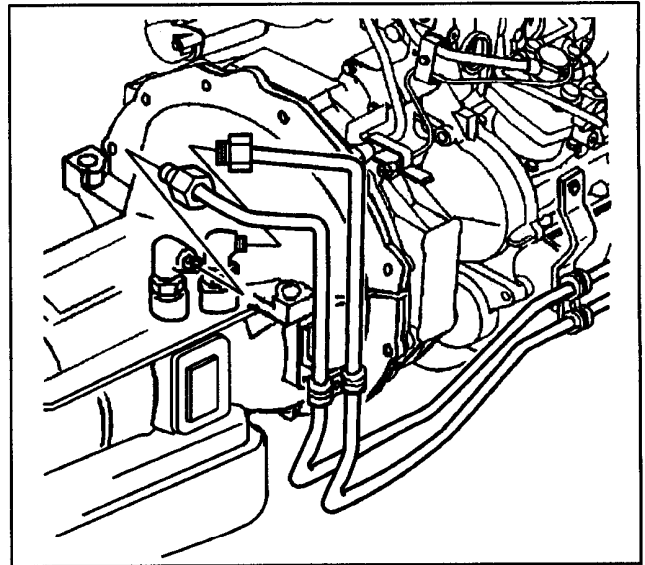
Tighten the bolt to 30 N.m (22 lb ft).

205262

7. Install the two nuts in order to secure the two cooler lines to the transmission oil cooler line connectors.

Tighten

Tighten the nuts to 25 N·m (18 lb ft).



205259

Flushing the Transmission Oil Cooler and Lines

Flush the oil cooler lines following a breakdown of the transmission in order to eliminate contaminated oil. This helps prevent trouble after repairs of the transmission.

1. Disconnect the oil cooler lines at the transmission case.
2. If an auxiliary filter has been installed, disconnect the oil cooler return line at the auxiliary filter instead of the transmission.
Notice: Do not exceed 689 kPa (100 psi) air pressure or damage may result to the oil cooler.
3. Back flush the oil cooler and lines using clean mineral spirits and compressed air.
4. Flush all remaining mineral spirits from the oil cooler and lines using compressed air.
5. Flush the oil cooler lines again with transmission oil.
 - 5.1. Test the oil cooler for free flow of oil.
 - 5.2. If the flow of oil is restricted, replace the tank and cooler assembly.
 - 5.3. If debris from the oil cooler circuit persists, install a new auxiliary filter in the oil return line between the oil cooler and the transmission.

Description and Operation

Transmission Description and Operation

The Allison AT 545 automatic transmission includes a hydraulic torque converter, a planetary gear train, and a hydraulic control system. The control system automatically changes gears. The control system provides pressure in order to apply the clutches. With the transmission in the drive range, the torque converter multiplies the engine torque in order to start the movement of the vehicle. The converter also acts as a hydraulic cushion between the engine and the transmission. The clutches and the gear sets provide multiple speeds forward and one speed reverse.

Automatic up shifting and down shifting depends on the vehicle load, the speed, and the foot pressure on the accelerator. When the pedal is fully depressed, the automatic up shifting occurs near the governed engine speed. A partially depressed accelerator pedal causes up shifts to occur at a lower engine speed.

The automatic transmission shift control consists of three components: a range selector mounted in the cab, a shift control lever which is part of the transmission, and an adjustable cable that connects the range selector and the shift control lever.

This section details the service procedures for supporting vehicles for the Allison Automatic Transmission AT 545. Allison Transmission also provides a publication for the testing, servicing, overhaul, and troubleshooting diagnosis of the AT 545 transmission. The name of the publication is the Allison AT 500 and AT 1500 Series Transmission Service Manual SA 1241.

Obtain a copy of the Allison AT 500 and AT 1500 Series Transmission Service Manual SA 1241 from any local Allison distributor or dealer. Order the Service Manual SA 1241 and Allison automatically sends the latest printing of that service manual.

Contact the local Allison distributor for additional information and guidance on overhaul procedures and services.

Overhaul Information

For the overhaul and the internal parts inspection of the AT 545 automatic transmissions, refer to the Allison AT 500 and AT 1500 Series Service Manual SA 1241 and the Allison AT 545 Inspection Analysis Technicians Guide SA 1948.

Clutch

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Clutch Actuator to Support Bracket Nut	16 N.m	12 lb ft
Clutch Actuator to Swivel Nut	40 N.m	30 lb ft
Clutch Fork Bolts	15 N.m	11 lb ft
Clutch Housing Bolts	35 N.m	26 lb ft
Front Bearing Cover Bolts	27 N.m	20 lb ft
Master Cylinder to Support Bolts	20 N.m	15 lb ft
Pedal Shaft Bolts	45 N.m	33 lb ft
Pressure Plate Bolts 8 mm (0.31")	25 N.m	18 lb ft
Pressure Plate Bolts 9.5 mm (0.37")	50 N.m	36 lb ft

Sealers and Lubricants

Clutch System Fluid	Fluid Levels
Use a brake fluid that meets DOT 3 specifications when adding fluid to the clutch system reservoir.	Fill the reservoir to the specified level shown on the reservoir. Do not overfill the system.

Diagnostic Information and Procedures

Clutch Slipping

Cause	Action
The release levers in the pressure plate and the cover are binding.	Replace the clutch cover.
The clutch release levers are not properly adjusted.	If the levers are in place, adjust the clutch cable.
The clutch release bearing adjustment is improper.	Adjust the clutch cable for proper clearance.
The clutch pedal is binding or sticking	Check the clutch cable for proper operation.
The clutch pressure springs are weak or broken.	Replace the clutch cover.
The clutch facings are burnt.	Replace the driven disc.
The release bearing is binding in the drive gear.	Lubricate or replace the release bearing.

Clutch Grabbing (Chattering) (Chattering)

Causes	Action
Grease or oil is on the facings.	Repair the oil leak and replace the driven disc.
The pressure springs are weak.	Replace the clutch cover.
The pilot bearings are worn or broken.	Replace the pilot bearings.
The pressure plates are bent.	Replace the clutch cover.
The pressure plate or the flywheel is warped.	Replace the pressure plate or the flywheel.

Clutch Grabbing (Chattering) (Grabbing)

Causes	Action
There is grease or oil on the clutch facings.	Repair the oil leak and replace the driven disc.
The clutch pressure springs are too stiff.	Replace the clutch cover.

Clutch Rattle (Trans Click)

Causes	Action
The retractor spring is loose or worn.	Repair or replace the retractor spring.
The linkage is worn.	Repair or replace as necessary.

Clutch Noisy

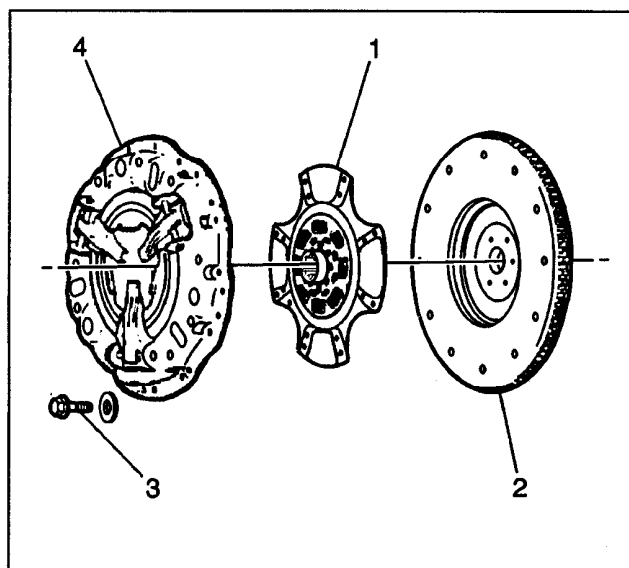
Causes	Action
The pilot bearing or the bushing is worn or broken.	Replace the pilot bearing or the bushing.
The release bearing is worn or broken.	Replace the release bearing.

Clutch Noisy During Engagement

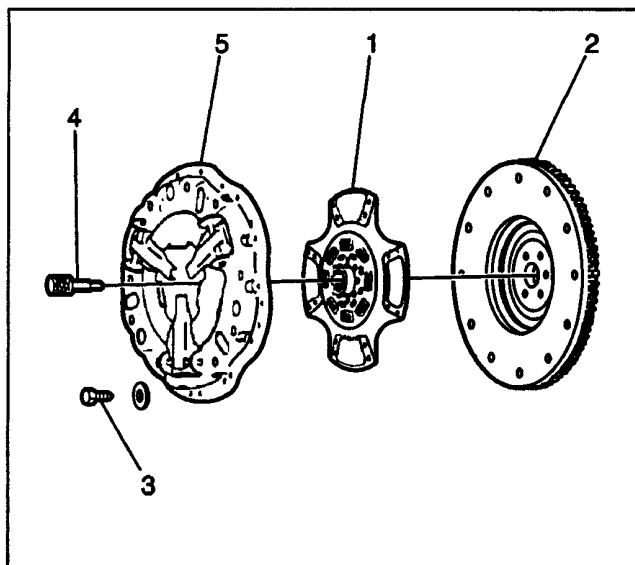
Causes	Action
The clutch release bearing is improper.	Adjust the clutch cable for pedal free play.
The clutch disc damper springs are weak or broken.	Replace the driven disc.
The clutch release bearing is binding.	Check for proper alignment. Replace the bearing if required.
The splines on the clutch disc are worn.	Replace the clutch disc.

