

SECTION 7B

MANUAL TRANSMISSION

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the correct location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors 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

New Venture Gear NV3500

The NV3500 is a 5-speed unit transmission that contains gears that are in constant mesh. All forward speeds are fully synchronized. The transmission has a two-piece aluminum housing containing the front input shaft, rear output shaft, mainshaft gears, countershaft, reverse idler gear, shift forks, and shift shaft components. Gear shifting is accomplished by using a shift tower mounted shift lever. The NV3500 transmission can be identified by the RPO code (M50) for four wheel drive and (MG5) for rear wheel drive.

New Venture Gear NV4500

The New Venture Gear NV4500 is a five-speed manual transmission that provides synchronized shifting in all forward gears and constant mesh helical gearing for reduced noise. Other features include an overspeed inhibitor from low to first gears, dual cone low, and first gear synchronizers. Gear shifting is accomplished by using a shift tower mounted shift lever. The NV4500 transmission can be identified by the RPO code (MW3).

DIAGNOSIS

Prior to performing a unit repair of the transmission, check the clutch and shifting linkages to ensure that the problem is inside the transmission.

TRANSMISSION MOUNT

1. Raise the vehicle and try to move the extension housing up and down.
2. If the plate is loose on the crossmember, tighten the bolts. Refer to "Specifications" in this section.
3. If the rubber mount is split or spongy, replace the mount.

CLUTCH SPINDOWN TIME

1. Run the engine at a normal idle with the transmission in neutral and the clutch engaged.
2. Disengage the clutch, wait 9 seconds, and shift the transmission into reverse.
3. If a grinding noise is heard, check the clutch system for broken or worn components. Refer to SECTION 7C.

DIAGNOSIS OF THE MANUAL TRANSMISSION**TROUBLESHOOTING CHART**

Problem	Probable Causes	Correction
Transmission Shifts Hard	1. Shift shaft binding.	1. Check for out of position shift shaft socket roll pin, worn shift shaft bearing or bushing, worn shift shaft, or bent shift shaft. Replace worn or damaged components as necessary.
	2. Clutch not releasing.	2. Verify with the clutch spin down time test on previous page and correct. Refer to SECTION 7C.
	3. Shift shaft lever broken.	3. Remove, disassemble, and replace the shift shaft lever.
	4. Internal bind in the transmission caused by shift forks or synchronizer assemblies.	4. Remove, disassemble, and inspect the shift forks and synchronizer assembly. Replace worn or damaged components as necessary.
	5. Incorrect lubricant.	5. Drain and refill the transmission.
Gears Clash When Shifting From One Gear To Another	1. Lubricant level is low or incorrect.	1. Drain and refill the transmission. If the lubricant level was low, check for leaks and repair as necessary.
	2. Clutch not releasing.	2. Verify with the clutch spin down time test on previous page and correct. Refer to SECTION 7C.
	3. Synchronizer assemblies worn or damaged.	3. Remove, disassemble, and inspect the transmission. Replace worn or damaged components as necessary.
	4. 4th gear only - Mainshaft or input gear snap ring missing.	4. Install missing snap ring.
Transmission Is Noisy	1. Lubrication level is low or incorrect lubricant.	1. Drain and refill the transmission. If lubricant level was low, check for leaks and repair as necessary.

MANUAL TRANSMISSION 7B-3

Problem	Probable Causes	Correction
	2. Crankshaft pilot bearing/bushing worn.	2. Replace the crankshaft pilot bearing/bushing.
	3. Transmission to engine bolts loose	3. Check and correct bolt torque as necessary.
	4. Gear selection mechanism, transmission gears, or bearing components worn or damaged.	4. Remove, disassemble, and inspect transmission. Replace worn components as necessary.
	5. Cab floor to shift lever boot screws contacting transmission case.	5. Replace screws with correct length screws.
	6. Transmission mounted fuel lines contacting the vehicle body.	6. Tighten/attach fuel line clips to prevent body contact.
	7. Transmission shift lever to floor boot out of position, foam insulator missing/damaged, boot screws too long and contacting transmission.	7. Correct/repair shift boot and isolator installation.
Transmission Jumps Out Of Gear.	1. 4th gear only - Crankshaft pilot bearing/bushing worn.	1. Replace the crankshaft pilot bearing/bushing.
	2. Gear selection mechanism, shift forks, shift rail detent spring worn, broken, or damaged.	2. Remove, disassemble, and inspect the transmission. Replace worn or damaged components as necessary.
	3. Gear teeth back taper on sleeve, or gear worn away, or damaged. Excessive end play caused by worn thrust washers or output shaft gears.	3. Remove, disassemble, and inspect the transmission. Replace worn or damaged components as necessary.
	4. 4th gear only - Mainshaft or input gear snap ring missing.	4. Install missing snap ring.
	5. Transmission shift lever to cab floor boot out of position (convolutions trapped under boot retainer ring) pulling transmission out of gear.	5. Correctly install boot retainer ring.
Transmission Will Shift Only Into One Gear.	1. Gear selection mechanism or shift forks worn or damaged.	1. Remove, disassemble, and inspect the transmission. Replace worn or damaged components as necessary.
	2. Synchronizer sleeves or hubs damaged or worn.	2. Remove, disassemble, and inspect the transmission. Replace worn or damaged components as necessary.
Transmission Is Locked In One Gear And Cannot Be Shifted Out.	1. Shift rail worn or broken, shift fork bent, worn, or broken.	1. Replace worn or damaged components as necessary.
	2. Shift shaft lever worn or broken. Gear train components damaged.	2. Replace worn or damaged components as necessary.

ON-VEHICLE SERVICE

TRANSMISSION OIL REPLACEMENT



Remove or Disconnect

- Raise the vehicle.
- 1. Fill plug.
- 2. Drain plug.
 - The lower PTO cover bolt is used as a oil drain plug on the NV4500.
- Position a container under the transmission to catch the oil.



Install or Connect

1. Drain plug or lower PTO cover bolt.



Tighten

- Drain plug for the NV3500 to 60 N.m (44.lb ft.).
 - Lower PTO cover bolt (drain plug) for the NV4500 to 37 N.m (27.lb ft.).
2. New transmission oil.
 - Fill to the level of the fill plug hole. Refer to "Specifications" in this section.
 3. Fill plug.



Tighten

- NV3500 fill plug to 60 N.m (46 lb. ft.).
- NV4500 fill plug to 41 N.m (30 lb. ft.).
- Lower the vehicle.

SHIFT LEVER AND BOOT REPLACEMENT



Remove or Disconnect (Figures 1 and 2)

1. Eight screws securing shift tower boot to the floor panel and insulator (Figure 1 or 2).
2. Shift lever from the transmission shift housing lever.
 - Do not disassemble the transmission shift housing. Internal parts for this shift housing are not available. Opening the shift housing voids the warranty.



Install or Connect (Figure 1)

1. Shift lever to the transmission shift tower lever (Figure 1).
2. Eight screws securing shift housing boot to the floor panel and insulator.



Tighten

- Screws to 2 N.m (18 lb. in.).

