INTRODUCTION

Tires are mounted on wheels that are bolted to the vehicle to provide:

1. Shock absorber action when driving over rough surfaces
2. Friction (traction) between the wheels and the road

Tread refers to the part of the tire that contacts the ground. Tread depth is usually 11/32 inch deep on new tires. Tread depth is always expressed in 1/32s of an inch, even if the fraction can be reduced to 1/16th or 1/8th.

The 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. Figure 1.

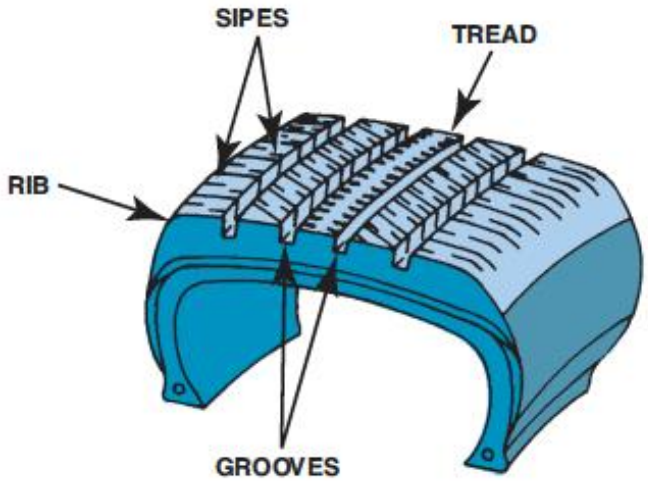

Figure 1. Tire tread.

Wear indicators (wear bars) are strips of bald tread that show when the tread depth is down to 2/32 inch, which is the legal limit in many states. Figure 2.

Figure 2. Tire wear indicators.

The bead is the foundation of the tire and is located where the tire grips the inside of the wheel rim. A tire gets its strength from the layers of material wrapped around both beads under the tread and sidewall rubber. This creates the main framework, or "carcass," of the tire; these body plies are often called carcass plies.

A tire belt is two or more layers of material applied over the body plies and under the tread area only to stabilize the tread and increase tread life and handling. Figure 3.

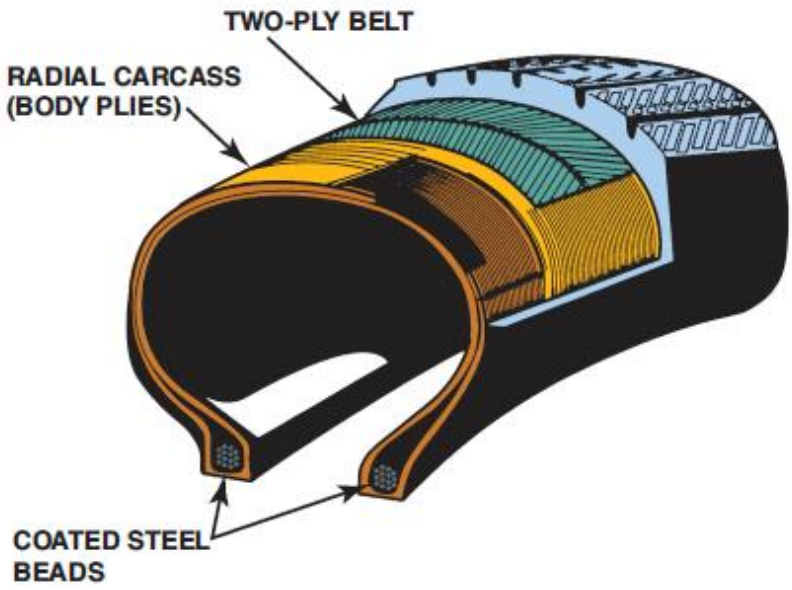

Figure 3. Construction of a typical radial tire.

ASE TEST TOPICS

1. Diagnose tire wear patterns; determine needed action.

All tires should be carefully inspected for faults in the tire itself or for signs that something may be wrong with the steering or suspension systems of the vehicle. Check all tires for the following signs:

- Excessive wear. Figure 4.
- Sidewall faults.
- Underinflation, which shows as wear on both the inside and outside edges of the tread.
- Overinflation, which shows as excessive wear in the center of the tread.
- Wear on the inner or outer part of the tire only which usually indicates alignment problem. Figure 5.

