ASE 2 - Automatic Transmission

Module 8
Transmission Diagnosis
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Introduction

Automatic Transmission And Transaxle
For every task in Automatic Transmission and Transaxle, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

NATEF Task

A. General Transmission and Transaxle Diagnosis
   4. Diagnose fluid usage, level, and condition concerns; determine necessary action. P-1
   5. Perform pressure tests; determine necessary action. P-1
   6. Perform stall test; determine necessary action. P-2
   7. Perform lock-up converter system tests; determine necessary action. P-1
   8. Diagnose electronic, mechanical, hydraulic, vacuum control system concerns; determine necessary action. P-1
   9. Diagnose noise and vibration concerns; determine necessary action. P-2
   10. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles. P-1

C. In-Vehicle Transmission and Transaxle Repair
   7. Diagnose electronic transmission control systems using a scan tool; determine necessary action. P-1
STC Competencies

A-2. Competencies for 4T65E 17041.32W

11. Describe the various checks, tests and available tools for use in diagnosing customer concerns.
   - Identify the three ways transmissions are typically diagnosed and the order in which the diagnosis should be conducted.
   - Describe the fluid check procedure.
   - Describe the OBD check procedure.
   - Describe the electrical function test.
   - Describe the garage shift test.
   - Describe the road test.
   - Describe noise and vibration analysis as a diagnostic tool.
   - Describe the line pressure test.
   - Apply Technical Service Bulletin information in diagnosis.
   - Apply Diagnostic Trouble Code (DTC) information in complaint diagnosis.
   - Describe the use of the Tech 1/2 scan tool.
   - Describe the use of the hydraulic pressure gauge set in the line pressure test.

A-2. Competencies for Automatic Transmissions 17041.20 W/D/H

K. Diagnosis

1. Describe diagnosis procedures and technique
2. Identify the appropriate procedures and techniques required
3. Evaluate driver’s concern and road test vehicle to verify problems
4. Diagnose noise and vibration problems
5. Perform pressure tests
6. Perform stall tests
7. Perform torque converter clutch tests
8. Diagnose mechanical and vacuum control systems
9. Diagnose electrical control systems
Objectives

• Describe diagnostic test procedures
  – Transmission Fluid Checking Procedure
  – Diagnostic System Check - Automatic Transmission
  – Road Test Procedure
  – Symptoms - Automatic Transmission
  – Line Pressure Check Procedure
  – Torque Converter Diagnosis Procedure

• Perform diagnostic test procedures
  – Transmission Fluid Checking Procedure
  – Diagnostic System Check - Automatic Transmission
  – Road Test Procedure
  – Symptoms - Automatic Transmission
  – Line Pressure Check Procedure
  – Torque Converter Diagnosis Procedure
Strategy Based Diagnosis

Refer to eSI Document ID# 6856

The goal of Strategy Based Diagnostics is to provide guidance when you create a plan of action for each specific diagnostic situation. Following a similar plan for each diagnostic situation, you will achieve maximum efficiency when you diagnose and repair vehicles. Although each of the Strategy Based Diagnostics boxes is numbered, you are not required to complete every box in order to successfully diagnose a customer concern. The first step of your diagnostic process should always be, verify the Customer Concern box. The final step of your diagnostic process should be Repair and verify the Fix box 7. Refer to the following chart for the correct Strategy Based Diagnostics.

(1) Verify the Customer Concern: The first part of this step is to obtain as much information as possible from the customer. Are there aftermarket accessories on the vehicle? When does the condition occur? Where does the condition occur? How long does the condition last? How often does the condition occur? In order to verify the concern, the technician should be familiar with the normal operation of the system and refer to the owner or service manual for any information needed.

(2) Preliminary Checks: Conduct a thorough visual inspection. Review the service history. Detect unusual sounds or odors. Gather diagnostic trouble code (DTC) information in order to achieve an effective repair.
(3) Perform Published Diagnostic System Checks: One or more DTCs may not support a system. System checks verify the proper operation of the system. This will lead the technician in an organized approach to diagnostics.

(4) Check Bulletins and Other Service Information: Use videos, newsletters, and the Pulsat programs.

(5.1) Stored DTCs: Follow the designated DTC table exactly in order to make an effective repair.

(5.2) Symptom No DTC: Select the symptom from the symptom tables. Follow the diagnostic steps or suggestions in order to complete the repair, or refer to the applicable component/system check.