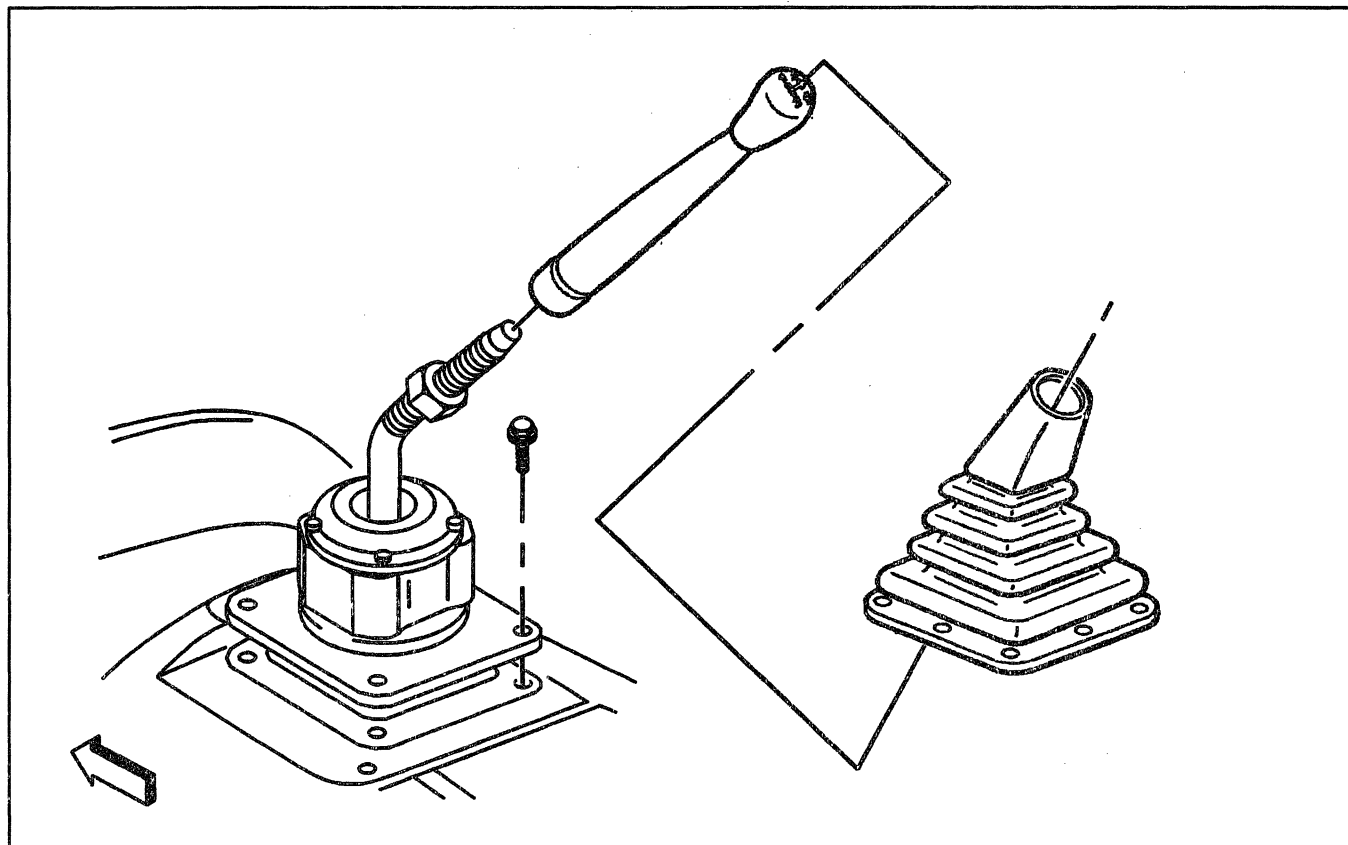


Figure 1—Shift Lever and Boot

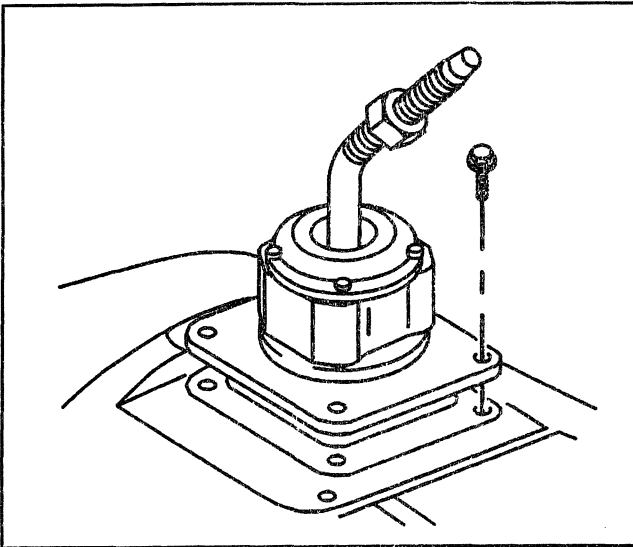


Figure 2—Shift Housing

TRANSMISSION SHIFT HOUSING REPLACEMENT



Remove or Disconnect (Figure 2)

- Ensure that the shift lever is positioned into the mechanical 3rd or 4th gear prior to removal of the shift housing from the transmission. The transmission must remain in this state when the shift housing is removed.
 - Do not disassemble the transmission shift housing. Internal parts for this shift housing are not available. Opening the shift housing voids the warranty.
 - When removing the shift housing from the transmission, use the exposed bolts on the base of the housing. Do not use the bolts under the rubber boot located at the top of the housing.
1. Shift lever and boot. Refer to "Shift Lever and Boot Replacement" in this section.
 2. Four bolts securing the shift housing to the transmission.
 3. Insulator from the transmission case.



Install or Connect (Figure 2)

1. Insulator to the transmission case.
2. Four bolts securing the shift housing to the transmission.



Tighten

- Shift housing bolts to 10 N.m (89 lb. in.).
3. Shift lever and boot. Refer to "Shift Lever and Boot Replacement" in this section.

SPEED SENSOR REPLACEMENT



Remove or Disconnect (Figures 3 and 4)

- Raise the vehicle.
1. Wiring harness connector from the speed sensor.

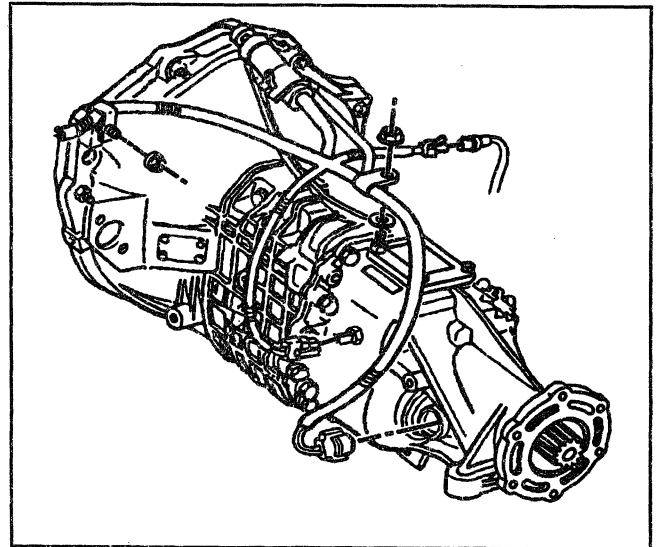


Figure 3—Vehicle Speed Sensor (NV3500)

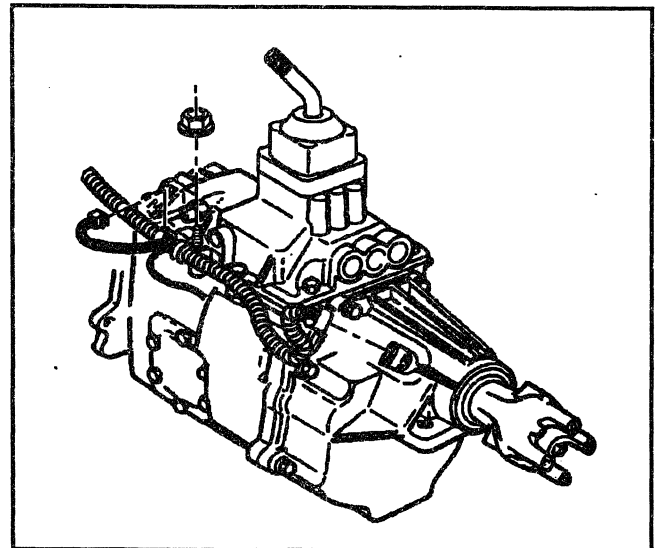


Figure 4—Vehicle Speed Sensor (NV4500)

2. Speed sensor bolt.
 - Place a drain pan under transmission to catch the oil.
3. Speed sensor from the transmission.
4. O-ring seal.



Install or Connect (Figures 3 and 4)

1. New O-ring seal.
 - Coat the O-ring with a thin film of transmission oil.
2. Speed sensor.
3. Speed sensor bolt.



Tighten

- Speed sensor bolt to 22 N.m (16 lb. ft.).
4. Wiring harness connector to the vehicle speed sensor.
 - Lower the vehicle.

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BACKUP LAMP SWITCH REPLACEMENT



Remove or Disconnect

- Raise the vehicle.
1. Wiring harness connector from the backup lamp switch.
 2. Backup lamp switch.



Install or Connect

3. Backup lamp switch.
 - Backup lamp switch has pre-applied thread sealant on threads.



Tighten

- Backup lamp switch to 28 N.m (21 lb. ft.).
4. Wiring harness connector to the backup lamp switch.
- Lower the vehicle.

EXTENSION OIL SEAL REPLACEMENT

NV3500 Extension Oil Seal (Two Wheel Drive)

Tool Required:

- J 36503 Extension Housing Seal Installer
- J 23907 Universal Slide Hammer
- J 26941 Output Shaft Seal Remover



Remove or Disconnect (Figure 5)

- Raise the vehicle.
1. Transmission oil. Refer to "Transmission Oil Replacement" in this section.
 2. Propeller shaft. Refer to SECTION 4A.
 3. Extension oil seal, using J 23907 and J 26941 (Figure 5).

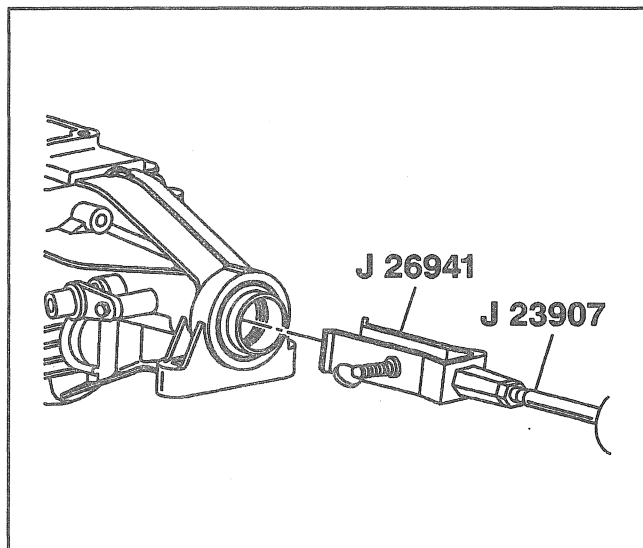


Figure 5—Extension Oil Seal Removal (2WD Models)



Install or Connect (Figure 6)

1. New extension oil seal, using J 36503 (Figure 6).
 - Apply a thin coat of chassis grease between the seal lips.
 2. Propeller shaft. Refer to SECTION 4A.
 3. Transmission oil. Refer to "Transmission Oil Replacement" in this section.
- Lower the vehicle.

NV3500 Extension Oil Seal (Four Wheel Drive)

Tools Required:

- J 23907 Universal Slide Hammer
- J 36825 Output Shaft Seal Remover
- J 36502-A Extension Housing Seal Installer



Remove or Disconnect (Figure 7)

- Raise the vehicle.
1. Transmission oil. Refer to "Transmission Oil Replacement" in this section.
 2. Propeller shaft. Refer to SECTION 4A.
 3. Extension oil seal, using J 23907 and J 36825 (Figure 7).



Install or Connect (Figure 8)

- Install seal protector J 36502-2A onto output shaft.
1. New seal, using J 36502-1 (Figure 8).
 - Apply a thin coat of chassis grease between the seal lips.
 - Remove the seal protector J 36502-2A.
 2. Propeller shaft. Refer to SECTION 4A.
 3. Transmission oil. Refer to "Transmission Oil Replacement" in this section.
- Lower the vehicle.