Figure 4. Excessive wear.

Figure 5. Wear on the outside shoulder only is an indication of an alignment problem.

2. Inspect tire condition, size, and application (load and speed ratings).

Tread depth should always be measured when inspecting tires and the results recorded in the work order. A tread depth gauge is used for this purpose. Figure 6.

Figure 6. Tread depth gauge.

Typical tread depth and what they mean are as follows:

- New tires = 9/32-11/32 (7–9 mm)
- 6/32 inch (5 mm) or more—No need to replace the tire
- 4/32 to 5/32 inch (3 to 4 mm) Consider replacement
- 2/32 inch (2 mm) or less Replace (2/32 in. is the legal limit)

Tires built after 1990 use a method of sidewall information that includes size, load, and speed rating together in one easy-to-read format. Figure 7.

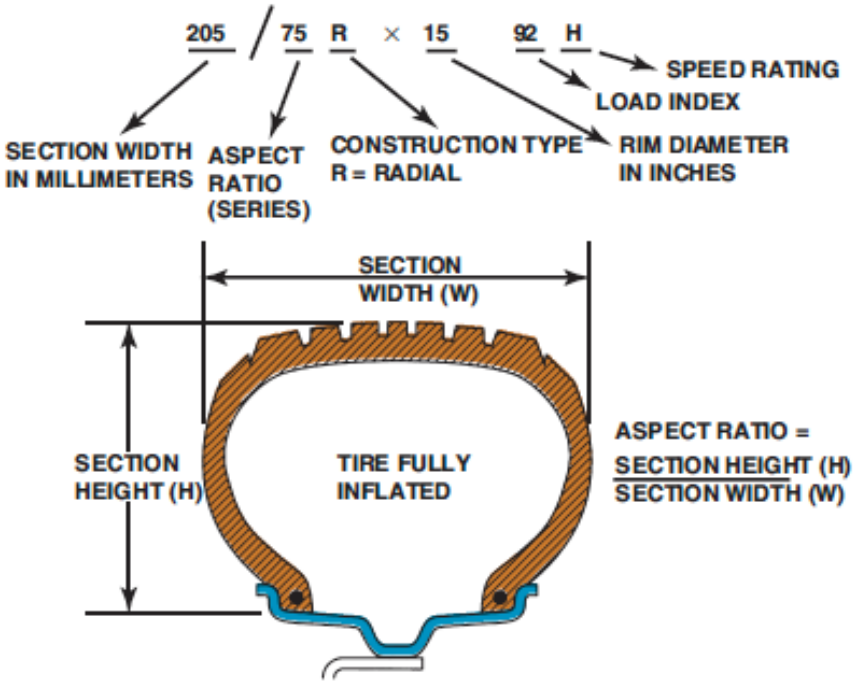

Figure 7. Tire size, load index, and speed rating.

The load index is an abbreviated method to indicate the load-carrying capabilities of a tire. The weights listed in the chart represent the weight that each tire can safely support. Figure 8.

Load Index	Load (kg)	Load (lbs)
87	545	1,201
88	560	1,235
89	580	1,279
90	600	1,323
91	615	1,356
92	630	1,389
93	650	1,433
94	670	1,477

Figure 8. Sample load index chart.

Tires are rated according to the maximum sustained speed. A vehicle should never be driven faster than the speed rating of the tires. Figure 9.

LETTER	MAXIMUM RATED SPEED
L	120 km/h (75 mph)
M	130 km/h (81 mph)
N	140 km/h (87 mph)
P	150 km/h (93 mph)
Q	160 km/h (99 mph)
R	170 km/h (106 mph)
S	180 km/h (112 mph)
T	190 km/h (118 mph)
U	200 km/h (124 mph)
H	210 km/h (130 mph)
V	240 km/h (149 mph)
W	270 km/h (168 mph)
Y	300 km/h (186 mph)
Z	open-ended*

Figure 9. Tire speed ratings.

3. Measure and adjust tire air pressure.

Tires should always be inflated to the pressure indicated on the driver's door or pillar sticker. Tires should be checked when cold, before the vehicle has been driven, because driving on tires increases the temperature and therefore the pressure of the tires. Figure 10.

