Automotive Technology 6th Edition
Chapter 115 TIRE & WHEEL SERVICE
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: 1. State the importance of proper tire inflation. 2. Describe tire inspection. 3. Describe the correct lug nut removal, tightening procedure, and torque for wheel installation. 4. State the purpose of tire rotation. 5. Discuss radial runout and lateral runout. 6. List the steps for replacing a tire. 7. Discuss how to balance wheel and tire assembly (static 8. and dynamic). 9. Discuss how to repair tires using internal patch. 10. This chapter will help prepare for ASE Suspension and Steering (A4) certification content area "E" (Wheel and Tire Diagnosis and Repair).
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.

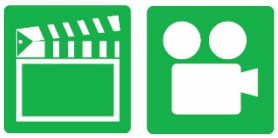
Automotive Technology 6th Edition

NOTE: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 115 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html

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

ICONS	Chapter 115 Tire & Wheel Service
	**1. SLIDE 1 CH115 TIRE AND WHEEL SERVICE**
	**2. SLIDE 2 EXPLAIN Figure 115-1** Using soapy water from a spray bottle is an easy method to find the location of an air leak from a tire.
	Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/
	**WEB SITE IS CONSTANTLY UPDATED**
	http://www.jameshalderman.com/automotive_principles.html
	DOWNLOAD
	Crossword Puzzle (Microsoft Word) (PDF)
	Word Search Puzzle (Microsoft Word) (PDF
	**Videos**
	**3. SLIDE 3 EXPLAIN Figure 115-2** chart shows the relationship between tire inflation pressure and load capacity of the tire.
	4. SLIDE 4 EXPLAIN Figure 115-3 chart shows that a drop in inflation pressure has a major effect on fuel economy.
	5. SLIDE 5 EXPLAIN Figure 115-4 Notice that if a tire is underinflated by10 PSI, life expectancy is reduced by 40%
	**DISCUSS FREQUENTLY ASKED QUESTION:**
	**DEMONSTRATION: Show the students how to use a spray bottle containing soapy water to check for the location of an air leak in a tire.**
	**DISCUSSION: Ask the students to discuss reasons for not overinflating tires.**
	**ON-VEHICLE ASEEDUCATION TASK F8: Inspect tire and wheel assembly for air loss; perform needed action.**
Education Foundation	

ICONS	Chapter 115 Tire & Wheel Service
	**DEMONSTRATION:** Show students an example of a temporary inflation pump and show how it is used. **FIGURE 115-5**
	**DEMONSTRATION:** Show students an aerosol can of sealer that is provided as standard equipment on vehicles not equipped with conventional spare tires. **FIGURE 115-6**
	7. **SLIDE 7 EXPLAIN FIGURE 115–6** Many vehicle manufacturers include aerosol can of sealer on vehicles that are not equipped with a conventional spare tire 8. **SLIDE 8 EXPLAIN Figure 115-7** Most shops that use nitrogen inflation install a green tire value cap to let others know that nitrogen, rather than air has been used to inflate the tire.
	**DISCUSSION:** discuss whether inflating tires with nitrogen is really necessary.
	9. **SLIDE 9 EXPLAIN FIGURE 115–8** Excessively worn tire showing the belt material on the inside edge. This tire requires replacement.
	10. **SLIDE 10 EXPLAIN FIGURE 115–9** bulge in a tire as a result of either an injury to sidewall, such as contact with a curb, or an internal fault in tire. This tire requires replacement.
	11. **SLIDE 11 EXPLAIN FIGURE 115–10** Wear on outside shoulder only is an indication of an alignment problem..
	12. **SLIDE 12 EXPLAIN FIGURE 115–11** display at a Lexus dealer used to show customers a visual representation of what a tire looks like at various tread depth amounts. This display helps vehicle owners understand tire tread depth measurements.
	**EXPLAIN TECH TIP:** ***Stop and Inform the Customer*** **If a lug nut is hard to turn when removing a wheel, stop. Inform customer before proceeding because There may be an issue with damaged or corroded wheel studs. If a wheel stud breaks, technician is often blamed and the shop may be responsible for the repair. By informing customer, this issue is**

fully documented and the customer will have a say whether or not to proceed with wheel service.