(5.3) No Published Diagnostics: Analyze the Concern. Develop a plan for the diagnostics. The service manual schematics will help you to see system power, ground, and input and output circuits. You can also identify splices and other areas where multiple circuits are tied together. Look at component locations to see if components, connectors or harnesses may be exposed to extreme temperature, moisture, road salt or other corrosives battery acid, oil or other fluids. Utilize the wiring diagrams, system description and operation, and system circuit description.

(5.4) Intermittent: An intermittent condition is one that does not occur continuously and will occur when certain conditions are met. Generally, intermittents are caused by faulty electrical connections and wiring, malfunctioning components, electromagnetic/radio frequency interference, and aftermarket equipment. Combine technician knowledge with efficient use of the available service information. Evaluate the symptoms and conditions described by the customer. Use a check sheet or other method in order to identify the component. Follow the suggestions for intermittent diagnosis found in the service manual. The Tech 1 and Tech 2 scan tools, and the J 39200 (Fluke 87) have data capturing capabilities that can assist in detection of intermittents.

(5.5) Vehicle Operates as Designed: This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Verify against another like vehicle that is operating normally under the same conditions described by the customer. Explain your findings and the operation of that system to the customer.

(6) Re-examine the Concern: If a technician cannot successfully find or isolate the concern, a re-evaluation is necessary. Re-verify the concern. The concern could be an intermittent or normal.

(7) Repair and Verify Fix: After isolating the cause, make the repairs and validate for proper operation. Verify that the symptom has been corrected, which may involve road testing the vehicle.
Application of SBD to Automatic Transmission

Accurate diagnosis of any system fault requires an organized systematic approach to your work. GM Strategy Based Diagnostics (SBD) provides the guidance to create such an approach for any diagnostic situation. The SBD process consist of three parts; the diagnostic thought process and problem solving, the vehicle specific diagnostic flow chart which provides the application specific details, and the knowledge and experience of the technician.

Diagnostic Procedures and Test

Introduction

Certain diagnostic procedures are a part of every transmission repair. These procedures are used to diagnose the concern and to verify the repair. These procedures are considered essential elements of a Diagnostic System Check for the automatic transmission.

Transmission Fluid Check

Ref. eSI Document ID# 862394 - Transmission Fluid Checking Procedure

Always perform the fluid level check as the first step in transmission diagnostics. Wrong fluid can cause improper operation of the transmission.

Before the fluid level start the engine and operate for 15 minutes or until the transaxle fluid reaches an operating temperature of 82-93°C (180-200°F). Park the vehicle on a level surface. Apply the park brake and block the wheels. With the engine idling and foot on the brake pedal, move the shift lever through each gear range, ending in PARK.

When examining the condition of the transmission fluid check for:

- Level
- Color
- Smell

The first check should be fluid level. If the transmission fluid is cold, the fluid will rise on the fluid level indicator. If the transmission fluid is at operating temperature, the fluid level will drop.

Fig. 8-2, Fluid Checking
There are several things that can be determined from the fluid color. Red or light brown in normal and is OK. Light pink suggest the possibility of water or coolant in the transmission. Dark brown or black that smells indicates the transmission has been overheated and is burned. Foamy fluid indicates the fluid level is too high or the fluid is contaminated.

Fig. 8-3, Fluid Color

You should smell the fluid. Burned smell usually indicates clutch plates and/or band friction material.
Transmission Fluid Leaks
Ref. eSI Document ID # 405522 - Fluid Leak Diagnosis

Check the transmission for leaks. If there is a leak verify that it is transmission fluid. If the fluid level is low, the leak may be from the transmission or the fluid cooling lines. If performing a leak detection procedure, clean the transmission first. Leak check methods and possible leak locations can be found in Service Information (eSI).

Fig. 8-4, Transmission Fluid Leaks
On Board Diagnostics

Ref. eSI Document ID# 838137 - Diagnostic System Check - Automatic Transmission

OBD check is as essential to transmission diagnosis as it is with engine performance. An OBD System Check insures the variety of sensors and actuating devise are operating properly.

Check the on-board diagnostics for any DTC codes because the transmission has default actions that take place when these codes are set. Some of these can be interpreted by the customer as a concern.

If a DTC is present in the PCM's memory, first move to the section in the Service Information (eSI) that contains DTC diagnosis. Find the document that describe the specific diagnostic tests for the DTC you found.

It is important (as it always has been) to be familiar with the DTC information and to use the added information to help during diagnostics. The DTC information is organized as follows:

Circuit Description - This contains information about the normal operation and operating parameters of the system or components.

Conditions for Setting the DTC (Conditions to Run for Cadillac) - This lists the specific enable criteria as well as the exact conditions that caused the DTC to set.