Repair Instructions**Clutch Pressure Plate and Clutch Driven Plate****Removal Procedure**

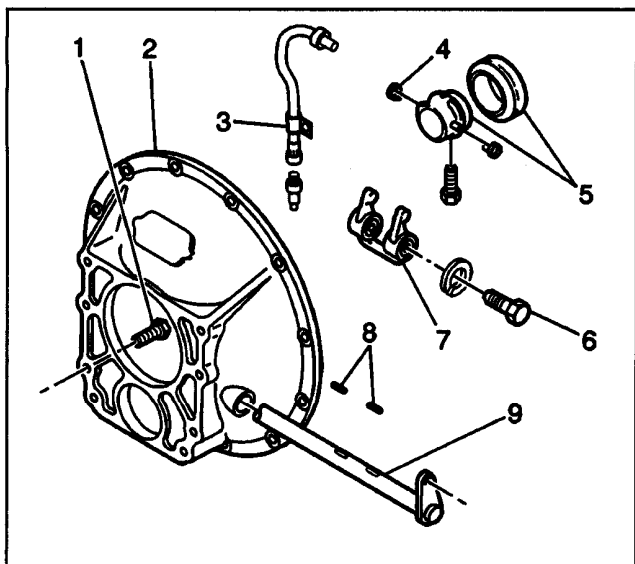
1. Remove the transmission. Refer to *Transmission Replacement* in Manual Transmission.
2. Remove the bolts (3) and the washers that secure the pressure plate (4) and the driven plate (1) to the flywheel (2).
3. Remove the pressure plate.
4. Remove the driven plate.
5. Inspect the following parts:
 - The clutch fork for wear, cracks, or distortion
 - The release bearing for roughness
 - The driven plate for broken springs, loose rivets, and cracks
 - The hub splines for wear and damage
 - The pressure plate for wear and damage
 - The flywheel for wear or damage
6. Inspect for unnecessary grease or oil on any of the components.
7. Measure the following components:
 - The driven plate friction material for thickness
Replace the driven plate if the material thickness is less than 1.27 mm (0.050 in).
 - The pressure plate friction surface flatness
Replace the pressure plate if the friction surface flatness is less than 0.10 mm (0.0039 in).



203663



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203656

Installation Procedure

Tools Required

J 37367 Clutch Pilot Aligner

1. Apply grease to the hub splines.
2. Install the driven plate (1).
3. Install the J 37367 to the center of the driven plate.
4. Install the pressure plate (5).
5. Install the bolts and the washers.
6. Remove the J 37367 from the driven plate.
7. Install the transmission. Refer to *Transmission Replacement* in Manual Transmission.

Release Bearing Replacement

Removal Procedure

1. Remove the transmission. Refer to *Transmission Replacement* in Manual Transmission or *Transmission Replacement* in Automatic Transmission.
2. Remove the bolt (6) and the washers that secure the fork (7).
3. Remove the following parts from the housing:
 - The shaft (9)
 - Use a drive bar in order to remove the shaft from the clutch housing.
 - The fork (7)
 - The keys (8)
4. For 200 HP models only, remove the flexible hose (3).
5. For 200 HP models only, remove the return spring (4).
6. Remove the release bearing (5) and the seal. Pry the seal from the clutch housing. Drive the bearing from the clutch housing.
7. Remove the bolts that secure the clutch housing to the transmission.

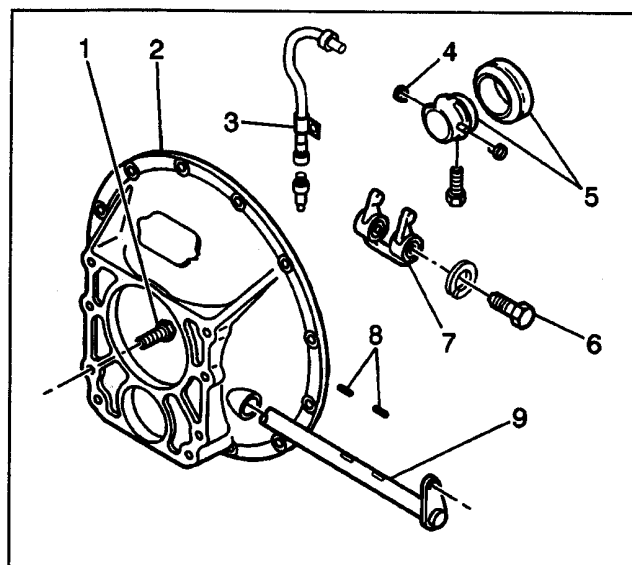
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the bolts that secure the clutch housing (2) to the transmission.

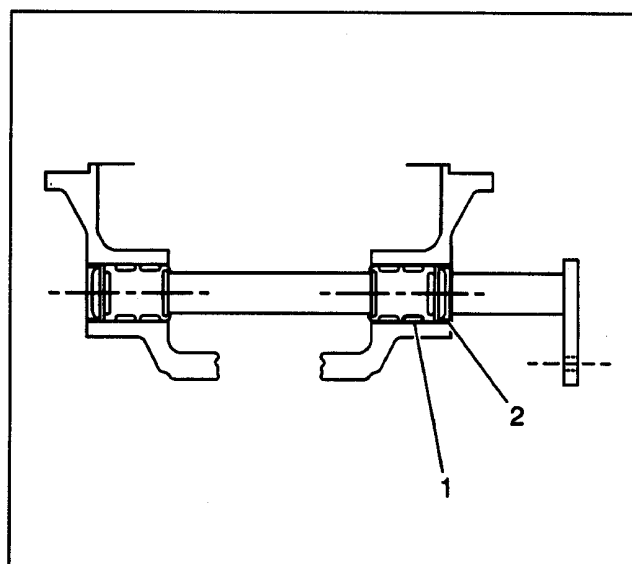
Tighten

Tighten the clutch housing bolts 35 N·m (26 lb ft).



203656

2. Install the release bearing (1) and the NEW seal (2).
 - Apply grease to the bearing and the clutch housing cavity.
 - Apply grease to the area between the seal and the bearing.
 - Drive the bearing to 10 mm (0.39 in) depth.
 - Drive the seal to 2 mm (0.08 in) depth.



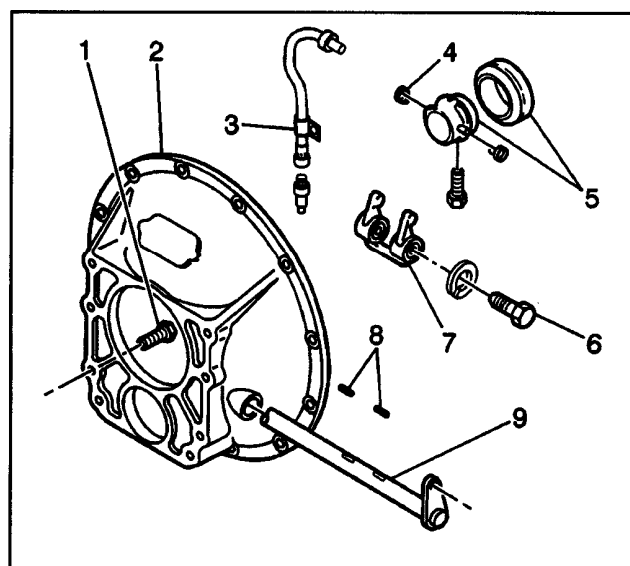
203652

3. For 200 HP models only, install the return spring (4).
4. For 200 HP models only, install the flexible hose (3).
5. Install the following parts to the housing:
 - The shaft (9)
 - The fork (7)
 - The keys (8)
6. Install the bolt (6) and the washers securing the fork (7).

Tighten

Tighten the fork bolt to 15 N·m (11 lb ft).

7. Install the transmission. Refer to *Transmission Replacement* in Manual Transmission or *Transmission Replacement* in Automatic Transmission.



203656

Description and Operation

Clutch Driving Members

The driving members of a clutch usually consist of two flat surfaces machined to a smooth finish. One of these surfaces is usually the rear face of the engine flywheel, and the other is a comparatively heavy flat ring with one side machined. This part is known as the pressure plate. The pressure plate is fitted onto a steel cover that contains some of the operating members and is bolted to the flywheel.

Clutch Driven Members

The driven member is a clutch disc with a spined hub that is free to slide lengthwise along the splines of the clutch shaft, but does not drive the shaft through these same splines. The suitable frictional facings are attached to each side of the clutch disk by means of rivets. The facings must be heat resistant in order to operate in a friction heated environment.

Clutch Operating Members

The driving and the driven members are held in contact by spring pressure. The throw-out (clutch release) bearing a ball thrust bearing contained in the clutch housing is mounted on a sleeve attached to the front of the transmission case. The throw out bearing is moved by the clutch release yoke to contact the release levers and move the pressure plate to the rear, thus separating the clutch driving members from the driven members when the clutch pedal is pushed.

Hydraulic Clutch Description

The hydraulic clutch system provides automatic clutch adjustments, no adjustment of clutch linkage or pedal position is required for clutch disc wear. When the clutch disc wears, the fluid level in the master cylinder reservoir will rise in order to accommodate for the extra fluid not required in the hydraulic system.