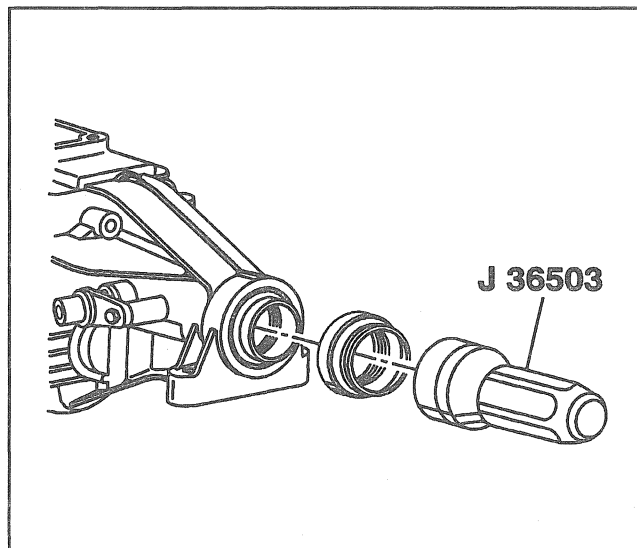


Figure 6—Extension Oil Seal Installation (2WD Models)

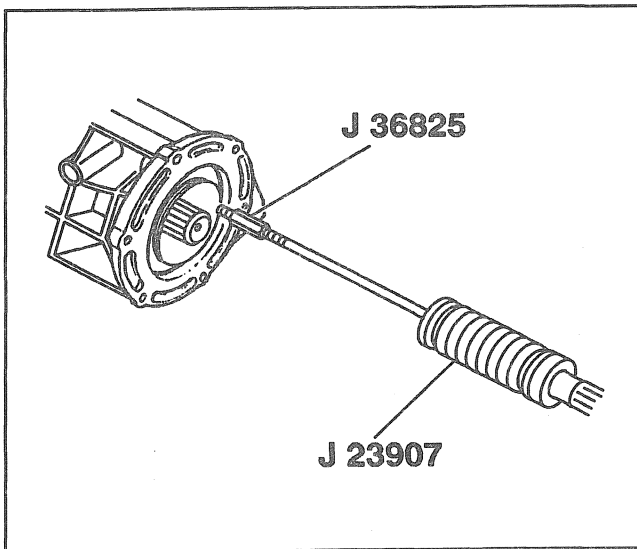


Figure 7—Extension Oil Seal Removal (4WD Models)

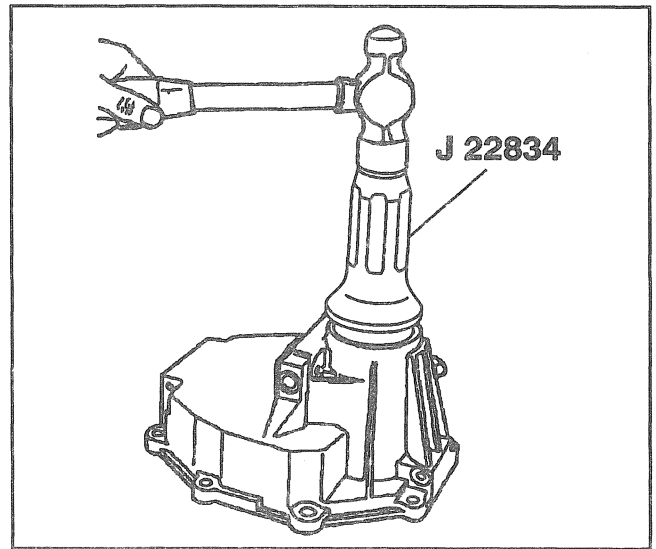


Figure 9—Extension Oil Seal Installation



Install or Connect (Figure 9)

1. New extension oil seal, using J 22834 (Figure 9).
2. Yoke.
3. Washers and yoke nut.



Tighten

- Yoke nut to 441 N.m (325 lb. ft.).
- 4. Parking brake, if the vehicle is equipped. Refer to SECTION 5F.
- 5. Propeller shaft. Refer to SECTION 4A.
- 6. Transmission oil. Refer to "Transmission Oil Replacement" in this section.
- Lower the vehicle.

TRANSMISSION REPLACEMENT



Remove or Disconnect (Figures 10 through 16)

- Shift the transmission into 3rd or 4th mechanical gear position.
- 1. Shift lever and boot. Refer to "Shift Lever and Boot Replacement" in this section.
- 2. Shift housing. Refer to "Transmission Shift Housing Replacement" in this section.
- Raise and support the vehicle.
- 3. Transmission oil. Refer to "Transmission Oil Replacement" in this section.
- 4. Propeller shaft. Refer to SECTION 4A.
- 5. Transfer case, if the vehicle is equipped with four wheel drive. Refer to SECTION 7D.
- 6. Parking brake and controls, if the vehicle is equipped. Refer to SECTION 5F.
- 7. Exhaust pipes from the exhaust manifold and catalytic converter from the muffler assembly, if required. Refer to SECTION 6F.
- 8. Wiring harness connectors from the speed sensor and backup lamp switch.
- 9. Wiring harness retainers from the transmission.

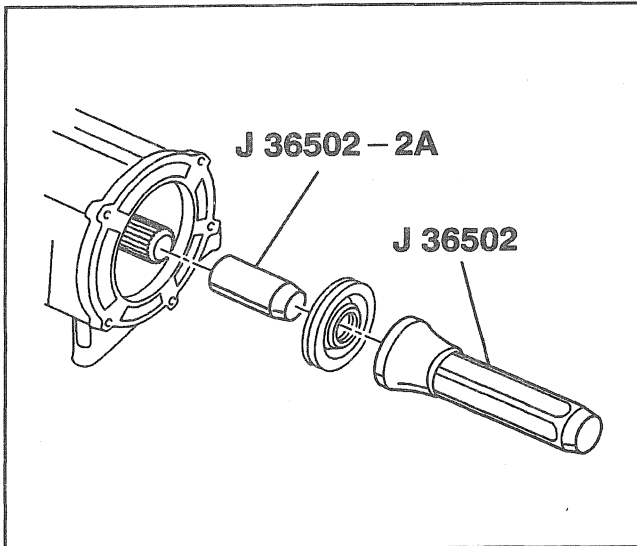


Figure 8—Extension Oil Seal Installation (4WD Models)

NV4500 Extension Oil Seal

Tool Required:

J 22834 Extension Housing Seal Installer



Remove or Disconnect (Figure 9)

- Raise the vehicle.

1. Transmission oil. Refer to "Transmission Oil Replacement" in this section.
2. Propeller shaft. Refer to SECTION 4A.
3. Parking brake, if the vehicle is equipped. Refer to SECTION 5F.
4. Yoke nut and washers.
5. Yoke.
6. Extension oil seal (Figure 9).

7B-8 MANUAL TRANSMISSION

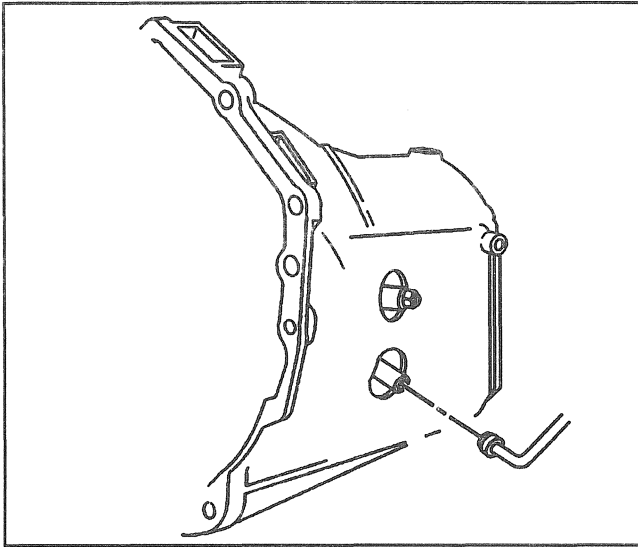


Figure 10—Quick Connect and Hydraulic Clutch Line

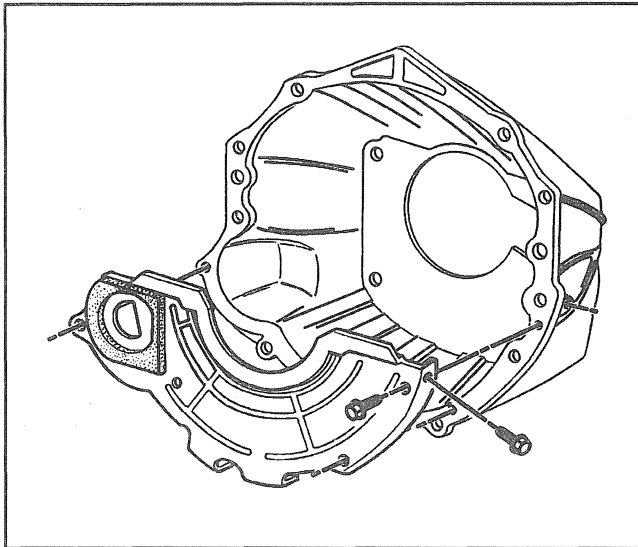


Figure 11—Clutch Housing Cover

10. Clutch line from the concentric slave cylinder quick connect (Figure 10).

- Use one of the two methods listed below to disconnect the clutch line from the concentric slave cylinder quick connect.
 - Use two small flat head screw drivers at 180 degrees from each other to depress the white plastic sleeve on the quick connect to separate the clutch line from the concentric slave cylinder quick connect.
 - Use special tool J 36221 to depress the white plastic sleeve on the quick connect to separate the clutch line end from the concentric slave cylinder quick connect.

11. Four bolts securing the clutch housing cover to the transmission (Figure 11).

12. Transmission vent hose from the NV4500 transmission (Figure 16).

13. Crossmember.

- Support the transmission with a jack.

14. Clutch plate and clutch cover from flywheel. Refer to SECTION 7C.

- Perform Step 15 if removing a NV3500 transmission.
- Perform Step 16 and 17 if removing a NV4500 transmission.