Action Taken When the DTC Sets - This lists a description of what the PCM will do when the diagnostic test fails and the DTC is set.

Conditions for Clearing the MIL/DTC - This lists the requirements to clear a DTC and what is required to turn off the MIL.

Diagnostic Aids - Additional information that should be checked if the condition is not resolved by following the diagnostic table.

Diagnostic Table - This table tells you which diagnostic tests to perform and the correct order in which to perform them. This diagnostic table has been redesigned into five columns.

The order in which DTCs are diagnosed has changed. The On-Board System check will often help you determine which DTC to repair first. If the OBD system check does not direct you to the first DTC to diagnose, diagnose the DTCs in the following order:

- PCM memory DTCs.
- System voltage and Ignition voltage DTCs.
- Component/circuit DTCs (sensors, etc.).
- System DTCs (misfire, fuel trim, etc.).

If more than one DTC is set in any group, diagnose DTCs from the lowest number to the highest.
Electrical/Garage Shift Test

Ref. eSI Document ID# 642876 - Road Test Procedure

Perform the Electrical/Garage Shift Test before a road test. You want to make sure the electronic control inputs are connected and operating before operate the transmission or you could misdiagnosis a simple electrical condition as a major transmission condition.

Verify the following signals are present on the scan too:

- Engine Speed
- Transmission Input Speed Sensor - TRANS ISS
- Transmission Output Speed Sensor - TRANS OSS
- Vehicle Speed
- Transmission Fluid Pressure TFP Switch Circuits A/B/C
- PC ACT Current
- PC REF Current
- PC Duty Cyclbrake Switch
- ECT
- Trans Fluid Temp
- TP Angle
- Ignition Voltage

Refer to service information for typical data values. Data that is questionable may indicate a concern.

Monitor the BRAKE SWITCH signal while tapping the brake pedal. The scan tool should read "applied" when the pedal is depressed and "released" when the pedal is released.
Check the garage shifts. Apply the brake pedal. Insure the parking brake is set. Move the gear selector through the following ranges:

- Park To Reverse
- Reverse To Neutral
- Neutral To Drive

Pause 2 to 3 seconds in each gear range position. Verify gear engagements are immediate and not harsh.

Fig. 8-5, Gear Ranges

When performing garage shift evaluations, remember the following:

- Harsh engagements may be caused by a number of conditions. For example, high idle speed. Compare the actual idle speed to desired idle speed.
- Pressure control solenoid current may be low, causing high line pressure. You will want to compare actual current to commanded current.
- Some DTCs, as default action, may result in maximum line pressure.
- Soft or delayed engagement may be caused by low idle speed, low fluid level, commanded high Pressure Control solenoid current or cold transmission fluid.

Monitor the PRNDL SELECT signal and move the gear selector through all ranges. Verify that PRNDL SELECT value matches gear range indicated on the instrument panel or console. Gear selection should be immediate and not harsh.

Move the gear selector to Neutral. Monitor the TP ANGLE signal while increasing and decreasing the engine RPM with the accelerator pedal. The TP ANGLE should increase and decrease with the engine RPM.
The road test involves the following:

- Electrical function check
- Upshift control and torque converter
- Clutch (TCC) apply
- Part throttle detent downshift
- Full throttle detent downshift
- Manual downshifts
- Coasting downshifts
- Manual gear range selection
  - Reverse
  - Manual 1st
  - Manual 2nd
  - Manual 3rd

Complete the road test in sequence given in the Service Information (eSI). Incomplete testing cannot guarantee an accurate evaluation.
Before the road test ensure the following:

- Engine is performing properly
- Transmission fluid level is correct
- Tire pressure is correct

Perform the test only when traffic conditions permit. Operate the vehicle in a controlled, safe manner. Observe all traffic regulations. View the scan tool data while conducting this test. If need be, take along qualified help in order to operate the vehicle safely. And, observe any unusual sounds or smells.

After the road test, check for the following:

- Transmission fluid level
- Diagnostic trouble codes (DTCs) that set during the testing
- Scan tool data for any abnormal reading or data
Symptom Diagnosis

The road test will provide the technician the opportunity to verify the customer concern and obtain other related symptoms. Having previously confirmed there are no DTCs it is time for Symptom Diagnosis.

Ref. eSI Document # 929871 - Symptoms - Automatic Transmission

The symptom diagnosis table consists of nine diagnostic categories.