SECTION 7B1B

**MLD6Q MANUAL TRANSMISSION
OVERHAUL**

NOTICE: Always use the correct fastener in the correct location. When you replace a fastener, use **ONLY** the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

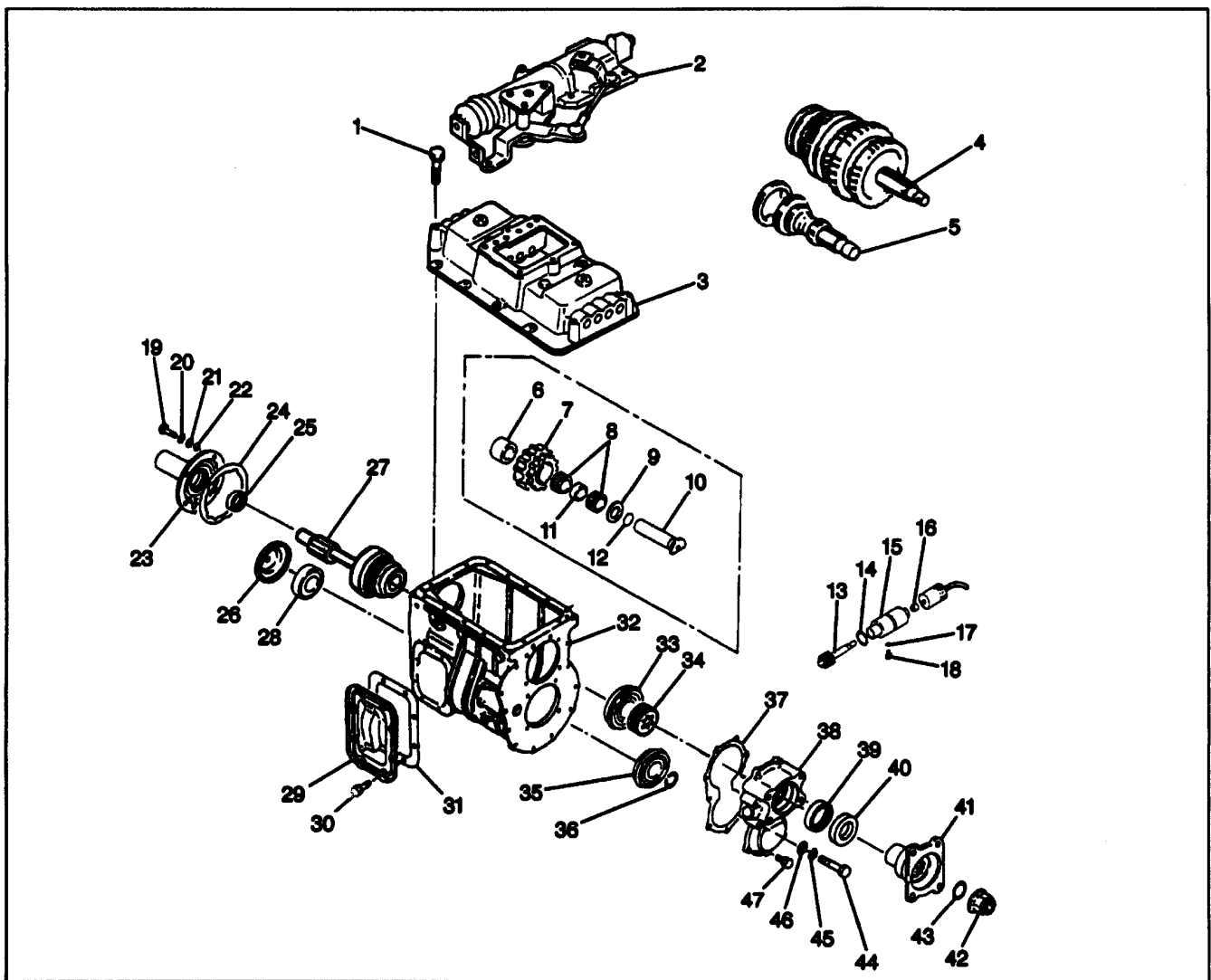
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GENERAL DESCRIPTION

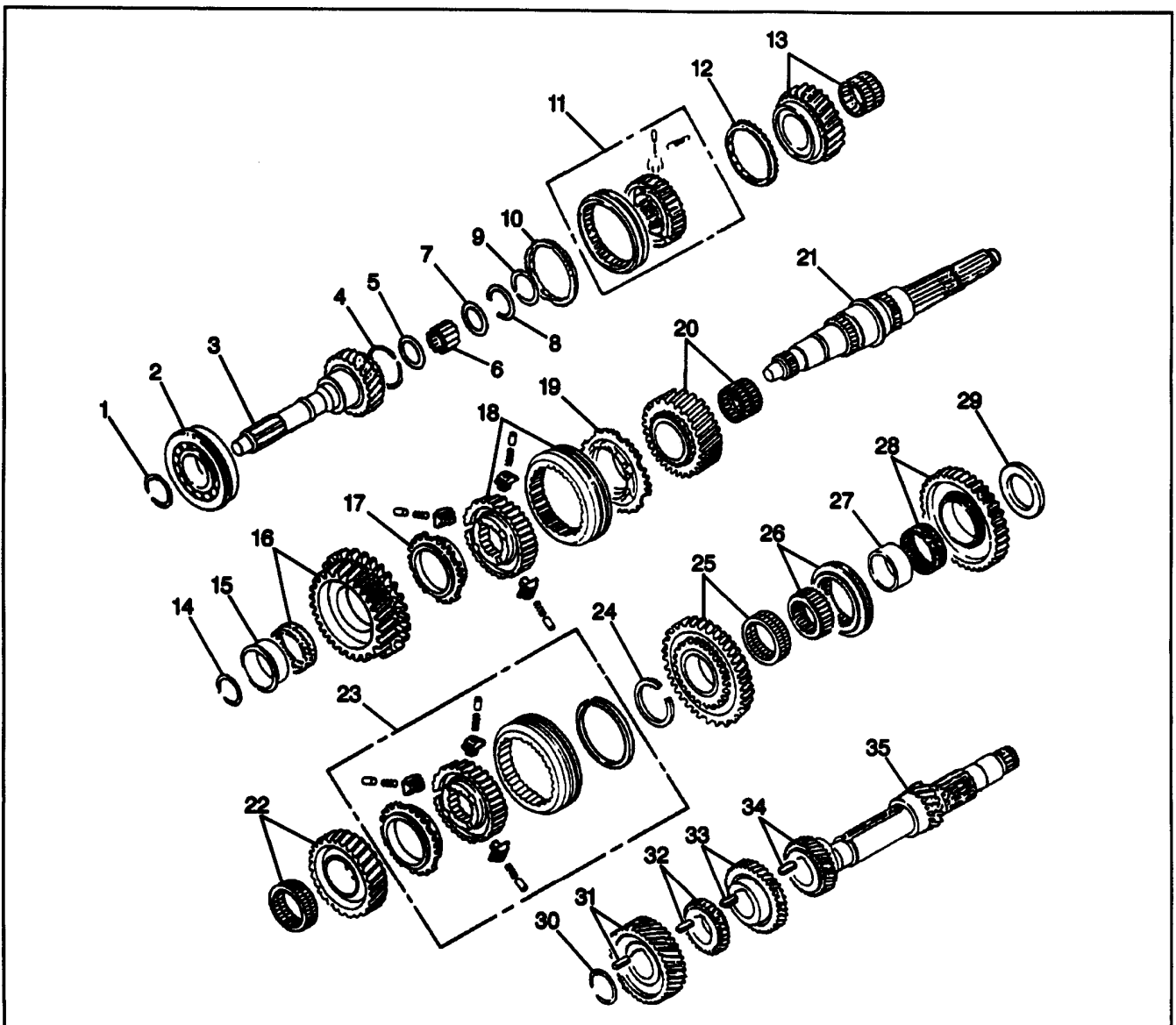
The six speed (MLD6Q) transmission has a constant mesh first and reverse gear. The remaining gears are synchronized. Shifting is done with a remote shift control connected to two cables that operate a shift

quadrant mounted on the top of the transmission. The transmission is equipped with a drive that can be connected to a power takeoff system.

