Section 5 Transmission, Transfer Case and Propeller Shafts

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ELECTRONIC CONTROLLED AUTOMATIC TRANSMISSION

The Hydra-matic 4L80-E is a 4-speed automatic transmission which uses electronic control for smoother shifting. It offers a fourth gear, overdrive, for increased fuel efficiency. The torque converter clutch automatically engages at cruising speeds to improve fuel efficiency. Typically, transmission shifts are controlled hydraulically, however, the 4L80-E transmission uses electric signals to specific gear shift solenoids to produce smooth shifts and quiet operation.

A neutral safety switch prevents the vehicle from being started if the transmission shift lever is in a position other than P (park) or N (neutral). Another safety feature is an interlock which prevents the vehicle from being shifted out of P unless the key is in the RUN position and the service brake pedal is depressed. A transmission warning light on the instrument panel will illuminate if there is a problem with the transmission.

The Transmission Control Module (TCM) selects the appropriate gear ratio based on the input from the throttle position (TP) sensor and the vehicle speed input. Other input data may modify the shift points to some extent but the throttle position and vehicle speed data are the primary basis of gear ratio selection.

For increased power, depressing the accelerator to the floor will activate the throttle position sensor kick-down feature and will shift the transmission into a gear range lower than is selected on the gear range lever. The throttle position sensor is located on the fuel pump.

The major components of the transmission are (Figure 5-1):

- TWO BAND ASSEMBLIES
  - Front band
  - Rear band
- FIVE MULTIPLE DISC CLUTCH ASSEMBLIES
  - Forward clutch
  - Intermediate clutch
  - Direct clutch
  - Fourth clutch
  - Overrun clutch
- THREE OVERRUNNING CLUTCHES
  - Lo Roller clutch
  - Intermediate sprag
  - Overdrive Roller clutch
- THREE PLANETARY GEAR SETS
- CONTROL VALVE ASSEMBLY WITH TWO ELECTRONIC SHIFT SOLENOIDS
- INPUT AND OUTPUT SPEED SENSORS
- TORQUE CONVERTER CLUTCH

Oil pressure is supplied by a gear-type oil pump. Oil pressure is regulated by a pressure control solenoid, and shift points are controlled by shift solenoids via powertrain control module (PCM) operation. The torque converter clutch apply and release is controlled by a pulse width modulated (PWM) solenoid.

The 4L80-E automatic transmission has a metal identification nameplate attached to the case exterior. This information will assist in the servicing and determination of replacement parts.

***CAUTION**: When fasteners are removed, reinstall in same location. Replace if necessary with a fastener of equal size and equal or better quality. Fasteners which will be not reused or which require locking compound are noted in the procedures. Torque fasteners as required in text, or equipment malfunction or damage could result.*

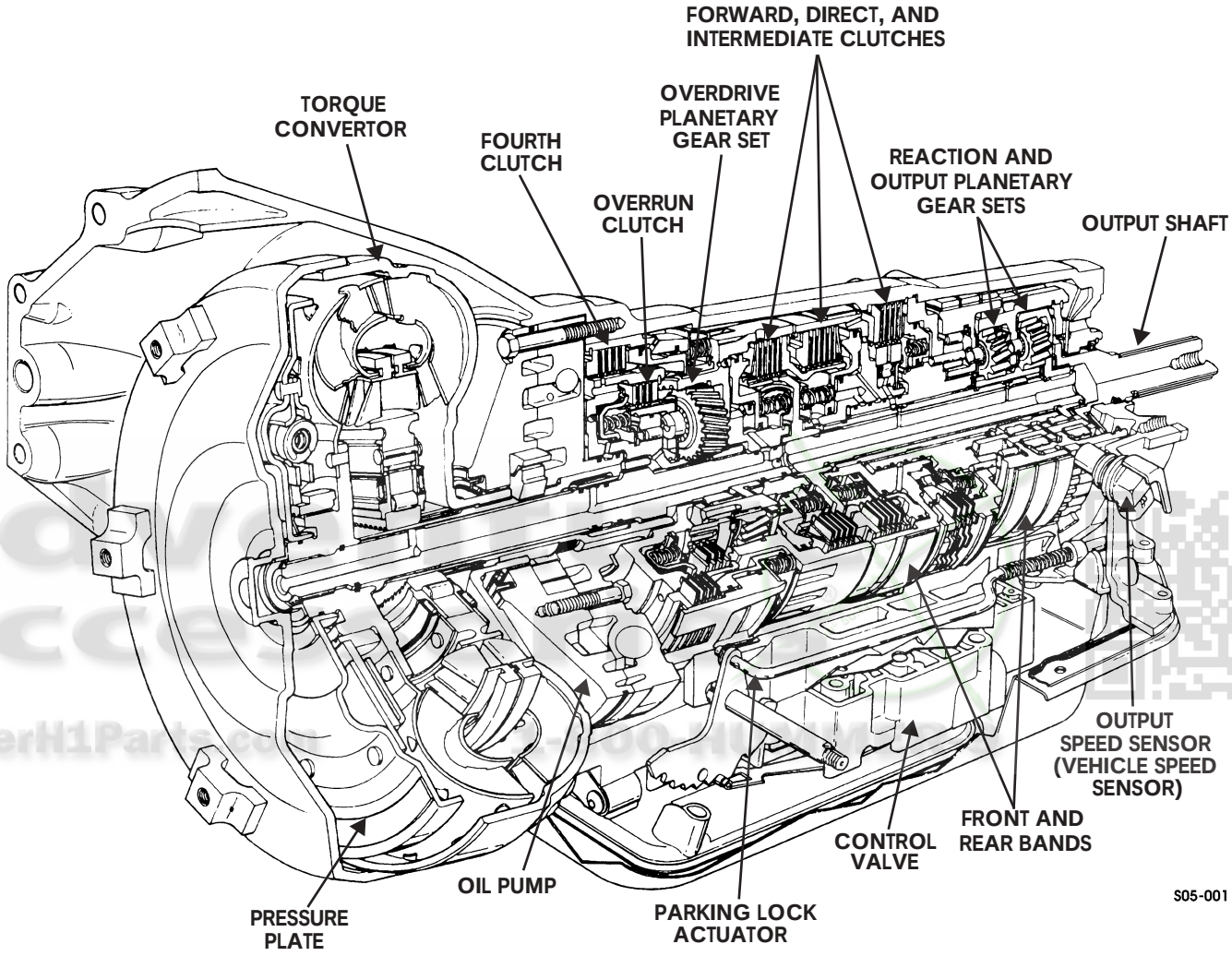


Figure 5-1: Transmission

***CAUTION**: Use of air powered tools is not recommended for assembling or disassembling transmissions. Incorrect bolt torquing can lead to misalignment of or breakage of parts and lead to malfunction of assemblies. This information, vital to diagnosis, can only be detected when using hand tools.*

TRANSMISSION CONTROL MODULE (TCM)

The Transmission Control Module (TCM) is an electronic device which monitors various inputs in order to control various transmission functions including shift quality and transmission diagnostics (Figure 5-3). The control module receives various input information from sensors, switches, and components to process for use within its control program. Based on this input information, the control module controls various transmission output functions and devices. The control module is located within the passenger compartment, underneath the engine access cover.

Data Link Connector (DLC)

The data link connector is the means of communicating with the TCM. This connector is mounted on a bracket on the left side of the steering column just below the instrument panel.

A scan tool (equivalent to the TECH-1) with appropriate adapters can be attached to the DLC and provide two-way communication with the TCM.

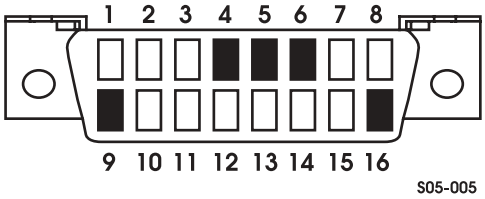


Figure 5-2: 16-Pin Connector

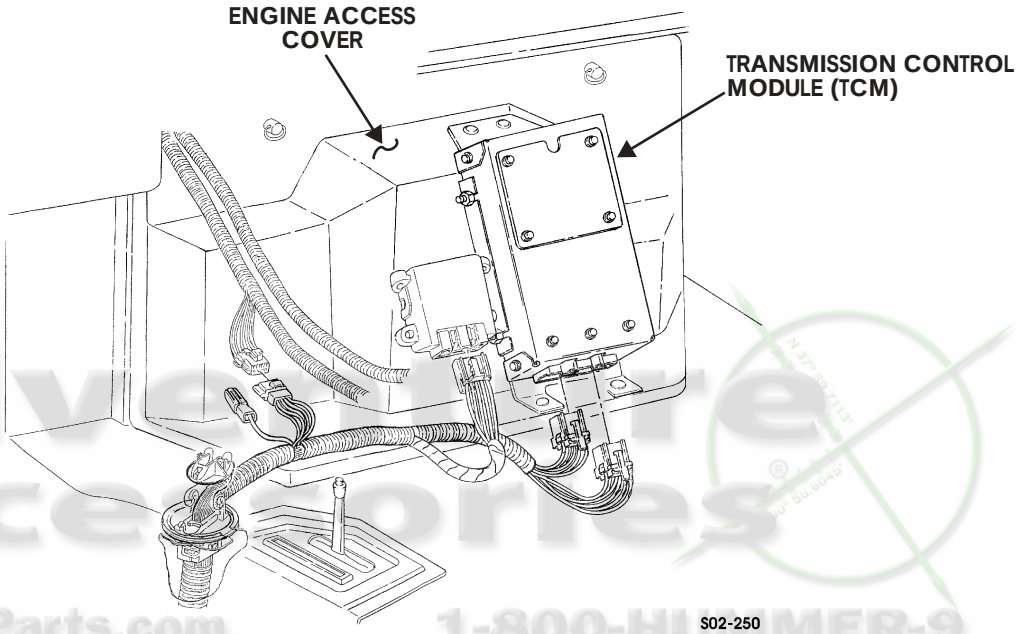


Figure 5-3: Transmission Control Module

To manually access information codes, locate the DLC connector. This connector contains 16 cavities (Figure 5-2). Trouble codes may be accessed by jumping across terminals 5 and 6 of the DLC connector with a wire spade connector, paper clip, or other suitable tool and turning the ignition key to the RUN position (the engine must not be running). The CHECK TRANS* lamp will flash three times (code 12) to indicate the TCM is capable of diagnostics. Following the code 12 display, each stored code will be displayed three times in numerical order from the lowest to the highest. When all codes have been displayed, code 12 will repeat to indicate the end of the code display.

*May be marked TRANS or have an ISO gear symbol. This lamp is also referred to as the MALFUNCTION INDICATOR LAMP (MIL).

SYSTEM OPERATION

In order to troubleshoot and service this transmission, it is important to understand how the TCM and transmission interact with their sensors and control elements.

The TCM receives data from various sensors, computes the optimum gear ratio based on the inputs, and causes the transmission to shift into the correct ratio at the best time.

Input sensors to the TCM:

- Throttle position (TP)
- Transmission Output Speed Sensor (TOSS) (Vehicle Speed Sensor)
- Transmission Input Speed Sensor (TISS)
- Transmission Range (TR) Pressure Switch Assembly
- Brake Switch
- Engine Coolant Temperature (ECT)
- Transmission Fluid Temperature (TFT)

Output Controls of the TCM:

- Shift Control Solenoids
- Pressure Control Solenoid
- Torque Converter Clutch Solenoid

Throttle Position (TP) Sensor

The Throttle Position (TP) sensor is a potentiometer (a device for measuring an unknown voltage or potential difference by comparison to a standard voltage). The TP sensor sends a voltage to the TCM, varying from approximately 0.5 volts to approximately 5 volts. This voltage signal to the TCM represents throttle shaft angle. At closed throttle, the signal voltage to the TCM is approximately 0.5 volts. As the throttle shaft angle increases, the signal voltage increases to greater than 4.5 volts at wide open throttle. The TP sensor is attached to the fuel injector pump assembly (Figure 5-4).

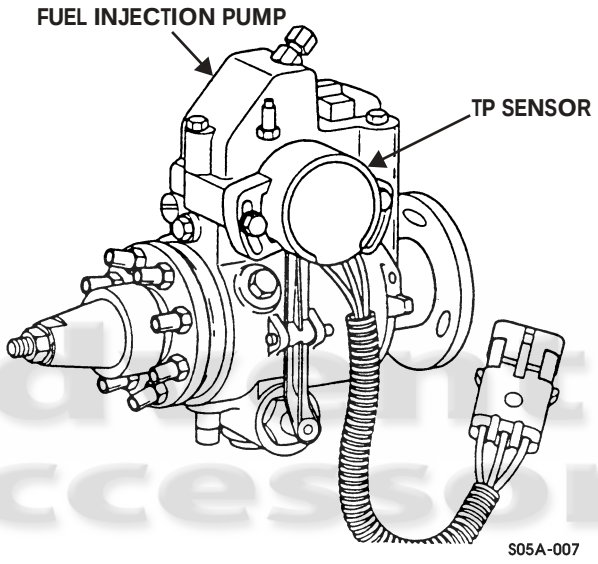


Figure 5-4: Throttle Position Senso

Transmission Output Speed Sensor (TOSS) (Vehicle Speed Sensor)

This device contains a permanent magnet surrounded by a coil of wire producing a magnetic field which is interrupted by rotor teeth on the output shaft. As the teeth interrupt the magnetic field, an AC voltage is generated in the circuit. This device is used to provide an output shaft speed signal to the control module. The TCM uses the TOSS signal input to:

- Calculate vehicle speed, trans output speed, and TCC slip speed.
- Control shift quality.

The TOSS is attached to the transmission output shaft housing (Figure 5-5).

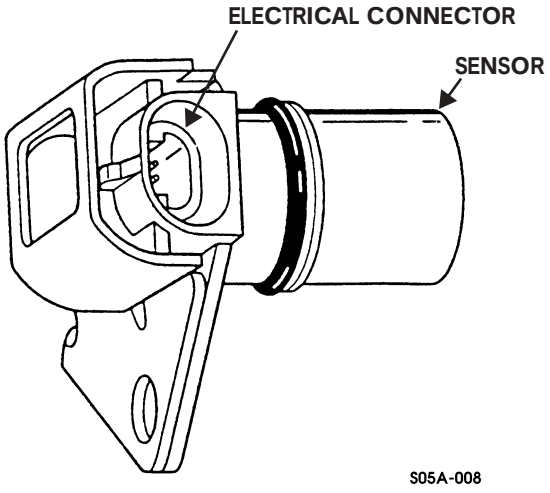


Figure 5-5: Input and Output Speed Sensors

Transmission Input Speed Sensor (TISS)

This device (Figure 5-6) contains a permanent magnet surrounded by a coil of wire producing a magnetic field which is interrupted by rotor teeth cut into the outside diameter of the forward clutch housing (Figure 5-5). As the serrations interrupt the magnetic field, an AC voltage is generated in the circuit. This device is used to provide an input speed signal to the control module. The TCM uses the TISS signal input to:

- Calculate TCC slip speed.
- Calculate gear ratios.

The TISS is attached to the transmission case over the forward clutch housing (Figure 5-6).

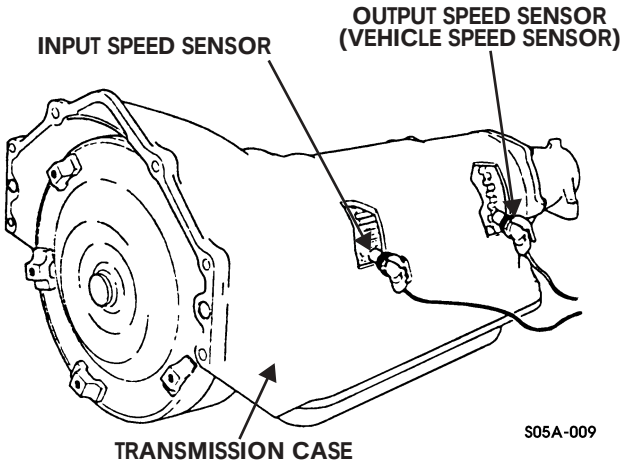


Figure 5-6: Locations of TISS and TOSS

Transmission Range (TR) Pressure Switch Assembly

This device is a set of five, normally open, pressure switches that detect fluid pressure within the control valve body passages (Figure 5-7). The five pressure switches are connected to three signal circuits referred to as range signals A, B, and C (Table 5-1).

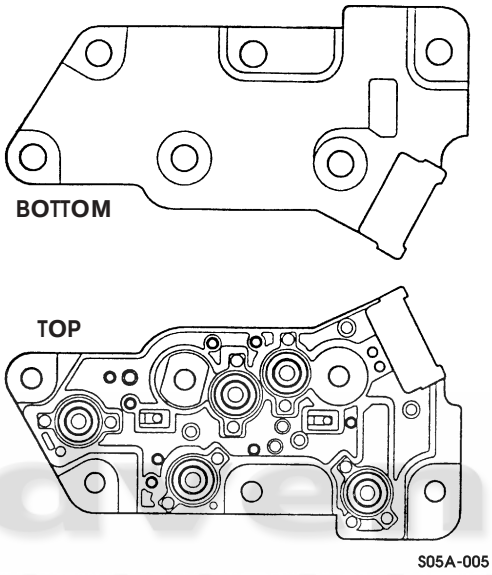


Figure 5-7: TR Pressure Switch Assembly

The combination of pressure switch states determine the voltage signal (B+ or 0) on each range signal circuit to the control module. These range signals are then interpreted by the TCM to indicate the transmission gear range selected. The transmission range fluid pressure switch assembly is attached to the control valve body within the transmission. The assembly is accessible by removing the oil pan.

Table 5-1: Valid Combination Chart

Range Signal	A	B	C
Park	ON	OFF	ON
Rev	OFF	OFF	ON
Neutral	ON	OFF	ON
D4	ON	OFF	OFF
D3	ON	ON	OFF
D2	ON	ON	ON
D1	OFF	ON	ON
Illegal	OFF	ON	OFF
Illegal	OFF	OFF	OFF

Expected Readings
ON = B+ OFF = 0 VOLTS

Brake Switch

This electrical switch is used to indicate brake pedal status. This switch is normally closed when the brake pedal is not applied. When the brake pedal is applied, the switch will open, changing the signal to the TCM. The TCM uses this signal to de-energize the TCC solenoid when the brake pedal is applied. The brake switch is located on the brake pedal mounting bracket.

Engine Coolant Temperature (ECT) Sensor

The Engine Coolant Temperature (ECT) sensor is a thermistor (a device that changes resistance according to change in temperature) used to indicate engine coolant temperature (Figure 5-8). High sensor resistance produces high signal input voltage which corresponds to low engine temperature. Low sensor resistance produces low signal input voltage which corresponds to high engine coolant temperature. The PCM uses the ECT sensor signal to determine the TCC apply and release schedules. The ECT sensor is attached to the engine assembly.

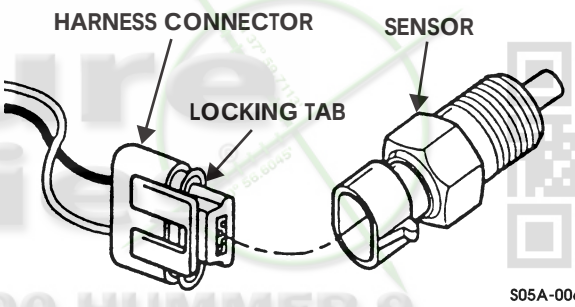


Figure 5-8: Engine Coolant Temperature (ECT) Sensor

Transmission Fluid Temperature (TFT) Sensor

The TFT sensor is a thermistor (a device that changes resistance according to changes in temperature) used to indicate transmission fluid temperature. High sensor resistance produces high signal input voltage which corresponds to low fluid temperature. Low sensor resistance produces low signal input voltage which corresponds to high fluid temperature. The TCM uses the TFT sensor signal input to determine the following:

- TCC apply and release schedules.
- Hot mode determination.
- Shift quality.

The TFT sensor is part of the internal wiring harness within the transmission (Figure 5-12).

OUTPUT CONTROLS OF TCM

The TCM determines the optimum gear ratio and TCC engagement. Signals are transmitted through a transmission wiring harness to control elements in the transmission, these are:

- l-2 Shift Solenoid.
- 2-3 Shift Solenoid.
- Pressure Control Solenoid (PCS).
- TCC PWM Solenoid.

NOTE: The transmission internal wiring harness ties the TR switch assembly and control solenoids together. The harness provides the wiring path through the transmission case (Figure 5-12).

1-2 Shift Solenoid

This electrical device is used to control fluid flow acting on the 1-2 and 3-4 shift valves (Figure 5-9). The solenoid is a normally open exhaust valve that is used with the 2-3 shift solenoid to allow four different shifting combinations. The solenoid is attached to the rear of the control valve body within the transmission, it is accessible by removing the oil pan.

2-3 Shift Solenoid

This electrical device is used to control fluid flow acting on the 2-3 shift valves (Figure 5-9). The solenoid is a normally open exhaust valve that is used with the l-2 shift solenoid to allow four different shifting combinations. The solenoid is attached to the rear of the control valve body within the transmission. It is accessible by removing the oil pan.

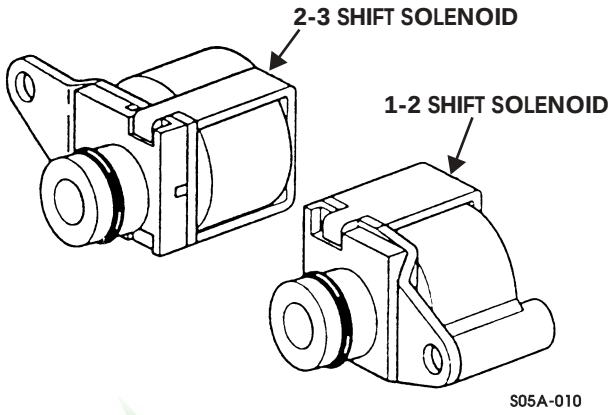


Figure 5-9: Shift Solenoids

Pressure Control Solenoid (PCS)

This electrical device is used to control fluid line pressure by controlling actuator feed limit fluid flow acting on an internal spool valve and spring pressure (Figure 5-10). The solenoid is a normally closed solenoid valve that controls fluid pressure when operating on a duty cycle. The solenoid is attached to the front of the control valve body within the transmission. It is accessible by removing the oil pan.

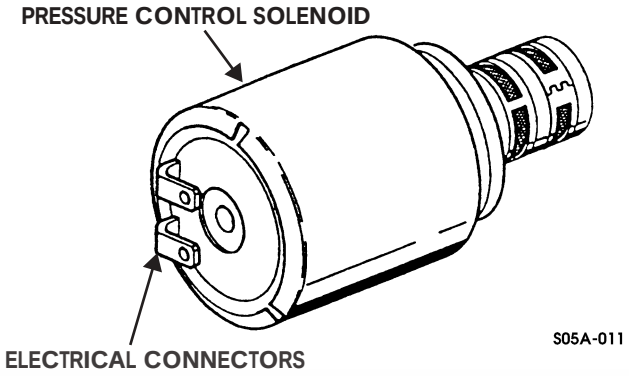


Figure 5-10: Pressure Control Solenoid

Torque Converter Clutch (TCC) PWM Solenoid

This electrical device is used to control fluid acting on the TCC converter clutch valve, which then controls TCC apply and release (Figure 5-11). The TCC PWM solenoid is used to provide smooth engagement of the torque converter clutch by operating on a negative duty cycle percent of ON time. This solenoid is attached to the front of the control valve body within the transmission. It is accessible by removing the oil pan.

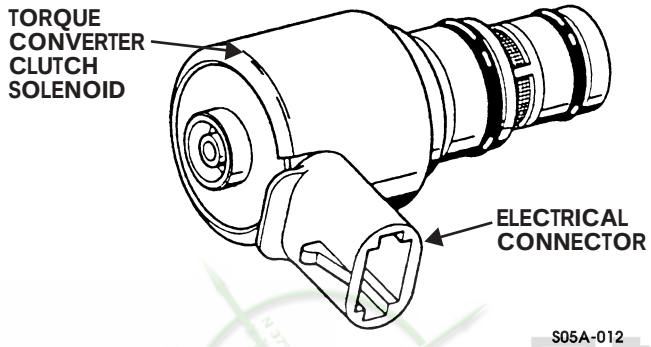


Figure 5-11: Torque Converter Clutch Solenoid

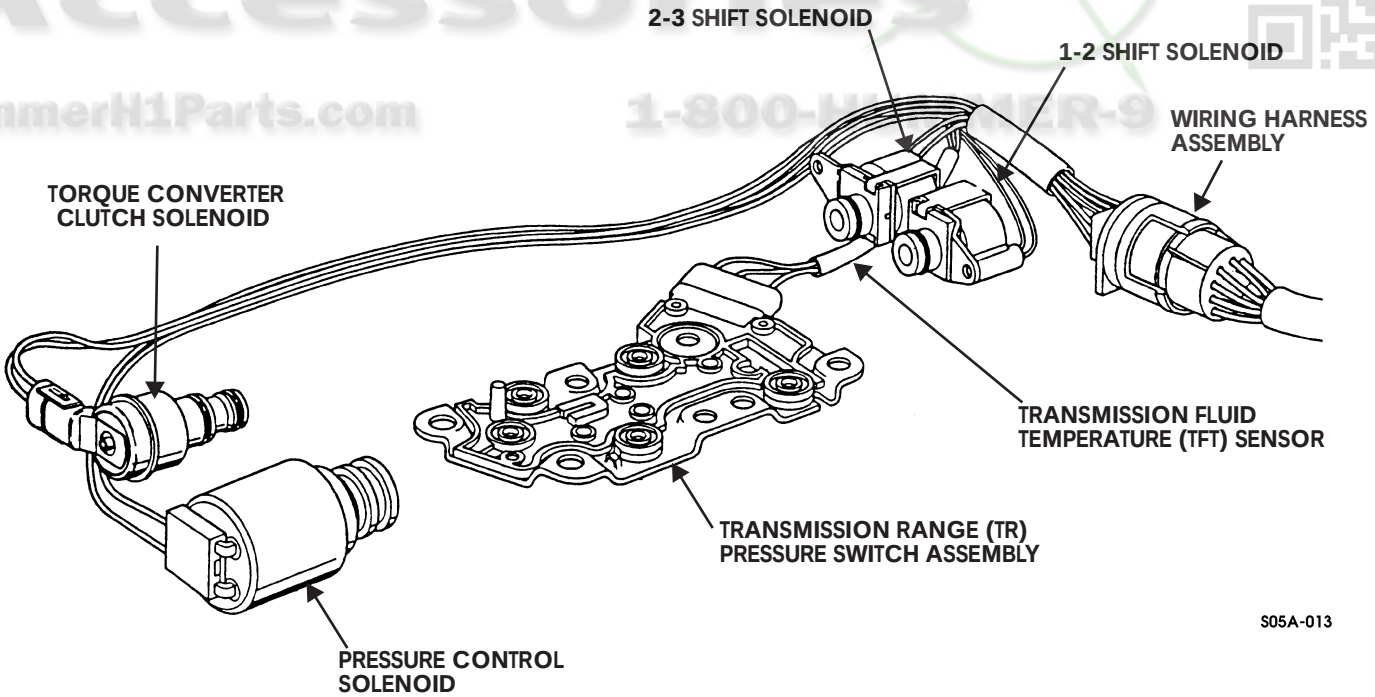


Figure 5-12: Transmission Internal Wiring Harness and Solenoids

TRANSMISSION DIAGNOSIS AND TROUBLESHOOTING

Initial Action

Obtain as much information as possible from the user. The technician may have to ask questions concerning the problem.

- When does it occur? Speed shifting up or down, loaded vehicle, full throttle, etc.
- Temperature? Transmission, engine, ambient, etc.
- Noise? Type, when, constant, intermittent, all gears, one gear, etc.
- Recent service? What and why?
- Refer to definitions to add more information

Transmission Definitions

The following definitions are being provided to establish a common language and assist the user in describing transmission related conditions.

Throttle Positions

Minimum Throttle - The least amount of throttle opening required for an upshift.

Light Throttle - Approximately 25% of accelerator pedal travel.

Medium Throttle - Approximately 50% of the accelerator pedal travel.

Heavy Throttle - Approximately 75% of the accelerator pedal travel.

Wide Open Throttle (WOT) - 100% travel of the accelerator pedal.

Full Throttle Detent Downshift - A quick application of the accelerator pedal to its full travel, forcing a downshift. Previously this was referred to as kickdown.

Zero Throttle Coastdown - A full release of the accelerator pedal while the vehicle is in motion and in drive range.

Engine Braking - A condition where the engine is used to slow the vehicle by manually downshifting during a zero throttle coastdown.

Shift Condition Definitions

Bump - A sudden and forceful application of a clutch or band.

Chuggle - a bucking or jerking condition that may be engine related. This condition may be most noticeable when the converter clutch is engaged. It is similar to the feel of towing a trailer.

Delayed (Late or Extended) - A condition in which a shift does not occur when expected. For example, a clutch or band engagement that hesitates during a part or wide open throttle acceleration or when manually downshifting.

Double Bump (Double Feel) - Two sudden and forceful applications of a clutch or band.

Early - A condition in which the shift occurs before the vehicle has reached a proper speed and tends to labor the engine after the upshift.

End Bump (End Feel or Slip Bump) - A firmer feel at the end of a shift than the feel at the start of the shift.

Firm - A noticeable quick application of a clutch or band that is considered normal with a medium to heavy throttle shift. Should not be confused with “harsh” (rough).

Flare (Slipping) - A quick increase in engine rpm accompanied by a momentary loss of torque. This most generally occurs during a shift.

Harsh (Rough) - A clutch or band application which is more noticeable than “firm”. This condition is considered undesirable at any throttle position.

Hunting (Business) - A repeating quick series of upshifts and downshifts that cause a noticeable change in engine rpm. An example could be described as a 4-3-4 shift pattern.

Initial Feel - A distinctly firmer feel at the start of a shift than at the end of a shift.

Late - A shift that occurs when the engine is at a higher than normal rpm for the current gear.

Shudder - A repetitious jerking sensation similar to “chuggle” but more severe and rapid. This condition may be most noticeable during certain speeds. The term shudder may also be used to define the condition experienced after converter clutch engagement.

Slipping - A noticeable increase in engine rpm without an increase in vehicle speed. A slip usually occurs during or after initial clutch or band engagement.

Soft - A slow, almost unnoticeable clutch application with very little shift feel.

Surge - A repeating engine-related feeling of acceleration and deceleration that is less intense than “chuggle.”

Tie-up - A condition where two opposing clutches are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine rpm.

Noise Conditions

Gear Noise - This noise is a whine which is related to vehicle speed and is most noticeable in first gear and reverse. A gear noise condition may become less noticeable or go away after an upshift.

Pump Noise - This noise is a high-pitched whine that increases in intensity with engine rpm. This condition may also be noticeable in PARK and NEUTRAL with the vehicle stationary.

Analysis Plan

Based on initial information and knowledge of transmission operation, a tentative plan of analysis should be made.

1. Is the problem of a mechanical nature? If so, is it internal or external?
2. Is the problem of an electrical nature? If so, is it internal or external?
3. Is the problem of an overheating nature? If so, is it internal or external?
4. Is a road test necessary?
5. If there was recent service, could the service have caused the problem?

Preliminary Checking Procedure

An automatic transmission which is not operating properly may be affected by one or more of the following conditions:

- Improper fluid level
- Improper manual linkage adjustment
- Internal and external fluid leaks
- Electrical system failure
- Mechanical component failure

Transmission Shift Linkage

Vehicle Starts In Shift Position Other Than N (Neutral) or P (Park)

1. Check operation of neutral safety switch. Disconnect harness leads 14A and 14B from neutral safety switch. Using ohmmeter, check for continuity in switch leads while moving shift lever through operating ranges. If continuity is indicated in any position other than N or P, replace neutral safety switch.
2. Check transmission shift linkage. Adjust transmission shift linkage so vehicle starts only in N or P. Adjustment is as follows:
   a. Position shift lever arm into N position.
   b. Remove cotter pin and washer securing shift rod trunnion to shift lever arm.
   c. Disconnect shift rod from shift lever arm. Ensure shift lever arm is in the N position. Turn shift rod trunnion forward or backward on shift rod so that it slips easily into hole in the shift lever arm.
   d. Connect shift rod to shift lever arm with washer and cotter pin.

Transmission Does Not Operate Properly According To Shift Lever Position

1. Check transmission shift linkage. Adjust shift linkage, if necessary.
2. Repair or replace transmission as required.

Transmission Slips In Any Gear

1. Check fluid level and condition. Service as indicated.
2. Test transmission oil pressures.
3. Repair or replace transmission as required.

Erratic Shift Points Or No Detent Downshifts

1. Check transmission fluid level. Add fluid, if necessary.
2. Check adjustment of throttle position sensor, adjust as necessary.
3. Replace transmission oil filter.
4. Test transmission oil pressure.
5. Repair or replace transmission.

Internal and External Fluid Leaks

Internal fluid leaks usually cause low pressure problems, improper control valve operation, slipping or failure of clutch packs (loss of a gear ratio).

External leaks cause poor performance due to loss of fluid, lowering pressure.

Electrical System Failure

This type failure can cause poor or erratic shifting, skipped gears, total transmission failure depending on which component failed.

Mechanical Failure

This type of failure can cause skipped gears, low pressure failure, total transmission failure.

Transmission Fluid Information

Check fluid level, color, and condition (refer to Transmission Fluid Check Chart) to diagnose transmission problems. Minor problems can result in major transmission repairs. Always check fluid level after it has reached a normal operating temperature of 180-200°F (82-93°C). Normal operating temperature is reached after approximately 15 miles (24 km) of driving. Use Dexron II E or Dexron III transmission fluid. Refer to Maintenance Intervals (Section 1) for maintenance information and servicing intervals.

***CAUTION**: Do not overfill. Overfilling will cause foaming, loss of fluid, and possible damage to the transmission.*

Transmission fluid is red when it is new. The red dye is added so technicians can distinguish it from engine oil or antifreeze. The red dye is not an indicator of the fluid quality and is not permanent. As the vehicle is driven, the transmission fluid will begin to look darker in color. The color may eventually appear light brown.

If the fluid is checked immediately after the vehicle has been operated under certain conditions, fluid level readings may be inaccurate. Driving in the following conditions may cause inaccurate readings:

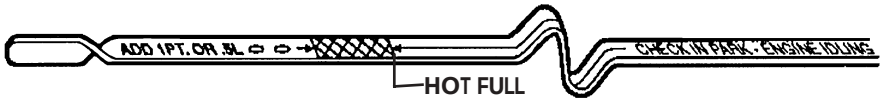
- Ambient temperature above 90 °F (32° C)
- Sustained high speed
- Heavy city traffic during hot weather
- Towing

Transmission Fluid Checking Procedure

NOTE: The automatic transmission fluid level must be checked with the vehicle at normal operating temperature 180-200° F (82-93° C). Temperature will greatly affect transmission fluid level. If the vehicle is not at normal operating temperature and the proper checking procedures are not followed, the result could be a false reading of the fluid level.

1. Start the engine and drive the vehicle for a minimum of 15 miles (24 km), or until normal operating temperature is reached.
2. Park the vehicle on level ground.
3. Move the gear selector to PARK.
4. Apply the parking brake.
5. Let the vehicle idle for 3 minutes with accessories off.
6. Check fluid level, color, and condition (refer to Transmission Fluid Check Chart).

Transmission Fluid Check Chart for Hydra-Matic 4L80-E



NOTE: Fluid level should be in crosshatched area on fluid level indicator blade. Check at operating temperature.

Noise And Vibration Analysis

A noise or vibration that is noticeable when the vehicle is in motion may not be from the transmission (refer to table 5-2).

If noise or vibration is noticeable in PARK and NEUTRAL with engine at idle, but it is less noticeable as rpm increases, the cause may be poor engine performance.

A screeching or clanking noise while cranking can usually be traced to a starter or flexplate problem. It may also occur when engine is shifting from driving the transmission to braking the transmission.

NOTE: Check engine accessory drive components: water pump, power steering pump, and alternator for the source of noise before checking transmission.

1. If noise is heard in neutral and all driving ranges:
   a. Check torque converter for loose mounting capscrews and damage. Tighten capscrews or replace torque converter if damaged.
   b. Check flywheel for damage. Replace flywheel if damaged (Section 2).

Table 5-2: Possible Causes of Noise and Vibration

Component to Inspect	Conditions to Check
Tires	• Uneven wear • Imbalance • Mixed sizes • Mixed radial and bias ply
Suspension components	• Alignment and wear • Loose fasteners
Engine/transmission mounts	• Damage • Loose bolts
Transmission case mounting holes	• Missing bolts, nuts, studs • Stripped threads • Cracks
Flywheel	• Missing or loose bolts • Cracks • Imbalance
Torque converter	• Missing or loose bolts or lugs • Missing or loose balance weights

PREPARING AND USING THE SCAN TOOL

Other scan tools can be used, however, the Tech-1A scan tool is preferred for quick and proper diagnosis of the 4L80-E transmission (Figure 5-13). The Tech-1A allows two-way communication between the operator and the vehicles' computerized transmission system and also allows for control of some transmission functions during testing.

WARNING: Before performing any checks or repairs on the vehicle:

- ***Always set the parking brake securely***
- ***Vent the exhaust***
- ***Shift the transmission into Neutral or Park***
- ***Block all driving wheels***

NOTE: Technicians should be familiar with scan tool operation before attempting to diagnose the transmission using the Tech-1A scan tool. Refer to the Tech-1A operating instructions if necessary.

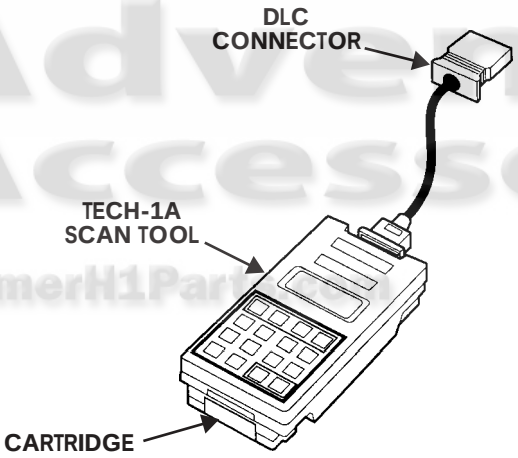


Figure 5-13: Scan Tool

1. Turn the ignition switch to the ON position and verify TRANS lamp operation. The lamp should illuminate. If it does not, for proper service procedures refer to Electrical Systems (Section 12).
2. Install a 1995 powertrain cartridge in the bottom slot of the Tech-1A by squeezing the tabs on the cartridge and sliding it into the connector. Do not force the cartridge in. It only fits in one way.
3. Make sure the ignition is off, then connect the power cord to the cigarette lighter receptacle. The Tech-1A display should become active.
4. If the Tech-1A display does not become active, inspect the cigarette lighter receptacle for damage or corrosion. If required, inspect fuse 4D in the lower mini-fuse box for proper operation. If you use the optional battery cable adapter, be sure the battery cable adapter polarity is correct. If the polarity is not correct, the scan tool could be damaged.
5. Connect the 14 to 12 pin adapter (supplied with the Tech-1A), and an additional 12 to 16 pin adapter to the Tech-1A DLC connector.
6. Locate the vehicle DLC connector under the left side dash near the steering column. Insert the Tech-1A DLC connector with adapters to the vehicle DLC diagnostic connector.
7. Turn the ignition on. Testing can begin by following the menu on the Tech-1A display.
8. Enter 95 for the model year. (Note that 1994 and 1995 are the same for this step.)
9. Select F6 for diesel.
10. Select NO until 6.5L VIN Y is displayed, then select ENTER.
11. Perform an on-board diagnostic check by selecting YES.
12. Continue following the Tech-1A display "menu" to perform additional testing as required. Refer to the Tech-1A operating instructions, as required, for proper procedures.

NOTE: If serial data is not displayed or the TRANS light fails to operate, disconnect the Tech-1A from the vehicle. Perform a self-diagnostic test on the scan tool. Refer to the Tech-1A operating instructions for proper procedures. If necessary, perform the following tests on the vehicle DLC diagnostic connector and fuse box.

***CAUTION**: Use only high impedance-type ohmmeters for electrical testing. If another type of meter is used, false readings and damage to the circuits may occur.*

NOTE: For more information, refer to Electrical System (Section 12).

13. With the ignition switch off and the TCM connectors disconnected, use a high-impedance ohmmeter to test the following vehicle DLC pin connections:
    - Vehicle DLC connector pin number 4 to ground. A low to zero resistance reading should be obtained. If not, repair vehicle DLC connector 4 to ground connection.
    - Vehicle DLC connector pin number 5 to ground. A low to zero resistance reading should be obtained. If not, repair vehicle DLC connector 5 to ground connection.
    - Vehicle DLC connector pin number 5 to TCM connector pin C1 and C2. A low to zero resistance reading should be obtained. If not, repair vehicle DLC connector 5 to TCM connector pin C1 and C2 connection.
    - Vehicle DLC connector pin number 6 to TCM connector pin A8. A low or zero resistance reading should be obtained. If not, repair vehicle DLC connector 6 to TCM connector pin A8 connection.

14. With the TCM connectors attached and ignition switch on, use a voltmeter to test the following vehicle DLC pin connections:
    - Connect the voltmeter negative probe to ground and the positive probe to vehicle DLC connector pin number 16. A reading of 12 volts should be obtained. If not, repair the connection between vehicle DLC connector and fuse H2 in the upper mini-fuse box.
    - Connect the voltmeter negative probe to ground and positive probe to vehicle DLC pin connector 6. A reading of 5 volts should be obtained. If not, back-probe TCM connector by removing connector pin retaining clip and testing for 5 volt diagnostic request signal directly from the TCM.

Electrical Shift Test

1. Move gear selector to PARK and set the parking brake.
2. Connect the scan tool to the DLC terminal.
3. Start the engine.
4. Verify that the following signals are present:
    - Input speed
    - Transmission output speed (TOSS)
    - Engine speed
    - Transmission range
    - Current gear
    - Desired pressure control solenoid
    - Actual pressure control solenoid
    - Transmission temperature
    - Throttle angle
    - TCC duty cycle
    - System voltage
    - Brake switch
5. Monitor the brake switch signal while tapping the brake pedal with your foot. The brake switch should be open when the brake pedal is depressed, and be closed when the brake pedal is released.
6. Monitor the transmission range switch signal and move the gear selector through all ranges. Verify that the transmission range switch value matches the gear range indicated on the instrument panel or console. Gear selections should be immediate and not harsh.
7. Move gear selector to NEUTRAL and monitor the throttle angle signal while increasing and decreasing engine rpm with the accelerator pedal. The throttle angle should increase with the engine rpm.

Road Test

Perform the electrical shift test prior to a road test.

This road test should only be performed when traffic and road conditions permit, observing all traffic regulations.

Upshifts and Torque Converter Clutch (TCC) Applications

The vehicle transmission control module calculates upshift points based on two inputs: percent throttle angle and transmission output speed. When the computer says a shift should occur, an electrical signal is sent to the shift solenoids which in turn move the valves to perform the upshift.

The shift speed chart; Table 5-3, has been updated to reference throttle angle instead of minimum throttle or wide open throttle (WOT) to make shift speed measurement more uniform and accurate. A scan tool is necessary to monitor throttle angle.

Scan tools like the Tech-1A have been programmed to measure and record shift point information. Check your scan tool instruction manual to see if this test is available with the scan tool you are using.

With the gear selector in D (overdrive):

1. Look at the shift speed charts and choose a 10 or 25 percent throttle angle.
2. Set up the scan tool to monitor throttle angle.
3. Accelerate to the chosen throttle angle and hold the throttle steady.
4. As the transmission upshifts, note the shift speed for:
    2nd gear
    3rd gear
    4th gear

NOTE: Shift speeds may vary due to slight hydraulic delays responding to electronic controls. A change from the original equipment tire size also affects shift speeds.

NOTE: Be alert to determine when the TCC applies. This should occur in third or fourth gear. If TCC application is not noticed by an rpm drop, refer to Torque Converter Clutch Diagnosis.

NOTE: The TCC will not apply unless the transmission fluid has reached a minimum operating temperature.

5. Repeat steps 1-4 using several different throttle angles.

Manual Downshifts

The shift solenoids do not control the initial downshift during manual downshifts. All manual downshifts are hydraulic. The solenoid states will change either during manual downshift selection or slightly afterward (Tables 5-4 through 5-11).

Table 5-3: Throttle Angle vs. Speed (VSS or TOSS)

Shift RPM (Transmission Output)					
Gear Change TPS%	**10%**	**25%**	**50%**	**100%**	**5 - 10%**
Upshift 1- 2 ± 150 rpm	455	600	1020	1260	—
Upshift 2 - 3 ± 200 rpm	800	1210	1810	—	—
Upshift 3 - 4 ± 250 rpm	1280	1400	2370	—	—
Downshift 3 - 2 ± 100 rpm	—	—	—	—	650
Downshift 2 - 1 ± 100 rpm	—	—	—	—	325

Table 5-4: 4-3 Downshift

VEHICLE SPEED	GEAR	ACTION	CONDITIONS TO OBSERVE
40 to 45 mph (64 to 72 km/h)	4th	Release accelerator pedal while moving gear selector to D3	• TCC releases • Trans downshifts to 3rd gear immediately • Engine slows vehicle down

Table 5-5: 4-2 Downshift

VEHICLE SPEED	GEAR	ACTION	CONDITIONS TO OBSERVE
40 to 45 mph (64 to 72 km/h)	4th	Release accelerator pedal while moving gear selector to D2	• TCC releases • Trans downshifts to 2nd gear immediately • Engine slows vehicle down

Table 5-6: 4-1 Downshift

VEHICLE SPEED	GEAR	ACTION	CONDITIONS TO OBSERVE
30 mph (48 km/h)	4th	Release accelerator pedal while moving gear selector to D1	• TCC releases • Trans downshifts to 1st • Engine slows vehicle down

Coasting Downshifts

Table 5-7: Check Torque Converter Clutch Release

VEHICLE SPEED	GEAR	ACTION	CONDITIONS TO OBSERVE
Coasting	4th	• Accelerate to 4th gear with TCC applied • Release accelerator pedal and lightly apply brakes	• TCC Releases • Downshifts occur at speeds shown on the shift speed chart

Manual Gear Range Selection

Upshifts in the manual gear range are controlled by the shift solenoids. Perform the following tests by accelerating at 10-15 percent TP Sensor.

Table 5-8: Manual Drive (D-Drive)

VEHICLE SPEED	GEAR	ACTION	CONDITIONS TO OBSERVE
Vehicle stopped	3rd	Accelerate	• 1-2 shift • 2-3 shift • TCC does not apply

Table 5-9: Manual Second (2)

VEHICLE SPEED	GEAR	ACTION	CONDITIONS TO OBSERVE
Vehicle stopped	2nd	Accelerate	• 1-2 shift
35 mph (56 km/h)	2nd	Accelerate to 35 mph (56 km/h)	• 2-3 shift does not occur • TCC does not apply

Table 5-10: Manual First (1)

VEHICLE SPEED	GEAR	ACTION	CONDITIONS TO OBSERVE
Vehicle stopped	1st	Accelerate to 20 mph (32 km/h)	• No upshifts occur • TCC does not engage

Table 5-11: Reverse (R)

VEHICLE SPEED	GEAR	ACTION	CONDITIONS TO OBSERVE
Vehicle stopped	Reverse	Accelerate slowly	1-2 solenoid is on

Use a scan tool to see if any transmission malfunction codes have been set. After repairing the vehicle, perform the road test and verify that the code has not been set again.

If the transmission is not performing well and no trouble codes have been set, there may be an intermittent condition. Check all electrical connections for damage or a loose fit. Some scan tools have a snapshot test which can help catch an intermittent condition that does not occur long enough to set a code.

TORQUE CONVERTER CLUTCH (TCC) DIAGNOSIS

The torque converter clutch is applied by fluid pressure which is controlled by a pulse width modulated (TCC) solenoid located inside the automatic transmission assembly. The solenoid is energized by completing an electrical circuit through a combination of switches and sensors.

TCC Functional Check Procedure

Inspect:

1. Install a tachometer or scan tool.
2. Drive the vehicle until proper transmission operating temperature is reached.
3. Drive the vehicle at 50 to 55 mph (80 to 88 km/h) with light throttle.
4. Maintaining throttle, lightly touch the brake pedal and check for release of the TCC and slight increase in engine RPM.
5. Release the brake, slowly accelerate, and check for a re-apply of the TCC and a slight decrease in engine rpm

To properly diagnose the torque converter clutch (TCC) system, perform all electrical testing first and then test the hydraulic system.

Additional TCC diagnosis information is available in the wiring diagram, Diagnostic Trouble Codes (DTC) Table 5-20, and the Malfunction Code and Defaults Table 5-13.

***CAUTION**: Use only high impedance-type ohmmeters for electrical testing on the TCC circuit. If another type of meter is used, false readings and damage to the circuits may occur.*

NOTE: The pulse width modulated (TCC) solenoid is different than other TCC solenoids; it runs on 32 hertz and is not an on-off switch.

Torque Converter Evaluation

The torque converter should be replaced if any of the following conditions exist:

- External leaks in the hub area.
- Converter hub is scored or damaged.
- Converter pilot is broken, damaged, or fits poorly into crankshaft.
- Steel particles are found after flushing the cooler and cooler lines.
- Pump is damaged, or steel particles are found in the converter.
- Vehicle has TCC shudder and/or no TCC apply. Replace only after all hydraulic and electrical diagnosis has been made. (Converter clutch material may be glazed.) Refer to TCC shudder diagnosis.
- Converter has an imbalance which cannot be corrected.
- Converter is contaminated with engine coolant containing antifreeze.
- Internal failure of stator roller clutch.
- Excess end play.
- Heavy clutch debris due to overheating (blue converter).
- Steel particles or clutch lining material are found in fluid filter or on magnet when no internal parts in unit are worn or damaged (indicates that lining material came from converter).

The torque converter should not be replaced if:

- The oil has an odor, is discolored, and there is no evidence of metal or clutch facing particles.
- The threads in one or more of the converter bolt holes are damaged. Correct with thread insert.
- Transmission failure did not display evidence of damage or worn internal parts, steel particles or clutch plate lining material in unit and inside the fluid filter.
- Vehicle has been exposed to high mileage (only). The exception may be where the TCC dampener plate lining has seen excess wear by vehicles operated in heavy and/or constant traffic.

Noise

Torque converter whine is usually noticed when the vehicle is stopped and the transmission is in DRIVE or REVERSE. The noise will increase when engine rpm is increased. The noise will stop when the vehicle is moving or when the torque converter clutch is applied because both halves of the converter are turning at the same speed.

Perform a stall test to make sure the noise is actually coming from the converter.

1. Place foot on brake.
2. Put gear selector in DRIVE.
3. Depress accelerator to approximately 1200 rpm for no more than six seconds.

***CAUTION**: If the accelerator is depressed for more than six seconds, damage to the transmission may occur.*

IMPORTANT: This noise should not be confused with pump whine noise which is usually noticeable in PARK, NEUTRAL, and all other gear ranges. Pump whine will vary with pressure ranges.

Torque Converter Stator

The torque converter stator roller clutch can malfunction in two different ways. It can either remain locked up at all times, or freewheel in both directions.

If the stator is freewheeling at all times, the vehicle tends to have poor acceleration from the standstill. The vehicle may act normal at speeds above 30 to 35 mph (48 to 56 km/h). If poor acceleration is noted, it should first be determined that the exhaust system is not blocked, the engine timing is correct, and the transmission is in FIRST gear when starting out.

If the engine accelerated freely to high rpm in NEUTRAL, it can be assumed that the engine and exhaust are normal. Checking for poor performance in DRIVE and REVERSE will help determine if the stator is freewheeling at all times.

If the stator is locked up at all times, performance from a standstill appears normal, however, engine rpm and acceleration is restricted or limited at high speeds. The engine may overheat with this condition. Visual examination of the converter may reveal a blue color from overheating.

If the torque converter has been removed from the vehicle, the stator roller clutch can be checked by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. The inner race should turn freely clockwise, but not turn or be very difficult to turn counterclockwise.

TCC Shudder Diagnosis

The key to diagnosing TCC shudder is to note when it happens and under what conditions.

TCC shudder should only occur during the applying and/or releasing of the converter clutch - never after the TCC plate is fully applied.

While TCC is Applying or Releasing

If the shudder occurs while the TCC is applying, the problem is within the transmission or torque converter. Something is not allowing the clutch to become fully engaged, not allowing clutch to release, or is trying to release and apply the clutch at the same time. This could be caused by leaking turbine shaft seals, a restricted release orifice, a distorted clutch, a damaged torque converter housing surface due to long converter bolts, or defective friction material.

After TCC Has Applied

If shudder occurs after the TCC has applied (often with engine under load such as climbing a hill), most of the time there is nothing wrong with the transmission. As mentioned before, once the TCC has been applied, it is very unlikely that it will slip. Engine problems that may go unnoticed under light throttle and load become noticeable when going up a hill, or when accelerating, due to the mechanical lockup between engine and transmission.

REMEMBER: Once TCC is applied, there is no torque converter (fluid coupling) assistance. Engine or driveline vibrations could be unnoticeable before TCC engagement.

LINE PRESSURE CHECK PROCEDURE (FIGURE 5-14)

This test should be performed during a shop or road test when leaks, clutch slippage, or low fluid pressures are suspected.

The hydra-matic 4L80-E uses a gear-type oil pump to produce hydraulic pressure, and a pressure control solenoid to control that pressure after it leaves the pump. The pressure control solenoid is controlled by an electrical signal that ranges from 0 to 1.1 amp. One amp corresponds to a minimum line pressure (not 0 psi) and zero amps corresponds to a maximum line pressure (Table 5-12).

For reverse, a reverse boost valve increases the line pressure.

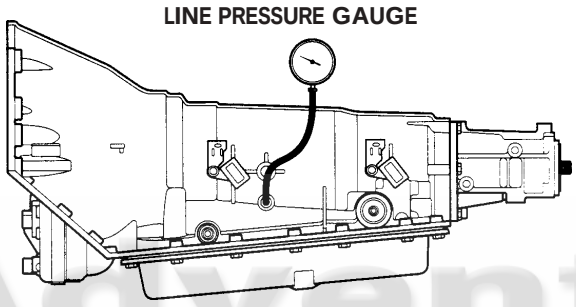


Figure 5-14: Line Pressure Gauge

Line pressures are calibrated for two sets of gear ranges – drive-park-neutral, and reverse. This allows the transmission line pressure to be appropriate for different pressure needs in different gear ranges:

Gear Range	Line Pressure Range
Drive, park, or neutral	35-171 PSI (241-1179 kPa)
Reverse	67-324 PSI (462-2334 kPa)

Before performing a line pressure check, verify that the pressure control solenoid is receiving the correct electrical signal from the vehicle computer:

1. Install a scan tool.
2. Start the engine and set parking brake.
3. Check for a stored pressure control solenoid malfunction code, and other malfunction codes.
4. Repair vehicle if necessary.

Inspect

- Fluid level
- Manual linkage

Install or connect

- Tech-1A scan tool
- Oil pressure gauge at line pressure tap (Figure 5-15)

5. Put gear selector in PARK and set the parking brake.
6. Start the engine and allow it to warm up at idle.
7. Access the override pressure control solenoid test on the Tech-1A scan tool.
8. Increase pressure control solenoid current in 0.1 amp increments and read the corresponding line pressure on the pressure gauge.

NOTE: Allow pressure to stabilize for 5 seconds after each current change.

9. Compare data to the drive-park-neutral line pressure, Table 5-12.

Line pressure will pulse either high or low every ten seconds to keep the pressure control solenoid plunger free. This is normal and will not harm the transmission.

***CAUTION**: Total test running time should not exceed 2 minutes, or transmission damage may occur. Increasing the engine speed above idle without vehicle movement (such as holding the brake) in a forward or reverse gear causes transmission stall. Continued operation in the stall condition can result in transmission overheat, malfunction, or fluid expulsion.*

If pressure readings differ greatly from the line pressure chart, refer to the diagnosis charts.

The Tech-1A scan tool is only able to control the pressure control solenoid in PARK and NEUTRAL with the vehicle stopped at idle. This protects the clutches from extremely high or low pressures in drive or reverse ranges

Table 5-12: Line Pressures

Pressure Control Solenoid (Amp)	PSI Line Pressure	kPa
0.02	157-177	1083-1220
0.10	151-176	1041-1214
0.20	140-172	965-1186
0.30	137-162	945-1117
0.40	121-147	834-1014
0.50	102-131	703-903
0.60	88-113	607-779
0.70	63-93	434-641
0.80	43-73	296-503
(Park, neutral) 0.90	37-61	255-421
0.98	35-55	241-379

DIAGNOSIS INFORMATION

Additional information useful for diagnosing trouble with the 4L80-E transmission.

Table 5-13 - Malfunction Code (DTC) and Defaults. This table, arranged in DTC numerical order, provides information relative to causes of a component failure and the resulting default action by TCM. This would be useful in may cases for running down an intermittent fault.

Transmission to TCM Connection Diagram. This diagram lays out the end connectors of the engine wiring harness to transmission harness connector.

TCM and Associated Wiring - External Components Diagrams. These two diagrams layout external input/output devices associated with TCM control.

Table 5-14 and Table 5-15 with Figure 5-15 and Figure 5-16 shows the end view of the connector and calls out the active circuit names.

Transmission range (TR) Pressure Switch Assembly Circuit Check (Figure 5-17). This procedure provides a systematic check of the TR pressure switch operation. In conjunction with the Pressure Switch Assembly Resistance Check in Figure 5-18 can diagnosis of TR PSA problems be found before disassembly.

Pressure Switch Assembly Resistance Check page 5-31. This check procedure can be used separately or with the previous two page module to diagnose suspected intermittent shift problems.

Internal Wiring Harness Check pages 5-32 and 5-33. This check describes the internal wiring harness and the continuity checks available to search for intermittent problems or component failure.

Clutch Application Chart page 5-34. This chart lists active mechanical parts in the transmission for each gear ratio condition. It is provided to indicate the relationship with the two shift solenoids.

Various testing maybe performed using the 05743196 DVM, or equivalent, high impedance volt-ohm meter.

