

Automotive Technology 6th Edition

Chapter 126 Clutches

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
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 a clutch. 2. Describe diagnose clutch problems and how to replace a clutch. 3. Explain how to adjust the clutch pedal. 4. Explain how to bleed a hydraulic clutch system.
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: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 126 Chapter Images: From http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

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             	<p>1. SLIDE 1 Chapter 126: Clutches</p> <p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED</p> <p>http://www.jameshalderman.com/automotive_principles.html DOWNLOAD</p> <p>Crossword Puzzle (Microsoft Word) (PDF) Word Search Puzzle (Microsoft Word) (PDF) <u>Videos</u></p> <p><u>Assemble Clutch (View) (Download)</u> <u>Cable Clutch Operation (View) (Download)</u> <u>Clutch Hydraulic Operation (View) (Download)</u> <u>Clutch Operation (View) (Download)</u></p> <p><u>DEMONSTRATION:</u> Show examples of a clutch disc, throw-out bearing and pressure plate.</p> <p>2. SLIDE 2 EXPLAIN Figure 126-1 Typical automotive clutch assembly showing all related parts</p> <p><u>DISCUSSION:</u> Ask the students to discuss the experiences they may have had with clutches. <u>SLIDE 126-1</u></p> <p><u>DEMONSTRATION:</u> Show examples of a pilot bearing and a bushing.</p> <p><u>DISCUSSION:</u> Ask the students to discuss the difference between the pilot bearing and the bushing. Which would be the better style to use and why?</p> <p>3. SLIDE 3 EXPLAIN Figure 126-2 (a) When the clutch is in the released position (clutch pedal depressed), the clutch fork is applying a force to the throwout (release) bearing,</p>

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  <p data-bbox="370 583 472 611">QUESTION</p>    	<p>which pushes on the diaphragm spring, releasing the pressure on the friction disc.</p> <p>4. SLIDE 4 EXPLAIN Figure 126-2 (b) When clutch is in engaged position (clutch pedal up), diaphragm spring exerts force on the clutch disc, holding it between flywheel and the pressure plate</p> <p>DISCUSSION: Show the students the leverage advantages used in clutch applications, such as the length of the clutch fork pushing on the throwout bearing in Figure 126–2. Another example would be the levers used in a lever and-rod linkage</p> <p>5. SLIDE 5 EXPLAIN Figure 126-3 transmission has just been removed. Note that this type of transmission incorporates the bell housing, which was therefore removed at the same time as the transmission. The clutch fork and throwout (release) bearing also came off together. All that remained attached to the engine was the flywheel, clutch disc, and pressure plate.</p> <p>HANDS-ON TASK: Have students inspect lever-and-rod, cable, & hydraulic clutch linkage systems. What are advantages and disadvantages of each?</p> <p>HANDS-ON TASK: CROSS-CURRICULAR ACTIVITY: PHYSICS Have the students use the Internet to research levers and fulcrums. Have them make a list of at least four levers and fulcrums used in everyday life. (Examples: bike pedal crank, vehicle jack handle, and playground equipment.) Develop a simple picture of each example to share with the class.</p> <p>6. SLIDE 6 EXPLAIN Figure 126-4 A typical cable-operated clutch.</p> <p>7. SLIDE 7 EXPLAIN Figure 126-5 A hydraulic clutch linkage uses a master cylinder and a slave cylinder.</p> <p>8. SLIDE 8 EXPLAIN Figure 126-6 A typical clutch master cylinder and reservoir mounted on the bulkhead on the driver’s side of the vehicle. Brake fluid is used in the hydraulic system to operate the slave cylinder located on the bell housing.</p> <p>9. SLIDE 9 EXPLAIN Figure 126-7 racing or high-performance clutch disc lacks the features of a stock clutch disc that help provide smooth engagement.</p>