**Legend**

- | | |
|-------------------------------|-----------------------------------|
| (1) Bolt, | (25) Seal |
| (2) Box, Upper Quadrant | (26) Cover, Counter Shaft Bearing |
| (3) Box, Lower Quadrant | (27) Shaft, Top Gear |
| (4) Mainshaft | (28) Bearing, Front Countershaft |
| (5) Countershaft | (29) Cover |
| (6) Collar | (30) Bolt |
| (7) Gear, Reverse | (31) Gasket |
| (8) Bearing | (32) Case, Transmission |
| (9) Washer, Thrust | (33) Bearing, Mainshaft Rear |
| (10) Shaft, Reverse Gear | (34) Gear, Speedometer Drive |
| (11) Piece, Distance | (35) Bearing, Countershaft Rear |
| (12) Gasket | (36) Ring, Snap |
| (13) Gear, Speedometer Driven | (37) Gasket |
| (14) Seal | (38) Cover, Rear Bearing |
| (15) Bushing | (39) Seal, Rear Oil |
| (16) Seal | (40) Cover, Dust |
| (17) Washer | (41) Flange |
| (18) Screw | (42) Nut |
| (19) Bolt | (43) O-Ring |
| (20) Washer, Spring | (44) Bolt |
| (21) Washer | (45) Washer, Spring |
| (22) O-Ring | (46) Washer |
| (23) Cover, Front Bearing | (47) Bolt |
| (24) Gasket | |

Figure 1—Manual Transmission Internal Components


Legend

- | | |
|--------------------------------|--------------------------------|
| (1) Ring, Snap | (19) Ring, 3rd Blocker |
| (2) Bearing | (20) Gear and Bearing, 3rd |
| (3) Shaft, Top Gear | (21) Mainshaft |
| (4) Clip, Retaining | (22) Gear and Bearing, 2nd |
| (5) Washer | (23) Synchronizer, 1st and 2nd |
| (6) Bearing, Pilot | (24) Ring, Snap |
| (7) Washer | (25) Gear and Bearing, 1st |
| (8) Ring, Snap | (26) Sleeve and Hub, Reverse |
| (9) Ring, Snap | (27) Collar, Reverse Gear |
| (10) Ring, 6th Blocker | (28) Gear and Bearing, Reverse |
| (11) Synchronizer, 5th and 6th | (29) Washer, Thrust |
| (12) Ring, 5th Blocker | (30) Ring, Snap |
| (13) Gear and Bearing, 5th | (31) Gear and Key, Driven |
| (14) Ring, Snap | (32) Gear and Key, 5th |
| (15) Collar, 4th Gear | (33) Gear and Key, 4th |
| (16) Gear and Bearing, 4th | (34) Gear and Key, 3rd |
| (17) Ring, 4th Blocker | (35) Countershaft |
| (18) Synchronizer, 3rd and 4th | |

Figure 2—Gearshaft and Components

OVERHAUL

TRANSMISSION CASE
DISASSEMBLY

Tool Required:

J 22912-01 Bearing Remover

J 34827 Countershaft and Mainshaft Bearing
Remover

J 35669 Puller Bar and Screw

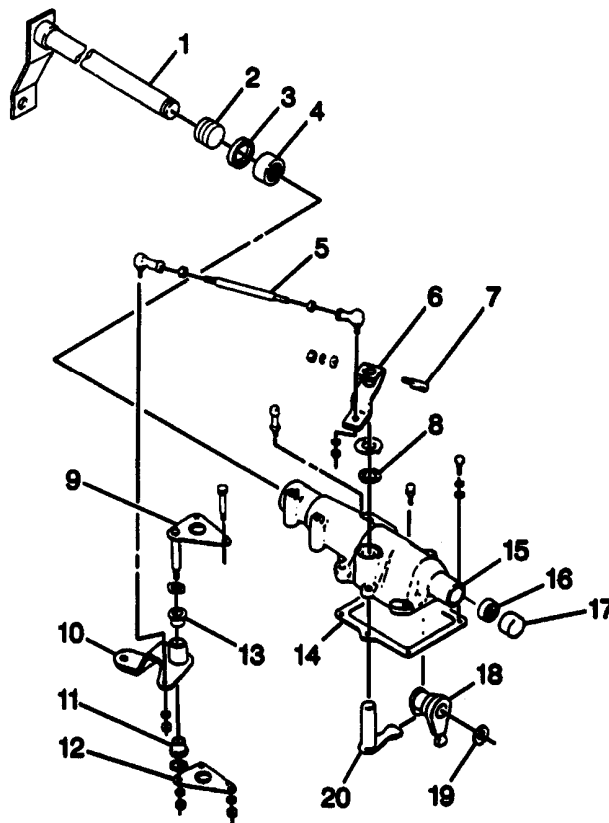
J 35833 Speedometer Gear Bushing Remover



Remove or Disconnect (Figures 1 through 6)

- Ensure the oil has been drained prior to transmission disassembly.
- 1. Upper and lower quadrant boxes from the transmission case (Figures 3 and 4).
 - Engage two gear sets to prevent the mainshaft from turning.

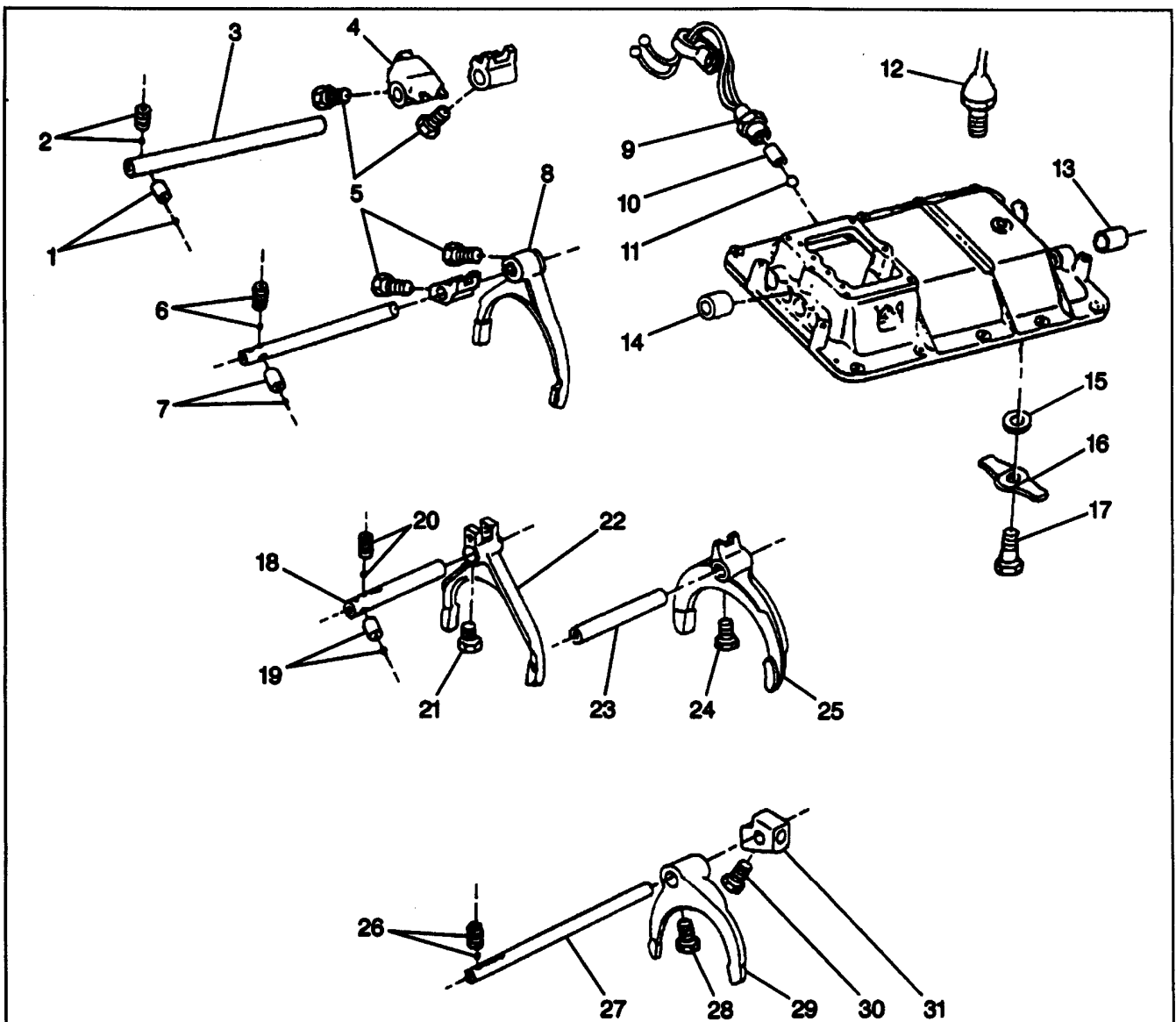
2. Flange nut, Flange and O-ring from the rear bearing cover (Figure 1).
3. Speedometer driven gear from the transmission. Refer to SECTION 7B.
4. Side cover and gasket.
5. Power takeoff if the transmission is equipped.
6. Clutch housing. Refer to SECTION 7C.
7. Front bearing cover, gasket, and oil seal.
8. Top gear shaft (Figure 5).
 - Use a screw driver between the top gear shaft and synchronizer clutch gear.
 - The synchronizer clutch gear can be separated from the top gear shaft.
9. Mainshaft rear bearing using J 34827 and J 2619-01.
10. Mainshaft assembly.