Figure 10. A typical vehicle safety certification label which shows the gross vehicle weight, gross axles weight rating, as well as the size and inflation pressure of the tires.

4. Diagnose wheel/tire vibration, shimmy, and noise concerns; determine needed action.

Even though a tire has no visible faults, it can be the cause of vibration. If vibration is felt above 45 mph, regardless of the engine load, the cause is usually due to an out-of-balance or a defective out-of-round tire. Both of these problems cause a tramp, which is an up-and-down-type vibration.

A possible problem that tires can cause is a type of vibration called shimmy, which is the rapid back-and-forth motion transmitted through the steering linkage to the steering wheel. Shimmy can also be caused by an internal defect of the tire or a bent wheel.

5. Rotate tires/wheels and torque fasteners according to manufacturers' recommendations.

Tire rotation is essential to ensure long life and even tire wear. For best results, tires should be rotated every 6,000 miles or every six months. Tire location must be re-learned by the tire pressure monitoring system after rotation. Figure 11.

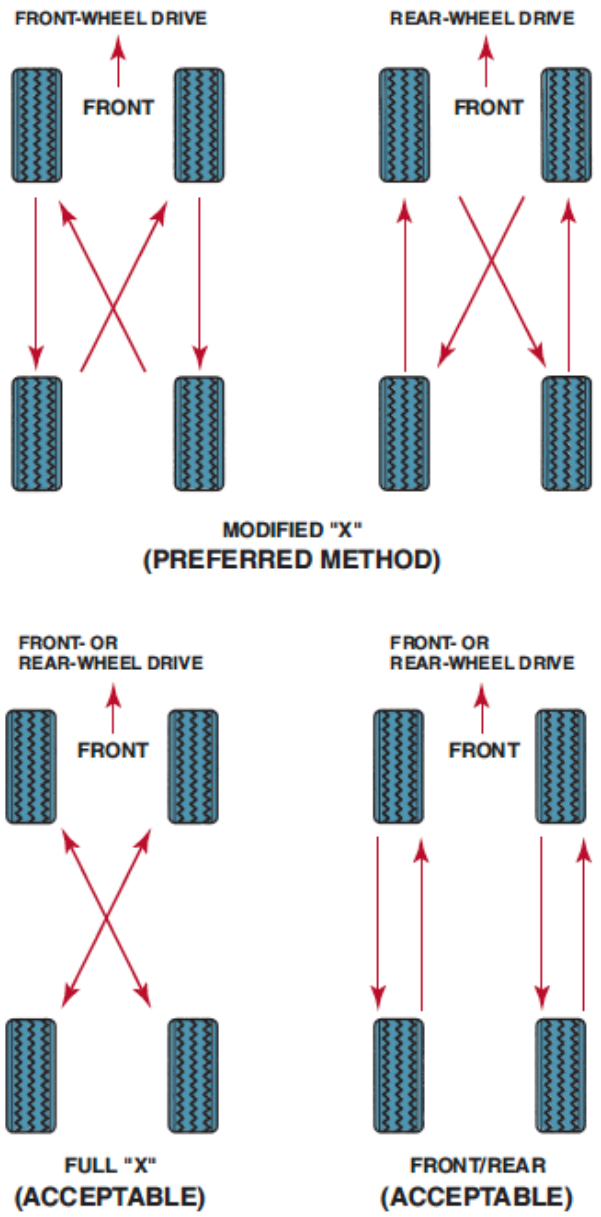

Figure 11. Tire rotation chart.

For wheel mounting torque, make certain that the wheel studs are clean and dry, and torqued to the manufacturer's specifications. The lug nuts should be tightened gradually in the proper sequence—star pattern (tighten one nut, skip one, and tighten the next nut). Figure 12.

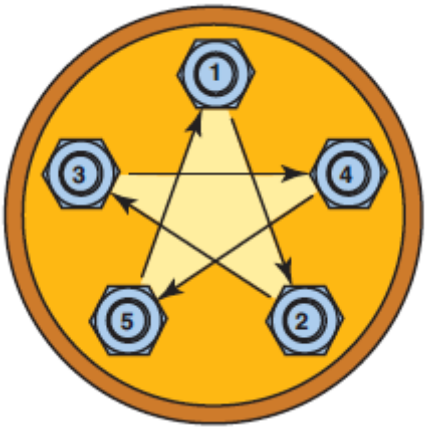

Figure 12. Lugnut torque sequence example.