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	<p>DISCUSSION: Ask the students to discuss the differences between a high performance clutch and standard clutch.</p>
	<p>DISCUSSION: Ask the students to discuss why a high performance clutch has to use better materials and design than a standard vehicle clutch.</p>
	<ol style="list-style-type: none"> 10. SLIDE 31 EXPLAIN Figure 126-8 typical stock clutch friction disc that uses coil spring torsional dampers. 11. SLIDE 11 EXPLAIN Figure 126-9 marcel is a wavy spring that is placed between the two friction surfaces to cushion the clutch engagement.
	<p>DEMONSTRATION: Show students torsion dampening springs in a clutch disc. Demonstrate how these springs dampen the twisting motion of the clutch disc as the clutch is engaged.</p>
	<ol style="list-style-type: none"> 12. SLIDE 12 EXPLAIN Figure 126-10 Cutaway of the center section of a clutch plate showing the various layers of steel plates used in the construction. 13. SLIDE 13 EXPLAIN Figure 126-11 coil spring (lever style) clutch pressure plate. 14. SLIDE 14 EXPLAIN Figure 126-12 Typical diaphragm-style pressure plate that uses a Belleville spring.
	<p>DEMONSTRATION: Show examples of pressure plates and how the lever style and diaphragm style work to disengage clutch plate.</p>
	<p>DISCUSSION: Ask the students to discuss why manufacturers use 2 types of pressure plates. What are advantages and disadvantages of each?</p>
	<p>EXPLAIN TECH TIP: <i>Shim It or Replace It.</i> Whenever replacing a clutch, most experts agree that flywheel should be removed from engine and resurfaced. When material is removed from surface of flywheel, the geometry (relationship) of clutch parts changes because pressure plate is now closer to rear of the engine by amount removed from flywheel. Ask your parts supplier for a shim equal in thickness to amount of material removed during resurfacing. Generally, these round shims</p>

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are available in 0.020” to 0.100” thicknesses. The shim is installed between crankshaft flange and the flywheel. If a shim is not used, flywheel may have to be replaced to properly restore proper clutch operation and service life.

15. SLIDE 15 **EXPLAIN** Figure 126-13 flywheel after it has been machined (ground) to provide the correct surface finish for the replacement clutch disc.
16. SLIDE 16 **EXPLAIN** Figure 126-14 starter motor will spin but the engine will not crank if the ring gear on the flywheel is broken.
17. SLIDE 17 **EXPLAIN** Figure 126-15 cutaway of a dual-mass flywheel used on a Ford diesel pickup truck.

DEMONSTRATION: Show the students examples of flywheels with pilot bearings and some without.

SAFETY Flywheels can be very heavy, and caution should be used when lifting. Flywheels also present a finger pinching hazard. Remind the students to follow appropriate safety precautions.

DEMONSTRATION: Show two rotating objects of considerably different weights. An example would be a bicycle tire compared to a car tire.

Demonstrate difference in inertia between the two.

The ring gear can be welded or press-fit on a flywheel

EXPLAIN TECH TIP: *Repair the Oil Leaks Before Replacing the Clutch.* If engine oil or transmission lube gets onto friction surface of the clutch, clutch will chatter when engaged. This grabbing and releasing of the clutch is not only harmful to the drive train (transmission, driveshaft, etc.) but also is disturbing to driver when vehicle vibrates and shakes while driving. To avoid the possibility of a chattering clutch, always repair oil leaks as soon as possible. Rocker (valve) cover gaskets, intake manifold gaskets, oil galley plugs, rear main seals,

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as well as input shaft seal on transmission/transaxle itself can all lead to clutch contamination. • SEE FIGURE 126-16.

18. SLIDE 18 **EXPLAIN FIGURE 126-16a** Before replacing the clutch, bell housing should be cleaned and clutch fork pivot lightly lubricated.
19. SLIDE 19 **EXPLAIN FIGURE 126-16b** input shaft seal should also be replaced to prevent possibility of getting transmission lubricant on friction surfaces of clutch.
20. SLIDE 20 **EXPLAIN Figure 126-17** transaxle assembly has been removed to replace the clutch. Note the short input shaft. This vehicle did not use a pilot bearing (bushing).
21. SLIDE 21 **EXPLAIN Figure 126-18** clutch pedal linkage moves the clutch fork, which then applies a force against the release bearing, which then releases the clamping force pressure plate is exerting on clutch disc.
22. SLIDE 22 **EXPLAIN Figure 126-19** release bearing rubs against the tips of the diaphragm spring.

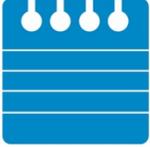
DISCUSS FREQUENTLY ASKED QUESTION:

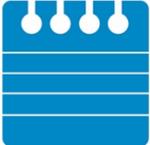
What Part Causes What Noise and When?

Many technicians try to determine which part causes noise before the clutch assembly is removed from the vehicle. Start your noise analysis by starting engine with manual transmission in neutral and clutch engaged (foot off clutch pedal). If you hear a growl or grinding sound, cause is the input shaft bearing in the transmission. If you are hearing a chirping noise, slowly depress clutch pedal. If noise stops, problem is lack of lubrication at the fork and pivot. If noise gets louder as you depress clutch, throwout (release) bearing is problem. The pilot bearing is cause of a squealing noise if sound changes as clutch pedal is depressed or released. Sound will be loudest when the difference in speed between engine and input shaft is greatest.