15. Bolts and studs securing the transmission to the engine (Figure 12).

- Do not let the transmission hang from the clutch plate and clutch cover.
- Pull the transmission straight back on the clutch hub splines.

16. Transmission from clutch housing (Figures 13 and 14).

- Remove the clutch plate and clutch cover from the clutch housing during transmission from clutch housing removal.
- Do not let the clutch plate and clutch cover drop from the clutch housing.
- Do not let the transmission hang from the clutch plate and clutch cover.
- Pull the transmission straight back on the clutch hub splines.

17. Clutch housing from engine (Figure 15).



Install or Connect (Figures 10 through 16)

- Perform Step 1 if installing a NV4500 transmission.

1. Clutch housing to the engine (Figure 16).



Tighten

- Studs securing the NV4500 clutch housing to the engine to 100 N·m (74 lb. ft.).

2. Raise the transmission using a transmission jack.

- Perform Steps 3 and 4 if installing a NV3500 transmission.
- Perform Steps 5 and 6 if installing a NV4500 transmission.

3. Transmission to the engine (Figure 12).



Important

- Push the transmission straight back onto the clutch hub splines.
- Do not force the transmission into the clutch hub splines.
- Do not let the transmission hang from the clutch plate and clutch cover.
- Keep the jack under the transmission to support it.

4. Bolts and studs securing the transmission to the engine.



Tighten

- Bolts and studs securing the NV3500 transmission to the engine to 47 N·m (35 lb. ft.).

5. Transmission to the clutch cover.

- position the clutch plate and clutch cover in to the clutch housing.

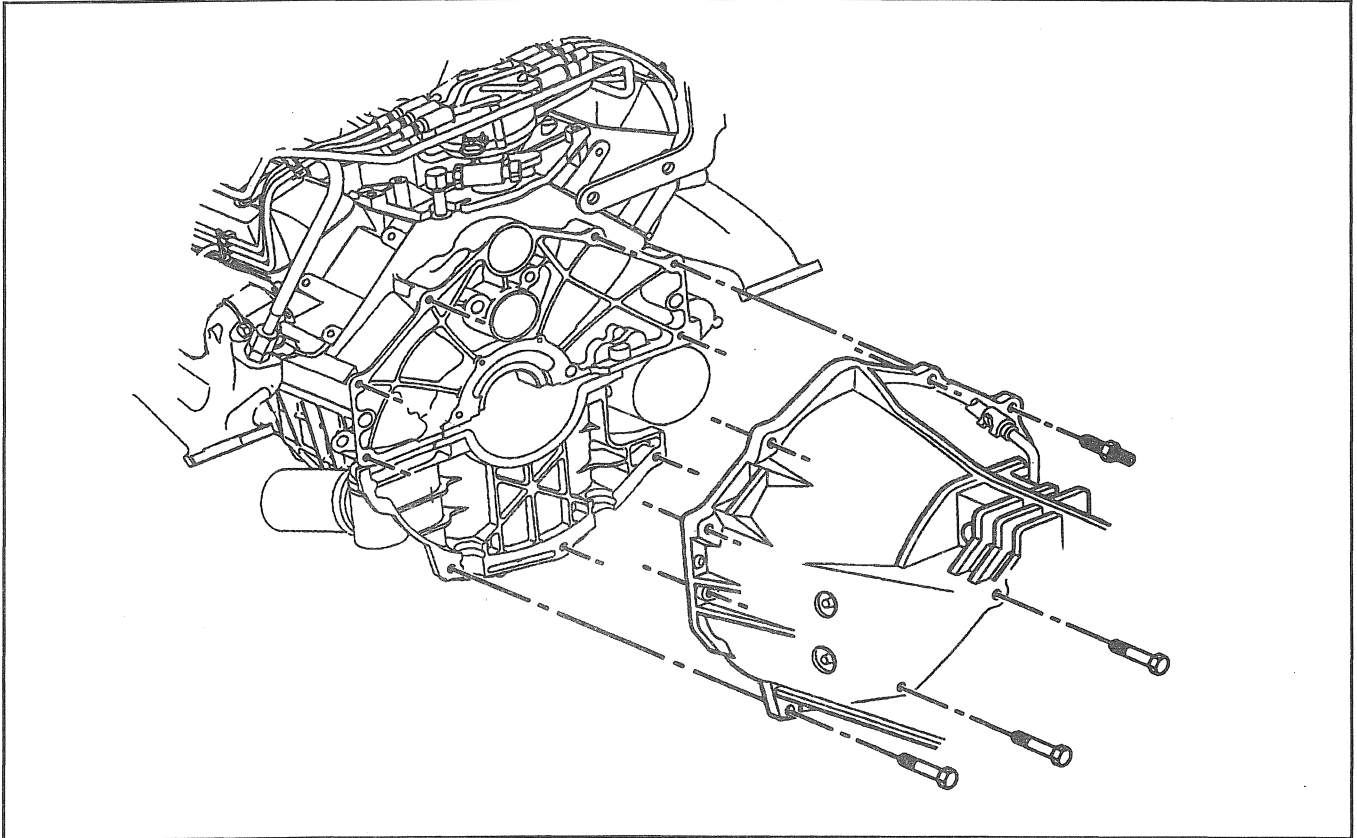


Figure 12—Transmission to Engine (New Venture Gear 3500)

6. Bolts securing the transmission to the clutch housing (Figures 13 and 14).
 - Position the clutch plate and clutch cover onto the transmission main shaft during transmission to clutch housing installation.
 - Do not let the transmission hang from the clutch plate and clutch cover.
 - Keep the jack under the transmission to support it.



Tighten

- Studs securing the NV4500 transmission to the clutch housing to 31 N.m (23 lb. ft.).
7. Clutch plate and clutch cover to the flywheel. Refer to SECTION 7C.
 8. Crossmember.
 - Lower and remove the jack.
 9. Four bolts securing the clutch housing cover to the NV3500 transmission (Figure 11).



Tighten

- Clutch housing cover bolts to 10 N.m (89 lb. in.).

10. Transmission vent hose on to the NV4500 transmission (Figure 16).
11. Hydraulic clutch line to the concentric slave cylinder quick connect (Figure 10).
12. Exhaust pipes to the exhaust manifold and catalytic converter to the muffler assembly if required. Refer to SECTION 6F.
13. Wiring harness retainers to the transmission.
14. Wiring harness connectors to the speed sensor and back up switch.
15. Transfer case, if the vehicle is equipped with four wheel drive. Refer to SECTION 7D.
16. Propeller shaft. Refer to SECTION 4A.
17. Parking brake and controls, if the vehicle is equipped. Refer to SECTION 5F.
18. New transmission oil. Refer to "Transmission Oil Replacement" in this section.
 - Lower the vehicle.
19. Shift housing. Refer to "Transmission Shift Housing Replacement" in this section.
20. Shift lever. Refer to "Shift Lever and Boot Replacement" in this section.