DEMONSTRATION: Show the students how to properly tighten lug nuts by using a star pattern.
FIGURE 115-12

DISCUSSION: Ask the students to discuss possible results of tightening lug nuts in the wrong sequence. FIGURE 115-12

13. **SLIDE 13 EXPLAIN FIGURE 115–12** Always tighten wheel lug nuts (or studs) in a star pattern to ensure even pressure on the axle flange, brake rotors or drums, and the wheel itself.
14. **SLIDE 14 EXPLAIN FIGURE 115–13** Most manufacturers recommend using hand tools rather than an air impact wrench to remove and install lock type lug nuts to prevent damage. If either the key or the nut is damaged, the nut may be very difficult to remove.

DEMONSTRATION: Show the students examples of lug nuts and anti-theft lug nuts.
FIGURE 115-13

DISCUSSION: discuss how a rim leak on a new set of tires could affect a shop's reputation.

15. **SLIDE 15 EXPLAIN FIGURE 115–14** A torque wrench being used to tighten lug nuts on a pickup truck..

Remove and Replace Tire & Wheel (View) (Download)
Tire Rotation (View) (Download)
Tire Rotation, FWD Vehicle (View) (Download)

16. **SLIDE 16 EXPLAIN FIGURE 115–15** torque-limiting adapter (torque stick) used with an air impact wrench still requires care to prevent overtightening. The air pressure to the air impact should be limited to 125 PSI (860 kPa) in most cases, and proper adapter must be selected for vehicle being serviced. Torque adapter absorbs any torque beyond its designed rating. Most vehicle manufacturers recommend that final tightening be performed using a torque wrench..

ICONS	Chapter 115 Tire & Wheel Service
	**DEMONSTRATION:** Show the students some examples of color-coded torque-limiting adapters. **FIGURE 115-15**
	**EXPLAIN TECH TIP:** ***All-Wheel-Drive Tire Concerns*** It is very important that all-wheel-drive vehicles be equipped with tires that are all the same outside diameter. If, for example, vehicle has 20,000 miles and tires are half worn, all of tires should be replaced in event of a problem requiring replacement of only one tire. Most vehicle manufacturers specify that all tires must be within 2/32 inch of tread depth without causing a constant strain on drivetrain.
	**DISCUSS CASE STUDY:** ***I Thought the Lug Nuts Were Tight!*** Proper wheel nut torque is critical, as one technician discovered when a customer returned complaining of a lot of noise from right rear wheel. The lug (wheel) nuts had loosened and ruined wheel. • **SEE FIGURE 115–16.**
	CAUTION: Most vehicle manufacturers also specify that the wheel studs/nuts should not be lubricated with oil or grease. The use of a lubricant on the threads could cause the lug nuts to loosen.
	Summary • **Complaint—Customer complained of a lot of noise from the rear of the vehicle after a routine tire rotation.** • **Cause—service technician got distracted when installing the wheels during a tire rotation and forgot to properly torque the lug nuts.** • **Correction—new wheel was used and tire mounted and balanced and properly installed. Technician learned to always keep focused on job being performed.**

ICONS	Chapter 115 Tire & Wheel Service
            	**17. SLIDE 17 EXPLAIN. FIGURE 115–16** This wheel was damaged because the lug nuts were not properly torqued. **SAFETY NOTE: Using torque-limiting adapters to remove lug nuts can cause adapters to fail, causing injury** Replace Wheel Stud (View) (Download) Tighten Lug Nuts (View) (Download) **ON-VEHICLE ASEEDUCATION TASK F2: Diagnose wheel/tire vibration, shimmy, and noise; determine needed action.** **18. SLIDE 18 EXPLAIN FIGURE 111-17** method most often recommended is modified X method. Using this method, each tire eventually is used at each of four wheel locations. An easy way to remember the sequence, whether front wheel drive or rear wheel drive, is to say to yourself, "Drive wheels straight, cross non-drive wheels." **DISCUSSION: Ask students to discuss why modified-X method of rotating tires is recommended method. Ask students to discuss why some OEMS do not recommend rotating tires.** **ON-VEHICLE ASEEDUCATION TASK F3: Rotate tires according to manufacturer's recommendation including vehicles equipped with tire pressure monitoring systems (TPMS)** **SEARCH INTERNET: search Internet to research temporary mobility kits. Ask the students to prepare a short report on what they are, their advantages/disadvantages, and list of automobiles that have them as standard equipment.** **19. SLIDE 19 EXPLAIN FIGURE 115–18** A tire runout gauge being used to measure radial runout of a tire.

