

ATE5 Chapter 127 Automatic Transmission/Transaxle Principles

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain learning objectives to students as listed below: <ol style="list-style-type: none">1. Explain the purpose, function, and operation of torque converters.2. Discuss planetary gear sets and compound planetary gear sets.3. Discuss the operation and servicing of continuously variable transmission.4. Explain how a dual clutch automatic transmission works.
Establish the Mood or Climate	Provide a WELCOME , Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: This lesson plan is based on the 5th Edition Chapter Images found on Jim's web site @

www.jameshalderman.com

LINK CHP 127: [ATE5 Chapter Images](#)

ICONS	Chapter 127 Automatic Transmissions
      <p data-bbox="350 856 456 884">QUESTION</p>      <p data-bbox="350 1619 456 1646">QUESTION</p>   <p data-bbox="350 1776 456 1803">QUESTION</p>	<p data-bbox="623 338 1268 405">1. SLIDE 1 Ch127 AUTOMATIC TRANSMISSION/TRANSAXLE PRINCIPLES</p> <p data-bbox="623 422 1130 453">2. SLIDES 2-3 EXPLAIN Objectives</p> <p data-bbox="583 470 1240 575">Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED</p> <p data-bbox="643 646 781 684"><u>Videos</u></p> <p data-bbox="583 751 1419 978"><u>DISCUSSION:</u> Refer to <u>Chart 127–1</u> to talk about changes in transmissions through the years. What are the major changes that have occurred? Ask the students to find the date closest to when they were born and discuss what major change was introduced at that time.</p> <p data-bbox="623 995 1398 1062">2. SLIDE 2 EXPLAIN Figure 127-1 cutaway of Chrysler PowerFlite 2-speed automatic transmission used in 1950s</p> <p data-bbox="623 1129 1419 1346">3. SLIDE 3 EXPLAIN Figure 127-2 torque converter is made from 3 parts: Impeller is located at transmission end, attached to housing, and is driven by engine. Turbine is located at engine side and is driven by fluid flow from impeller & drives input shaft of transmission. Stator redirects flow to improve efficiency and multiply torque.</p> <p data-bbox="583 1356 1386 1503"><u>DEMONSTRATION:</u> Using a converter that has been cut open, show various parts inside a torque converter, including the impeller, turbine, stator, one-way clutch, and converter clutch (if present)</p> <p data-bbox="583 1514 1395 1661"><u>DISCUSSION:</u> Have the students talk about the purposes a torque converter plays in an automatic transmission. What is the reason for allowing slippage?</p> <p data-bbox="583 1671 1321 1787"><u>DISCUSSION:</u> Have the students talk about couplings. What is difference between a fluid coupling and a mechanical coupling?</p>

ICONS

Chapter 127 Automatic Transmissions



4. **SLIDE 4 EXPLAIN** Figure 127-3 The slip rings help direct the flow of fluid and improve the efficiency of the torque converter by reducing turbulence.



DISCUSSION: Have the students discuss how the torque converter drives the transmission oil pump. How does the inner portion of front pump couple to the torque converter hub? **FIGURE 127-3**



5. **SLIDE 5 EXPLAIN** Figure 127-4 Two fans can be used to show how fluid, or air in the case of fans instead of automatic transmission fluid, can be used to transfer energy. If one fan is operating, the blades of a second fan will be rotated by the flow of air past the fan that is unplugged, causing the blades to rotate.



DEMONSTRATION: To demonstrate how fluid coupling in converter works, use 2 fans facing each other. Turn one fan on & have the students observe other fan's blades turning. **FIGURE 127-4**



[Torque Converter Fluid Flows \(View\) \(Download\)](#)
[Torque Converter Power Flows \(View\) \(Download\)](#)



HANDS-ON TASK: Have the students **DOWNLOAD** a transmission schematic for specific transmission or transaxle and explain powerflow for that schematic to the class.



6. **SLIDE 6 EXPLAIN** Figure 127-5 The torque converter bolts to the flexplate which is attached to the engine crankshaft and rotates at engine speed.



DEMONSTRATION: Show examples of a **Flexplate & Flywheel.** Have them talk about differences between the two. Why do the flexplate and flywheel need to be different?



DISCUSSION: While showing the students examples of flexplates & discuss the external gear welded to the flexplate. What is purpose of this gear? What will happen if the gear goes bad?



