Learning Objectives (1 of 2)

1.1 Prepare for the Manual Drivelines and Axles (A2) ASE certification test content area “C” (Transmission/Transaxle Diagnosis and Repair).
1.2 Explain how to perform transaxle/transmission maintenance operations.
1.3 Explain manual transaxle/transmission diagnosis.

Learning Objectives (2 of 2)

1.4 Discuss the procedure for transaxle/transmission removal and replacement.
1.5 Discuss the procedure for transaxle/transmission overhaul.
Preventive Maintenance (1 of 2)

- Normal maintenance operation includes:
  - Periodic check of the lubricant level
  - Linkage/shifter adjustment
  - Mount inspection or replacement as needed
  - Visual inspection for leaks and other abnormal conditions
- Lubricant check
  - What are some things to check for?

Preventive Maintenance (2 of 2)

- Transmission Lubricant replacement steps
- How should the transaxle linkage get adjusted?
- How can an alignment check get accomplished?

Figure 8-1 (a) Transaxles and transmissions use either a dipstick or level plug to check the oil level, (b) To determine the fluid level, insert a finger into the opening and feel for the fluid level.
FIGURE 8–2 (a) Operate the shift levers through all of the gears with the engine off and again with it running. (b) If necessary, adjust the shift linkage following the vehicle manufacturer’s specified procedure.

FIGURE 8–3 The enlarged views of the inner CV joints show that the engine and transaxle are misaligned; they should be moved toward the right.

Manual Transmission/Transaxle Diagnosis

- Verify the customer concern by performing a road test.
- Perform a visual inspection.
- Follow service information and follow pinpoint tests to determine the root cause.
- Perform the needed repair.
- Verify the repair.

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Perform the needed repair.

Verify the repair.
Typical manual transmission/transaxles faults and some possible causes.

<table>
<thead>
<tr>
<th>TRANSMISSION/TRANSAXLE FAULT</th>
<th>DESCRIPTION OF FAULT</th>
<th>POSSIBLE CAUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Junior</td>
<td>Possibility exists for the transaxle/</td>
<td>Locking plates or seals</td>
</tr>
<tr>
<td>Hard shift junior</td>
<td>Requires an abnormally high amount of force to shift into gear</td>
<td>Possible worn or damaged synchronizer or shift fork problems</td>
</tr>
<tr>
<td>Shift stick-out</td>
<td>Will shift into gear or lock up</td>
<td>Possible shifter linkage or shift fork problems</td>
</tr>
<tr>
<td>Locked into gear</td>
<td>Transmission/transaxle will not shift out of a gear</td>
<td>Stiff shift linkage or shift fork problems</td>
</tr>
<tr>
<td>Jumper out of gear</td>
<td>Will shift into neutral on its own</td>
<td>Often caused by worn synchronizer assemblies</td>
</tr>
<tr>
<td>Shifting grinding during a shift</td>
<td>Grate/grinding noise occurs as shift is made</td>
<td>Often caused by worn synchronizer assemblies</td>
</tr>
<tr>
<td>Noisy</td>
<td>A grinding, growling noise in neutral</td>
<td>Wear or defective bearings</td>
</tr>
<tr>
<td>No gear at all</td>
<td>Sometimes the teeth are sheared and there is no gear at all (casing second gear)</td>
<td>Usually caused by short shifter</td>
</tr>
</tbody>
</table>

**Figure 8.5** When performing a visual inspection, check for “rust dust,” which is evidence of a worn components such as universal joints.

**Typical noises, their causes and possible items to look for to solve the noise concerns**

<table>
<thead>
<tr>
<th>CONDITION/NOISE</th>
<th>TYPICALLY HEARD WHEN</th>
<th>POSSIBLE CAUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gear rattle</td>
<td>Most noticeable while accelerating at low RPM and lagging the engine</td>
<td>Possible condition: clutch drum, bearings, or shift linkage problem</td>
</tr>
<tr>
<td>Neutral rattle</td>
<td>Occurs with the engine running in neutral with the brakes engaged</td>
<td>These vibrations can occur in the engine with an improperly set engine idle speed, engine balance, or clutch underdamped or lagging</td>
</tr>
<tr>
<td>Backpack</td>
<td>Occurs when the vehicle is load or driven at a constant speed, while the transaxle is shifted into various gears</td>
<td>May be caused by too much or too little lubrication on the driveshaft of a rear-wheel-drive transaxle</td>
</tr>
<tr>
<td>Cogging</td>
<td>The gear shifter engages at high RPM or under acceleration</td>
<td>May be caused by the “shift skip” system which forces a shift to occur at a specific RPM, or it could be a problem with the column shift mechanism</td>
</tr>
</tbody>
</table>