Legend

- | | |
|----------------------------|-----------------------------|
| (1) Lever, External Shift | (11) Bushing |
| (2) Boot | (12) Bracket |
| (3) Seal | (13) Bushing |
| (4) Bushing | (14) Gasket |
| (5) Rod, Link | (15) Upper Quadrant Box |
| (6) Lever, External Select | (16) Bushing |
| (7) Bolt, Key | (17) Cap |
| (8) Seal, Oil | (18) Lever, Internal Shift |
| (9) Bracket | (19) Ring, Snap |
| (10) Arm, Select Cable | (20) Lever, Internal Select |

Figure 3—Upper Quadrant Box Components



Legend

- | | |
|------------------------------|-------------------------------|
| (1) Ball and Pin, Interlock | (17) Screw |
| (2) Ball and Spring, Detent | (18) Rod, 3rd and 4th Shift |
| (3) Rod, Reverse Block Shift | (19) Ball and Pin, Interlock |
| (4) Block, Reverse Shift | (20) Ball and Spring, Detent |
| (5) Setscrew | (21) Setscrew |
| (6) Ball and Spring, Detent | (22) Arm, 3rd and 4th Shift |
| (7) Ball and Pin, Interlock | (23) Rod, Reverse Shift |
| (8) Arm, 1st and 2nd Shift | (24) Setscrew |
| (9) Neutral Position Switch | (25) Arm, Reverse Shift |
| (10) Bar | (26) Ball and Spring, Detent |
| (11) Ball, Interlock | (27) Rod, 5th and 6th Shift |
| (12) Switch, Back up Light | (28) Setscrew |
| (13) Cap | (29) Arm, 5th and 6th Shift |
| (14) Cap | (30) Setscrew |
| (15) Washer | (31) Block, 5th and 6th Shift |
| (16) Lever, Shift | |

Figure 4—Lower Quadrant Box Components

11. Reverse gear shaft and O-Ring using J 34539 and J 2619-01.
12. Thrust washer, reverse gear, bearing, and distance piece.
13. Collar.
14. Snap ring and counter shaft rear bearing using J 22912-01 and J 35699.
15. Countershaft assembly.
16. Countershaft front bearing cover and bearing from the transmission case (Figure 6).

GEARSHAFTS DISASSEMBLY

Tools Required:

- J 35699 Puller Bar and Screw
- J 35909 Mainshaft Collar Remover

TOP GEAR SHAFT DISASSEMBLY

Disassemble (Figure 2)

1. Retaining clip.
2. Snap ring.
3. Washers and pilot bearing.
4. Snap ring and bearing.

MAINSHAFT DISASSEMBLY

Disassemble (Figures 2 and 7)

1. 6th blocker ring.
2. Thrust washer, reverse gear, bearing, and collar.
3. Reverse sleeve and hub.
4. 1st gear, bearing, and thrust washer.
5. Snap ring and 1st and 2nd synchronizer (Figure 7).

Important

- Remove the synchronizers as one piece to avoid losing the synchronizers springs and blocks.

6. 2nd gear and bearing.
7. Snap ring and 5th and 6th synchronizer.

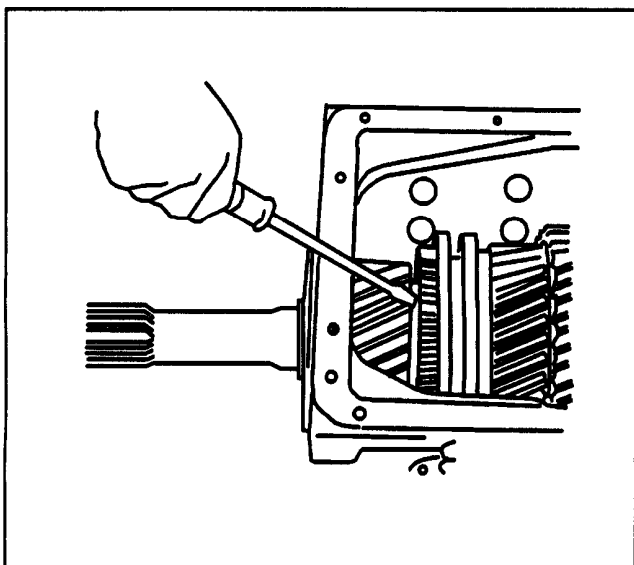


Figure 5—Top Gear Shaft Removal

8. 5th blocker ring.
9. 5th gear and bearing.
10. Snap ring and 4th gear collar.
11. 4th gear and bearing.
12. 4th blocker ring.
13. 3rd and 4th synchronizer.
14. 3rd blocker ring.
15. 3rd gear, bearing, and oil catcher.

COUNTERSHAFT DISASSEMBLY

Disassemble (Figures 2 and 8)

1. Snap ring.
2. Driven gear and key.
3. 5th gear and key.
4. 4th gear and key.
5. 3rd gear and key.

Clean

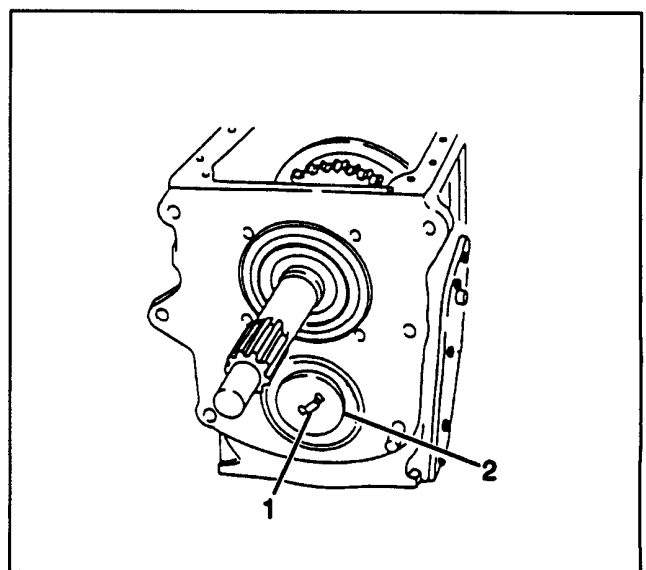
- All parts in a cleaning solvent.

Inspect

- All parts for wear or damage.
- Gear teeth and splines for chips and wear.
- Bearing and bearing surfaces for loose fit and pitting.
- Worn away blocker ring grooves (Figure 8).
— Replace the blocker ring assembly if the blocker ring grooves are worn away.

Measure (Figure 9)

- Block spring length.
- Blocker ring slots.
- Blocker ring to gear clearance.



Legend

- (1) Tab
- (2) Cover, Countershaft Front Bearing

Figure 6—Countershaft Front Bearing Cover

! Important

- The standard clearance between the 5th and 6th blocker ring and the gear is 2.0 mm (0.0787 in.).
- The minimum clearance between the 5th and 6th blocker ring and the gear is 0.
- The standard clearance between the 2nd, 3rd, and 4th blocker ring and the gear is 2.0 mm (0.0787 in.).
- The minimum clearance between the 2nd, 3rd, and 4th blocker ring and the gear is 0.
- Block to hub clearance.

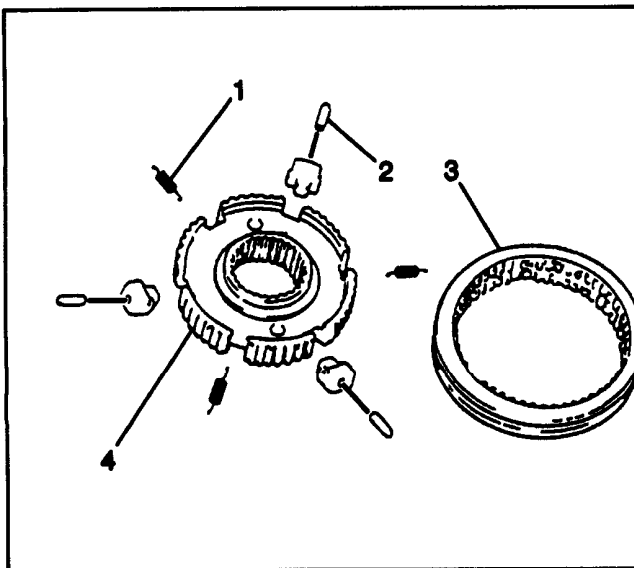
! Important

- The standard clearance between the block and the hub is 0.1 - 0.35 mm (0.00393 - 0.01377 in.).
- The maximum clearance between the block and the hub is 0.5 mm (0.0196 in.).

LOWER QUADRANT BOX DISASSEMBLY

Disassemble (Figure 3)

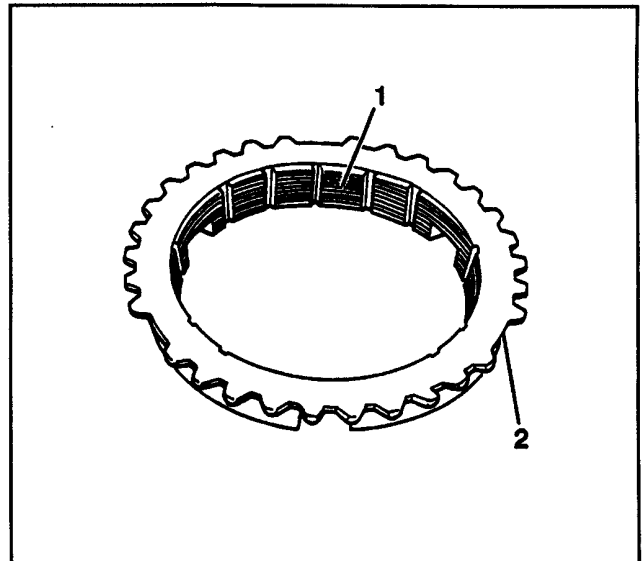
- Move all of the shift rods to the neutral position.
 - Interlock and detent balls will fall from the lower quadrant box when the shift shafts are removed.
1. 1st and reverse shift rod and shift arm setscrew and shift block setscrew.
 2. 1st and reverse shift rod, shift block, and shift arm.
 3. Cap, interlock balls, pin, detent balls, and spring.
 4. 2nd and 3rd shift rod and shift arm.
 5. 2nd and 3rd shift rod and shift arm setscrew.
 6. Cap, interlock balls, pin, detent balls, and spring.
 7. 4th and 5th shift rod and shift arm setscrew.