Table 5-13: Malfunction Code and Defaults

DTC	SETTING PARAMETER(S)	DEFAULT
21 TP HIGH	• Engine operations • TP Signal > 4.9 V for one second	Maximum line pressure Use 35% TP as default Inhibit 4th gear in HOT Mode
22 TP LOW	• Engine operating • TP signal < 0.2 volt	Same as DTC 21
24 VSS/TOSS LOW	• Input speed at least 3,000 rpm • Output < 200 rpm for 1.5 seconds	Maximum line pressure 2nd gear Calculate output speed
28 TR FAULT	• Range signal on A + C at 0 (OFF) volt for 2 seconds	D4 shift pattern continued, No TCC No 4th gear in HOT mode
37 Brake Switch ON	Circuit 810 (TCM PIN B4) open VSS <5 mph (8 km/h)> 6 seconds Then VSS/TOSS between 5 & 20 mph (8 & 32 km/h) > 6 seconds Then VSS/TOSS > 20 mph (32 km/h)> 6 seconds Total of seven times	No 4th gear in HOT mode
38 Brake Switch OFF	Circuit 810 (TCM PIN B4) constant voltage (B+) VSS > 20 mph (32 km/h)> 6 seconds Then VSS between 5 & 20 mph (8 & 32 km/h)> 6 seconds Total of seven seconds	No 4th gear in HOT mode No TCC
39 TCC Stuck OFF	No DTC(s) 28, 71, 74 • TCC commanded on position • TCC slip speed > 65 rpm • TR in D3 or D4 position • 2nd or 3rd gear, all conditions for 2 seconds	No 4th gear in HOT mode
51 PROM ERROR	PROM internal fault	None System inoperative
52 System Voltage HIGH LONG	Ignition on, voltage > 16V for 109 minutes	Maximum line pressure 2nd gear No TCC
53 System Voltage HIGH	Ignition on, Voltage > 16V for 2 minutes	Same as DTC 52
58 TFT Circuit LOW	Signal voltage indicates trans fluid temp > 304°F (151°C) for 1 second	Use warm fluid values
59 TFT Circuit HIGH	Signal voltage indicates trans fluid temp < -40°F (-40°C) for 1 second	Same as DTC 58
63 BARO HIGH	BARO signal voltage > 4.9 V for more than 2 seconds	No altitude compensation

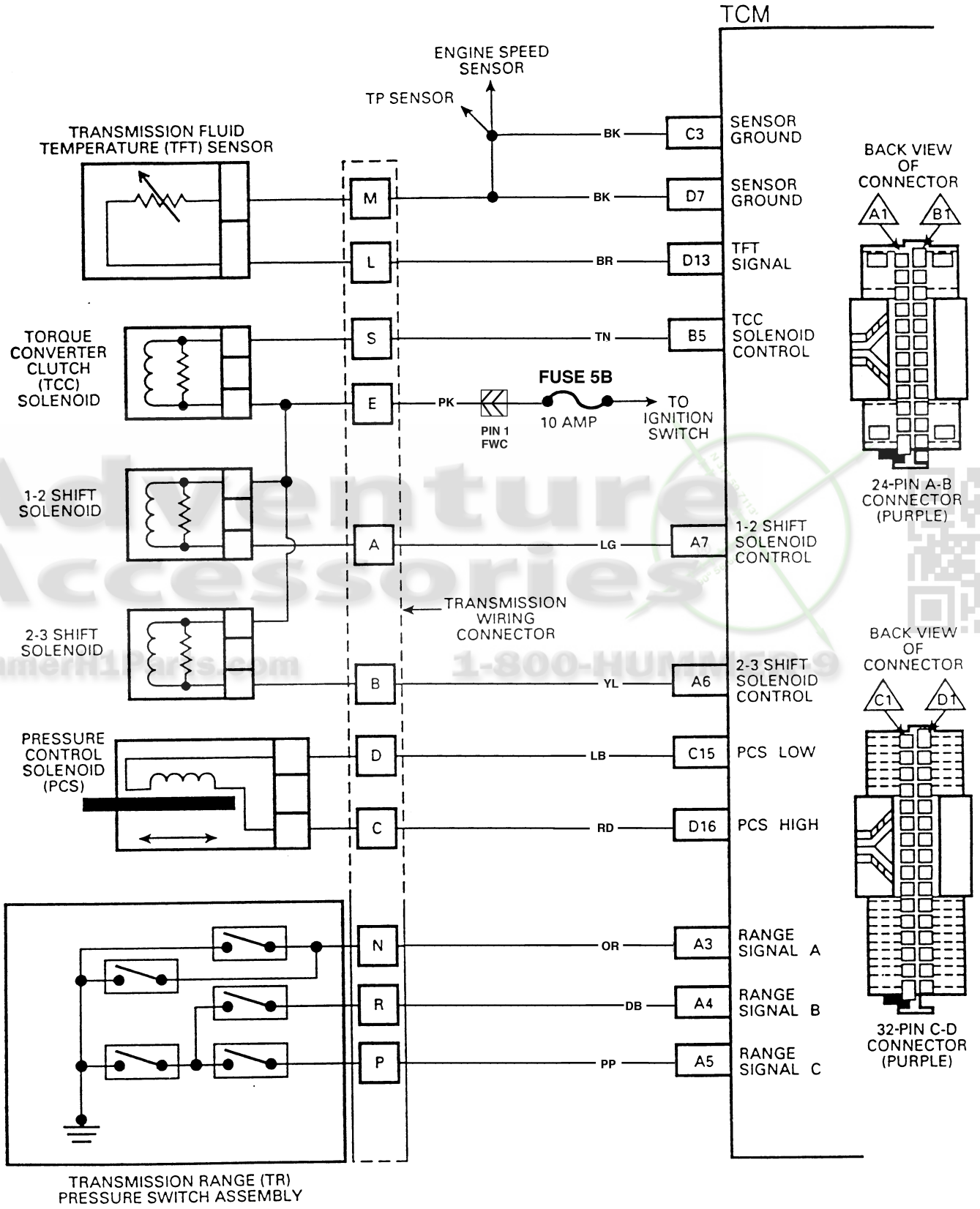
Table 5-13: Malfunction Code and Defaults

DTC	SETTING PARAMETER(S)	DEFAULT
64 BARO LOW	BARO signal voltage < 1.9 V for more than 2 seconds	Same As DTC 63
68 TRANS COMP SLIPPING	• No DTC(s) 28, 71, 74 present • TCC slip speed > 200 rpm FOURTH GEAR INDICATED • TCC locked • Not in PARK or NEUTRAL • Lasts longer than 2 seconds	No TCC No manual mode operation
69 TCC Stuck ON	No DTC(s) 21, 22, 71, or 74 present TCC slip rpm between -5 and +10 rpm TCC off TP Signal > 25% D3 or D4 on range SW Commanded gear indicated 2nd or 3rd gear • Lasts longer than 2 seconds	None
71 Cam Position Engine Speed Sensor	No DTC 28 • Trans in R, D, 1, 2, or O/D • Engine Speed < 50 rpm • Lasts longer than 2 minutes	No TCC
72 VSS/TOSS Circuit Loss	Not in PARK or NEUTRAL Transmission output speed change > 1000 rpm Engine speed > 300 rpm • Lasts longer than 2 seconds No DTC 28 in P/N Output speed change > 2050 rpm No DTC 28 Engine speed > 300 rpm	Soft shift to 2nd Maximum line pressure
73 PCS Circuit	No DTC 75 • Return current > 0.16A from commanded amp • Lasts longer than 1 second	Maximum line pressure
74 TISS Circuit	• No DTC(s) 24, 28, or 71 • TR not in PARK or NEUTRAL • Engine Speed > 300 rpm • TISS < 50 rpm • TOSS > 200 rpm • Lasts longer than 2 seconds	No TCC
75 System Voltage LOW	Ignition ON Ign feed is less than at 40°C = 7.3V at 90°C = 10.3V at 150°C = 11.7V Engine speed > 1000 All conditions for 4 seconds	Maximum line pressure 2nd gear No TCC Inhibit 4th gear

Table 5-13: Malfunction Code and Defaults

DTC	SETTING PARAMETER(S)	DEFAULT
79 TRANS FLUID OVERTEMP	No DTC 58 Trans fluid temp > 295°F (146°C) Met for 30 minutes	HOT MODE TCC in 2nd, 3rd, 4th
81 2-3 SHIFT SOL. CIRCUIT	TCM command: SOL. ON and voltage stays high TCM command: SOL. OFF and voltage stays low Lasts longer than 2 seconds	Maximum line pressure No TCC Second or 3rd gear only
82 1-2 SHIFT SOL. CIRCUIT	TCM command: SOL. ON and voltage stays high TCM command: SOL. OFF and voltage stays low Lasts longer than 2 seconds	Maximum line pressure Second or 3rd gear only or First or 2nd gear only
83 TCC PWM Circuit	TCM command: SOL. ON and voltage stays high TCM command: SOL. OFF and voltage stays low Lasts at least 2 seconds	NO TCC Inhibit 4th gear in HOT MODE
85 Undefined Ratio ERROR	No DTC(s) 11, 22, 24, 28, 71, 72, 87 TP > 25% Not in PARK, NEUTRAL, or 4th gear Engine speed > 300 rpm Vehicle speed > 7 mph	Line pressure to maximum No TCC
86 Low Ratio ERROR	No DTC(s) 21, 22, 24, 28, 72 and 74 Not in PARK, REVERSE, NEUTRAL Engine > 300 rpm TP > 25% Vehicle speed > 7 mph (11 km/h) Trans ratio < 1.06 in. (2.7 cm)1st or 2nd Lasts longer than 2 seconds	2nd gear Maximum line pressure No TCC
87 High Ratio ERROR	No DTC 21, 22, 24, 28, 71, 72 and 74 TP > 25% Not in P/R/N Engine speed > 300 rpm Vehicle speed > 7 mph (11 km/h) Transmission Temp > 68°F (20°C) Trans gear ratio > 1.42 in 3rd or 4th Lasts longer than 2 seconds	2nd gear Maximum line pressure No TCC

Transmission to TCM Connection Diagram



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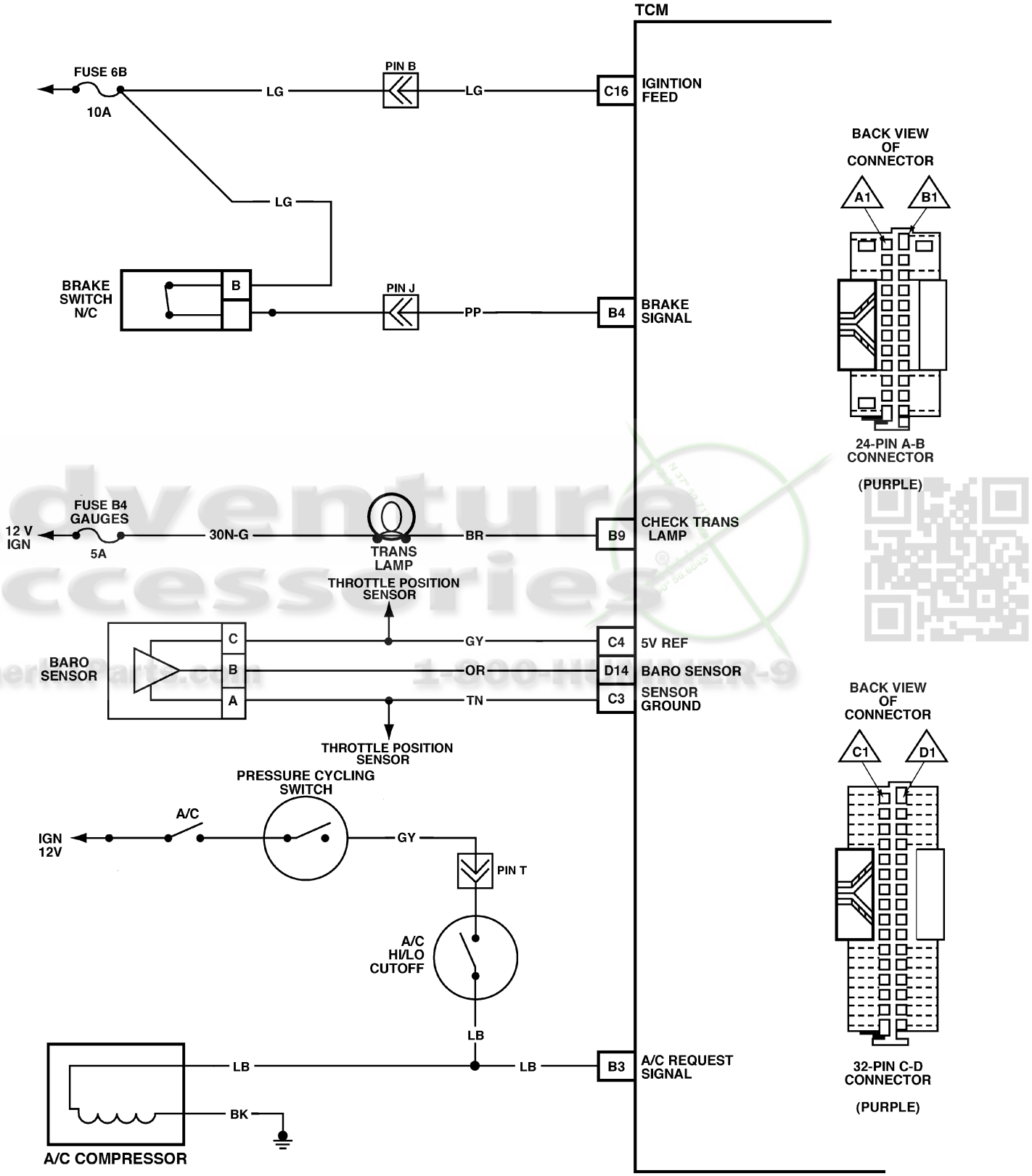
TCM and Associated Wiring - External Components Diagram



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TCM and Associated Wiring - External Components Diagram - Continued

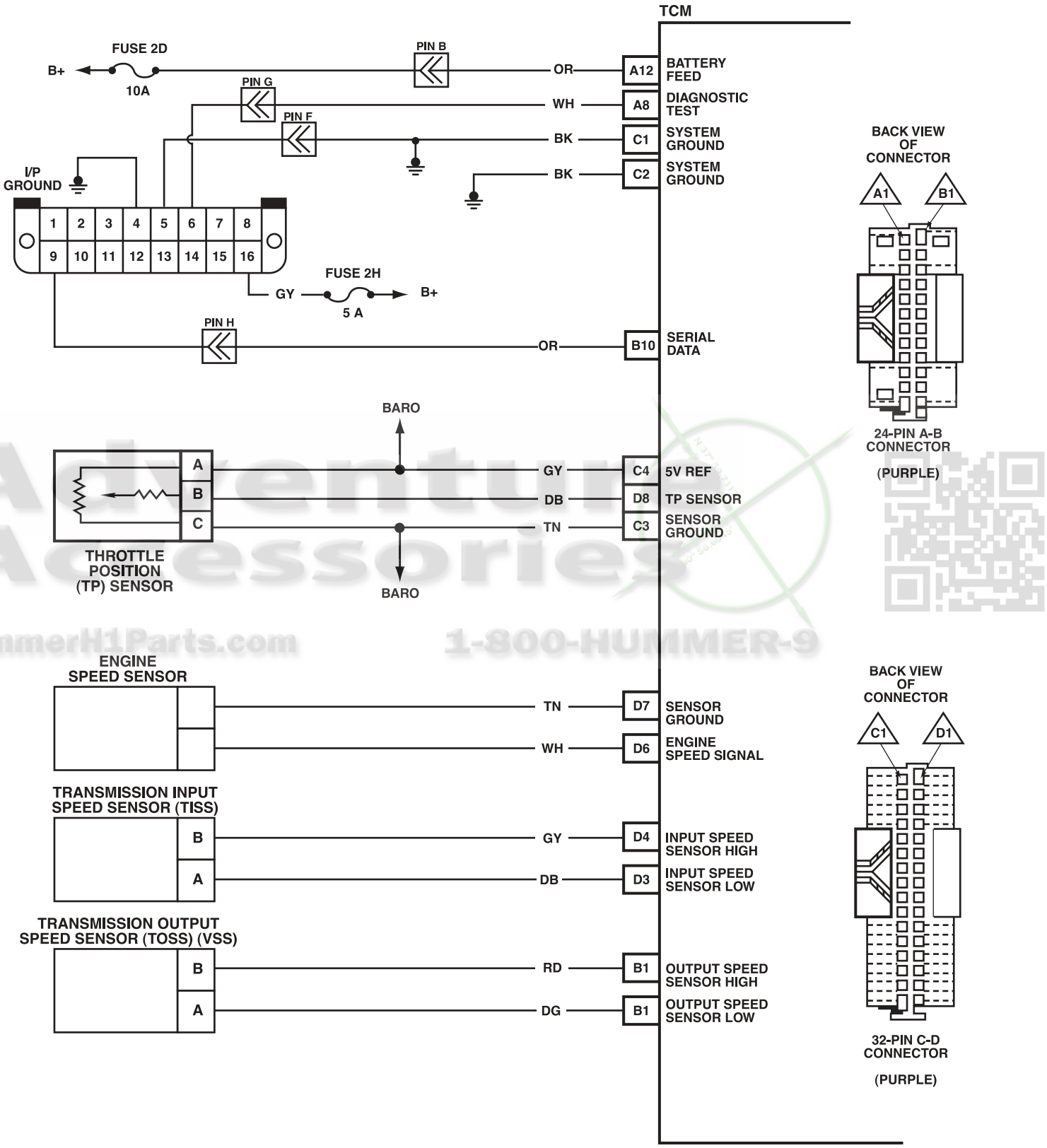


Table 5-14: Control Module - 24 Pin Chart

PIN	DESCRIPTION	WIRE	PIN	DESCRIPTION	WIRE
A1	—	—	B1	—	—
A2	—	—	B2	—	—
A3	Range sig A	18 OR	B3	A/C clutch	18 LB
A4	Range sig B	18 DB	B4	Brake SW	18 PP
A5	Range sig C	18PP	B5	TCC/PWM	18 TN
A6	2-3 solenoid	18YL	B6		—
A7	1-2 solenoid	18 LG	B7		—
A8	DLC* Pin 6	18 WH	B8		—
A9	—	—	B9	Check Trans Lamp	18 BR
A10	—	—	B10	DLC serial data	18 OR
A11	—	—	B11	VSS (TOSS) HI	18 RD
A12	BATT Feed	18 OR	B12	VSS (TOSS) LOW	18 DG

* DLC – Data Link Connector. This is the term used in the field and is replacing ALDS (Assembly Line Data Link).

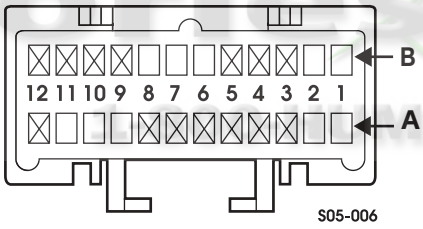


Figure 5-15: 24-Pin Connector

Table 5-15: Control Module – 32 Pin Chart

PIN	DESCRIPTION	WIRE	PIN	DESCRIPTION	WIRE
C1	DTC/SYS ground	18 BG	D1	—	—
C2	System ground	18 BG	D2	—	—
C3	Sensor ground	18 TN	D3	TISS LOW	18 DB
C4	TP + Baro +5V ref	18 GY	D4	TISS HIGH	18 GY
C5	—	—	D5	—	—
C6	—	—	D6	ENG SPEED	18 WH
C7	—	—	D7	Sensor ground	18 TN
C8	—	—	D8	TP signal	18 DB
C9	—	—	D9	—	—
C10	—	—	D10	—	—
C11	—	—	D11	—	—
C12	—	—	D12	—	—
C13	—	—	D13	TFT signal	18 BR
C14	—	—	D14	BARO signal	18 OR
C15	PCS LOW	18 LB	D15	—	—
C16	IGN FEED	18 LG	D16	PCS HIGH	18 RD

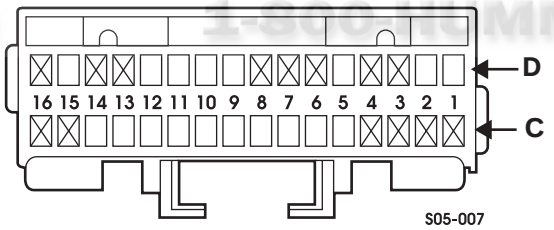


Figure 5-16: 32-Pin Connector

TTRANSMISSION RANGE (TR) PRESSURE SWITCH ASSEMBLY CIRCUIT CHECK (FIGURE 5-17)

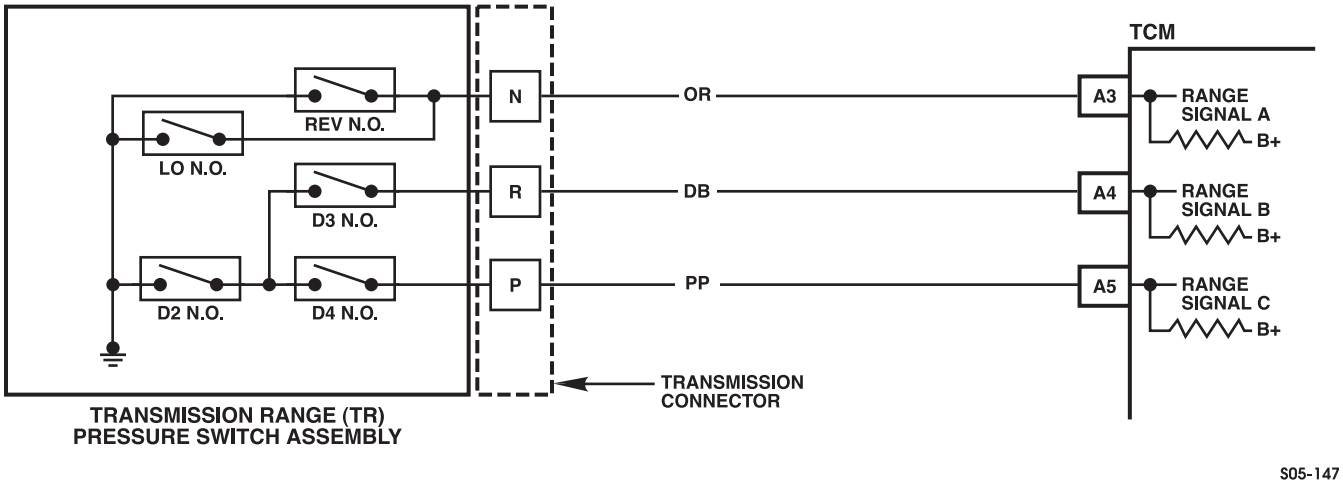


Figure 5-17: TTransmission Range (Tr) Pressure Switch Assembly Circuit Check

Circuit Description

The Transmission Range (TR) switch assembly consists of five normally open pressure switches and is attached to the valve body. The control module supplies battery voltage to each range signal. By grounding one or more of these circuits through various combinations of the pressure switches, the control module detects what manual valve position has been selected by the vehicle operator. With ignition ON and engine OFF, P/N will be indicated. When transmission electrical connector is disconnected, the ground potential for the three range signals to the control module will be removed, and with ignition ON, D2 will be indicated.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks the indicated range signal to the manual valve position actually selected.
2. This test checks for correct voltage from the control module to the transmission external connector.
3. This test checks for a short to ground from the control module to the transmission external connector in any one of the three circuits.

Diagnostic Aids

- Refer to accompanying chart for various A/B/C range combinations. Check all wiring connectors for proper terminal tension.
- Refer to Pressure Switch Assembly Resistance Check.

Table 5-16: Expected Readings

Range Signal	A	B	C
Park	ON	OFF	ON
Rev	OFF	OFF	ON
Neutral	ON	OFF	ON
D4	ON	OFF	OFF
D3	ON	ON	OFF
D2	ON	ON	ON
D1	OFF	ON	ON
Illegal	OFF	ON	OFF
Illegal	OFF	OFF	OFF

ON = B+/ OFF = 0 VOLTS
(Scan tool readings)

TRANSMISSION RANGE (TR) PRESSURE SWITCH ASSEMBLY CIRCUIT CHECK

This chart assumes that:
- The transmission linkage from the selector lever to the manual valve is adjusted properly.
- On-Board Diagnostic (OBD) system check has been performed.
- Fluid checking procedure has been performed.
- All DTC(s) have been recorded and then cleared.
- Scan tool still installed.

(1)
- Engine idling at normal operating temperature.
- Parking brake applied and wheels blocked.
- Apply brake pedal and select each transmission range D1, D2, D3, D4, N, R, P.
- Does each selected transmission range match the TECH-1A scan tool TRANS RANGE SW display?

NO

- Ignition OFF.
- Disconnect transmission wiring connector ASM.
- Install 05743732 Jumper Harness/Probe Kit on the external wiring connector.
- Ignition ON, engine OFF.
- With 05743196 DVM to ground, check voltage at vehicle harness connector terminals N, R, and P.
- Does 05743196 DVM display B+ at all three circuits?

NO

(3)
- Ignition OFF.
- Disconnect control module connector.
- With 05743196 DVM to ground, check resistance at vehicle harness connector terminals N, R, and P.
- Does 05743196 DVM display high resistance (greater than 50k Ohms) on all three circuits?

NO

- Check low resistance circuit A3, A4, or A5 for short to ground. Repair pinched or chaffed wires per wiring harness repair procedures (Section 12).

YES

- Ignition ON, Engine OFF.
- With 05743196 DVM to ground, check voltage at control module terminals A3, A4, and A5 (TCM). If 05743196 DVM does not display B+ at all three circuits, replace control module

YES

(2)
- Verify that CKT(s) A3, A4, or A5 are not shorted together. If OK, refer to Pressure Switch Assembly Resistance Check (Figure 5-18).

YES

- No trouble found.
- Refer to diagnostic aids.

PRESSURE SWITCH ASSEMBLY RESISTANCE CHECK (FIGURE 5-18)

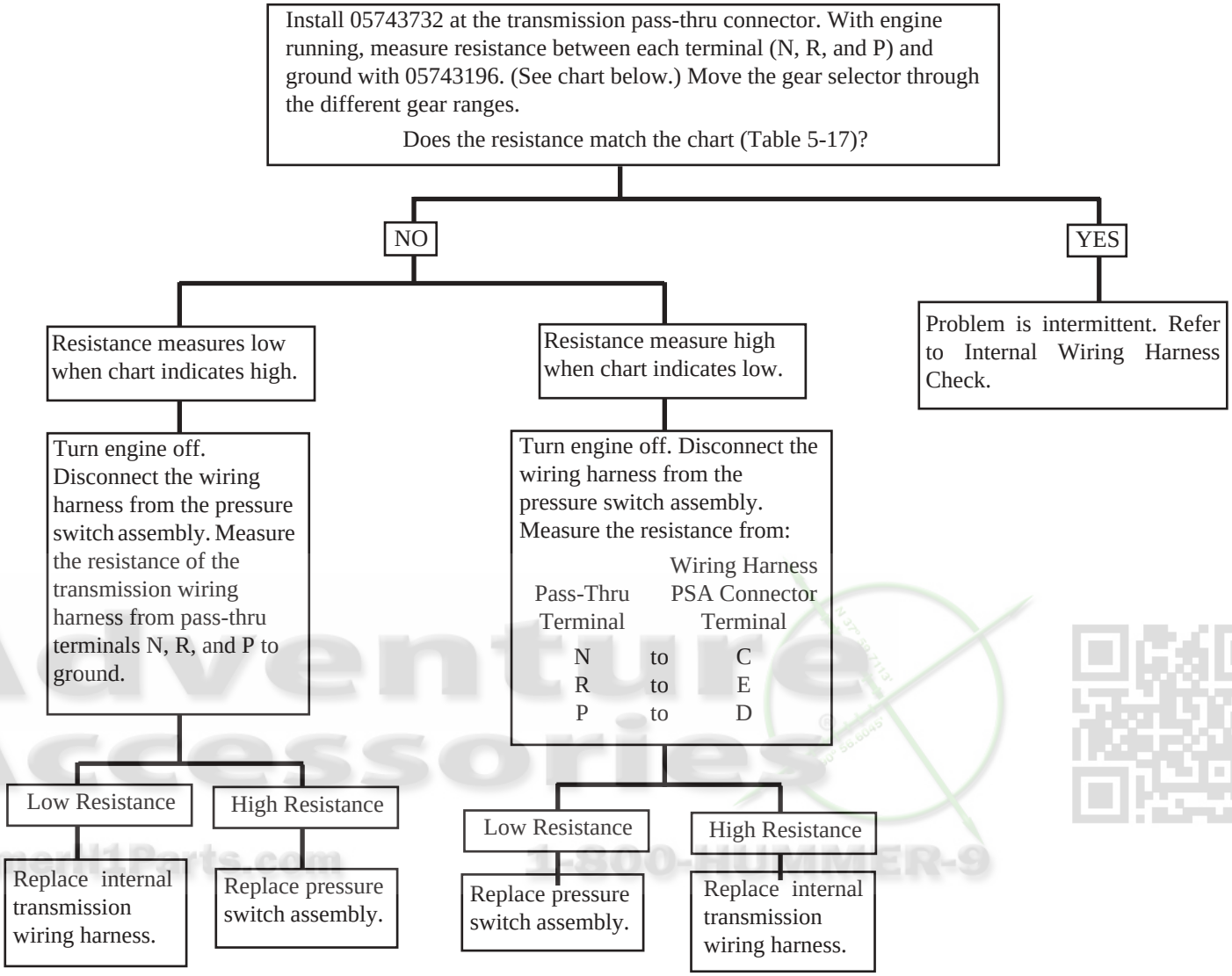


Table 5-17: Pressure Switch Assembly (PSA) Resistance Chart

Gear Selector Position	Range		
	A	B	C
Park	H	L	H
Reverse	L	L	H
Neutral	H	L	H
D4	H	L	L
D3	H	H	L
D2	L	H	H
D1	L	H	H

t

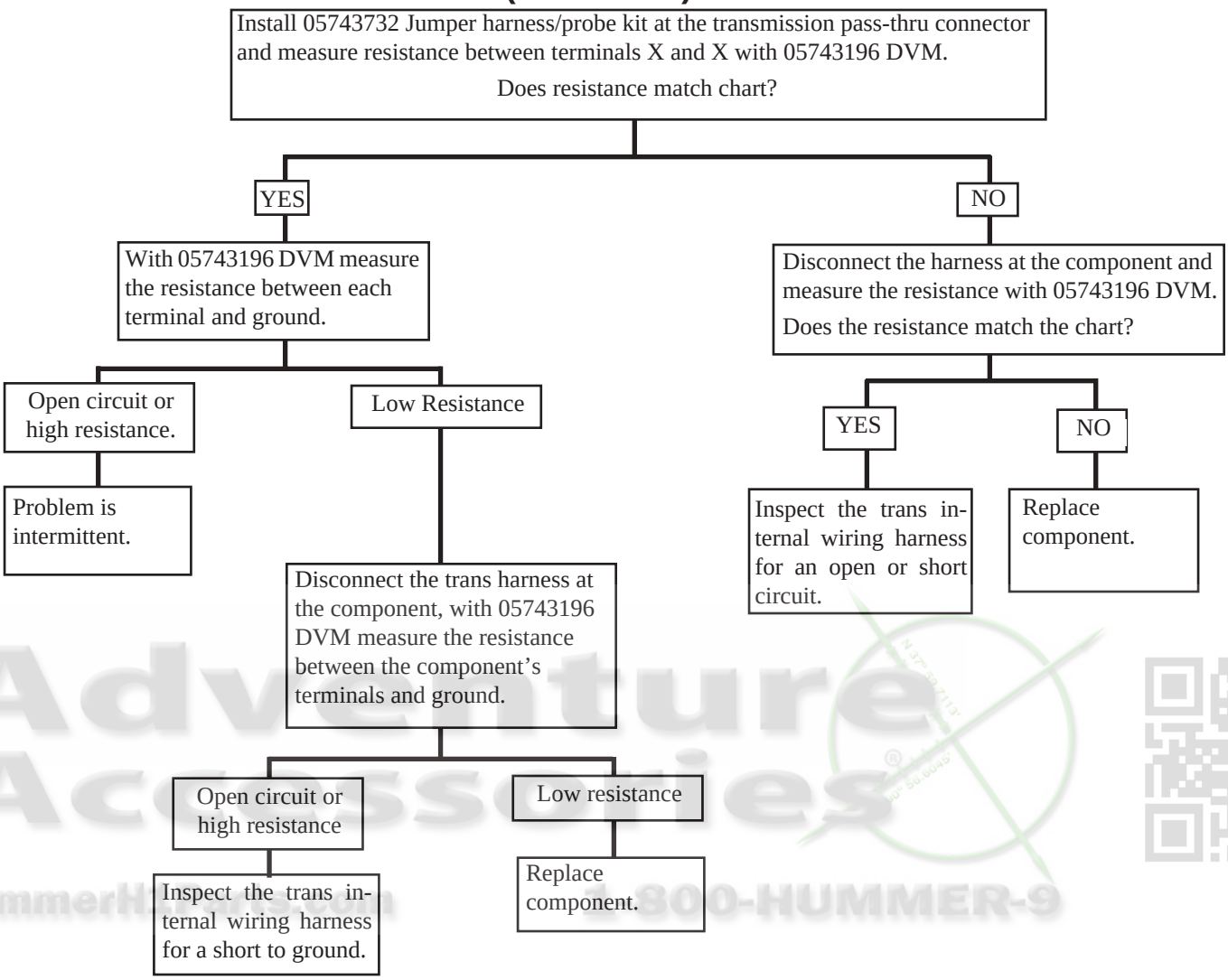
When range “X” is measured for resistance to ground,
H = High resistance (over 2000 Ohms) - open circuit
L = Low resistance (under 100 Ohms) - grounded circui

IMPORTANT:

Whenever the transmission pass-thru connector is disconnected from the vehicle harness and the engine is running, multiple transmission Diagnostic Trouble Codes will set. Be sure to clear these codes when finished with this procedure.

Figure 5-18: Pressure Switch Assembly Resistance Check

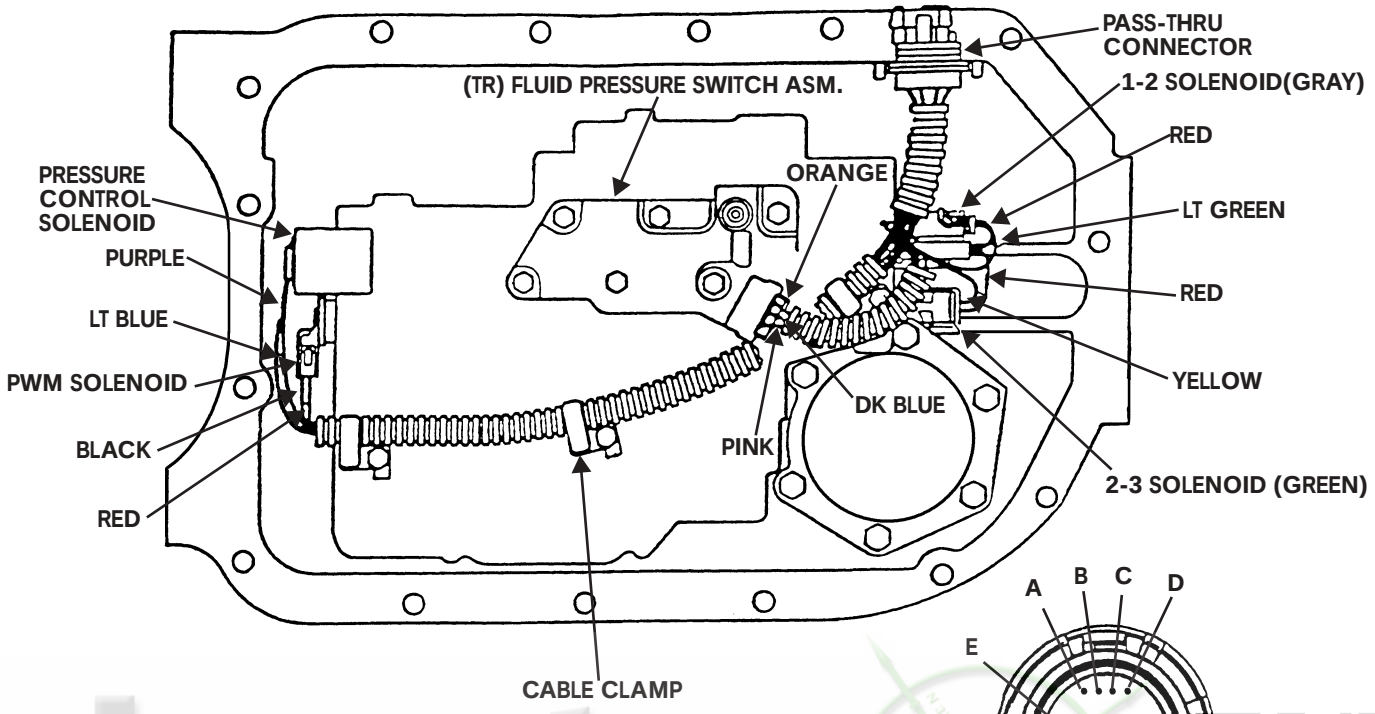
INTERNAL WIRING HARNESS CHECK. (FIGURE 5-19)

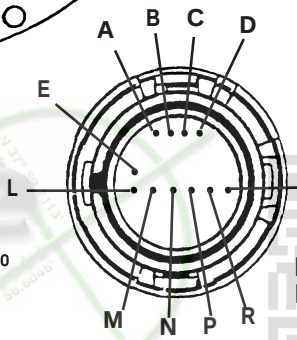


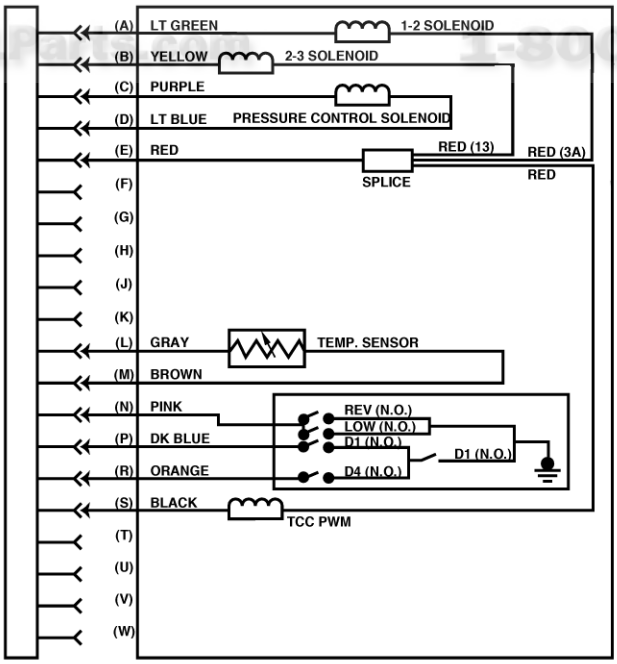
4L80-E COMPONENT RESISTANCE CHART			
Component	Wire Color	Pass-Thru Pin	Resistance @ 68°F (20°C)
1-2 Shift Solenoid	Red	E (1)	20-40 Ohms
	Lt. Green	A	
2-3 Shift Solenoid	Red	E(1)	20-40 Ohms
	Yellow	B	
Pressure Control Solenoid	Purple	C	3.5-8 Ohms
	Lt. Blue	D	
TCC Solenoid	Red	E (1)	20-40 Ohms
	Black	S	
(1) Spliced internally to Pin E. (2) Internal harness number.			

Figure 5-19: Internal Wiring Harness Testing

TRANSMISSION INTERNAL WIRING HARNESS ASSEMBLY (FIGURE 5-20)







CAVITY	FUNCTION
A	PCM TO TRANS 1-2 SHIFT SOL, A
B	PCM TO TRANS 2-3 SHIFT SOL, B
C	PCM TO PRESSURE CONTROL SOL (HIGH)
D	PCM TO PRESSURE CONTROL SOL (LOW)
E	+12 V, IGN, CRANK ON
L	PCM TO TRANS TEMP SENSOR
M	GROUND LEVEL LOW
N	PCM TO TRANS RANGE MODE A
P	PCM TO TRANS RANGE MODE C
R	PCM TO TRANS RANGE MODE B
S	PCC PWM TO TCM

S05A-040/B

Figure 5-20: Transmission Internal Wiring Harness Assembly

CLUTCH APPLICATION

The transmission clutch application chart provides valuable source information for explaining the overall function of the 4L80-E transmission.

This chart highlights the major components that function in a selected gear range, and the specific gear operation within that gear range.

If a component is active in a specific gear range, a word describing its action will be listed.

Table 5-18: Clutch Application Chart

	GEAR	1-2 SHIFT SOLE-NOID	2-3 SHIFT SOLE-NOID	FOURTH CLUTCH	OVER-RUN CLUTCH	OVER-DRIVE ROLLER CLUTCH	FOR-WARD CLUTCH	DIRECT CLUTCH	FRONT BAND	INTER-MEDIATE SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LO ROLLER CLUTCH	REAR BAND
P-N		ON	OFF			Holding							
R	Rev.	ON	OFF			Holding		Applied					Applied
D	1st	ON	OFF			Holding	Applied			*		Holding	
	2nd	OFF	OFF			Holding	Applied			Holding	Applied	Over-running	
	3rd	OFF	ON			Holding	Applied	Applied		Over-running	Applied	Over-running	
	4th	ON	ON	Applied		Over-running	Applied	Applied		Over-running	Applied	Over-running	
D	1st	ON	OFF		Applied	Holding	Applied			*		Holding	
	2nd	OFF	OFF		Applied	Holding	Applied			Holding	Applied	Over-running	
	3rd	OFF	ON		Applied	Holding	Applied	Applied		Over-running	Applied	Over-running	
2	1st	ON	OFF		Applied	Holding	Applied			*		Holding	
	2nd	OFF	OFF		Applied	Holding	Applied		Applied	Holding	Applied	Over-running	
1	1st	ON	OFF		Applied	Holding	Applied			*		Holding	Applied

* Holding, but not effective

The shift solenoid's state follows a shift pattern which depends upon vehicle speed and throttle position. It does not depend upon the selected gear.

ON = Solenoid energized

OFF = Solenoid de-energized

NOTE: Descriptions above apply to component function during acceleration.

DIAGNOSIS USING THE SCAN TOOL

The control module is equipped with a self diagnostic feature that detects system failures and aids the technician in locating a faulty circuit. The control module has memory for comparing the various input information to programmed information. These conditions are described on the facing page of each Diagnostic Trouble Code (DTC) chart. If a value is not within the control module parameters, a DTC will set and default values will be used.

The control module will continually perform a self diagnosis check. The control module can be requested to display any stored DTC by using a scan tool or manually grounding the diagnostic test terminal. When the diagnostic test terminal of the Data Link Connector (DLC) is grounded, the control module will check the engine speed circuit input, if the voltage is zero, the control module will flash DTC 12 and any other DTC(s) stored*. If DTC 12 will not flash, refer to CHART A-1 or CHART A-2 for further diagnostic information.

***CAUTION**: Always perform the On-Board Diagnosis (OBD) System Check before proceeding to diagnose the system.*

The scan tool will display all stored DTC(s) in current or history status. A DTC 12 is not a fault condition with the ignition ON, engine, OFF. When the manual grounding procedure is used, the MIL will flash all DTC(s) stored in the TCM memory (current and history). The DTC charts assume the DTC is in current status. If the DTC is in history status, the fault may be an intermittent. An intermittent DTC is one which will not reset during the current ignition cycle. The facing page of a DTC chart will contain DIAGNOSTIC AIDS to help locate intermittent conditions.

If a visual (physical) check does not locate the cause of the fault, 05743196 DVM can be used to test the suspected circuit. The 05743196 DVM can be used to check.

- SHORT TO VOLTAGE–Connect 05743196 to a known good ground on the DC voltage scale.
- SHORT TO GROUND–Connect 05743196 to a known GOOD B+ on the DC voltage scale.
- OPEN CIRCUIT–Connect 05743196 to each end of the circuit on the ohms scale with voltage removed from the circuit. A very large or infinite reading is indicative of an open circuit.

* This method uses the flashing or blinking of the Malfunction Indicator lamp (MIL). This lamp may have either symbols or lettering. It may be referred to as CHECK TRANS lamp. It flashes in number series following DTC 12 any DTC's in order from the lowest number to the highest number. Each DTC is given three times.

TCM Intermittent Diagnostic Trouble Codes or Performance

The DTC charts will help to determine if there is a fault within the circuit. The fault must be present to locate the problem. If an intermittent condition occurs, a DTC will be stored in history status, but the circuit check will indicate a normal condition. Most intermittent conditions are usually a faulty connection or component. When diagnosing intermittents, thoroughly check the suspected circuit for:

- Poor terminal tension.
- Poor seating of connector halves.
- Poor terminal to wire connection.
- Improperly formed or damaged terminals.
- Improperly installed electrical options.
- Faulty control module power or ground connection.
- Intermittent short or open circuit.
- Electrical system surges caused by a defective relay, solenoid, or switch. Normally these conditions will occur when the faulty component is operated.

Clearing History DTC(s)

All history DTC(s) can be cleared after all repairs have been completed in the following ways:

- With a scan tool.
- By removing voltage from the control module.
- Fifty ignition cycles with fault not occurring or removed.

NOTES

ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK/TCM (WITH TECH-1A SCAN TOOL) (FIGURE 5-21)

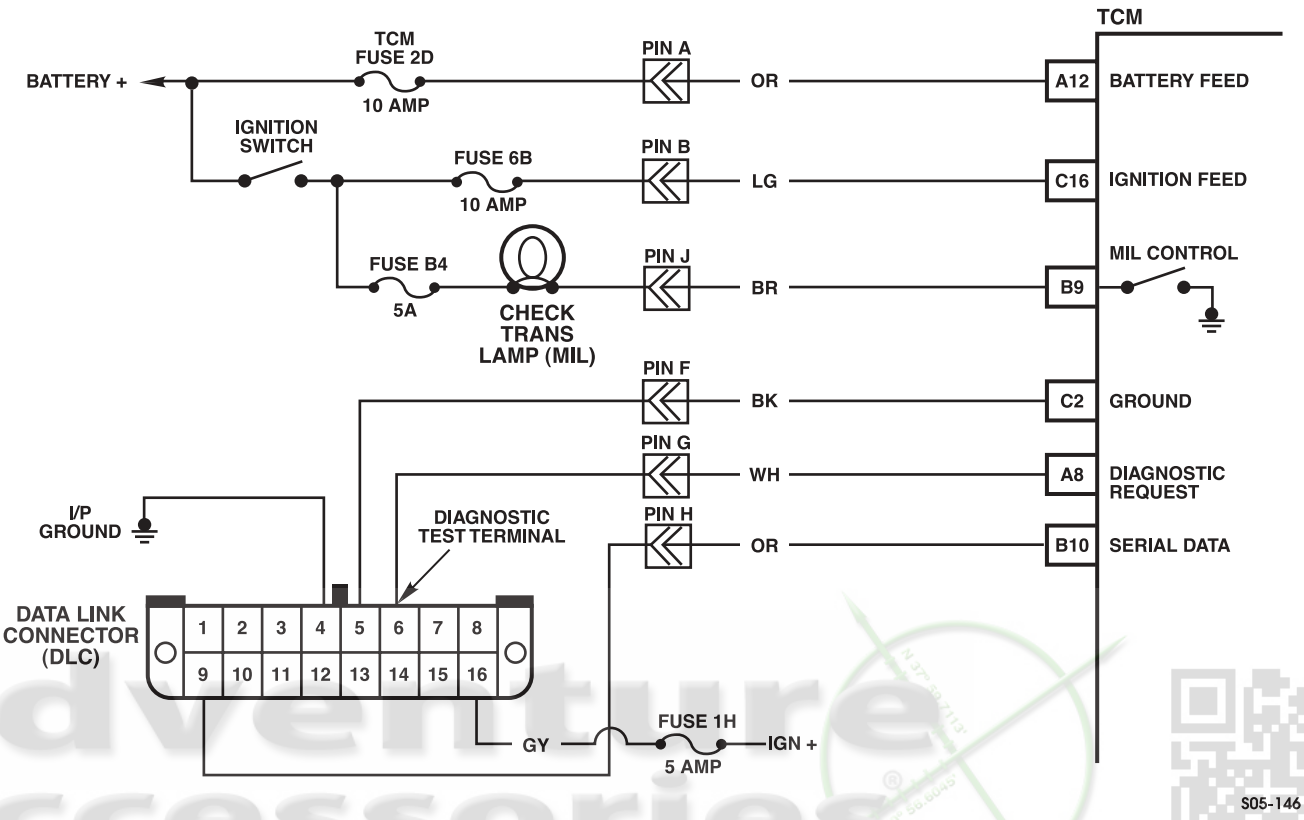


Figure 5-21: TCM OBD Check

Circuit Description

The On-Board Diagnostic (OBD) System Check is an organized approach to identifying a problem created by a control module system malfunction. It must be the starting point for any driveability complaint diagnosis, this will direct the service technician to the next logical step in diagnosing the complaint. Understanding the chart and using it properly will reduce diagnostic time and prevent the unnecessary replacement of good parts.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. When the ignition switch is cycled to ON, the MIL should turn ON briefly, then OFF briefly, then remain ON steady. This sequence will determine that the vehicle diagnostics are operational.
2. This step will isolate if the customer complaint is a MIL or driveability problem.
3. Although the control module is powered up, a symptom could exist because of a system fault.
4. To use Tech-1A to aid diagnosis, serial data must be available. If a PROM (MEM-CAL) error is present, the TCM may have been able to flash DTC 12-51, but not enable serial data.
5. This step will isolate if the customer complaint is a MIL or driveability problem with no MIL. (Refer to Diagnostic Trouble Code Identification (Table 5-20) for a list of valid DTC(s).) An invalid DTC may be the result of a faulty scan tool, PROM or TCM.
6. Comparison of actual control system data with the typical Tech-1A Data Values (Table 5-19) is a quick check to determine if any parameter is not within limits. A base engine problem (i.e., advanced cam timing) may substantially alter sensor values.

ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK/TCM (WITH TECH 1A SCAN TOOL)

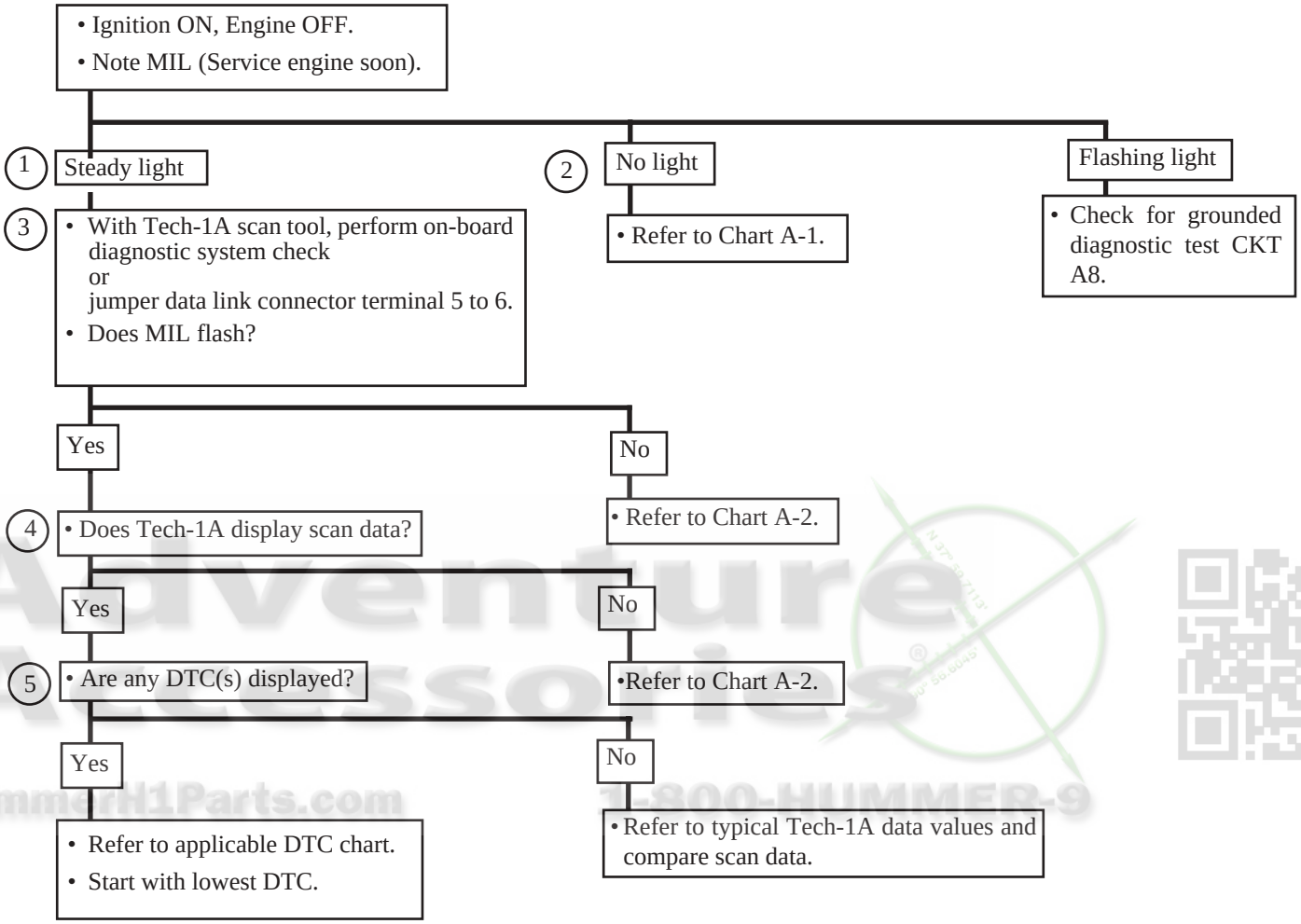


CHART A-1 /TCM

No Malfunction Indicator Lamp (MIL) (Check Trans Lamp) (Figure 5-22)

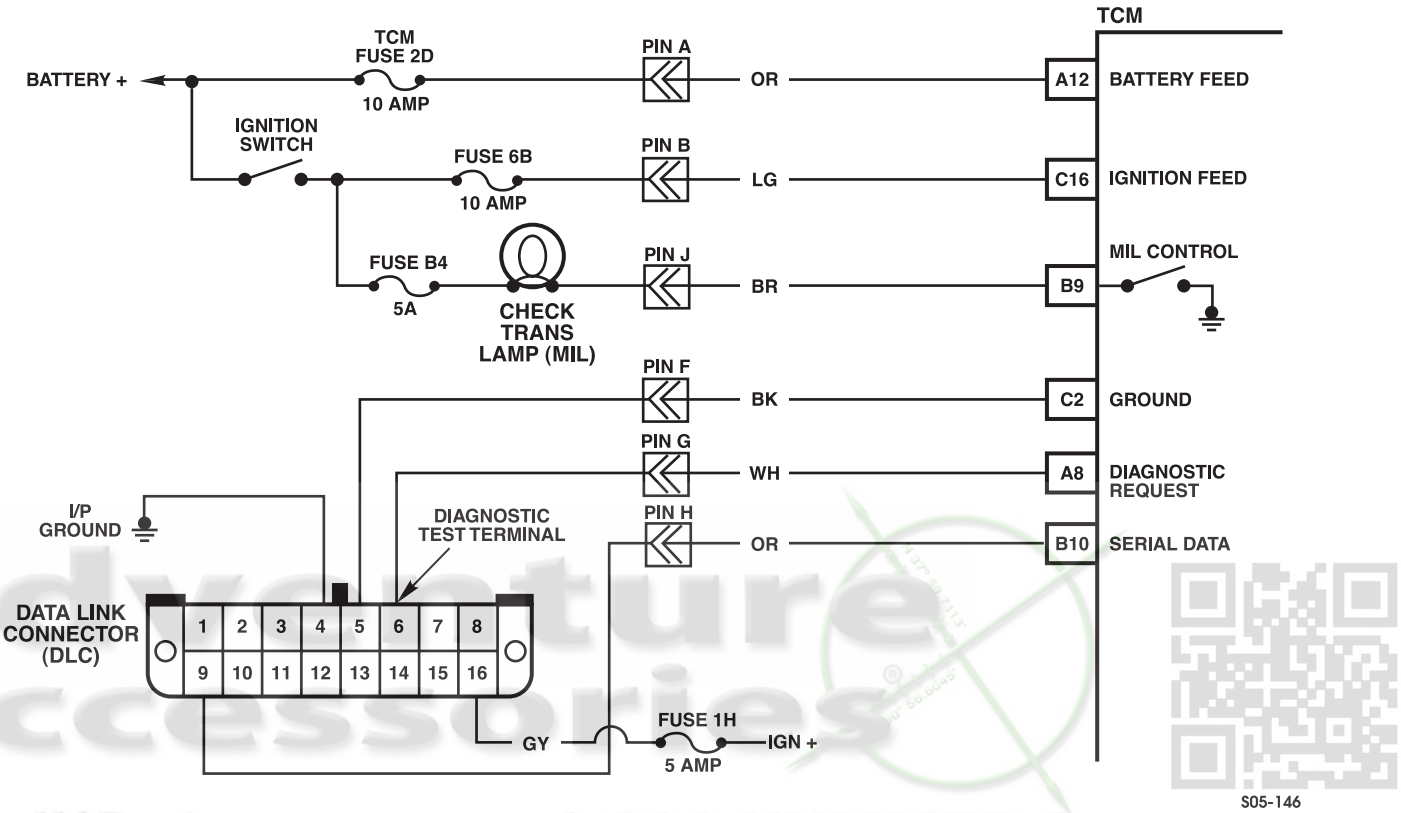


Figure 5-22: TCM Malifunction Indicator Lamp

Circuit Description

There should always be a steady Malfunction Indicator Lamp (MIL) with the ignition ON and engine OFF. Switched battery voltage is supplied to the lamp. The TCM will control the lamp and turn it ON by providing a ground path through CKT B9.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. If the TCM-B fuse 2D is open, refer to TCM Wiring Diagram for complete circuit.
2. Using a test light connected to 12 volts, probe each of the system ground circuits and check that a good ground is present. Refer to TCM Terminal End View (Table 5-14 and Table 5-15) (Figures 5-15 and 5-16) for TCM pin locations of ground circuits.

Diagnostic Aids

If the engine operates OK, check:

- Faulty light bulb.
- CKT B9 open.
- Gauges fuse open. This will result in no brake warning light, oil or generator lights, seatbelt reminder, etc.

If the engine cranks but will not operate, check:

- Continuous battery TCM fuse 2D open.
- TCM ignition In-Line fuse 6B open.
- Battery CKT A12 to TCM open.
- Ignition CKT C16 to TCM open.
- Poor connection to TCM.

CHART A-1/TCM

No Malfunction Indicator Lamp (MIL) (Check Trans Lamp)

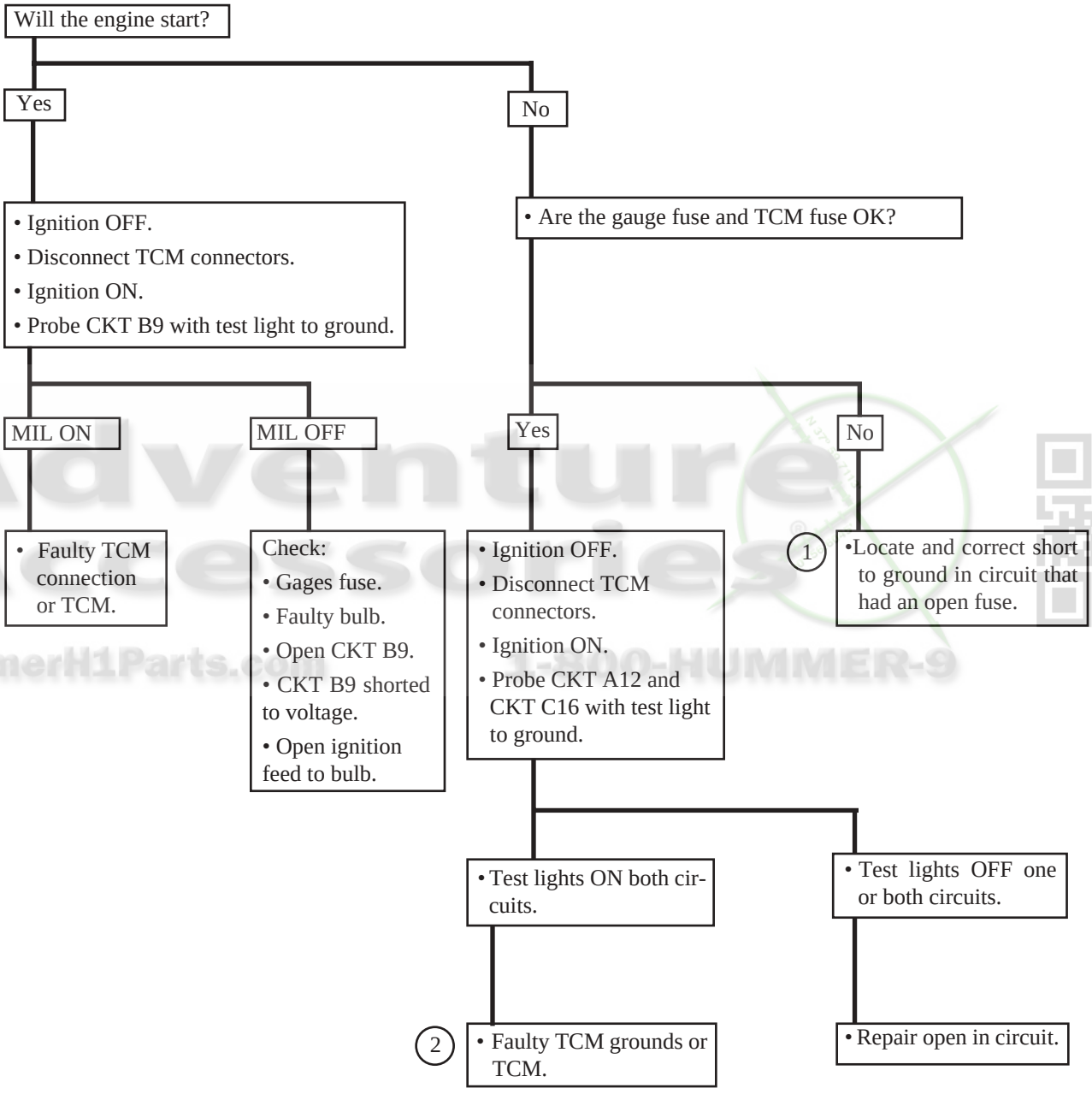


CHART A-2/TCM

No Data Link Connector (DLC) Data, Will Not Display Diagnostic Trouble Code (DTC) 12, or Malfunction Indicator Lamp (MIL) (Check Trans Lamp) On Steady (Figure 5-23)

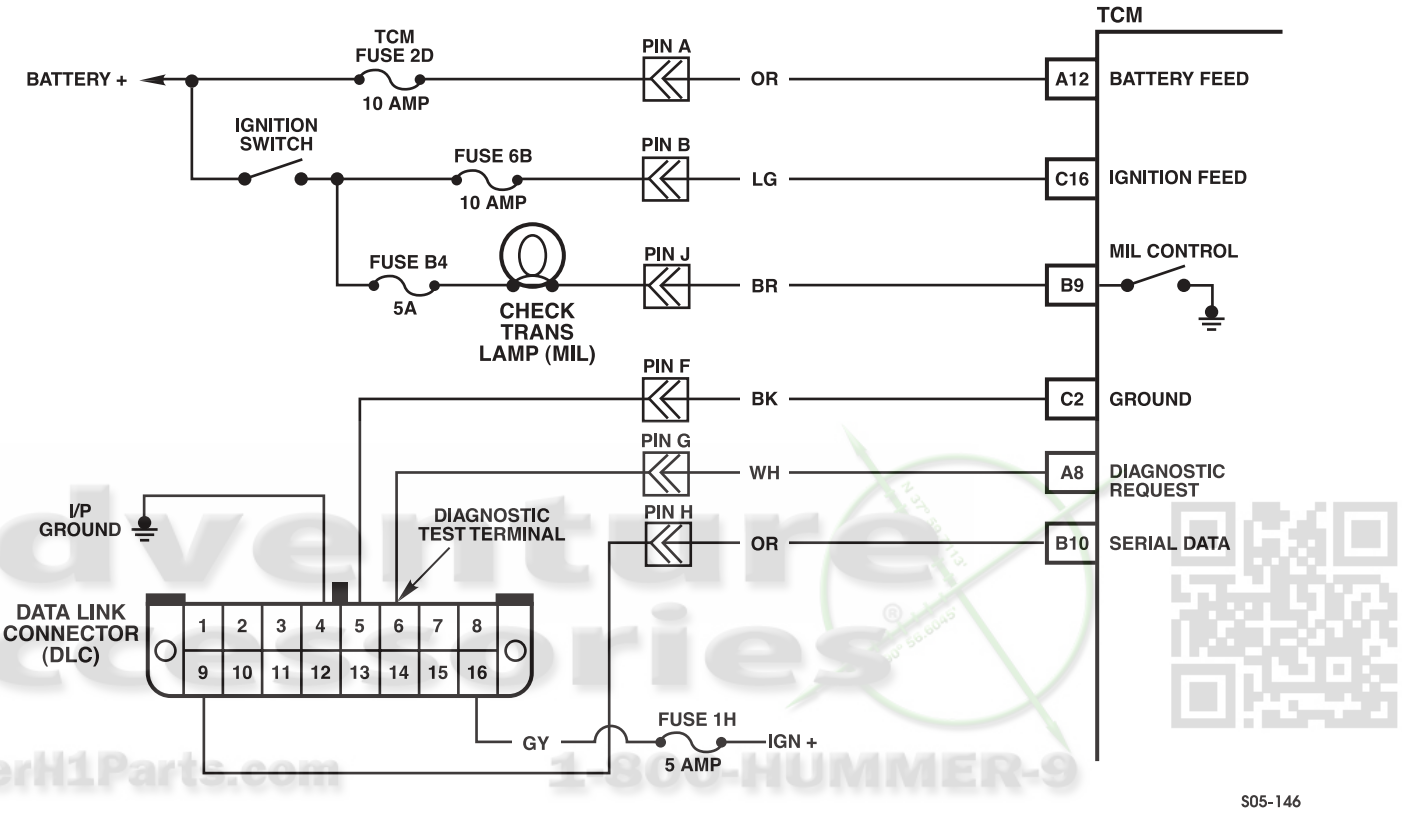


Figure 5-23: TCM OBD Check

Circuit Description

There should always be a steady Malfunction Indicator Lamp (MIL) when the ignition is ON and engine OFF. Switched battery voltage is supplied to the lamp. The TCM will control the lamp and turn it ON by grounding CKT B9.

With the diagnostic terminal grounded, the lamp should display a DTC 12, followed by any Diagnostic Trouble Code (DTC) stored in memory.

A steady lamp indicates a short to ground in the lamp control CKT B9, or an open in diagnostic CKT A8.

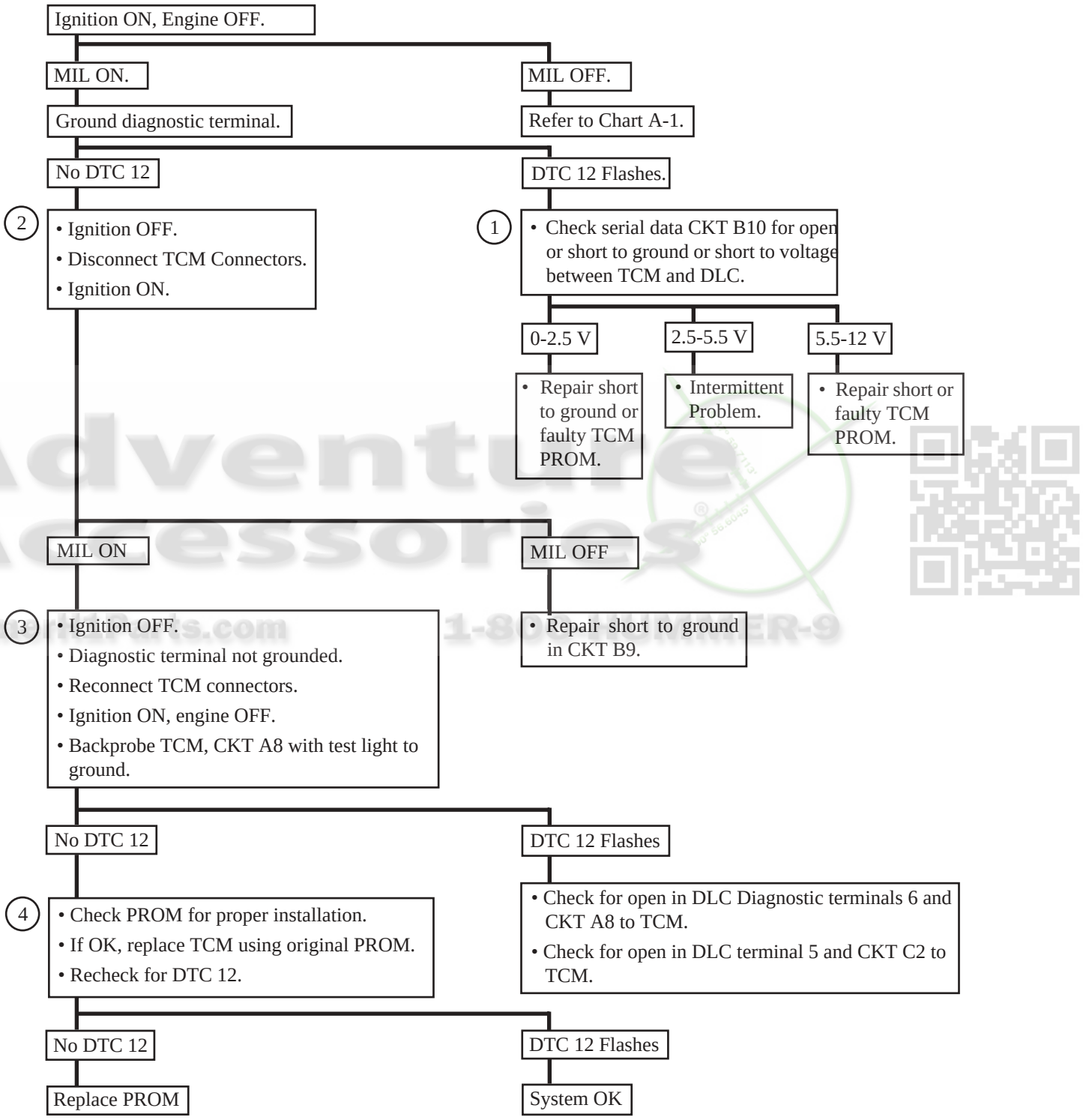
Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. If there is a problem with the TCM that causes a scan tool not to read serial data, then the TCM should not display a DTC 12. If DTC 12 does display, check that the scan tool is functioning properly on another vehicle. If the scan tool is functioning properly, and CKT B10 is OK, the PROM or TCM may be at fault for NO DLC symptom.
2. If the lamp turns OFF when the TCM connector is disconnected, then CKT B9 is not shorted to ground.
3. This step will check for an open diagnostic CKT A8.
4. At this point, the MIL wiring is OK. The problem is a faulty PROM. If DTC 12 does not display, the TCM should be replaced using the original PROM. Replace the PROM only after trying a TCM. A defective PROM usually is an unlikely cause of the fault.

CHART A-2/TCM

No Data Link Connector (DLC) Data, Will Not Display Diagnostic Trouble Code 12, or Malfunction Indicator Lamp (MIL) ON Steady



If after completing the On-Board Diagnostic (OBD) system check and finding the Tech-1A scan tool diagnostics functioning properly and no DTC(s) displayed, the Transmission Tech-1A scan tool Values may be used for comparison with values obtained on the vehicle being diagnosed. The Transmission Tech-1A Scan Tool Values are an average of display values recorded from normally operating vehicles and are intended to represent what a normally functioning system would display (Table 5-19) .

A SCAN TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED, AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY SCAN TOOL CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

Only the parameters listed below are used in this manual for diagnosing If a scan tool displays other parameters, the values are not recommended by AM General for use in diagnosing. For further description on the values and use of the Tech-1A scan tool to diagnose TCM inputs, refer to General Description. If all values are within the range illustrated, refer to Road Test.

Definitions of scan tool data on following page.