ICONS	Chapter 115 Tire & Wheel Service
	20. **SLIDE 20 EXPLAIN FIGURE 115–19** To check wheel radial runout, the dial indicator plunger tip rides on a horizontal surface of wheel, such as bead seat. 21. **SLIDE 21 EXPLAIN FIGURE 115–20** To check lateral runout, the dial indicator plunger tip rides on a vertical surface of the wheel, such as wheel flange..
DEMO	**DEMONSTRATION: Show the students how to use a runout gauge to check lateral & RADIAL runout. FIGURE 115-19**
DEMO	**DEMONSTRATION: Show how to measure LATERAL wheel runout FIGURE 115-20**
	22. **SLIDE 22 EXPLAIN FIGURE 115–21** most accurate method of measuring wheel runout is to dismantle tire and take dial indicator readings on inside of wheel rim.. 23. **SLIDE 23 EXPLAIN FIGURE 115–22** Cleaning bead seat of an alloy wheel using an abrasive pad.
DEMO	**DEMONSTRATION: Show the students how to correctly use an air powered wire brush to clean the bead area of a wheel. FIGURE 115-22**
	**HANDS-ON TASK: Have students use tire runout gauges to measure radial runout of 2 different tires.**
	**ON-VEHICLE ASEEDUCATION TASK F4: Measure wheel, tire, axle flange, and hub runout; determine needed action.**
Education Foundation	
 QUESTION	**DISCUSSION: Ask the students to discuss symptoms of tires with excessive runout.**
	**EXPLAIN TECH TIP: *Spin the Tires.* When performing a vehicle inspection and vehicle has been hoisted on a frame-type lift, check tires by rotating them by hand. The tires on non-drive wheels should spin freely.** • **FWD-drive vehicles, rear wheels rotate easily.** • **RWD vehicles, front wheels rotate easily.**

ICONS	Chapter 115 Tire & Wheel Service
	• AWD vehicles, all 4 wheels require effort **What to Look For** • When rotating wheels, look at tires from front or rear and check that the tread of tires does not change or look as if tread is moving inward or outward. If the tread is moving, this indicates an internal fault with the tire and it should be replaced. This type of fault can cause a vibration even though tire/wheel assembly has been correctly balanced. • Look from side of the vehicle as the wheel/tire assembly is being rotated. Look carefully at tread of tire and see if tire is round. If tire is out of round, tread will appear to move up and down as tire is being rotated.
	**EXPLAIN TECH TIP:** ***Think Like a Wheel.*** When mounting directional tires, keep in mind which direction the wheels will be rotating when vehicle is moving forward. • When looking at the right side of vehicle, wheels will be rotating in a clockwise direction. • When looking at left side of vehicle, wheels will be rotating counterclockwise.
	**EXPLAIN TECH TIP:** ***Dispose of Old Tires Properly*** Old tires cannot be thrown out in the trash but instead must be disposed of properly. Tires cannot be buried because they tend to come to surface. They also trap and hold water, which can be a breeding ground for mosquitoes. Used tires should be sent to a local or regional recycling center where the tires will be ground up and used in asphalt paving or other industrial uses. Because there is often a charge to dispose of old tires, it is best to warn customer of disposal fee.
	**DEMONSTRATION: Show how to install a tire-pressure monitoring system (TPMS) sensor.**