Legend

- (1) Spring
- (2) Blocker
- (3) Sleeve
- (4) Hub

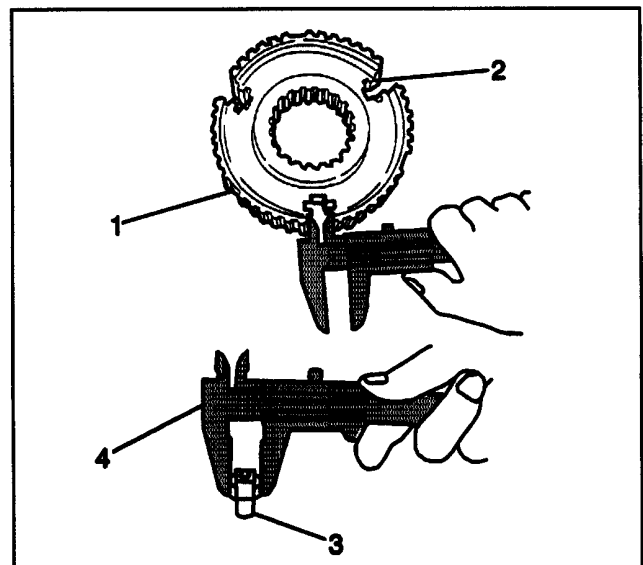
Figure 7—Synchronizer Assembly



Legend

- (1) Grooves
- (2) Ring, Blocker

Figure 8—Blocker Ring

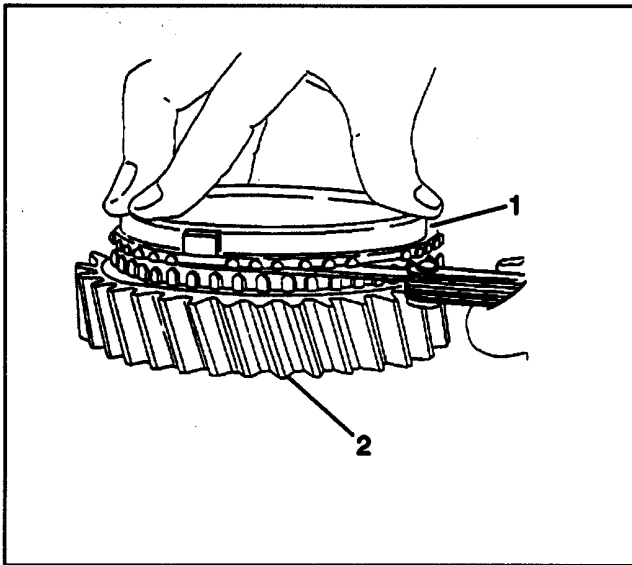


Legend

- (1) Hub, Clutch
- (2) Slot, Clutch Hub
- (3) Block
- (4) Caliper

Figure 9—Measuring the Block to Hub Clearance

8. 4th and 5th shift rod and shift arm.
9. Cap, detent ball and spring.
10. Nut, washer, and key bolt.
11. External select lever, washer, seal, and internal select lever.
12. Key pin, external shift lever, and seal.
13. Neutral switch.
14. Back-up light switch.

**Legend**

- (1) Ring, Blocker
- (2) Gear

Figure 10—Measuring the Blocker Ring to Gear Clearance**UPPER QUADRANT BOX DISASSEMBLY****Disassemble (Figure 4)**

1. Link rod.
2. Select cable arm, bracket, and bushings.
3. Key bolt and external washer.
4. Washer and oil seal.
5. Internal select lever.
6. Snap ring, external lever, seal, and bushing.
7. Internal shift lever.

**Clean**

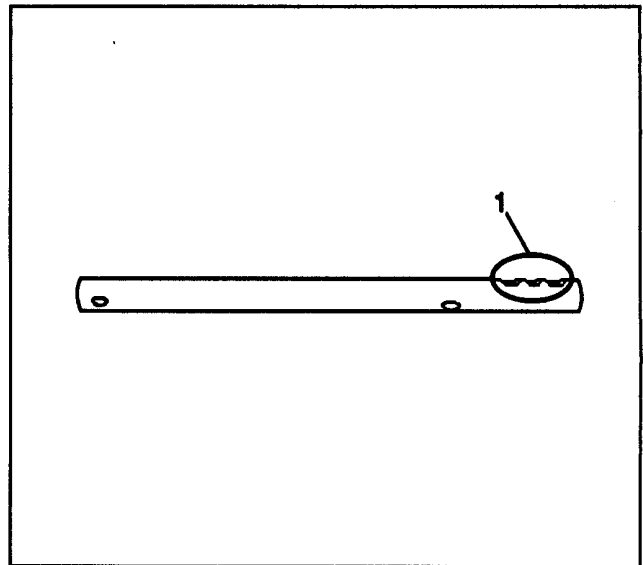
- Clean all parts with a cleaning solvent.

**Inspect**

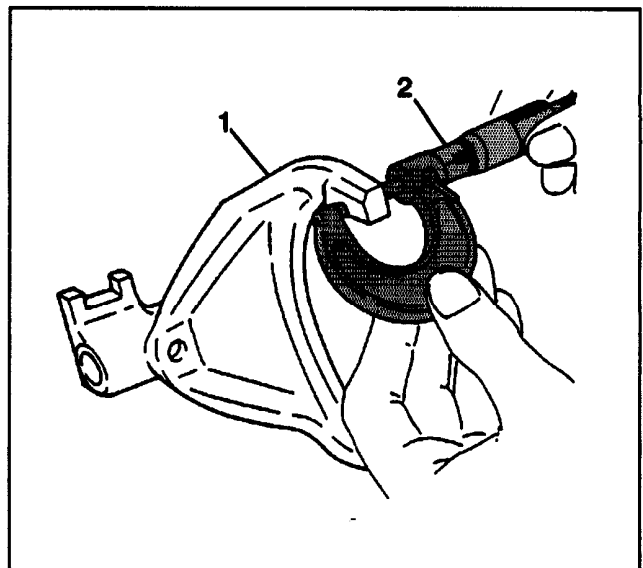
- All parts for wear and damage.
- Seal surfaces for scratching and pitting.
- Shafts for rounding of detent shoulders (Figure 11).

**Measure (Figures 12 and 13)**

1. Shift arm thickness (Figure 12).
 - The standard thickness of the shift arm is 11 mm (0.4331 in.).
 - The minimum thickness of the shift arm is 10 mm (0.3937 in.).
2. Detent spring length (Figure 13).
 - The standard length of the detent spring is 37.8 mm (1.4881 in.).
 - The minimum length of the detent spring is 34 mm (1.3385 in.).

**Legend**

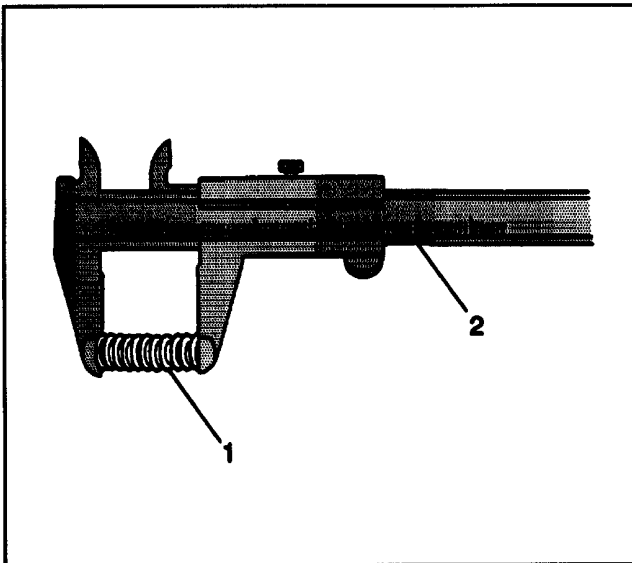
- (1) Shoulders

Figure 11—Shift Rod and Detent Shoulders**Legend**

- (1) Arm, Shift
- (2) Micrometer

Figure 12—Shift Arm Thickness Measurement**UPPER QUADRANT BOX ASSEMBLY****Assemble (Figure 4)**

- Apply a thin coat of transmission oil to all of the shift rods and bushings prior to installation.
1. Internal shift lever.
 2. Bushing, seal, external lever, and NEW snap ring.
 3. Internal select lever.
 4. Oil seal and washer.
 5. External washer and key bolt.
 6. Bushings, bracket, and select cable arm.
 7. Link rod.



Legend

- (1) Spring, Detent
- (2) Caliper

Figure 13—Detent Spring Measuring

LOWER QUADRANT BOX ASSEMBLY



Assemble (Figures 3, 14, and 15)

- 1. Back-up light switch.
- 2. Neutral switch.
- 3. Seal, external shift lever, and key pin.
- 4. Internal select lever, seal, washer, and external select lever.
- 5. Key bolt, washer, and nut.
- 6. Spring, detent ball, and cap.
- 7. Shift arm and 4th and 5th shift rod.
- 8. Shift arm setscrew and 4th and 5th shift rod.
- 9. Spring, detent balls, pin, interlock balls, and cap.
- 10. Shift arm setscrew and 2nd and 3rd shift rod.
- 11. Shift arm and 2nd and 3rd shift rod.
- 12. Spring, detent balls, pin, interlock balls, and cap.
- 13. Shift arm, shift block, and 1st and reverse shift rod.
- 14. Shift block setscrew, shift arm setscrew, and 1st and reverse shift rod.

