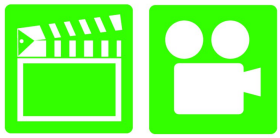
Manual Drive Train and Axles 1st Edition

Chapter 15 Four-Wheel and All-Wheel Drive

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Manual Drive Trains and Axles.** It correlates material to task lists specified by ASE and NATEF.
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 the chapter learning objectives to the students. 1. Prepare for the ASE Manual Drive Train and Axles (A3) certification test content area "F" (Four-Wheel-Drive/All-Wheel-Drive Component Diagnosis and Service). 2. Explain the characteristics of four-wheel-drive (4WD) vehicles. 3. Differentiate between part-time and full-time four-wheel-drive vehicles. 4. Explain the purpose and function of the central differential and transfer case in a four-wheel drive vehicle. 5. Explain the purpose and function of electronic transfer cases and the power transfer unit of a four-wheel-drive vehicle. 6. Explain the purpose and function of couplers and torque bias devices. 7. Discuss the operation of front drive axles and drive axle/wheel disconnect systems.
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.

ICONS	Ch15 Four-Wheel and All-Wheel Drive
	**1. SLIDE 1 4WD & AWD** 2. SLIDES 2-4 EXPLAIN OBJECTIVES
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED**
	**DEMONSTRATION: SHOW FWD VEHICLE ON THE HOIST. POINT OUT THE TWO DIFFERENTIALS AND THE TRANSFER CASE**
	**DEMONSTRATION: SHOW FWD SELECTOR IN A VEHICLE AND PROCEDURE IN ITS OWNER'S MANUAL FOR CHANGING FROM FWD TO TWO-WHEEL-DRIVE.**
	5. SLIDES 5-6 EXPLAIN Characteristics of 4WD Vehicles
	7. SLIDE 7 EXPLAIN Figure 15–3 Four-wheel-drive vehicles can be achieved by using an existing rear-wheel-drive arrangement and adding a transfer case, or a front-wheel-drive arrangement with the addition of rear axle output shaft and center differential assembly. 8. SLIDE 8 EXPLAIN Figure 15–5 A typical electronic transfer case control that is used to shift between two-wheel drive and four-wheel drive (mode shift) or from four-wheel high to four-wheel low (range shift)
	9. SLIDES 9-10 EXPLAIN **Part-time & Full-time** 4WD Vehicles
	**DISCUSSION: DISCUSS DIFFERENCES BETWEEN PART-TIME & FULL-TIME FOUR-WHEEL-DRIVE**
	**HANDS-ON-TASK: HAVE THE STUDENTS' RESEARCH AUTOMOTIVE CAREERS THAT REQUIRE THE ABILITY TO REPAIR AND TROUBLESHOOT FWD VEHICLES. HAVE THEM DISCUSS IN CLASS CAREER OPPORTUNITIES, THEIR ADVANTAGES & DISADVANTAGES, & COMPENSATION LEVELS.**

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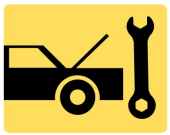
	11. **SLIDE 11 EXPLAIN Figure 15–6** Cutaway of a manually operated locking hub. 12. **SLIDE 11 EXPLAIN Figure 15–7** Manual locking hubs require that the hubs be rotated to the locked position by hand to allow torque to be applied to the front wheels. Automatic locking hubs enable the driver to shift into four-wheel drive from inside the vehicle
	**DEMONSTRATION: SHOW EXAMPLE OF A LOCKING HUB ASSEMBLY. DEMONSTRATE THE INNER WORKINGS OF THE HUB**
	**DISCUSSION: DISCUSS PATH TORQUE FOLLOWS THROUGH CENTER OF HUB, THROUGH LOCKING DEVICE, & OUT TO WHEEL.**
	**HANDS-ON-TASK: HAVE STUDENTS INSPECT A LOCKING HUB ASSEMBLY. HAVE THEM DETERMINE WHICH PARTS ARE THE LOCKING SYSTEM AND WHICH ARE THE DRIVE COMPONENTS.**
	13. **SLIDE 13 EXPLAIN Figure 15–8** typical **planetary** gear set used in a transfer case.
	**DISCUSSION: DISCUSS HOW GEAR REDUCTION IS ACHIEVED WITH A PLANETARY GEAR SET**
	14. **SLIDE 14 EXPLAIN** Central Differentials and **Transfer Case** in 4WD Vehicles 15. **SLIDE 15 EXPLAIN Figure 15–4** A typical transfer case is attached to the output of the transmission and directs engine torque to the rear or to the front and rear differentials.
	**4WD Drivetrain, FWD Based** **4WD Drivetrain, RWD Based** **Active 4WD** **Active 4WD Transfer Case** **FWD Driveshaft Operation** **FWD Drivetrain**
	