**CHART 8–2**

Transaxle/Transmission Removal (1 of 3)

• Transaxle Removal
  – Disconnect the negative (–) battery cable.
  – Disconnect the shift cables or rods, clutch linkage, backup light switch or wires speedometer cable or speed sensor connections, and any hose or cable brackets.
  – Installation of an engine support tool.
  – Remove the upper clutch housing bolts and install a guide pin into one or two of the bolt holes.

Transaxle/Transmission Removal (2 of 3)

  – Raise and securely support the vehicle on a hoist or on jack stands.
  – Drain the transaxle oil
  – Install the second guide pin.

• How does the transaxle get installed?

• Transmission Removal/Replacement
  – Disconnect the negative (–) battery cable.
  – Raise and securely support the vehicle.
  – Drain the fluid.

Transaxle/Transmission Removal (3 of 3)

  – Remove the backup light wires, speedometer cable or speed sensor connections, any hose or cable brackets attached to the vehicle, and the shift linkage.
  – Remove transmission bolts.
  – Remove transmission-to-clutch housing or transmission-to-engine bolts.
  – Lower the unit out of the vehicle.

• Transmission installation
The following points should be observed during disassembly of the unit:

- Disassembly of the unit
- Clean and identify the unit
- Gear inspection
- Bearing inspection
- Reconditioning of the subassemblies
- Checking gear end float and adjusting bearing clearances as the unit is reassembled

What wear items should be checked?

The procedure usually follows the procedure just described, only in reverse. Be sure that wires, cables, and hoses are positioned correctly as the transaxle is slid into place.

Drain the fluid, noting the amount and condition. The fluid is usually already drained before the transmission is removed from the vehicle. It is highly recommended that the procedure specified in service information be followed along with the clearances and torque specifications.

Typical Procedure

- Disconnect the negative (–) battery cable.
- Move the transmission and jack to the rear to clear the exhaust system.
- Remove the transmission-to-clutch housing or transmission-to-engine bolts.
- If necessary, check and adjust clutch pedal free travel and the shift linkage.
- If the front suspension mounting points were disturbed, check and adjust the front wheel alignment and front suspension before the transmission is removed from the vehicle. 
- Drain the fluid, noting the amount and condition. The fluid is usually already drained before the transmission is removed from the vehicle. It is highly recommended that the procedure specified in service information be followed along with the clearances and torque specifications.
- Most front-wheel-drive (FWD) vehicles require a transaxle being removed from underneath a vehicle and being supported by a transmission jack. If the front suspension mounting points were disturbed, check and adjust the front wheel alignment and front suspension before the transmission is removed from the vehicle.
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The internal shift linkages for rough operation and wear should be checked during disassembly:

- Bearing inspection
- Gear inspection
- Cleaning teeth, or excessive fifth-gear end float. Experienced technicians diagnose the problem and usually know what is wrong.
- Slingers
- Bushings
- Roller bearings
- Synchronizer springs
- New snap rings
- Strut keys
- Bushings
- Roller bearings
- Synchronizer springs
- New snap rings
- Strut keys

What wear items should be checked?

Transaxle/Transmission Overhaul (1 of 3)

- Typical Procedure
  - Disassembly of the unit
  - Clean and identify the unit
  - Gear inspection
  - Bearing inspection
  - Reconditioning of the subassemblies
  - Checking gear end float and adjusting bearing clearances as the unit is reassembled

What wear items should be checked?
Transaxle/Transmission Overhaul (2 of 3)

• What is included in a typical transmission/transaxle kit?

• Transaxle Disassembly
  – Install holding fixture
  – Remove drain plug and check fluid
  – On some transaxles, the differential bearing retainer, extension housing, and differential are removed first. On some transaxles, the disassembly begins with the removal of the left side case cover, fifth-gear synchronizer assembly, and the fifth counter gear.