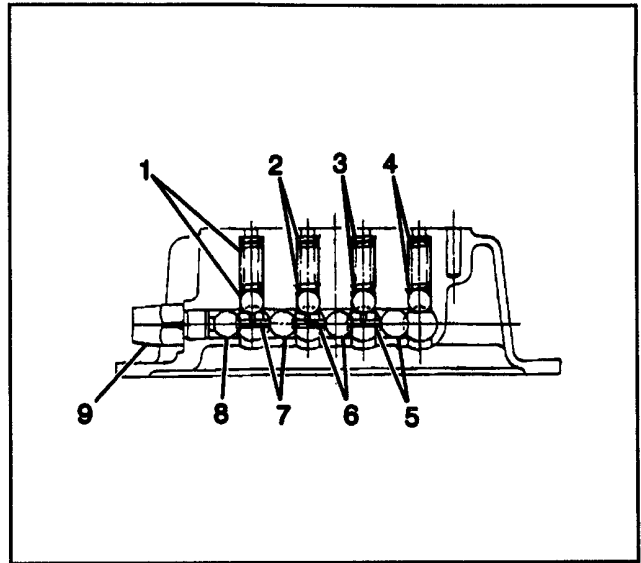
GEARSHAFTS ASSEMBLY

COUNTERSHAFT ASSEMBLY



Assemble (Figure 2)

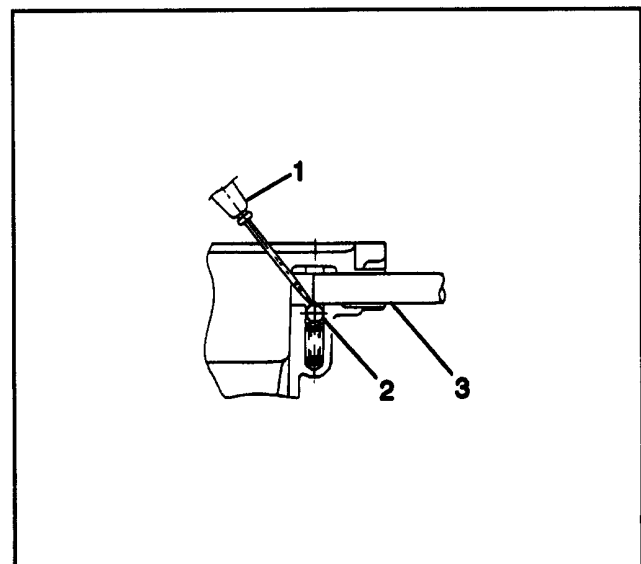
- Apply a light coat of transmission oil to all gears, bearings, and shafts prior to installation.
- 1. 3rd gear and key.
- 2. 4th gear and key.
- 3. 5th gear and key.
- 4. Driven gear and key.
- 5. NEW snap ring.



Legend

- (1) Ball, Detent and Spring
- (2) Ball, Detent and Spring
- (3) Ball, Detent and Spring
- (4) Ball, Detent and Spring
- (5) Ball, Interlock and Pin
- (6) Ball, Interlock and Pin
- (7) Ball, Interlock and Pin
- (8) Ball, Interlock
- (9) Switch, Neutral

Figure 14—Interlock Balls, Detent Balls, and Springs



Legend

- (1) Screwdriver
- (2) Ball, Detent
- (3) Rod, Shift

Figure 15—Shift Rod and Detent Ball Installation

MAINSHAFT ASSEMBLY**Assemble (Figures 2, 16, and 17)**

1. Oil catcher, bearing, and 3rd gear.
2. 3rd blocker ring.
3. 3rd and 4th synchronizer (Figure 16).
4. 4th blocker ring.
5. Bearing and 4th gear.
6. 4th gear collar and NEW snap ring.
7. Bearing and 5th.
8. 5th blocker ring.
9. 5th and 6th synchronizer and NEW snap ring (Figure 16).
10. Bearing and 2nd gear.
11. 1st and 2nd synchronizer and NEW snap ring.
12. Thrust washer, bearing, and 1st gear.
13. Hub and reverse sleeve (Figure 17).
14. Collar, bearing, reverse gear, and thrust washer.
15. 6th blocker ring.

TOP GEAR SHAFT ASSEMBLY**Assemble (Figures 2 and 18)**

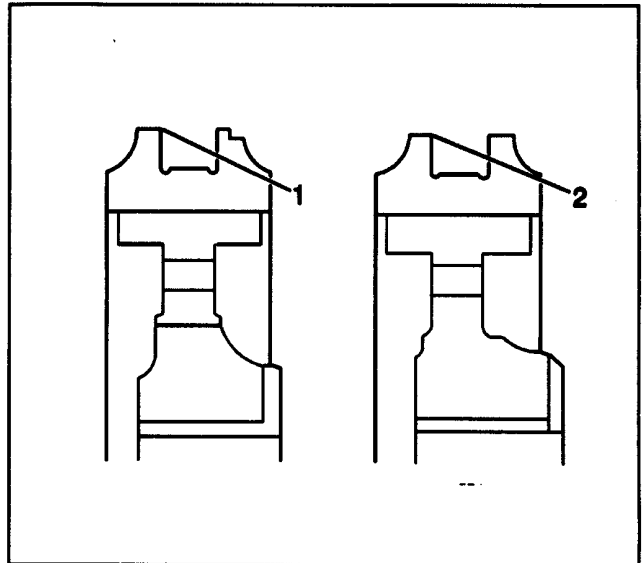
1. Bearing and NEW snap ring.
 - Select a snap ring thickness that will allow a minimum amount of axial play.
 - White snap ring thickness 2.01 - 2.06 mm (0.0790 - 0.0811 in.).
 - Yellow snap ring thickness 2.53 - 2.58 mm (0.0996 - 0.1016 in.).
 - Blue snap ring thickness 2.57 - 2.62 mm (0.1012 - 0.1013 in.).
 - Green snap ring thickness 2.61 - 2.66 mm (0.1028 - 0.1047 in.).
2. Washers and pilot bearing.
3. NEW snap ring.
4. NEW retaining clip.

TRANSMISSION CASE ASSEMBLY**Install or Connect (Figures 1 through 4 and 19)**

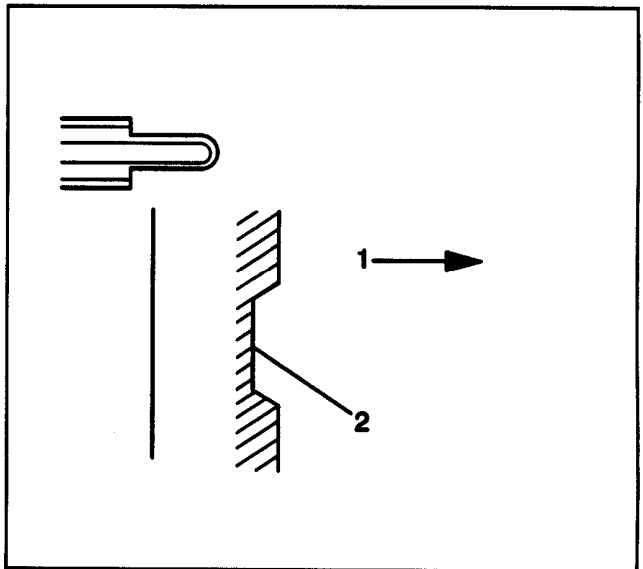
1. Countershaft front bearing to the transmission case.
2. Countershaft assembly.
3. Counter shaft rear bearing and NEW snap ring.
4. Collar.
5. Distance piece, bearing, reverse gear, and thrust washer.
6. NEW O-Ring and reverse gear shaft.
7. Mainshaft assembly.
8. Mainshaft rear bearing.
9. Top gear shaft.
10. Oil seal, NEW gasket, and front bearing cover.
 - Apply Loctite® 242 or the equivalent to the threads of the bolts.

**Tighten**

- Front bearing cover bolts to 27 N·m (20 lb. ft.).