Table 5-19: TRANSMISSION TECH-1A SCAN TOOL DATA

Idle/Lower Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories Off			
SCAN Position	Units Displayed	Typical Data Value	Refer to Section
Engine Speed	RPM	±50 RPM from Desired	2
Trans Output Speed	RPM	0 RPM	5
Eng. Cool Tamp	F°/C°	185°F-221°F (85° - 105°C)	2
Trans Fluid Temp	F°/C°	180°F - 200°F (82°C - 93°C)	5
Throt Position	Volts	0.3 - 0.9V	2
Throttle Angle	Percentage	0%	2
A/B/C RNG	Off/On	On/Off/On	5
Trans Range Sw	Invalid, Rev, Drive 4, 3, 2, Low		
	Park/Neut	Park/Neut	5
Commanded Gear	1-4	1	5
Current Gear	1-4	1	5
1-2 Sol, 2-3 Sol	Off/On	On/On	5
CTR FDBK 1/2 2/3	Off/On	On/On	5
Trans Input Speed	RPM	±50 RPM of Engine Speed	5
Hot Mode	No, Yes	No	5
TCC PWM Solenoid	Percentage	0%	5
TCC Slip Speed	RPM	±50 RPM from Engine Speed	5
CTR FDBK TCC Sol	Off/On	Off	5
Desired PCS	Amps	0.1 - 1.1 Amps	5
Actual PCS	Amps	0.1 - 1.1 Amps	5
PSC Duty Cycle	Percentage	40% - 60%	5
MPH Km/h	0-255	0	5
4WD Low Switch	No, Yes	No	5
Cruise Engaged	No, Yes	No	12
TCC Brake Switch	Open/Closed	Closed	12
Kickdown Enabled	No, Yes	No	5
Trans Gear Ratio	Ratio	0.00	5
Turbine Speed	RPM	±50 RPM of Engine Speed	5
1-2Shift Time	Seconds	0	5
2-3 Shift Time	Seconds	0	5
Trans Calib ID	0-65535	Internal ID	5
System Voltage	Volts	12.0 - 14.5 V	12

TRANSMISSION TECH-1A SCAN TOOL DATA DEFINITIONS

ENGINE SPEED - Scan tool displays 0 RPM to 8191 RPM. - This parameter indicates the rotational speed of the engine expressed as revolutions per minute.

TRANS OUTPUT SPEED - Scan tool displays 0 RPM to 8191 RPM. - This parameter indicates the rotational speed of the transmission output shaft expressed as revolutions per minute.

ENGINE (ENG) COOLANT (COOL) TEMPERATURE (TEMP) - Scan tool displays a range of -40°C to 151°C and -40°F to 304°F. - This parameter is the input signal of the engine coolant temperature sensor. Engine coolant temperature is high(151 °C) when signal voltage is low (0 volt), and engine coolant temperature is low (-40°C) when signal voltage is high (5 volts).

TRANS FLUID TEMP - Scan tool displays a range of -40°C to 151°C and -40°F to 304°F. - This parameter is the input signal of the transmission fluid temperature sensor. Transmission fluid temperature is high (151°C) when signal voltage is low (O volt), and transmission fluid temperature is low (-40°C) when signal voltage is high (5 volts).

THROTTLE (THROT) POSITION - Scan tool displays a range of 0.00 volt to 5.10 volts. - This parameter indicates the signal input of the throttle position sensor circuit. Low voltage (approximately 0.3V to 1.3V) indicates closed throttle, high voltage (approximately greater than 4.5V) indicates wide open throttle.

THROTTLE ANGLE - The scan tool will display this value of 0% to 100%. - This parameter indicates the signal input of the throttle position sensor circuit. Low voltage (approximately l.3V) indicates closed throttle, high voltage (approximately greater than 4.5V) indicates wide open throttle.

A/B/C RANGE (RNG) - Scan tool displays ON/OFF, ON/OFF. - These parameters are the three inputs from the transmission range pressure switch assembly. ON represents a B+ voltage signal, OFF represents a 0 voltage signal.

TRANS RANGE SWITCH (SW) - Scan tool displays a range of invalid, Park/Neutral, Reverse, Drive 4, Drive 3, Drive 2, and Low. - This parameter is the decoded status of the three A/B/C range inputs from the transmission range pressure switch assembly and represents the position of the transmission manual valve.

COMMANDED GEAR - Scan tool displays a range of 1, 2, 3, or 4. - This parameter is the decoded commanded state of the l-2 and 2-3 shift solenoids.

CURRENT GEAR - Scan tool displays a range of 1, 2, 3, or 4. - This parameter is the decoded command state of the l-2 and 2-3 shift solenoids.

1-2 SOLENOID (SOL) / 2-3 SOLENOID (SOL) - Scan tool displays ON/OFF. - These parameters are the commanded status of the 1-2 and 2-3 shift solenoids. ON represents a commanded energized state (current flowing through solenoid). OFF represents a commanded non-energized state (current not flowing through solenoid).

CONTROL (CTR) FEEDBACK (FDBK) 1/2 2/3 - Scan tool displays ON/OFF. - These parameters are the actual states of the l -2 and 2-3 shift solenoid driver control circuits. ON represents a driver control signal at 0 voltage. OFF represents a driver control signal at B+ voltage.

TRANS INPUT SPEED - Scan tool displays 0 RPM to 8191 RPM - This parameter indicates the rotational speed of the transmission input shaft expressed as revolutions per minute.

HOT MODE - The scan tool will display this value either ON or OFF. - When displayed ON, the transmission fluid temperature has become greater than 295°F (146°C).

TCC SLIP SPEED - Scan tool displays a range of -4096 RPM to + 4095 RPM. - This parameter is the difference between transmission input speed and engine speed. A negative value indicates engine speed is less than input speed (deceleration). A positive value indicates engine speed is greater than input speed (acceleration). A value of zero indicates input speed is equal to engine speed (TCC applied).

TCC PWM SOLENOID - Scan tool displays a range of 0% to 100%. - This parameter is the commanded percentage of ON time of the TCC solenoid. 100% represents an ON (energized) commanded state. 0% represents (non-energized) commanded state.

CONTROL (CTR) FEEDBACK (FDBK) TCC SOL -Scan tool displays ON/OFF. - This parameter is the actual state of the TCC solenoid driver control circuit. ON indicates a driver control signal at 0 voltage. OFF indicates a driver control signal at B+ voltage.

DESIRED PRESSURE CONTROL SOLENOID (PCS) - Scan tool displays a range of 0.00 amp to 1.10 amps. - This parameter is the commanded current of the pressure control solenoid circuit. 0.00 amp (no current flow) indicates commanded higher line pressure. 1.10 amps (high current flow) indicates commanded lower line pressure.

ACTUAL PRESSURE CONTROL SOLENOID (PCS) - Scan tool displays a range of 0.00 amp to 1.10 amps. - This parameter is the actual current of the pressure control solenoid circuit at the control module. 0.00 amp (no current flow) indicates actual high line pressure.

PRESSURE CONTROL SOLENOID (PCS) DUTY CYCLE - Scan tool displays a range of 0% to 100% - This parameter is the commanded state of the pressure control solenoid expressed as a percent of energized on time. 0% indicates zero on time (nonenergized) or no current flow. 100% indicates maximum on time (energized) or high current flow.

MPH Km/h - Scan tool displays a range of 0 mph to 55 mph. - This parameter is the input signal from the vehicle speed sensor.

FOUR WHEEL DRIVE (4WD) LOW SWITCH - Scan tool displays NO/YES. - This parameter is the signal state of the four wheel drive low circuit. NO indicates a B+ voltage signal (4WD low not requested), YES indicates a 0 voltage signal (4WD low requested).

CRUISE ENGAGED - Scan tool displays NO/ YES. - This parameter is the signal state of the cruise control ON/OFF switch. NO indicates a 0 voltage signal (cruise control not requested). YES indicates a B+ voltage (cruise control requested).

TCC BRAKE SWITCH - Scan tool displays OPEN/ CLOSED. - This parameter indicates the state of the TCC brake switch circuit input. Open indicates a 0 voltage input (brake switch open, brake pedal applied). Closed indicates a B+ voltage input (brake switch closed, brake pedal released).

KICKDOWN ENABLED - (Above approximately 75YO TPS) - Scan tool displays NO/YES. - This parameter indicates whether enabling conditions exist for an acceleration mode downshift. NO indicates enabling conditions (throttle position, vehicle speed, input speed, etc.) do not exist for an acceleration mode downshift. YES indicates enabling conditions exist for an acceleration mode downshift.

1-2 SHIFT TIME - Scan Tool displays a range of 0.00 seconds to 6.38 seconds. -This parameter is the actual time of the last l-2 shift.

2-3 SHIFT TIME - Scan tool displays a range of 0.00 seconds to 6.38 seconds. **-** This parameter is the actual time of the last 2-3 shift.

TRANS GEAR RATIO - Scan tool displays a range of 0.00 to 5.00. -This parameter is the difference between input speed and output speed

TURBINE SPEED - Scan tool displays a range of 0 RPM to 8191 RPM. - This parameter indicates rotational speed of the turbine shaft expressed as revolutions per minute.

TRANS CALIBRATION (CALIB) ID - Scan tool displays a range of 0000 to 9999. - This parameter is the four digit identification of the transmission software calibration.

SYSTEM VOLTAGE - Scan tool displays 0.00 volt to 25.5 volts. - This parameter is the battery ignition voltage input to the control module.

PRESSURE CONTROL SOLENOID (PCS) DUTY CYCLE - Scan tool displays a range of 0 to 100%. - This parameter is the commanded state of the pressure control solenoid expressed as a percent of energized on time. 0% indicates zero on time (nonenergized) or no current flow. 100% indicates maximum on time (energized) or high current flow.

MPH Km/h - Scan tool displays a range of 0 mph to 255 mph. - This parameter is the input signal from the vehicle speed sensor.

TRANS GEAR RATIO - Scan tool displays a range of 0.00 to 5.00. - This parameter is the difference between input speed and output speed.

TURBINE SPEED - Scan tool displays a range of 0 RPM to 8191 RPM. - This parameter indicates rotational speed of the turbine shaft expressed as revolutions per minute.

Table 5-20: 4L80-E Diagnostic Trouble Codes

DTC	MALFUNCTION
21	Throttle position (TP) sensor circuit high
22	Throttle position (TP) sensor circuit low
24	Vehicle speed sensor (VSS)/(TOSS) circuit low
28	Transmission range (TR) pressure switch circuit
37	Torque converter clutch (TCC) brake switch stuck ON
38	Torque converter clutch (TCC) brake switch stuck OFF
39	Torque converter clutch (TCC) solenoid stuck OFF
51	Programmable read only memory (PROM) error
52	System voltage (BATT) high long (length of time)
53	System voltage (BATT) high
58	Transmission fluid temp (TFT) circuit low
59	Transmission fluid temp (TFT) circuit high
63	Barometric pressure sensor (BARO) circuit high
64	Barometric pressure sensor (BARO) circuit low
68	Transmission component slipping
69	Torque converter clutch (TCC) stuck ON
71	CAM Position (CMP) sensor (Engine Speed)
72	Vehicle speed sensor (VSS)/(TOSS) circuit open
73	Pressure control solenoid (PCS) circuit
74	Transmission input speed sensor (TISS) circuit
75	System voltage (BATT) low
79	Transmission fluid overtemp
81	2-3 shift solenoid circuit fault
82	1-2 shift solenoid circuit fault
83	Torque converter clutch (TCC PWM) solenoid circuit fault
85	Undefined ratio error
86	Low ratio error
87	High ratio error

DTC 21/22
Throttle Position (TP) Sensor Circuit High /Throttle Position (TP) Sensor Circuit Low (Figure 5-24)

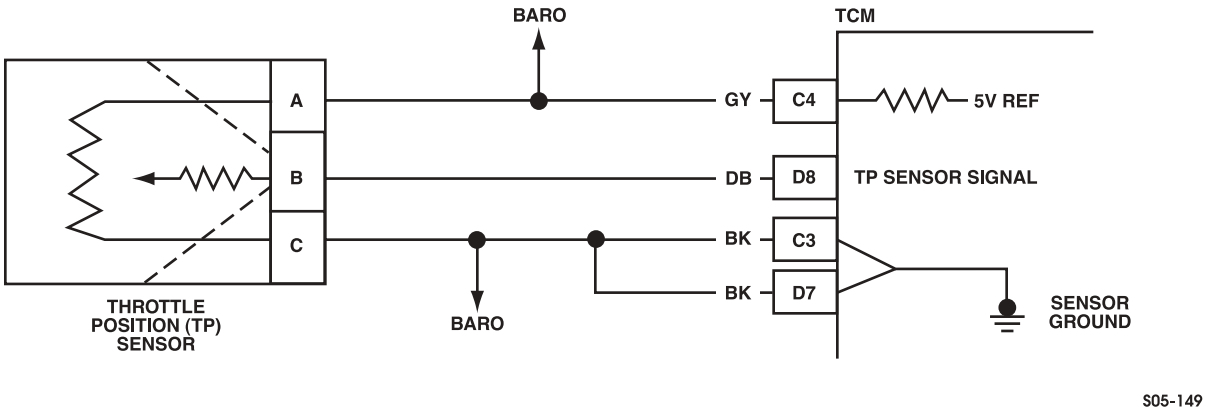


Figure 5-24: Throttle Position Sensor

Circuit Description

The TP sensor contains a resistor strip with one end connected to a 5volt supply and the other to ground.

The signal circuit is connected to a movable contact within the TP sensor. As the accelerator pedal is applied, the voltage signal will increase from approximately 0.5 volt to 4.5 volts.

DTC 21 Will Set When

- Engine operating.
- TP sensor signal voltage greater than 4.9 volts.
- Conditions met for one second.

DTC 22 Will Set When

- Engine operating.
- TP sensor signal voltage less than 0.2 volts.
- Conditions met for one second.

Action Taken (TCM will default to)

- Maximum line pressure.
- Use 35% throttle as default.
- Inhibit 4th gear if in hot mode.

DTC 21/22 Will Clear When: Fault condition(s) are removed, and the ignition is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for presence of 5 volts at the TP sensor.
2. Scan tool should display the 5 volt reference to the TCM.

Diagnostic Aids

- The TP Sensor voltage should increase smoothly as the accelerator pedal is applied.
- If an intermittent is suspected, check terminal at TP sensor and TCM. Also, use snapshot mode on scan tool to trigger on is DTC.

DTC 21/22

Throttle Position (TP) Sensor Circuit High/Throttle Position (TP) Sensor Circuit Low

- Be sure TP sensor is properly adjusted before proceding.
- Install Tech-1A scan tool.
- Ignition ON, engine OFF.
- Observe throttle position on scan tool display, as accelerator pedal is applied to wide open throttle.
- Does scan display gradually increase from greater than 0.2 volts to less than 4.9 volts?

NOTE: TP sensor and Baro have wiring to ground and 5V reference respectively spliced together in wiring harness.

NO

1
- Ignition OFF.
- Disconnect TP sensor connector.
- Ignition ON.
- With J 39200 DVM, measure 5 volt supply voltage at TP sensor connector.
- Is voltage 5 volts ± 0.3 volts?

YES

- With test light to B+, probe ground CKT C3 or D7
- Is test light ON?

YES

2
- Jumper CKT's C4 and D8 together.
- Does scan tool display throttle position greater than 4.9 volts?

YES

- Verify proper terminal tension at the TP sensor connections.

  If OK, replace TP sensor.

NO

- Repair sensor ground CKT C3 or D7 to TP sensor.

NO

- Check TP sensor signal CKT D8 for an open or short to ground. Also verify proper TCM terminal tension on this circuit at the TCM. If OK, replace TCM.

YES

- System checks OK.

  Refer to Diagnostic Aids.

NO

- Repair 5 volt supply feed CKT C4 to TP sensor.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 24
Vehicle Speed Sensor (VSS) (TOSS) Circuit Low (Figure 5-25)

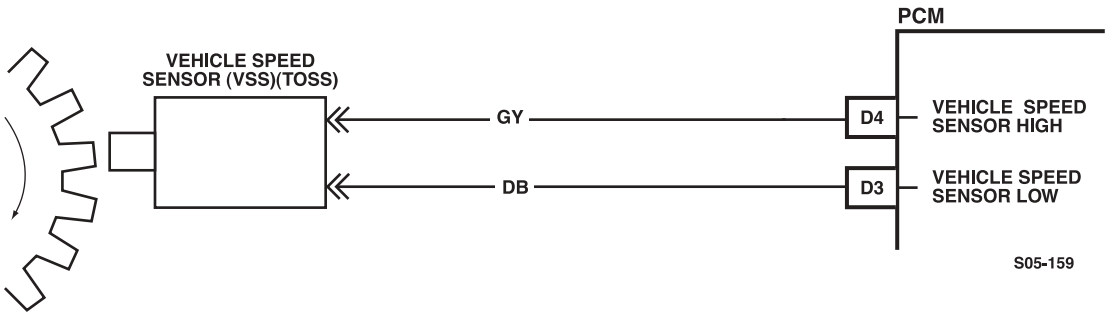


Figure 5-25: Vehicle Speed Sensor (VSS) (TOSS) Circuit

Circuit Description

The VSS/TOSS sensor consists of a permanent magnet surrounded by a coil of wire. As the transmission output shaft rotates, an AC voltage is induced in the circuit. The signal voltage and frequency will vary directly with the output shaft rotational speed.

DTC 24 Will Set When

- No DTC(s)
- Trans range not in PARK or NEUTRAL.
- Engine speed greater than 3000 RPM.
- Trans output speed less than 200 RPM.
- Throttle position 10% to 100%.
- No DTC(s) 21, 22, 28, and 72.
- All conditions met for 2 seconds.

Action Taken (TCM will default to)

No TCC operation.

DTC 24 Will Clear When

The fault condition(s) no longer exist.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This checks the entire circuit for continuity.
2. This checks the output of the output speed sensor.

Diagnostics Aids

- DTC 24 will set when no vehicle speed detected at start off.
- DTC 72 will set when vehicle speed was detected then lost.
- Refer to Control Module Intermittent DTC(s) or Performance.

DTC 24

Vehicle Speed Sensor (VSS) (TOSS) Circuit Loss

- Install Tech-1A.
- Record then clear DTC(s).
- Disconnect front and rear propeller shafts from transfer case.
- Engine operating.
- Transmission in any drive range.
- With transfer output shaft rotating, does Trans Output Speed increase with increased speed?

NO

1
- Disconnect harness connector from TOSS.
- With engine still running and transmission still in drive range, connect J 39200 DVM to sensor terminals. Measure on AC scale voltage at TOSS terminals. Voltage should vary proportionally to engine RPM. Does TOSS AC voltage vary above 7 VAC for engine RPM above 10 MPH equivalent?

YES

2
- Stop engine.
- Check wiring and connectors at TCM and TOSS for opens, shorts, grounds, or damaged pins.
- Was there a fault in connectors or wiring?

NO

- Replace faulty TCM or PROM.

YES

- Repair wiring or connector fault. Retest and check for DTC(s).

YES

- Problem is intermittent. Refer to Diagnostic Aids.

NO

- Replace defective TOSS.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 28

Transmission Range (TR) Pressure Switch Assembly Fault (Figure 5-26)

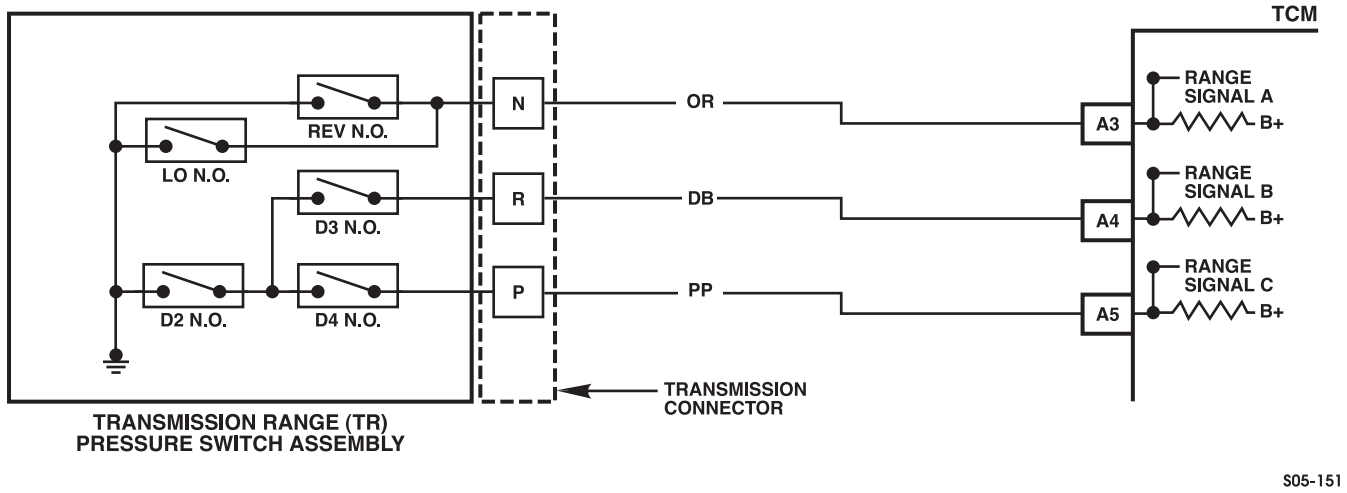


Figure 5-26: Transmission Range Pressure Switch Assembly

Circuit Description

The Transmission Range (TR) switch assembly consists of five normally open pressure switches and is attached to the valve body. The control module supplies battery voltage to each range signal. By grounding one or more of these circuits through various combinations of the pressure switches, the control module detects what manual valve position has been selected by the vehicle operator. With ignition ON and engine OFF, P/ N will be indicated. When the transmission electrical connector is disconnected, the ground potential for the three range signals to the control module will be removed, and with ignition ON, D2 will be indicated.

DTC 28 Will Set When

Range signals A and C are both zero volts OFF for 2 seconds.

Action Taken (TCM will default to)

Harsh shifts, drive 4 shift control. TCC will be inhibited, and if in hot mode, there will be no fourth gear. DTC 28 will be stored in the TCM memory but will not turn ON the Malfunction Indicator Lamp (MIL).

DTC 28 Will Clear When

The fault condition(s) no longer exist, and the ignition switch is cycled from OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks the indicated range signal to the manual valve position actually selected.
2. This test checks for correct voltage from the control module to the transmission external connector.
3. This test checks for a short to ground from the control module to the transmission external connector in any one of the three circuits.

Diagnostic Aids

- DTC 28 will set if the control module detects one of two illegal combinations.
- Refer to accompanying chart for various A/B/C range combinations. Check all wiring connectors for proper terminal tension.
- Refer to TR Pressure Switch Assembly Resistance Check or Functional Test Procedure.

Table 5-21: Expected Readings

Range Signal	A	B	C
Park	ON	OFF	ON
Rev	OFF	OFF	ON
Neutral	ON	OFF	ON
D4	ON	OFF	OFF
D3	ON	ON	OFF
D2	ON	ON	ON
D1	OFF	ON	ON
Illegal	OFF	ON	OFF
Illegal	OFF	OFF	OFF

ON = B+/OFF = 0 VOLTS
(Scan Tool Readings)

DTC 28 TRANSMISSION RANGE (TR) PRESSURE SWITCH ASSEMBLY FAULT

This chart assumes that:
- The transmission linkage from the selector to the manual valve is adjusted properly.
- OBD system check has been performed.
- Fluid checking procedure has been performed.
- All DTC(s) have been recorded and then cleared.
- Scan tool installed.

1
- Engine idling at normal operating temperature.
- Parking brake applied and wheels blocked.
- Apply brake pedal and select each transmission range D1, D2, D3, D4, N, R, P.
- Does each selected transmission range match the Tech-1A scan tool TRANS RANGE SW display?

NO

- Ignition OFF.
- Disconnect transmission wiring connector ASM.
- Install J 39775 Jumper Harness/Probe Kit on the external wiring connector.
- Ignition ON, engine OFF.
- With J 39200 DVM to ground, check voltage at vehicle harness connector terminals N, R, and P.
- Does J 39200 DVM Display B+ at all three circuits?

YES

- No trouble found.
- Refer to diagnostic aids.

NO

3
- Ignition OFF.
- Disconnect control module connector.
- With J 39200 to ground, check resistance at vehicle harness connector terminals N, R, and P.
- Does J 39200 DVM display high resistance (greater than 50k ohms) on all three circuits?

YES

2
- Verify that CKTs A3, A4, or A5 are not shorted together. If OK, refer to TR Pressure Switch Assembly Resistance Check.

NO

- Check low resistance circuit A3, A4, or A5 for short to ground. Repair pinched or chaffed wires per wiring harness repair procedures (Section 12).

YES

- Ignition ON, engine OFF.
- With J 39200 to ground, check voltage at control module terminals A3, A4, and A5 (TCM). If J 39200 DVM does not display B+ at all three circuits, replace control module.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 37/38

TCC Brake Switch Stuck ON/TCC Brake Switch Stuck OFF (Figure 5-27)

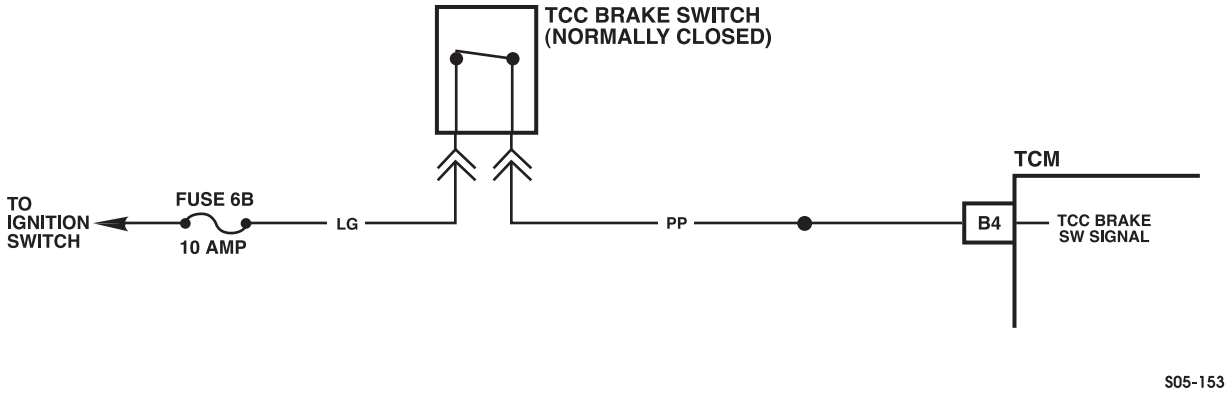


Figure 5-27: TCC Brake Switch

Circuit Description

The normally closed brake switch supplies a B+ signal on CKT B4 to the control module. The signal voltage drops to 0 volt when the TCC brake switch is opened (brake pedal applied).

DTC 37 Will Set When

- CKT B4 is open.
  - Vehicle speed is less than 5 mph for greater than 6 seconds.
  - Then vehicle speed is between 5 mph and 20 mph for greater than 6 seconds.
  - Then vehicle speed is greater than 20 mph for greater than 6 seconds.
  - For a total of seven times.

DTC 38 Will Set When

- CKT B4 has constant Voltage.
  - Vehicle speed is greater than 20 mph for greater than 6 seconds.
  - Then vehicle speed is between 5 mph and 20 mph for greater than 6 seconds.
  - For a total of seven times.

Action Taken (TCM will default to)

DTC 37:

- No fourth gear in hot mode.

DTC38:

- No fourth gear in hot mode.
- No TCC.

DTC 37/38 Will Clear When

Fault condition no longer exists.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for voltage at the brake switch.
2. This test checks the brake switch.
3. This test checks CKT B4 at the control module.

Diagnostic Aids

- Refer to Control Module Intermittent Diagnostic Trouble Code or Performance.
- Check customer driving habits and/or unusual traffic conditions (i.e., stop and go, express way traffic).

DTC 37/38 - TCC BRAKE SWITCH STUCK ON/TCC BRAKE SWITCH STUCK OFF

- Install scan tool.
- Ignition switch ON, engine OFF.
- Record then clear DTC(s).
- Apply then release brake pedal.
- Does scan tool display TCC brake SW OPEN with brake pedal applied, and then display CLOSED when released?

NO

1

- With test light connected to ground, backprobe ignition feed circuit on brake switch.
- Is test light ON?

YES

- With test light connected to ground, backprobe harness CKT B4 at brake switch.
- Is test light ON?

YES

2

- Apply brake pedal.
- Is test light OFF when pedal is applied?

YES

- Ignition OFF.
- Disconnect control module connectors.
- Ignition ON, engine OFF.
- With a test light connected to ground, probe control module CKT B4 harness connector.
- Is test light ON?

YES

3

- Ignition OFF.
- Reconnect control module connections.
- Ignition ON.
- Apply then release brake pedal.
- Does scan tool display TCC brake SW OPEN with brake applied, and then displayed CLOSED when released?

YES

- Electrical system checks OK at this time. The malfunction may be intermittent or may have been corrected during the diagnostic procedure. Refer to Diagnostic Aids.

YES

- No trouble found. Refer to Diagnostic Aids.

NO

- Repair open in the ignition feed circuit to the brake switch. If the ignition voltage feed fuse 6B is open, also check CKT B4 for a short to ground.

NO

- Brake switch out of adjustment or faulty brake switch.

NO

- Check CKT B4 for short to B+. If OK, replace brake switch.

NO

- Repair open CKT B4 from TCC brake switch to control module.

NO

- Faulty control module.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 39

TCC Solenoid Stuck OFF (Figure 5-28)

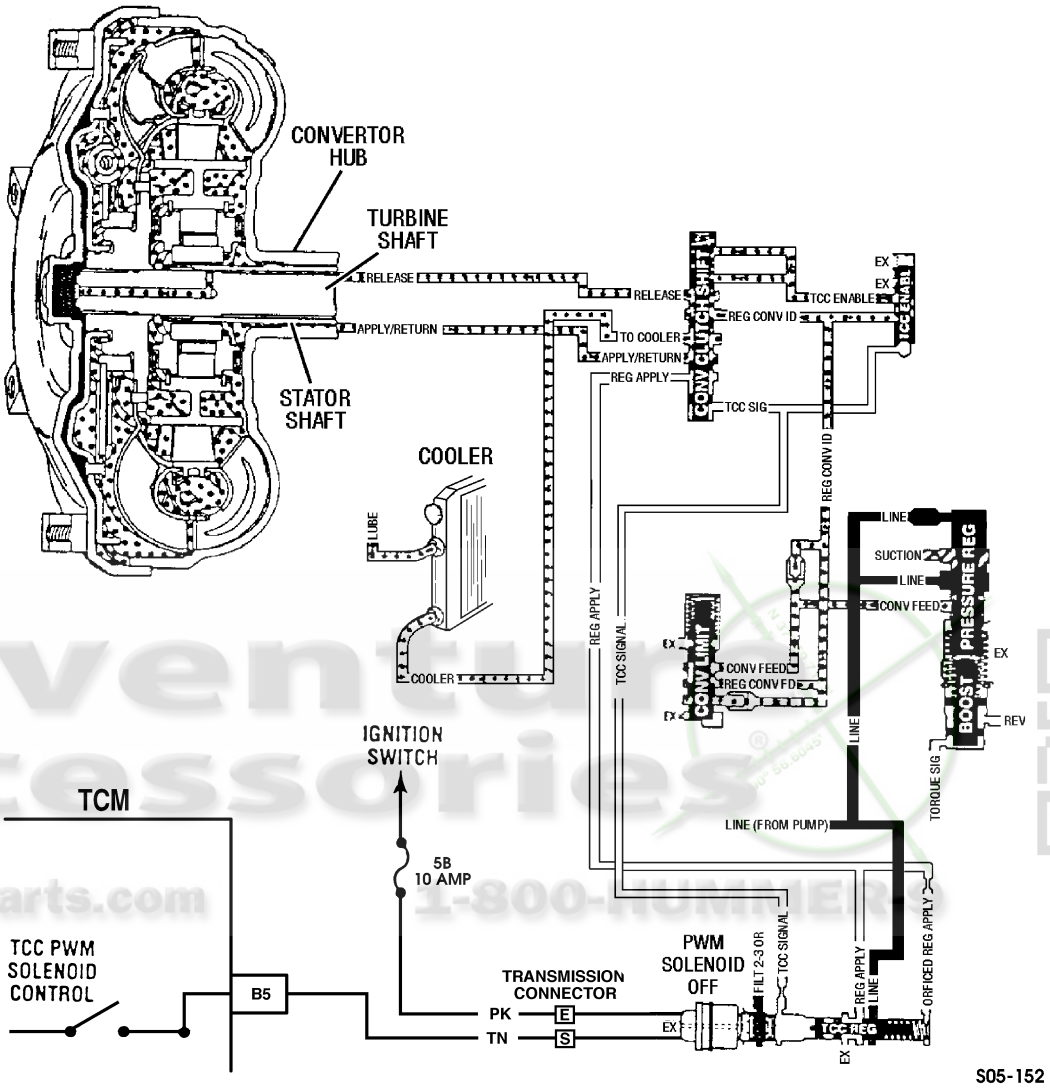


Figure 5-28: TCC Solenoid

Circuit Description

The control module commands the TCC PWM solenoid ON by modulating TCC signal fluid acting on the converter clutch shift valve. Then TCC apply fluid applies the torque converter clutch.

DTC 39 Will Set When

- No DTC(s) 28, 71, or 74.
- TCC is commanded ON.
- TCC slip speed greater than 65 RPM.
- Trans range in D3 or D4.
- 2nd or 3rd gear.
- All conditions are met for two seconds.

Action Taken (TCM will default to)

No 4th gear in hot mode.

DTC 39 Will Clear When

The fault condition no longer exists, and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This checks the mechanical and hydraulic operation of the TCC, while commanded ON by the control module.

Diagnostic Aids

Snapshot mode will record 5 data parameters per second.

DTC 39

TCC Solenoid Stuck OFF

1

- If DTC is set, refer to that chart before proceeding.
- Install scan tool.
- Drive vehicle in D3 and in 3rd gear.
- Use snapshot mode to record data parameters.
- While reviewing data, is TCC slip speed greater than 65 rpm while TCC PWM solenoid is commanded ON (greater than 95%), for 2 seconds?

YES

- The torque converter clutch is mechanically stuck OFF refer to symptom diagnosis charts, NO TCC Torque Converter Clutch Diagnosis.

NO

- The condition may be intermittent, refer to Torque Converter Clutch Diagnosis.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 51

PROM Error (Faulty or Incorrect PROM)

Check that all pins are fully inserted in the socket. If OK, replace PROM, clear memory and recheck. If DTC 51 Reappears, replace control module.

NOTES

DTC 52/53

System Voltage High Long/System Voltage High (Figure 5-29)

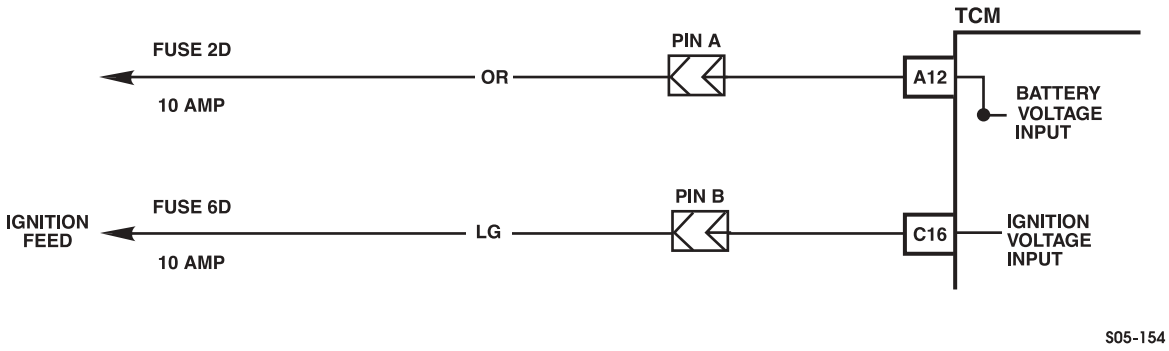


Figure 5-29: TCM Voltages

Circuit Description:

Ignition voltage is supplied to the control module to indicate the ignition status of the ignition switch.

Battery voltage is supplied to the control module to, in part, maintain memory of learned functions and parameters.

DTC 52 Will Set When

- The ignition is ON and the system voltage is greater than 16 volts.
- All conditions are met for 109 minutes.

DTC 53 Will Set When

- The ignition is ON and the system voltage is greater than 19.5 volts.
- All conditions are met for 2 minutes.

Action Taken (TCM will default to)

- Maximum line pressure.
- 2nd gear.
- Inhibit TCC.

DTC 52/53 Will Clear When

Fault condition no longer exists, and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

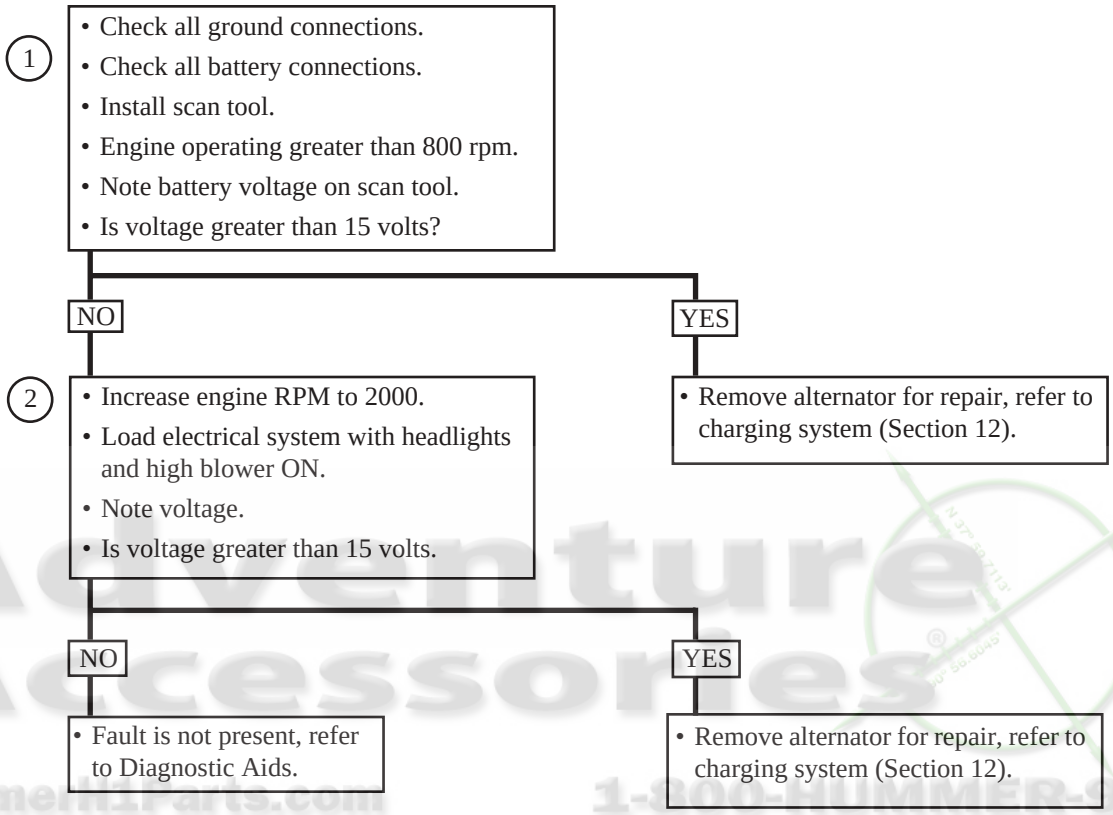
1. Normal battery voltage is between 9-l5 volts.
2. This test checks if the alternator is faulty under load conditions. If the voltage is greater than 15 volts, refer to SECTION 12 of this manual.

Diagnostic Aids

- Charging the battery and jumpstarting an engine may set DTC 52/DTC 53. If DTC(s) set when an accessory is operated, check for faulty connections or excessive current draw. Refer to Section 12 of this manual for circuit details.
- Check for faulty connections at the starter solenoid or fusible link.

DTC 52/53

System Voltage High Long/System Voltage High



When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 58

Transmission Fluid Temperature (TFT) Sensor Circuit Low (High Temperature Indicated) (Figure 5-30)

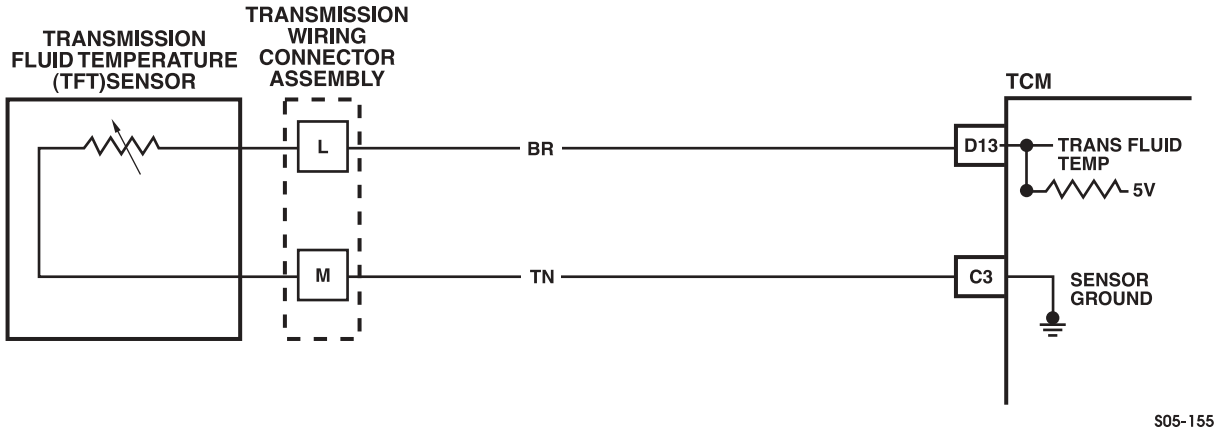


Figure 5-30: TFT Sensor

Circuit Description

The TFT sensor is a thermistor that controls the signal voltage to the control module. The control module supplies a 5 volt reference signal to the sensor on CKT D13. When the transmission fluid is cold, the sensor resistance is high and the control module will sense high signal voltage.

As the transmission fluid temperature warms to normal transmission operating temperature 212°F (100°C), the sensor resistance becomes less and the voltage decreases to approximately 1.5 to 2.0 volts. With a DTC 79 also set, check the transmission cooling system.

DTC 58 Will Set When

- Signal voltage indicates TFT greater than 306°F (152 °C).
- All conditions are met for 1 second.

Action Taken (TCM will default to)

The control module will use a warm default transmission fluid temperature value.

DTC 58 Will Clear When

The fault condition(s) no longer exist.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for a short to ground or a “skewed” sensor.
2. This test checks for an internal fault within the transmission by creating an open.

Diagnostic Aids

- Check harness routing for a potential short to ground in CKT D13.
- Scan tool TFT display should rise steadily to about 212°F (100°C) then stabilize.
- Refer to Control Module Intermittent Diagnostic Trouble Codes or Performance.
- The temperature to resistance value scale may be used to test the TFT sensor at the various temperature levels to evaluate the possibility of a “skewed” sensor. A “skewed” (mis-scaled) sensor could result in delayed shifts or TCC complaints.

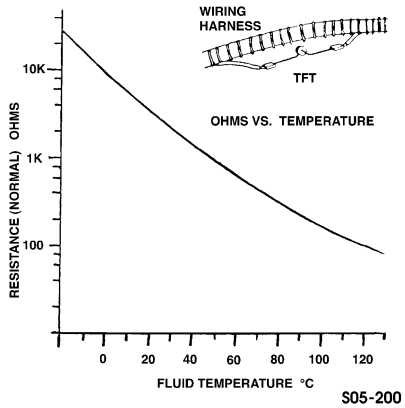
DTC 58

Transmission Fluid Temperature (TFT) Sensor Circuit Low (High Temperature Indicated)

- Has fluid checking procedure been performed?
  - YES
    1. Does scan tool display transmission fluid temperature of 306°F (152°C)?
       - YES
         2. Ignition OFF.
            - Disconnect transmission wiring connector assembly (additional DTC(s) will set).
            - Ignition ON, engine OFF.
            - Does scan tool display temperature of -40°F (-40°C)?
               - YES
                 - TFT sensor is indicating high temperature, refer to Internal Wiring Harness Check.
               - NO
                 - CKT D13 shorted to ground or faulty control module or connections.
            - NO
              - DTC is intermittent.
              - If no additional DTC(s) were stored, refer to Diagnostic Aids.
       - NO
         - Refer to Fluid Checking Procedure.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

Temperature vs. Resistance Chart



DTC 59

Transmission Fluid Temperature (TFT) Sensor Circuit High (Low Temperature Indicated) (Figure 5-31)

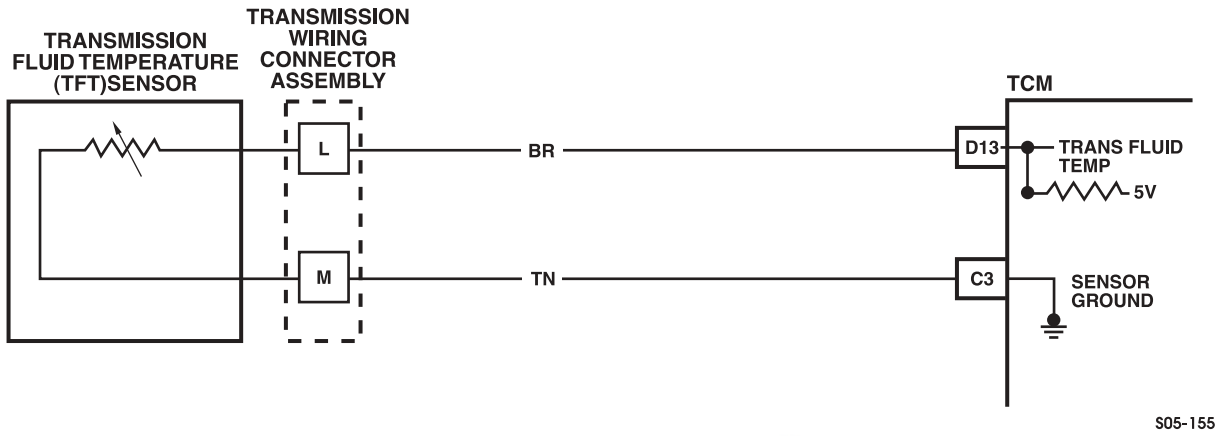


Figure 5-31: TFT Sensor

Circuit Description

The TFT sensor is a thermistor that controls the signal voltage to the control module. The control module supplies a 5 volt reference signal to the sensor on CKT D13. When the transmission fluid is cold, the sensor resistance is high and the control module will sense high signal voltage.

As the transmission fluid temperature warms to normal transmission operating temperature 212°F (100°C), the sensor resistance becomes less and the voltage decreases to approximately 1.5 to 2.0 volts.

DTC 59 Will Set When

- Signal voltage indicates TFT less than -40°F (-40°C).
- All conditions are met for 1 second.

Action Taken (TCM will default to)

The control module will use a warm default transmission fluid temperature value.

DTC 59 Will Clear When

The fault condition(s) no longer exist.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

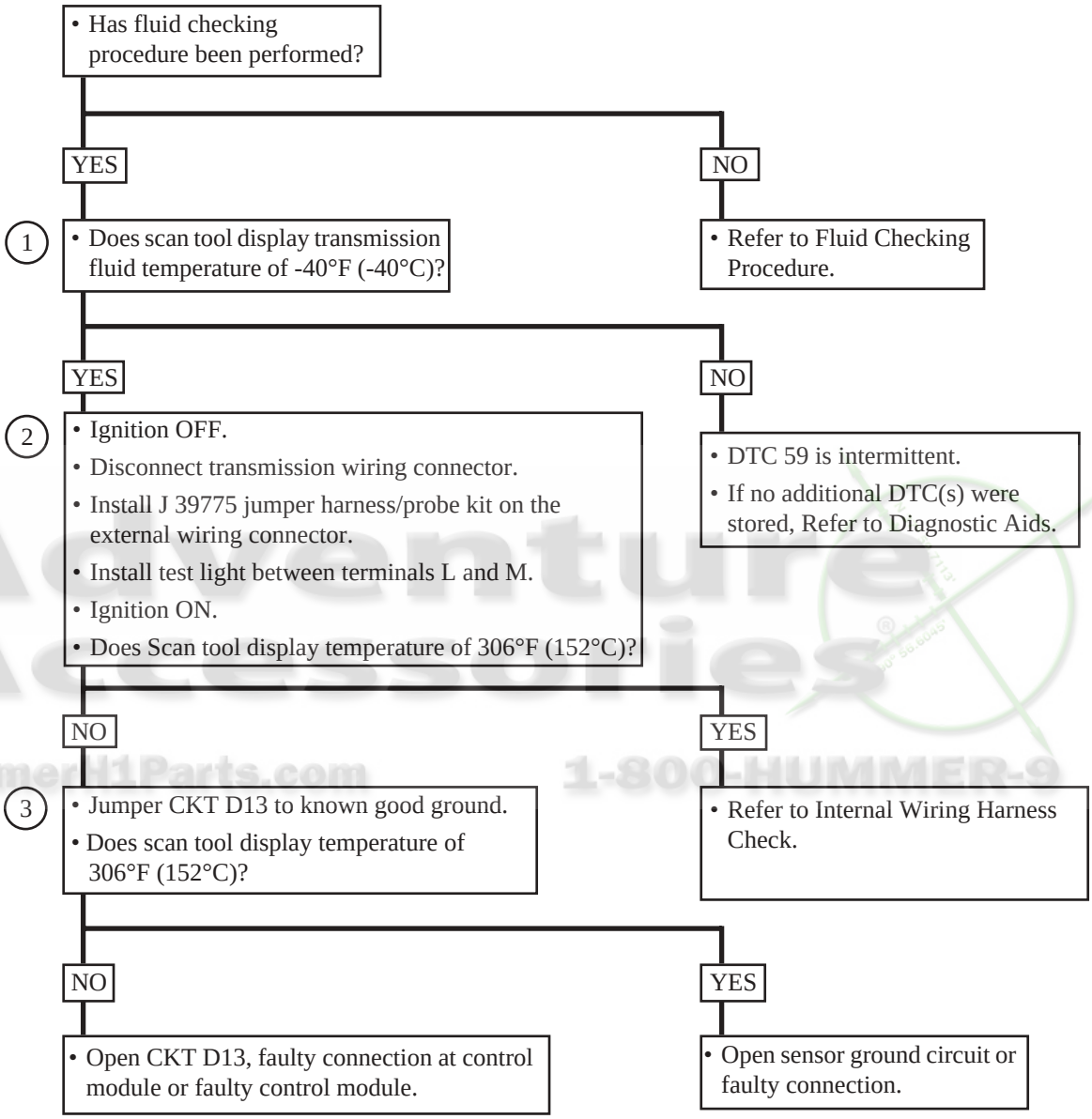
1. This checks the entire circuit and indicates whether the malfunction is present.
2. This test simulates a DTC 58. If the control module recognizes the low signal voltage (high temperature), and the scan tool displays 306°F (152°C) or greater, the control module and wiring are OK.
3. This test checks if CKT D13 is open. There should be 5 volts present at the sensor connector if measured with J 39200.

Diagnostic Aids

- Scan tool displays transmission fluid temperature in degrees. After transmission is operating, the temperature should rise steadily to about 212°F (100°C) then stabilize.
- A faulty connection or an open in CKT 452 or CKT 1227 can result in a DTC 59.
- The Temperature to Resistance Value scale in DTC 58 may be used to check the TFT sensor at various temperature levels to evaluate the possibility of a “skewed” (mis-scaled) sensor. A “skewed” sensor can result in firm shifts, or TCC complaints.

DTC 59

Transmission Fluid Temperature (TFT) Sensor Circuit High (Low Temperature Indicated)



When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 63/64

Baro Sensor Circuit High/Baro Sensor Circuit Low (Figure 5-32)

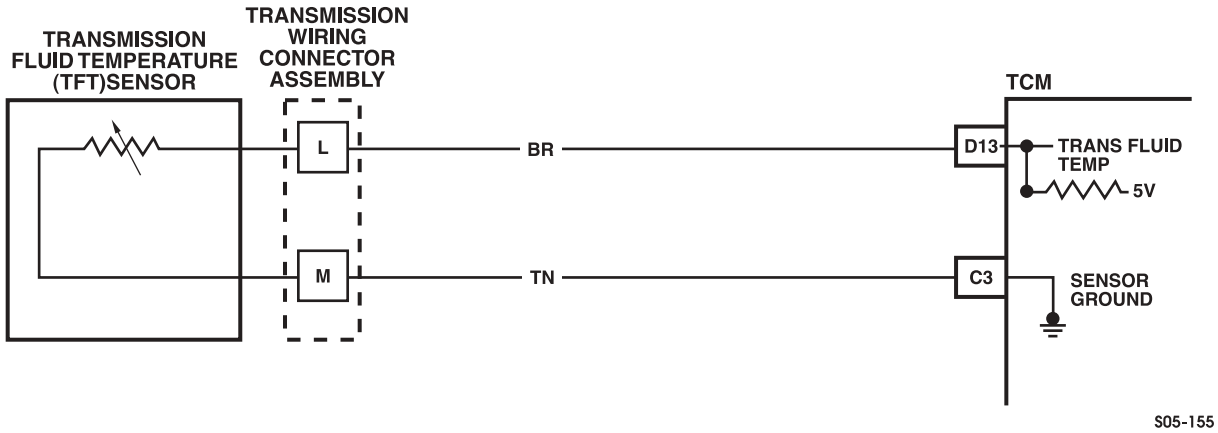


Figure 5-32: Baro Sensor

Circuit Description

The Transmission Control Module (TCM) supplies 5 volts to the BARO sensor. As the atmospheric pressure changes the resistance within the BARO sensor also changes, modifying the voltage on the BARO sensor input signal. When atmospheric pressure is high (14.5 psi) input signal voltage will also be high (approx. 4.5V). As atmospheric pressure decreases, so does the input signal voltage.

DTC 63 Will Set When

- BARO sensor signal voltage greater than 4.9 volts.
- Longer than 2 seconds.

DTC 64 Will Set When

- BARO sensor signal voltage less than 1.9 volts.
- Longer than 2 seconds.

Action Taken (TCM will default to)

No altitude compensation of shift patterns.

DTC 63/64 Will Clear When

Fault condition(s) no longer exist.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This verifies the 5 volt supply to the BARO sensor.
2. If the entire circuit is OK, the voltage measured will be 5 volts.

Diagnostic Aids

If the DTC will not set, use snapshot mode on scan tool to trigger ON this DTC, then review data to identify source.

DTC 63/64

BARO Sensor Circuit High/BARO Sensor Circuit Low

- Install scan tool.
- Ignition ON.
- Record then clear DTCs.
- Does DTC 63 or 64 set?

YES

1
- Ignition OFF.
- Disconnect BARO sensor connector.
- Ignition ON.
- With J 39200 DVM measure 5 volt supply voltage at BARO sensor connector.
- Is voltage 5 volts ± 0.3 volts?

YES

- With test light to B+, probe ground CKT D7 at TCM D7 and BARO sensor connector at B.
- Is test light ON at both connectors?

YES

2
- Jumper CKTs C4 and D14 together at BARO sensor connector.
- Backprobe CKT D14 at TCM with J 39200 DVM.
- Is voltage 5 volts ± 0.3 volts?

YES

- Check BARO sensor signal CKT D14 for a short to 5V.
- If OK, replace BARO sensor.

NO

- Check BARO sensor signal CKT D14 for an open or short to ground. Also check terminal tension in connectors on that circuit. If OK, replace TCM.

NO

- Repair sensor ground CKT D7.

NO

- Repair 5 volts supply feed CKT C4 to BARO sensor.

NO

- Malfunction is not present at this time. Refer to Diagnostic Aids

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 68

Transmission Component Slipping (Figure 5-33)

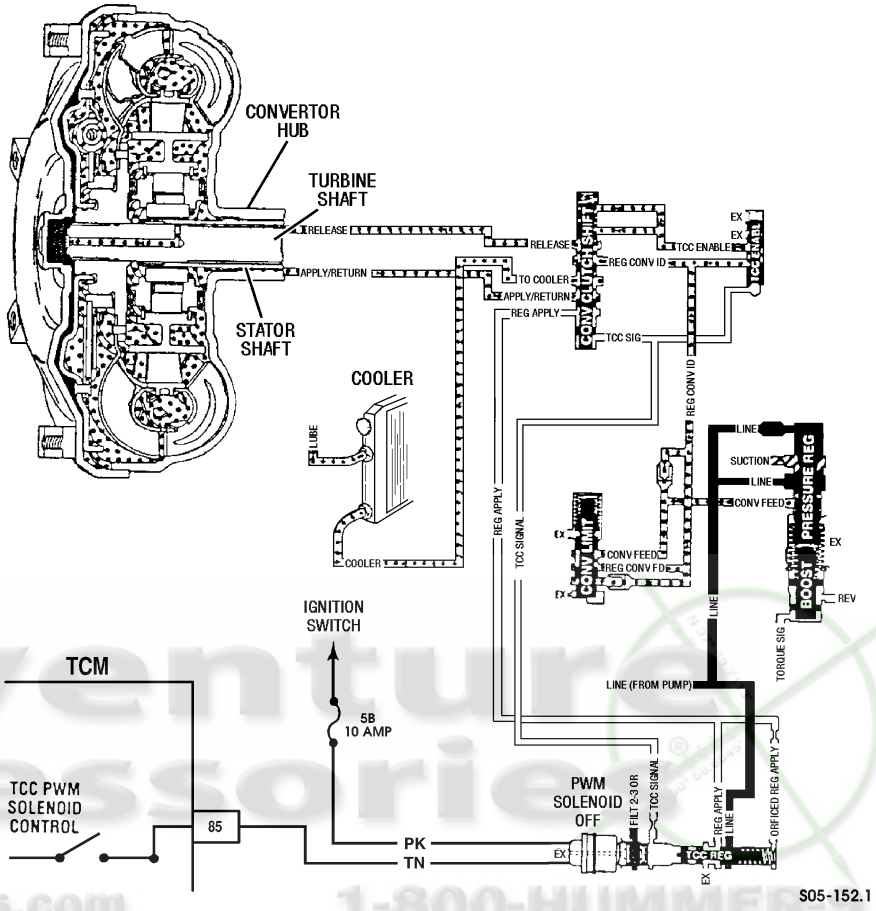


Figure 5-33: Torque Converter Clutch

Circuit Description

The control module monitors the difference in engine speed and input speed. With transmission in drive and TCC locked, the scan tool should display engine speed closely matching input speed.

DTC 68 Will Set When

- No DTC(s) 28, 71, and 74.
- TCC slip speed greater than 200 RPM.
- Fourth gear is indicated.

Action Taken (TCM will default to)

- Inhibit TCC operation.

68 Will Clear When

The fault condition(s) no longer exists and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks the indicated range signal to the actual selected range. A faulty switch could set DTC 68.
2. This test checks the torque converter for slippage while in a commanded lock-up state.
   - TCC is locked.
   - Not in park/neutral.
   - All conditions are met for 2 seconds.

Diagnostic Aids

- Check for deformed connectors at pass-thru connector.
- DTC 68 will set when going to default (second gear).
- Refer to Control Module Intermittent DTC(s) or Performance.
- Check for Internal Transmission Faults (i.e.: leaking seals, failed clutches, etc.).
- An intermittent incorrect engine speed signal will set a DTC 68 if the incorrect signal lasts for greater than 2 seconds.
- A mechanical failure in the 1-2 shift solenoid (stuck OFF) or 2-3 shift solenoid (stuck ON), could set DTC 68.

DTC 68

Transmission Component Slipping

1. • Install Scan Tool.
   • Engine Idling.
   • Record then clear DTC(s).
   • Apply brake pedal and select each transmission range D1, D2, D3, D4, N, R, P.
   • Does each selected trans range match trans range SW on scan tool?

   YES

2. • Drive vehicle in 4th gear and TCC engaged.
   • Use snapshot mode to record data parameters.
   • Is TCC slip speed ever greater than 200 rpm for 2 seconds while TCC is engaged?

   YES

   • The condition may be intermittent. Refer to Torque Converter Clutch (TCC) diagnosis.

   NO

   • Mechanical component failure.

   NO

   • Refer to DTC 28.

DTC 69

Torque Converter Clutch (TCC) Stuck ON (Figure 5-34)

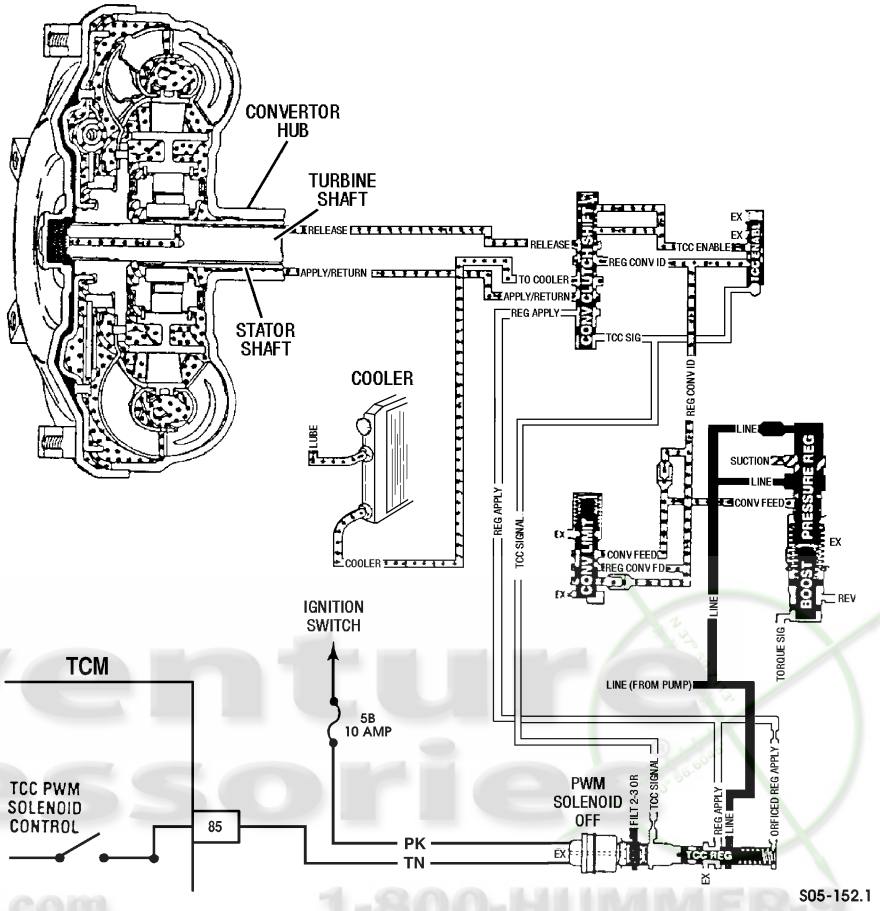


Figure 5-34: Torque Converter Clutch

Circuit Description

The control module commands the TCC PWM solenoid ON by modulating TCC signal fluid acting on the converter clutch shift valve. Then TCC apply fluid applies the torque converter clutch.

DTC 69 Will Set When

- No DTC(s) 21, 22, 28, 71, 74 are set.
- TCC slip speed RPM indicates between -5 and +10.
- TCC solenoid is commanded OFF.
- TP sensor signal is greater than 25%.
- Trans range switch indicates D3 or D4.
- Commanded gear indicates 2nd or 3rd gear.
- All conditions are met for 2 seconds.

DTC 69 Will Clear When

Fault condition no longer exists and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

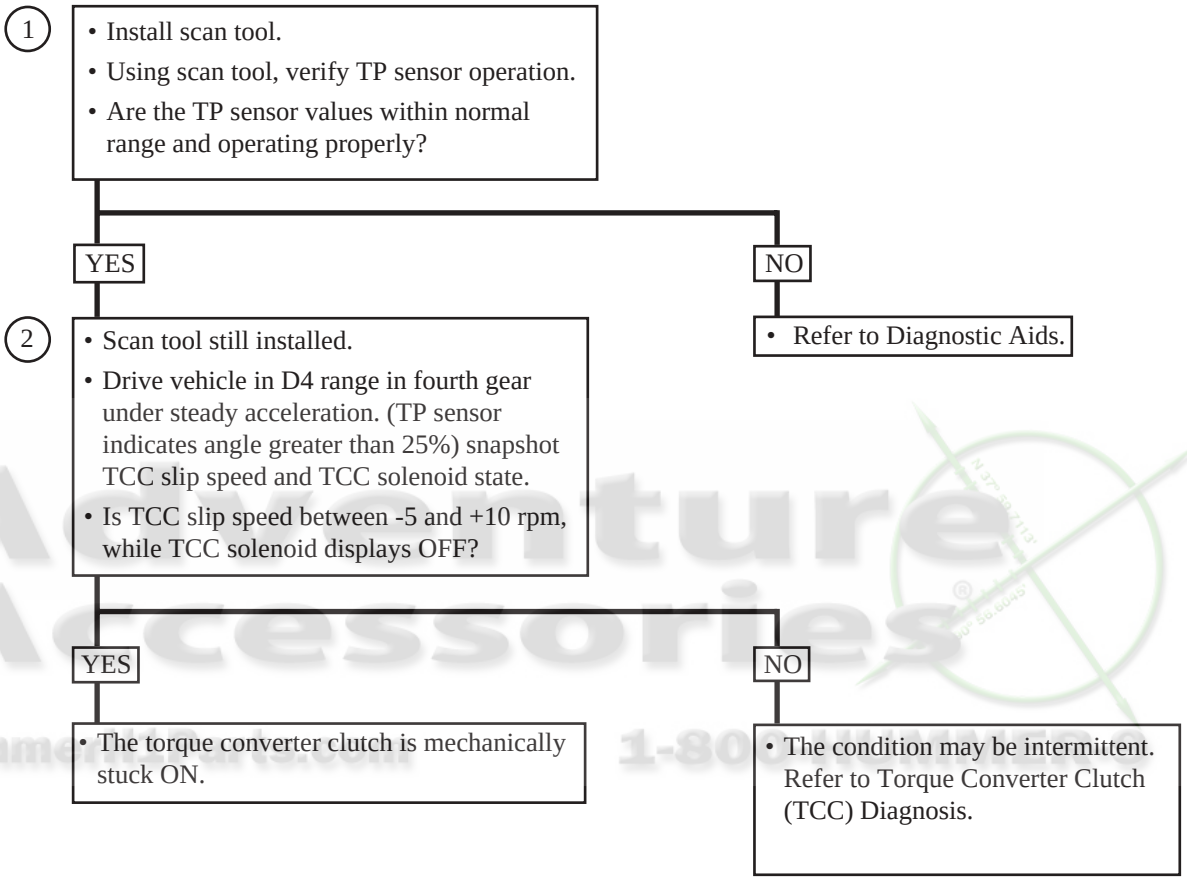
1. This test checks for proper throttle position sensor operation.
2. This test checks the mechanical state of the TCC. When the control module commands the TCC solenoid OFF. TCC slip speed should increase.