- Fluid Diagnosis
- Noise and Vibration Diagnosis
- Range Performance Diagnosis
- Shift Quality (Feel) Diagnosis
- Shift Pattern
- Shift Speed Diagnosis
- Torque Converter Diagnosis
- Indicator On or Message Center Displays Message

These categories are located in the left column. Using this column, choose the appropriate category based on the operation conditions of the vehicle or transmission. After selecting a category, use the right column to locate the specific diagnostic information. Each item in this column is a link to a procedure that can be found in Diagnostic Information and Procedures.

Fig. 8-7, Symptom Diagnostic Table
Line Pressure Check

If the vehicle is experiencing shift quality or engage symptoms, a line pressure check will be part of the diagnosis.

Ref. eSI Document ID# 1087242 - Line Pressure Check Procedure

To perform a line pressure check, perform the following:

• Check the fluid level
• Check the manual linkage for proper adjustment
• Turn the engine OFF
• Remove the oil pressure test hole plug
• Install J21867 Line Pressure Gauge
• Put the gear selector in PARK range
• Set the brake
Start the engine and allow the engine to warm up at idle. Access the pressure control solenoid valve control test on the scan tool. Increase the PC solenoid actual current from 0.0 to 1.0 amps in 0.1 amp increments. Allow the pressure to stabilize for five seconds after each pressure change. Read the corresponding line pressure on the J21867 line pressure gauge. Compare the data to the table in the Service Information (eSI). If the pressure readings differ greatly for the table; refer to Incorrect Line Pressure section of the Service Information (eSI).

<table>
<thead>
<tr>
<th>Pressure Control Solenoid Current (Amp)</th>
<th>Approximate Line Pressure (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02</td>
<td>170-190</td>
</tr>
<tr>
<td>0.10</td>
<td>165-185</td>
</tr>
<tr>
<td>0.20</td>
<td>160-180</td>
</tr>
<tr>
<td>0.30</td>
<td>155-175</td>
</tr>
<tr>
<td>0.40</td>
<td>148-168</td>
</tr>
<tr>
<td>0.50</td>
<td>140-160</td>
</tr>
<tr>
<td>0.60</td>
<td>130-145</td>
</tr>
<tr>
<td>0.70</td>
<td>110-130</td>
</tr>
<tr>
<td>0.80</td>
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</tr>
<tr>
<td>0.90</td>
<td>65-90</td>
</tr>
<tr>
<td>0.98</td>
<td>55-65</td>
</tr>
</tbody>
</table>

*Fig. 8-9, Line Pressure Chart*
Torque Converter Diagnosis

Ref. eSI Document ID# 642878 - Torque Converter Diagnosis

Procedure

The Torque Converter Clutch (TCC) is applied by fluid pressure, which is controlled by a PWM solenoid valve. This solenoid valve is located inside of the automatic transmission assembly. The solenoid valve is controlled through a combination of computer controlled switches and sensors.

Torque converter concerns fall into the following:

• Torque Converter Stator
• Noise
• Torque Converter Shudder

Torque Converter Stator

The torque converter stator roller clutch can have two different malfunctions.

• The stator assembly freewheels in both directions.
• The stator assembly remains locked up at all times.
• Poor Acceleration at Low Speed

If the stator is freewheeling at all times, the car tends to have poor acceleration from a standstill. At speeds above 50-55 km/h (30-35 mph), the car may act normally. For poor acceleration, you should first determine that the exhaust system is not blocked, and the transmission is in First gear when starting out.

If the engine freely accelerates to high RPM in NEUTRAL, you can assume that the engine and the exhaust system are normal. Check for poor performance in DRIVE and REVERSE to help determine if the stator is freewheeling at all times.

Poor Acceleration at High Speed

If the stator is locked up at all times, performance is normal when accelerating from a standstill. Engine RPM and car speed are limited or restricted at high speeds. Visual examination of the converter may reveal a blue color from overheating.

If the converter has been removed, you can check the stator roller clutch by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. You should be able to freely turn the inner race clockwise, but you should have difficulty in moving the inner race counterclockwise or you may be unable to move the race at all.
**Noise**

**Important:**
Do not confuse this noise with pump whine noise, which is usually noticeable in PARK, NEUTRAL and all other gear ranges. Pump whine will vary with line pressure.

You may notice a torque converter whine when the vehicle is stopped and the transmission is in DRIVE or REVERSE. This noise will increase as you increase the engine RPM. The noise will stop when the vehicle is moving or when you apply the torque converter clutch, 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 your foot on the brake.
2. Put the gear selector in DRIVE.
3. Depress the accelerator to approximately 1,200 RPM for no more than six seconds.

A torque converter noise will increase under this load.

