Automotive Technology 6th Edition
Chapter 113 TIRES & WHEELS
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. Explain the purpose and functions of tires. 2. Identify the parts of a tire and describe how it is constructed. 3. Discuss tire sizes, load index, ratings, specifications, and grading. 4. Discuss tire conicity and vehicle handling. 5. Describe spare tires and run-flat tires. 6. Describe tire selection considerations. 7. Explain the construction and sizing of steel and alloy wheels and attaching hardware. 8. 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.

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

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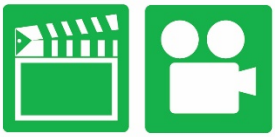
http://www.jameshalderman.com/automotive_principles.html

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

ICONS	Chapter 113 Tires & Wheels
	**1. SLIDE 1 CH113 TIRES & WHEELS**
	**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**
	**2. SLIDE 2 EXPLAIN Figure 113-1 (a)** typical tire tread depth gauge. The center movable plunger is pushed down into the groove of the tire. **(b)** tread depth is read at top edge of sleeve. In this example, tread depth is 6/32 in.
	**DEMONSTRATION: Show typical tread depth gauge. explain how to use it, SEE FIGURE 109-1**
	**DISCUSSION: Discuss other possible symptoms of bad or defective tires. Discuss the importance of tread depth and to discuss why all tire manufacturers don't use the same standard depth.**
	**HANDS-ON TASK: Have the students use a tread depth gauge to measure tread depth. Ask them to read you the gauge and indicate depth of tread.**
	**3. SLIDE 3 EXPLAIN Figure 113-2** Wear indicators (wear bars) are strips of bald tread that show when tread depth is down **to 2/32 in**., legal limit in many states.
	**DEMONSTRATION: Show the students examples of tires with wear bars**
	**DISCUSSION: Discuss whether there is a generally accepted practice regarding repair of tires with sidewall punctures. Discuss why it is necessary to replace a tire if the tire's bead is cut or**

damaged. Discuss which are stronger: bias-ply tires or radial-ply tires.

HANDS-ON TASK: Using a tire crayon, have students circle wear bars on both new & used tires.

4. **SLIDE 4 EXPLAIN Figure 113-3** tire tread runs around the circumference of the tire, and its pattern helps maintain traction. The ribs provide grip, while the grooves direct any water on the road away from the surface. The sipes help the tire grip the road.
5. **SLIDE 5 EXPLAIN Figure 113-4** Hydroplaning can occur at speeds as low as 30 mph (48 km/h). If the water is deep enough and the tire tread cannot evacuate water through its grooves fast enough, the tire can be lifted off the road surface by a layer of water. Hydroplaning occurs at lower speeds as the tire becomes worn.
6. **SLIDE 6 EXPLAIN Figure 113-5** Typical construction of a radial tire. Some tires have only one body ply, and some tires use more than two belt plies.
7. **SLIDE 7 EXPLAIN Figure 113-6** The major splice of a tire can often be seen and felt on the inside of the tire. The person who assembles (builds) the tire usually places a sticker near the major splice as a means of identification for quality control.

DEMONSTRATION: Using both new and used tires, show the students the major Splice.

DISCUSSION: Ask the students to discuss why damage to the inner liner will cause a flat tire.

8. **SLIDE 8 EXPLAIN FIGURE 113–7** Complete stage 1 (body plies, sidewall components, and beads) 2. Building drum expands in preparation to receive belts and tread 3. Application of belt #1. 4. Application of belt #2. 5. Application of the tread 6. Drum retracts to release the completed green (uncured) tire.

DISCUSS FREQUENTLY ASKED QUESTION: ***Why Do I Get Shocked by Static Electricity When I Drive a Certain Vehicle?*** **Static electricity builds up in insulators due to friction**

of tires with road. Newer tires use silica and contain less carbon black in rubber, which makes tires electrically conductive. Because tires cannot conduct static electricity to ground, it builds up inside vehicle and is discharged through body of driver and/or passenger whenever the metal door handle is touched.

NOTE: Toll booth operators report being shocked by many drivers as money is being passed between driver and toll booth operator.

Newer tire sidewall designs that use silica usually incorporate carbon sections that are used to discharge static electricity to ground. To help reduce static charge buildup, spray the upholstery with an antistatic spray available at discount and grocery stores.

9. **SLIDE 9 EXPLAIN Figure 113-8** After the entire tire has been assembled into a completed "green" tire, it is placed into a tire-molding machine where the tire is molded into shape and the rubber is changed chemically by the heat. This nonreversible chemical reaction is called vulcanization

DISCUSS FREQUENTLY ASKED QUESTION:

How Much Does Tire Pressure Change with a Change in Temperature? As temperature of a tire increases, the pressure inside tire also increases. The general amount of pressure gain (when temperatures increase) or loss (when temperatures decrease) is as follows:

10°F increase causes 1 PSI increase

10°F decrease causes 1 PSI decrease

For example, if a tire is correctly inflated to 35 PSI when cold and then driven on a highway, the tire pressure may increase 5 PSI or more.