Diagnostic Aids

- If the TCC is mechanically stuck ON, vehicle speed is zero, brakes are applied, and D2 is selected, the TCC fluid will mechanically apply the TCC causing an engine stall.
- Scan TP signal while depressing accelerator pedal with engine OFF and ignition ON. Display should vary from below 0.85 volt when the throttle is closed to over 4.0 volts when the throttle is held at wide open throttle. Incorrect TP sensor values may affect TCC operation.

DTC 69

Torque Converter Clutch (TCC) Stuck ON



When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 71

Camshaft Position Sensor Circuit Low (Figure 5-35)

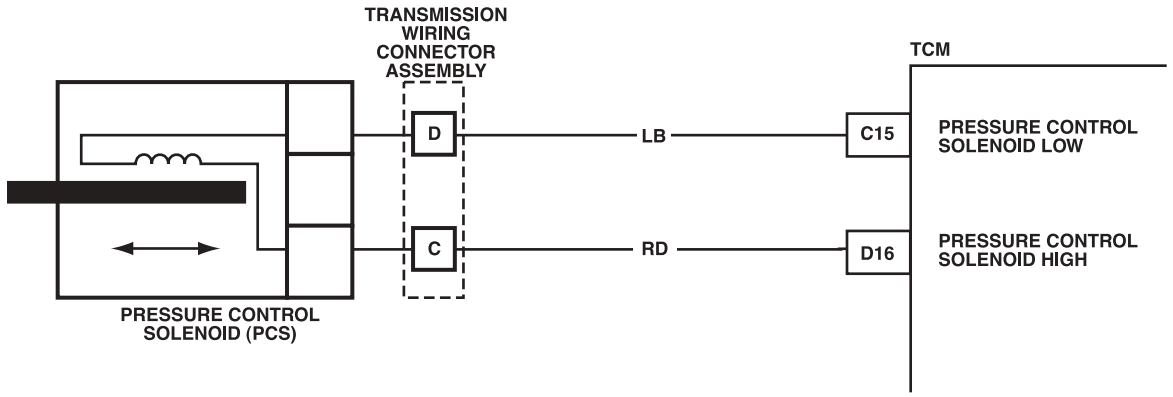


Figure 5-35: Camshaft Position Sensor

Circuit Description

The camshaft position sensor detects the rotational speed of the camshaft. As the camshaft rotates, an AC signal is generated in the circuit. This signal provides the input to determine engine speed, for use in various calculations including TCC slip speed and overdrive ratio.

DTC 71 Will Set When

- No DTC 28 set.
- Engine speed less than 50 RPM.
- Trans range indicates R, D4, D3, or D1.
- Conditions are met for 2 seconds.

Action Taken (TCM will default to)

Inhibit TCC.

DTC 71 Will Clear When

Fault condition(s) no longer exist.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. A malfunctioning trans range pressure switch could indicate an inaccurate actual transmission range.
2. This checks the entire CMP sensor circuit for proper signal.
3. A signal at this point indicates that the sensor is capable of inducing an AC voltage in the circuit.

Diagnostic Aids

Refer to TCM Intermittent Diagnostic Trouble Code or Performance.

DTC 71

Camshaft Position Sensor Circuit Low

1. • Install scan tool.
   • Record then clear DTC(s).
   • Ignition ON, engine operating.
   • Apply brake pedal and select each transmission range D1, D2, D3, D4, N, R, P.
   • Does each selected transmission range match the scan tool TRANS RANGE SW display?

   NO → • Improper transmission range input. Refer to DTC 28 for diagnosis.

   YES →

2. • Trans shift selector in park.
   • Does Engine Speed on scan tool display increase as throttle increases?

   YES → • System checks OK at this time. Refer to Diagnostic Aids.

   NO →

3. • Ignition OFF.
   • Disconnect CMP engine speed sensor connector.
   • Connect J 39200 DVM (AC scale) to sensor.
   • Does J 39200 DVM display AC voltage while cranking engine?

   NO → • Replace CMP engine speed sensor.
   • Refer to Diagnostic Aids.

   YES →

   • Ignition OFF.
   • Reconnect CMP sensor connector.
   • Disconnect TCM connectors.
   • Connect J 39200 DVM (AC scale) to harness terminals D7 and D6.
   • Does J 39200 DVM display AC voltage while cranking engine?

   NO → • Circuit malfunction in CKT D6 or CKTs D7 or C3.
   • Repair as necessary.

   YES →

   • Ignition OFF.
   • Reconnect TCM sensor connectors.
   • Engine operating
   • Does Engine Speed on scan tool increase as throttle increases?

   NO → • Verify proper terminal tension on CKTs D6, C3, or D16 at the TCM connectors and CMP sensor connector.
   • If OK, replace TCM.

   YES → • System checks OK at this time. Malfunction may be intermittent or repaired during this procedure.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 72

Vehicle Speed Sensor (VSS) (TOSS) Circuit Open (Trans Output Speed Signal) (Figure 5-36)

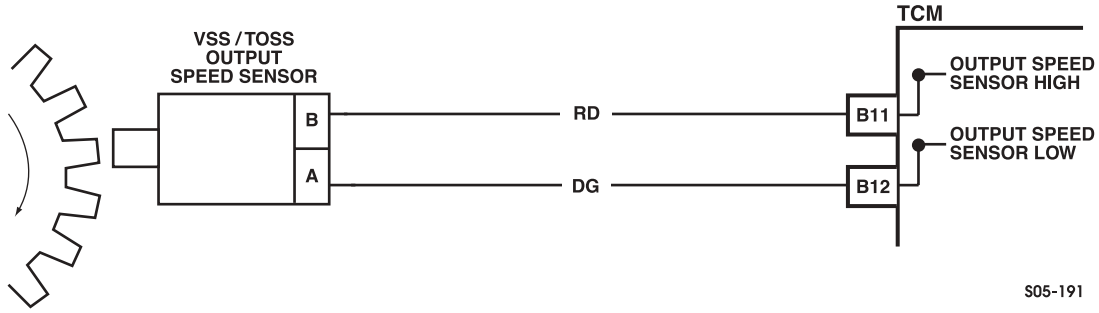


Figure 5-36: VSS/TOSS

Circuit Description

The VSS/TOSS sensor consists of a permanent magnet surrounded by a coil of wire. As the transmission output shaft rotates, an AC voltage is induced in the circuit. The signal voltage and frequency will vary directly with the output shaft rotational speed.

DTC 72 Will Set When

Not in P/N.

- Transmission output speed change is greater than 1000 RPM.
- Engine speed is greater than 200 RPM.
- Conditions met for 2 seconds.
- No DTC 28 set.

In P/N.

- Transmission output speed change is greater than 2050 RPM.
- Engine speed is greater than 200 RPM.
- Conditions met for 2 seconds.
- No DTC 28 set.

Action Taken (TCM will default to)

Delayed soft shift second gear and second gear start.

DTC 72 Will Clear When

The fault condition(s) no longer exist.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This checks the entire circuit for continuity.
2. This checks the output of the VSS/TOSS sensor.

Diagnostic Aids

- DTC 24 will set if no vehicle speed at start off.
- DTC 72 will set if vehicle speed was detected then lost.
- Refer to Control Module Intermittent DTC(s) or Performance.

DTC 72

Vehicle Speed Sensor (VSS) (TOSS) Circuit Open

- Install Tech-1A scan tool.
- Record then clear DTC(s).
- Disconnect both propeller shafts at transfer case.
- Engine operating.
- Transmission in any drive range.
- With transmission output shaft rotating, does Trans Output Speed increase with increased speed?

NO

1
- Disconnect connector from TOSS.
- With engine still running and transmission still in drive range, connect J 39200 DVM to sensor terminals. Measure on AC scale voltage at TOSS terminals. Voltage should vary proportionally to engine RPM (for same trans range).
- Does TOSS AC voltage vary above 7 VAC for engine RPM above 10 MPH equivalent?

YES

2
- Stop engine.
- Check wiring and connectors at TCM and TOSS for opens, shorts, grounds, or damaged pins.
- Was there a fault in connectors or wiring?

NO

- Replace faulty TCM or PROM.

YES

- Repair wiring or connector fault. Retest and check for DTC(s).

YES

- Problem is intermittent. Refer to Diagnostic Aids.

NO

- Replace defective TOSS.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 73

Pressure Control Solenoid (PCS) Circuit (Current Error) (Figure 5-37)

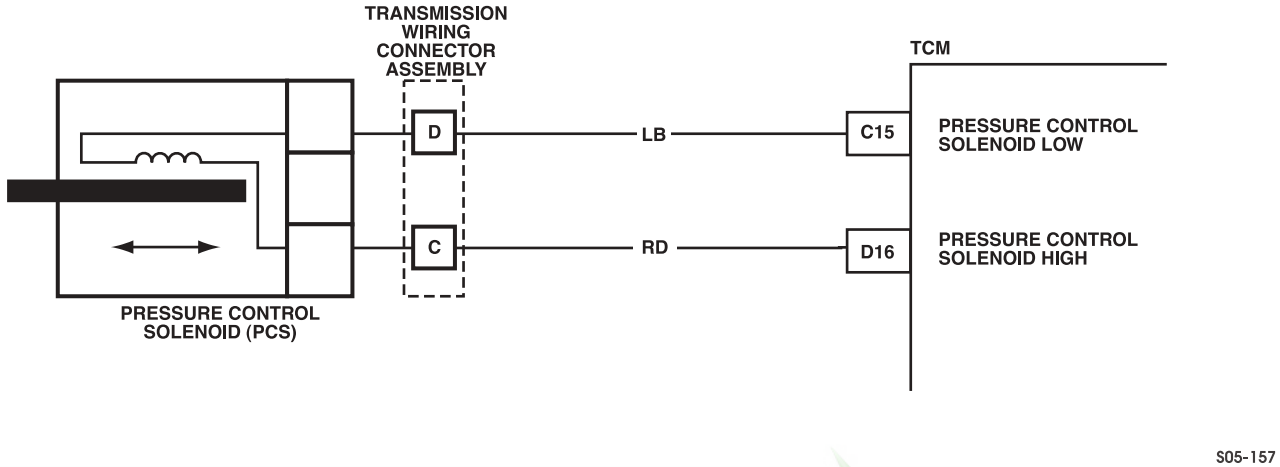


Figure 5-37: Pressure Control Solenoid

Circuit Description

The pressure control solenoid is a TCM controlled device used to regulate transmission line pressure. The TCM compares TP voltage, engine RPM, and other inputs to determine the line pressure appropriate for a given load. The TCM will regulate the pressure by applying a varying amperage to the pressure control solenoid. The applied amperage can vary from 0.1 to 1.1 amps. The TCM then monitors the amperage at the return line.

DTC 73 Will Set When

The return amperage varies greater than 0.16 amp from the commanded amperage, for at least one second, and no DTC 75 stored.

Action Taken (TCM will default to)

Full line pressure will be applied causing harsh shifts. DTC 73 will be stored in the TCM memory but will not turn ON the MIL (Malfunction Indicator Lamp).

DTC 73 Will Clear When

The fault condition(s) no longer exist, and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks the ability of the TCM to command the pressure control solenoid.
2. This test checks internal transmission harness and the pressure TCM for incorrect resistance.

Diagnostic Aids

- Check for poor connections at PCM and at transmission connector.
- If pressure readings differ greatly from the line pressure chart, repair transmission.

Line Pressure Chart

Pressure Control Solenoid Current (Amp)	Line Pressure (PSI)
0.02	157-177
0.10	151-176
0.20	140-172
0.30	137-162
0.40	121-147
0.50	102-131
0.60	88-113
0.70	63-93
0.80	43-73
0.90	37-61
0.98	35-55

DTC 73

Pressure Control Solenoid (PCS) Circuit (Current Error)

1
- Install Tech-1A scan tool.
- Record then clear DTC(s).
- Engine operating, transmission in PARK.
- Enter Misc. Tests/Transmission/PCS Control.
- Using scan tool, apply 1.0 amps thru 1.1 amps while observing desired PCS and actual PCS.
- Is actual PCS reading always within 0.16 amps of desired PCS?

NO

2
- Ignition OFF.
- Connect oil pressure gauge at transmission line pressure tap.
- Set parking brake/transmission in PARK.
- Start engine and allow it to warm at idle.
- Scan tool still installed, enter Misc. Test/ Transmission/PCS Control.
- Using scan tool, increase desired PCS in 0.1 amp increments (allow pressure to stabilize for 5 seconds after each current charge).
- Compare actual line pressure and current readings to line pressure chart.

  CAUTION: Total time should not exceed 2 minutes, or transmission damage could occur.
- Do readings match chart?

YES

- Problem is intermittent. Refer to Diagnostic Aids.

YES

- Ignition OFF.
- Check trans wiring connector terminal tension on the PCS circuits.
- If OK, refer to internal PCS circuit diagnosis.

NO

- Disconnect control module connector
- With J 39200 DVM, check resistance between vehicle harness terminals C15 and D16 (TCM).
- Does J 39200 DVM display resistance between 3.5 and 8 ohms?

NO

- Transmission electrical connector disconnected, check vehicle harness circuits C15 and D16 for open or short to ground.
- If no trouble is found, replace PCS.

YES

- Replace control module.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 74

Transmission Input Speed (TISS) Sensor Circuit (Figure 5-38)

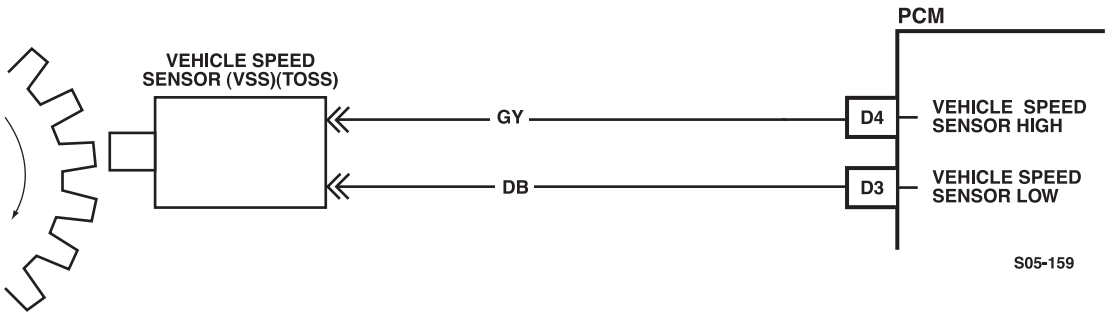


Figure 5-38: Input Speed Sensor

Circuit Description

The TISS sensor consists of a permanent magnet surrounded by a coil of wire. As the forward clutch housing rotates, an AC voltage is induced in the circuit. The signal voltage and frequency will vary directly with the forward clutch rotational speed.

DTC 74 Will Set When

- No DTC(s) 24, 28, or 71.
- Trans range not in park or neutral.
- Engine speed greater than 300 RPM.
- Trans output speed greater than 200 RPM.
- Trans input speed less than 50 RPM.
- All conditions met for 2 seconds.

Action Taken (TCM will default to)

No TCC operation.

DTC 74 Will Clear When

The fault condition(s) no longer exist.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This checks the entire circuit for continuity.
2. This checks the output of the input speed sensor.

Diagnostic Aids

Refer to Control Module Intermittent DTC(s) or Performance.

DTC 74

Transmission Input Speed Sensor (TISS) Circuit

1. Backprobe across CKT D4 and D3 at control module connector.
2. Engine at normal operating temperature and transmission in Drive.
3. J 39200 DVM on A/C voltage scale.
4. Does voltage increase above 7 volts with engine speed increase above approximately 10 mph?

NO

2. Ignition OFF.
3. Disconnect input speed sensor connector.
4. Engine operating and transmission in gear.
5. J 39200 DVM on A/C voltage scale.
6. With jumper wire and J 39200, measure voltage across sensor terminals.
7. Does voltage increase above 7 volts with drive wheel speed increase above approximately 10 mph?

NO

- Replace input speed sensor.

YES

- Check for open or shorted CKTs D3 and D4. Also check terminal tension of these circuits at the control module and the input speed sensor connector.
- If OK, replace control module.

YES

- Problem is intermittent or internal transmission.
- Refer to Diagnostic Aids.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 75

System Voltage Low (Figure 5-39)

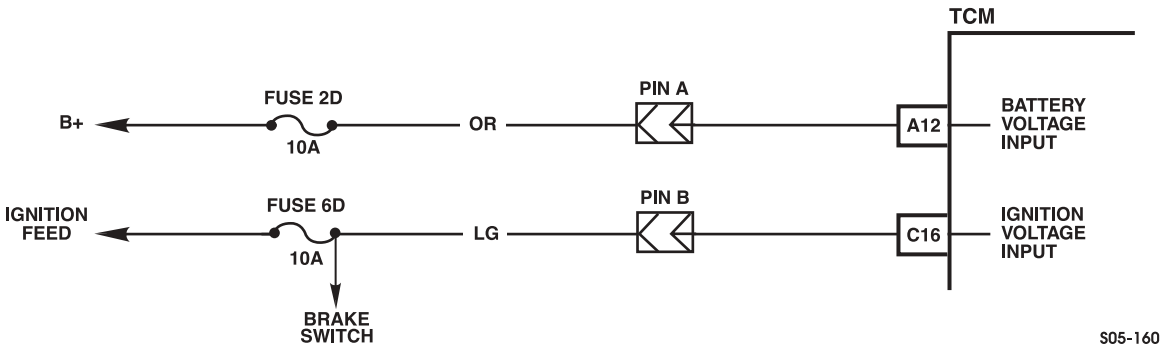


Figure 5-39: Voltage Inputs

Circuit Description

CKT A12is the battery feed for the control module. CKT C16 is the ignition voltage feed for the TCM.

DTC 75 Will Set When

The ignition is ON and TCM terminal A12 voltage is less than the graduated scale of: -40°F (-40°C) = 7.3 volts, 194°F (90°C) = 10.3 volts, or 304°F (151°C) = 11.7 volts, with engine speed greater than 1000 RPM for 4 seconds.

Action Taken (TCM will default to)

During the time the failure is present, the pressure control solenoid is turned OFF, soft landing to default second gear and TCC operation is inhibited. (The setting of additional diagnostic trouble codes may result.) DTC 75 will be stored in the TCM memory but will not turn ON the MIL (Malfunction Indicator Lamp).

DTC 75 Will Clear When

The fault condition(s) no longer exist.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

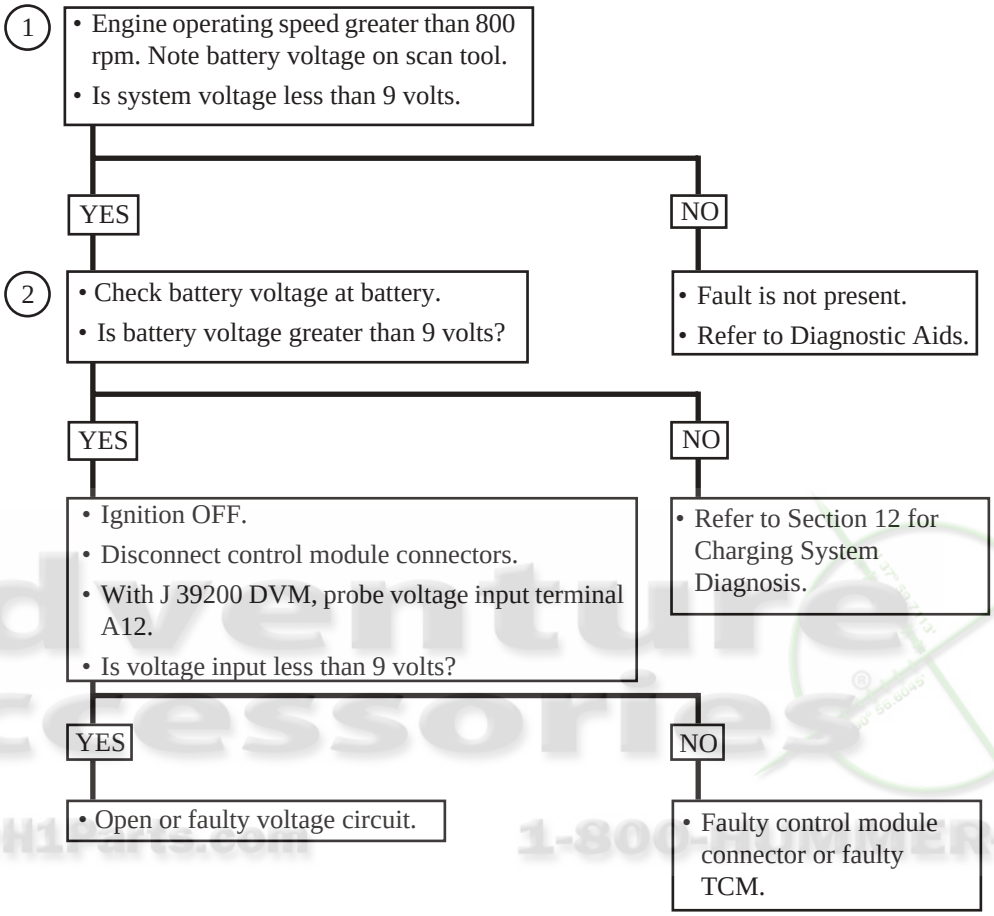
1. This test checks for normal battery voltage between 9 to 15 volts.
2. This test checks if the low voltage display is due to the alternator, CKT A12,or TCM, while the engine is running. If the voltage is less than 8.6 volts, the control module is OK.

Diagnostic Aids

- CKT A12 supplies battery voltage to the control module.
- Charging battery with a battery charger and jump starting engine may set DTC 52/DTC53. If diagnostic trouble code sets when an accessory is operated, check for poor connections or excessive current draw. Refer to Section 12 for circuit details. Also, check for poor connections at starter solenoid or fusible link.

DTC 75

System Voltage Low



When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 79

Transmission Fluid Overtemp (Figure 5-40)

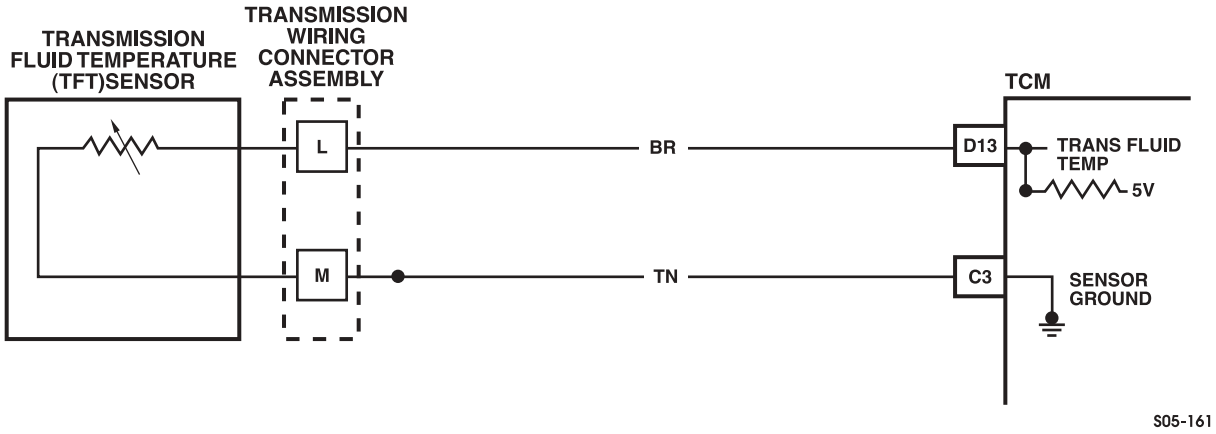


Figure 5-40: TFT Sensor

Circuit Description

The Transmission Fluid Temperature (TFT) sensor is a thermistor that controls the signal voltage to the TCM. The control module supplies a 5 volt reference signal to the sensor on CKT D13. When the transmission fluid is cold, the sensor resistance is high and the control module will sense high signal voltage.

As the transmission fluid temperature warms to normal transmission operating temperature 212°F (100°C), the sensor resistance becomes less and the voltage decreases to approximately 1.5 to 2.0 volts.

DTC 79 Will Set When

- No DTC 58.
- Trans fluid temp greater than 295°F (146°C).
- All conditions met for 30 minutes.

DTC 79 Will Clear When

The fault condition(s) no longer exists.

Chart Test Description

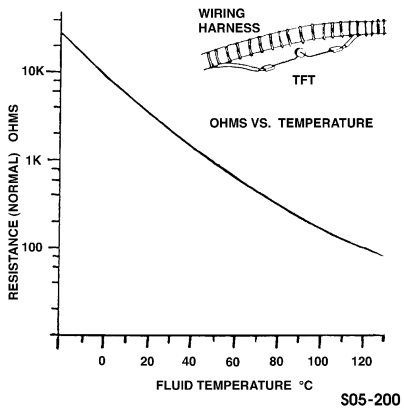
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for a skewed sensor or shorted circuit.
2. This test simulates a DTC 59.

Diagnostic Aids

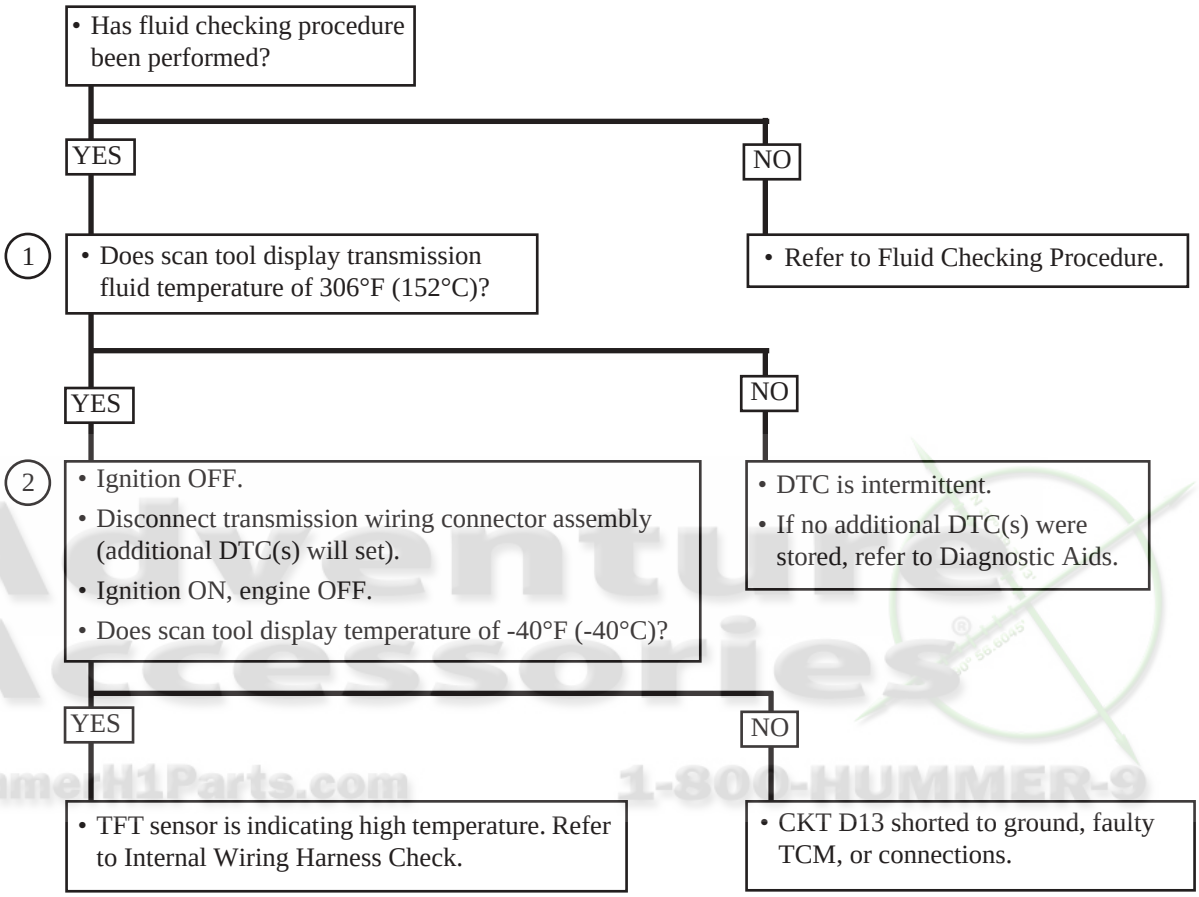
- Check harness routing for a potential short to ground in CKT D13.
- Scan tool TFT display should rise steadily to about 212°F (100°C) then stabilize.
- Refer to Control Module Intermittent Diagnostic Trouble Codes or Performance.
- The temperature to resistance value scale may be used to test the transmission sensor at the various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in delayed shifts or TCC complaints.
- Check transmission fluid. Refer to Fluid Checking Procedure.

Temperature vs. Resistance



DTC 79

Transmission Fluid Overtemp



When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 81

2-3 Shift Solenoid Circuit Fault (Figure 5-41)

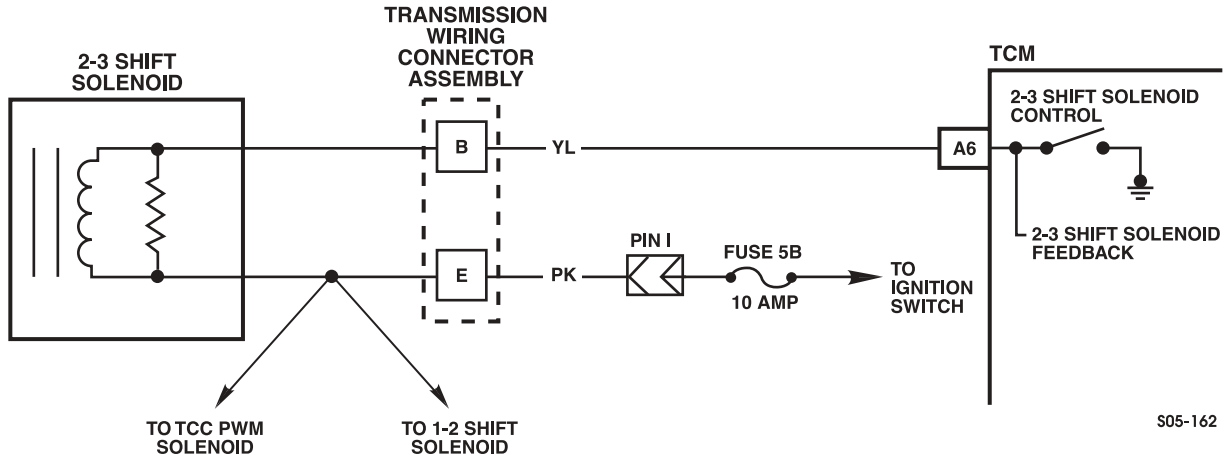


Figure 5-41: Shift Solenoid

Circuit Description

Ignition voltage is supplied directly to the 2-3 shift solenoid. The TCM controls the solenoid by providing the ground path through CKT A6.

DTC 81 Will Set When

The TCM commands the solenoid ON and voltage remains high for 2 seconds. The TCM commands the solenoid OFF and voltage remains low for 2 seconds.

Action Taken (TCM will default to)

If the solenoid is shorted OFF third gear only will occur. If the solenoid is shorted ON second gear only will occur, maximum line pressure, and no TCC. DTC 81 will be stored in the TCM memory but will not turn ON the MIL (Malfunction Indicator Lamp).

DTC 81 Will Clear When

The fault condition(s) no longer exist, and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

If the voltage remains high for at least 2 seconds, DTC 8l will set. If the voltage drops for more than two seconds, DTC 81 will set.

1. This test checks the function of the 2-3 shift solenoid and the internal transmission wiring.
2. This test checks for power to 2-3 shift solenoid from the ignition through the fuse.

Diagnostic Aids

- Check all connections at the transmission.
- Refer to Control Module Intermittent Diagnostic Trouble Codes or Performance.
- An open in the ignition feed circuit can cause multiple DTC(s) to set.

Shift Solenoids Chart

GEAR	1-2 SHIFT SOLENOID	2-3 SHIFT SOLENOID
1	ON	OFF
2	OFF	OFF
3	OFF	ON
4	ON	ON

DTC 81

2-3 Shift Solenoid Circuit Fault

1
- Install Tech-1A scan tool.
- Record then clear DTC(s).
- Ignition ON, engine OFF.
- Enter Misc. Tests/Transmission/2-3 Solenoid.
- Command 2-3 shift solenoid ON/OFF three times while listening at bottom of transmission pan (use stethoscope if necessary).
- Does solenoid click when commanded?

NO

2
- Ignition OFF.
- Disconnect transmission wiring connector assembly. (Additional DTCs will set.)
- Install J 39775 Jumper Harness/Probe Kit on the external wiring connector.
- Ignition ON, engine OFF.
- Connect test light from cavity E of J 39775 to ground.
- Is test light ON?

YES

- Install test light from cavities E to B of J 39775.
- Command 2-3 shift solenoid ON/OFF three times.
- Is test light ON when commanded ON, and OFF when commanded OFF?

NO

- Check CKT A6 for an open or short from control module to transmission wiring connector.
- If OK, replace TCM.

YES

- External transmission wiring check OK.
- Refer to Internal Wiring Harness Check.

NO

- Repair open or short to ground in the ignition voltage feed circuit to the transmission.
- If the fuse 5B is open, check the transmission internal wiring harness or solenoid for short to ground.

YES

- Electrical system check OK.
- Refer to Diagnostic Aids.

When all diagnosis and repairs are completed, clear DTC(s) and verify operation.

DTC 82

1-2 Shift Solenoid Circuit Fault (Figure 5-42)

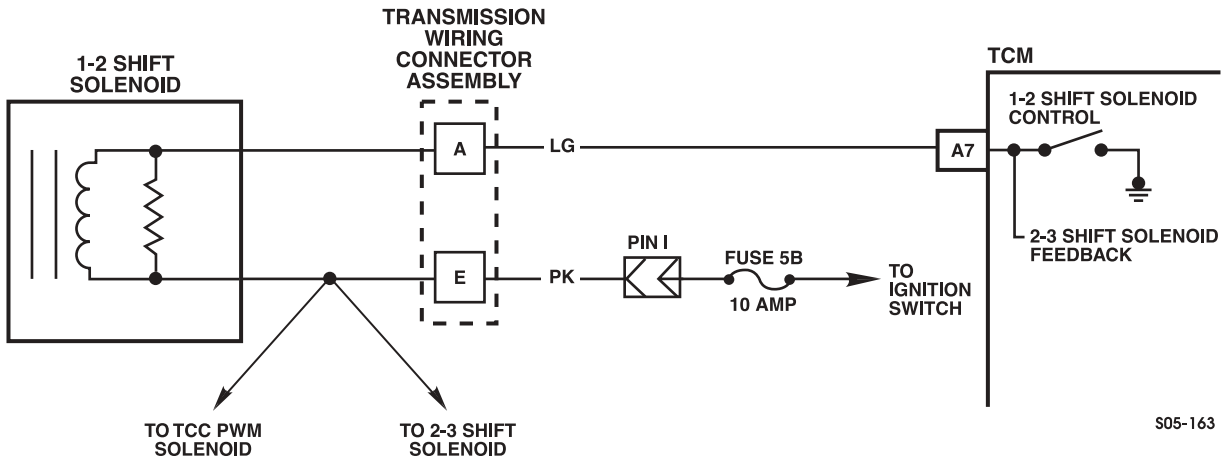


Figure 5-42: Shift Solenoid

Circuit Description

Ignition voltage is supplied directly to the 1-2 shift solenoid. The TCM controls the solenoid by providing the ground path through CKT A7.

DTC 82 Will Set When

The TCM commands the solenoid ON and voltage remains high for 2 seconds. The TCM commands the solenoid OFF and voltage remains low for 2 seconds.

Action Taken (TCM will default to)

The transmission will only allow second and third gear, or first and fourth gear and maximum line pressure. DTC 82 will be stored in the TCM memory but will not turn ON the MIL (Malfunction Indicator Lamp).

DTC 82 Will Clear When

The fault condition(s) no longer exist, and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

If the voltage remains high for at least 2 seconds, DTC 82 will set. If the voltage drops for more than 2 seconds, DTC 82 will set.

1. This test checks the function of the 1-2 shift solenoid and the internal transmission wiring harness.
2. This test checks for power to 1-2 shift solenoid from the ignition through the fuse.

Diagnostic Aids

- Check all connections for the transmission.
- Refer to Control Module Intermittent Diagnostic Trouble Codes or Performance.
- An open in the ignition feed circuit can cause multiple DTC(s) to set.

Shift Solenoids Chart

GEAR	1-2 SHIFT SOLENOID	2-3 SHIFT SOLENOID
1	ON	OFF
2	OFF	OFF
3	OFF	ON
4	ON	ON

DTC 82

1-2 Shift Solenoid Circuit Fault

1
- Install Tech-1A scan tool.
- Record then clear DTC(s).
- Ignition ON, engine OFF.
- Enter Misc. Tests/Transmission/1-2 Solenoid.
- Command 1-2 shift solenoid ON/OFF three times while listening at bottom of transmission pan (use stethoscope if necessary).
- Does solenoid click when commanded?

NO

2
- Ignition OFF.
- Disconnect transmission wiring connector ASM. (Additional DTCs will set.)
- Install J 39775 Jumper Harness/Probe Kit on the external harness connector.
- Ignition ON, engine OFF.
- Connect test light from cavity E of J 39775 to ground.
- Is test light ON?

YES

- Install test light from cavities E to A of J 39775.
- Command 1-2 shift solenoid ON/OFF three times.
- Is test light ON when commanded ON, and OFF when commanded OFF?

NO

- Check CKT A7 for an open or short from the transmission external wiring connector to the control module connector.
- If OK, replace TCM.

YES

- External transmission wiring check OK.
- Refer to Internal Wiring Harness Check.

NO

- Repair open or short to ground in the ignition voltage feed circuit to the transmission. If the fuse is open, check the transmission internal wiring harness or solenoid for short to ground.

YES

- Electrical system check OK.
- Refer to Diagnostic Aids.

When all diagnosis and repairs are completed, clear DTC(s) and verify proper operation.

DTC 83

TCC PWM Solenoid Circuit Fault (Figure 5-43)

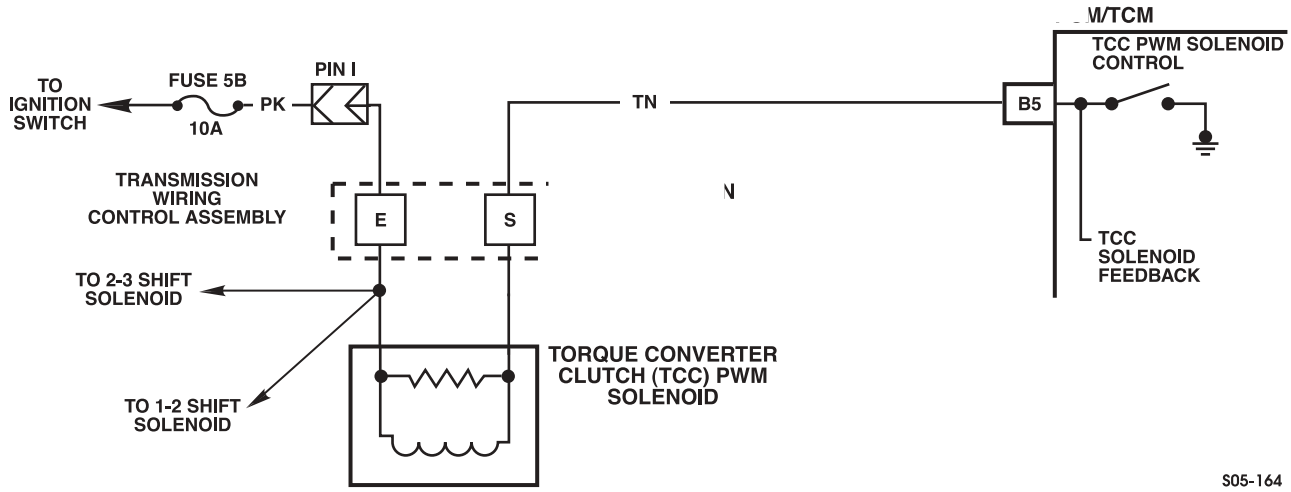


Figure 5-43: TCC PWM Solenoid

Circuit Description

The TCM supplies a ground, through an internal Quad-Driver Module (QDM), allowing current to flow through the solenoid coil according to the duty cycle (percentage of ON and OFF time). This current flow through the solenoid coil creates a magnetic field that magnetizes the solenoid core. The magnetized core attracts the checkball to seat against spring pressure. This blocks the exhaust for the TCC signal fluid and allows 2-3 drive fluid to feed the TCC signal circuit. The TCC signal fluid pressure acts on the TCC regulator valve to regulate line pressure and to apply fluid pressure to the torque converter clutch shift valve. When the TCC shift valve is in the apply position, regulated apply fluid pressure is directed through the TCC valve to apply the torque converter clutch.

DTC 83 Will Set When

• The TCM commands the solenoid ON and voltage remains high (B+).

Or

• The TCM commands the solenoid OFF and voltage remains low (zero volts).

• All conditions met for 2 seconds.

Action Taken (TCM will default to)

- Inhibit TCC operation.
- Inhibit 4th gear operation if in hot mode.

DTC 83 Will Clear When

The fault condition(s) no longer exist, and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test will check if the TCM is commanding the TCC solenoid ON.

2. This test will check for voltage to the solenoid.

Diagnostic Aids

- Check all connections at the transmission pass-thru connector.
- If they are OK, refer to Control Module Intermittent DTC(s) or Performance.

DTC 83

TCC PWM Solenoid Circuit Fault

1
- Install Tech-1A scan tool.
- Record then clear DTC(s).
- Enter Misc. Tests/Transmission/TCC PWM Solenoid.
- With engine at normal operating temperature, select D4 and accelerate to indicated speed of 75 mph (40 km/h).
- Command TCC PWM solenoid ON, then OFF while observing TCC slip speed on scan tool display.
- Is TCC slip speed less than 10 RPM while commanded ON, or is TCC slip speed greater than 10 RPM while commanded OFF?

NO

2
- Ignition OFF.
- Disconnect transmission wiring connector assy. (Additional DTCs will set.)
- Install J 39775 Jumper Harness/Probe Kit on the external wiring connector.
- Ignition ON, engine OFF.
- Connect test light from cavity E of J 39775 to ground.
- Is test light ON?

YES

- Install test light from cavities E to S of J 39775.
- Command TCC PWM solenoid ON/OFF three times.
- Is test light ON when commanded ON, and OFF when commanded OFF?

NO

- Check CKT B5 for an open or short from the control module to the transmission wiring connector.
- If OK, replace TCM.

YES

- External transmission wiring checks OK.
- Refer to Internal Wiring Harness Check.

YES

- Electrical system check OK.
- Refer to Diagnostic Aids.

NO

- Repair open or short to ground in the ignition voltage feed circuit to the transmission. If the fuse 5B is open, check the transmission internal wiring harness or solenoid for short to ground.

When all diagnosis and repairs are completed, clear DTC(s) and verify proper operation.

DTC 85

Undefined Ratio Error (Figure 5-44)

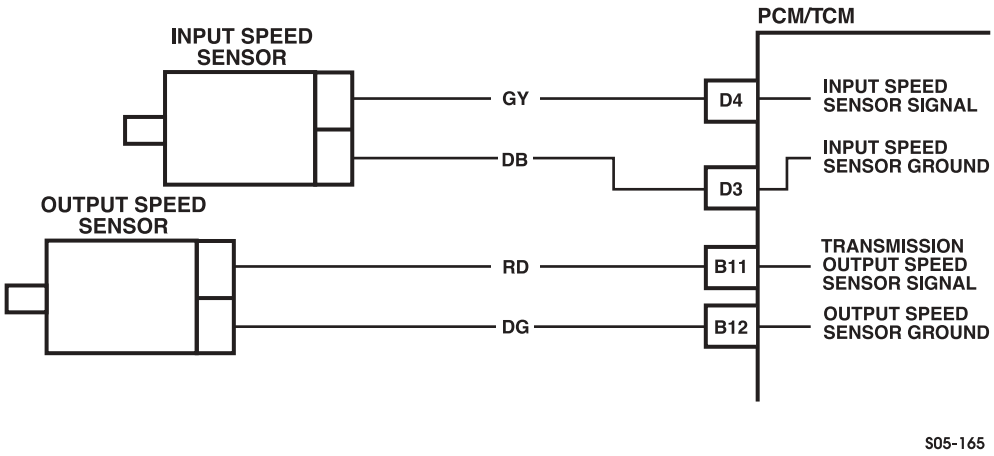


Figure 5-44: Gear Ratio Circuits

Circuit Description

The TCM calculates the actual gear ratio based on the transmission input speed and output speed sensor readings. The TCM compares the known transmission ratio to the calculated ratio, for the particular gear range selected.

DTC 85 Will Set When

- No DTC(s) 21, 22, 24, 28, 71, 72 and 87.
- TP is greater than 25%.
- Not in P/N or 4th gear.
- Engine speed is greater than 300 RPM.
- Vehicle speed is greater than 7 mph.
- All conditions are met for 2 seconds.

Action Taken (TCM will default to)

- Line pressure set to maximum.
- Inhibits TCC operation.

Gear Ratios Chart

COMMANDED GEAR	IF CALCULATED RATIO IS	
	LESS THAN	MORE THAN
1st	2.38	2.63
2nd	1.43	1.58
3rd	0.95	1.05
REV	1.97	2.17

DTC 85 Will Clear When

The condition no longer exists, and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

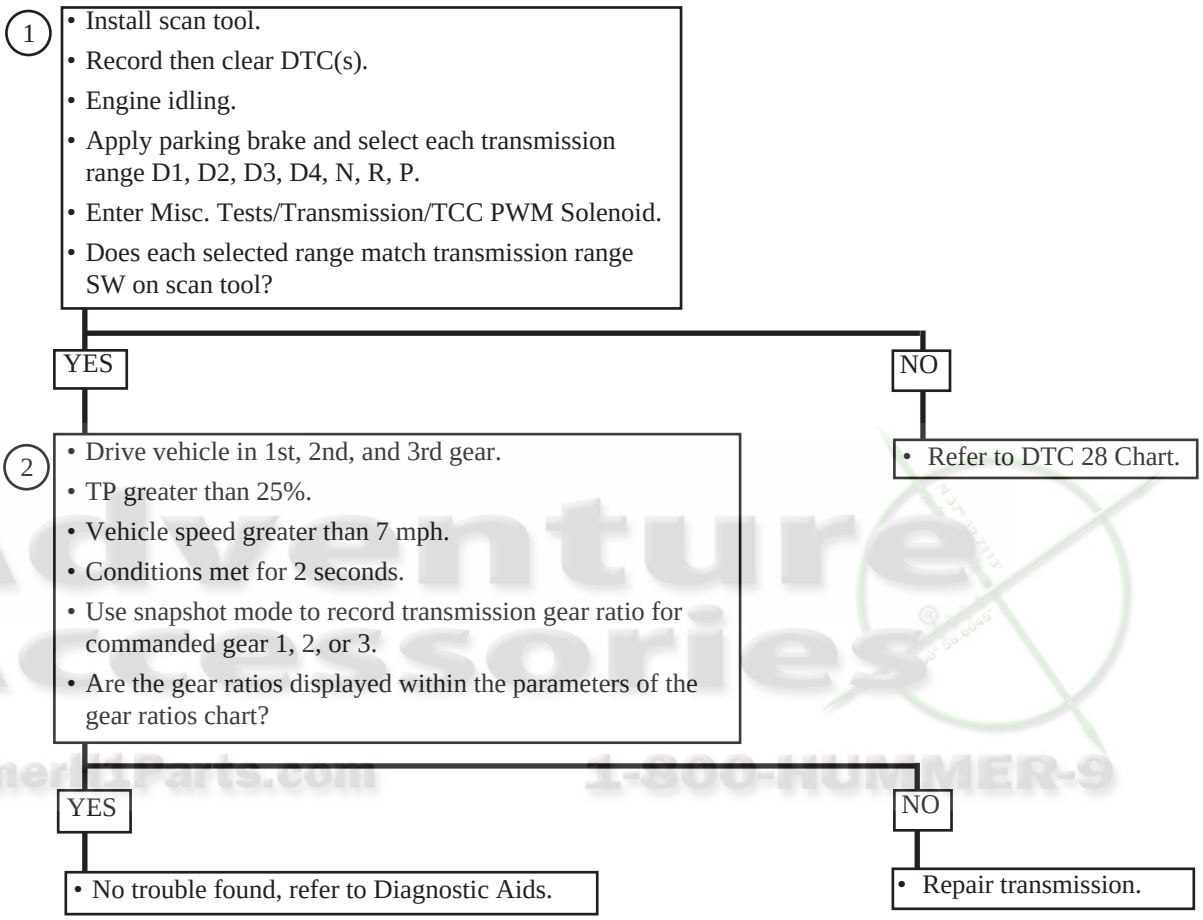
1. A malfunctioning trans range pressure switch could indicate an incorrect transmission range.
2. This test checks the calculated ratio to determine if the ratio is within the parameters.

Diagnostic Aids

DTC 85 will set when an unknown gear ratio is detected for any gear but 4th. Note commanded gear and incorrect ratio. Check transmission fluid level.

DTC 85

Undefined Ratio Error



When all diagnosis and repairs are completed, clear DTC(s) and verify proper operation.

DTC 86

Low Ratio Error (Figure 5-45)

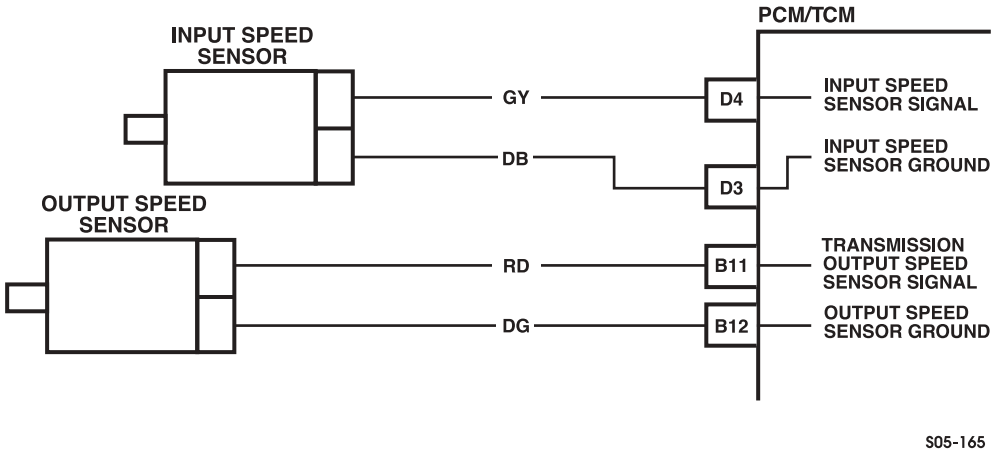


Figure 5-45: Gear Ratio Circuits

Circuit Description

The TCM calculates ratio based on the transmission input speed and output speed sensor readings. The TCM compares the known transmission ratio to the calculated ratio, for the particular gear range selected.

DTC 86 Will Set When

- No DTC(s) 21, 22, 24, 28, 71, 72, and 74.
- Engine speed greater than 300 RPM.
- TP greater than 25%.
- Vehicle speed greater than 7 mph.
- Trans gear ratio is less than 1.06 in first or second gear.
- All conditions met for 2 seconds.

Action Taken (TCM will default to)

- 2nd gear.
- Line pressure set to maximum.
- Inhibit TCC operation.

DTC 86 Will Clear When

The fault no longer exists, and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. A malfunctioning trans range pressure switch could indicate an incorrect transmission range.
2. This test compares the known ratio for a commanded gear to the calculated ratio displayed on the scan tool.

Diagnostic Aids

This DTC will set when transmission commanded gear is 1or 2 and transmission is mechanically in 3rd or 4th gear. DTC 81 is used to detect a 2-3 shift solenoid circuit malfunction.

DTC 86

Low Ratio Error

1. • Install scan tool.
   • Record then clear DTC(s).
   • Engine idling.
   • Apply park brake and select each transmission range D1, D2, D3, D4, N, R, P.
   • Enter Misc. Tests/Transmission/TCC PWM Solenoid.
   • Does each selected range match transmission range SW on scan tool?

YES

2. • Drive vehicle with 1st then 2nd gear commanded.
   • TP greater than 25%.
   • Vehicle speed greater than 7 mph.
   • Conditions met for 2 seconds.
   • Use snapshot mode to record transmission gear ratio for commanded gear ratio on scan tool display for commanded gear 1 and 2.
   • Is transmission gear ratio displayed less than 1.06 while commanded gear is 1 or 2?

YES

• Repair transmission.

NO

• No trouble found, refer to Diagnostic Aids.

NO

• Refer to DTC 28.

Gear Ratios Chart		
Commanded Gear	If Calculated Ratio Is	
	Less Than	More Than
1st	2.38	2.63
2nd	1.43	1.58
3rd	0.95	1.05
REV	1.97	2.17

When all diagnosis and repairs are completed, clear DTC(s) and verify proper operation.

DTC 87

High Ratio Error (Figure 5-46)

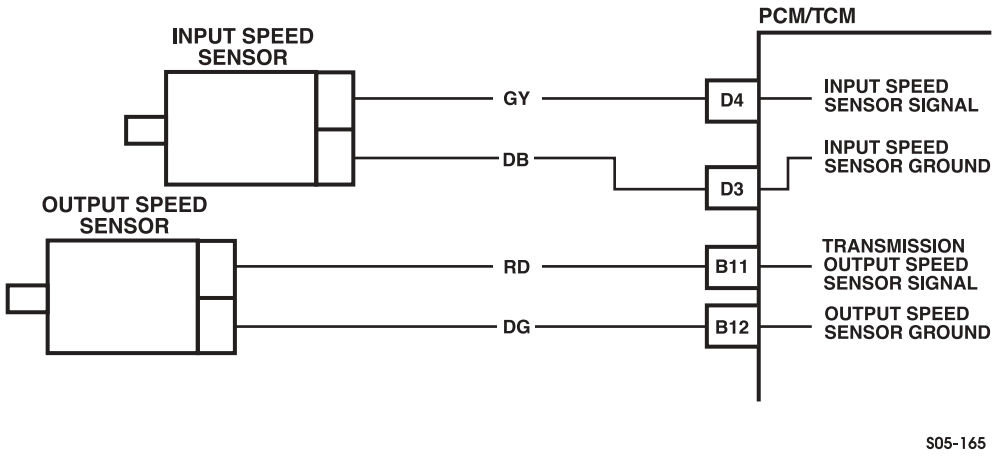


Figure 5-46: Gear Ratio Circuits

Circuit Description

The TCM calculates ratio based on the transmission input speed and output speed sensor readings.

The TCM compares the known transmission ratio to the calculated ratio for the particular gear range selected.

DTC 87 Will Set When

- No DTC(s) 21, 22, 24, 28, 71, 72, and 74.
- TP greater than 25%.
- Not in P, R, N.
- Engine speed greater than 300 RPM.
- Vehicle speed greater than 7 mph.
- Transmission temperature is greater than 68°F (20°C).
- Transmission gear ratio is greater than 1.42 in 3rd or 4th gear.
- All conditions met for 2 seconds.

Action Taken (TCM will default to)

- 2nd gear.
- Line pressure set to maximum.
- Inhibit TCC operation.

DTC 87 Will Clear When

The fault condition(s) no longer exists, and the ignition switch is cycled OFF then ON.

Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. A malfunctioning transmission range pressure switch could indicate an incorrect transmission range.
2. This test compares the known ratio for a commanded gear to the calculated ratio displayed on the scan tool.

Diagnostic Aids

This DTC will set when transmission commanded gear is 3 or 4 and transmission is mechanically in 1st or 2nd gear. DTC 81 is used to detect a 2-3 shift solenoid circuit malfunction.

DTC 87

Low Ratio Error

1. Install scan tool.
   - Record then clear DTC(s).
   - Engine idling.
   - Apply park brake and select each transmission range D1, D2, D3, D4, N, R, P.
   - Enter Misc. Tests/Transmission/TCC PWM Solenoid.
   - Does each selected range match transmission range SW on scan tool?

YES

2. Drive vehicle with D3 or D4 selected. Vehicle speed greater than 45 MPH.
   - TP greater than 25%.
   - Trans fluid temp greater than 68°F (20°C).
   - Use snapshot mode to record transmission gear ratio on scan tool display.
   - Is the transmission gear ratio displayed greater than 1.42 while commanded gear displays 3 or 4?

YES

- Repair transmission.

NO

- No trouble found, refer to Diagnostic Aids.

NO

- Refer to DTC 28.

Gear Ratios Chart		
Commanded Gear	If Calculated Ratio Is	
	Less Than	More Than
1st	2.38	2.63
2nd	1.43	1.58
3rd	0.95	1.05
REV	1.97	2.17

When all diagnosis and repairs are completed, clear DTC(s) and verify proper operation.

TCM CONNECTOR IDENTIFICATION

This TCM voltage chart is for use with a J 39200 DVM to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

The "B+" symbol indicates a nominal system voltage of 12-14 volts.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- Engine at operating temperature
- Engine idling (for "Engine Operating" column)
- Test terminal not grounded

PIN	PIN FUNCTION	WIRE COLOR	COMPONENT CONNECTOR	NORMAL VOLTAGE		DTC(s) AFFECTED	POSSIBLE SYMPTOMS
				IGNITION ON	ENGINE OPERATING		
A1	Not Used	—	—	—	—	—	—
A2	Not Used	—	—	—	—	—	—
A3	Range Signal A	OR	Transmission N	B+	B+ (1)	28	
A4	Range Signal B	DB	Transmission R	0*	0* (1)	28	
A5	Range Signal C	PP	Transmission P	B+	B+ (1)	28	
A6	2-3 Shift Solenoid Control	YL	Transmission B	B+	B+	81	Incorrect Gear State
A7	1-2 Shift Solenoid Control	LG	Transmission A	B+	0*	82	Incorrect Gear State
A8	DLC Diagnostic	WH	Data Link Connector	5V	5V	None	No Change
A9	Not Used	—	—	—	—	—	—
A10	Not Used	—	—	—	—	—	—
A11	Not Used	—	—	—	—	—	—
A12	Battery Feed	OR	Battery	B+	B+	None	

* Less than 0.5 VOLT (500 mV).

(1) Readings in the P/N position.

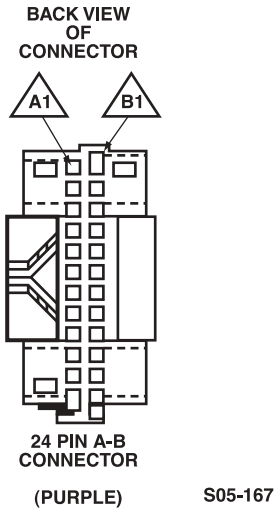


Figure 5-47: TCM Connector Identification

TCM CONNECTOR IDENTIFICATION

This TCM voltage chart is for use with a J 39200 DVM to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

The "B+" symbol indicates a nominal system voltage of 12-14 volts.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- Engine at operating temperature
- Engine idling (for "Engine Operating" column)
- Test terminal not grounded
- Scan tool not installed

PIN	PIN FUNCTION	WIRE COLOR	COMPONENT CONNECTOR	NORMAL VOLTAGE		DTC(s) AFFECTED	POSSIBLE SYMPTOMS
				IGNITION ON	ENGINE OPERATING		
B1	Not Used	—	—	—	—	—	—
B2	Not Used	—	—	—	—	—	—
B3	A/C Signal	LB	A/C Switch	(1)	(1)	None	Incorrect Idle
B4	Brake Signal	PP	Brake Switch	(2)	(2)	None	No TCC
B5	TCC Control	TN	Transmission S	B+	B+	39, 83	No TCC
B6	Not Used	—	—	—	—	—	—
B7	Not Used	—	—	—	—	—	—
B8	Not Used	—	—	—	—	—	—
B9	Trans Lamp Control	BR	Instrument Panel	0*	B+	None	MIL Inoperative
B10	Serial Data	OR	Data Link Connector	(3)	(3)	None	No Serial Data
B11	Trans Output Speed Sensor (TOSS)	RD	TOSS	(3)	(3)	85, 86, 87	No Output
B12	Trans Output Speed Sensor (TOSS)	DG	TOSS	(3)	(3)	85, 86, 87	Speed

* Less than 0.5 VOLT (500 mV).

(1) 0 Volts A/C OFF.Battery Voltage A/C ON.

(2) Battery voltage brakes released and 0 Volts brakes applied.

(3) Varies.

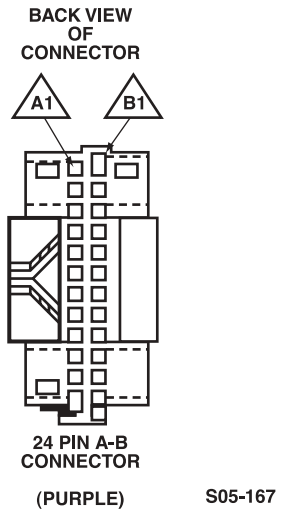


Figure 5-48: TCM Connector Identification

TCM CONNECTOR IDENTIFICATION

This TCM voltage chart is for use with a J 39200 DVM to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

The "B+" symbol indicates a nominal system voltage of 12-14 volts.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- Engine at operating temperature
- Engine idling (for "Engine Operating" column)
- Test terminal not grounded
- Scan tool not installed

PIN	PIN FUNCTION	WIRE COLOR	COMPONENT CONNECTOR	NORMAL VOLTAGE		DTC(s) AFFECTED	POSSIBLE SYMPTOMS
				IGNITION ON	ENGINE OPERATING		
C1	System Ground	BK	Engine Block	0*	0*	None	
C2	System Ground	BK	Engine Block	0*	0*	None	—
C3	Sensor Ground	TN	Splice	0*	0*	21, 59	Lack of Power
C4	TP Reference	GY	TP Sensor	5V	5V	22	Lack of Power
C5	Not Used	—	—	—	—	—	—
C6	Not Used	—	—	—	—	—	—
C7	Not Used	—	—	—	—	—	—
C8	Not Used	—	—	—	—	—	—
C9	Not Used	—	—	—	—	—	—
C10	Not Used	—	—	—	—	—	—
C11	Not Used	—	—	—	—	—	—
C12	Not Used	—	—	—	—	—	—
C13	Not Used	—	—	—	—	—	—
C14	Not Used	—	—	—	—	—	—
C15	Pressure Control Solenoid Low	LB	Transmission D	0*	0.85V	73	Harsh Shifts
C16	Ignition Feed	LG	Splice	B+	B+	None	No Start

* Less than 0.5 VOLT (500 mV).

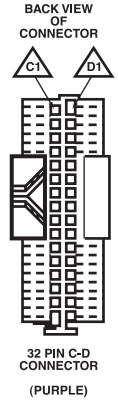


Figure 5-49: TCM Connector Identification

TCM CONNECTOR IDENTIFICATION

This TCM voltage chart is for use with a J 39200 DVM to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

The “B+” symbol indicates a nominal system voltage of 12-14 volts

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- Engine at operating temperature
- Engine idling (for “Engine Operating” column)
- Test terminal not grounded
- Scan tool not installed

PIN	PIN FUNCTION	WIRE COLOR	COMPONENT CONNECTOR	NORMAL VOLTAGE		DTC(s) AFFECTED	POSSIBLE SYMPTOMS
				IGNITION ON	ENGINE OPERATING		
D1 or D2	Not Used	—	—	—	—	—	—
D3	Transmission Input Speed Sensor Low	DB	Input Speed Sensor	0*	0*	None	—
D4	Transmission Input Speed Sensor Low	GY	TP Sensor	5V	5V	22	Lack of Power
D5	Not Used	—	—	—	—	—	—
D6	Engine Speed Signal	WH	Engine Speed Sensor	0*	(2)	12	—
D7	Sensor Ground	TN	Splice	0*	0*	21, 59	Harsh Shifts
D8	TP Signal	DB	TP Sensor	0.67V (1)	(2)	21, 22	Harsh Shifts
D9	Not used	—	—	—	—	—	—
D10	Not Used	—	—	—	—	—	—
D11	Not Used	—	—	—	—	—	—
D12	Not Used	—	—	—	—	—	—
D13	Transmission Fluid Temperature Signal	BR	Transmission L	(2) 2V	(2) 2V	58, 59	Early TCC
D14	Baro	OR	Baro B	(2)	(2)	None	—
D15	Not Used	—	—	—	—	—	—
D16	Pressure Control Solenoid High	RD	Splice	B+	B+	None	No Start

* Less than 0.5 VOLT (500 mV).