Transaxle/Transmission Overhaul (3 of 3)

• Sometimes service information specifies that the disassembly begin with the removal of the backup light switch, reverse idler shaft retaining bolt, detent plunger retaining screw, interlock sleeve retaining pin, and fill plug.
  – Remove case-to-clutch housing or end-cover-to-case attachment bolts.
  – Remove shift mechanism, reverse idler gear, and shaft
  – Remove input and main shaft
  – Remove ring gear and differential assembly

Figure 8–9 A service parts kit for a Borg-Warner T5 manual transmission which includes bearings, seals, and snap rings.
perform the following steps:

Many bearings, synchronizer assemblies, and some countershafts will slide out of and into the proper location using only pry bars. A service parts kit for a Borg-Warner T5 manual transmission is used in many makes and models of vehicles. The Borg-Warner T5 five-speed manual transmission is used in many makes and models of vehicles.

Worn parts are normally replaced with new ones. When purchasing parts, sometimes upgraded parts, which are stronger than the original, should be purchased to solve problems. In most cases, if any part of this assembly is damaged, except for the blocker rings, replacement of the entire assembly is necessary. The service information specifies that the disassembly for disassembling a specific transmission is found in service information.

10 Most transaxles use formed-in-place gaskets that tend to glue the case and covers together. After removing the cover, remove the shift mechanism. Remove the input and main shaft assemblies together, noting their length so that they can be replaced in the proper location. It will usually be necessary to tap the shafts leave their bearings.

11 Using a holding fixture is a great way to support the transaxle during disassembly and reassembly. A holding fixture is a great way to support the transaxle during disassembly and reassembly.

8–10

12 Removing the side cover allows access to the shift forks and differential assembly.
Transmission Disassembly (1 of 3)

• What is the procedure to disassemble a typical transmission?

• Parts cleaning
  – Check the debris attached to the magnet
  – Cleanup

• Gear inspection
  – Sometimes damage is easy to locate; a close inspection is necessary

Transmission Disassembly (2 of 3)

• Bearing inspection
  – Normally done by sight, feel, and sound
  – Brinelling; Contamination; Electric arcing; Fretting; Misalignment; Peeling; Seizing; Spalling

• Bearing Removal and installation
  – The inner races of bearing are often pressed onto the shaft and the pressing force should be transmitted only to the inner race.

• Main shaft disassembly
  – What are the steps to disassemble a main shaft?

Transmission Disassembly (3 of 3)

• Synchronizer disassembly, inspection, and reassembly
  – What are the steps for reassembling a synchronizer?

• Blocker ring inspection
  – Cone surface should be smooth and polished

• Main shaft reassembly
  – What are the steps to reassemble a main shaft?
FIGURE 8–13 The Borg-Warner T5 five-speed manual transmission is used in many makes and models of vehicles and they vary with the number of splines for either the input shaft or output shaft or both.

Shift Mechanism

• Check the following during visual inspection:
  – Shift forks
  – Shift rails
  – Detent springs
  – Detent cam
  – Interlock plates
  – Selector plates
  – Reverse lockout mechanism/solenoid

FIGURE 8–25 Having service information readily available is important so that each step can be checked as the unit is being reassembled.
Case and Covers (1 of 2)

- Cleaning and inspection
  - Should be thoroughly cleaned and carefully checked

- Seal installation
  - Each shift shaft that passes through the case
  - One or two output shaft seals
  - Sometimes an input shaft seal

- End play/preload checks
  - What are the steps used to check and adjust bearing clearance/preload on a transaxle?

Case and Covers (2 of 2)

- Case sealants
  - Room-temperature vulcanizing (RTV)
  - Anaerobic sealants

- Final checks

FIGURE 8-28 When using RTV to seal a transmission/transaxle case, be sure to surround each bolt hole to help prevent leakage.
Summary (1 of 2)

- Transmissions must have clean gear oil at the proper level and of the proper type.
- The cause of improper transmission operation is determined using several diagnostic steps.
- Internal transmission problems require that the transmission be removed from the vehicle.

Summary (2 of 2)

- Transmission and transaxle disassembly and reassembly varies between different makes and models.
- Gears, bearings, synchronizer assemblies, shift forks, and transaxle differentials are the major wear components.