7B-10 MANUAL TRANSMISSION

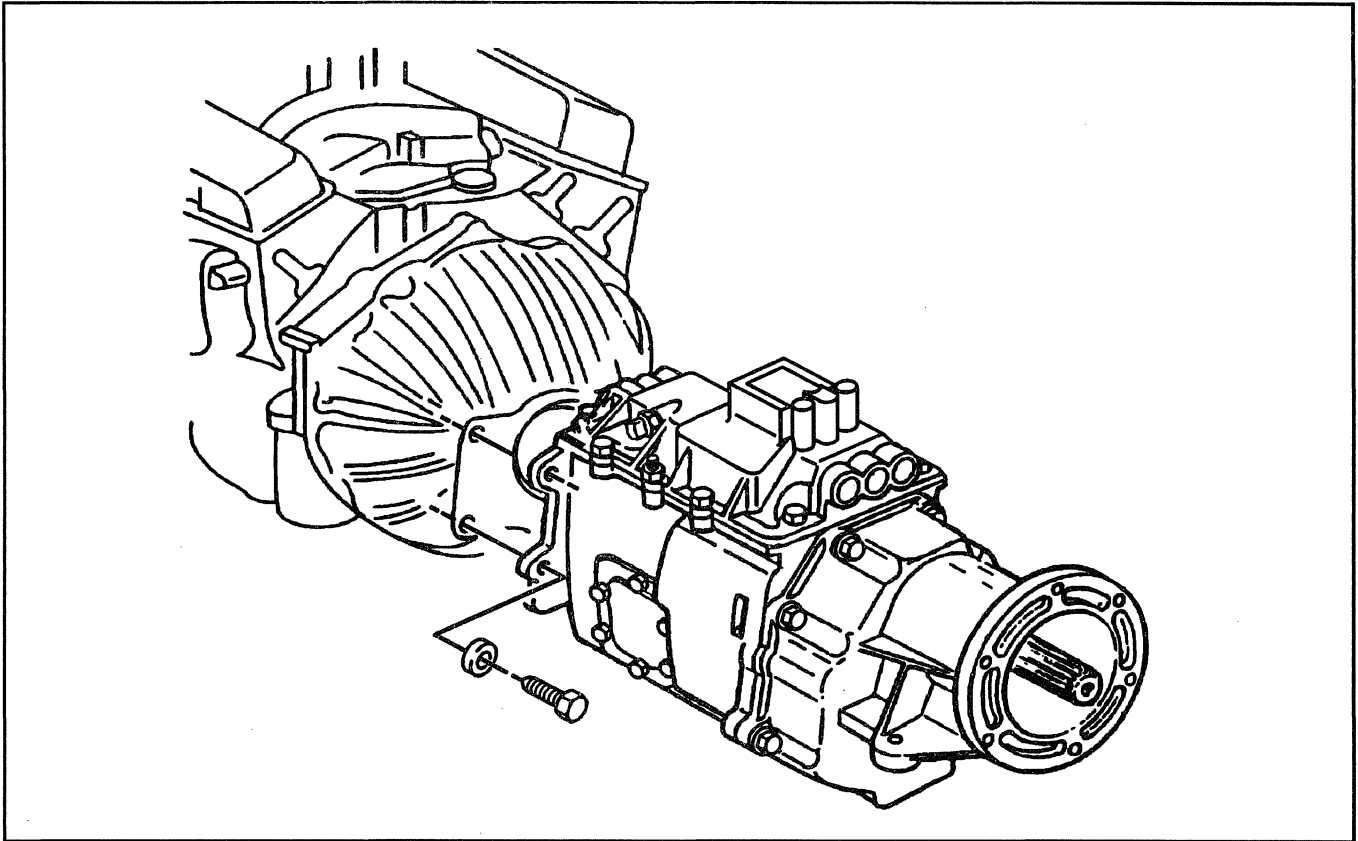


Figure 13—Transmission to Clutch Housing (New Venture Gear 4500) - 4WD Models

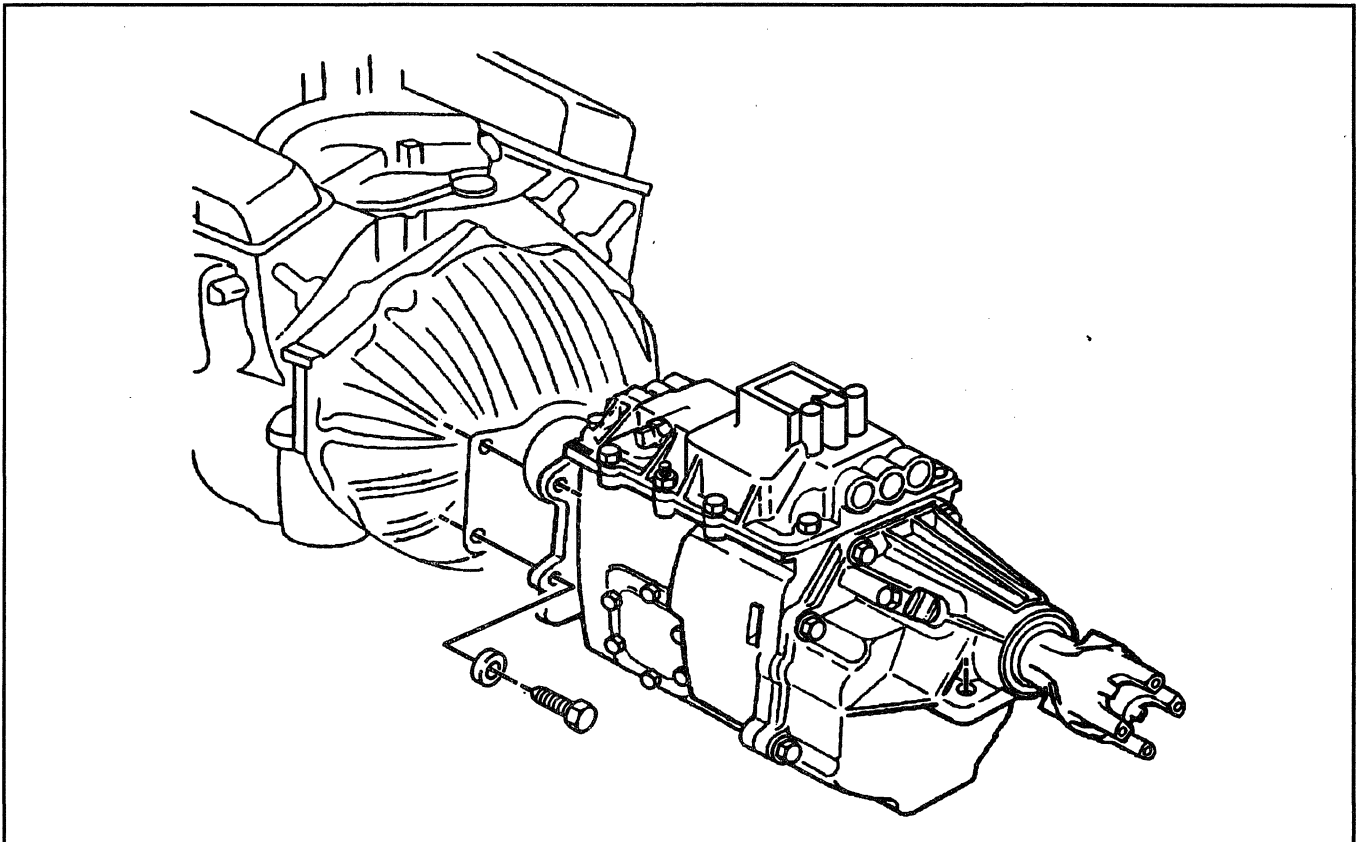


Figure 14—Transmission to Clutch Housing (New Venture Gear 4500) - 2WD Models

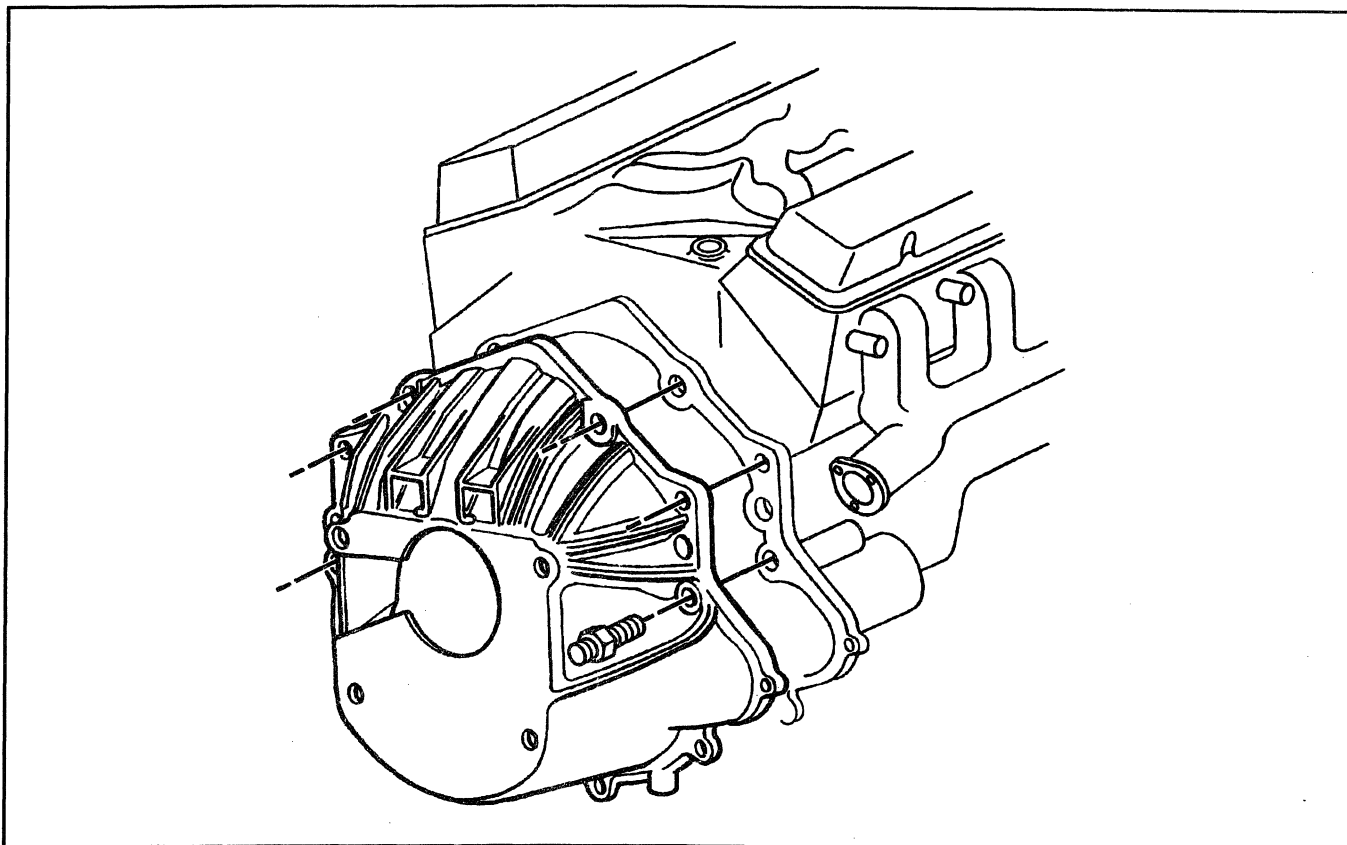


Figure 15—Clutch Housing to Engine (New Venture Gear 4500)

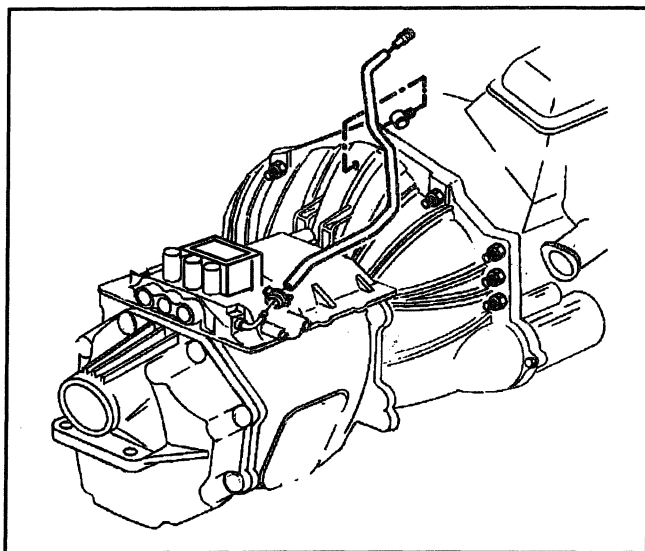


Figure 16—Transmission Vent Hose (NV4500)

7B-12 MANUAL TRANSMISSION

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Item	N·m	Lb. Ft.	Lb. In.
Backup Lamp Switch.....	28	21	—
Clutch Housing Cover Bolts.....	10	—	89
Lower PTO Cover Bolt (Oil Drain) (NV4500).....	37	27	—
Oil Drain Plug (NV3500).....	60	44	—
Oil Fill Plug (NV4500).....	41	30	—
Oil Fill Plug (NV3500).....	60	46	—
Transmission to Clutch Housing Bolts (NV4500).....	100	74	—
Transmission to Engine Studs (NV3500).....	47	35	—
Clutch Housing to Engine Studs (NV4500).....	31	23	—
Yoke Nut (NV4500, 2WD Models).....	441	325	—
Shift Housing Boot Screws.....	2	—	18
Shift Housing to Transmission Bolts.....	10	—	89
Speed Sensor Bolt.....	22	16	—
Vibration Damper Mounting Nut (NV4500, 4WD Models).....	100	74	—

LUBRICATION SPECIFICATIONS

New Venture Gear NV4500 Manual Transmission

Capacity..... 3.78L (4.0 Qts.)