(1) Readings in the P/N position.

(2) Varies

S05A-038

Figure 5-50: TCM Connector Identification

TRANSMISSION/TRANSFER CASE ASSEMBLY REPLACEMENT

WARNING: Allow transmission/transfer case to cool before performing this task. Failure to do this may cause injury.

CAUTION: *Cover or plug all open lines, ports, and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.*

NOTE: Drain transmission before removal. Examine or save oil for later examination. Look for metal debris, burned clutch material, and contaminants.

Removal

1. Remove catalytic converter and crossover pipe (Section 3).
2. Remove rear propeller shaft.
3. Remove front propeller shaft.
4. Remove converter housing covers.
5. Remove cotter pin, washer, and shift rod and trunnion from relay lever. Discard cotter pin (Figure 5-51).

WARNING: Brakes must be applied at all times to prevent unexpected vehicle motion. Failure to do this may cause injury.

6. Remove cotter pin, washer, and transfer case shift rod from range lever. Discard cotter pin (Figure 5-52).
7. Disconnect range switch.

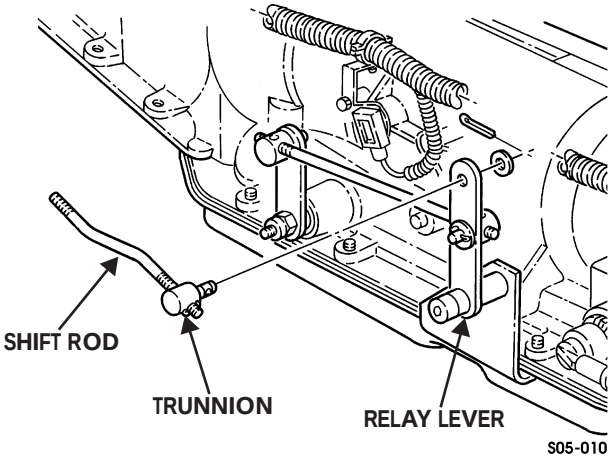


Figure 5-51: Relay Lever

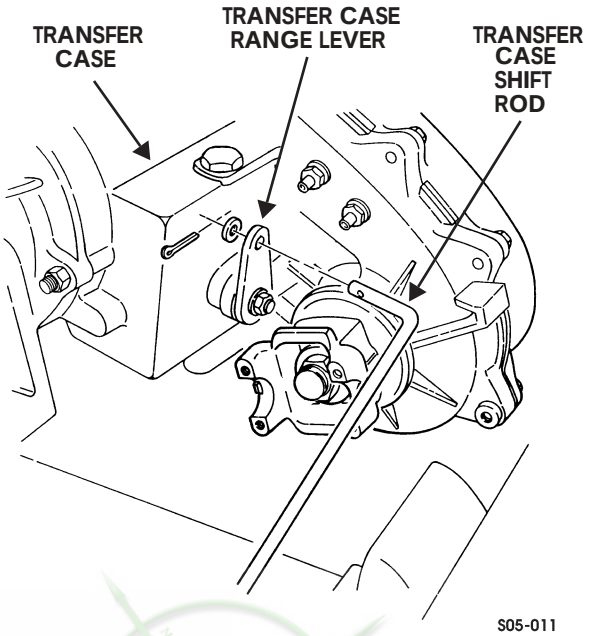


Figure 5-52: Shift Rod and Range Lever

8. Remove capscrew and washer from dipstick tube bracket and cylinder head (Figure 5-53).
9. Remove dipstick tube and multi-lip seal from transmission. Discard seal only if damaged.

NOTE: Have drainage container ready to catch fluid. Tag hoses for installation.

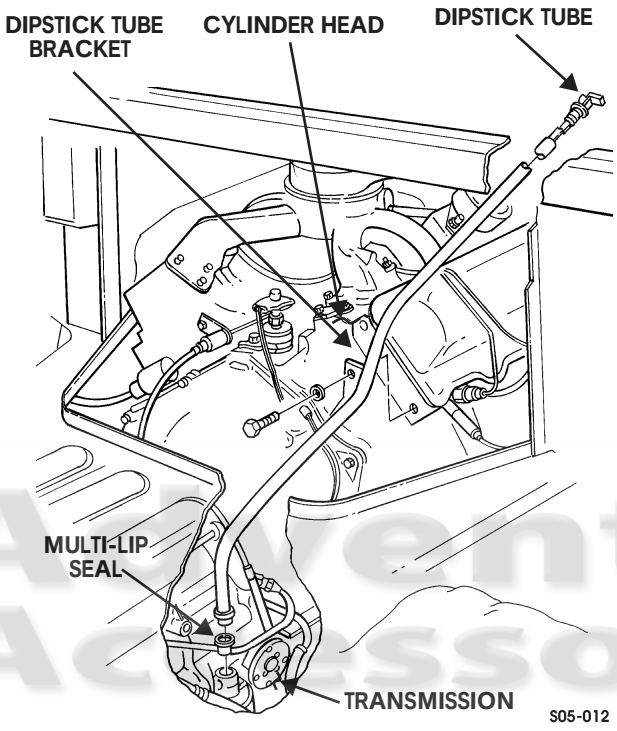


Figure 5-53: Dipstick Tube

10. Loosen hose clamps and disconnect oil cooler lines from transmission/transfer case cooler line hoses (Figure 5-54).
11. Disconnect main vent line from transmission/transfer case vent line (Figure 5-54).

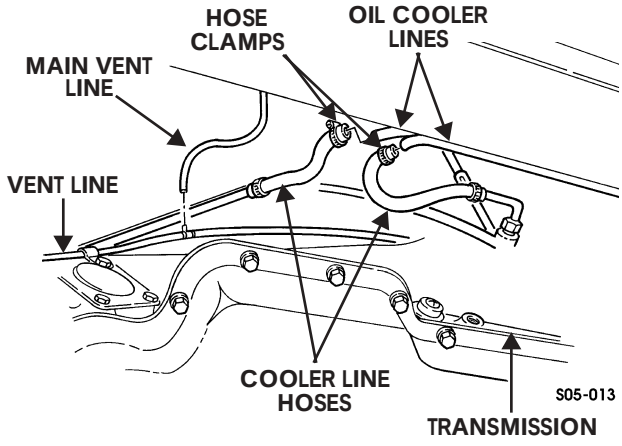


Figure 5-54: Oil Cooler Lines

NOTE: Some connector plugs have a soft multi-lip seal for environmental protection. Unless damaged, these seals are reusable.

12. Disconnect connector from vehicle speed sensor on transfer case (Figure 5-55).

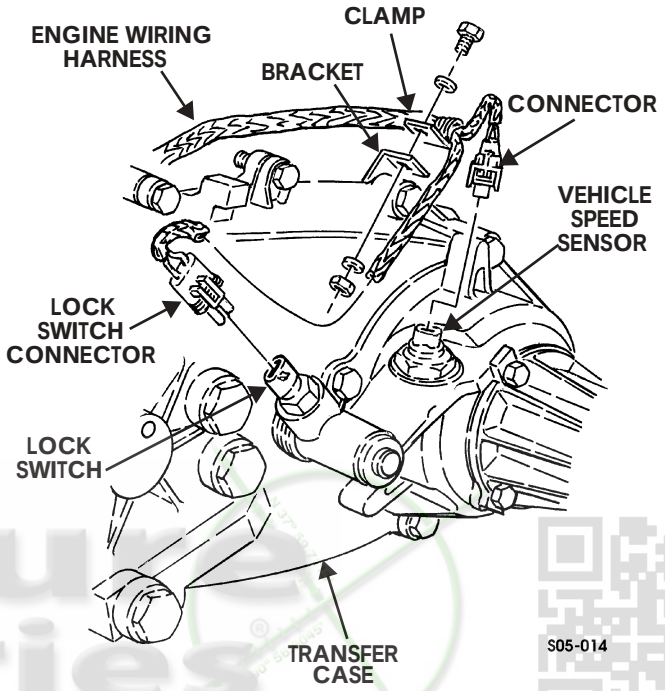


Figure 5-55: Vehicle Speed Sensor and Lock Switch Harness

13. Disconnect lock switch connector from lock switch on transfer case.

***CAUTION**: Protect connectors, switch, and speed sensor from dust, dirt, and damage.*

14. Remove nut, lockwasher, capscrew, washer, and engine wiring harness clamp from bracket.

***CAUTION**: Remove engine wiring harness connector by pressing both tabs and pulling straight away from transmission case connector. Do not twist, wiggle, or pry connectors apart. Damage to pins or loosening of wires could result and cause inoperative or malfunctioning transmission.*

15. Remove wiring harness connector from transmission case connector. Squeeze two tabs together and pull straight apart (Figure 5-56).
16. Remove connectors from input speed sensor and output speed sensor (Figure 5-57). Tag connectors for front or rear installation.
17. Remove two plastic harness clips from sensor brackets

NOTE: Protect connectors and sensor connections from dust, dirt, and damage.

18. Remove tow plastic harness clips from sensor brackets.

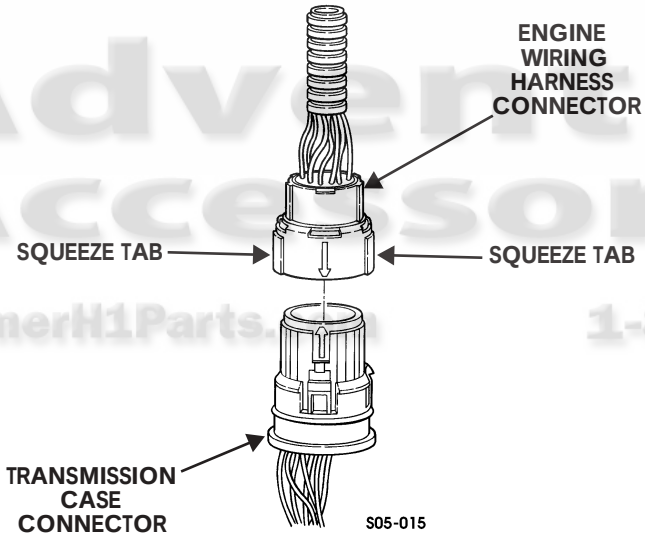


Figure 5-56: Wiring Harness Connector

19. Support transmission and transfer case with transmission jack and secure with safety chain (Figure 5-58).

***CAUTION**: Safety chain must be routed under transmission oil cooler and vent lines and away from speed sensors, or damage may result.*

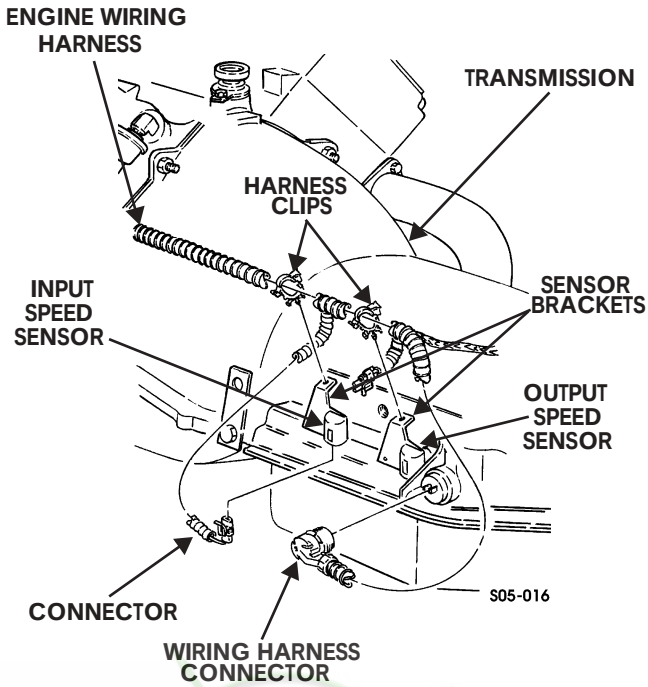


Figure 5-57: Speed Sensor

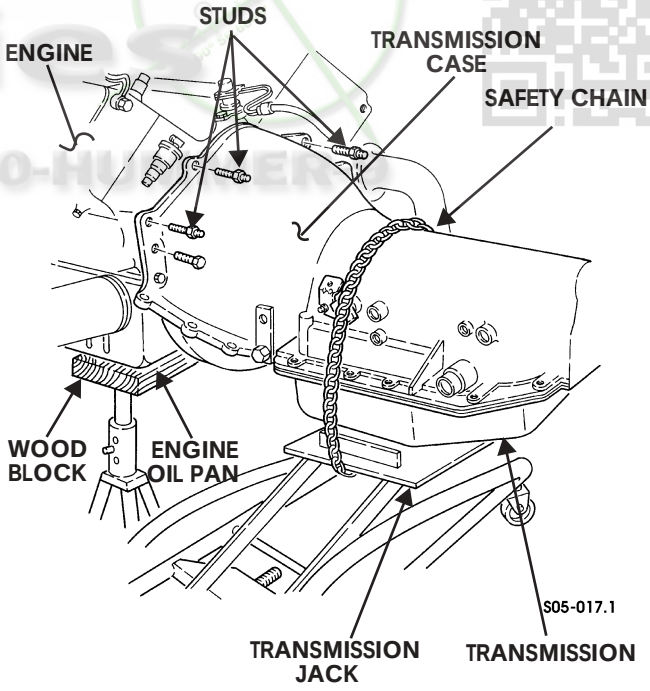


Figure 5-58: Transmission Supported on Jack

20. Remove four capscrews and three studs from transmission case and engine.

21. Remove two capscrews from transmission adapter and transmission mount (Figure 5-59).

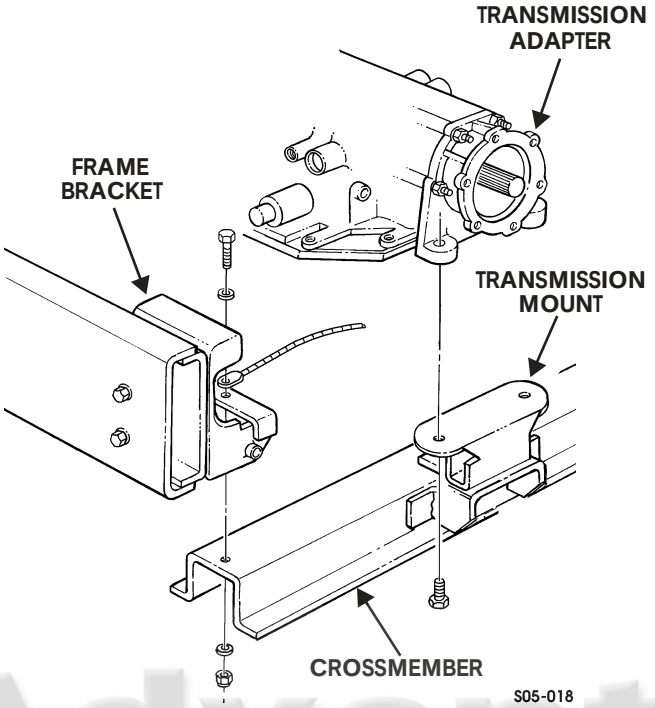


Figure 5-59: Transmission Adapter

22. Remove two locknuts, washers, capscrews, washers, and crossmember from frame brackets. Discard locknuts.
23. Remove six capscrews from flexplate (flywheel) and torque converter (Figure 5-60).

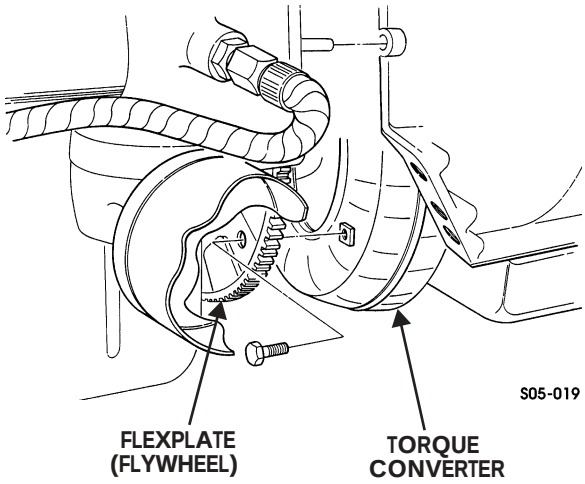


Figure 5-60: Torque Converter and Flexplate

***CAUTION**: If transmission is lowered too far, cooling fan damage will result. Wood block must completely cover bottom of engine oil pan, or oil pan damage will result.*

24. Support engine under oil pan with wood block and stand, and lower transmission slightly (Figure 5-58).

WARNING: Torque converter must be removed with the transmission as an assembly. Keep transmission tipped slightly, with front high. The converter may slide off front of transmission and cause injury or damage to converter. Do not use hands to free transmission/transfer case assembly. Use prybar to avoid injury.

***CAUTION**: Always remove the transmission/transfer case assembly slowly and watch for transmission binding. If it is hard to move, something may be connected, which must be removed. Ensure that wiring, lines, cables, and rods are not in the path of the transmission removal.*

25. Move transmission and transfer case rearward so it is clear of engine.
26. Lower transmission and transfer case slowly.

Disassembly

1. Remove transmission/transfer case assembly to work area.
2. Disconnect two cooler lines from transmission (Figure 5-61).
3. Remove capscrew securing vent line clamp to transmission.
4. Disconnect vent line from transmission vent line nipple.
5. Remove six locknuts securing transmission to transfer case adapter. Discard locknuts.
6. Separate transmission from transfer case adapter.
7. Clean old sealer from transfer case adapter and transmission mounting surface.

Assembly

1. Apply flange sealant to transmission mounting surface (Figure 5-61).
2. Install transmission on transfer case adapter and secure with six locknuts. Using torque adapter, tighten locknuts to 37 lb-ft (50 N•m).
3. Connect vent line to transmission vent line nipple.
4. Secure vent line to transmission with clamp and capscrew. Tighten capscrew to 11 lb-ft (15 N•m).
5. Connect two cooler lines to transmission.

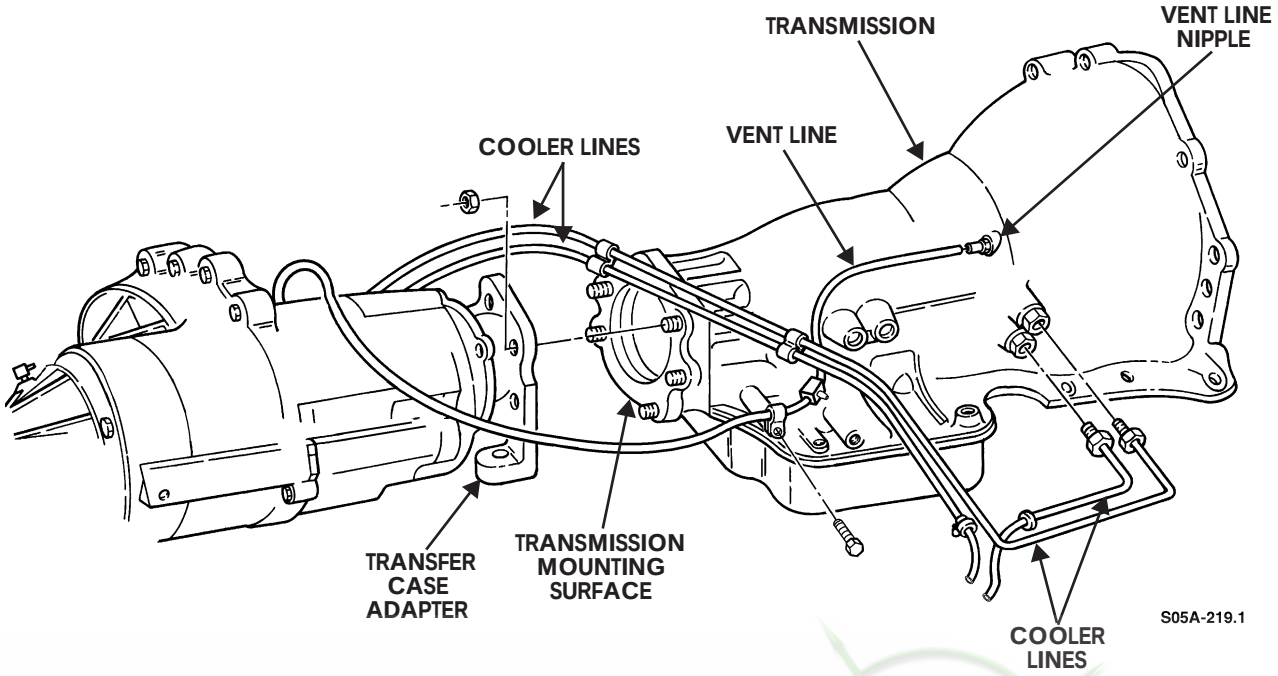


Figure 5-61: Transmission/Transfer Case Assembly

Installation

WARNING: Torque converter must be installed with transmission as an assembly. Keep transmission tipped slightly, with front high. The torque converter may slide off front of transmission and cause injury or damage to converter.

***CAUTION**: Torque converter must be properly installed in transmission, or transmission damage will result. Safety chain must be routed under transmission oil cooler and vent lines, or damage to cooler lines will result.*

1. Prepare transmission/transfer case assembly for installation.
2. Place transmission and transfer case assembly on transmission jack and secure with safety chain (Figure 5-62).
3. Tip transmission slightly to a front-high position to retain torque converter during movement.

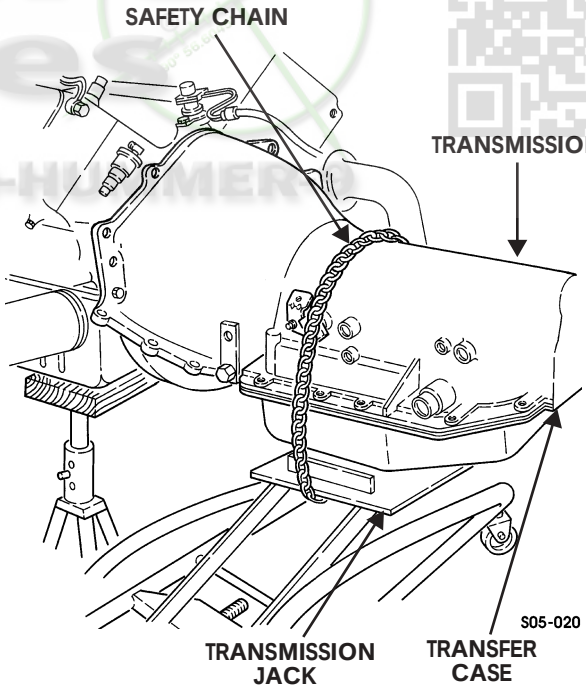


Figure 5-62: Transmission/Transfer Case Assembly

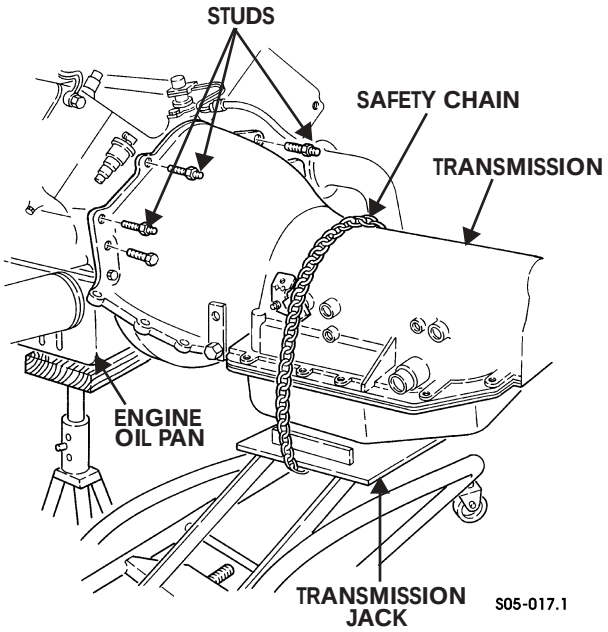


Figure 5-63: Transmission Support

WARNING: Do not use hands to free transmission/transfer case assembly of hang-ups or snags. Use pry-bar to avoid injury.

***CAUTION**: Always install transmission/transfer case assembly slowly. Raise into chassis carefully and closely observe all components to prevent damage.*

4. Position transmission and transfer case under vehicle and raise transmission into position against engine, align converter pilot into crankshaft, and align transmission case with engine (Figures 5-63 and 5-64).

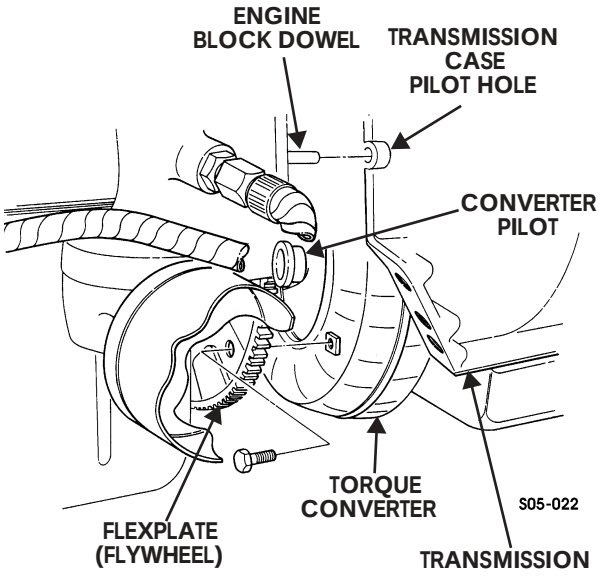


Figure 5-64: Converter Pilot

5. Carefully align transmission case pilot holes with engine block dowels as they meet.
6. Install transmission case on engine with four capscrews and three studs. Tighten capscrews and studs to 35 lb-ft (47 N•m).
7. Align holes and secure torque converter to flexplate (flywheel) with six capscrews. Tighten capscrews to 32 lb-ft (43 N•m) (Figure 5-64).
8. Install crossmember on frame brackets with two capscrews, washers, and locknuts. Tighten locknuts to 90 lb-ft (122 N•m) (Figure 5-65).

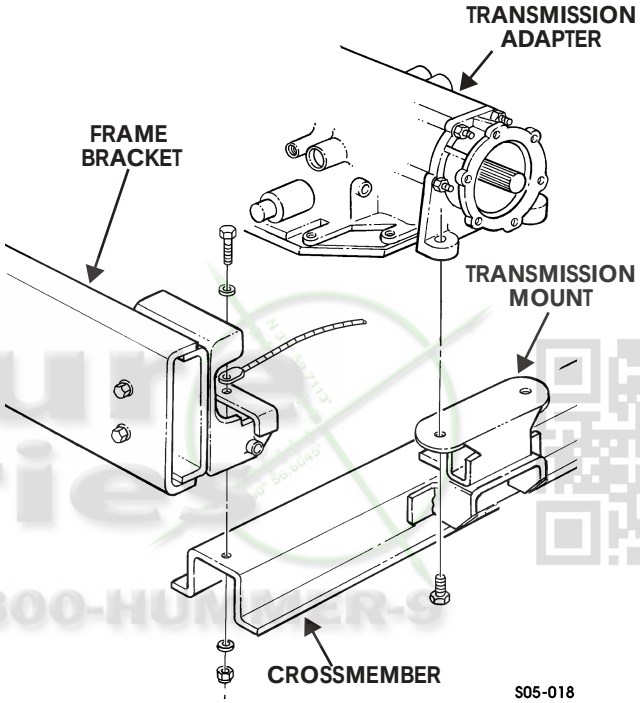


Figure 5-65: Crossmember on Frame Brackets

9. Install two capscrews through mount on crossmember and into transmission adapter. Tighten capscrews to 65 lb-ft (88 N•m).

***CAUTION**: Use care when connecting engine wiring harness connector to transmission case connector. Plugs can be easily misaligned, bent, or broken. This could result in erratic or inoperative transmission.*

10. Carefully align arrows on wiring harness connector and transmission case connector and push connectors straight together until a solid click is felt (Figure 5-66).

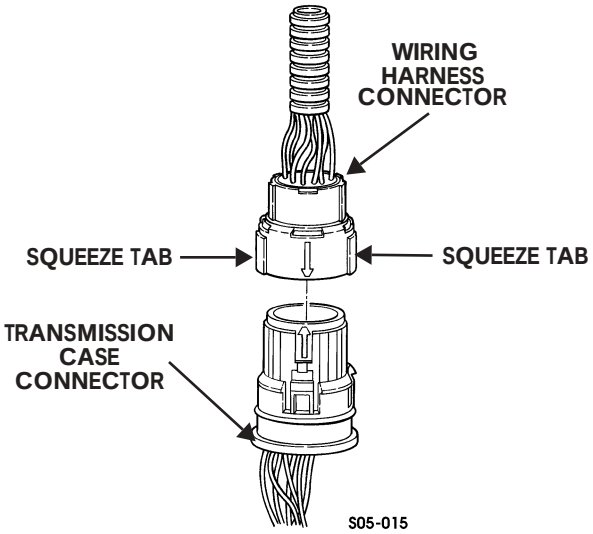


Figure 5-66: Wiring Harness Connector

11. Connect, as tagged, input speed sensor and output speed sensor connectors from engine wiring harness to sensors on transmission (Figure 5-67).

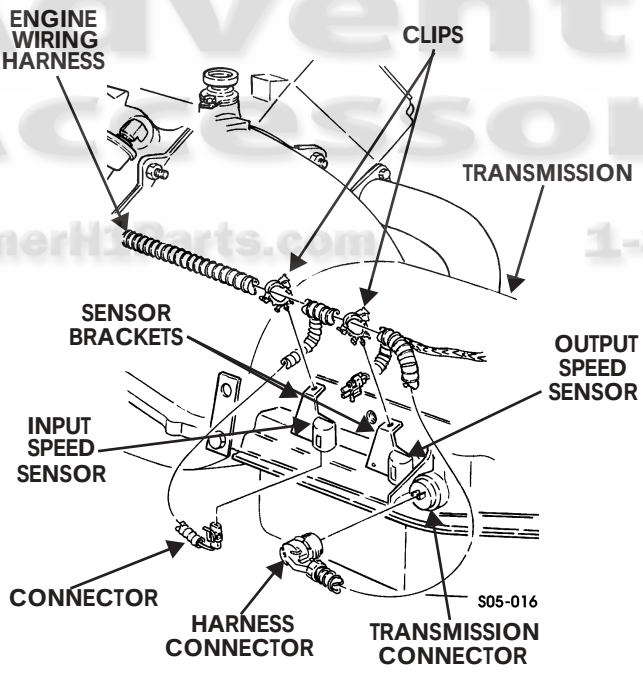


Figure 5-67: Engine Wiring Harness Connectors

12. Install engine wiring harness on transmission by reseating two plastic wiring clips in sensor brackets.
13. Connect transfer case shift rod to transfer case range lever with washer and cotter pin. Connect low range switch (Figure 5-68).

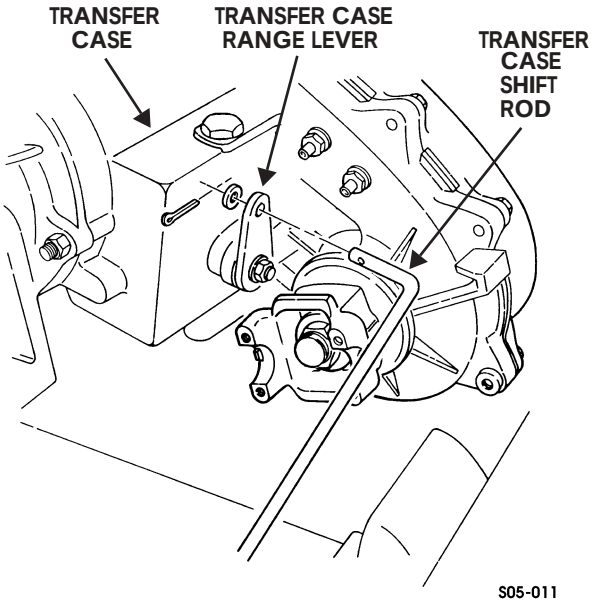


Figure 5-68: Shift Rod and Range Lever

14. Connect connector to vehicle speed sensor on transfer case (Figure 5-69).

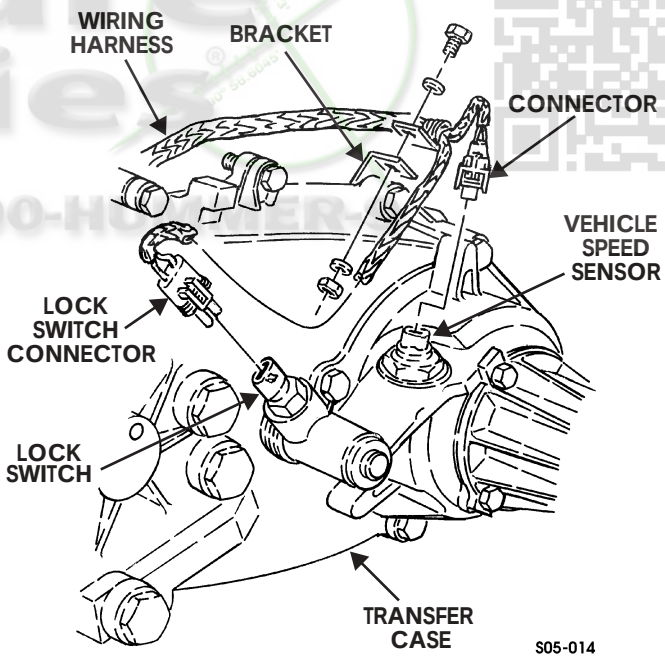


Figure 5-69: Vehicle Speed Sensor and Lock Switch Harness

15. Connect lock switch connector to lock switch.
16. Connect wiring harness clamp to bracket with washer, capscrew, lockwasher, and nut.
17. Connect main vent line to transmission/transfer case vent line (Figure 5-70).

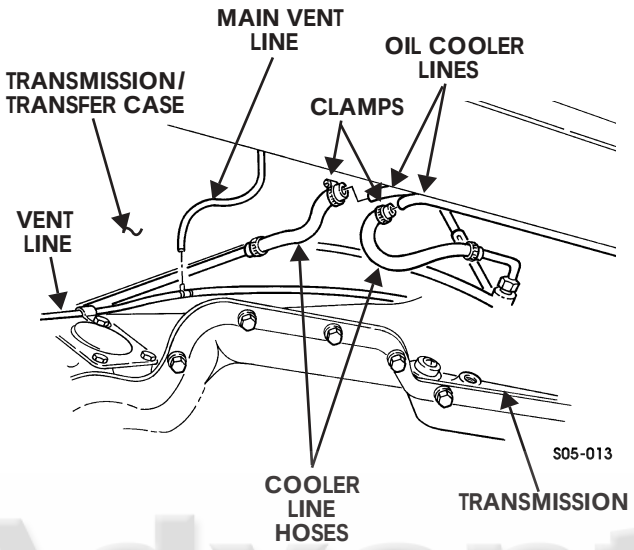


Figure 5-70: Oil Cooler Lines

18. Connect cooler line hoses to oil cooler lines and tighten clamps.
19. Install shift rod and trunnion on relay lever with washer and cotter pin (Figure 5-71).

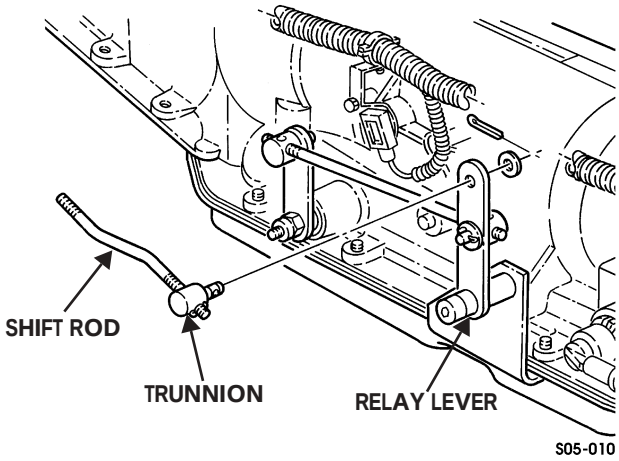


Figure 5-71: Relay Lever

20. Install multi-lip seal and dipstick tube in transmission. Secure dipstick tube bracket to cylinder head with capscrew and washer. Tighten capscrew to 25-37 lb-ft (34-50 N•m) (Figure 5-72).

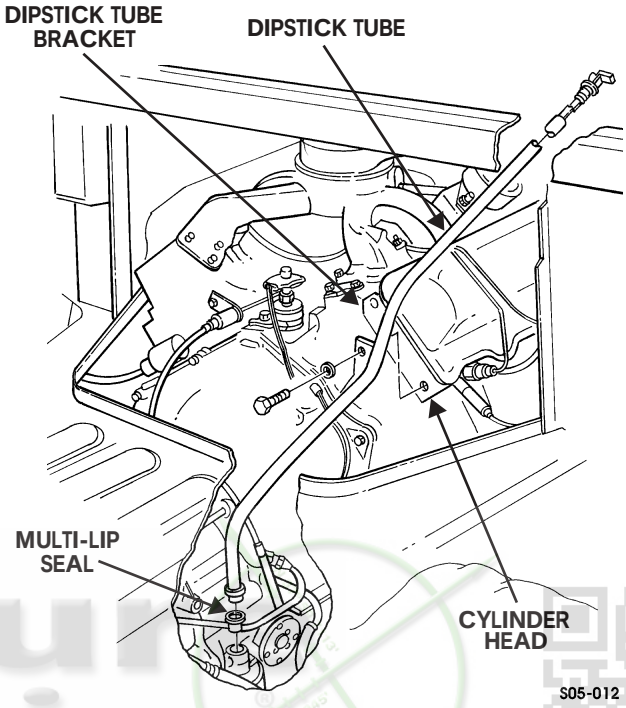


Figure 5-72: Dipstick Tube

21. Install converter housing covers.
22. Install front propeller shaft.
23. Install rear propeller shaft.
24. Install catalytic converter and crossover pipe (Section 3).
25. Fill transmission to proper fluid level.
26. Start engine and check for leaks.
27. Road test vehicle and check for proper transmission/transfer case operation.

TRANSMISSION SERVICE

Draining Fluid

NOTE: Do not shift through driving gears when warming transmission fluid for removal. Shifting through driving gear ranges is only done when refilling transmission. Transmission should be warm when draining fluid. Have an adequate size drainage container ready to catch fluid.

NOTE: Observe fluid for chips, grittiness, foaminess, or milkiness. All these indicate potential problems.

1. Remove two capscrews from transmission adapter and transmission mount (Figure 5-73).
2. Support transmission and transfer case assembly with jack under transfer case.
3. Remove two capscrews, washers, locknuts, and crossmember from frame brackets. Discard locknuts.

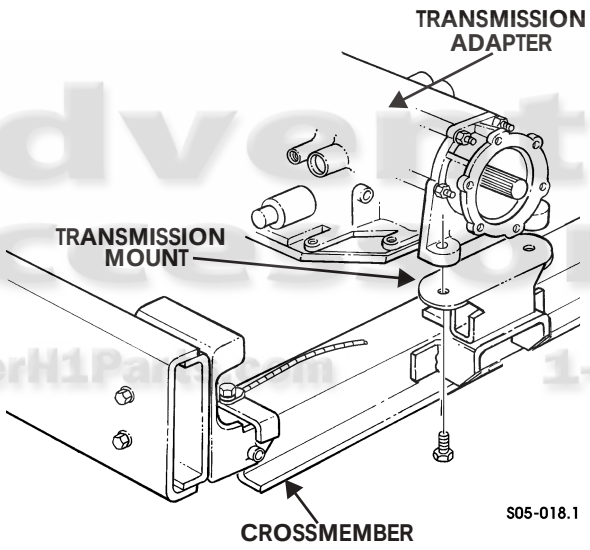


Figure 5-73: Transmission Adapter and Crossmembe

4. Loosen seventeen capscrews on transmission oil pan, and allow fluid to drain (Figure 5-74).
5. Complete oil drainage by removing seventeen capscrews, relay lever, gasket, and oil pan from transmission. Pan gasket is reusable. Replace if damaged. Position relay lever to side.

Transmission Filter

Removal

1. Remove oil filter from transmission. Discard oil filter (Figure 5-75).
2. Undamaged multi-lip seal is reusable. Inspect and replace if damaged.
3. Remove magnet, and clean oil pan and magnet (Figure 5-74) (Section 1).

Installation

1. Rotating oil filter, install pipe on filter in multi-lip seal. Align filter with control valve (Figure 5-75).
2. Position magnet in oil pan (Figure 5-74).
3. Install gasket, relay lever, and oil pan on transmission with seventeen capscrews. Tighten capscrews to 12 lb-ft (16 N•m).
4. Install crossmember capscrews, retainer cable, and relief valve, lockwashers, and washers. Tighten to 90 lb-ft (122 N•m) (Figure 5-73).
5. Lower transmission adapter onto transmission mount, install capscrews and tighten to 65 lb-ft (88 N•m) (Figure 5-73).

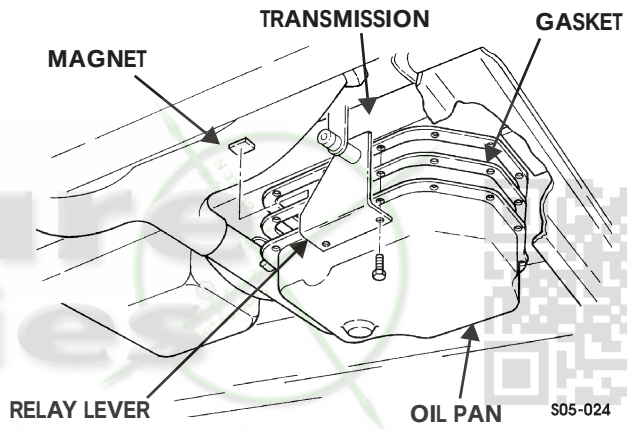


Figure 5-74: Oil Pan

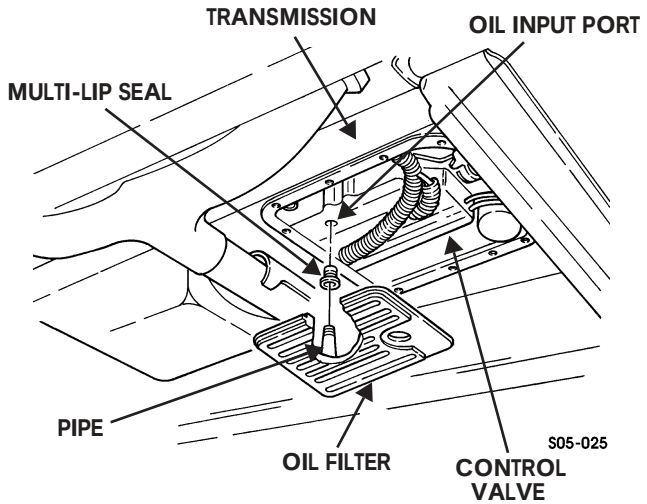


Figure 5-75: Oil Input Port

Refilling Fluid

1. Remove transmission oil dipstick and add transmission fluid. Fill only to full level marked on dipstick (Section 1).
2. Check fluid level when warm and after shifting through gears.
3. Install oil dipstick and check for external leaks.

TRANSMISSION OIL COOLER LINES REPLACEMENT

WARNING: Allow transmission to cool before performing this task. Hot oil will cause injury.

***CAUTION**: Plug all ports after removal of oil cooler lines from transmission and oil cooler.*

NOTE: Oil cooler lines are in sections connected by rubber hoses. Each section can be removed independently of others.

Removal

1. Remove right splash shield only when replacing lines connected to oil cooler (Section 10).
2. Remove oil cooler lines and retaining clamps from frame rail (Figure 5-76).

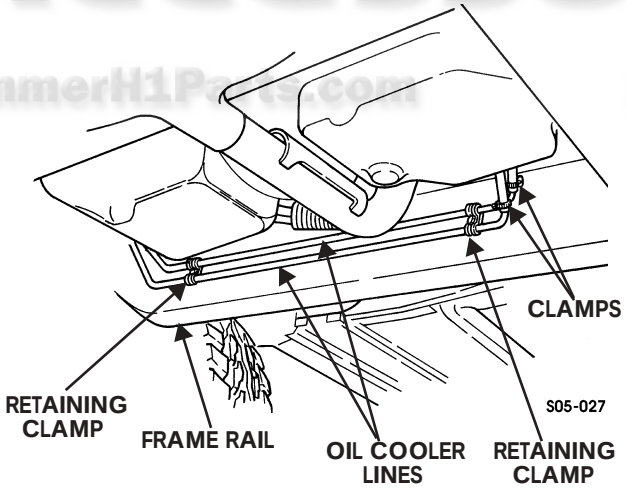


Figure 5-76: Oil Cooler Lines at Frame

NOTE: Have drainage container ready to catch fluid.

3. Loosen clamps and disconnect rubber hoses from fittings on transfer case (Figure 5-77).
4. Disconnect oil cooler lines from fittings on transmission (Figure 5-78).

NOTE: Steps 5 and 6 are performed only if oil cooler lines are to be removed from oil cooler.

5. Loosen clamps and disconnect tee fittings in oil cooler lines from hoses to check valve (Figure 5-78).

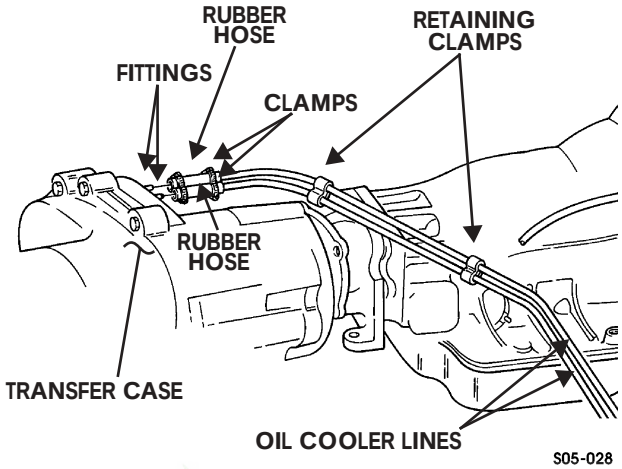


Figure 5-77: Transfer Case Cooler Lines

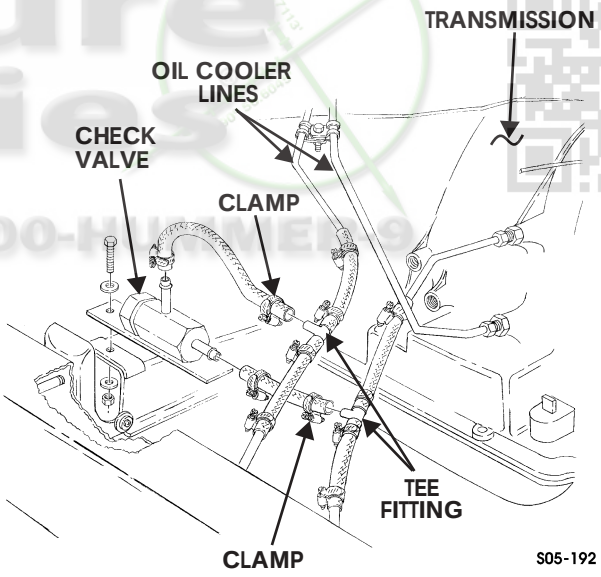


Figure 5-78: Check Valve And Transmission Oil Cooler LIne

6. Remove four locknuts, washers, and capscrews securing radiator supports to airlift bracket (Figure 5-79). Discard locknuts.

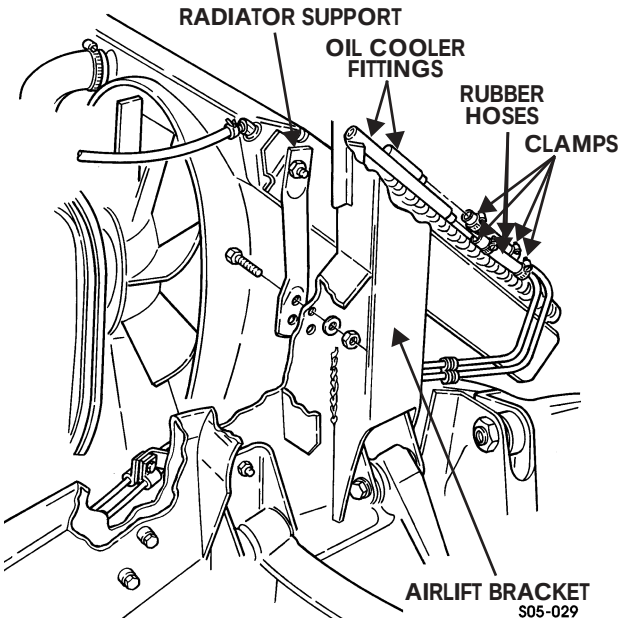


Figure 5-79: Radiator Supports

7. Remove locknut, two washers, large washer, mount, and capscrew from mounting bracket and radiator (Figure 5-80). Discard locknut.

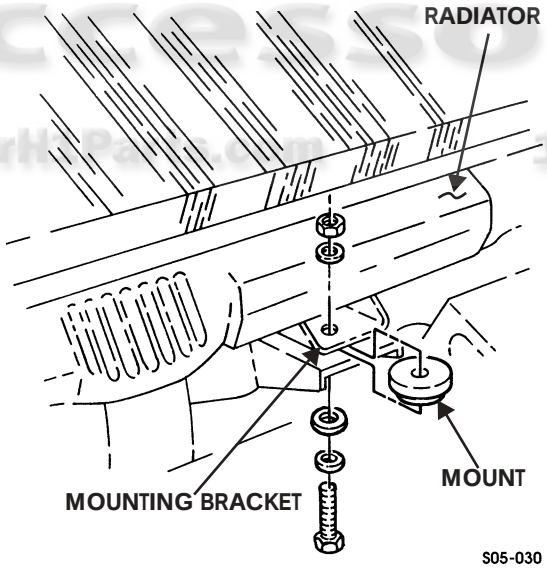


Figure 5-80: Radiator Mounting Bracke

8. Loosen clamps and disconnect rubber hoses from oil cooler fittings (Figure 5-79).
9. Remove oil cooler lines from vehicle.

Installation

NOTE: Oil cooler lines are in sections connected by rubber hoses. One section can be installed independently of others.

1. Position rubber hoses and oil cooler lines in approximate mounting location on vehicle.
2. Connect oil cooler lines to transmission fittings, and secure rubber hoses on oil cooler fittings and transfer case fittings with clamps. Tighten clamps to 35-45 lb-in. (4-5 N•m) (Figures 5-78 and 5-81) .

NOTE: Steps 3 and 4 are performed only if oil cooler lines are to be connected to oil cooler.

3. Connect hoses to tee fittings in oil cooler lines and tighten clamps.
4. Secure radiator on mounting bracket with mount, large washer, two washers, capscrew, and locknut. Tighten locknut to 30 lb-ft (41 N•m) (Figure 5-80).
5. Install radiator supports on airlift brackets with four capscrews, washers, and locknuts. Tighten locknuts to 31 lb-ft (42 N•m) (Figure 5-79).
6. Install retaining clamps and oil cooler lines on frame rail (Figures 5-82 and 5-83).
7. Start engine and check for leaks.
8. Install right splash shield (if removed) (Section 10).
9. Check fluid level and replenish as necessary.

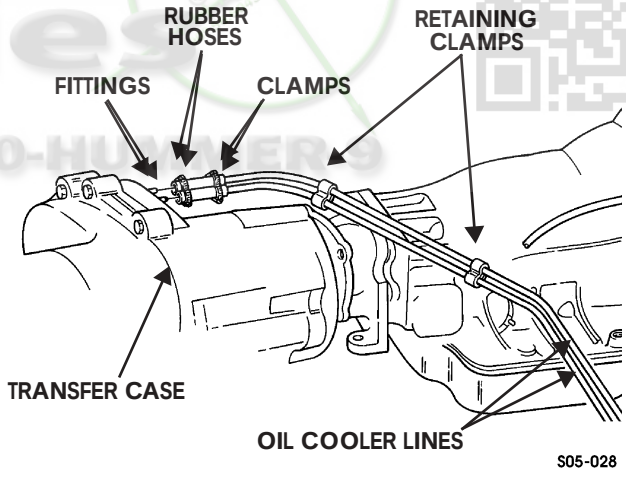


Figure 5-81: Transfer Case Oil Cooler Lines

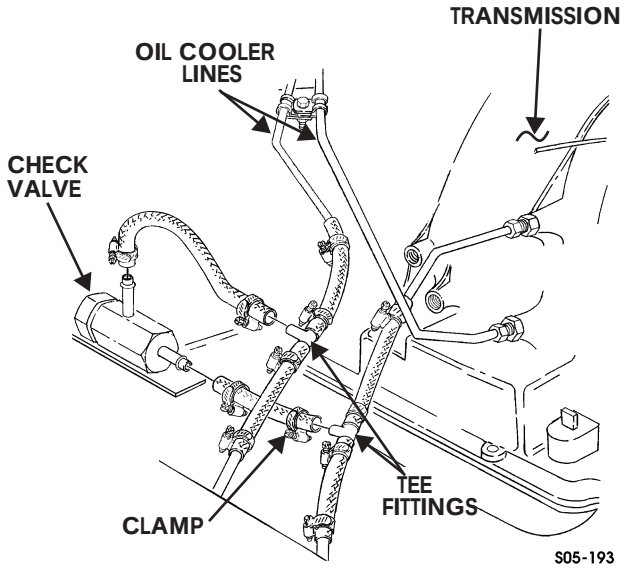


Figure 5-82: Check Valve and Transmission Oil Cooler Lines

TRANSMISSION COOLER CHECK RELIEF VALVE REPLACEMENT

CAUTION: *Do not bypass check-relief valve, or pressure damage to transfer case cooler or transmission cooler may result.*

Removal

1. Loosen clamps and disconnect two oil cooler hoses from check-relief valve (Figure 5-84).
2. Support transmission crossmember. Remove nut, two washers, and capscrew and check-relief valve from crossmember.

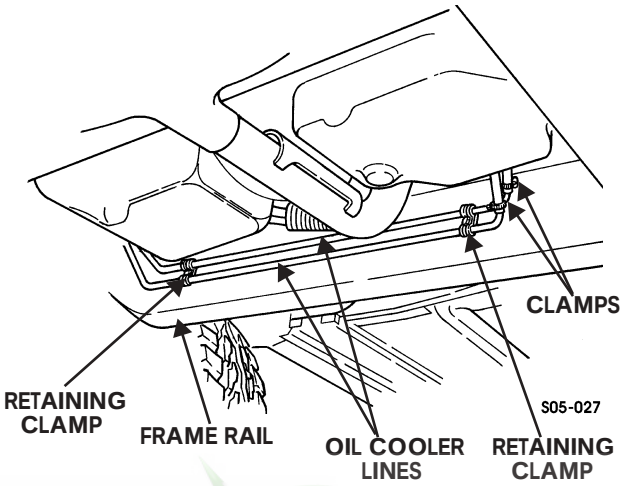


Figure 5-83: Oil Cooler Lines at Frame

Installation

1. Install check-relief valve on frame with two washers, capscrew, and nut. Tighten capscrew to 90 lb-ft (122 N•m) (Figure 5-84).
2. Connect oil cooler hoses to check-relief valve. Tighten clamps to 35-45 lb-in. (4-5 N•m).
3. Refill fluid (Section 1).
4. Operate transmission and check for leaks.

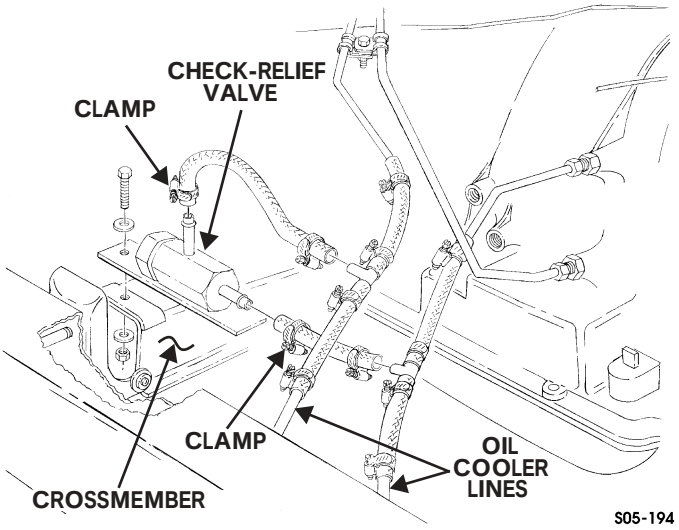


Figure 5-84: Transmission Check-Relief Valve

FLUSHING OIL COOLER

This procedure is only to be done when servicing transmission to correct a heavy level of contamination (metal or clutch material).

1. Loosen clamps and disconnect front cooler lines at frame rail (Figure 5-85).
2. Using compressed air and a drain hose placed into a suitable container, blow fluid from cooler and lines.
3. Using a pump gun or vacuum unit, either pump or draw clean transmission fluid through cooler to flush remaining contaminants.
4. Connect cooler lines at frame rail and tighten clamps.
5. Follow above procedure to flush transfer case cooler and lines, if required.

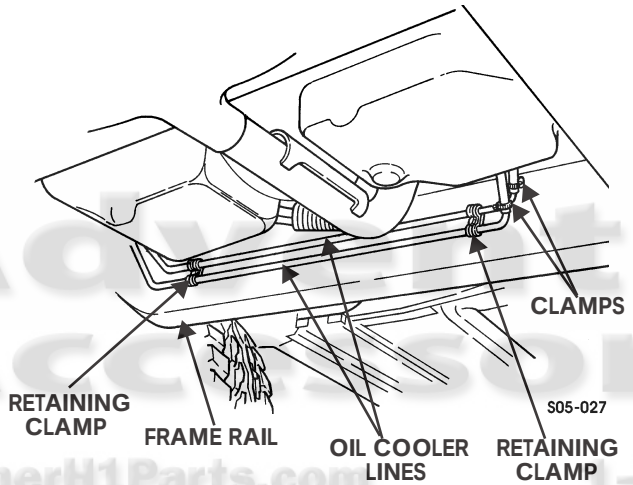


Figure 5-85: Oil Cooler Lines

TRANSMISSION OIL DIPSTICK TUBE REPLACEMENT

NOTE: Plug transmission port to prevent contamination. Have drainage container ready to catch fluid.

Removal

1. Remove right side exhaust manifold heat shield (Section 3).
2. Remove transmission oil dipstick from dipstick tube.
3. Remove capscrew, washer, and dipstick tube from cylinder head (Figure 5-86).
4. Remove dipstick tube from transmission.
5. Remove multi-lip seal from dipstick tube or port. Inspect seal and discard if damaged.

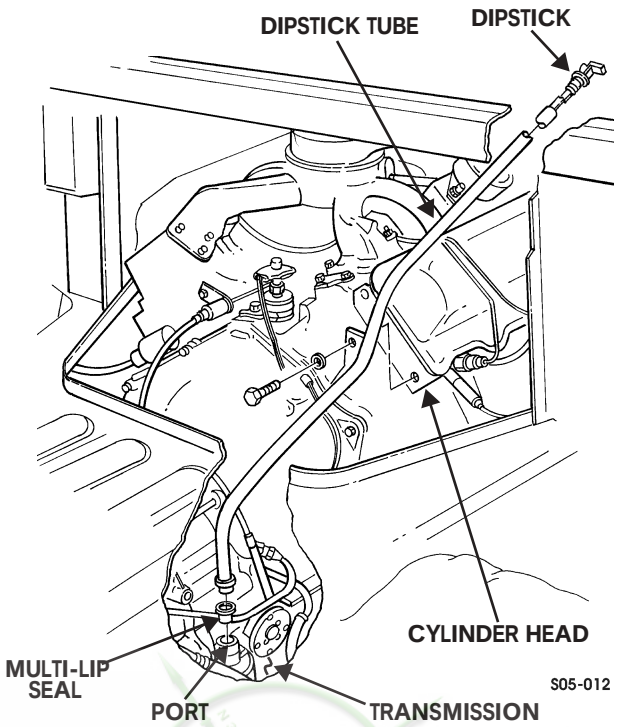


Figure 5-86: Transmission Oil Dipstick Tube

Installation

1. Install multi-lip seal in port in transmission (Figure 5-86).
2. Push dipstick tube into port in transmission.
3. Install dipstick tube on cylinder head with capscrew and washer. Tighten bolt to 25-37 lb-ft (34-50 N•m).
4. Install transmission oil dipstick in dipstick tube.
5. Install right side exhaust manifold rear heat shield (Section 3).
6. Start engine, fill transmission as indicated on transmission oil dipstick, and check for transmission fluid leaks.

NEUTRAL START SWITCH REPLACEMENT

NOTE: Tag electrical leads for installation.

Removal

1. Remove driver's inner kick panel (Section 10).
2. Remove shift controls housing assembly (Figure 5-87).
3. Remove rubber boot from shift controls housing assembly.
4. Remove two screws, lockwashers and neutral start switch from housing. Discard lockwashers.
5. Remove tiedown strap and neutral start switch leads from backup light switch leads. Discard tiedown strap.

Installation

1. Secure neutral start switch leads to backup light switch leads with tiedown strap (Figure 5-87).
2. Install neutral start switch on shift control housing with two lockwashers and screws.
3. Position neutral start switch leads, backup light switch leads, and light lead through boot, and install boot on housing assembly.
4. Install shift controls housing assembly.

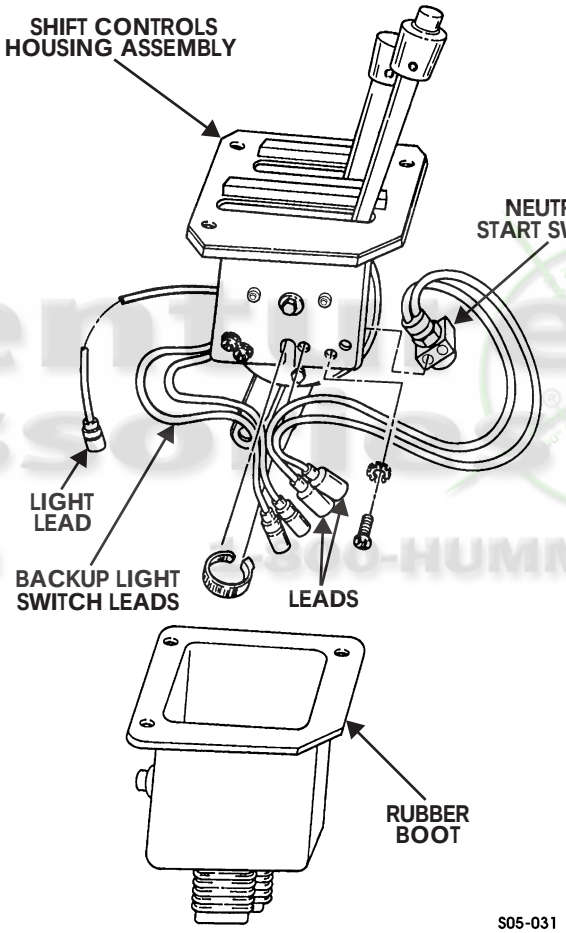


Figure 5-87: Neutral Start Switch

TRANSMISSION SHIFT ROD MAINTENANCE

Removal

1. Place transmission shift arm in neutral (Figure 5-88).
2. Remove cotter pin, washer, and trunnion from shift arm. Discard cotter pin.
3. Remove cotter pin and washer from rear trunnion. Remove trunnion, wave washer, and shift rod from relay lever. Discard cotter pin.

NOTE: Mark positions of trunnions on shift rod for installation.

4. Remove two cotter pins and two trunnions from shift rod. Discard cotter pins.

Installation

1. Install two trunnions and cotter pins on shift rod to positions marked (Figure 5-88).
2. Install trunnion on relay lever with wave washer, washer, and cotter pin. Do not spread cotter pin.
3. Install trunnion on shift arm with washer and cotter pin. Do not spread cotter pin.
4. Check shift rod adjustment.