ON-VEHICLE NATEF TASK: Inspect converter flex plate. [Page 444](#)

ICONS	Chapter 127 Automatic Transmissions
	<p>7. SLIDE 7 EXPLAIN Figure 127-6 The flat sections that are cut into the hub of the torque converter are used to drive the fluid pump.</p>
	<p>8. SLIDE 8 EXPLAIN Figure 127-7 The internal splines inside the torque converter are connected to the splines on the stator support shaft and turbine splines to input shaft.</p>
	<p>DEMONSTRATION: Show front seal, stator support, and input shaft of automatic transmission. Point out importance of making certain converter is installed all the way so that serious damage does not result. FIGURES 127-5, 6, 7</p>
	<p>9. SLIDE 9 EXPLAIN Figure 127-8 Torque multiplication occurs when fluid leaving the turbine strikes the front of stator vanes and is redirected back to impeller.</p>
	<p>DISCUSSION: Discuss how the fluid pump in an automatic transmission is driven by the converter. If possible, show them the flat sections machined in the torque converter hub that are used to drive the pump. What ensures that the fluid pump spins only when the engine spins? FIGURE 127-8</p>
	<p>DISCUSSION: Have students talk about the different converter phases of torque converter operation. What are rotary flow, vortex flow, & torque multiplication? FIGURE 127-8</p>
	<p>DISCUSSION: Have the students talk about the coupling phase. How will the coupling phase be affected if the one-way clutch (Stator) fails? FIGURE 127-8</p>
	<p>10. SLIDE 10 EXPLAIN Figure 127-9 stator contains a one-way roller clutch which locks it from rotating in one direction & allows it to rotate freely in opposite direction.</p>
	<p>HANDS-ON TASK: Have students CORRECTLY R & R a torque converter. Remind them of the importance of installing torque converter correctly. Evaluate students on whether they can identify all of parts inside a torque converter and whether they correctly install converter</p>

ICONS



Chapter 127 Automatic Transmissions

ON-VEHICLE NATEF TASK: Measure torque converter endplay; check stator clutch. [Page 445](#)

11. **SLIDE 11 EXPLAIN** Figure 127-10 An expanded view of a typical torque converter assembly showing the torque converter clutch (TCC)

DISCUSSION: Have the students talk about the purpose and function of a lockup torque converter. What are the advantages of having a lockup or torque converter clutch? **FIGURE 127-10**

12. **SLIDE 12 EXPLAIN** Figure 127-11 Torque converter clutch friction material is determined by the vehicle manufacturer to provide the needed coefficient of friction needed. For example, many older units use a paper-type friction material because they are fully applied or released, whereas most newer units use a synthetic material such as Kevlar® or carbon fiber because the torque converter clutch is pulsed on and off, therefore requiring a more robust material for long service life.

DEMONSTRATION: Using cut-open converters for examples, show students different types of converter clutch material. Why would *Kevlar* and carbon fiber be needed in some applications? If **CUT-AWAYS** are not available for demonstration: Refer to **FIGURE 127-11**

13. **SLIDE 13 EXPLAIN** Figure 127-12 A cross-sectional view of a pulse-width modulated (PWM) torque converter clutch. The powertrain control module (PCM) pulses the control solenoid which then controls the fluid flow to apply the torque converter clutch.

TCC Operation (View) (Download)

DISCUSSION: Discuss how engine computer controls are used to control converter lockup. How do engine performance issues affect transmission operation? **FIGURE 127-12**

ICONS	Chapter 127 Automatic Transmissions
	<p>DISCUSSION: Discuss converter clutch control. What regulates the timing and application of the clutch? Have the students talk about importance of using the correct fluid in a transmission with a lockup torque converter. What are possible customer complaints if wrong type of fluid is used?</p>
	<p>DEMONSTRATION: Show how to use a Scan Tool to check & Diagnose a TCC</p>
	<p>HANDS-ON TASK: Based on DEMO have students use a Scan Tool to check & Diagnose a TCC</p>
	<p>ON-VEHICLE NATEF TASK: Perform lock-up converter tests; determine necessary action. P432</p>
	<p>DISCUSSION: Discuss what stall speed is. How do different stall speeds affect the performance & emissions of an engine?</p>
	<p>DISCUSSION: Discuss torque multiplication qualities of a torque converter. Why do high-performance vehicles use a small diameter converter? <u>(ANS. Small diameter results in higher stall speeds)</u></p>
	<p>DEMONSTRATION: Demonstrate what "creep" is. Then show them how to check torque converter stall speed by power braking a vehicle & observing the tachometer. Make sure the students understand that a stall test should last for only 5 seconds so that the transmission or transaxle is not damaged. After a stall test is performed engine should be idled for a few minutes to let transmission cool down.</p>
	<p>Tell students when stall speed is about 1/3 of specification, it is an indicator that one-way (Stator) clutch in converter is bad.</p>