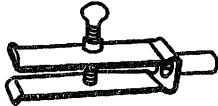

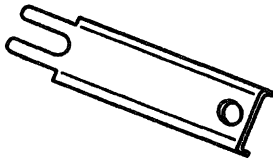
Type Recommended..... Castrol Syntorq LT Transmission Fluid

New Venture Gear NV3500 Manual Transmission

Capacity..... 2.0L (2.2 Qts.)

Type Recommended..... Synchronesh Transmission Fluid P/N 9985648
T2850

SPECIAL TOOLS

- | | | | | | |
|----|---|---------|----|---|-------------|
| 1. |  | J 22834 | 4. |  | J 36502 - A |
| 2. |  | J 23907 | 5. |  | J 36503 |
| 3. |  | J 26941 | 6. |  | J 36825 |
| | | | 7. |  | J 36221 |
1. EXTENSION HOUSING SEAL INSTALLER
2. SLIDE HAMMER
3. OUTPUT SHAFT OIL SEAL REMOVER
4. EXTENSION HOUSING SEAL INSTALLER
5. EXTENSION HOUSING SEAL INSTALLER
6. OUTPUT SHAFT OIL SEAL REMOVER
7. QUICK CONNECT DISENGAGEMENT TOOL

SECTION 7C

CLUTCH

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: When servicing clutch parts, do not create dust by grinding or sanding clutch disc or by cleaning parts with a dry brush or with compressed air. Many mid-year 1995 and earlier models or aftermarket clutch parts may contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on clutch parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

NOTICE: Always use the correct fastener in the correct location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors 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 principal parts of the clutch system are the driving members, the driven members, and the operating members. The clutch housing on some models are part of the manual transmission assembly.

DRIVING MEMBERS

The driving members consist of two flat surfaces machined to a smooth finish. One of these is the rear face of the engine flywheel, and the other is the front face of the clutch cover assembly.

DRIVEN MEMBERS

The driven member is the clutch disc with a splined hub that is free to slide lengthwise along the splines of the input shaft and drive the input shaft through the same splines. The driving and driven members are held in contact by spring pressure. This pressure is exerted by a diaphragm spring in the clutch cover assembly.

OPERATING MEMBERS

Hydraulic Clutch

The clutch release system consists of a combined clutch master cylinder, reservoir, switch, and actuator cylinder connected to the hydraulic tubing.

When the clutch pedal is depressed, the clutch master cylinder push rod is forced into the clutch master cylinder causing the clutch master cylinder to become pressurized. Hydraulic fluid is then forced down the hydraulic tubing from the clutch master cylinder to the concentric slave cylinder. When the hydraulic fluid is pushed into the slave cylinder, the slave cylinder engages by pushing the release bearing into the diaphragm spring and releasing the clutch.

The clutch master cylinder is positioned through the cowl panel. The hydraulic tubing is routed from the clutch master cylinder to the concentric slave cylinder

via a quick connect coupling. The concentric slave cylinder is located inside the transmission on the transmission input bearing retainer.

Replacement of the hydraulic control system is made easier because the hydraulic tubing connecting the slave cylinder to the master cylinder can be removed from the internalized slave cylinder by engaging the quick connect coupling mounted through the transmission housing. This allows replacement of the hydraulic control system without having to gain access to the clutch system internal components.

The hydraulic clutch system provides automatic clutch adjustments, no adjustment of clutch linkage or pedal position is required. As the clutch disc wears, the fluid level in the master cylinder reservoir will rise to accommodate for the extra fluid not required in the hydraulic system. A new system will have a completely filled reservoir, with the hydraulic fluid level at the top of the reservoir.

A two function electrical switch, located on the push rod, is used as a clutch interlock to ensure that the engine does not start unless the clutch pedal is engaged (positioned to the floor). A second function of the switch is to cut off the cruise control system (if the vehicle is so equipped) when the clutch pedal is engaged.

Hydraulic Clutch Fluid

When adding fluid to or refilling the system after service operations use DOT 3 brake fluid GM P/N 1052535 or equivalent.

NOTICE: *Do not use mineral or paraffin base oil in the clutch hydraulic system. These fluids will damage the rubber parts in the cylinders.*

DIAGNOSIS

PRELIMINARY CHECKS

Before attempting to repair the clutch, transmission, or related components for any reason other than an obvious failure, identify the problem and probable cause. A large percentage of clutch and manual transmission problems are revealed by shifting difficulties such as high shift effort, gear clash, or grinding. When any of these problems occur, a careful analysis of these difficulties should be made. Use the "Diagnosis of Clutch System" and "Diagnosis of Hydraulic System" charts in this section to assist in proper diagnosis of clutch problems.

Before removing a suspected failed hydraulic clutch system, check the reservoir fluid level. The actuator cylinder must be in place when checking the fluid level. If low, fill the reservoir to the specified level with DOT 3 brake fluid GM P/N 1052535 or equivalent. Do not overfill the system.

NOTICE: *Carefully clean the top and sides of the reservoir before opening to prevent contamination of the system with dirt, water, or other foreign material. Remove the reservoir diaphragm before adding fluid. Carefully replace the diaphragm and cover after filling.*

If the reservoir requires any fluid, check the hydraulic system components for leakage. A slight wetting of the surfaces is acceptable. Replace the system if excessive leakage is evident.

CLUTCH SPIN DOWN TIME

1. Run the engine at a normal idle with the transmission in neutral and the clutch engaged.
2. Disengage the clutch, wait 9 seconds and shift the transmission into reverse.
3. If a grinding noise is heard, Refer to the "Diagnosis Of Clutch" chart in this section.

DIAGNOSIS OF CLUTCH SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Will Not Disengage (Pedal to the floor and hard to shift into reverse).	<ol style="list-style-type: none"> 1. Air in the hydraulic system. 2. Master or actuator hydraulic cylinder seals worn. 3. Not enough pedal travel. 4. Concentric slave cylinder worn or damaged. 5. Driven plate worn or damaged. 6. Driven plate binding. 	<ol style="list-style-type: none"> 1. Bleed and check for damage. 2. Replace components as necessary. 3. Remove aftermarket floor covering from behind clutch pedal. 4. Replace. 5. Replace. 6. Replace the plate.
Slipping.	<ol style="list-style-type: none"> 1. Driven plate friction material worn or oil soaked. 2. Clutch cover or flywheel warped. 3. Diaphragm spring weak. 4. Driven plate overheated. 	<ol style="list-style-type: none"> 1. Replace. Check for leaks as needed. 2. Replace as necessary. 3. Replace the clutch cover. 4. Allow to cool and make 30-40 normal starts - DO NOT OVERHEAT.
Grabbing (Chattering).	<ol style="list-style-type: none"> 1. Clutch cover or flywheel warped. 2. Driven plate friction material damaged. 3. Driven plate friction material contaminated. 4. Engine mounts loose or damaged. 5. Transmission pilot bearing worn. 	<ol style="list-style-type: none"> 1. Replace as necessary. 2. Replace as necessary. 3. Replace and check for leaks. 4. Tighten or replace. 5. Replace pilot bearing.
Rattling (Transmission Click).	<ol style="list-style-type: none"> 1. Driven plate springs weak or damaged. 	<ol style="list-style-type: none"> 1. Replace the driven plate.
Release Bearing Noisy With The Clutch Engaged.	<ol style="list-style-type: none"> 1. Concentric slave cylinder release bearing binding. 	<ol style="list-style-type: none"> 1. Replace bearing.
Noisy.	<ol style="list-style-type: none"> 1. Release bearing worn or damaged. 2. Pilot bearing worn or damaged. 	<ol style="list-style-type: none"> 1. Replace. 2. Replace.
Pedal Stays On The Floor When Disengaged.	<ol style="list-style-type: none"> 1. Release bearing binding. 2. Diaphragm spring weak. 	<ol style="list-style-type: none"> 1. Free up or replace, and lubricate. 2. Replace the clutch cover.
Pedal Is Hard To Push.	<ol style="list-style-type: none"> 1. Hydraulic tube blocked or crimped. 2. Master or actuator cylinders binding. 3. Driven plate worn. 	<ol style="list-style-type: none"> 1. Replace. 2. Replace as necessary. 3. Replace driven plate and clutch cover.
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7C-4 CLUTCH

DIAGNOSIS OF HYDRAULIC SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Pedal Travels To Floor. No Pressure Or Very Little Resistance.	Master or actuator cylinder faulty. Hydraulic line burst or leaking. No fluid in reservoir.	Replace hydraulic clutch control assembly.
Pedal Travels To Floor. No Pressure Or Very Little Resistance. Fluid On Floor Cover Or On Carpet.	Seal faulty in master cylinder.	Replace hydraulic clutch control assembly.
Pedal Travels To Floor. No Pressure Or Very Little Resistance. Fluid Level In Reservoir Rises As Pedal Is Depressed.	Master cylinder center valve seal faulty	Replace hydraulic clutch control assembly.
Fluid In Area Of Pedal Or On Carpet.	Seal faulty in master cylinder.	Replace hydraulic clutch control assembly.
Fluid In Actuator Cylinder And On Cylinder Body	Actuator cylinder seal faulty.	Replace hydraulic clutch control assembly.
Pedal Feels "Spongy" When Depressed	Air in system.	Check fluid level, bleed system, if necessary. Check and replace hydraulic clutch control assembly if symptom recurs.
Unable To Select Gears. Pedal Effort And Travel Normal.	Clutch or transmission faulty.	Check and replace clutch or transmission components.
Difficulty In Selecting Gears. Pedal Effort And Travel Normal.	Clutch or transmission faulty.	Check and repair or replace faulty or worn assembly.
Pedal Sticks or Binds During Travel.	Clutch pedal bushings worn.	Check and replace worn parts.