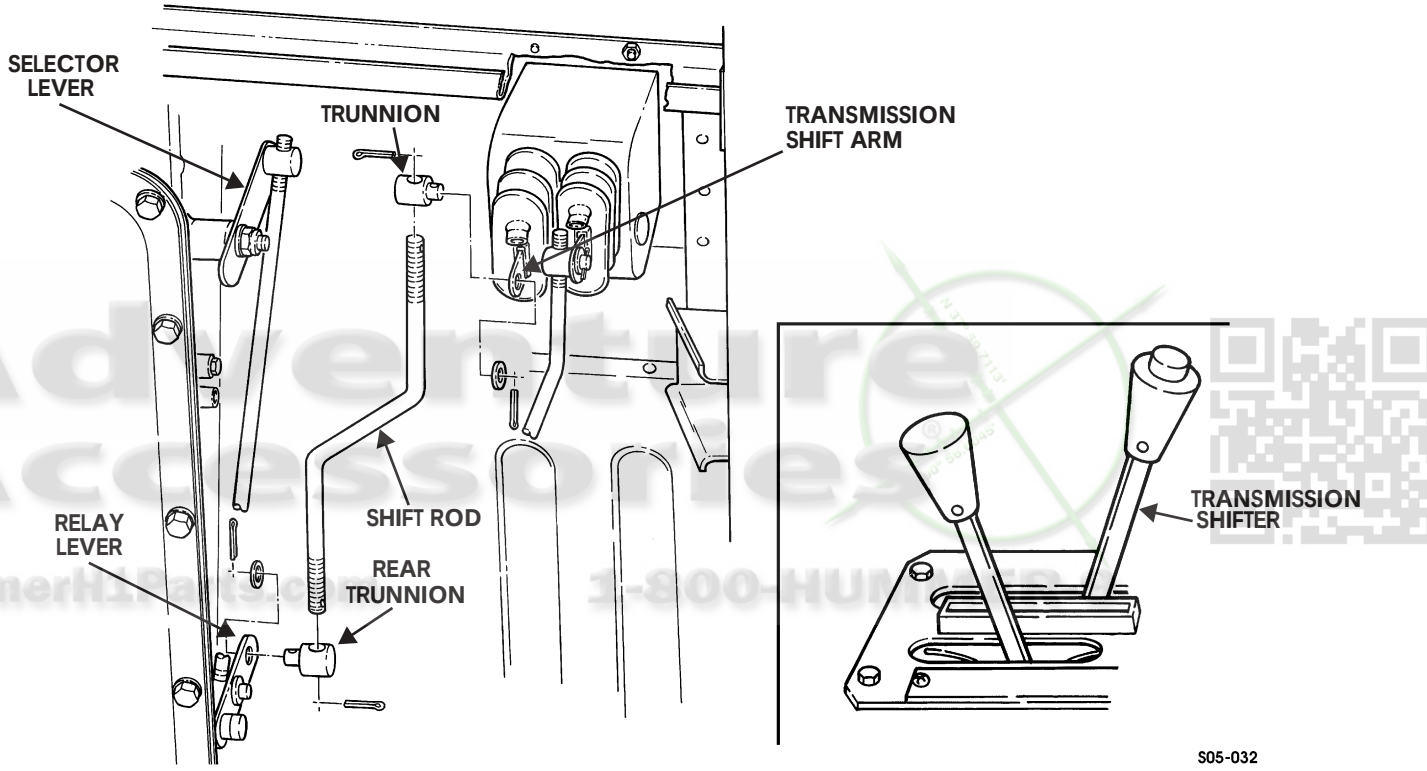


Figure 5-88: Transmission Shift Rod

Adjustment

***CAUTION**: If the manual control linkage is not in proper detent for selector lever position, transmission will be damaged.*

NOTE: Proper adjustment ensures end of shift rod movement is parallel to relay lever movement (Figure 5-88).

1. Move shifter to 1 (LOW) position and ensure selector lever is in forward detent position 1 or LOW. If not, remove cotter pin and washer, and turn trunnion until trunnion aligns with shift arm. Install cotter pin and washer (Figure 5-88).
2. To align shift rod, turn one trunnion in one direction and opposite trunnion same amount in opposite direction.
3. When adjustment is correct, spread four cotter pins.

SHIFT CONTROLS HOUSING ASSEMBLY REPLACEMENT

Removal

NOTE: If the shift controls housing assembly is to be reinstalled, tape trunnions to shift rods to prevent loss of adjustment. Shift rod trunnions are removed from shift rods only if damaged, or if shift rods are replaced.

1. Remove the driver's side front inner kick (Section 10).
2. Remove cotter pin, washer, and trunnion from transmission shift lever arm. Discard cotter pin (Figure 5-89).

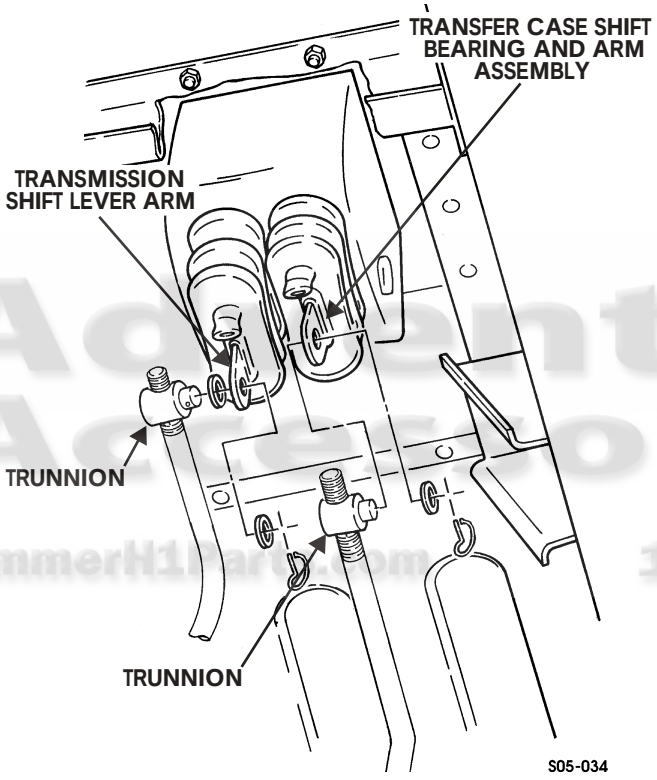


Figure 5-89: Shift Trunnions

3. Remove cotter pin, washer, and trunnion from transfer case shift bearing and arm assembly. Discard cotter pin.
4. Remove four locknuts, washers, bolts, and shift controls housing assembly from body (Figure 5-90).

NOTE: Tag leads for installation.

5. Disconnect two body harness leads from backup light switch leads.
6. Disconnect two body harness leads from neutral start switch leads.

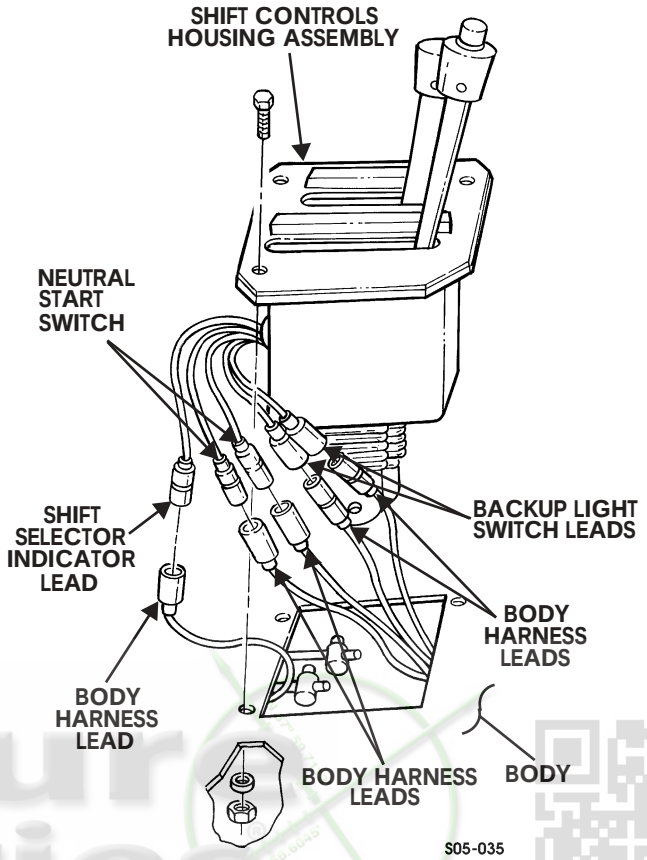


Figure 5-90: Shift Controls Housing Assembly

7. Disconnect body harness lead from shift selector indicator lead.
8. Remove boot from shift control housing assembly.
9. Remove nut, screw and interlock cable from shifter (Figure 5-91).

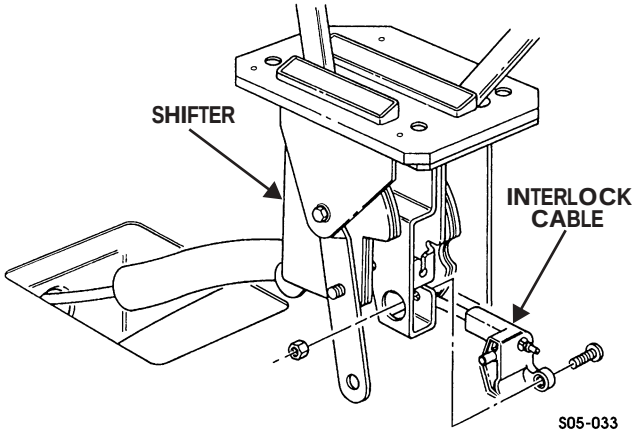


Figure 5-91: Interlock Cable and Shifter

Installation

1. Feed interlock cable end through boot and install on shifter housing assembly (Figure 5-91).
2. Work boot onto shifter housing assembly passing wire leads through boot. Install external tie strap (Figure 5-92).
3. Position shift controls housing assembly in body, with transmission lever to the right, and install with four bolts, washers, and locknuts. Tighten locknuts to 6 lb-ft (8 N•m) (Figure 5-90).
4. Connect two body harness leads to backup light switch leads.
5. Connect two body harness leads to neutral start switch leads.
6. Connect body harness lead to shift selector indicator lead.
7. Install transfer case shift rod trunnion on transfer case shift bearing and arm assembly with washer and cotter pin (Figure 5-89).
8. Install transmission shift rod trunnion on transmission shift lever arm with washer and cotter pin.
9. Start engine and check shift controls for proper operation. Adjust as needed.
10. Install the driver's side front inner kick panel (Section 10).

SHIFT CONTROLS HOUSING ASSEMBLY MAINTENANCE

Disassembly

1. Remove shift controls housing assembly.
2. Drive out pin and remove knob from transfer case shift tube.
3. Drive out pin and remove knob from transmission shift tube.

NOTE: Tag leads for installation.

4. Cut tie straps, if present, and work boot off neutral start switch, backup light switch, and shift indicator leads, and down interlock cable, if present (Figures 5-91 and 5-92).
5. Slide rubber boot from shift controls housing assembly.
6. Remove two transmission selector lens covers.
7. Remove two fiber optic indicator strips from bulbs.
8. Remove two bulbs.
9. Remove four screws, cover plate, and rubber gasket from

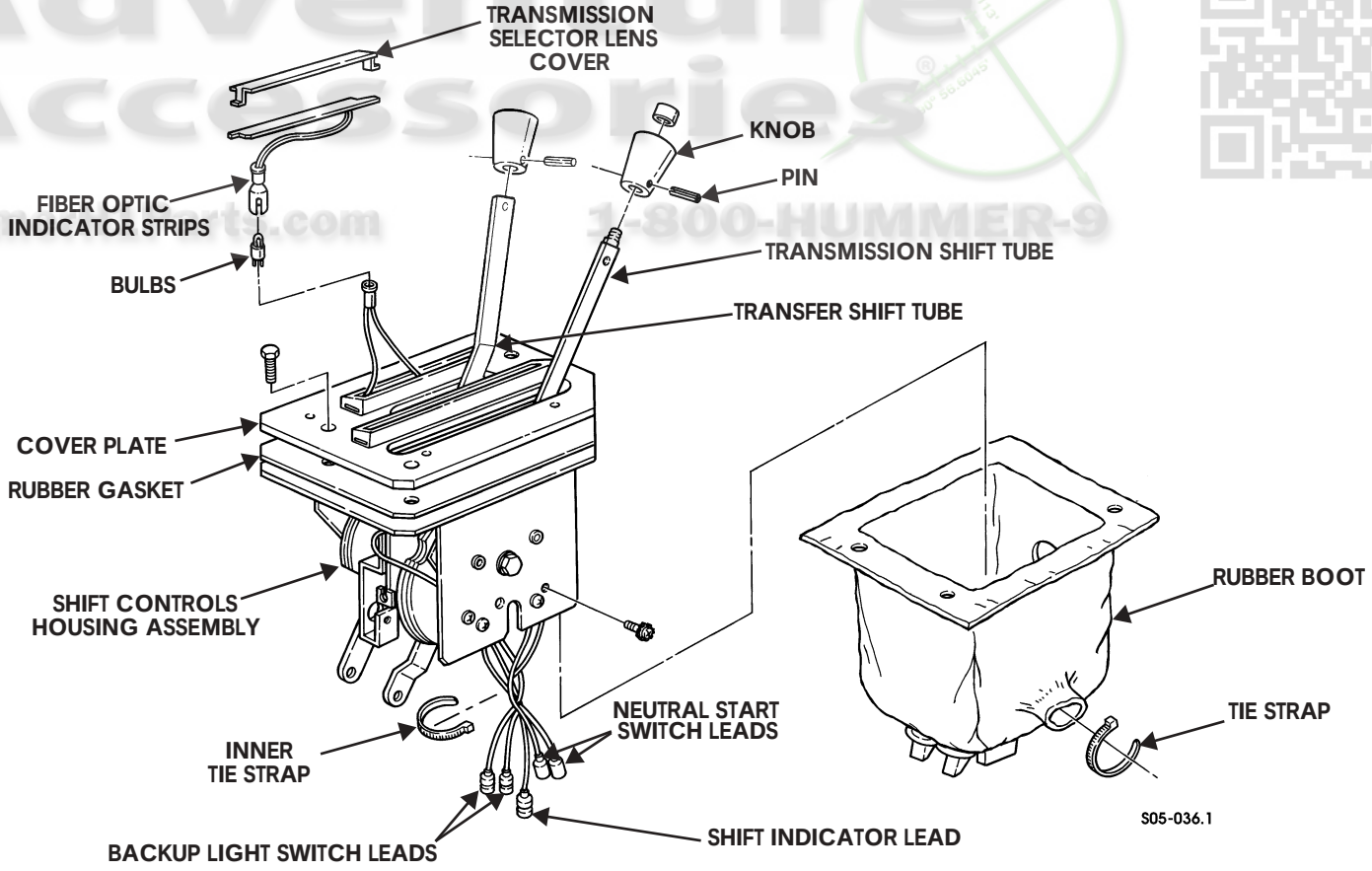


Figure 5-92: Shift Controls Housing Assembly

Assembly

1. Install rubber gasket and cover plate on shift controls housing assembly with four screws (Figure 5-92).
2. Install two bulbs.
3. Install two fiber optic indicator strips on bulbs.
4. Install two transmission selector lens covers.
5. Install inner tiestrap.
6. Start installation of rubber boot on shift controls housing assembly, placing two neutral start switch backup light switch leads, interlock cable (if present) and shift indicator lead through openings in rubber boot.
7. Complete sliding rubber boot onto shift controls housing assembly, ensuring mounting screw holes align.
8. Place outer tiestrap on wires and boot.
9. Install knob onto transmission shift tube and secure with pin.
10. Install knob onto transfer case shift tube and secure with pin.
11. Install shift controls housing assembly.

TRANSMISSION VENT LINE REPLACEMENT

Removal

1. Disconnect vent line from transmission and tee fitting and remove vent line (Figure 5-93).
2. Disconnect vent line at two tee fittings and remove vent line.
3. Remove bolt, clamp, and main vent line from engine mount bracket.
4.

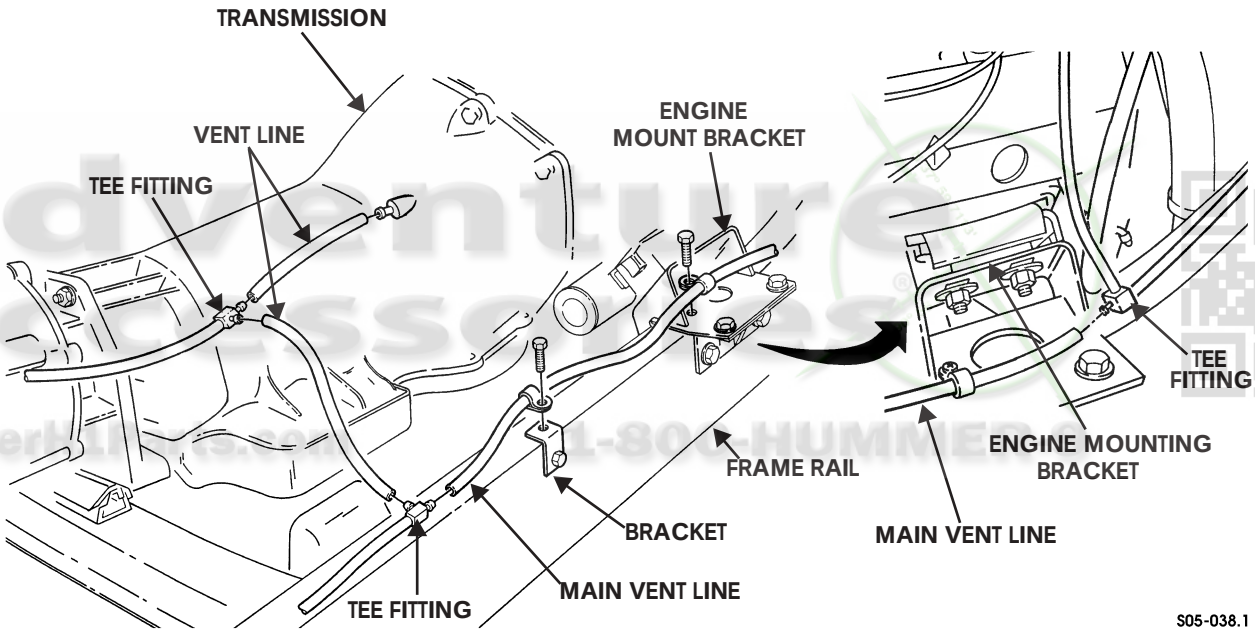


Figure 5-93: Transmission Vent Line

5. Remove bolt, clamp, and main vent line from bracket on frame rail.
6. Remove main vent line from tee fitting near engine mount bracket and tee fitting on frame rail.
7. Remove main vent line.

Installation

1. Install vent line on tee fitting and transmission (Figure 5-93).
2. Install vent line on two tee fittings.
3. Install clamps on main vent line.
4. Install clamp and main vent line on engine mount bracket with bolt.
5. Install clamp and main vent line on bracket on frame rail with bolt.
6. Connect main vent line on tee fittings near engine mount bracket and frame rail.

SEALED LOWER CONVERTER HOUSING COVER REPLACEMENT

Removal

1. Remove crossover pipe (Section 3).
2. Remove sealed upper converter housing cover.
3. Remove four bolts and lower converter housing cover from transmission flange (Figure 5-94).
4. Remove gasket from lower converter housing cover. Discard gasket.
5. Clean any adhesive or gasket remains from flange of transmission.

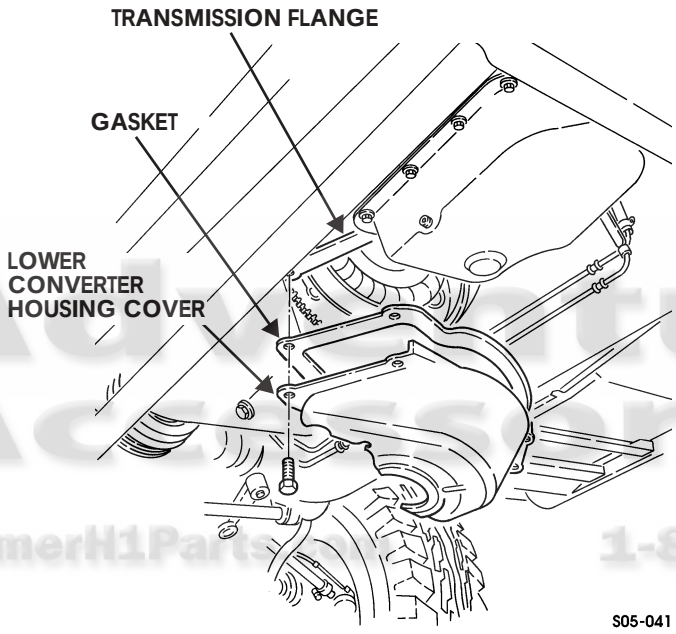


Figure 5-94: Lower Converter Housing Cover

Installation

NOTE: Gasket may require bending over edge of converter housing cover to make gasket seat properly.

1. Apply adhesive to gasket and install on lower converter housing cover (Figure 5-94).
2. Apply adhesive to lower converter housing cover.
3. Install lower converter housing cover on transmission flange with four bolts.
4. Install sealed upper converter housing cover.
5. Install crossover pipe (Section 3).

SEALED UPPER CONVERTER HOUSING COVER REPLACEMENT

Removal

1. Remove two bolts and upper converter housing cover from transmission flange (Figure 5-95).
2. Remove gasket from upper converter housing cover. Discard gasket.
3. Clean any gasket or adhesive remains from flange of transmission.

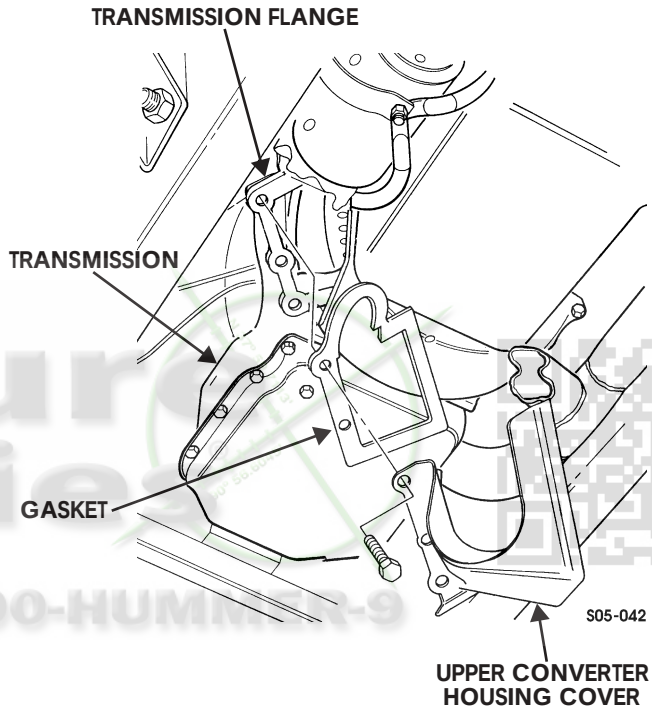


Figure 5-95: Upper Converter Housing Cover

Installation

NOTE: Gasket may require bending over edge of converter housing cover to make gasket seat properly.

1. Apply adhesive to gasket and install gasket on upper converter housing cover (Figure 5-95).
2. Install upper converter housing cover on transmission with two bolts.

TRANSMISSION OIL PUMP SEAL REPLACEMENT

WARNING: Torque converter must be supported during removal and installation. Failure to do this may cause injury or damage to equipment.

Removal

1. Remove transmission/transfer case assembly.

NOTE: Have drainage container ready to catch fluid.

2. Remove torque converter from transmission (Figure 5-96).
3. Remove oil seal from oil pump and discard (Figure 5-97).

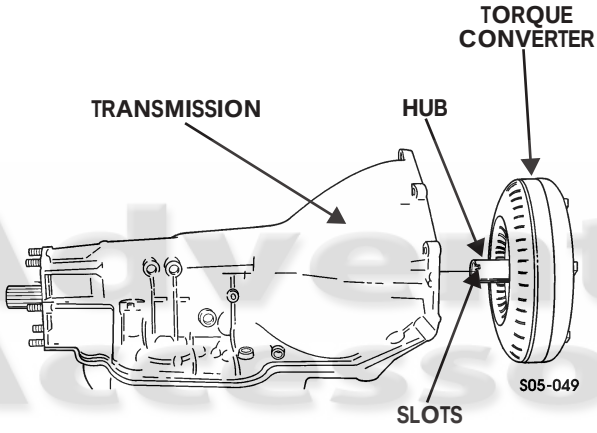


Figure 5-96: Transmission and Torque Converter

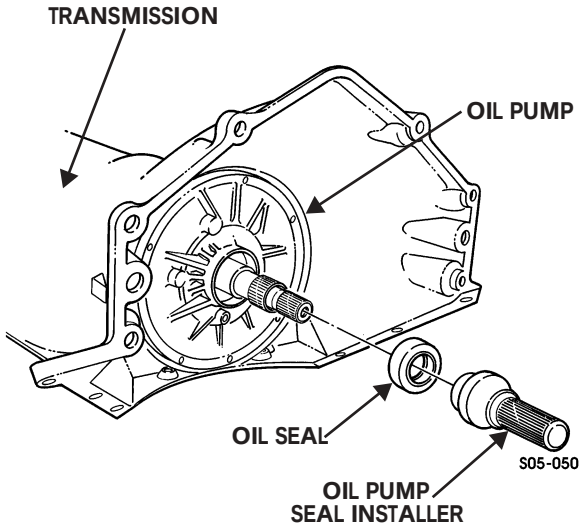


Figure 5-97: Oil Seal Removed From Oil Pump

Installation

1. Apply sealing compound to outside diameter of oil seal (Figure 5-97).
2. Using oil pump seal installer, install oil seal in oil pump.
3. Install torque converter in transmission. Ensure drive lugs of inner pump rotor in oil pump are properly engaged with drive slots of torque converter hub (Figures 5-96 and 5-97).
4. Install transmission/transfer case assembly.

TRANSMISSION MOUNT REPLACEMENT

Removal

1. Support transmission with jack.
2. Remove two capscrews from transmission mount and adapter, and raise transmission slightly.
3. Remove two nuts, lockwashers, and transmission mount from crossmember. Discard lockwashers (Figure 5-98).

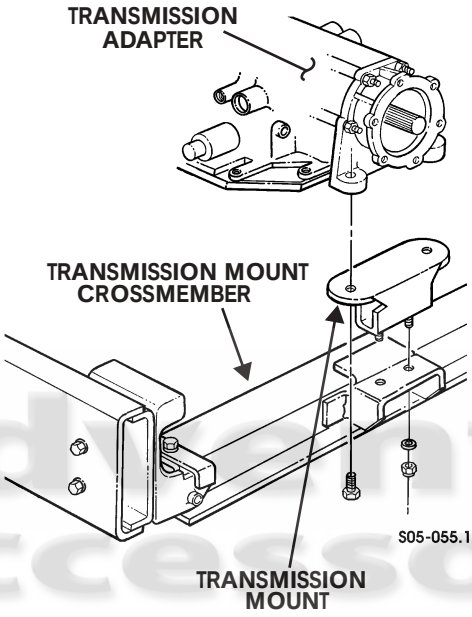


Figure 5-98: Transmission Adapter and Crossmember

Installation

1. Install transmission mount on crossmember with two lockwashers and nuts. Tighten nuts to 65 lb-ft (88 N•m) (Figure 5-98).
2. Install transmission mount with two bolts, but do not tighten. Lower transmission.
3. Tighten adapter bolts to 28 lb-ft (38 N•m).

TRANSMISSION CONTROL MODULE (TCM) AND BRACKET REPLACEMENT

***CAUTION**: Ensure that ignition switch is OFF before disconnecting or reconnecting the transmission control module (TCM). Failure to do this may cause internal damage to TCM.*

Removal

1. Turn ignition switch OFF.
2. Remove front console cover (Section 10).
3. Disconnect two multi-pin connectors from TCM. Protect connectors from dust, dirt, and damage (Figure 5-99).
4. Remove four nuts and washers from clip studs.

NOTE: Perform step 5 only if bracket is to be replaced.

5. Carefully pry out four trim buttons and remove bracket from engine cover. Discard trim buttons.

NOTE: Perform step 6 only if replacing TCM.

6. Remove four nuts and clip studs from TCM bracket slots.

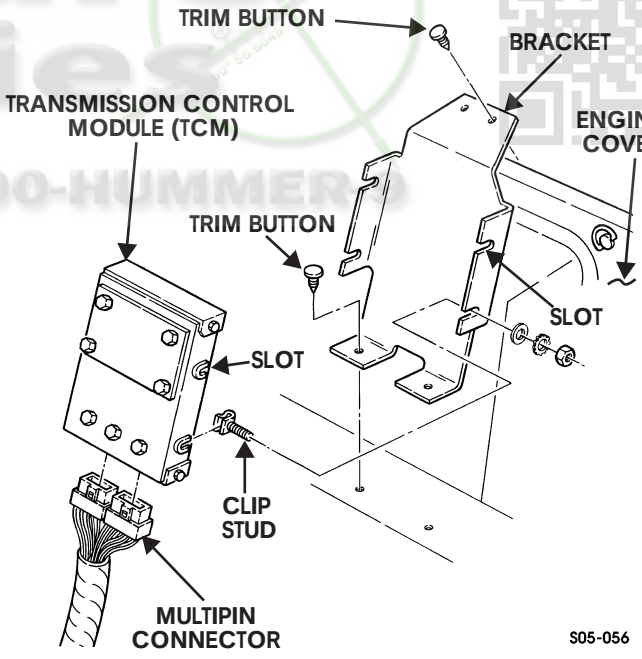


Figure 5-99: TCM and Bracke

Installation

NOTE: The new TCM does not contain a Programmable Read Only Memory (PROM). If old PROM is to be used, refer to PROM replacement. Ensure replacement unit part number is the same as old part number.

1. Refer to PROM Replacement to install PROM in new TCM.

NOTE: Perform step 2 only if bracket is being replaced.

2. Install bracket on engine cover with four trim buttons.

NOTE: Perform step 3 if TCM is being replaced.

3. Install four clip studs and nuts on TCM.
4. Connect two multi-pin connectors to bottom of TCM.
5. Secure TCM to bracket with four washers and nuts.

PROM REPLACEMENT

Removal

1. Remove transmission control module (TCM) from the vehicle.

***CAUTION**: Do not remove any other screws from TCM. Do not remove cover from PROM. Any other method of removal may cause damage to the PROM or PROM socket in TCM.*

2. Remove four screws and access cover from TCM (Figure 5-100).

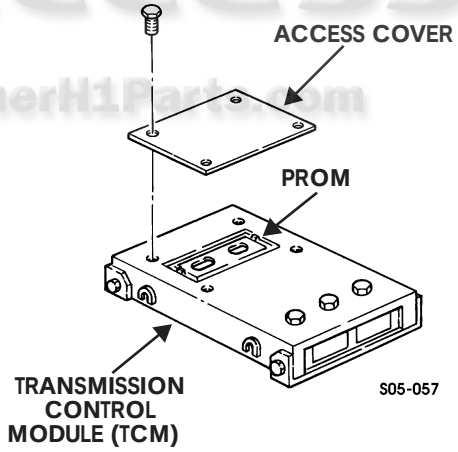


Figure 5-100: CM Access Cover

3. Using two fingers, push both retaining clips away from PROM. While grasping PROM at both ends, lift it straight up out of socket (Figure 5-101).

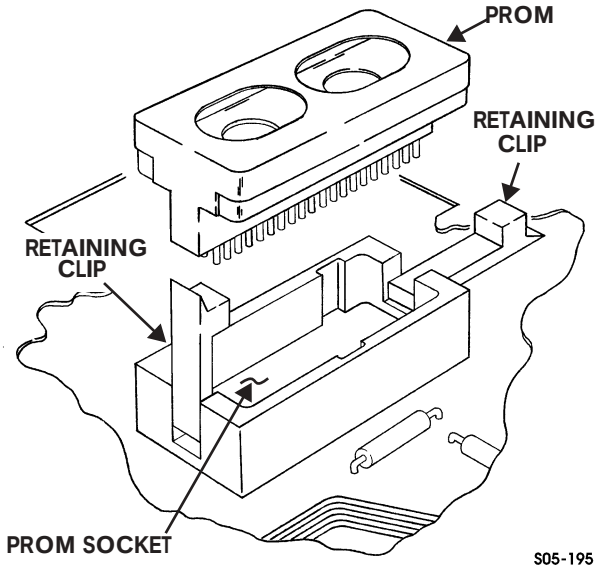


Figure 5-101: Retaining Clip

***CAUTION**: To prevent possible electrostatic discharge damage to the TCM, do not touch the connector pins or soldered components on the circuit board. Also, do not remove cover from PROM.*

4. Inspect alignment nodes and pins of the PROM for damage or contaminants (Figure 5-102). Inspect socket notches and connectors for damage and contaminants (Figure 5-103). Remove any contaminants. Replace PROM if pins or nodes are bent, burred, or dented. Carefully set aside.

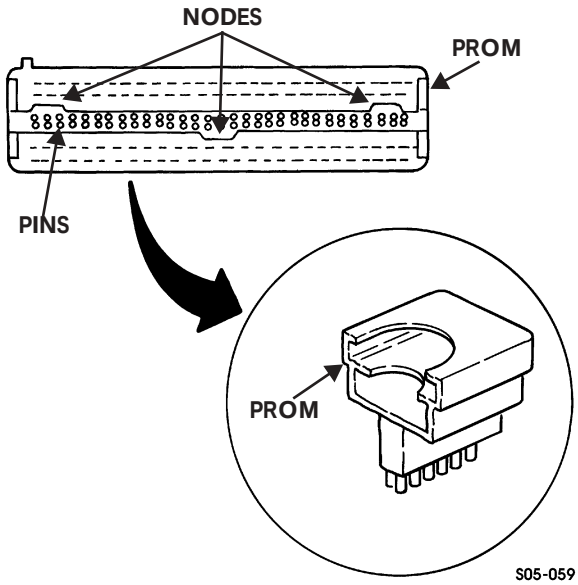
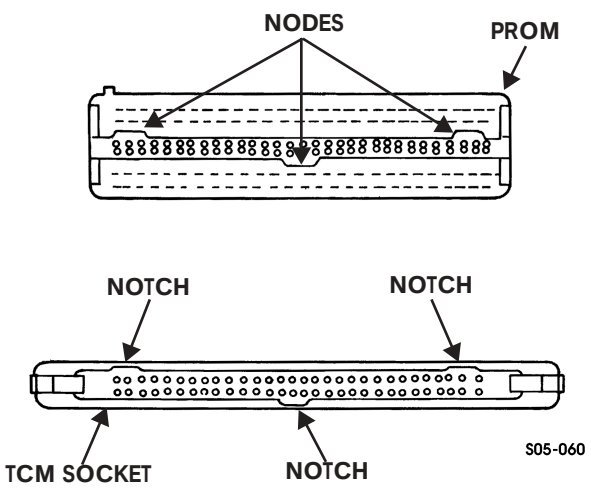


Figure 5-102: Alignment Nodes and Pins



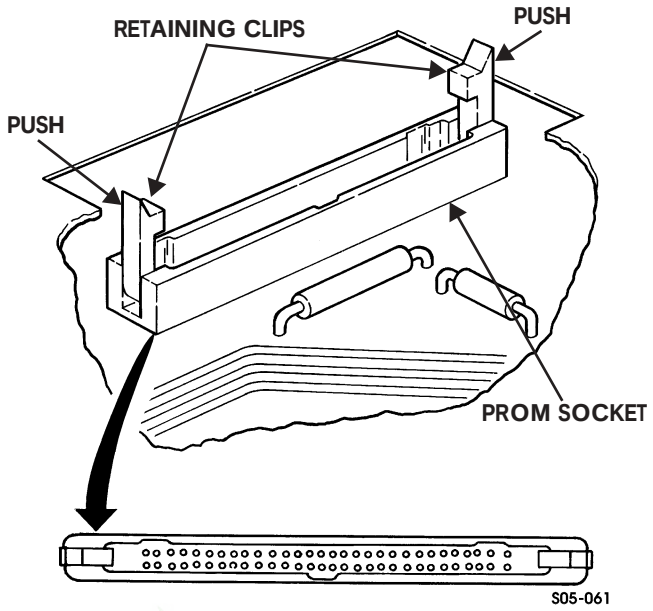


Figure 5-103: Notches and Connectors

Installation

NOTE: Check that the replacement TCM part number is the same as old TCM.

1. Align nodes of the PROM with mating notches on TCM socket (Figure 5-103).

***CAUTION**: Do not press on the ends of the PROM until the clips snap into place because the controller circuit board and/or clips may be damaged.*

2. Press straight down gently on ends of PROM until retaining clips are against side of PROM (Figure 5-104).
3. Press in on both retaining clips until they snap into place. A click should be heard as the clips lock onto PROM.

Figure 5-104: Lock Retaining Clips Onto PROM

4. Install access cover on TCM with four screws (Figure 5-100).
5. Install TCM in vehicle.

Functional Check

1. Turn ignition ON.
2. Enter diagnostics (i.e., ground DLC pin B). DTC 12 should flash four times on MIL light (if no other DTC(s) are present). This indicates the PROM is installed properly, and is functioning.

If DTC 51 occurs, or if the MIL light is ON constantly with no DTC(s), the PROM is not fully seated, or is defective.

a. Turn ignition off and disconnect TCM.

b. If not fully seated, remove access cover and press firmly on the ends of the PROM.

c. If necessary, remove the PROM, and reinstall.

THROTTLE POSITION (TP) SENSOR REPLACEMENT

***CAUTION**: The throttle position (TP) sensor is an electrical component and must not be soaked in any liquid cleaner or solvent, as damage may result.*

Removal

1. Ensure ignition switch is off.
2. Release locking tab on socket of engine wiring harness and disconnect plug from engine wiring harness (Figure 5-105).
3. Remove two screws, washers, and TP sensor from fuel injection pump.

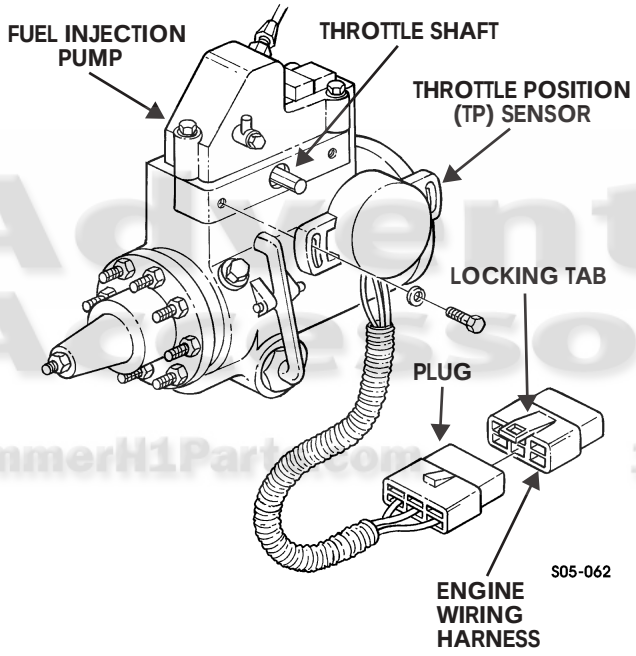


Figure 5-105: Throttle Position Sensor

Installation

1. Ensure throttle is closed, and place TP sensor on throttle shaft of fuel injection pump (Figure 5-105).
2. Rotate TP sensor counterclockwise to align screw holes in sensor with holes in injection pump.
3. Secure TP sensor with two screws and washers.
4. Connect TP sensor plug and engine wiring socket. Ensure locking tab is secure.
5. Adjust TP sensor.

THROTTLE POSITION (TP) SENSOR ADJUSTMENT PROCEDURE

To adjust the throttle position (TP) sensor, perform the following steps:

1. Disconnect TP sensor connector from engine wiring harness connector and install the jumper wires between the TP sensor and the engine wiring harness (Figure 5-106).
2. Turn the ignition switch to the RUN position.
3. Using a voltmeter, measure the voltage between terminals A and C of the TP sensor connector, and multiply the measurement by 0.33 to obtain the desired TP sensor voltage.

   Example: 5.05 volts x 0.33 = 1.66 (± 1%)
4. Install a 0.646 in. (16.4 mm) gauge block between the throttle adjusting screw and the boss on the fuel injection pump housing (Figure 5-107).
5. Rotate the fuel injection pump throttle lever so that the throttle adjusting screw holds the gauge block against the housing boss.

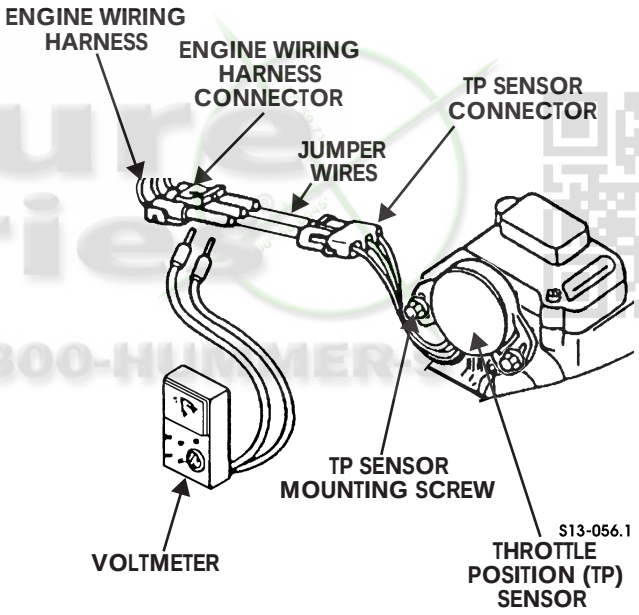


Figure 5-106: Throttle Position Sensor

NOTE: Keep the fuel injection pump throttle lever in this position during the rest of the procedure.

6. Measure the voltage between terminals B and C of the TP sensor connector:
   - If the voltage is within the calculated specification (from step 3), proceed to step 10.
   - If the voltage is not within the calculated specification (from step 3), go to the next step.
7. Loosen the TP sensor mounting screws and rotate the TP sensor toward the rear of the vehicle (counterclockwise) (Figure 5-106).
8. With the voltmeter connected to terminals B and C of the TP sensor connector, rotate the TP sensor slowly toward the front of the vehicle (clockwise) until the voltmeter indicates the correct voltage (for example: 1.65 to 1.67 volts). Hold the sensor in this position and tighten the TP sensor mounting screws.
9. Confirm that the adjustment did not change. Voltage should be approximately 90 percent (± 5%) of the voltage measured in step 3.

   Example: 5.05 (measured voltage) x 0.33 (ratio) = 1.66 volts (sensor voltage).
10. Reconnect the TP sensor connector to engine wiring harness and remove gauge block.

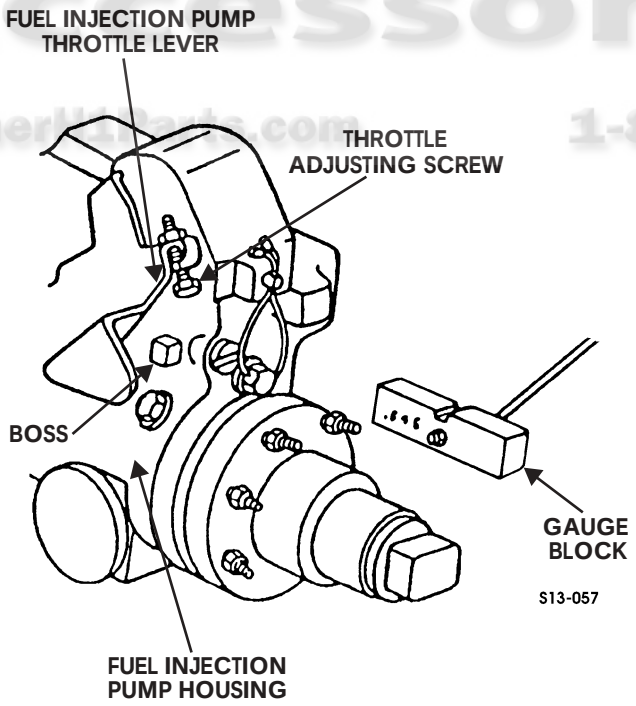


Figure 5-107: Throttle Adjusting Screw

TRANSMISSION INPUT SPEED SENSOR (TISS) AND OUTPUT SPEED SENSOR (TOSS) REPLACEMENT

NOTE: Both the input and output speed sensors are replaced the same way.

Removal

1. Ensure ignition switch is off.
2. Disconnect TOSS harness connector from sensor body. Environmental seal is reusable if not damaged (Figure 5-108).
3. Remove bolt from TOSS and transmission.
4. Using a twisting motion, remove sensor from transmission.
5. Remove and discard O-ring seal from barrel of TOSS.

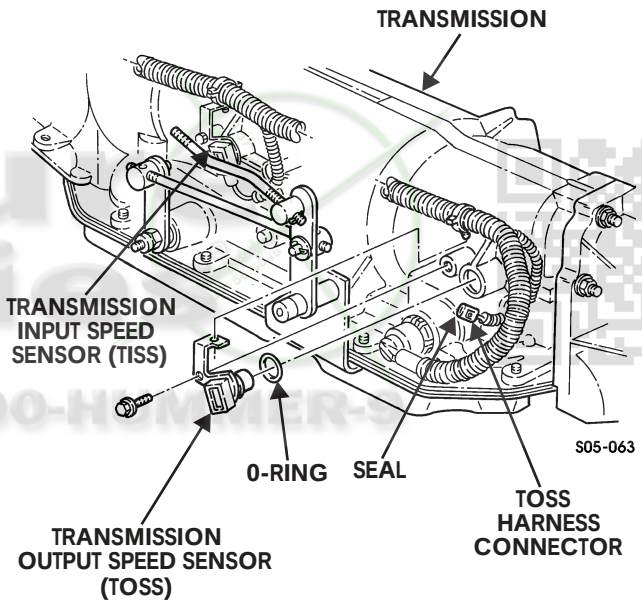


Figure 5-108: Transmission Input and Output Speed Sensors

Installation

1. Lubricate O-ring seal with ATF and place it on TOSS barrel (Figure 5-108).
2. Using a twisting motion, install sensor in transmission and secure with bolt.
3. Ensure that environmental seal is on harness connector and install connector on TOSS.
4. Start engine and:
   a. Check for TISS signal.
   b. Drive vehicle slowly and check for TOSS signal.

TRANSFER CASE

Description

The transfer case used with this vehicle is the new departure model 242. It is a chain driven internally, two speed, locking, and differentiated gearing system that provides a front axle and rear axle drive output through front and rear transfer output shafts. The transfer case is bolted to an adapter on the rear of the automatic transmission. The output shaft of the transmission is splined to the transfer case input gear.

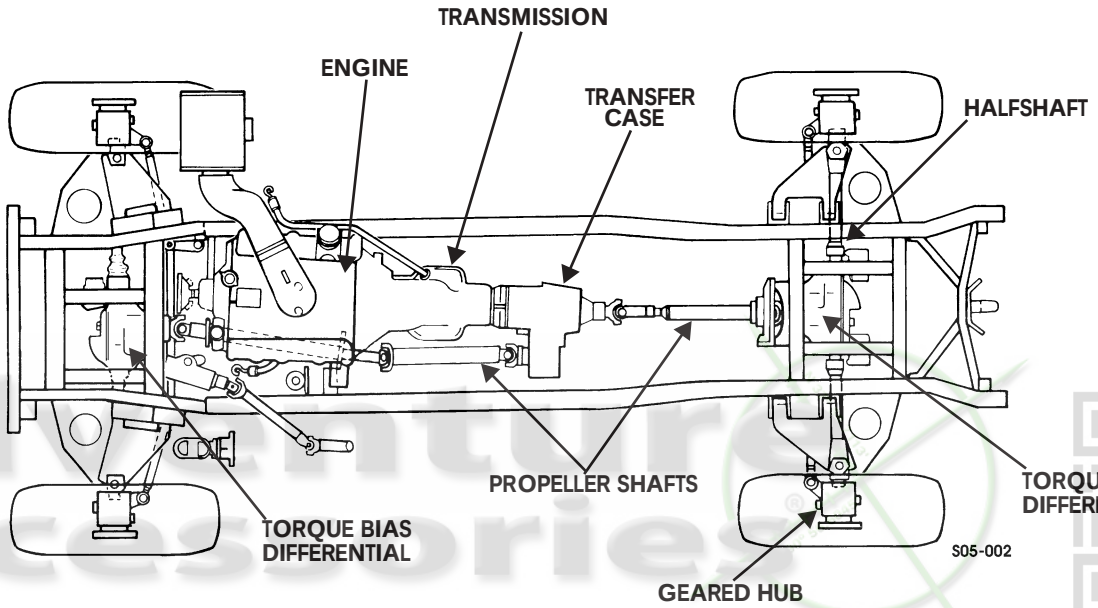


Figure 5-109: Drive System

Drive System Operation

The transfer case evenly distributes power form the transmission to the front and rear axle assemblies (Figure 5-109). Power is delivered from the transfer case through the propeller shafts which are linked to the differentials. Universal joints located at either end of the front and rear propeller shafts permit in-line driving power between the transfer case and the differentials. The differentials transfer driving power through the halfshafts and geared hubs. The differentials ensure that power is applied to the wheel which has traction, regardless of which wheel is slipping. This feature is called torque biasing. The geared hubs serve as the front wheel steering spindle and act as the final drive components to the front and rear wheels.

Transfer Case Oil Cooler

The transfer case lubricant (Dexron III) is cooled by transmission fluid which flows from the transmission fluid cooler, through the transfer case cooler, back into the transmission, and then to the transmission fluid cooler (Figure 5-110).

Some transfer cases allow the driver to select either 2-wheel or 4-wheel drive. However, the HUMMER's transfer case provides full-time 4-wheel drive in all gear ranges. It also contains an internal differential that allows for independent drive or lockup between the front and rear axles. The transfer case is designed to compensate for the different speeds between the front and rear axles when driving over uneven terrain (such as bumpy or snowy roads). In this way, the transfer case permits the vehicle to be continuously operated in 4-wheel drive.

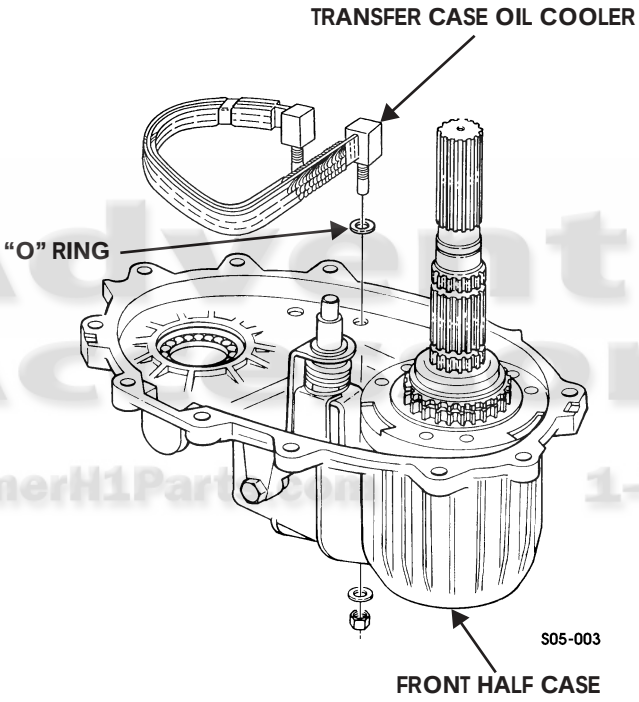


Figure 5-110: Transfer Case Oil Cooler

Transfer Case Gear Range Selection

The transfer case is operated by the transfer case shift lever (Figure 5-111).

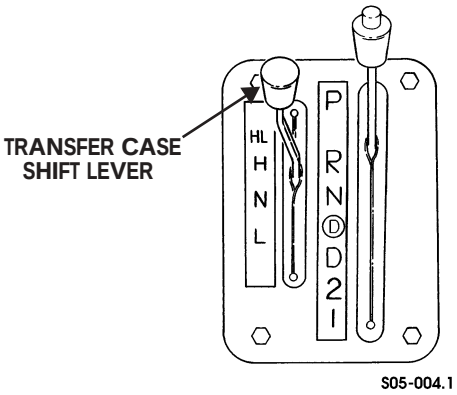


Figure 5-111: Transfer Case Gear Range Selection

HL (high-lock) - The HL position should *only* be used in moderate off-road conditions in which there is a chance of wheel slippage, such as bumpy or muddy secondary roads, snow covered roads, etc...

H (high) - The H position should be used under all "normal" operating conditions, such as highway and hard surface driving.

N (neutral) - The N position should only be used when towing the vehicle.

L (low-lock) - The L position should be used for adverse off-road conditions such as deep, loose sand; deep mud; very steep, rough hills; ditch crossing; log crossing; etc.

The H position permits the front and rear differential to operate independently through the differential inside of the transfer case and still maintain 4-wheel drive. The HL and L positions provide full-time 4-wheel drive with both differentials locked together, bypassing the differential in the transfer case. The L position also provides an additional gear reduction of 2.72:1 to the drivetrain. The N position disengages the transfer case.

The transfer case can be shifted from the H to the HL position "on-the-fly" (while the vehicle is moving). The differential within the transfer case is engaged only when the transfer case is in the H position. All other transfer case shifts should be made when the vehicle is stopped and the transmission is in N.

TRANSFER CASE DIAGNOSIS AND TROUBLESHOOTING

Transfer Case Difficult to Shift

1. Check transfer case shift linkage for improper adjustment or damage which would interfere with operation. Adjust or replace shift rod.
2. Check transfer case fluid lever (Section 1). Add fluid, if necessary.
3. Repair or replace transfer case.

Transfer Case Noise

1. Check transfer case fluid level (Section 1). Add fluid, if necessary.
2. Repair or replace transfer case.

TRANSFER CASE SHIFT ROD MAINTENANCE

Removal

1. Remove cotter pin, washer, and shift rod from transfer case range lever. Discard cotter pin (Figure 5-112).
2. Remove cotter pin, washer, and shift rod trunnion from bearing and arm assembly. Discard cotter pin.

NOTE: Mark trunnion position on shift rod for installation.

3. Remove trunnion from shift rod.

Installation

1. Install trunnion on shift rod (Figure 5-112).
2. Install shift rod and trunnion on bearing and arm assembly with washer and cotter pin. Do not spread cotter pin.
3. Insert end of shift rod into transfer case range lever and secure with washer and cotter pin.
4. Check transfer case shifting detents with positions on transfer range indicator (Figure 5-113).

Adjustment

NOTE: Transfer case shift rod must be adjusted so that detents of transfer case shift lever align shifter lever with position on transfer range indicator.

1. Remove cotter pin, washer, and trunnion from bearing and arm assembly (Figure 5-112).
2. Engage parking brake, and place transmission shift lever in D (drive) position (Figure 5-113).
3. Place transfer case shift lever forward in HL (high lock) position and hold in position.
4. Ensure transfer case range lever is in most rearward position (HL) (Figure 5-112).
5. Adjust trunnion on shift rod so that trunnion end slides easily into bearing and arm assembly.
6. Secure trunnion to bearing and arm assembly with washer and cotter pin.
7. Ensure all transfer case detent positions align with transfer range indicator positions.

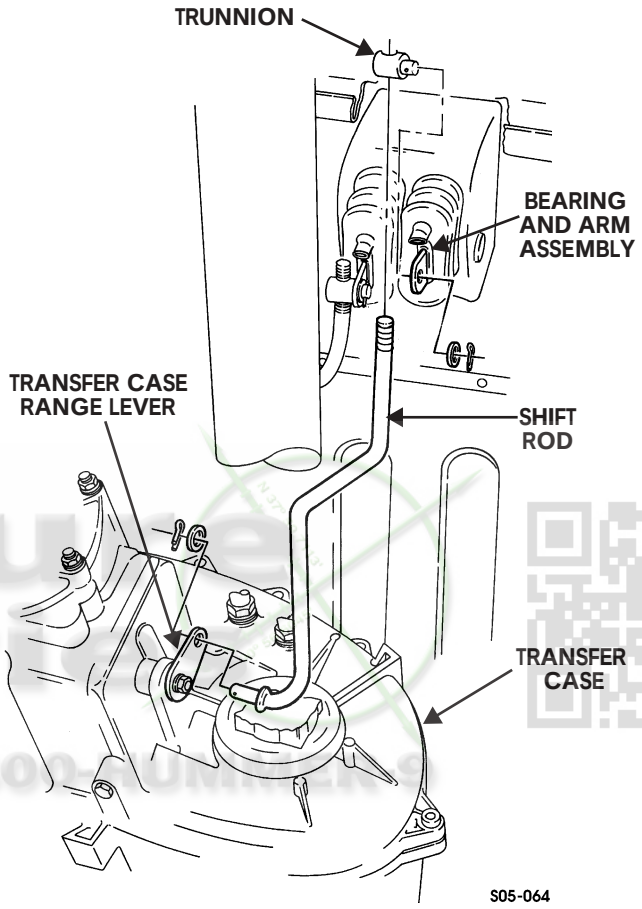


Figure 5-112: Transfer Case Shift Rod

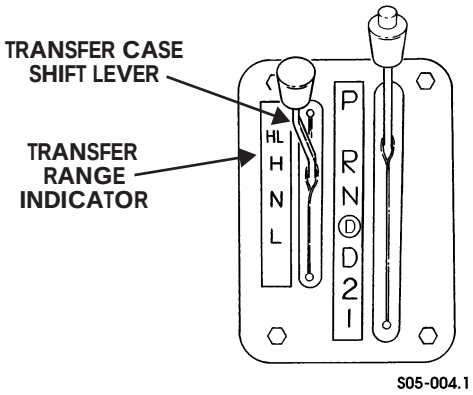


Figure 5-113: Transfer Case Range Indicator

SPEEDOMETER SPEED SENSOR AND TRANSFER CASE LOCK SWITCH REPLACEMENT

Removal

1. Disconnect engine wiring harness connector from speed sensor (Figure 5-114).
2. Remove bolt, speed sensor, and O-ring from transfer case. Discard O-ring (Figure 5-115).
3. Disconnect wiring harness connector from transfer case lock switch (Figure 5-114).
4. Remove lock switch from transfer case.

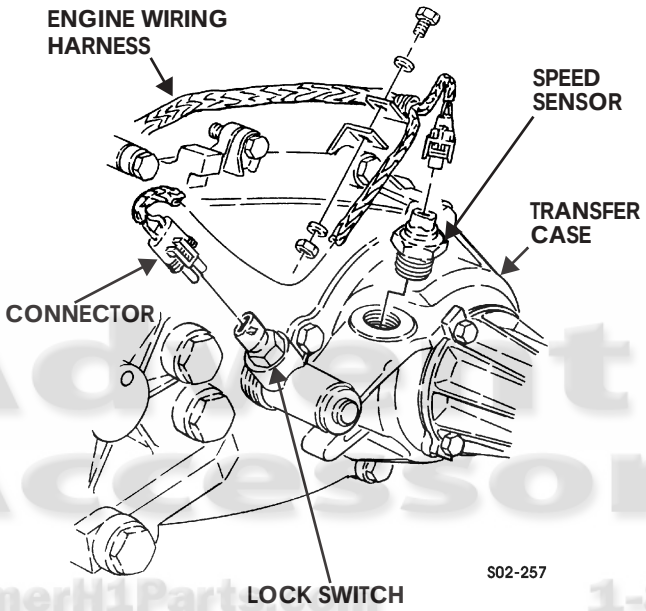


Figure 5-114: Speedometer Speed Sensor and Lock Switch

Installation

1. Install lock switch in transfer case (Figure 5-114).
2. Connect wiring harness connector to lock switch.
3. Install O-ring on speed sensor (Figure 5-115).
4. Install speed sensor in transfer case. Ensure speed sensor is seated in transfer case opening.

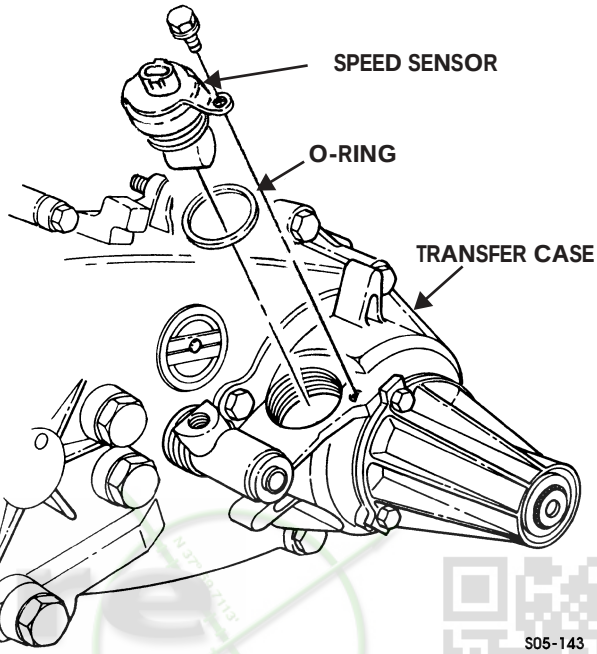


Figure 5-115: Speed Sensor

5. Secure speed sensor to transfer case with bolt. Tighten bolt to 15 lb-ft (20 N•m).
6. Connect engine wiring harness connector to speed sensor.

NOTE: In PCM diagnostics and troubleshooting, the speed sensor in the transfer case is referred to as Vehicle Speed Sensor (VSS).

TRANSFER CASE GUIDE CABLE REPLACEMENT

Removal

1. Remove nut, washer, screw, and spacer from muffler mounting bracket and guide cable bracket (Figure 5-116).
2. Remove two nuts and washers from transfer case and guide cable bracket.
3. Remove screw, washer, guide cable, washers, and brake line support bracket from left-hand frame rail.
4. Remove nut, washer, guide cable and washer from crossmember.

Installation

1. Install guide cable bracket on muffler mounting bracket with screw, spacer, washer, and nut (Figure 5-116).
2. Install guide cable bracket on transfer case with two washers and nuts.
3. Install guide cable and brake line support bracket on left-hand frame rail with two washers and screw. Tighten screw to 27-33 lb-ft (37-45 N•m).
4. Install guide cable on crossmember with two washers and nut.

TRANSFER CASE VENT LINE REPLACEMENT

Removal

1. Loosen clamp and remove vent line from fitting on rear of transfer case (Figure 5-117).
2. Remove bolt, clamp, and vent line from transmission.
3. Disconnect vent line from tee fitting and remove vent line from vehicle.
4. If a new vent line is to be installed, remove clamp from vent line.

Installation

1. If installing a new vent line, position clamp on vent line (Figure 5-117).
2. Connect vent line to tee fitting.
3. Install vent line to fitting on rear of transfer case and tighten clamp.
4. Install clamp and vent line on transmission with bolt. Tighten bolt to 16-20 lb-ft (22-27 N•m).

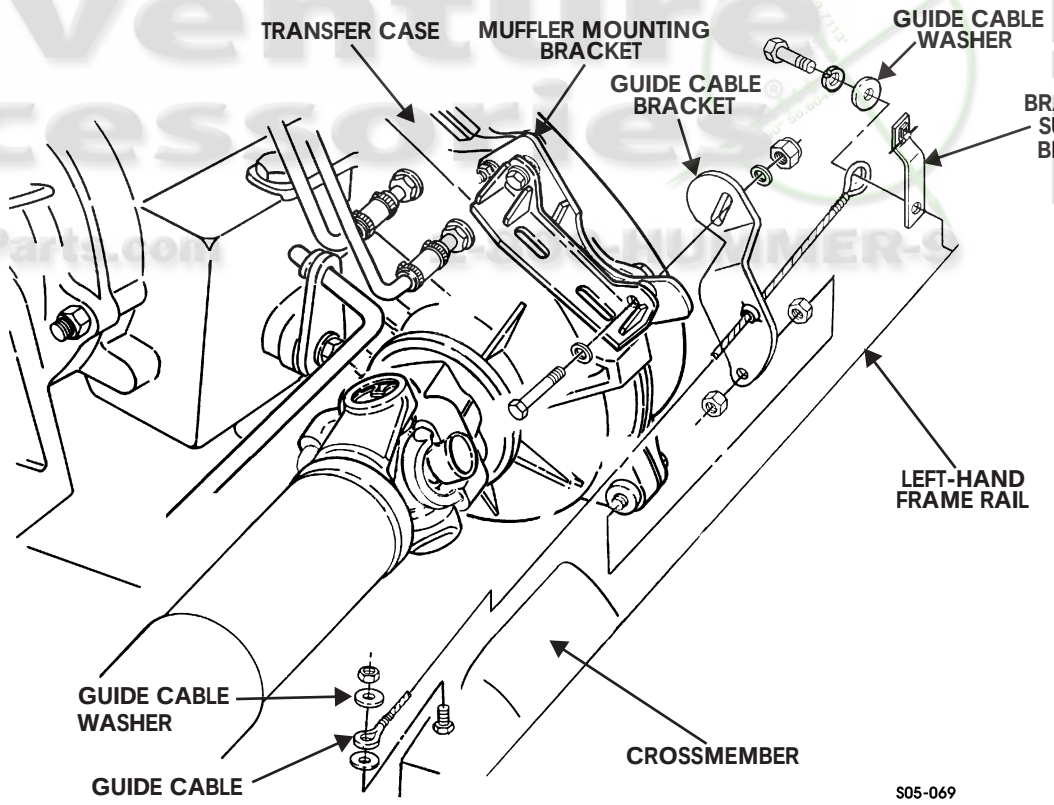


Figure 5-116: Transfer Case Guide Cable

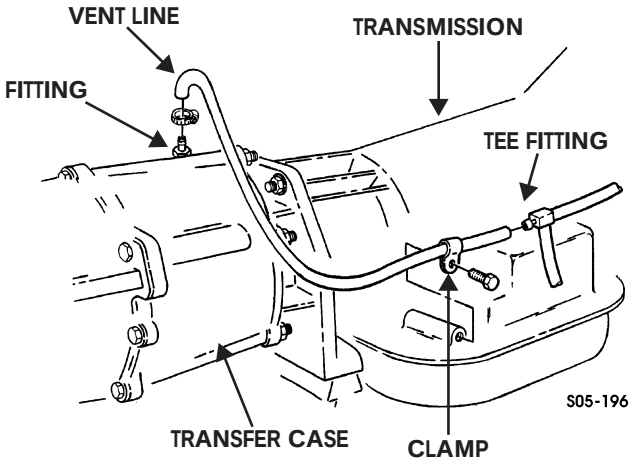


Figure 5-117: Transfer Case Vent Line

TRANSFER CASE OIL SEAL REPLACEMENT

NOTE: Replacement procedures for front and rear oil seals are basically the same except the rear Yoke is part of propeller shaft which must be removed. This procedure is for the front oil seal.