ICONS	Chapter 127 Automatic Transmissions
 	<p><u>ON-VEHICLE NATEF TASK:</u> Perform stall test; determine necessary action. Page 431</p>
	<p><u>OPTIONAL HANDS-ON TASK:</u> Have students <u>LEAK TEST</u> a torque converter</p>
	<p>14. SLIDE 14 EXPLAIN Figure 127-13 gear selector is often called the “PRNDL,” pronounced “prindle,” regardless of the actual letters or numbers used.</p>
  <p>QUESTION</p>	<p><u>DISCUSSION:</u> Have the students talk about the <u>SHIFT MODES</u> that most automatic transmissions & transaxles include. What is a common name for a gear selector? <u>FIGURE 127-13</u></p>
  <p>QUESTION</p>	<p><u>DISCUSSION:</u> Have the students talk about the importance of operating a vehicle in the proper <u>SHIFT MODE</u> at the proper time. Which gears are used on gentle, long, or steep grades?</p>
	<p><u>HANDS-ON TASK:</u> Pulse width is measured in Hertz. Hertz are often displayed in milliseconds. How many milliseconds in a second? Have students determine speed of electricity. Understanding speed of electricity helps students understand how electronics can operate so fast.</p>
	<p>15. SLIDE 15 EXPLAIN Figure 127-14 typical planter gear set showing terms that are used to describe each member.</p>
	<p>16. SLIDE 16 EXPLAIN Figure 127-15 A typical planetary gear set showing planet carrier which supports all of pinion gears (also called planet pinion gears).</p>
	<p><u>DEMONSTRATION:</u> Show <u>planetary gear set.</u> Identify parts including <u>sun gear, planetary carrier, & ring (annulus) gear</u></p>
<p>DEMO</p>	<p><u>SAFETY</u> Caution parts on a <u>planetary gear set</u> can be very sharp and can cause personal injury. Also warn students that planetary gear sets have many pinch points that also can cause injury</p>
 	

ICONS	Chapter 127 Automatic Transmissions
  	<p>HANDS-ON TASK: Have the students identify parts on <u>planetary gear set</u>. Grade them on their ability to correctly identify parts including sun gear, planetary carrier, & ring (annulus) gear</p> <p>PGS 1, Reduction (View) (Download)</p> <p>PGS 2, Rev Reduction (View) (Download)</p> <p>PGS 3, Reduction (View) (Download)</p> <p>PGS 4, Rev OD (View) (Download)</p> <p>PGS 5, OD (View) (Download)</p> <p>PGS 6, OD (View) (Download)</p> <p>PGS 7, Direct Drive (View) (Download)</p> <p>17. SLIDE 17 EXPLAIN Figure 127-16 Maximum reduction can be achieved by using the sun gear as the input, holding the ring gear and using the planet carrier as the output.</p> <p>18. SLIDE 18 EXPLAIN Figure 127-17 Minimum reduction can be achieved by using the ring gear as the input, holding the sun gear and using the planet carrier as the output.</p> <p>19. SLIDE 19 EXPLAIN Figure 127-18 Reverse can be achieved by using the sun gear as the input, holding the planet carrier and using the ring gear as the output.</p> <p>144. SLIDE 144 EXPLAIN Planetary Gear Sets</p>
  	<p>DEMONSTRATION: Using a planetary gear set, demonstrate for students when 3 gears are used and when 2ND gear moved in a driven gear becomes a drive gear to third gear</p> <p>DISCUSSION: Have the students talk about what an input member, a reaction member, and output member are. Are these members always the same in a planetary gear set?</p> <p>HANDS-ON TASK: Have students work in groups to experiment with a <u>planetary gear set</u>. Ask them to hold and drive different parts of the gear set to see what the results will be. Ask them to determine when a gear reduction, a 1:1 ratio, or an overdrive will occur.</p>