**Legend**

- (1) Synchronizer, 5th and 6th
- (2) Synchronizer, 3rd and 4th

Figure 16—Synchronizer Arrangement**Legend**

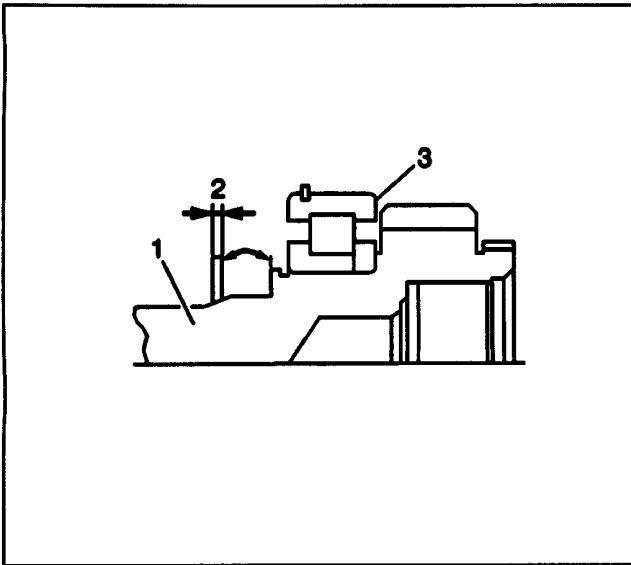
- (1) Direction, Rear Side
- (2) Groove, Oil

Figure 17—Reverse Sleeve and Hub

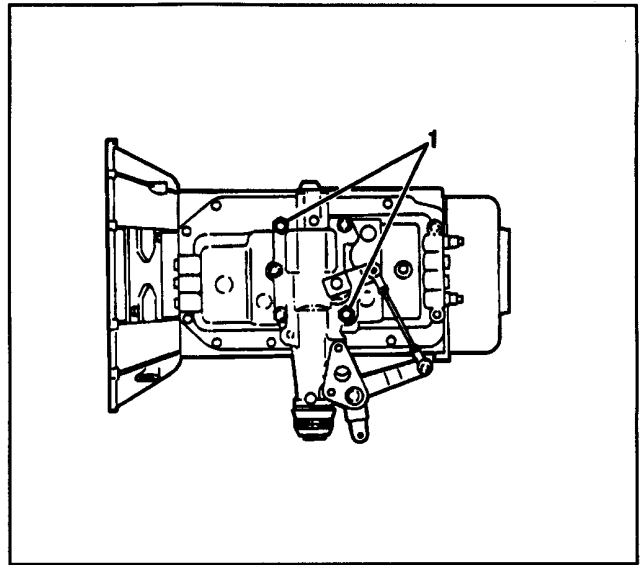
11. Clutch housing. Refer to SECTION 7C.
12. Power take off if the transmission is equipped.
13. NEW gasket and side cover.
14. Speedometer driven gear to the transmission. Refer to SECTION 7B.
15. Rear bearing cover.

**Tighten**

- Rear bearing cover bolts to 71 N·m (52 lb. ft.).


Legend

- (1) Shaft, Top Gear
- (2) Thickness, Snap Ring
- (3) Bearing

Figure 18—Top Gear Shaft Bearing Clearance

Legend

- (1) Bolt, Reamer

Figure 19—Installing Reamer Bolts

16. O-ring, flange, and flange nut.



Tighten

- Flange nut to 800 N.m (590 lb. ft.), then stake the nut.

17. Upper and lower quadrant boxes to the transmission case.

- Apply a thin coat of Loctite® 17430 or the equivalent to the transmission case and quadrant box sealing surfaces.

- Install the reamer bolts first (Figure 19).



Tighten

- Reamer bolts to 37 N.m (27 lb. ft.).
- Install the remaining quadrant box bolts.



Tighten

- Quadrant bolts to 37 N.m (27 lb. ft.).

18. Countershaft front bearing cover to the transmission case.

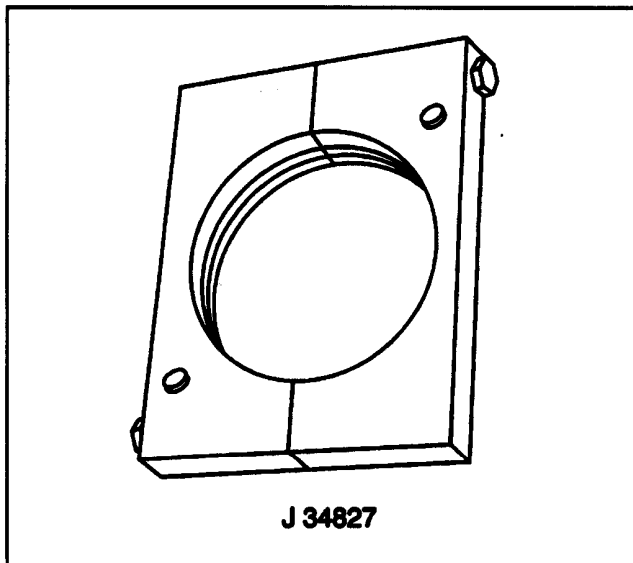
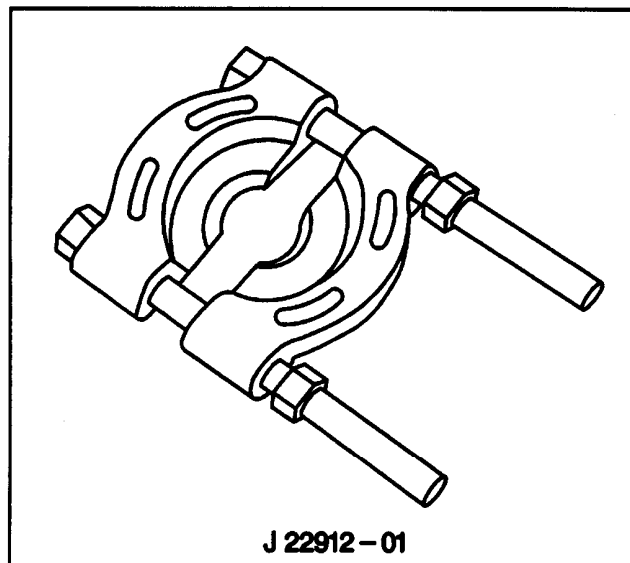
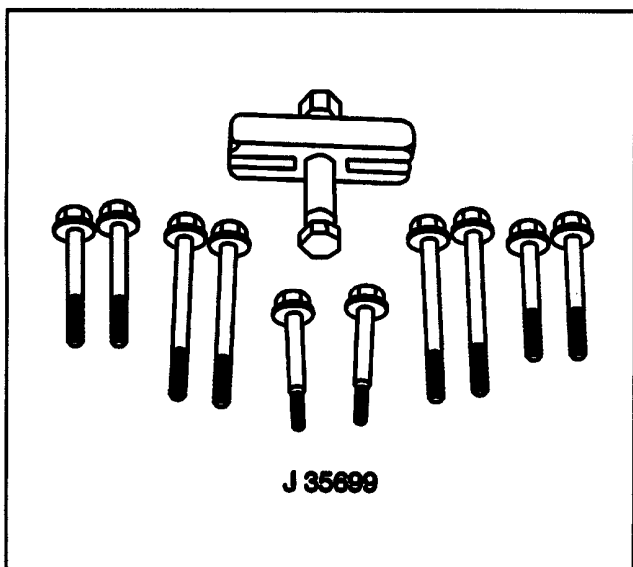
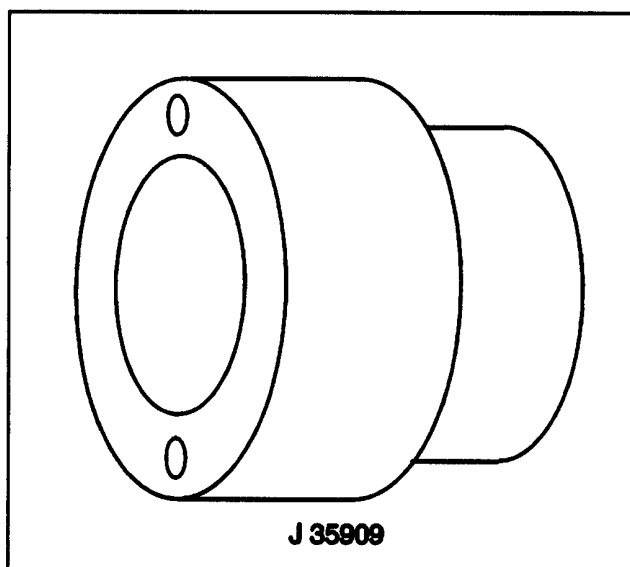
SPECIFICATIONS

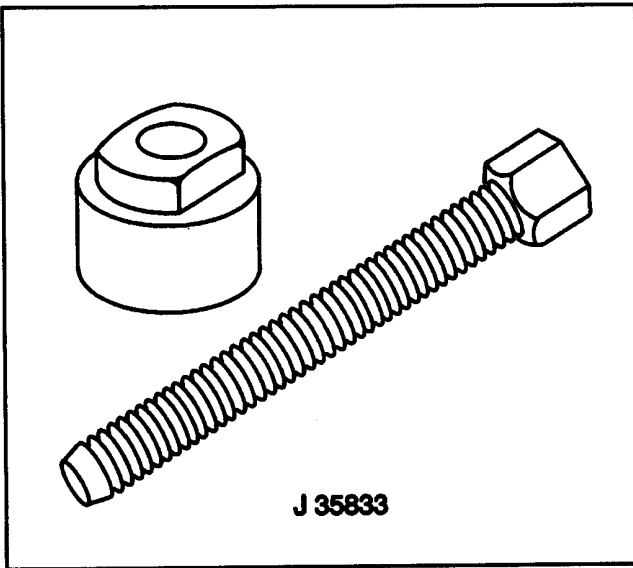
CAPACITIES

Application	Liters	Gallons	Quarts
API GL5, SAE 90 Multipurpose Oil (Use SAE 80 in Canada)	6.5	—	6.9

FASTENER TIGHTENING SPECIFICATIONS

Application	N.m	Lb Ft	Lb In.
Flange Nuts	800	590	—
Front Bearing Cover Bolts	27	20	—
Quadrant Box Bolts	37	27	—
Reamer Bolts	37	27	—
Rear Bearing Cover Bolts	71	52	—

SPECIAL TOOLS**Countershaft and Mainshaft Bearing Remover****Bearing Remover****Puller Bar and Screws****Mainshaft Collar Tool**



Speedometer Gear Bushing Remover

BLANK