Removal

1. Remove four nuts, washers, two U-bolts, and front propeller shaft from output yoke (Figure 5-118).

NOTE: Have drainage container ready to catch oil.

2. Remove yoke nut, yoke washer, and output yoke from transfer case. Discard yoke washer (Figure 5-119).
3. Remove and discard oil seal.

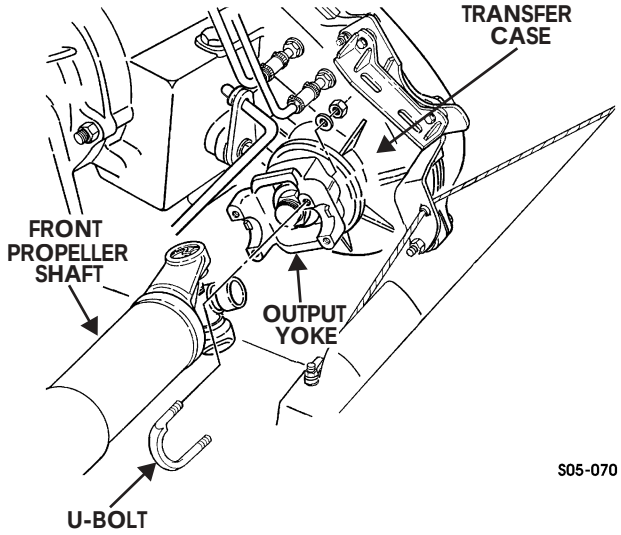


Figure 5-118: Output Yoke

Installation

1. Using output shaft seal installer, install oil seal in transfer case (Figure 5-119).
2. Install slinger, output yoke, yoke washer, and yoke nut on transfer case. Tighten nut to 110 lb-ft (149 N•m).
3. Connect front propeller shaft to output yoke with two U-bolts, four lockwashers, and nuts. Tighten nuts to 13-18 lb-ft (18-24 N•m) (Figure 5-118).

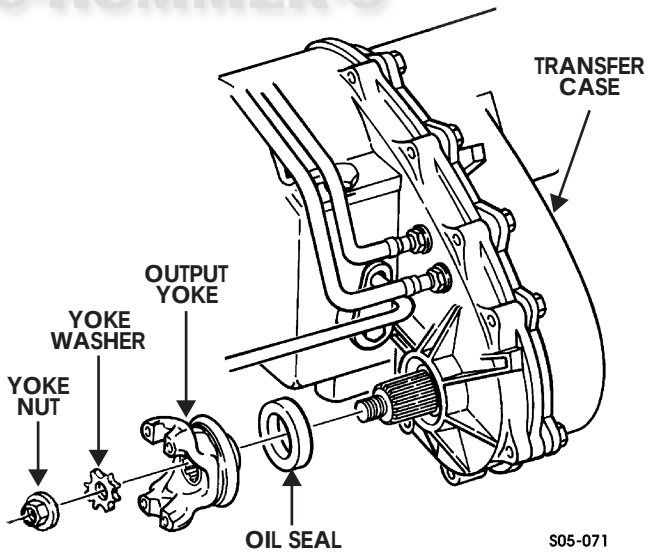


Figure 5-119: Oil Seal

TRANSFER CASE MAINTENANCE

WARNING: To avoid injury, support transfer case during removal. Allow hot transfer case to cool before performing maintenance.

***CAUTION**: Cover or plug all open lines, connections, and ports immediately after disconnection to prevent contamination.*

NOTE: Have drainage container ready to catch oil.

Removal

1. Remove drainplug and O-ring, and drain oil from transfer case. Reinstall drainplug and tighten to 35 lb-ft (47 N•m) (Figure 5-120).

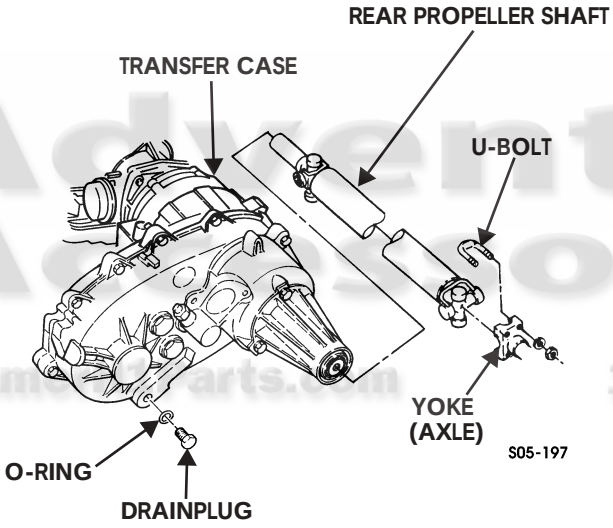


Figure 5-120: Transfer Case Drainplug

2. Remove four nuts, lockwashers, two U-bolts, and rear propeller shaft from axle. Remove shaft. Discard lockwashers.
3. Disconnect engine wiring harness connectors from output speed sensor and range lock switch (Figure 5-121).
4. Remove bolt, output speed sensor, and range lock switch from transfer case.
5. Remove nut, lockwasher, harness clamp, washer, and screw from transfer case.
6. Loosen clamp and remove vent line from fitting and tie vent line out of the way (Figure 5-122).

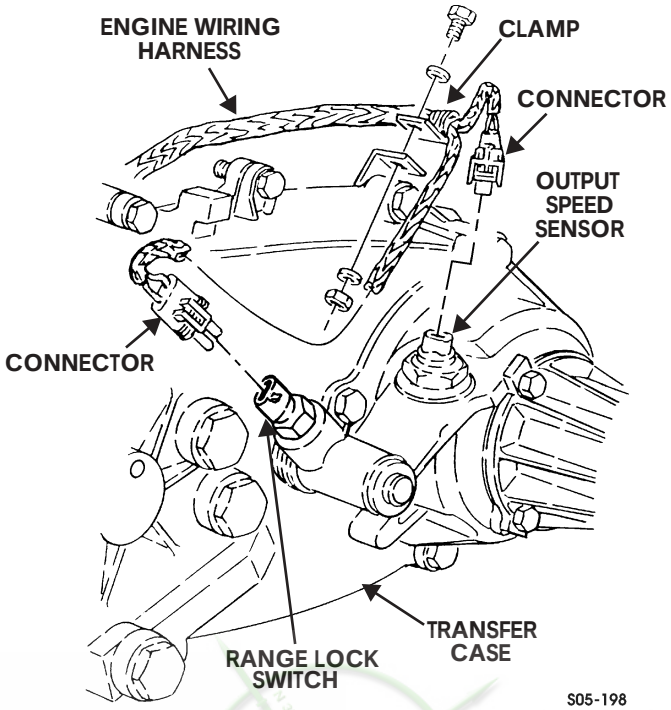


Figure 5-121: Speed Sensor and Lock Switch Connectors

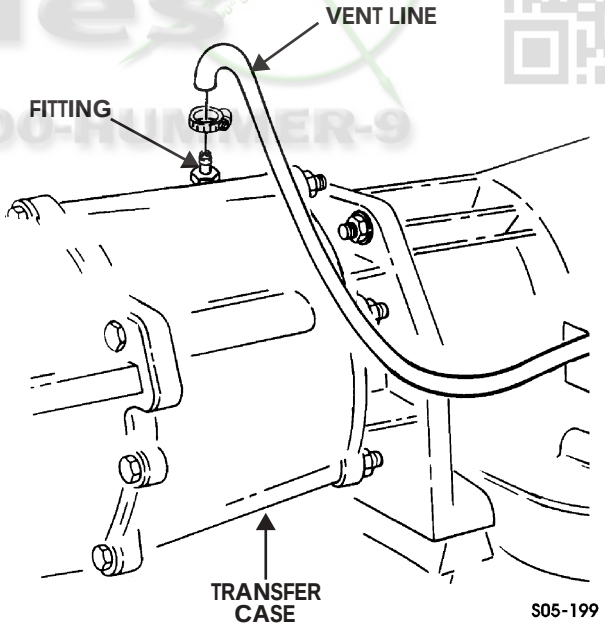


Figure 5-122: Vent Line

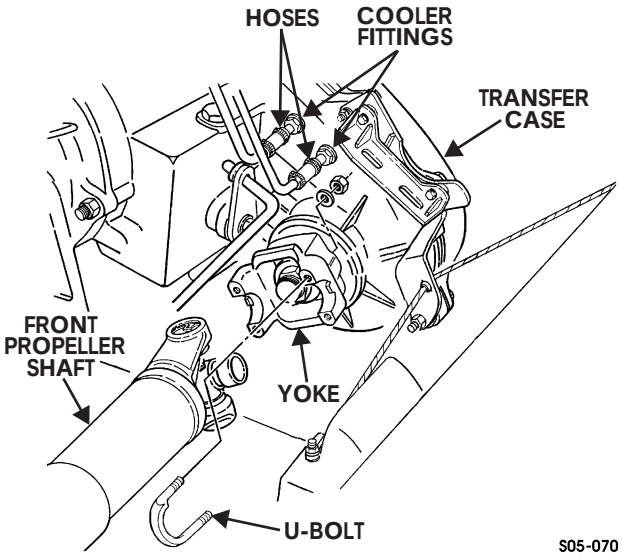


Figure 5-123: Front Propeller Shaft

7. Remove four nuts, lockwashers, two U-bolts and front propeller shaft from yoke. Discard lockwashers (Figure 5-123).
8. Loosen two clamps and remove hoses from transfer case cooler fittings.
9. Remove cotter pin, washer, and shift rod from range lever. Discard cotter pin (Figure 5-124).
10. Remove exhaust U-bolt pipe hanger and retainer cable bracket from transfer case.

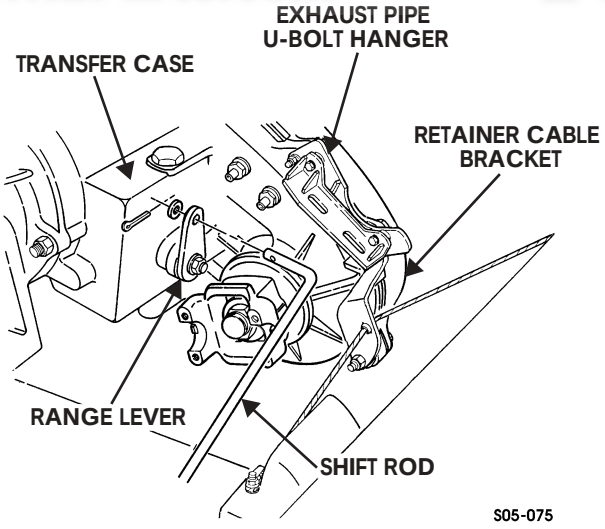


Figure 5-124: Range Lever

11. Place jack under transfer case. Secure transfer case to jack with chain and wood blocking.
12. Remove six locknuts securing transfer case to transfer case adapter. Discard locknuts (Figure 5-125).

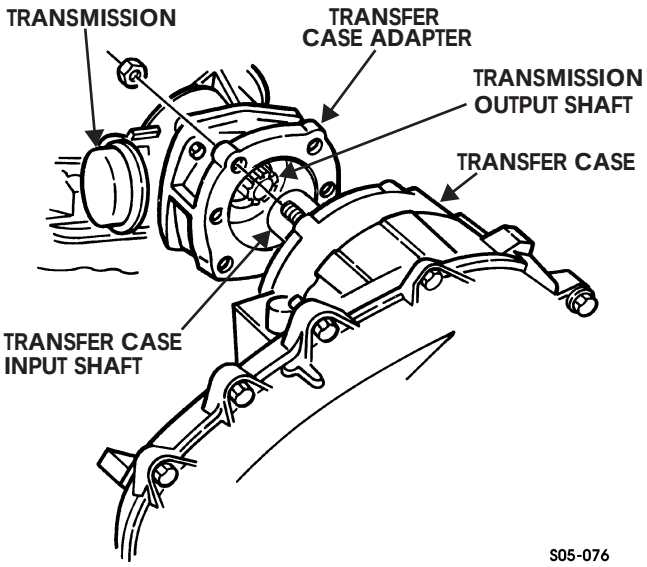


Figure 5-125: Transfer Case Adapter

13. Slide transfer case rearward from adapter and remove from transmission.

Cleaning and Inspection

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

Clean sealant remains from transfer case and adapter (Figure 5-125).

Installation

1. Mount transfer case securely on jack with chain and blocking wood.
2. Apply anaerobic sealer to transfer case mounting surface on transfer case adapter (Figure 5-125).

NOTE: Ensure sufficient anaerobic sealer is applied to transfer case mounting surface to form a consistent bead of squeeze upon installation on transfer case adapter.

3. Align transfer case female input shaft with male transmission output shaft and install transfer case on adapter with six locknuts. Tighten locknuts to 37 lb-ft (50 N•m).
4. Remove jack.

5. Install shift rod on range lever with washer and cotter pin (Figure 5-126).
6. Install exhaust pipe U-bolt hanger and retainer cable bracket on transfer case.

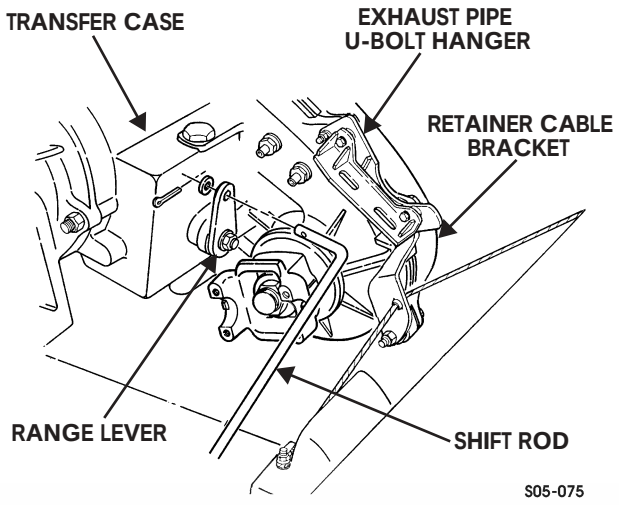


Figure 5-126: Range Lever

7. Install vent line to fitting on transfer case and tighten clamp (Figure 5-126).

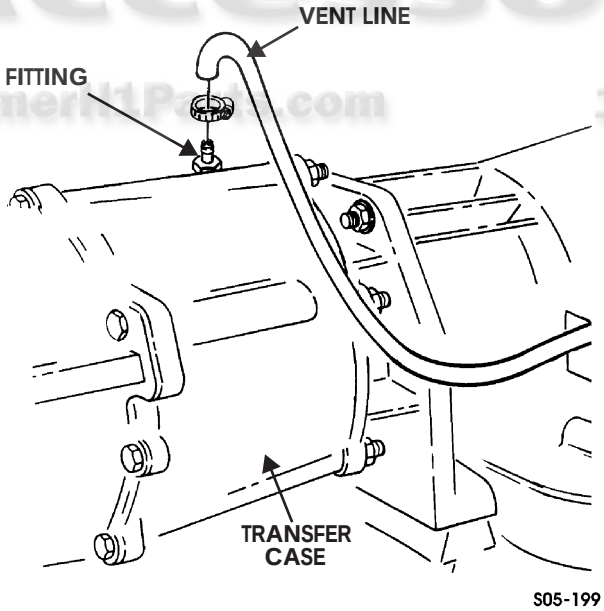


Figure 5-127: Vent Line

8. Install two hoses on transfer case cooler fittings and tighten clamps to 35-45 lb-in. (4-5 N•m) (Figure 5-128).
9. Connect front propeller shaft to yoke with two U-bolts, four lockwashers, and nuts. Tighten nuts to 13-18 lb-ft (18-24 N•m).

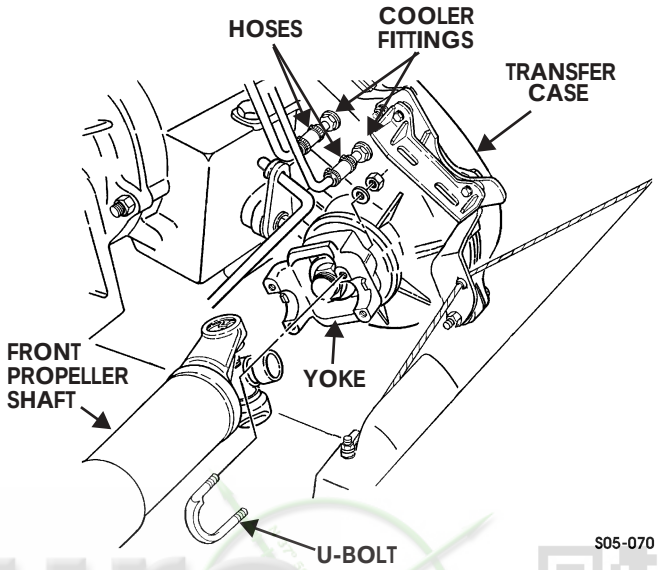


Figure 5-128: Front Propeller Shaft

10. Coat seal on output speed sensor with Dexron II and install speed sensor in transfer case with bolt. Tighten bolt to 15 lb-ft (20 N•m) (Figure 5-127).
11. Install range lock switch in transfer case (Figure 5-129).
12. Install harness clamp on transfer case with screw, washer, lockwasher, and nut.
13. Connect engine wiring harness connectors to output speed sensor and range lock switch (Figure 5-128). Ensure connectors are latched.

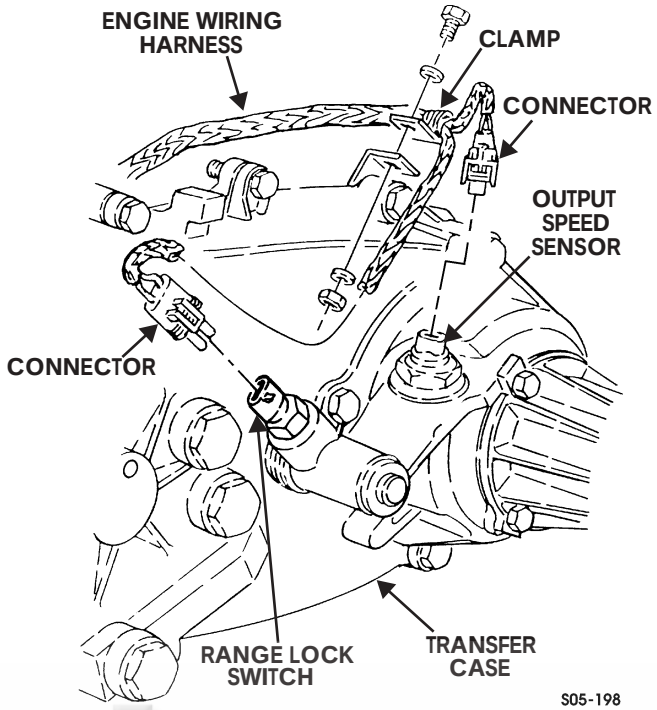


Figure 5-129: Speed Sensor and Lock Switch Connectors

14. Install rear propeller shaft on axle with two U-bolts, four lockwashers, and nuts. Tighten nuts to 21 lb-ft (28 N•m) (Figure 5-130).

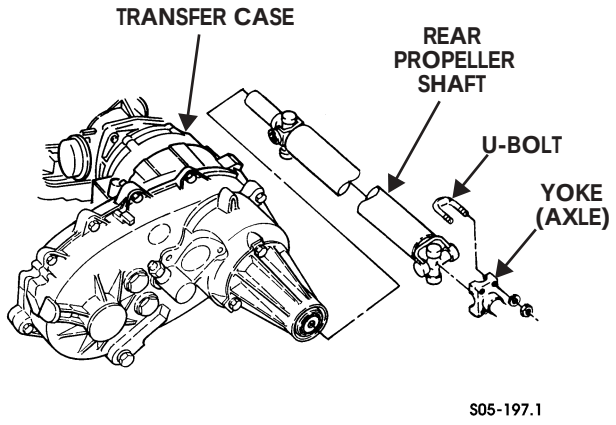


Figure 5-130: Rear Propeller Shaft

TRANSFER CASE REPAIR

WARNING: Transfer case is very heavy and tends to be unstable during disassembly and assembly. The work surface must be of sufficient size and strength to prevent the transfer case from falling and causing injury or damage to the case.

Disassembly

1. Remove transfer case from transmission.
2. Remove bolt and speed sensor from bearing retainer (Figure 5-131).

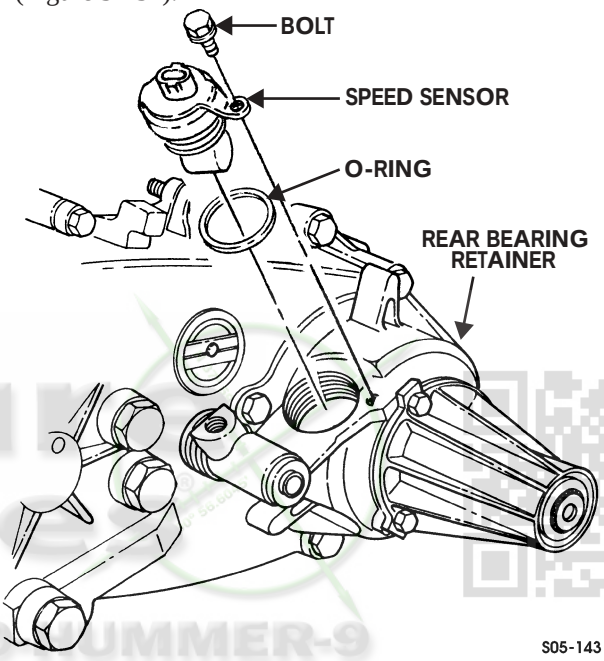


Figure 5-131: Front Seal

3. Remove and discard O-ring from speed sensor.
4. Remove yoke nut, yoke washer, and front output yoke from transfer case (Figure 5-132).

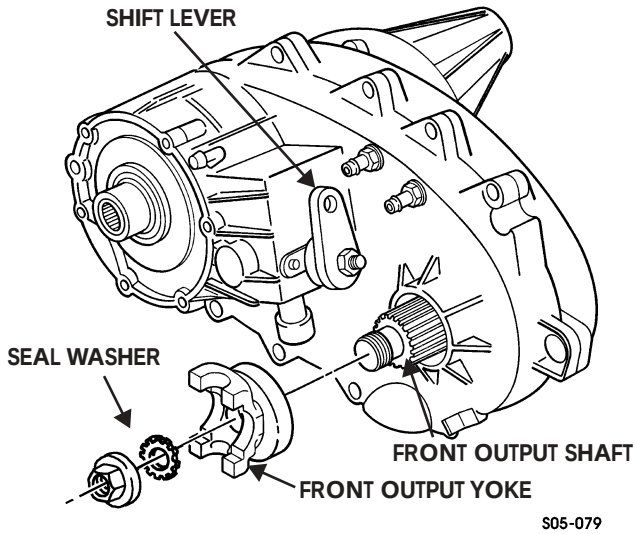


Figure 5-132: Front Output Yoke

5. Remove three capscrews securing rear extension to transfer case (Figure 5-133).
6. Using a soft-nosed hammer or mallet, tap on rear extension screw bosses to break seal between rear extension and rear bearing retainer. Remove rear extension.
7. Remove and discard encased seal.

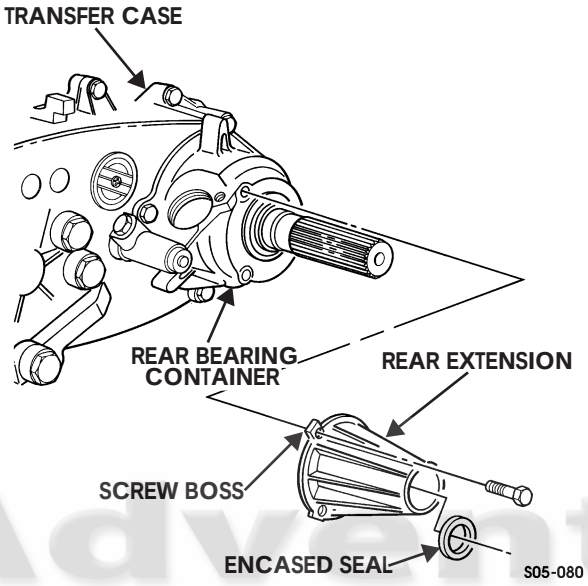


Figure 5-133: Rear Extension

8. Remove snapring from mainshaft (Figure 5-134).

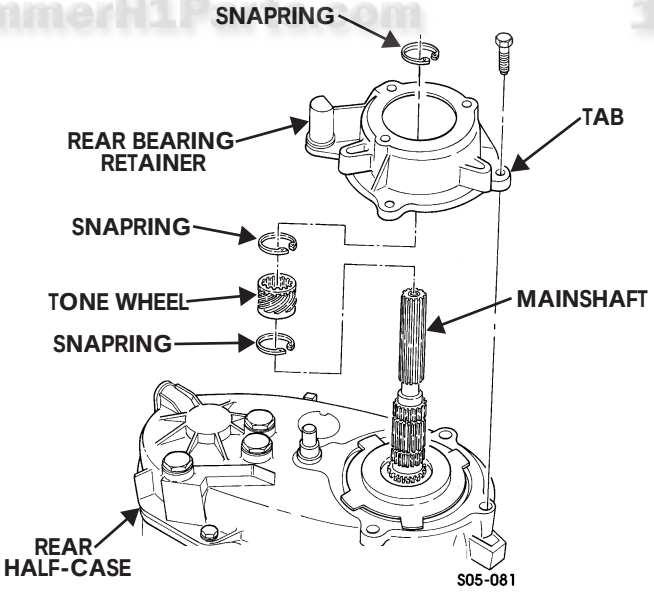


Figure 5-134: Mainshaft Snapring

9. Remove four capscrews securing rear bearing retainer to rear half-case.
10. Break seal to rear half-case by prying on tabs of rear bearing retainer, and remove rear bearing retainer from mainshaft.
11. Remove two snaprings and tone wheel from mainshaft.
12. Remove two screws and washers securing ends of rear half-case to front half-case (Figure 5-135).

NOTE: Mark position of long screws for installation.

13. Remove three long screws securing side of rear half-case to front half-case.
14. Remove seven screws securing rear half-case to front half-case.
15. Using slots in front half-case, break seal between half-cases, and remove rear half-case.
16. Remove magnetic pickup from front half-case.
17. Rotate oil pickup tube and oil screen out of rear half-case and disconnect oil pickup tube from oil pump inlet port (Figure 5-136).

NOTE: Mark position of oil pump on rear half-case for installation.

18. Remove oil pump.
19. Disconnect hose from oil pickup tube and screen.
20. Remove and discard O-ring from oil pump (Figure 5-137).

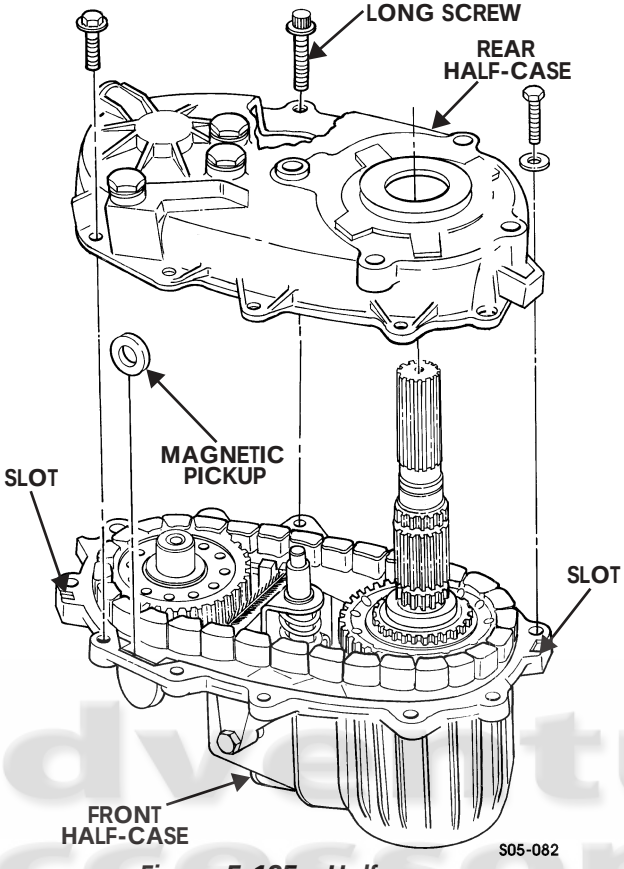


Figure 5-135: Half-cases

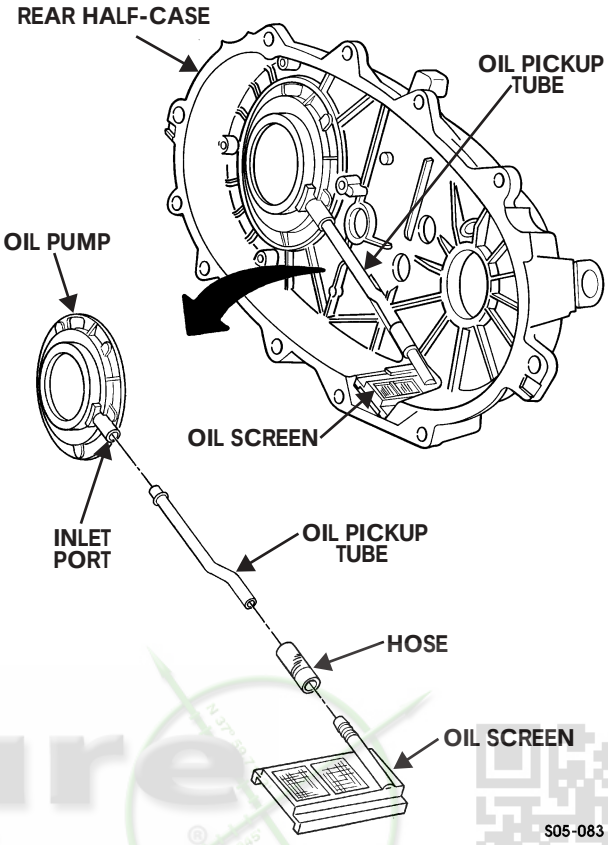


Figure 5-136: Rear Half-case

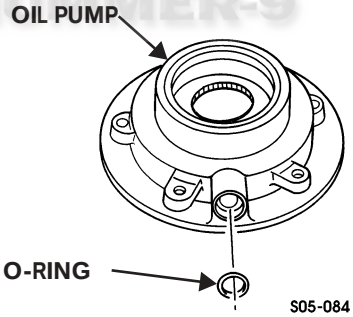


Figure 5-137: O-Ring

21. Remove snapring from mainshaft (Figure 5-137).
22. Remove snapring from front output shaft. (Figure 5-138)

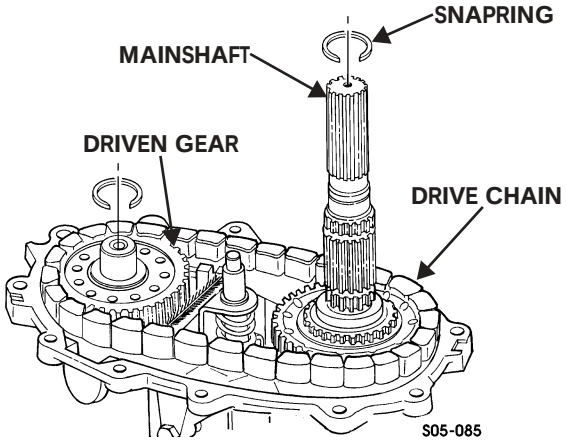


Figure 5-138: Mainshaft and Output Shaft Snaprings

23. Remove drive chain drive gear and driven gear from mainshaft and front output shaft.
24. Remove front output shaft from front half-case (Figure 5-139).

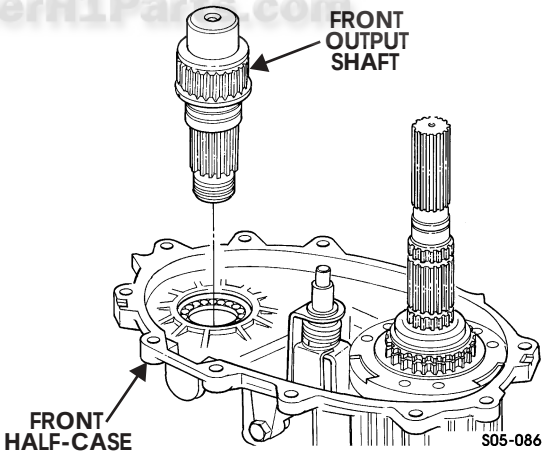


Figure 5-139: Front Half-case

25. Remove nut, washer, and shift lever from sector shaft (Figure 5-140).

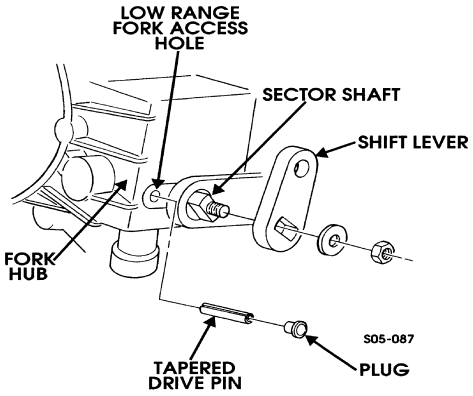


Figure 5-140: Shift Leve

26. Remove plug from low range fork access hole. Remove range switch.
27. Using screw extractor in tapered drive pin, turn pin counterclockwise and remove from fork hub.

28. Remove shifter detent plug, spring, and poppet from front half-case (Figure 5-141).

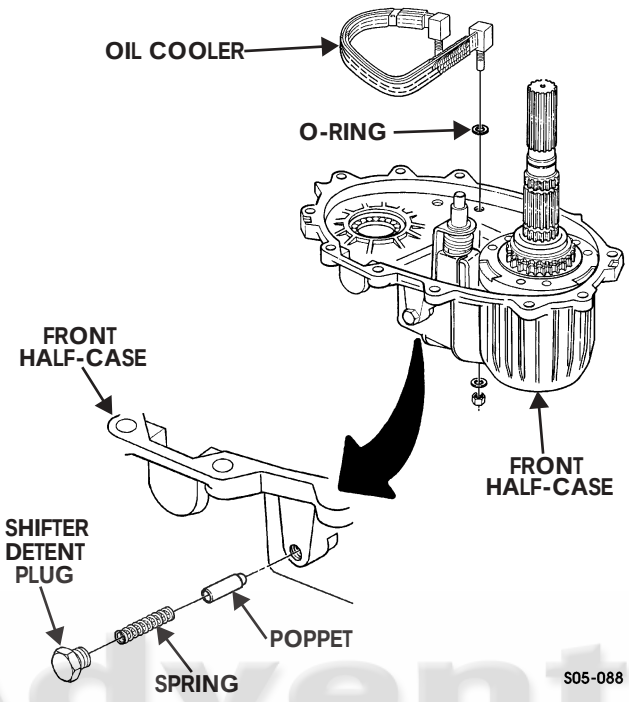


Figure 5-141: Plug, Spring, and Poppet

29. Remove two nuts, washers, O-rings, and oil cooler from front half-case. Discard O-rings.
30. Remove shift rail from mode fork assembly (Figure 5-142).
31. Remove mode fork assembly and mainshaft assembly from front half-case as a unit.
32. Remove mode fork assembly from mode shift sleeve.
33. Remove mode shift sleeve from mainshaft.
34. Remove snapring, thrust washer, and intermediate clutch shaft from mainshaft (Figure 5-143).

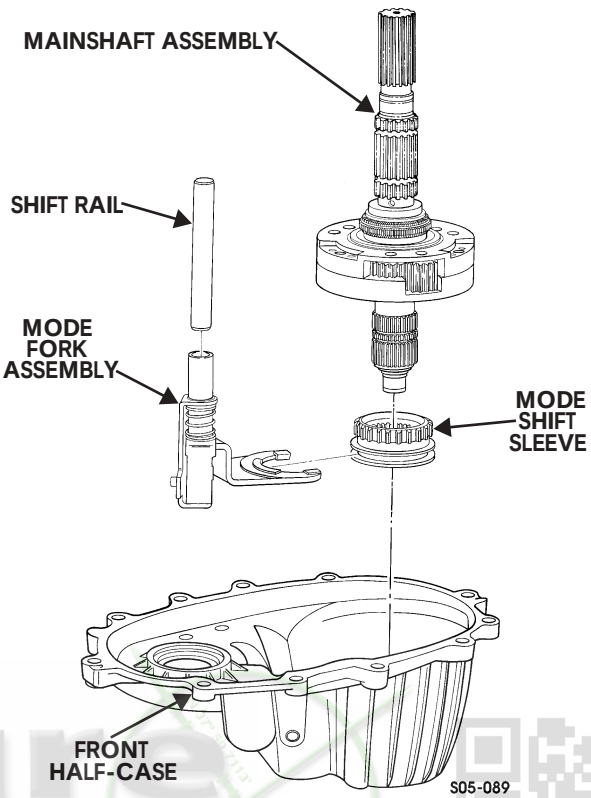


Figure 5-142: Mainshaft Assembly

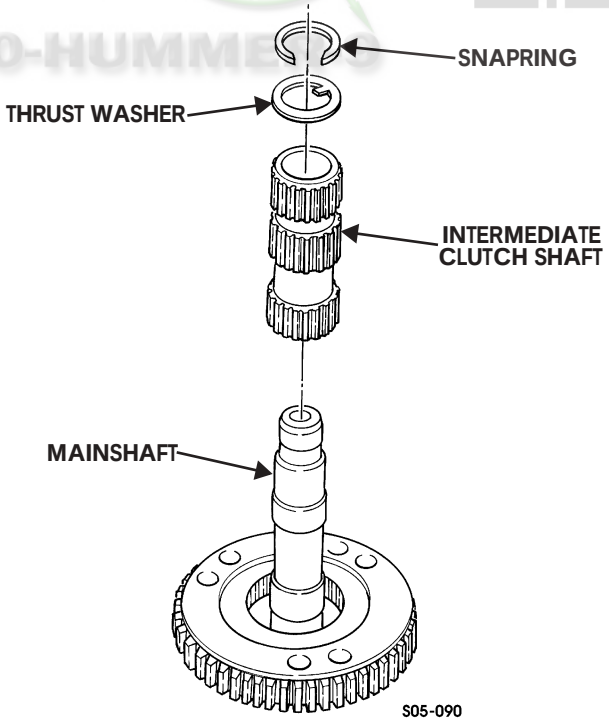


Figure 5-143: Mainshaft

NOTE: Needle bearings may fall free when differential assembly is removed from mainshaft.

35. Remove snapring and differential assembly from mainshaft (Figure 5-144).

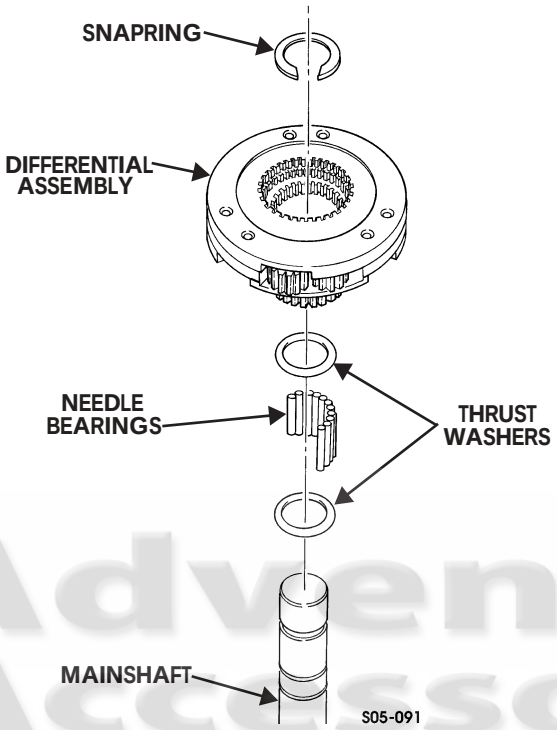


Figure 5-144: Differential Assembly

36. Remove two thrust washers and collect fifty-three needle bearings from differential assembly and mainshaft.
37. Twist range fork and range clutch sleeve to disengage stud from shift sector, and remove from front half-case and low range gear (Figure 5-145).
38. Remove range clutch sleeve from range fork.
39. Remove shift sector from front half-case.
40. Remove four screws and front bearing retainer from front half-case. Pry on front bearing retainer slots only (Figure 5-146).
41. Remove and discard seal from front bearing retainer.
42. Remove snapring from input gear shaft.

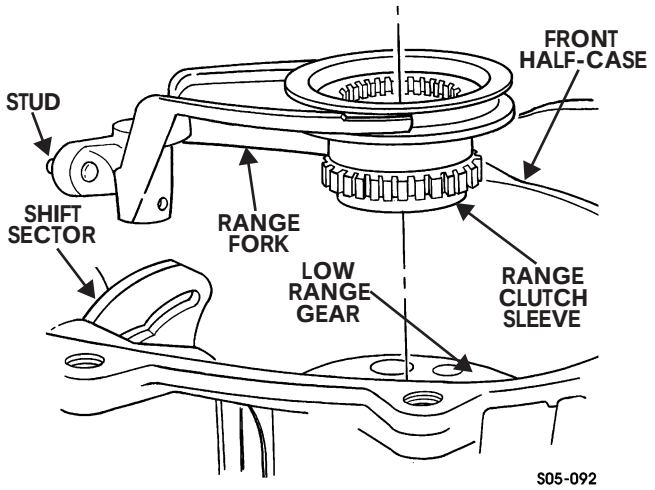


Figure 5-145: Range Fork and Range Clutch Sleeve

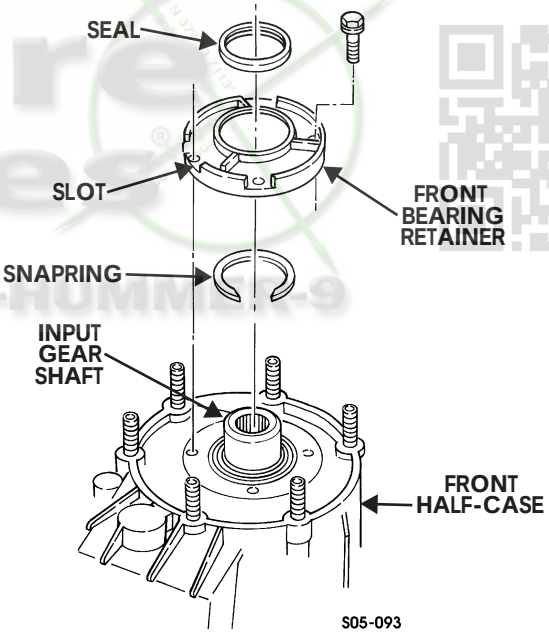


Figure 5-146: Front Bearing Retainer

43. Using driver handle and input gear bearing installer, press shaft of input gear from input bearing (Figure 5-147).

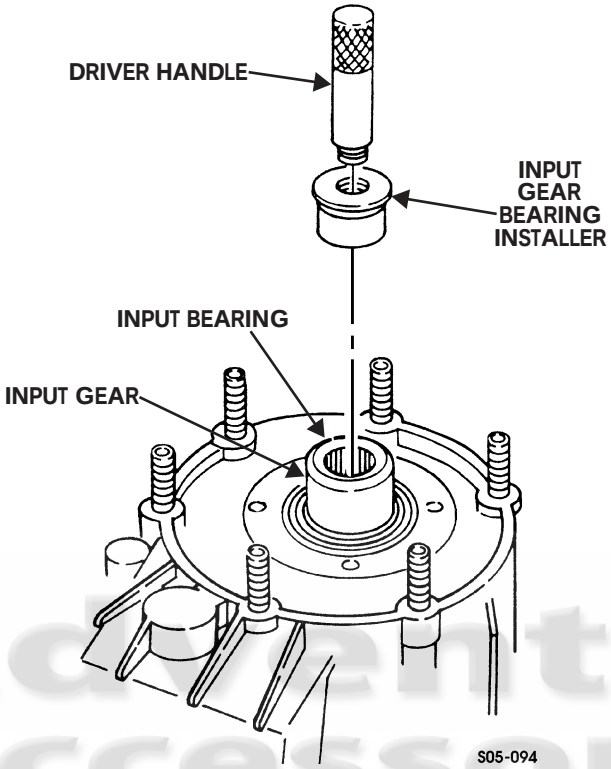


Figure 5-147: Input Bearing

44. Remove input gear and low range planetary gear from front half-case (Figure 5-148).
45. Remove snapring, retainer, two thrust washers, and input gear from low range planetary gear.

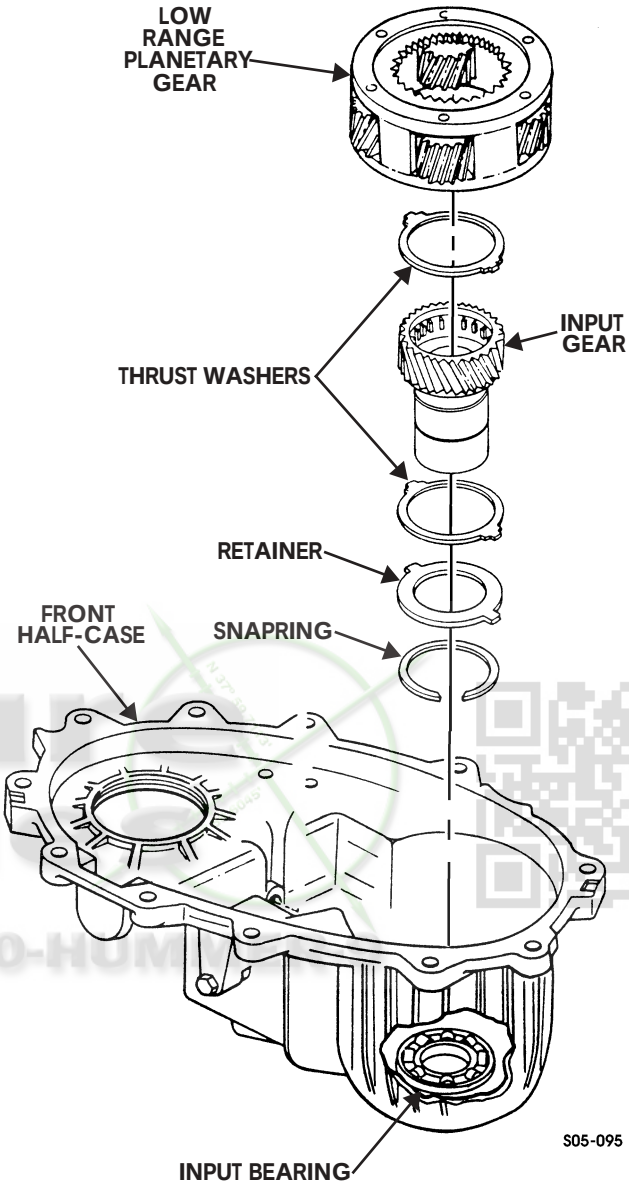


Figure 5-148: Planetary Gear

Cleaning and Inspection

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

Repair or replace all damaged or worn components.

Front Half-Case Repair

1. Inspect front half-case for damaged bearings, front output seal, cracked or broken casting, and damaged studs (Figure 5-149).
2. Replace half-case if casting is damaged, or if annulus gear is loose or damaged.
3. Replace input bearing if worn or damaged.
4. Using input gear bearing installer and driver handle, press input bearing out of half-case.
5. Remove snapring and install on replacement bearing.
6. Press in bearing until snapring is seated against half-case.
7. Remove snapring from front output bearing.
8. Using bearing tool and driver handle, remove front output bearing.

NOTE: If front output bearing is replaced due to damage or wear, replace front output seal.

9. Remove front output seal.
10. Press in new bearing and install snapring.
11. Using output shaft seal installer, install front output seal.
12. Inspect O-ring and retainer. Replace both if either is damaged.
13. Replace missing or damaged studs.

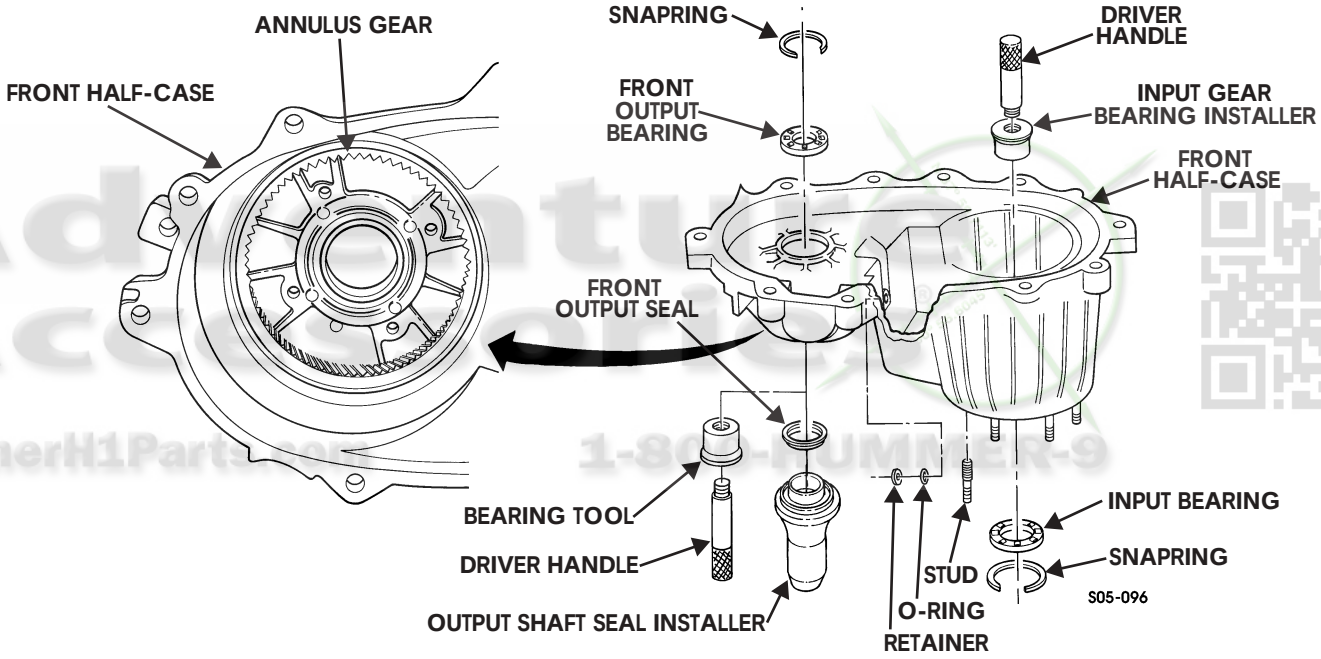


Figure 5-149: Front Seals

Rear Half-Case Repair

1. Inspect rear half-case for cracked or damaged casting, missing or damaged alignment dowels, and worn or damaged roller bearing (Figure 5-150).
2. Replace missing or damaged dowels.
3. Using slide hammer adapter and slide hammer, remove roller bearing.
4. Coat bearing with oil, and install in half-case using bearing installer and driver handle.

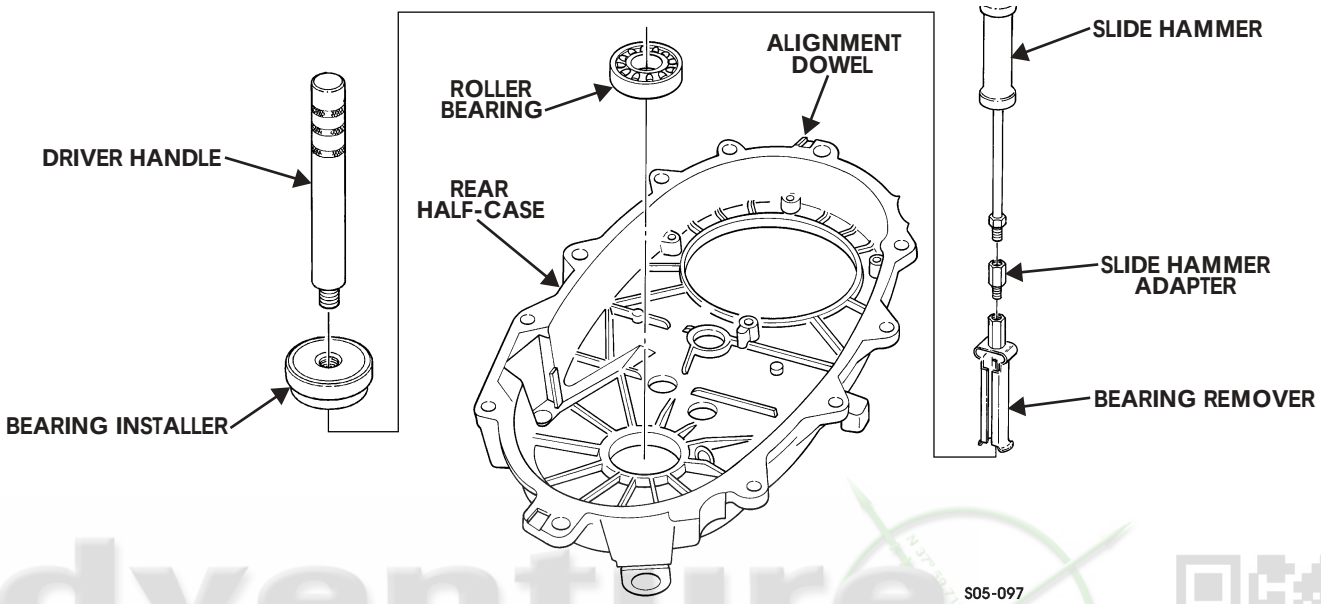


Figure 5-150: Front Bearing

Input Gear Repair

1. Inspect input gear for damaged main pilot bearing and snapring groove (Figure 5-151).
2. Using bearing remover, slide hammer adapter, and slide hammer, remove main pilot bearing from input gear.
3. Using main pilot bearing installer and driver handle, install bearing in input gear.

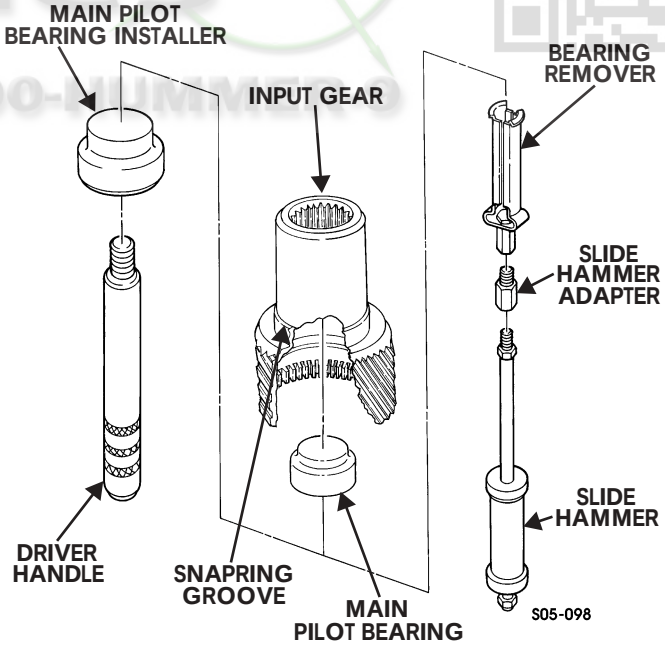


Figure 5-151: Pilot Bearing

Differential Repair

NOTE: Mark front and rear carriers for assembly.

1. Remove six screws securing front and rear carriers (Figure 5-152).

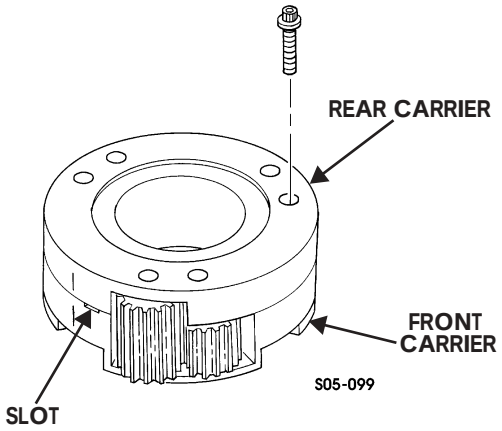


Figure 5-152: Differentia

2. Using slots, pry rear carrier off front carrier.

NOTE: Needle bearings may fall out when short pinion gears are removed.

3. Remove three pinion washers, long pinion gears, pinion washers, thrust washers, short pinion gears, fifty-four needle bearings and three thrust washers from front carrier pins (Figure 5-153).

NOTE: Record positions of mainshaft gear, sprocket gear, and front carrier for assembly.

4. Remove sprocket and mainshaft gears from front carrier.
5. Inspect front and rear carriers. Replace if damaged.
6. Inspect long and short pinion gears. Replace long or short gears as a set if any one is damaged.
7. Inspect thrust washers and pinion washers for breaks, cupping, and scoring. Replace all pinion and thrust washers if any one is damaged.
8. Inspect mainshaft and sprocket gears, and replace either if damaged. Inspect brass ring on bottom of mainshaft gear for gouging or deep scoring. Replace mainshaft gear if brass ring on bottom of mainshaft gear is damaged.
9. Inspect needle bearings. Replace all needle bearings if any one is damaged or missing.

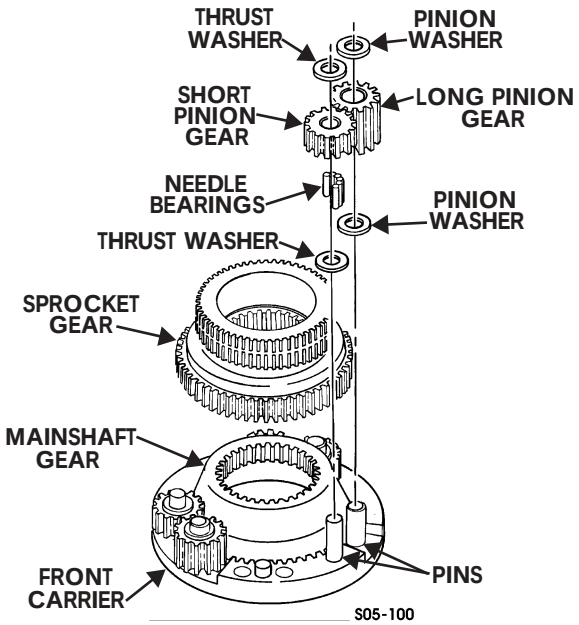


Figure 5-153: Differential Pinions

NOTE: Coat all differential parts with clean transmission oil before assembly.

10. Place mainshaft gear in front carrier, with cone surface up (Figure 5-154).

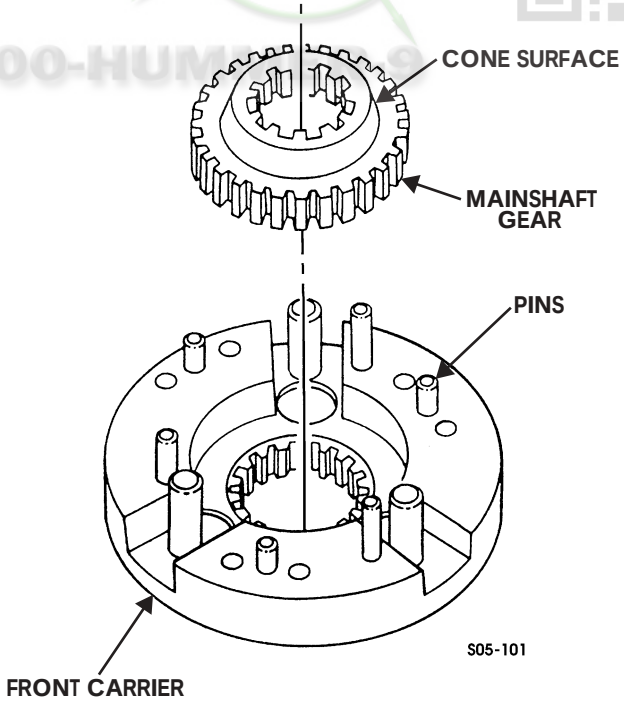


Figure 5-154: Mainshaft Gear

11. Place sprocket gear over mainshaft gear, with splined hub of sprocket gear up (Figure 5-155).

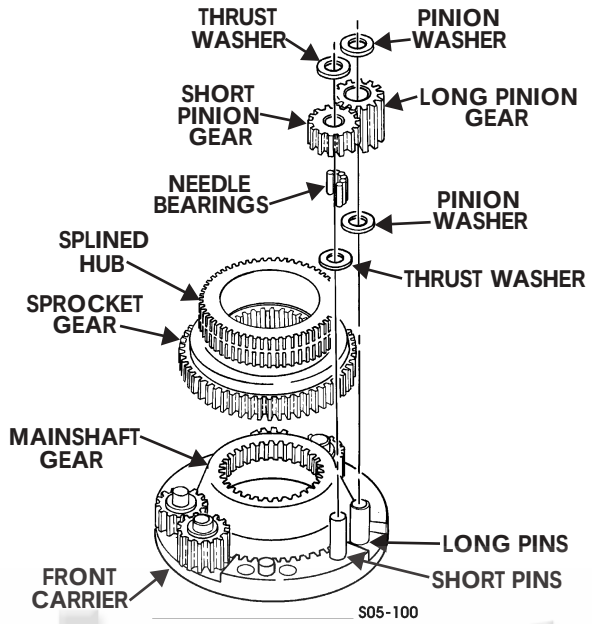


Figure 5-155: Pinion Location

NOTE: Use petrolatum to hold needle bearings in place during assembly.

12. Install three thrust washers, fifty-four needle bearings, three short pinion gears, and thrust washers on short pins.
13. Install three pinion washers, long pinion gears, and pinion washers on long pins.
14. Align index marks on front and rear carriers and set rear carrier over spacer pins (Figure 5-156).
15. Start six screws securing rear carrier to front carrier. Tighten screws evenly.

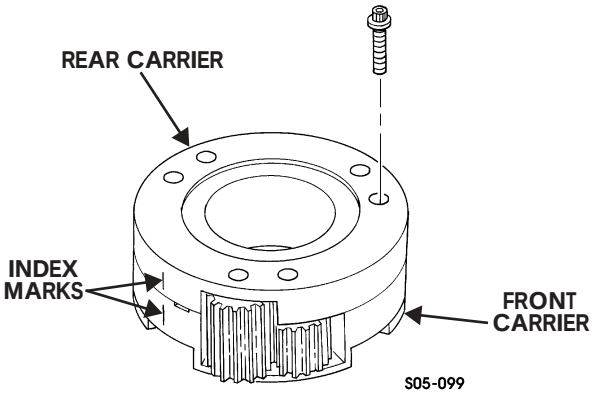


Figure 5-156: Differential

Mainshaft Repair

Inspect mainshaft gears, splines, bearing surfaces, oil passages, and snapring grooves. Remove minor scoring and burrs with crocus cloth. Replace mainshaft if otherwise damaged (Figure 5-157).

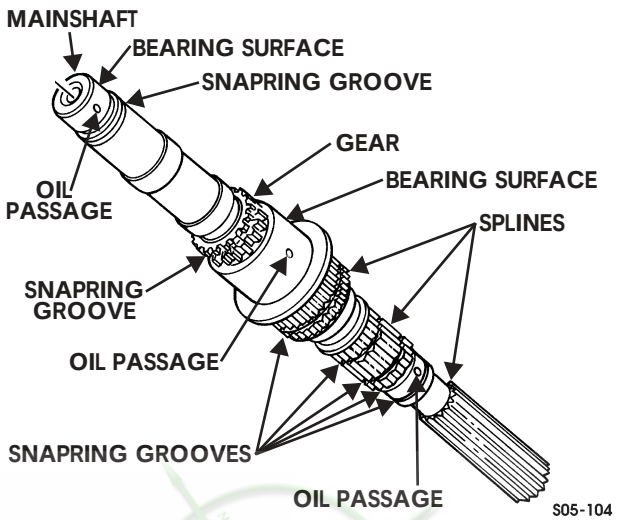


Figure 5-157: Pinion Location

Oil Pump Repair

Inspect oil pump for cracks, breaks, scoring, and damaged threads. Replace pump if any parts are damaged (Figure 5-158).

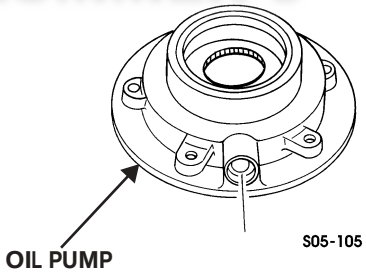


Figure 5-158: Oil Pump

Rear Bearing and Retainer Repair

1. Replace bearing if worn or damaged (Figure 5-159).
2. Using hammer and soft punch, remove bearing from rear bearing retainer.
3. Using output shaft front bearing installer and driver handle, install bearing in bearing retainer. Seat bearing to shoulder of retainer.
4. Replace alignment retainer dowel if loose, worn, or damaged.