ICONS	Chapter 127 Automatic Transmissions
	<p>HANDS-ON TASK: Using <u>ON-LINE SERVICE INFORMATION</u>, have the students look up what the gear ratios for all forward gears are in an SUV, a pickup, and a compact. Are there any Similarities? Ask them to report their findings to class</p>
	<p>HANDS-ON TASK: Using <u>Chart 127-2</u>, have the students determine what input member, reaction member, & output member will be in maximum reduction & maximum increase. Have them point out these parts on planetary gear set</p>
	<p>Power Flow, Simpson Geartrain (View) (Download) Power Flow, Simpson Geartrain + Overdrive (View) (Download)</p>
	<p>20. SLIDE 20 EXPLAIN Figure 127-19 A Simpson planet gear set is composed of two ring gears and two planet carrier assemblies that share one sun gear.</p> <p>21. SLIDE 21 EXPLAIN Figure 127-20 Ravigneaux gear set is composed of 2 sun gears, 1 planet carrier that supports two sets of pinion gears, and a single ring gear.</p>
	<p><u>Power Flow, Ravigneaux Four-Speed (View) (Download)</u> <u>Power Flow, Allison 1000, 5-Speed (View) (Download)</u></p>
	<p>DISCUSSION: discuss and compare Ravigneaux gear set (FIGURE 127-20), Lapelletier gear set, & Simpson gear set. What are advantages and disadvantages, if any, of different gear sets? Is a planetary gear capable of producing an overdrive?</p>
	<p>HANDS-ON TASK: Have the students identify what model of transmission or transaxle (GM 4L80E) their own or their parents' vehicle has in it. Have the students determine what the numbers and letters mean for vehicle</p>
	<p>22. SLIDE 22 EXPLAIN Figure 127-21 On one style of transaxle the turbine shaft drives the input shaft through a drive chain assembly.</p>
	<p>DISCUSSION: discuss automatic transaxles. What does an automatic transaxle include? In what applications can automatic transaxles be used?</p>

ICONS	Chapter 127 Automatic Transmissions
 	<p><u>ON-VEHICLE NATEF TASK (A2-A-9)</u> Diagnose noise and vibration concerns; determine necessary action. <u>(P-2) Page 433</u></p>
	<p><u>Power Flow, 6T70/6F50 (View) (Download)</u></p>
	<p>23. SLIDE 23 EXPLAIN Figure 127-22 Another type of transaxle uses a chain to transfer engine torque from the output of gear sets to differential assembly (final drive).</p>
  <p>QUESTION</p>	<p>24. SLIDE 24 EXPLAIN Figure 127-23 cutaway showing the final drive assembly of a transaxle.</p> <p><u>DISCUSSION:</u> Have the students discuss final drive units. What does a final drive assembly include? <u>FIGURE 127-22, 23</u></p>
	<p><u>DEMONSTRATION:</u> Show students how to disassemble a transaxle FINAL DRIVE unit and explain the parts.</p>
	<p><u>HANDS-ON TASK:</u> Have the students disassemble a FINAL DRIVE UNIT & identify the parts used post-it notes.</p>
	<p>25. SLIDE 25 EXPLAIN Figure 127-24 Honda non-planetary gear set type automatic transmission that uses helical cut gears instead of planetary gears. Hydraulically applied clutches as commanded by PCM with fluid flow controlled by shift solenoids to make the shifts</p>
	<p><u>Honda 4-Speed Automatic Transaxle (View) (Download)</u></p>
  <p>QUESTION</p>	<p><u>DISCUSSION:</u> Have the students talk about the automatic transmission used in Honda or a Saturn. What is different about this type of automatic transmission? <u>FIGURE 127-24</u></p>
	<p><u>HANDS-ON TASK:</u> Have the students locate in the ON-LINE SERVICE INFORMATION, details about the operation of a Saturn or Honda NON-PLANETARY Transaxle and have them select a spokesperson who will explain the advantages and</p>

ICONS

Chapter 127 Automatic Transmissions



disadvantages of this design compared to a standard automatic transaxle using planetary gearsets.

26. SLIDE 26 EXPLAIN Figure 127-25 (a) belt and pulley CVT uses variable width pulleys and a special chain to provide an infinite number of speed ratios. (b) A belt and pulley CVT uses variable width pulleys and a special chain to provide an infinite number of speed ratios.