CAUTION: DO NOT LET AIR OUT OF A HOT TIRE! If air is released from a hot tire to bring the pressure down to specifications, the tire

will be underinflated when tire has cooled. Tire-pressure specification is for a cold tire. Always check the tire pressures on a vehicle that has been driven fewer than 2 miles (3.2 km). Air pressure in tires also affects fuel economy. If all 4 tires are underinflated (low on air pressure), fuel economy is reduced about 0.1 mile per gallon (mpg) for each 1 PSI low. For example, if all four tires were inflated to 25 PSI instead of 35 PSI, not only is tire life affected but fuel economy is reduced by about 1 mile per gallon (10 × 0.1 = 1 mpg).

DISCUSS FREQUENTLY ASKED QUESTION: ***What Effect Does Tire Size Have on Overall Gear Ratio?*** Customers often ask what effect changing tire size has on fuel economy and speedometer readings. If larger (or smaller) tires are installed on a vehicle, many other factors also will change. These include the following:

1. Speedometer reading. If larger-diameter tires are used, the speedometer will read slower than you are actually traveling. This can result in speeding tickets!
2. Odometer reading. Even though larger tires are said to give better fuel economy, just the opposite can be calculated! Since a larger-diameter tire travels farther than a smaller-diameter tire, the larger tire will cause odometer to read a shorter distance than vehicle actually travels. For example, if odometer reads 100 miles traveled on tires that are 10% oversized in circumference, actual distance traveled is 110 miles.
3. Fuel economy. If fuel economy is calculated on miles traveled, the result

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	will be lower fuel economy than for same vehicle with original tires. **DISCUSSION:** discuss problems that would develop by using a space-saving spare tire over an extended period of time. **DISCUSS FREQUENTLY ASKED QUESTION:** ***How Much Bigger Can I Go?*** **See page 1343 of the text** 10. **SLIDE 10 EXPLAIN FIGURE 113–9** (a) Tire size designation includes cross-sectional width and aspect ratio. The aspect ratio is the proportional relationship between width and height of tire expressed as a percentage. (b) Cross-sectional view of a typical tire showing terminology. 11. **SLIDE 11 EXPLAIN FIGURE 113-10** Notice that the overall outside diameter of the tire remains almost the same and at the same time the aspect ratio is decreased and the rim diameter is increased. 12. **SLIDE 12 EXPLAIN FIGURE 113–11** Typical sidewall markings for load index and speed rating following the tire size. 13. **SLIDE 13 EXPLAIN FIGURE 113–12** A typical door placard used on a GM vehicle indicating recommended tire inflation. Note that the information also includes the size and speed rating of tire as well as the recommended wheel size. **DISCUSS CHART 113-1 SPEED RATINGS**
	
	**DEMONSTRATION: Show how to decode several tire sizes using service description.**
	**EXPLAIN TECH TIP:**
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***Is There a Rule of Thumb for Rim Size?*** **See page 1345 of the text**

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	**DISCUSS FREQUENTLY ASKED QUESTION:** ***What Type of Tires Should Be Used and When?*** **See page 1345 of the text** **DISCUSS CASE STUDY:** ***Tire Date Code Information Saved Me Money!*** **This author was looking at a three-year-old vehicle when I noticed that the right rear tire had a build date code newer than vehicle. I asked owner, "How badly was this vehicle hit?" The owner stumbled and stuttered a little, then said, "How did you know that an accident occurred?" I told the owner that right rear tire, while exact same tire as others, had a date code indicating that it was only one year old, whereas original tires were same age as vehicle. The last three numbers of DOT code on sidewall indicate week of manufacture (first two numbers of three-digit date code) followed by last number of year. The owner immediately admitted that vehicle slid on ice and hit a curb, damaging right rear tire and wheel. Both tire and wheel were replaced and alignment checked. The owner then dropped price of vehicle $500! Knowing date code helps assure that fresh tires are purchased and can also help technician determine if tires have been replaced. For example, if new tires are found on a vehicle with 20,000 miles, then technician should check to see if vehicle may have been involved in an accident or may have more miles than indicated on the odometer.** **Summary:** • **Complaint—buyer of a used car noticed that one tire was newer than the others.** • **Cause—owner admitted that vehicle had slid off road and hit a curb causing damage to wheel and tire.**