**Torque Converter Clutch Shudder**

The key to diagnosing Torque Converter Clutch (TCC) shudder is to note when it happens and under what conditions.

TCC shudder which is caused by the transmission should only occur during the apply or the release of the converter clutch. Shudder should never occur after the TCC plate is fully applied.

**If Shudder Occurs During TCC Apply or Release**

If the shudder occurs while the TCC is applying, the problem can be within the transmission or the torque converter. Something is causing one of the following conditions to occur:

- Something is not allowing the clutch to become fully engaged.
- Something is not allowing the clutch to release.
- The clutch is releasing and applying at the same time.

One of the following conditions may be causing the problem to occur:

- Leaking turbine shaft seals
- A restricted release orifice
- A distorted clutch or housing surface due to long converter bolts
- Defective friction material on the TCC plate
If Shudder Occurs After TCC has Applied

If shudder occurs after the TCC has applied, most of the time there is nothing wrong with the transmission.

The TCC is not likely to slip after the TCC has been applied. Engine problems may go unnoticed under light throttle and load, but they become noticeable after the TCC apply when going up a hill or accelerating. This is due to the mechanical coupling between the engine and the transmission.

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

Inspect the following components in order to avoid misdiagnosis of TCC shudder. An inspection will also avoid the unnecessary disassembly of a transmission or the unnecessary replacement of a torque converter.

**Spark Plugs** - Inspect for cracks, high resistance or a broken insulator.

**Plug Wires** - Look in each end. If there is red dust (ozone) or a black substance (carbon) present, then the wires are bad. Also look for a white discoloration of the wire. This indicates arcing during hard acceleration.

**Coil** - Look for a black discoloration on the bottom of the coil. This indicates arcing while the engine is misfiring.

**Fuel Injector** - The filter may be plugged.

**Vacuum Leak** - The engine will not get a correct amount of fuel. The mixture may run rich or lean depending on where the leak occurs.

**EGR Valve** - The valve may let in too much or too little unburnable exhaust gas and could cause the engine to run rich or lean.

**MAP/MAF Sensor** - Like a vacuum leak, the engine will not get the correct amount of fuel for proper engine operation.

**Carbon on the Intake Valves** - Carbon restricts the proper flow of air/fuel mixture into the cylinders.

**Flat Cam** - Valves do not open enough to let the proper fuel/air mixture into the cylinders.

**Oxygen Sensor** - This sensor may command the engine too rich or too lean for too long.

**Fuel Pressure** - This may be too low.

**Engine Mounts** - Vibration of the mounts can be multiplied by TCC engagement.
Axle Joints - Check for vibration.

TP Sensor - The TCC apply and release depends on the TP Sensor in many engines. If the TP Sensor is out of specification, TCC may remain applied during initial engine loading.

Cylinder Balance - Bad piston rings or poorly sealing valves can cause low power in a cylinder.

Fuel Contamination - This causes poor engine performance.

Torque Converter Replacement
Torque converter replace at times becomes a controversial issue. Follow the guidelines below for torque converter replacement and repair order documentation.

Replace the torque converter if any of the following conditions exist:

• External leaks appear in the hub weld area.
• The converter hub is scored or damaged.
• The converter pilot is broken, damaged, or fits poorly into the crankshaft.
• You discover steel particles after flushing the cooler and the cooler lines.
• The pump is damaged, or you discover steel particles in the converter.
• The vehicle has TCC shudder and/or no TCC apply. Replace the torque converter only after all hydraulic and electrical diagnoses have been made. The converter clutch material may be glazed.
• The converter has an imbalance which cannot be corrected. Refer to Flexplate/Torque Converter Vibration Test.
• The converter is contaminated with engine coolant which contains antifreeze.
• An internal failure occurs in the stator roller clutch.
• You notice excessive end play.
• Overheating produces heavy debris in the clutch.
• You discover steel particles or clutch lining material in the fluid filter or on the magnet, when no internal parts in the unit are worn or damaged. This condition indicates that lining material came from the converter.
Do not replace the torque converter if you discover any of the following symptoms:

• The oil has an odor or the oil is discolored, even though metal or clutch facing particles are not present.

• The threads in one or more of the converter bolt holds are damaged. Correct the condition with a new thread inset.

• Transmission failure did not display evidence of damaged or worn internal parts, steel particles or clutch plate lining material in the unit and inside the fluid filter.

• The vehicle has been exposed to high mileage only. An exception may exist where the lining of the torque converter clutch dampener plate has seen excess wear by vehicles operated in heavy and/or constant traffic, such as taxi, delivery, or police use.