[CVT Forward and Reverse \(View\) \(Download\)](#)

[CVT Operation \(View\) \(Download\)](#)

[CVT Ratio Control \(View\) \(Download\)](#)

DEMONSTRATION: Using a variable-speed drill press, show students that by changing the pulley diameter, you can change the speed of drill. This will help them understand how a continuously variable transaxle operates. **FIGURE 127-25**

27. SLIDE 27 EXPLAIN Figure 127-26 Honda CVT belt construction.
28. SLIDE 28 EXPLAIN Figure 127-27 Honda CVT power flow in park (P) and neutral (N)

DISCUSSION: Discuss CVT variable diameter pulleys. What function do these pulleys DO that planetary gear sets perform in transmissions transaxles? **FIGURE 127-25, 26, 27**

DISCUSSION: Have the students talk about how a vehicle equipped with a CVT will drive a little differently than a vehicle with a conventional automatic transmission or transaxle. What are some driving advantages of a CVT?

29. SLIDE 29 EXPLAIN Figure 127-28 Honda CVT operation in drive (D) or low (L)

DISCUSSION: Have students talk about the **Honda CVT** used as part of **HEV system** on some Hondas. Why would a CVT be used for a hybrid vehicle? **FIGURE 127-28**. Discuss why a start clutch is needed. What does a start clutch replace in an automatic transmission?

ICONS**Chapter 127 Automatic Transmissions**

30. **SLIDE 30 EXPLAIN** Figure 127-29 Location of the Honda CVT start clutch.

31. **SLIDE 31 EXPLAIN** Figure 127-30 The Honda CVT transmission control module (TCM) showing the inputs (sensors) on the left and the outputs on the right Transmission

HANDS-ON TASK: Have the students use **ON-LINE service INFO** to look up service procedures for a CVT transmission. Is there a filter to change? Can the fluid be easily changed? Does a CVT use special ATF? Have them list service procedures they find.

ON-VEHICLE NATEF TASK: Describe the operational characteristics of a continuously variable transmission (CVT). **(P-3) Page 459**

32. **SLIDE 32 EXPLAIN** Figure 127-31 dual clutch automatic uses best features of an automatic transmission without the power loss of a torque converter.

DISCUSSION: Have the students study and talk about **Figure 127-31**. Which parts differ between dual-clutch automatic transmission & conventional automatic transmission they discussed earlier? Create a power loss comparison between a **DUAL CLUTCH** trans and Torque Converter trans.

Dual Clutch Transaxle (View) (Download)

Dual Clutch Transmission Hydraulic & Electronic Control (View) (Download)

7-Speed Dual Clutch Transmission (View) (Download)

33. **SLIDE 33 EXPLAIN** Figure 127-32 Dual clutch automatic transaxles that use two dry clutches. The larger clutch drives the odd number gear ratios (first, third, and fifth) and the smaller clutch drives the even numbered gear ratios (second, fourth, and sixth).

DISCUSSION: Have students talk about the operation of a dual-clutch automatic transmission. What types of vehicles use dual dry clutches? What type of vehicles use dual wet clutches?

DISCUSSION: Have the students talk about the various advantages and disadvantages of a dual-clutch automatic transmission. Which vehicles use a dual clutch automatic transmission?

ICONS	Chapter 127 Automatic Transmissions
 	<p>HANDS-ON TASK: Have the students use <u>ON-LINE service INFO</u> to look up HOW A DUAL-CLUTCH transaxle OPERATES. Have them DISCUSS what they found.</p>
	<p>HANDS-ON TASK: Have the students use <u>ON-LINE service INFO</u> to look up service procedures for a DUAL-CLUTCH transmission. Is there a filter to change? Can the fluid be easily changed? Does IT use special ATF? Have them list service procedures they find.</p>
  <p>QUESTION</p>	<p>DISCUSSION: Have the students discuss how many engine computer inputs are used by the transmission. Let them know that engine driveability issues can affect transmission operation. What is the purpose of the TCM?</p>
 	<p>ON-VEHICLE NATEF TASK: Describe the operational characteristics of a hybrid vehicle drive train. <u>Page 460</u></p>
	<p><u>Crossword Puzzle (Microsoft Word) (PDF)</u> <u>Word Search Puzzle (Microsoft Word) (PDF)</u></p>