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	• **Correction—Because perspective buyer knew date code, and mentioned this to seller, purchase price was reduced saving buyer money.**
	**HANDS-ON TASK: Have students decode several tire sizes using service description.**
	**When changing from an older tire measuring system to a newer system, speedometer calibration should be checked.**
	**DEMONSTRATION: show how to decode the Metric tire coding and explain it**
	**HANDS-ON TASK: Have students decode several metric tire sizes.**
	14. **SLIDE 14 EXPLAIN FIGURE 113–13** Typical "Uniform Tire Quality Grading System" (UTQGS) ratings imprinted on the tire sidewall.
	**DISCUSSION: Ask the students whether using tires with suffix LT (Light Truck) page 1245 is acceptable on passenger cars and/or SUVs.**
	**DISCUSSION: Ask the students to discuss the advantages, if any, of using radial tires on an older automobile.**
	**DISCUSSION: Ask the students how changing the section height will affect the ride quality**
	**DISCUSSION: discuss why tires are made with H-speed ratings of 130 mph or 210 km/h despite the fact that driving that fast would not only be unsafe but also illegal in most areas of the world.**
	**DISCUSSION: Ask the students to compare DOT standards & E.C.E. (Economic Commission for European Small "e") standards. Ask students to**

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	discuss whether US should have anti-noise standards similar to E.C.E pass-by noise limits.
	15. **SLIDE 15 EXPLAIN FIGURE 113–14** Typical DOT date code. This tire was built 12th week of 2015. 16. **SLIDE 16 EXPLAIN FIGURE 113–15** Conicity is a fault in the tire that can cause vehicle to pull to one side due to the cone effect (shape) of the tire.
	**DEMONSTRATION: Show the students how to determine proper tire pressure by using the information on door placards.**
	**HANDS-ON TASK: Have students compare tire pressure recommendations of several automobiles by using the information on door placards.**
	**DEMONSTRATION: Using a foam cup, show the students how a cone shape will cause a pull.**
	17. **SLIDE 17 EXPLAIN FIGURE 113-16** Notice the angle of the belt material in this worn tire. The angle of the belt fabric can cause a "ply steer" or slight pulling force toward one side of the vehicle. 18. **SLIDE 18 EXPLAIN Figure 113-17** Slip angle is angle between direction tire tread is heading and direction it is pointed.
	**DISCUSSION: Ask the students to discuss how tread depth and aspect ratio affect tire slip angle**
	**DISCUSSION: Ask the students to discuss whether people living in hot climates should purchase tires with C Temperature resistance rating.**
	**DISCUSSION: Ask the students to discuss whether a tire's tread wear rating number has any relationship to the price of the tire**
	**Aligning a vehicle to correct for a bad tire will cause the pull to return when the tires are rotated.**

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	19. **SLIDE 19 EXPLAIN FIGURE 113-18** Cutaway of a run-flat tire showing the reinforced sidewalls and the required pressure sensor.
	**DISCUSSION: Ask the students to discuss how important DOT date code is when deciding to purchase a tire.**
	**When installing aftermarket wheels using non-stock lug nuts, wire tie a set of stock lug nuts to the spare tire wheel**
	**Many tire manufacturers require only returning the DOT code of the tire for claims on a warranty. This saves shipping cost.**
	**Be sure to include checking spare tire mounting hardware as part of a general service.**
	20. **SLIDE 20 EXPLAIN Figure 113-19** A conventional tire on the left and a run-flat tire on right, showing what happens when there is no air in the tire.
	**DISCUSSION: Ask the students to discuss the advantages and disadvantages of using run-flat tires.**
	**HANDS-ON TASK: Have the students use visual clues to identify run-flat tires on vehicles.**
	21. **SLIDE 21 EXPLAIN Figure 113-201** PAX run-flat tire system is composed of 3 unique components: special asymmetrical wheel, urethane support ring, & special tire.
	22. **SLIDE 22 EXPLAIN Figure 113-21** The Tire Performance Criteria (TPC) specification number is imprinted on the sidewall of all tires used on General Motors vehicles from the factory.
	**DEMONSTRATION: Show the students how to read and interpret the Tire Performance Criteria (TPC) specification number on a tire standard on a General Motors vehicle.**

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	**HANDS-ON TASK:** find TPC numbers on several tires on GM Lab or Personal Vehicle
	**DISCUSSION:** discuss why rolling resistance is a concern on hybrid vehicles.
	EXPLAIN TECH TIP: ***PAX Replacement Tip*** **In most cases, fastest and easiest approach to follow if a PAX tire requires replacement is to purchase a replacement tire/wheel assembly. While more expensive than replacing just tire, this approach is often used to help vehicle owner get back on road faster without any concerns as to whether replacement tire was properly installed.**
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***What Is a Low-Rolling-Resistance Tire?*** **Low-rolling-resistance (LRR) tires reduce rolling resistance, which is power-robbing friction between tire and crown. The E-metric tire, designated for use on electric or hybrid vehicles, operates at higher inflation pressures, reduced load percentages, and lower rolling resistance. These tires were first used on the GM EV1 electric vehicle.**
	**23. SLIDE 23 EXPLAIN Figure 113-22** The size of the wheel is usually cast or stamped into the wheel. This wheel is 7 inches wide. The letter "J" refers to the contour of the bead seat area of the wheel.
	24. SLIDE 24 EXPLAIN Figure 113-23 The wheel rim well provides a space for the tire to fit during mounting; the bead seat provides a tire-to-wheel sealing surface; the flange holds the beads in place.
	**25. SLIDE 25 EXPLAIN Figure 113-24** A cross section of a wheel showing part designations.
	26. SLIDE 26 EXPLAIN Figure 113-25 Offset is distance between centerline of wheel and wheel mounting surface
	**27. SLIDE 27 EXPLAIN Figure 113-26** Back spacing (rear spacing) is the distance from the mounting pad to the edge of the rim. Most custom wheels use this