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	16. **SLIDE 16 EXPLAIN Electronic Transfer Cases** and Power Transfer Unit of 4WD Vehicles 17. **SLIDE 17 EXPLAIN Figure 15–20** Four-wheel-drive/low-range torque flow in a NV231 transfer case. The mode synchronizer assembly remains engaged and the range clutch is moved to the rear- ward position. The annulus (ring) gear is fixed to the case and the input (sun) gear drives the pinion gears, which walk around the stationary annulus gear and drive the planetary carrier and output shaft at a speed lower than the input gear.
	18. **SLIDE 18 EXPLAIN** Couplers & Torque Bias Devices
	19. **SLIDES 19-20 EXPLAIN** Operation of Front Drive Axles and Drive Axles/Wheel Disconnect Systems
	**DISCUSSION: DISCUSS WHY SOME VEHICLES HAVE FWD. DISCUSS WHEN FWD WOULD BE NEEDED**
	**DEMONSTRATION: SHOW VISCOUS COUPLING. DEMONSTRATE HOW THE COUPLING LOCKS UP AS SPEED INCREASES.**
	**DISCUSSION: DISCUSS OPERATION OF A VISCOUS COUPLING**
	**AWD Differentials**
	**AN EXAMPLE OF A DILATANT FLUID SIMILAR TO THAT USED IN A VISCOUS COUPLER IS SILLY PUTTY. UNDER LOW SHEAR FORCE, SUCH AS PULLING IT APART SLOWLY, SILLY PUTTY IS SOMEWHAT FLUID. PULLING IT APART FAST (HIGH SHEAR FORCE) CAUSES IT TO BECOME STRUCTURALLY LESS FLUID, AND IT SNAPS APART. THIS IS ALSO WHY SILLY PUTTY BOUNCES.**

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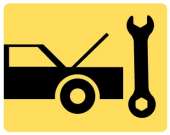
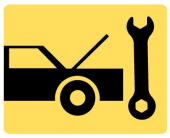
	ANOTHER VISCOUS COUPLER FOUND ON REAR-WHEEL-DRIVE CARS IS THE CLUTCH THAT HOLDS THE FAN TO THE FRONT OF THE ENGINE. AS ENGINE HEATS UP, THE FLUID BECOMES STIFFER, CAUSING FAN TO ENGAGE.
	**DEMONSTRATION:** SHOW TRANSFER CASE **SHIFTING OPTIONS**, INCLUDING MANUAL FLOOR, VACUUM-OPERATED, AND ELECTRIC
	**DISCUSSION:** DISCUSS OPERATION AND SERVICE CONCERNS RELATED TO EACH OF THE THREE ENGAGEMENT OPTIONS: **MANUAL FLOOR, VACUUM-OPERATED, AND ELECTRIC**
	**DISCUSSION:** DISCUSS THE DIFFERENCE BETWEEN MODE SHIFT AND RANGE SHIFT
	**DISCUSSION:** DISCUSS WHEN FOUR-WHEEL LOW RANGE WOULD BE APPROPRIATE
	**HANDS-ON-TASK:** HAVE THE STUDENTS ROTATE INPUT SHAFT AND OBSERVE THE TORQUE FLOW AND THEN SHIFT INTO ALL WHEEL AND SEE HOW TORQUE FLOW CHANGES TO BOTH SHAFTS
	**HANDS-ON-TASK:** HAVE THE STUDENTS USE AN INTERAXLE DIFFERENTIAL AND DETERMINE THE GEAR RATIO OF THE FRONT AND REAR AXLES IN ALL-WHEEL DRIVE. HAVE THEM DETERMINE THE GEAR RATIO OF FRONT AXLE WHEN THE DIFFERENTIAL IS IN REAR-WHEEL DRIVE
	21. SLIDES 21-22 EXPLAIN Summary