6. Diagnose problems with radial and lateral runout of wheel assembly; measure wheel, tire, axle flange, and hub runout (radial and lateral); determine needed action.

Radial runout (out of round) can be checked by using a runout gauge.

- Raise the vehicle so that the tires are off the ground approximately 2 inches (5 cm).
- Place the runout gauge against the tread of the tire in the center of the tread and, while rotating the tire, observe the gauge reading. Figure 13.

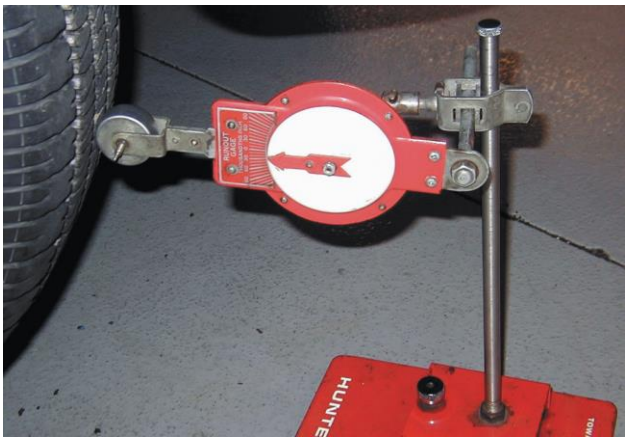

Figure 13. Checking radial runout.

- Maximum radial runout should be less than 0.060 inch (1.5 mm). Little, if any, tramp will be noticed with less than 0.030 inch (0.8 mm) runout. If the reading is over 0.125 inch (3.2 mm) replacement of the tire may be required. Check the wheel first.
- To check radial runout of the wheel position a gauge on the inner part of the wheel. Figure 14.

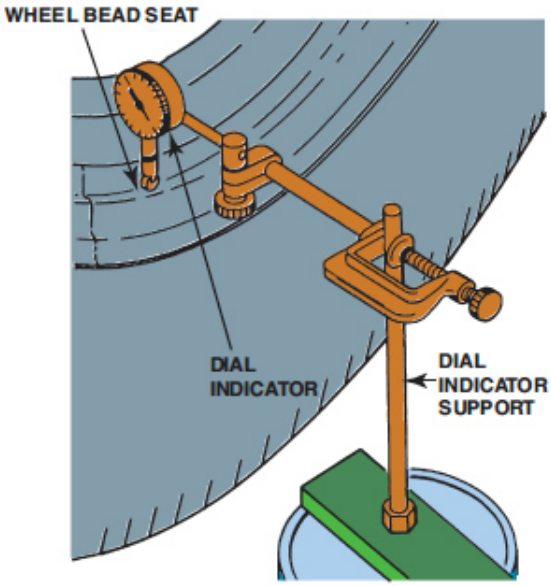

Figure 14. Checking wheel radial runout.

Tire lateral runout can be checked by using a runout gauge on the side of the tire or wheel.

- Place the runout gauge against the side of the tire and rotate the wheel.
- Observe the readings. If more than 0.125 inch (3.2 mm), remove the tire and check the rim directly.
- Most manufacturers specify a maximum lateral runout of 0.035 inch (0.9 mm) for alloy wheels and 0.045 inch (1.1 mm) for steel wheels. Figure 15.

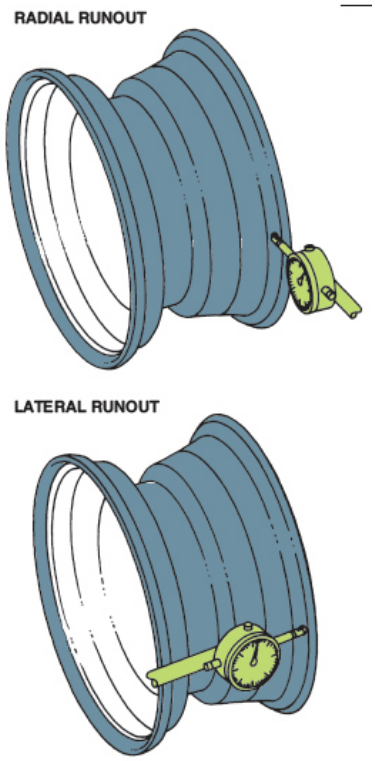

Figure 15. Checking wheel radial and lateral runout.