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ON-VEHICLE SERVICE

CLUTCH PEDAL REPLACEMENT



Remove or Disconnect (Figures 1 and 2)

1. Push rod from the clutch pedal.
2. Clutch pedal by pushing in the two spring loaded bushings.



Install or Connect (Figures 1 and 2)

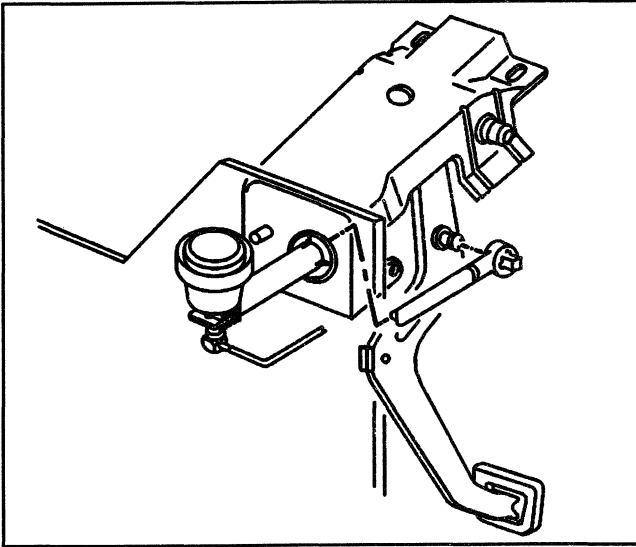
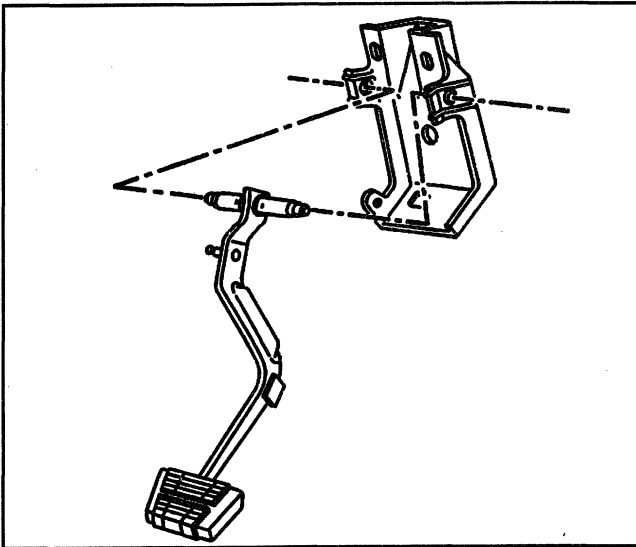
1. Depress both spring loaded bushings and position into support. Bushings will spring (pop) out and hold pedal in place.
2. Push rod to the clutch pedal.

MASTER CYLINDER REPLACEMENT

NOTICE: *If servicing a vehicle that requires master cylinder, reservoir, or tubing replacement, the entire master cylinder assembly must be replaced. Replacement of individual components cannot be performed. A complete pre-filled, pre-bled master cylinder assembly must be installed.*

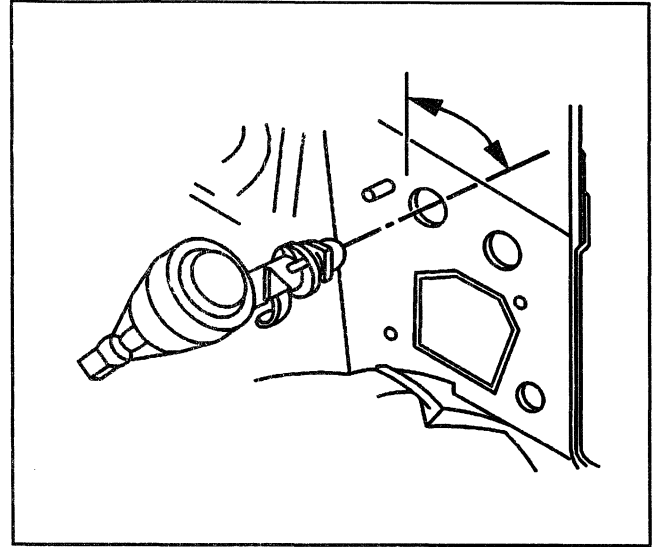
Tools Required:

J 36221 Quick Connect Coupling Special Tool


Figure 1—Push Rod

Figure 2—Clutch Pedal Assembly

Remove or Disconnect (Figure 3)

1. Push rod from the clutch pedal.
2. Hydraulic tube from the concentric slave cylinder quick connect coupling.
 - Use one of the two methods listed below to disconnect the clutch line from the concentric slave cylinder quick connect coupling.
 - Use two small flat head screw drivers at 180 degrees from each other to depress the white plastic sleeve on the quick connect coupling to separate the clutch line from the concentric slave cylinder.
 - Use special tool J 36221 to depress the white plastic sleeve on the quick connect coupling to separate the clutch line from the concentric slave cylinder.
3. Tubes clips from wiring harness bracket and sheet metal.
4. Master cylinder from the cowl panel.


Figure 3—Master Cylinder

- To remove, the master cylinder body must be rotated 45 degrees clockwise.


Install or Connect (Figure 3)

1. Master cylinder to the cowl panel.
 - Install the master cylinder by holding at a 45 degree angle and rotating counterclockwise. Be careful not to over rotate the master cylinder or damage will occur.
2. Hydraulic tube to the concentric slave cylinder quick connect coupling.
3. Tube clips to the wiring harness bracket and the sheet metal.
4. Push rod to the clutch pedal.
 - Check the reservoir for fluid, if required, add GM Delco Supreme No. 11® Brake Fluid P/N 1052535 or equivalent.

HYDRAULIC CLUTCH BLEEDING

1. Fill the reservoir to the specified level with DOT 3 brake fluid GM P/N 1052535 or equivalent. Do not overfill the system.


Important (Figure 4)

- Never use fluid which has been bled from a system to fill the reservoir, as it may be aerated, have too much moisture content, and possibly be contaminated.
2. Depress the clutch pedal and hold down.
 3. Open the bleed screw, located on the side of the trasmission, to expel air. (Figure 4).
 4. Close the bleed screw and release the clutch pedal.
 5. Repeat Steps 2, 3, and 4 until all air is out of the system.
 - Check and refill the reservoir as needed while bleeding so that air is not drawn into the system.
 - After bleeding, pump the clutch pedal several times. If clutch engagement is not satisfactory, repeat the bleeding procedure.

7C-6 CLUTCH

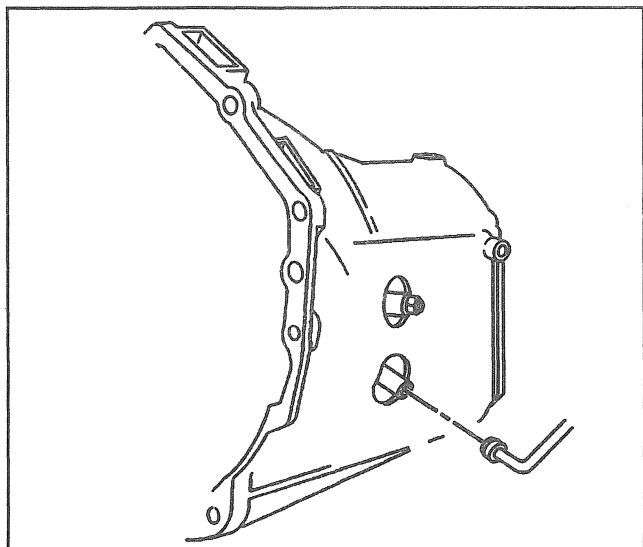


Figure 4—Quick Disconnect on Transmission

6. If the previous procedure is unsuccessful, perform the following Steps.
 - A. Remove reservoir cap.
 - B. Pump the pedal very fast for 30 seconds.
 - C. Stop to let the air escape.
 - D. Repeat procedure as necessary.

CLUTCH START SWITCH REPLACEMENT

↔ Remove or Disconnect (Figure 5)

1. Plastic retainer tabs from the switch.
2. Start switch from the push rod.
3. Connector from the switch.

↔ Install or Connect (Figure 5)

1. Connector to the switch.
2. Start switch to the push rod.
3. Plastic retainer tabs to the switch.

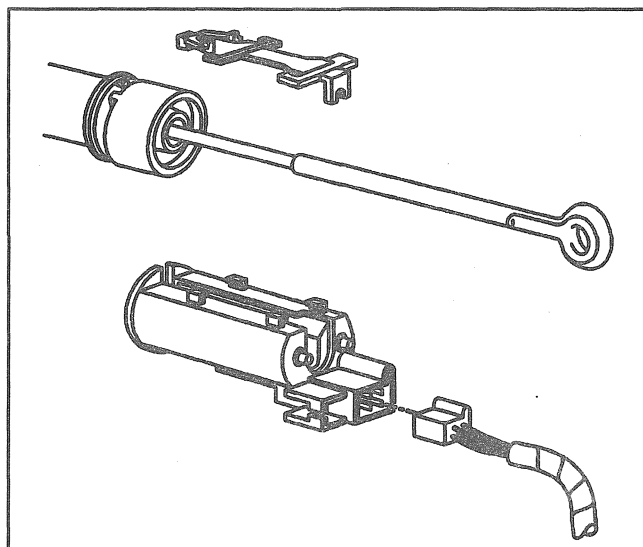


Figure 5—Clutch Start Switch

CONCENTRIC SLAVE CYLINDER REPLACEMENT

↔ Remove or Disconnect (Figure 6)

1. Transmission. Refer to SECTION 7B.
2. Bolts securing the concentric slave cylinder to the clutch housing shaft.
3. Slave cylinder from the transmission input shaft.
4. Bearing from slave cylinder.