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    	<p>DISCUSS FREQUENTLY ASKED QUESTION: <i>What Is a Pull-Type Release Bearing?</i></p> <p>The pressure plate used on a few FWD vehicles is bolted directly onto engine's crankshaft, and flywheel is bolted onto the pressure plate. This allows release bearing to be placed inside the pressure plate and operated by a pull rod through transmission input shaft. It is often called a pull-type clutch. The mounting of the diaphragm spring is moved in the cover and at the pressure ring so a pulling force is used to release the clutch instead of the normal pushing force. This change produces an improvement in clutch system efficiency and a lower clutch pedal effort.</p> <p>DISCUSS CASE STUDY:</p> <p>SEARCH INTERNET: Research automotive careers that require the ability to repair, replace, and troubleshoot clutches. Ask the students to prepare to present to the groups at the next class the following: career opportunities, their advantages and disadvantages, and their compensation levels.</p> <p>DISCUSSION: Ask the students to discuss the reason for disconnecting battery, as stated in text, before replacing the clutch.</p> <ol style="list-style-type: none"> 23. SLIDE 23 EXPLAIN Figure 126-20a release (throwout) bearing on a transmission that uses a clutch fork and a mechanical or cable-operated linkage. 24. SLIDE 24 EXPLAIN Figure 126-20b style of release bearing that includes the slave cylinder, sometimes called a concentric slave cylinder 25. SLIDE 25 EXPLAIN Figure 126-20c combination release bearing and slave cylinder showing the two hydraulic lines

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   	<p><u>SAFETY</u> Disconnect Battery Before Work Begins It is always a safe idea to disconnect the negative (–) battery cable before performing major work to the vehicle as a safety precaution.</p> <p>DISCUSS CASE STUDY: <i>Best to Double-Check Your Parts Before Installation.</i> A beginning technician installed a new clutch in a Chevrolet pickup truck. After the transmission was installed and driveshaft connected, technician started engine to check operation of clutch with the truck still on lift and off ground. The drive wheels never turned even though clutch was released. It was almost as if clutch disc was left out completely although the clutch pedal felt normal. The transmission was removed and the clutch parts inspected. Everything looked okay until technician slid clutch disc over the splines of transmission input shaft. The diameter of hole in clutch disc was a lot larger than diameter of shaft. The clutch also simply revolved without even touching input shaft. Obviously, technician received wrong clutch disc from parts department. The experienced technician explained that not only should all parts be carefully inspected before installation but that clutch disc should have been slid over splines of input shaft to check for any possible burrs that could prevent clutch disc from disengaging.</p> <p>Summary:</p> <ul style="list-style-type: none">• Complaint—Clutch did not work after installation.• Cause—incorrect clutch disc with a too large spline opening was installed.

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	<ul style="list-style-type: none"> • Correction—correct size clutch disc was installed. <p>DISCUSSION: Have the students discuss the operation of the clutch-fork pivot. How can wear on this pivot affect the operation of the clutch?</p>
	<p>26. SLIDE 26 EXPLAIN Figure 126-21 Using an abrasive disc to remove the glaze and to restore the proper surface finish to a flywheel</p> <p>27. SLIDE 27 EXPLAIN Figure 126-22 typical clutch kit, which includes the clutch disc, pressure plate, and release (throwout) bearing as well as grease for the spline and a clutch disc alignment tool</p>
	<p>DISCUSSION: Ask the students to discuss the effect of bad release bearing. What would the driver notice about the operation of the clutch?</p>
	<p>DEMONSTRATION: Show the students an example of a release bearing. Show how one part is stationary with the vehicle and the other part must spin at engine speed.</p>
	<p>DISCUSSION: Have the students discuss the importance of proper alignment and lubrication of release bearing.</p>
	<p>HANDS-ON TASK: Have students push in and release clutch on a vehicle and feel for the transmitted clutch feel in a lever system.</p>
	<p>Even a good clutch system makes noticeable noise changes during release and engagement.</p>
	<p>There is more transmitted feel in a lever system than in a hydraulic or cable system.</p>
	<p>DEMONSTRATION: Show how an improperly adjusted clutch linkage will cause the clutch to slip or not disengage.</p>