measurement method to indicate the location of the mounting pad in relation to the rim.

DEMONSTRATION: Show the students examples of several wheels and explain how to determine the size of wheel and the exact shape of flange area.

DISCUSSION: Ask the students to discuss why the flange area shape and the angle that the rim drops down from the flange are important.

HANDS-ON TASK: Have the students use sticky notes or masking tape to label the parts of the rim.

28. **SLIDE 28 EXPLAIN Figure 113-27** Bolt circle is the diameter of a circle that can be drawn through the center of each lug hole or stud. The bolt circle is sometimes referred to as PCD for pitch circle diameter.
29. **SLIDE 29 EXPLAIN FIGURE 113–28** Measuring bolt circle on a five-lug wheel is difficult, but a quick and easy way includes measuring as shown to determine approximate bolt circle of a five-lug wheel.

DEMONSTRATION: Show the students how to use a tape measure to determine approximate bolt circle of a 5-lug wheel

HANDS-ON TASK: Have the students use tape measures to determine the approximate bolt circles of five-lug wheels

Most tire shops have bolt circle templates.
The templates have several bolt circles on them.
This makes it faster to identify a bolt circle.

30. **SLIDE 30 EXPLAIN FIGURE 113–29** Measure center-to-center distance and compare distance to the figures in chart in text to determine diameter for a five-lug bolt circle..

DISCUSS FREQUENTLY ASKED QUESTION:
What Does This Mark in a Wheel Mean?
The symbol JWL, for Japan Wheel Light Metal, means that wheel meets technical standards for passenger-car light-alloy disk wheels. See

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	mark in • FIGURE 113–30. OEM is responsible for conducting inspections set forth in technical standard, and JWL mark is displayed on those products that pass inspection.
	**31. SLIDE 31 EXPLAIN FIGURE 109.30** typical JWL symbol for the Japan Wheel Light Metal standard mark.
	32. SLIDE 32 EXPLAIN Figure 109-31 (a) A rubber snap-in style tire valve assembly. (b) A metal clamp-type tire valve assembly used on most high pressure (over 60 PSI) tire applications such as is found on many trucks, RVs, and trailers. The internal Schrader valve threads into the valve itself and can be replaced individually, but most experts recommend replacing entire valve assembly every time tires are replaced to help prevent air loss.
	**Racers quote a 4:1 ratio gain in removing UNSPRUNG WEIGHT. As an example, removing 25 lb of unsprung weight would have the same effect on handling as removing 100 lb of sprung weight.**
	**33. SLIDE 33 EXPLAIN FIGURE 113–32** Various styles of lug nuts.
	**DISCUSS FREQUENTLY ASKED QUESTION: *What Is a "Knock-Off" Wheel?* A knock-off design wheel is retained to axle hub using one large retaining nut that has three arms that are used to loosen and tighten them. They are mostly found on older European sports cars and race cars. The wheel is removed by using a lead hammer which has weight to loosen nut yet soft enough to not damage aluminum spokes of nut. • SEE FIGURE 113–33.**
	**34. SLIDE 34 EXPLAIN FIGURE 113–33** (a) A typical knock-off-type wheel showing large three prong wing nuts and te threads on wheel hub. (b) A lookalike knock-off wheel that looks like a knock-off but uses lug nuts.
	**DEMONSTRATION: Show the students various types of lug nuts and explain why there are different types.**

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	**DISCUSSION:** Ask the students to discuss why some OEMS use lug nuts and other manufacturers use lug bolts.
	**HANDS-ON TASK:** Have the students inspect tires on an assigned vehicle.
	35. SLIDES 35-43 EXPLAIN OPTIONAL TIRE INSPECTION
	**ON-VEHICLE NATEF TASK:** Research applicable vehicle and service information, such as suspension and steering system operation, vehicle history, service precautions, & TSBs
	**SEARCH INTERNET** Have the students search the Internet to research the process of vulcanization. Ask them to prepare to report on vulcanization and its importance to the automotive industry during the next class.