↔ Install or Connect (Figure 6)

1. Bearing to slave cylinder.
2. Slave cylinder to the transmission input shaft. Ensure that the bleed screw and coupling are positioned with the transmission ports.
3. Two bolts securing the concentric slave cylinder to the clutch housing shaft.

⌚ Tighten

- Concentric slave cylinder bolts to 8 N·m (71 lb. in.).
4. Transmission. Refer to SECTION 7B.

CLUTCH ASSEMBLY REPLACEMENT

Tools Required:
J 33169 Clutch Alignment Tool

↔ Remove or Disconnect (Figures 7 and 8)

! Important

- Install J 33169 clutch alignment tool or a used clutch drive gear to support the clutch (Figure 7).
 - Mark the flywheel, clutch cover, and a clutch plate lug for alignment when installing.
1. Clutch cover bolts and washers (Figure 8).
 2. Clutch cover and the clutch plate. Remove the clutch alignment tool.

🧼 Clean

1. All parts with a clean, water dampened cloth to remove any fibers.
2. Flywheel housing with solvent. Wipe dry.

🔍 Inspect

- All parts for wear and damage.
- Contact surfaces for scoring and flatness with a straight edge. Driven plate run out must not be more than 0.508 mm (0.020 inch).
- Friction pads for scoring, gouges, and loose rivets. Check to see if they are oil soaked.
- All splines for nicks, burrs, and sliding fit.
- Clutch cover spring for bending and breaks.

↔ Install or Connect (Figures 7 and 8)

1. Clutch plate and clutch cover assembly.

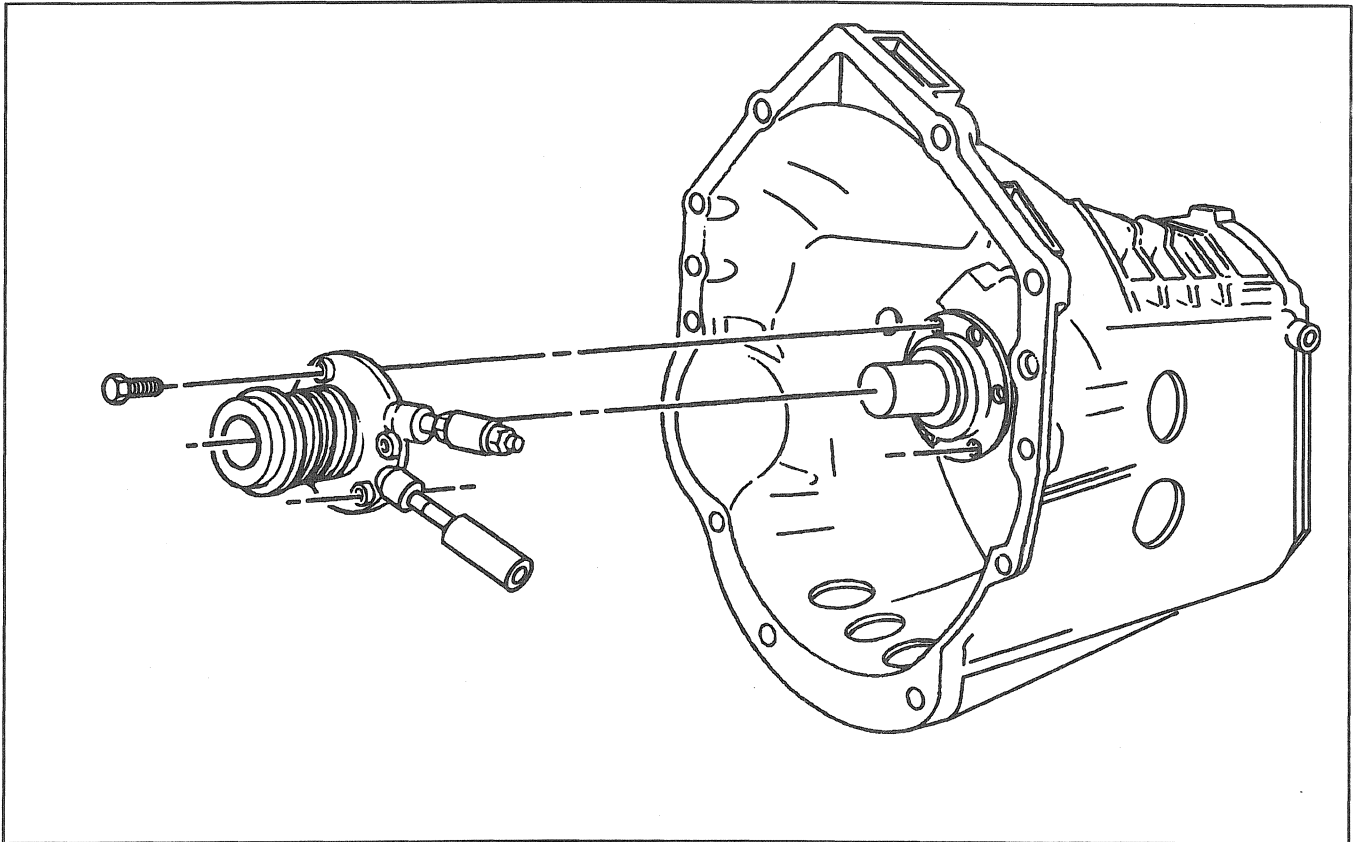


Figure 6—Concentric Slave Cylinder

**Important**

- Install J 33169 clutch alignment tool or a used clutch drive gear to support the clutch cover and clutch plate (Figure 8).
- Align the marks made during removal or, if new, align the lightest part of the clutch cover, identified by a yellow dot, with the heaviest part of the flywheel, identified by an "X".

2. Clutch cover to flywheel with washers and bolts (Figures 7 and 8).

**Important**

- Tighten each bolt one turn at a time to avoid warping the clutch cover.
- Remove the clutch alignment tool.

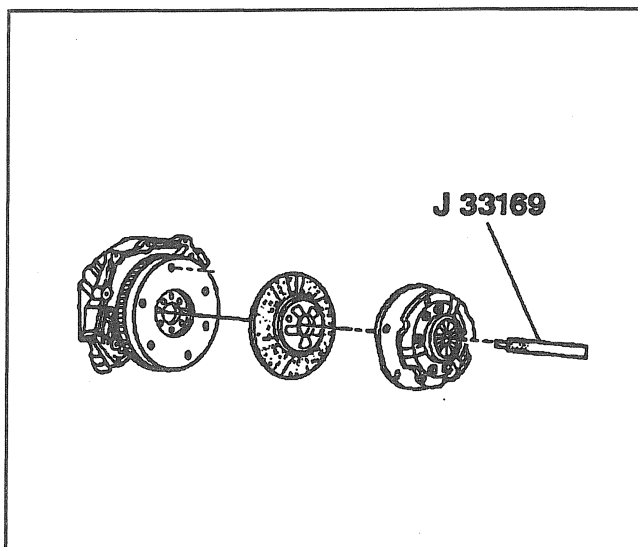


Figure 7—Clutch Alignment Tool

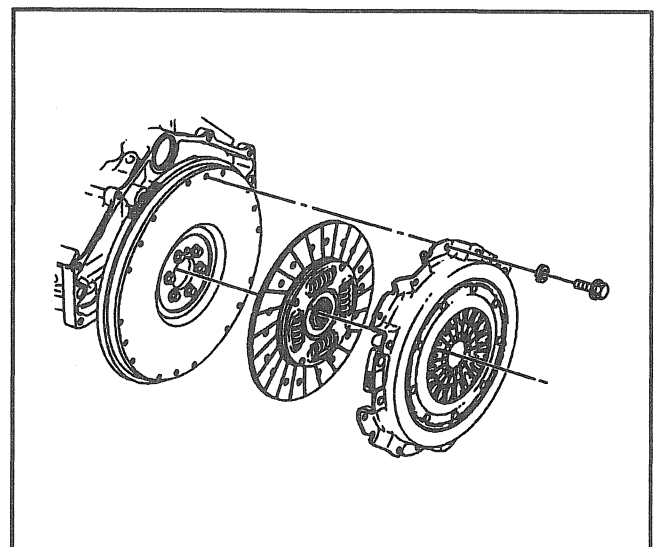


Figure 8—Flywheel, Clutch Plate, and Clutch Cover

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Tighten

- Clutch cover to the flywheel bolts (Gasoline Engine) to 40 N.m (29 lb. ft.).

- Clutch cover to the flywheel bolts (Diesel Engine) to 34 N.m (25 lb. ft.).
- 3. Transmission. Refer to SECTION 7B.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

ITEM	N·m	Lb. Ft.	Lb. In.
Clutch Cover Bolts (Diesel Engine)	34	25	—
Clutch Cover Bolts (Gasoline Engine)	40	29	—
Concentric Slave Cylinder Bolts	8	—	71
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SPECIAL TOOLS

1. CLUTCH ALIGNMENT TOOL



2. QUICK CONNECT DISENGAGEMENT TOOL