ICONS	Chapter 115 Tire & Wheel Service
	**24. SLIDE 24 EXPLAIN FIGURE 115–23** When installing a tire-pressure monitoring system sensor, be sure that flat part of the sensor is parallel to the center section of rim.
	**25. SLIDE 25 EXPLAIN FIGURE 115–24** Many new tires have painted dots placed there at the tire manufacturer. Yellow Dot- Indicates the light (static) balance point of the tire Red Dot- Indicates the "radial force variation first harmonic maximum". If a tire has both red and yellow dots, red dot has priority so ignore the yellow dot. Match yellow dot to wheel valve stem if no red dot. Just remember "red rules". If any other color of dot is seen, ignore them as they are used for factory purposes only.
	**26. SLIDE 26 EXPLAIN FIGURE 115–25** Always check the wording on tires and install them correctly to insure that the tire performs as designed.
	**DISCUSSION: discuss whether tires should be balanced based on a mileage schedule or only if they exhibit problems.**
	**DISCUSSION: Ask the students to discuss customer complaints due to tire imbalance.**
	**27. SLIDE 27 EXPLAIN FIGURE 115–26** Note difference in shape of the rim contour of 16 inch and 16 1/2 inch diameter wheels. While it is possible to mount a 16 inch tire on a 16 1/2 inch rim, it cannot be inflated enough to seat against rim flange. If an attempt is made to seat tire bead by overinflating (over 40 PSI), tire bead can break, resulting in an explosive force that could cause serious injury or death.
	28. SLIDE 28 EXPLAIN FIGURE 115-27 Liquid tire stop leak was found in all four tires.
	29. SLIDE 29 EXPLAIN FIGURE 115–28 wheel balancer detects heavy spots on wheel and tire, and indicates where to place weight to offset both static and dynamic imbalance.
	30. SLIDE 30 EXPLAIN FIGURE 115–29 An assortment of wheel weights designed to fit different shaped rims.
	**DISCUSSION: discuss possible effects on a tire if tire's bead seat is not cleaned properly before tire is installed.**

ICONS	Chapter 115 Tire & Wheel Service
	**DISCUSS FREQUENTLY ASKED QUESTION: *Does "MC" Mean "Most Cars"?*** **Maybe. MC is wheel flange shape that is used on most domestic alloy rims. The next most popular shape is "AW," which is used on older GM, Ford, and Chrysler alloy rim and then "FN" which is used on many Acura, Honda, Nissan, and Toyotas since about 1990. To be sure, always use a rim flange gauge to determine exact shape before using clip-on wheel weights. • SEE FIGURE 115–30.**
	**31. SLIDE 1 EXPLAIN FIGURE 115–30** (a) Using a rim gauge can be a little tricky as shape may appear to match several patterns on the rim gauge. **This "AW" shape is not a good match. (b) Using the gauge shape for "MC"** appears to be a perfect match to their rim flange..
	**DISCUSS FREQUENTLY ASKED QUESTION: *How Much Is Too Much Weight?*** **Whenever balancing a tire, it is wise to use as little amount of weight as possible. For most standard-size passenger vehicle tires, most experts recommend that no more than 5.5 oz. of total weight be added to correct an imbalance condition. If more than 5.5 oz. total or more than 3 oz. on either side is needed, remove tire from wheel (rim) and carefully inspect for damage to tire or the wheel. If tire still requires more than 5.5 oz. and wheel is not bent or damaged, replace tire.**
	**DEMONSTRATION: Show examples of wheel weights used for variously shaped rims.**
	**DEMONSTRATION: Show how to use wheel weight pliers. Show how to remove a tire valve by using a tire valve remover.**

ICONS	Chapter 115 Tire & Wheel Service
 	**HANDS-ON TASK:** Have the students remove and install wheel weights by using wheel weight pliers. 32. **SLIDE 32 EXPLAIN FIGURE 115–31** Stick-on weights are used from the factory to balance the alloy wheels of this vehicle. 33. **SLIDE 33 EXPLAIN FIGURE 115–32** Wheel weight pliers are specially designed to remove and install wheel weights. 34. **SLIDE 34 EXPLAIN FIGURE 115–33** tire balancer that can also detect radial and lateral force variation and instruct the operator where to rotate tire to achieve the best ride, or indicate a bent wheel
	**DISCUSSION:** discuss proper number of weights to use on a tire.
	**HANDS-ON TASK:** Have the students perform the **Prebalance Checks**
	**HANDS-ON TASK:** Have the students remove tire valves by using tire valve removers & **balance a set of tires.**
 	**ON-VEHICLE ASEEDUCATION TASK F7:** Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.
	**DISCUSS CASE STUDY: *Vibrating Ford Van*** **A technician was asked to solve a vibration problem on a RWD Ford van. During test-drive, vibration was felt everywhere—dash, steering wheel, front seat, shoulder belts; everything was vibrating! Technician balanced all four tires on a computer balancer. Even though wheel weights were put on all 4 wheels and tires, vibration was even worse than before. Technician rebalanced all wheels time after time, but vibration was still present. The shop**

supervisor then took over job of solving mystery of vibrating van. The supervisor balanced one wheel/tire assembly and then tested it again after installing weights. The balance was way off! The supervisor broke tire down and found about 1 quart (1 liter) of liquid in each tire! No wonder the tires couldn't be balanced! Every time tire stopped, liquid would settle in another location. The customer later admitted to using a tire stop-leak liquid in all four tires. Besides stop leak, another common source of liquid in tires is water that accumulates in storage tank of air Compressors, which often gets pumped into tires when air is being added. All air compressor storage tanks should be drained of water regularly to prevent this from happening.