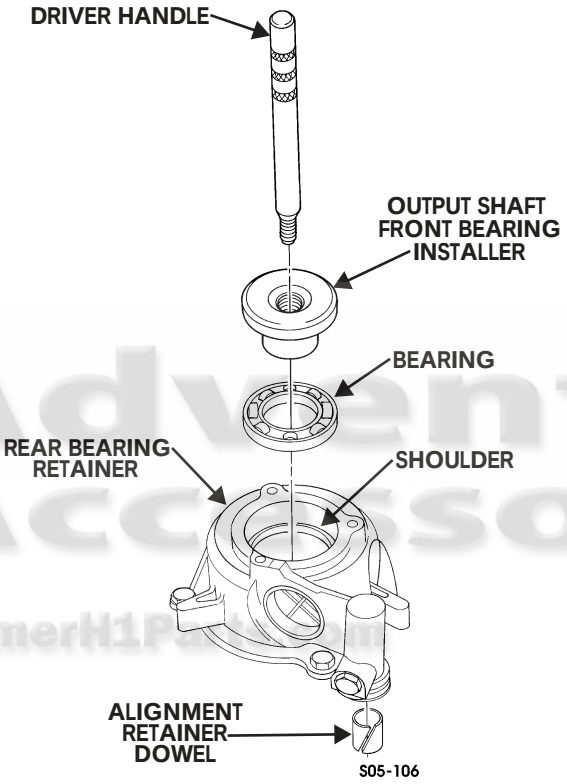


Figure 5-159: Rear Bearing

Rear Extension and Bushing Repair

1. Inspect rear extension and bushing. Replace if damaged or worn (Figure 5-160).
2. Using extension bushing remover and driver handle, remove bushing from rear extension.
3. Using bearing installer and driver handle, install bushing in rear extension.

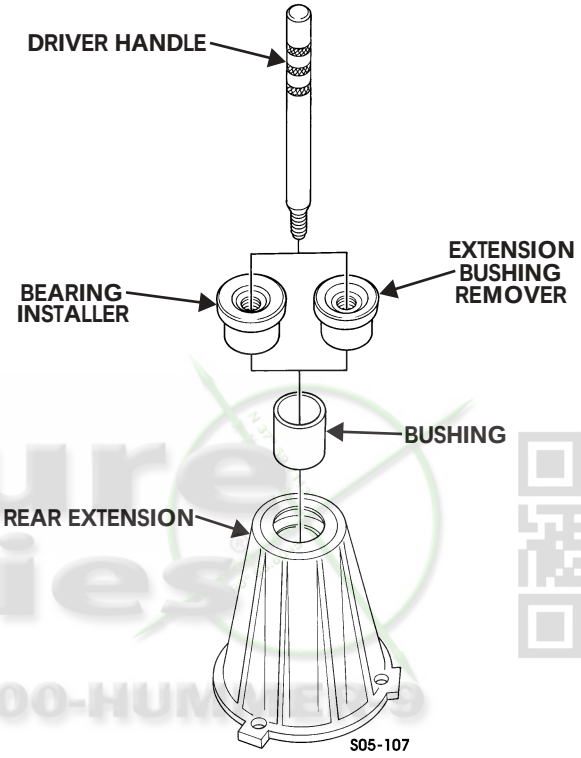


Figure 5-160: Extension Bushing

Intermediate Shaft Repair

Inspect intermediate shaft. Replace if damaged (Figure 5-161).

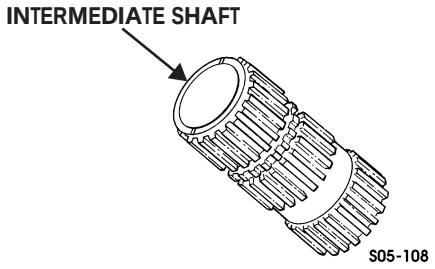


Figure 5-161: Intermediate Shaft

Sector Shaft Repair

Inspect sector shaft assembly for burrs, cracks, breaks, loose shaft, and damaged threads. Replace if damaged (Figure 5-162).

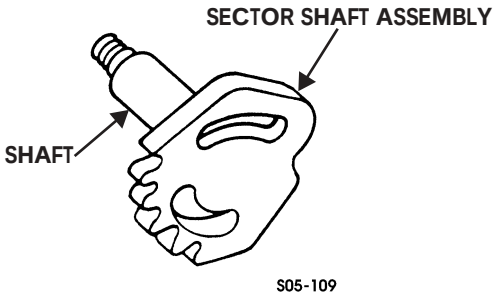


Figure 5-162: Sector Shaft

Oil Screen, Hose, and Pickup Tube Repair

Inspect oil screen, hose, and pickup tube. Clean screen, inspect for holes, and inspect components for bends or cracks that would prevent sealing. Replace damaged parts (Figure 5-163).

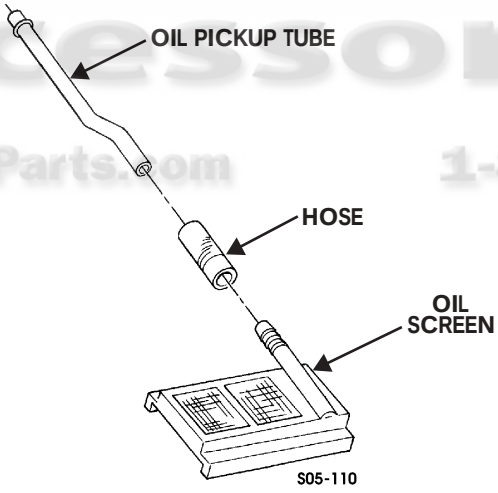


Figure 5-163: Oil Pickup Screen

Range Shift Fork and Clutch Sleeve Repair

1. Inspect range shift fork for burrs, bends, breaks, loose pin, and worn pads. Remove minor burrs and replace worn or missing pads. Replace fork if otherwise damaged (Figure 5-164).
2. Inspect range clutch sleeve for burrs, cracks, breaks, and damaged splines or gear teeth. Remove minor burrs, or replace if otherwise damaged.

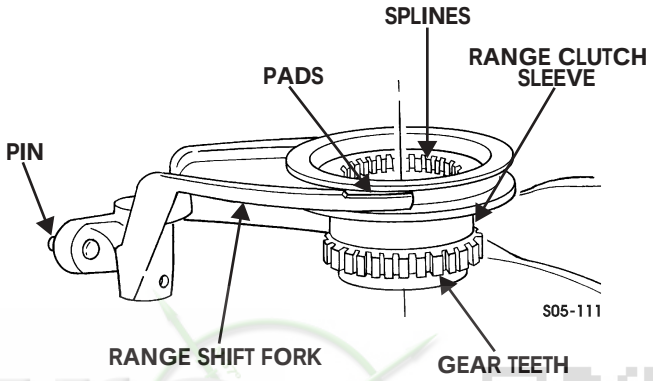


Figure 5-164: Fork Location

Mode Shift Fork Assembly Repair

1. Position mode shift fork assembly in vise, with jaws clamped on long bracket only (Figure 5-165).

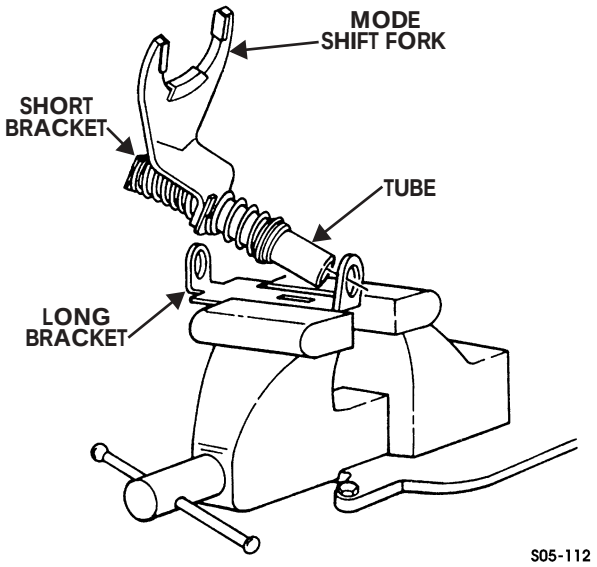


Figure 5-165: Fork Assembly

***CAUTION**: Components of mode shift fork assembly are under spring tension. Exercise caution when releasing fork.*

2. Press mode shift fork forward and disengage tube from rear of long bracket. Ease fork and short bracket out of long bracket (Figure 5-166).
3. Remove bushing, spring, and thrust washer from long end of tube.
4. Remove short bracket, cup, spring, and bushing from short end of tube.
5. Remove long bracket from vise.
6. Inspect mode shift fork, brackets, and fork-to-tube bonding for cracks, bends, or breaks, and replace if damaged. Inspect tab on short bracket, and replace if bent or broken. Replace worn, missing, or damaged pads and springs.
7. Ensure mode shift fork tube slides easily on shift rail. Remove minor burrs, or replace if otherwise damaged.
8. Inspect mode shift sleeve for burrs, cracks, breaks, and damaged spline or gear teeth. Remove minor burrs or replace if otherwise damaged.

NOTE: Assemble parts named and use technique shown in illustrations (Figures 5-165 and 5-166).

9. Clamp long bracket in vise (Figure 5-166).
10. Install spring, cup, bushing, and short bracket on short end of tube. Ensure open end of short bracket is under lip of mode shift fork.
11. Install thrust washer, spring, and bushing on long end of tube.
12. Insert long end of tube in long bracket. Turn short bracket until tab will align in slot of long bracket.
13. Press long end of tube through end of long bracket until short bracket and tube align with rear of long bracket. Seat short end of tube in long bracket. Tab must be in slot.

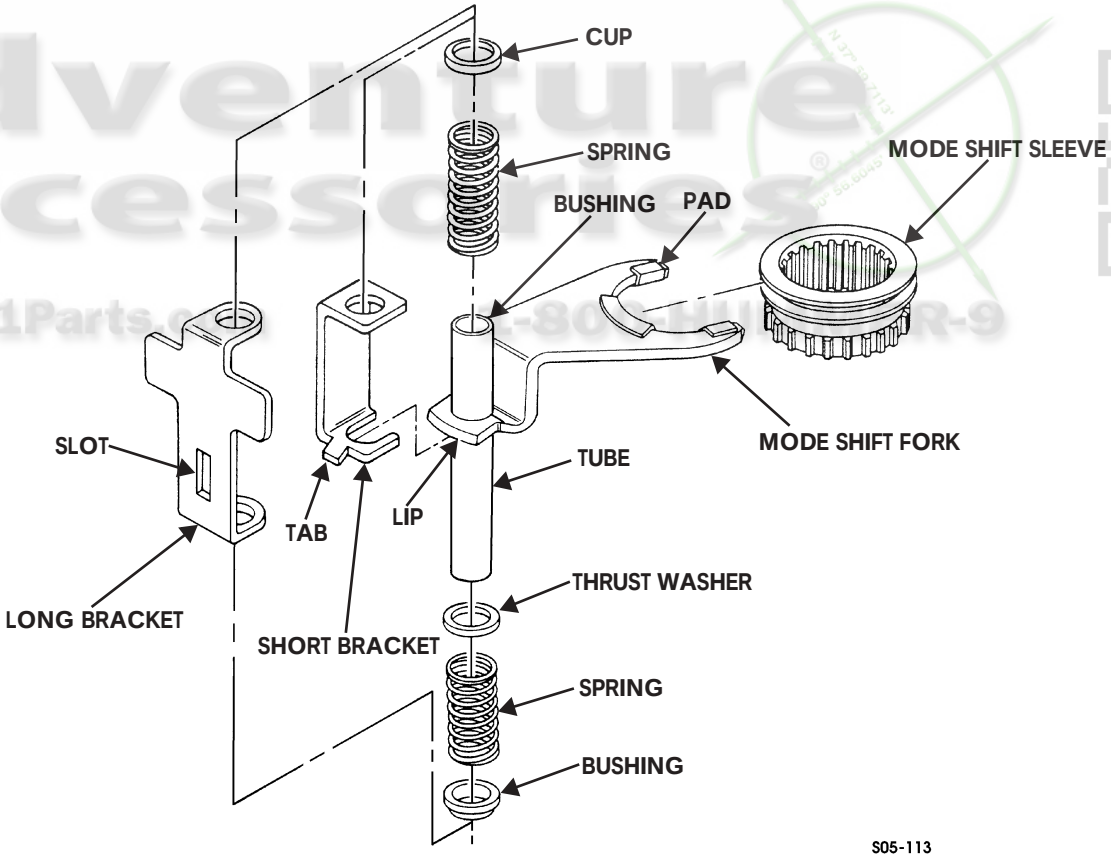


Figure 5-166: Shift Fork Components

Shift Rail, Detent, and Drive Chain Repair

1. Inspect shift rail for bends, cracks, and grooving. Replace if damaged (Figure 5-167).
2. Inspect detent assembly for broken or kinked spring, broken or burred poppet, or damaged plug. Replace O-ring and any other damaged parts.
3. Inspect drive chain for breaks, missing parts, kinks, and scratching on contact surfaces. Replace if damaged.

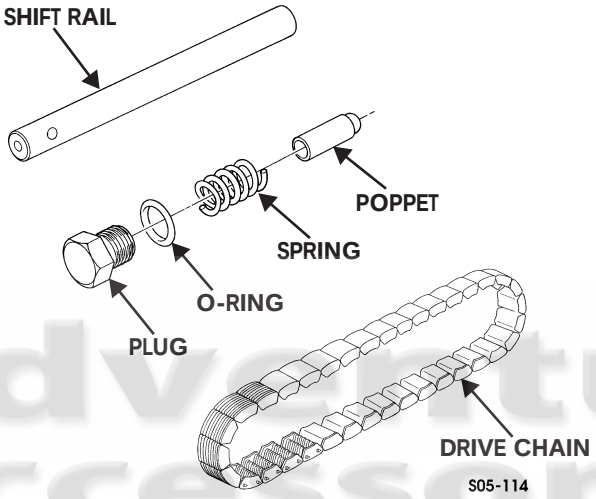


Figure 5-167: Drive Chain

Sprocket and Output Shaft Repair

1. Inspect drive and driven sprockets. Replace if damaged (Figure 5-168).
2. Inspect front output shaft. Replace if damaged.

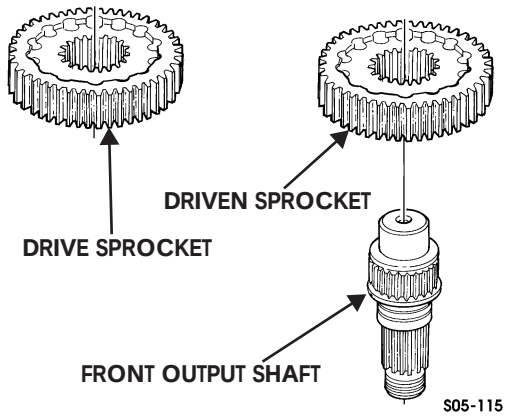


Figure 5-168: Chain Sprockets

Low Planetary Gear Repair

Inspect low planetary gear assembly for cracks, breaks, chipped or broken pinion gear teeth, pinion side play, and smooth rotation. If front and rear carriers are loose, tighten screws evenly. If carriers are still loose, or if other damage is present, replace low planetary gear assembly (Figure 5-169).

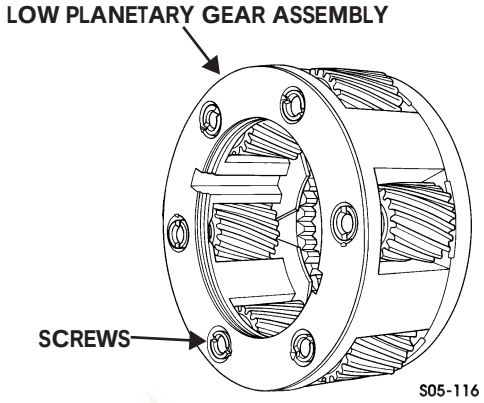


Figure 5-169: Planetary Gear

Oil Cooler Repair

Inspect oil cooler for bends, breaks, and leaks. Straighten bent fins. Fill with cleaning fluid to check for leaks. Replace cooler if tubes are bent, cracked, or leaking (Figure 5-170).

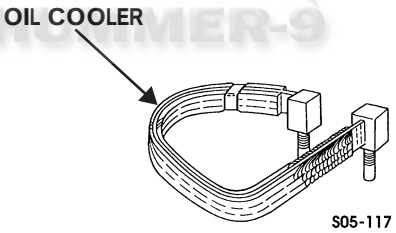


Figure 5-170: Oil Cooler

Assembly

1. Install thrust washer, input gear, thrust washer, and retainer into low planetary gear. Secure with snapring. Ensure snapring is completely seated in groove of low planetary gear (Figure 5-171).

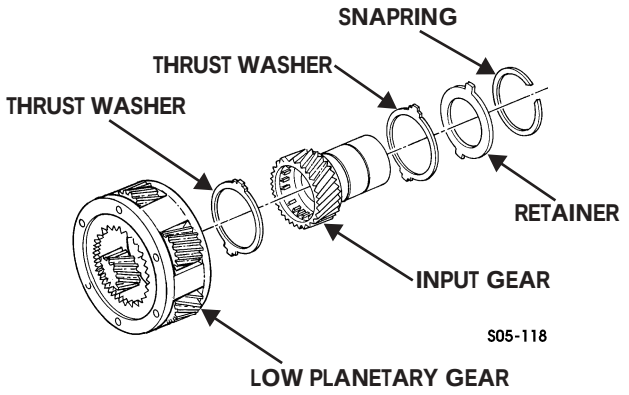


Figure 5-171: Input Gear

2. Using main pilot bearing installer and driver handle, press on input gear until gear is seated in input bearing (Figure 5-172).

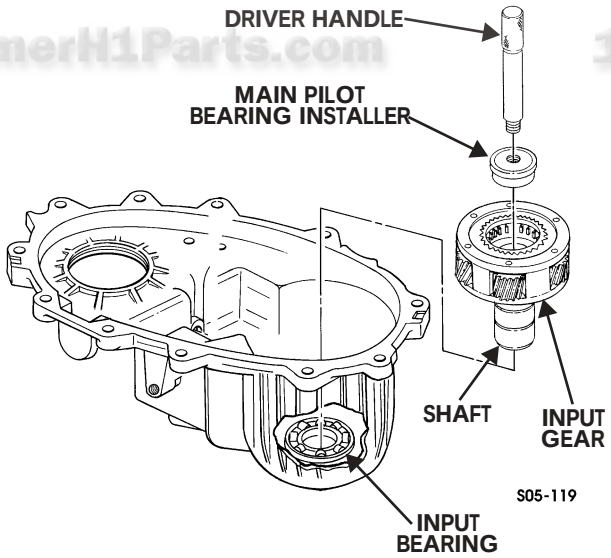


Figure 5-172: Pilot Bearing

3. Install snapring in front groove of input gear shaft (Figure 5-173).
4. Using input gear seal installer, install seal in front bearing retainer.
5. Apply sealant to contact surface of front bearing retainer, carefully align retainer over input gear shaft, and seat on front half-case.
6. Install front bearing retainer on half-case with four capscrews. Tighten capscrews to 12-20 lb-ft (16-27 N•m).

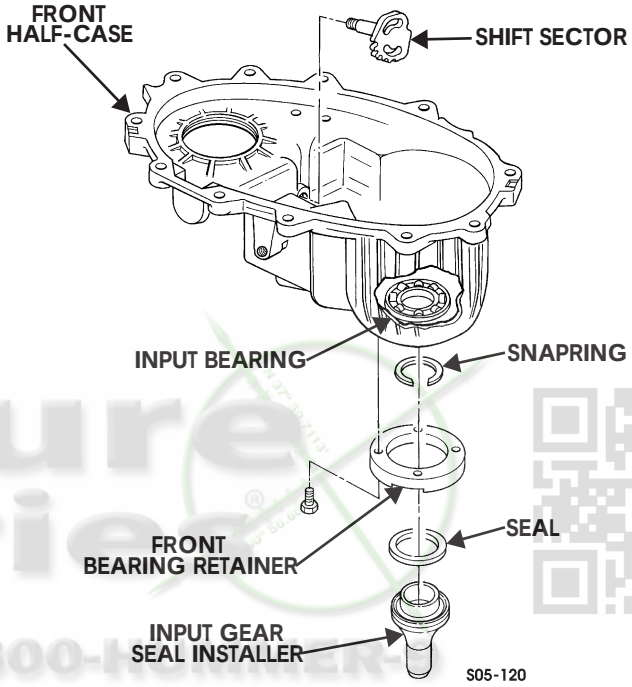


Figure 5-173: Front Seal

7. Install shift sector shaft in front half-case.
8. Install shift lever on shift sector shaft with washer and nut. Finger tighten nut.
9. Turn shift sector until teeth align on poppet bore and install poppet and spring in half-case with plug. Tighten plug to 12-18 lb-ft (16-24 N•m).
10. Position range shift fork in range clutch sleeve (Figure 5-174).
11. Hold range shift fork and range clutch sleeve together, insert sleeve into input gear (in low range planetary gear), and insert shift range fork pin into range slot in shift sector. Turn shift sector as necessary to align pin. (Figure 5-175)
12. Install rear thrust washer on front of mainshaft (Figure 5-176).

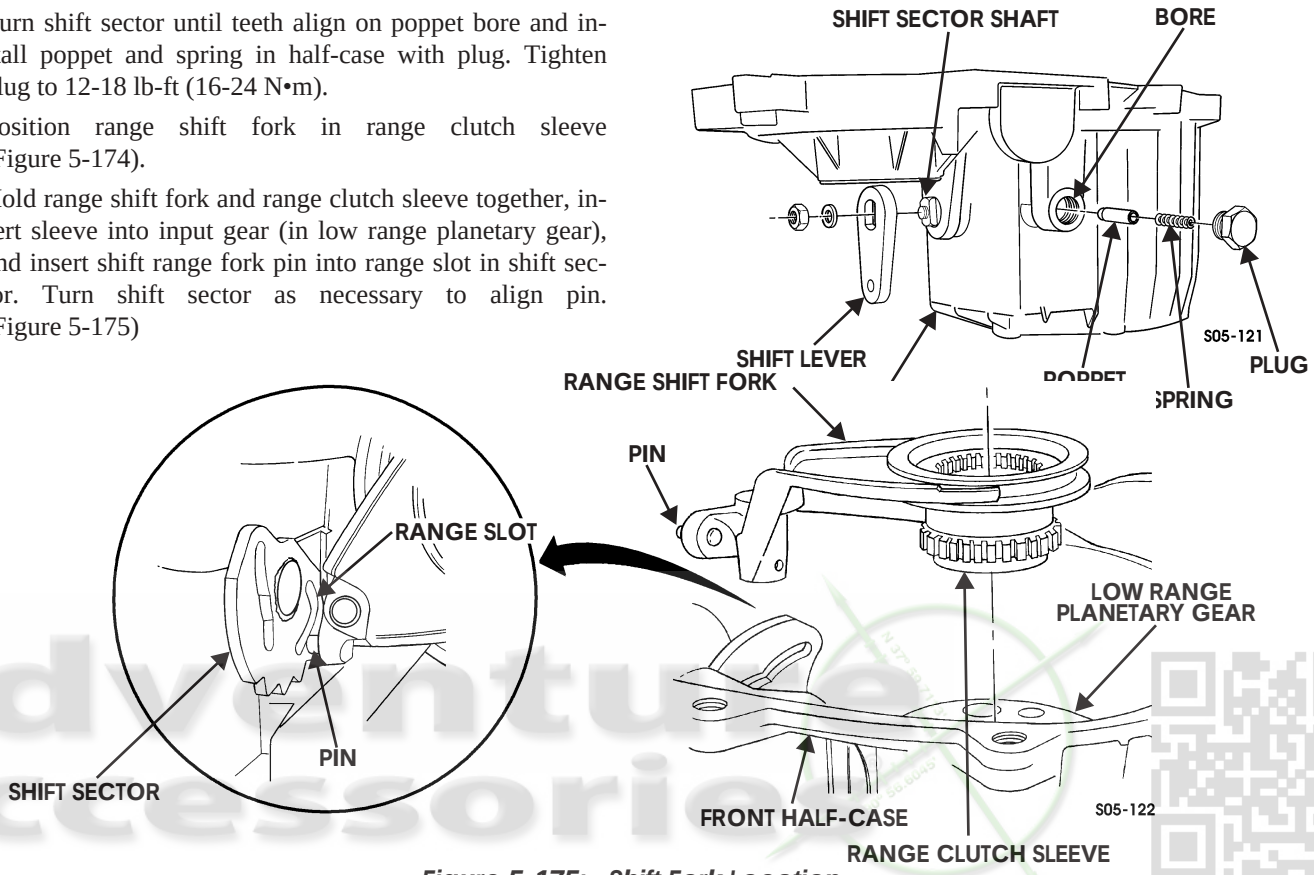


Figure 5-175: Shift Fork Location

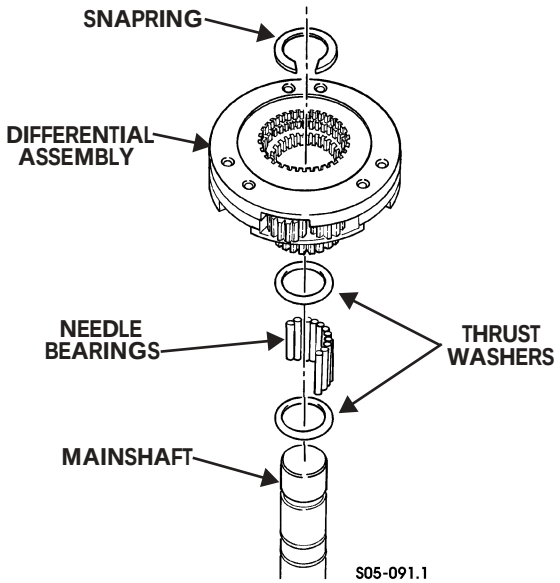


Figure 5-176: Mainshaft

13. Liberally coat mainshaft bearing journal with petrolatum and align fifty-three needle bearings on journal. Install front thrust washer on mainshaft against needle bearings.
14. Carefully slide differential assembly over front of mainshaft and align sprocket gear over needle bearings. Secure with snapring.
15. Place intermediate shaft over main shaft and engage in mainshaft gear (inside differential assembly). Double groove of intermediate shaft is up (Figure 5-177).
16. Place tab washer over mainshaft and secure with snapring in groove in end of mainshaft.
17. Slide mode shift sleeve onto mode fork (Figure 5-178).
18. Hold mode shift sleeve and mode fork together, slide sleeve over intermediate shaft, and engage in differential assembly (Figure 5-177).
19. Lifting on long end of mainshaft, and holding mode fork assembly in place, set short end of mainshaft assembly in input gear.
20. Align mode fork pin in long shift sector slot.

NOTE: Mainshaft rail drive pin hole must align with range fork hole.

21. Align mode fork and range fork, and insert shift rail through both forks into front half-case.

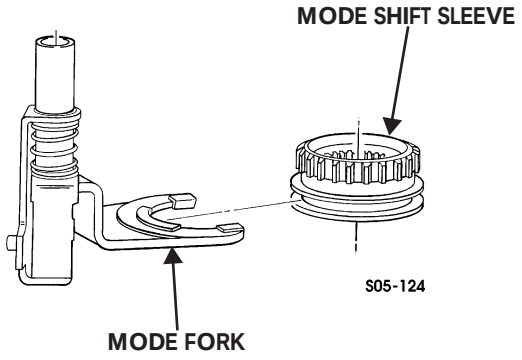


Figure 5-177: Shift Fork and Sleeve

NOTE: Use screw extractor, and move shift lever if necessary to start drive pin in range fork.

22. Ensure range fork and shift rail holes are aligned, and install tapered drive pin into range fork and shift rail, through access hole in front of half-case.
23. Install plug in access hole.

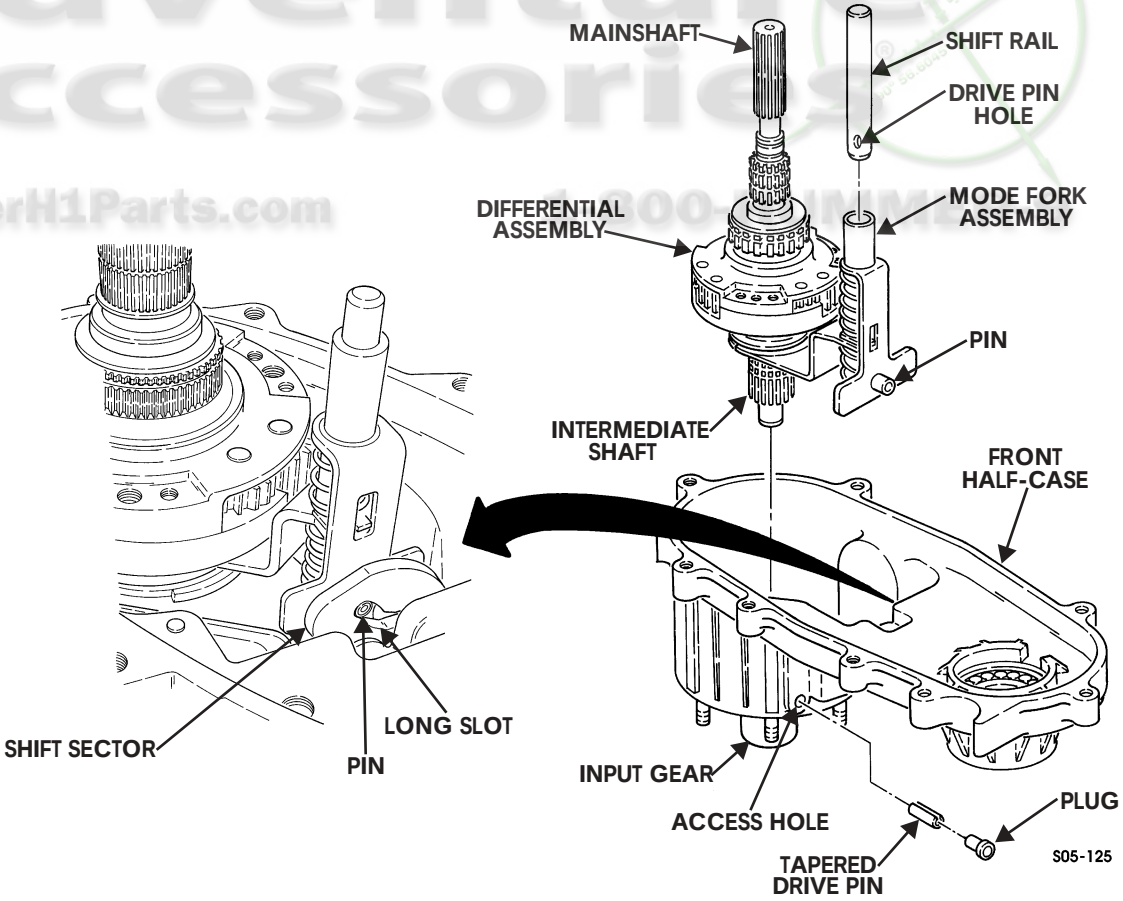


Figure 5-178: Shift Sector

24. Install two O-rings and oil cooler in front half-case with two washers and nuts (Figure 5-179).

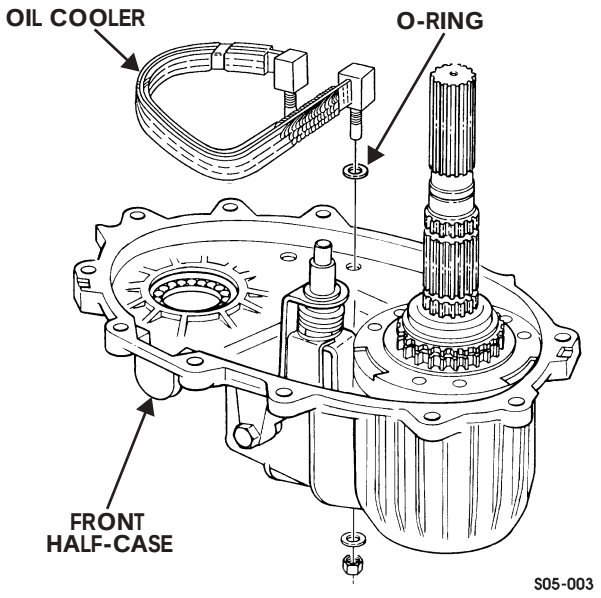


Figure 5-179: Oil Cooler

25. Install driven gear on front output shaft with snapring (Figure 5-180).

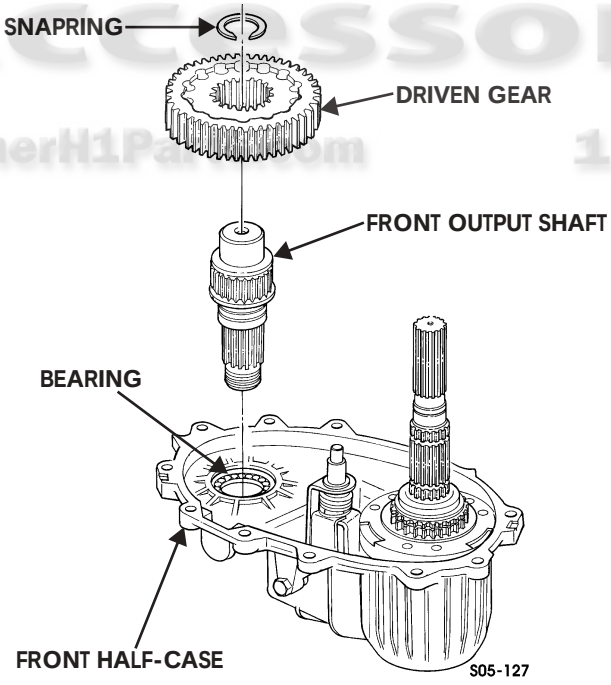


Figure 5-180: Sprocket Snapring

26. Install front output shaft and driven gear in half-case bearing.
27. Position drive chain over mainshaft and driven gear (Figure 5-181).

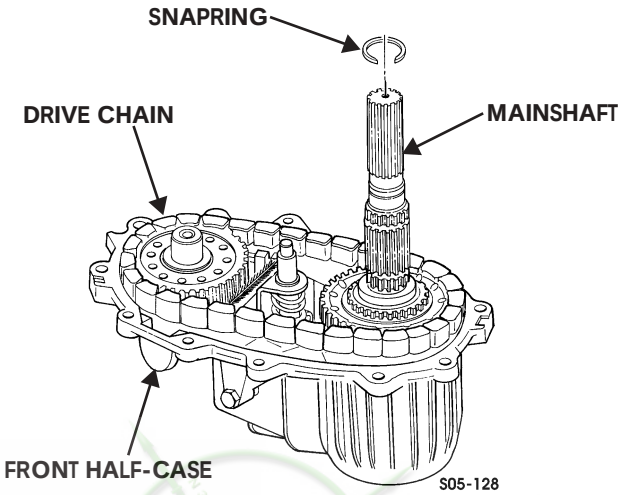


Figure 5-181: Drive Chain

28. Work drive gear onto mainshaft and into drive chain, and secure with snapring.

29. Install O-ring in oil pump inlet port (Figure 5-182).
30. Install oil pump pickup tube in oil pump.
31. Connect hose to oil pickup tube and oil screen.
32. Guide oil screen through outside of rear half-case and seat in notch.

NOTE: Support oil pump by holding against rear half-case.

33. Ensure oil pickup tube is in notch in rear half-case and turn half-case flat, with outside surface up.
34. Install magnet in pocket of front half-case (Figure 5-183).

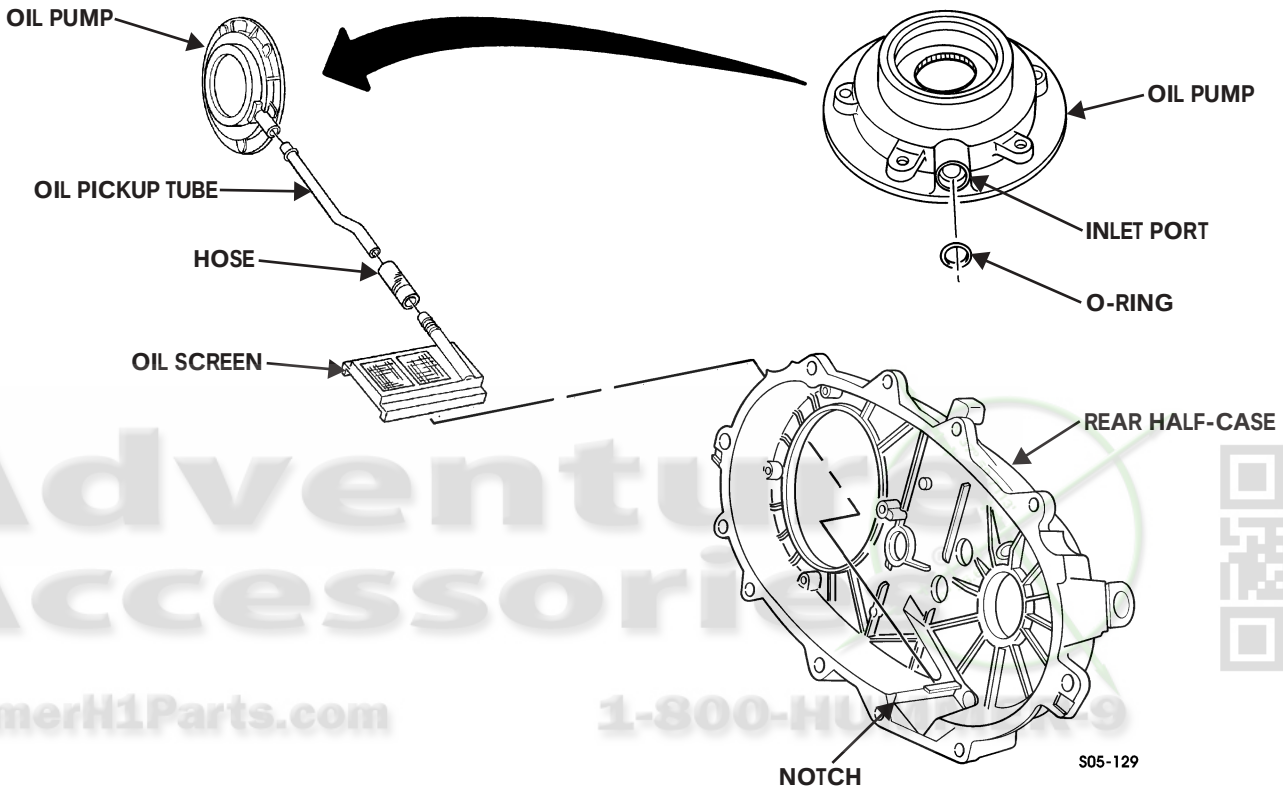


Figure 5-182: Oil Pump and Pickup

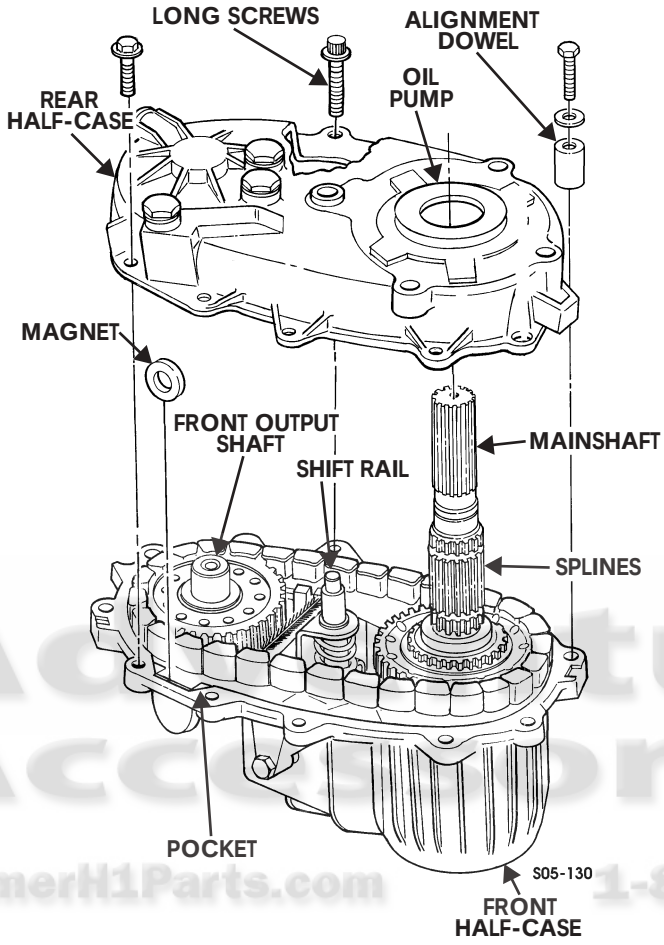


Figure 5-183: Case Half Assembly

35. Install two alignment dowels in rear half-case, if removed.
36. Apply a 1/8 in. (3 mm) bead of sealant on contact surface of front half-case mating flange.
37. Position rear half-case over mainshaft, and guide oil pump in to mesh with mainshaft mating splines. Turn mainshaft as necessary.
38. Ensure front output shaft and shift rail are properly seated in rear half-case. Both half-case flanges must be in full contact.
39. Install two washers and screws through front half-case alignment dowels.
40. Install two long screws in positions marked and seven screws securing rear half-case to front half-case.
41. Tighten all screws to 26-34 lb-ft (35-46 N•m).
42. Install tone wheel on mainshaft with two snaprings (Figure 5-184).

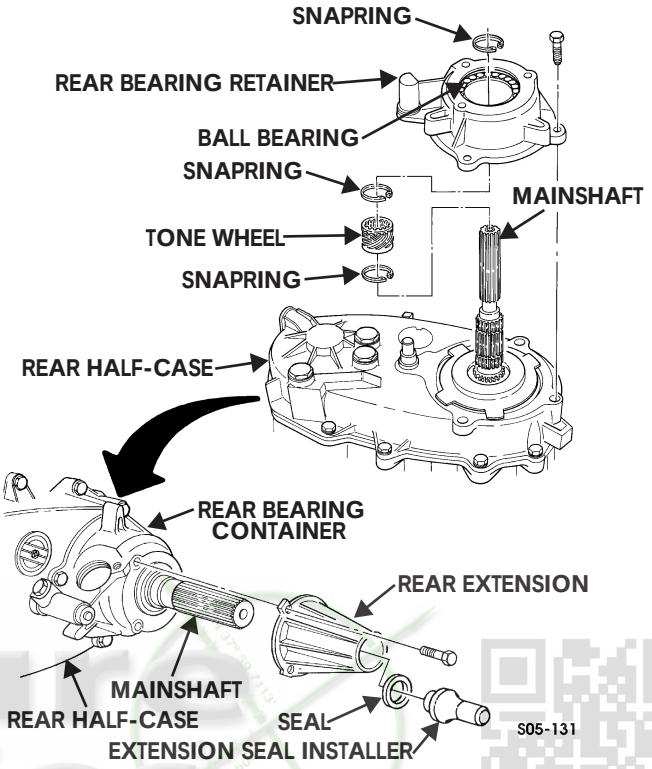


Figure 5-184: Rear Extension

43. Apply a 1/8 in. (3 mm) bead of sealant on transfer case side of rear bearing retainer, and install retainer on rear half-case with four capscrews. Tighten capscrews to 26-34 lb-ft (35-46 N•m).
44. Lifting on mainshaft as necessary, install snapring on mainshaft over ball bearing in rear bearing retainer. Ensure snapring is fully seated in mainshaft groove.
45. Using 05742583 extension seal installer, install seal in rear extension.
46. Apply a 1/8 in. (3 mm) bead of sealant on rear extension contact surface, and install on rear bearing retainer with three capscrews. Tighten capscrews to 26-34 lbft (35-46 N•m).

47. Install seal washer and front output yoke on front output shaft with nut. Tighten nut to 110 lb-ft (149 N•m) (Figure 5-185).

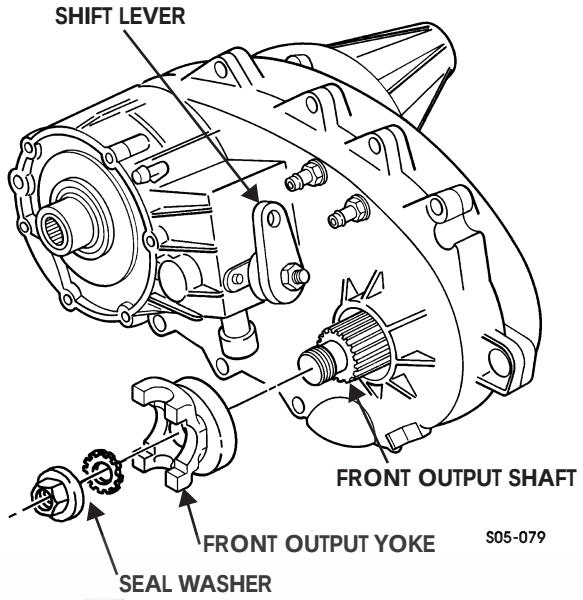


Figure 5-185: Front Seal

48. Install O-ring and speed sensor in rear bearing retainer with bolt. Tighten bolt to 15 lb-in. (2.0 N•m) (Figure 5-186).

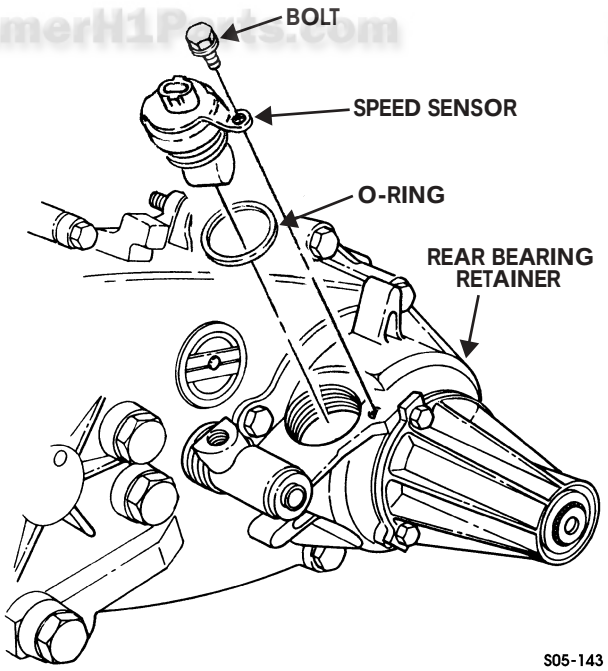


Figure 5-186: Speed Sensor

49. Move shift lever into all four detent positions and ensure shafts are turning. Shafts may need to be turned to obtain engagement in detent positions.
50. Install transfer case to transmission.

FRONT PROPELLER SHAFT ASSEMBLY MAINTENANCE

NOTE: Propeller shaft bearing caps should be taped together to prevent loss of bearings.

Removal

1. Remove four capscrews, two bearing straps, and front propeller shaft assembly from differential pinion yoke (Figure 5-187).

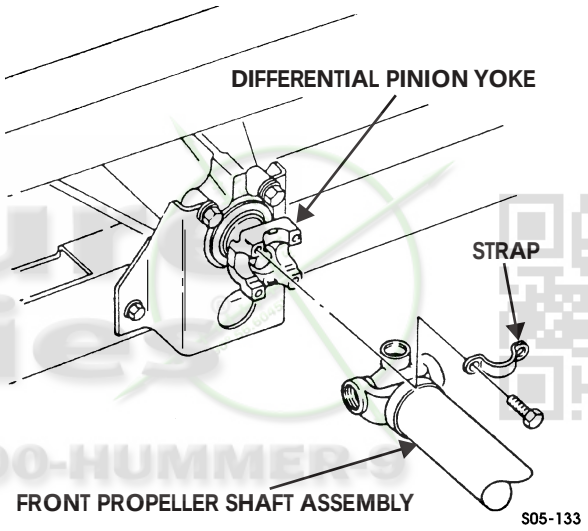


Figure 5-187: Front Propshaft

2. Remove four nuts, washers, two U-bolts, and front propeller shaft assembly from transfer case output yoke (Figure 5-188).

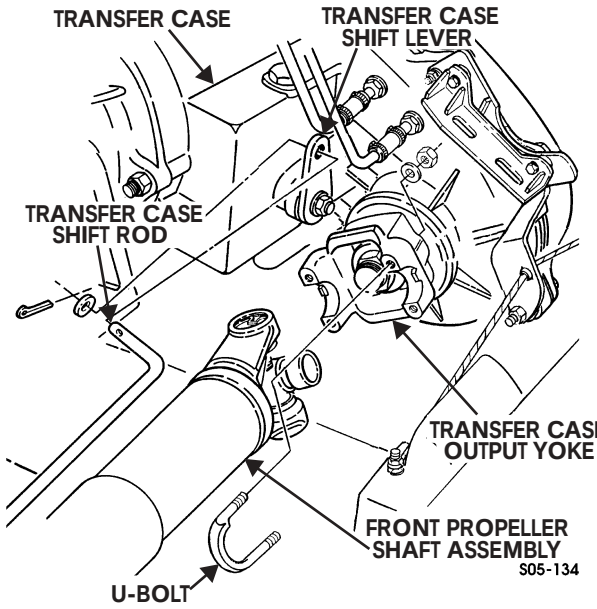


Figure 5-188: Propeller Shaft to Transfer Case

3. Remove cotter pin, washer, and transfer case shift rod from transfer case shift lever. Discard cotter pin.
4. Remove two locknuts, washers, capscrews, washers, and center bearing assembly from engine mount. Discard locknuts (Figure 5-189).

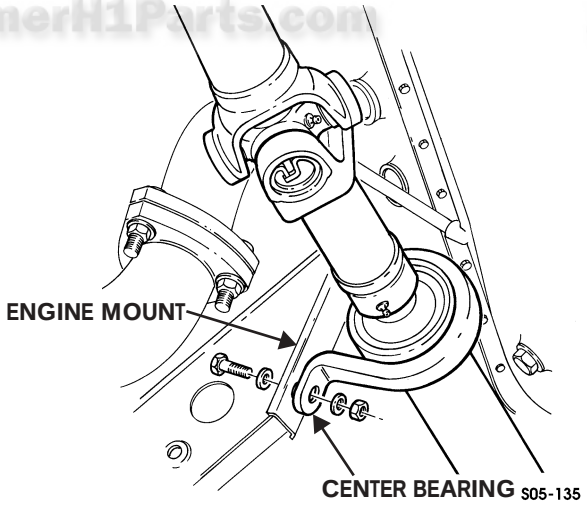


Figure 5-189: Center Bearing

5. Move front propeller shaft assembly forward, then rearward over top of transfer case and remove from vehicle.

Disassembly

NOTE: Prior to disassembly, mark alignment of slip yoke, universal yoke, and front propeller shaft for reassembly.

1. Place slip yoke in vise. Pry dust cap off slip yoke (Figure 5-190).
2. Pull slip yoke apart from front propeller shaft. Discard dust cap.
3. Place universal yoke in vise. Pry dust cap off universal yoke.
4. Pull universal yoke apart from front propeller shaft. Discard dust cap.
5. Install bearing puller between center bearing and shield (Figure 5-191).
6. Remove center bearing and retainer from front propeller shaft.
7. Remove shield from front propeller shaft.

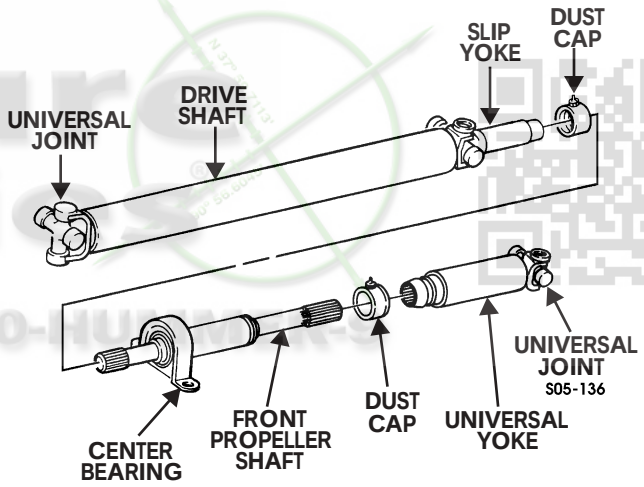


Figure 5-190: Front Shaft

Cleaning and Inspection

***CAUTION**: To avoid damage to equipment, do not allow solvent to contact U-joint.*

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

1. Clean all metallic parts with solvent.
2. Inspect drive shaft, front propeller shaft, slip yoke, and universal yoke for cracks or dents (Figure 5-191).
3. Inspect splined ends of front propeller shaft, slip yoke, and universal yoke for damage.
4. Inspect center bearing for roughness or damage.
5. Replace unserviceable universal joints and grease fittings.

Assembly

1. Install shield on front propeller shaft (Figure 5-191).

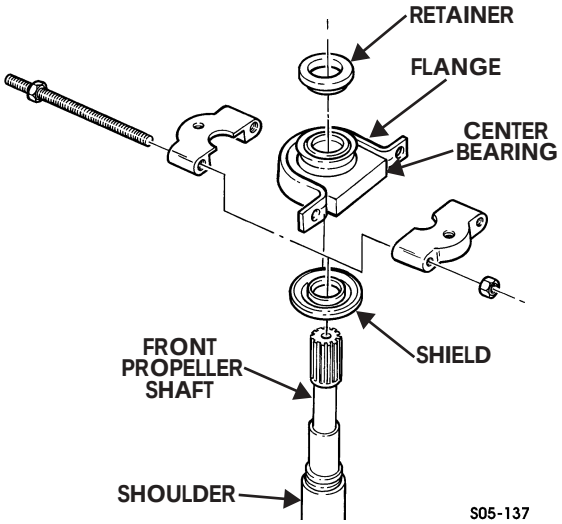


Figure 5-191: Center Bearing

2. Install retainer on center bearing.
3. Press center bearing on front propeller shaft until seated against shoulder. Ensure flange on center bearing faces up.

NOTE: Ensure grease fittings on dust caps are aligned with wide splines in slip yoke and universal yoke.

4. Install dust caps on front propeller shaft (Figure 5-190).
5. Coat front propeller shaft and drive shaft splines with grease.

NOTE: Ensure wide splines on front propeller shaft are aligned with grease fittings on slip yoke and universal yoke.

6. Align marks and install front propeller shaft into slip yoke and universal yoke. Secure with dust caps.

Installation

1. Position front propeller shaft assembly over exhaust pipe and transfer case (Figure 5-192).
2. Connect transfer case shift rod to transfer case shift lever with washer and cotter pin.
3. Connect front propeller shaft assembly to transfer case output yoke with two U-bolts, four nuts, and washers. Tighten nuts to 13-18 lb-ft (18-24 N•m).

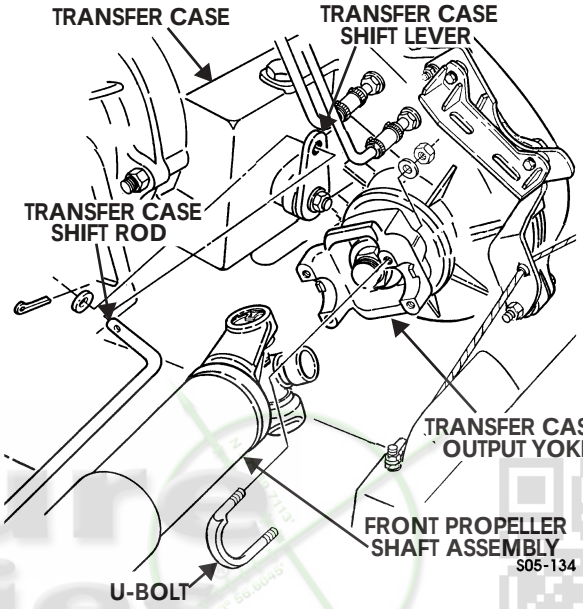


Figure 5-192: Front Propeller Shaft

4. Connect front propeller shaft assembly to differential pinion yoke with two bearing straps and four capscrews. Tighten capscrews to 13-18 lb-ft (18-24 N•m) (Figure 5-193).

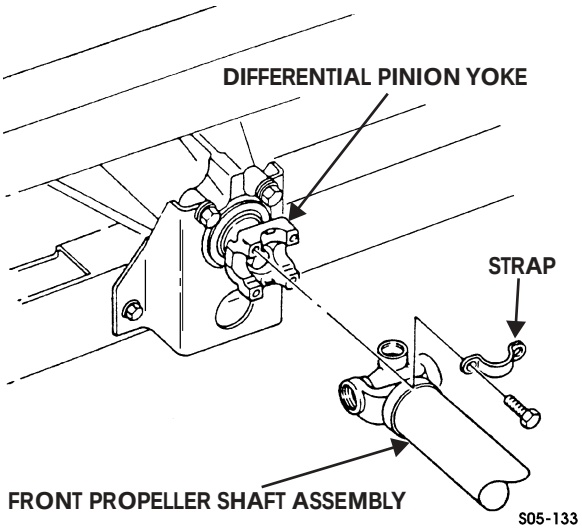


Figure 5-193: Front Propeller Shaft to Axle

5. Secure center bearing to engine mount with two washers, capscrews, washers, and locknuts. Tighten capscrews to 60 lb-ft (81 N•m) (Figure 5-194).
6. Lubricate propeller shaft assembly.

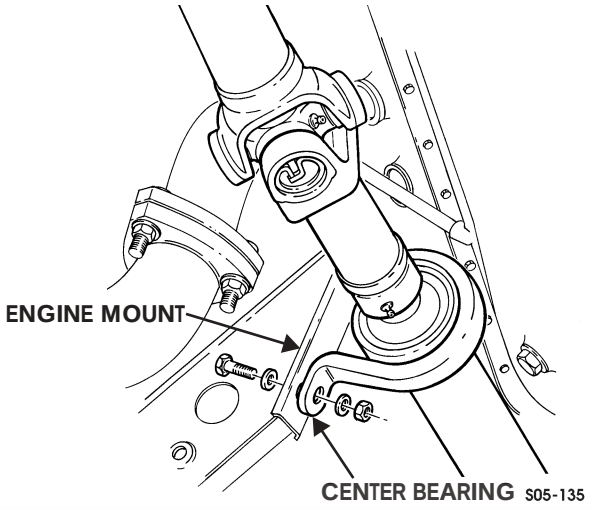


Figure 5-194: Center Bearing

REAR PROPELLER SHAFT MAINTENANCE

Removal

1. Chock wheels and set parking brake.
2. Remove four nuts, lockwashers, and two straps, and rear propeller shaft from differential pinion yoke (Figure 5-195).
3. Slide propeller shaft end yoke out of transfer case extension and remove propeller shaft.

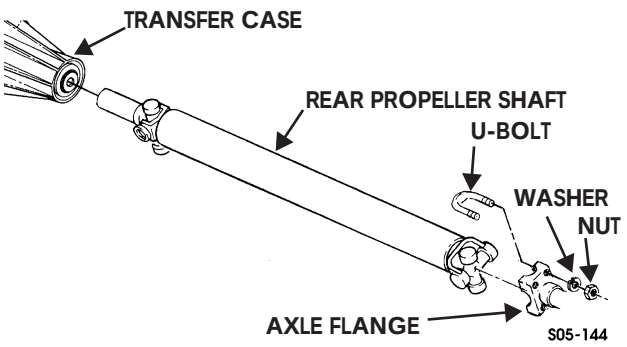


Figure 5-195: Rear Propeller Shaft

Inspection

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

1. Inspect propeller shaft for cracks and dents (Figure 5-196).
2. Inspect grease fittings and universal joints for serviceability. Replace if damaged.
3. Inspect splined end of end yoke for damage.

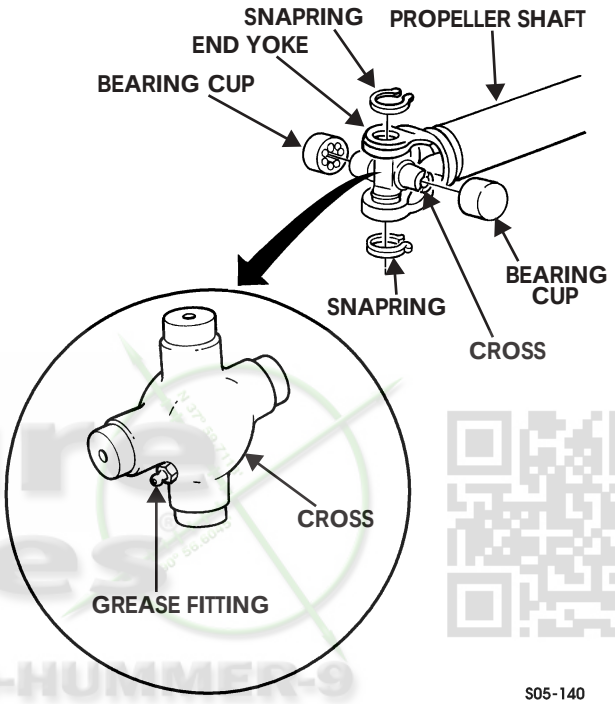


Figure 5-196: Universal Joint

Installation

1. Slide propeller shaft end yoke into transfer case extension (Figure 5-195).
2. Connect rear propeller shaft to differential pinion yoke with two straps, four lockwashers, and nuts. Tighten to 13-18 lb-ft (18-24 N•m).
3. Lubricate propeller shaft.

UNIVERSAL JOINT REPLACEMENT

Disassembly

***CAUTION**: Do not drop bearing cups. Needle bearings can be easily lost.*

1. Remove propeller shaft.
2. Remove grease fitting from cross (Figure 5-196).
3. Remove two bearing cups from cross.
4. Remove two snaprings from end yoke.
5. Position propeller shaft in vise with 1-1/8 in. socket between vise jaw and bearing cup being removed. Ensure open end of socket is facing bearing cup (Figure 5-197).

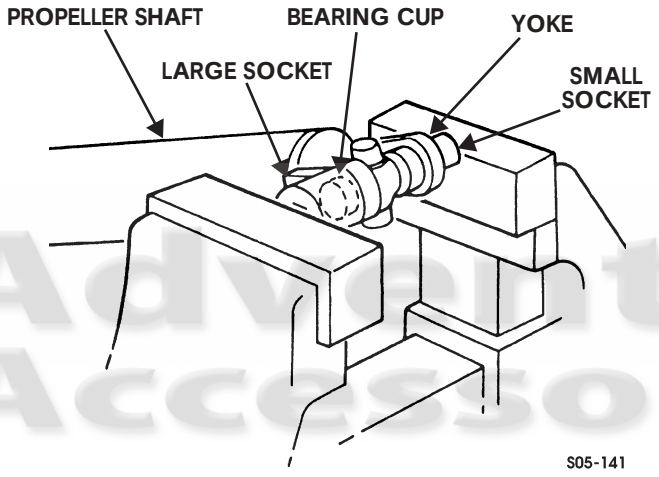


Figure 5-197: Bearing Installation

6. Place 11/16 in. socket between opposite bearing cup and vise jaw. Ensure open end of socket is facing vise jaw.
7. Press bearing cup out of yoke and remove bearing cup from cross (Figure 5-196).
8. Reverse position of sockets and press remaining bearing cup out of yoke (Figure 5-198).
9. Remove cross from yoke.

Assembly

***CAUTION**: Ensure grease fitting on cross faces yoke. Damage to equipment will result if improperly installed.*

1. Install cross into yoke (Figure 5-198).
2. Install bearing cup into yoke.

***CAUTION**: Ensure bearing cup is aligned with yoke before pressing in with vise. Damage to cross and bearing cups will result if forced into yoke.*

3. Place yoke in vise with 11/16 in. socket between vise jaw and bearing cup (Figure 5-197).
4. Press bearing cup into yoke far enough to install snapring and install snapring into yoke (Figure 5-198).
5. Install bearing cup into yoke.
6. Place yoke in vise with 11/16 in. socket between bearing cup and vise jaw (Figure 5-197).
7. Press bearing cup into yoke far enough to install snapring and install snapring into yoke (Figure 5-198).
8. Install two bearing cups on cross.
9. Install grease fitting into cross (Figure 5-196).
10. Install propeller shaft.
11. Grease joint(s) and slip yoke as required.

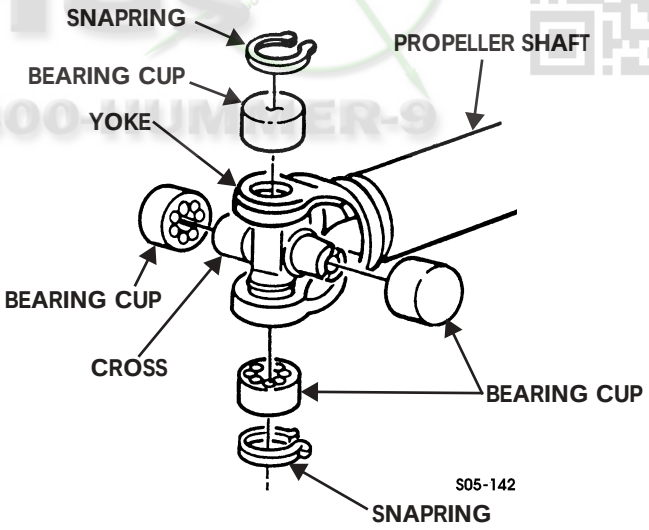


Figure 5-198: Universal Joint Components