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	<p><u>DEMONSTRATION:</u> Show the students how sound in the clutch area changes when the clutch is released and engaged.</p>
	<p><u>EXPLAIN TECH TIP:</u></p>
	<p>28. SLIDE 28 <u>EXPLAIN</u> Figure 126-23 A clutch alignment tool is inserted into the pilot bearing and over the splines of the clutch disc to keep the disc properly centered before installing the pressure plate.</p>
	<p><u>DEMONSTRATION:</u> Show a worn clutch plate & have them determine possible causes of failure.</p>
	<p><u>ON-VEHICLE ASE EDUCATION TASK B1:</u> Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine needed action.</p>
	<p><u>HOMEWORK:</u> SEARCH INTERNET explain the difference between a medium or heavy duty truck push and pull type of clutch and internal and external adjustments</p>
	<p>29. SLIDE 29 <u>EXPLAIN</u> Figure 126-24 To check that the clutch is properly installed before replacing all of the components, try to turn output shaft with transmission in gear and clutch pedal depressed by an assistant</p>
	<p><u>DEMONSTRATION:</u> Show the students how to mark a drive shaft's relationship to the pinion flange before removing the shaft.</p>
	<p><u>DISCUSSION:</u> Ask the students to discuss what it means to keep the drive shaft in phase when you remove it.</p>
	<p><u>DISCUSSION:</u> Ask the students to discuss what it means to keep the drive shaft in phase when you remove it.</p>
	<p><u>You can use an old transmission input shaft as an alignment tool if a shaft of right type is available.</u></p>

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	<p>Check the pilot bushing or bearing for clearance with the input shaft of transmission before & after installing the bushing. The inside diameter of a bushing can change slightly after installation. Inadequate clearance may result in damage to the bushing or inability to install the shaft into the bushing.</p>
	<p>BRAKE cleaner used for brakes works very well to clean clutch components.</p>
	<p><u>SAFETY</u> Before removing clutch assemblies from the flywheel, wash the entire unit on the vehicle to remove any dust that may be present. It is best to use a wet captured system equivalent to what is used on brakes</p>
	<p><u>DEMONSTRATION:</u> Show the students how to properly support back of the engine before removing the rear transmission support.</p>
	<p>To keep transmission level during removal, it is best to use two people: one to move the transmission back and one to keep it level.</p>
	<p><u>DEMONSTRATION:</u> Show the proper way to lubricate the bushing, release bearing, output shaft splines, and release bearing support.</p>
	<p>30. SLIDE 30 <u>EXPLAIN</u> Figure 126-25 A typical cable-operated clutch adjustment location.</p>
	<p><u>DEMONSTRATION:</u> Show how to properly check clutch-pedal free travel. Use a dial indicator to measure for proper free travel.</p>
	<p><u>DEMONSTRATION:</u> Show how to make the proper adjustment on the clutch linkage for several types of systems.</p>
	<p><u>DEMONSTRATION:</u> Show several clutch master cylinders. & several slave cylinders.</p>

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 	<p><u>ON-VEHICLE NATEF TASK B2:</u> Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform needed action.</p>
	<p><u>SEARCH INTERNET:</u> Have the students search www.youtube.com for a video on clutch replacement and have them report out at the next class on what was different in that procedure from what they learned in class.</p>
	<p><u>HANDS-ON TASK:</u> Have the students go through OEM recommendations for adjusting the clutch. Have them follow OEM SPECS for pedal's free play.</p>
	<p>31. SLIDE 31 <u>EXPLAIN</u> Figure 126-26 Gravity bleeding a hydraulic clutch.</p>
 	<p>32. SLIDES 32-49 <u>EXPLAIN CLUTCH REPLACEMENT</u></p>
 	<p><u>ON-VEHICLE ASEEDUCATION TASK B3:</u> Inspect and/or replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing, linkage, and pilot bearing/bushing (as applicable).</p>
 	<p><u>ON-VEHICLE ASEEDUCATION TASK B4:</u> Bleed clutch hydraulic system.</p>
 	<p><u>ON-VEHICLE ASEEDUCATION TASK B5:</u> Check and adjust clutch master cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification.</p>
 	<p><u>ON-VEHICLE ASEEDUCATION TASK B6:</u> Inspect flywheel and ring gear for wear, cracks, and discoloration; determine needed action.</p>

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 	<p><u>ON-VEHICLE ASE EDUCATION TASK B7:</u> Measure flywheel runout and crankshaft end play; determine needed action.</p>
 	<p><u>ON-VEHICLE ASE EDUCATION TASK B8:</u> Describe the operation and service of a system that uses a dual mass flywheel.</p>
	<p><u>OPTIONAL HOMEWORK:</u> Have the students use the Internet to research early farm machinery and why a flywheel was such an important part of these engines. Early machinery examples could be steam engines, hit and miss engines, thrashers, and diesel engines. Ask students to create presentations on their findings for the class.</p>