- **SEE FIGURE 115–34.**

Summary:

- **Complaint—Customer complained of a vibration.**
- **Cause—technician found stop leak liquid in all four tires.**
- **Correction—stop leak was removed from all tires and then they were rebalanced. Vibration issues were corrected.**

CAUTION: Stop leak should never be used in a tire that is equipped with the TPMS sensor because the sensor can be damaged.

35. **SLIDE 35 EXPLAIN FIGURE 115–34** Liquid tire stop leak was found in all four tires. This liquid caused the tires to be out of balance.

.

DISCUSS FREQUENTLY ASKED QUESTION: ***When Are Pin Plates Used When Tire Balancing?*** **Pin plates are often specified to attach a chrome clad wheel to tire balancers**

to insure an accurate balance. The chrome cladding is not removable or replaceable and has cladding tabs that extend into the wheel bore. Traditional high-taper cones will come into contact with cladding tabs rather than properly seat on the hub bore chamfer. Many recent aluminum wheel designs cannot be mounted with traditional cones. Most OEMS recommend using a pin plate clamping method as the only way to properly center and protect clad wheels during the balance process. Most balance manufacturers have clad wheel packages along with standard cone mounting. Some national tire chains use only pin plates when balancing any wheel because they get better results and it eliminates some operator influence when using a cone in the center bore. • SEE FIGURE 115–35.

36. SLIDE 36 EXPLAIN FIGURE 115–35 pin plate adapter that is designed to support wheel/tire assembly on a tire balancer instead of using a centering cone..

DISCUSS FREQUENTLY ASKED QUESTION: ***What Are Hubcentric Wheels?*** Most wheels are designed to fit over and be supported by axle hub. Some wheels use an enlarged center hub section and rely on the wheel studs for support and to keep wheel centered on the axle. Some aftermarket wheels may be designed to fit several different vehicles. As a result, wheel manufacturers use plastic hubcentric adapter rings. • SEE FIGURE 115–36

37. SLIDE 37 EXPLAIN FIGURE 115–36 (a) A hubcentric plastic ring partially removed from an aftermarket wheel. (b) A hubcentric plastic ring left on hub when removing a wheel.
39. SLIDE 39 EXPLAIN FIGURE 115–37 A tire should only be repaired if the hole is within the tire puncture repair area. Do not make a repair that is located in the

shoulder or belt edge part of the tire. If a tire is punctured outside of the area, the tire will require replacement.

EXPLAIN TECH TIP: ***Open-End Wrenches Make It Easier.*** **Tire repair is made easier if two open-end wrenches are used to hold the beads of the tire apart. See step 4 in the tire repair photo sequence**

WARNING: Most experts agree that tire repairs should be done from inside. Many technicians have been injured and a few killed when the tire they were repairing exploded as a steel reamer tool was inserted into tire. The reamer can easily create a spark as it is pushed through the steel wires of a steel-belted tire. This spark can ignite a combustible mixture of gases inside tire caused by using stop leak or inflator cans. Since there is no way a technician can know if a tire has been inflated with a product that uses a combustible gas, always treat a tire as if it could explode.

DEMONSTRATION: Show the students examples of various tire repair products, then show students how to apply a plug patch when repairing a tire.

39. **SLIDE 39 EXPLAIN FIGURE 115–38** A stitching tool being used to force any trapped air out from under the patch.
40. **SLIDE 40 EXPLAIN FIGURE 115–39** A rubber plug being pulled through a hole in tire. The stem is then cut off flush with the surface of the tire tread.

ON-VEHICLE ASEEDUCATION TASK F9: Repair tire following vehicle manufacturer approved procedure

SEARCH INTERNET: Have the students search the Internet for tire manufacturers' recommendations for tire repairs.

ICONS	Chapter 115 Tire & Wheel Service
	41. SLIDES 41-58 OPTIONAL EXPLAIN TIRE MOUNTING
	58. SLIDES 58-69 OPTIONAL EXPLAIN TIRE REPAIR