7. Diagnose tire pull (lead) problems; determine needed action.

Many alignment requests come from customers attempting to have a lead or pull condition corrected. Before aligning the vehicle, verify the customer complaint first, then perform a careful inspection.

- Inspect all tires for proper inflation. Both tires on the same axle (front and rear) should be the same size and brand.
- Before attempting to correct the lead/pull condition by changing alignment angles, try rotating the tires front to back or side to side.

8. Dismount and mount tire on wheel.

Tire removal from a wheel procedure includes the following steps:

STEP 1 Before the tire can be removed from the wheel, the air must be removed by removing the valve core. Removing the valve core allows the air to escape. Figure 16.

STEP 2 After the air has been removed from the tire, the beads are broken from both sides. Use caution when working on a wheel that has TPMS so as to not harm the sensor. Position the valve stem 90 degrees away from the bead breaker shovel to protect the sensor. Figure 17.

STEP 3 Remove the tire from the rim following the tire machine instructions for proper use. Figure 18.

Figure 16. Remove the valve core.

Figure 17. Break the bead.

Figure 18. Remove the tire.

Installing new tires.

STEP 1 Clean the wheel flange (seat bead) of any dirt, scale, corrosion, or loose or flaked rubber buildup prior to mounting the tire to insure of a proper seal.

STEP 2 Install the tire-pressure monitoring system in the specified position.

STEP 3 Check for directional and asymmetric tires.

STEP 4 When mounting new tires, use only special lubricant such as rendered (odorless) animal fat or rubber lubricant. Figure 19.

STEP 5 Inflate the tire but never use more than 40 PSI (275 kPa) to seat a tire bead. Figure 20.

Figure 19. Lubricate the new tire beads.

Figure 20. Seat the beads.

9. Balance wheel and tire assembly.

Tire balancing is needed because of the lack of uniform weight and stiffness (due to splices) and a combination of wheel runout and tire runout. Computer balancers are designed to balance wheels and tires off the vehicle. Figure 21.

Figure 21. Typical computer balancer.

Clip-on wheel weights must match the flange of the rim to fit properly. Figure 22.

Figure 22. A rim contour gauge is used to select the correct weight type.

10. Test and diagnose indirect/direct tire pressure monitoring systems (TPMS); determine needed action; perform system initialization/relearn as required.

Federal law requires that all vehicles be equipped with a tire-pressure monitoring system that will warn the driver in the event of an underinflated tire. The law requires tire-pressure monitoring systems be

installed in passenger vehicles and light trucks to warn the driver when a tire is 25% below the cold placard pressure.

A tire-pressure monitoring system (TPMS) is a system that detects a tire that has low inflation pressure and warns the driver. There are two systems used:

1. Indirect—Commonly used until the 2008 model year and then from 2010 on, there are some vehicles that use the indirect system. Indirect TPMSs do not measure the actual tire pressure. Instead, the system uses the wheel speed sensors to detect differences in the speed of the wheels.

2. Direct—A direct-reading pressure system that uses a pressure sensor in each tire is the most commonly used system at this time. All direct TPMS sensors transmit tire inflation pressures to a module using a radio frequency (RF) signal. Figure 23.

Figure 23. TPMS sensors.

The wireless TPMS receiver is housed in one of the following locations, depending on the vehicle:

- Remote keyless entry (RKE) receiver
- Body control module (BCM)
- Door module

The FMVSS 138 law specifies that the driver must be warned of a low tire inflation pressure by turning on an amber warning lamp.

- If the TPMS warning lamp is on at start-up, the system has detected a tire with low inflation pressure.
- If the TPMS warning lamp is flashing for 60 to 90 seconds, a system fault has been detected.

If the TPMS light is on, perform the following steps:

STEP 1 Check the door placard for the specified tire inflation pressure.

STEP 2 Check all tires using a known-accurate tire-pressure gauge.

STEP 3 Inflate all tires to the specified pressure.

If the TPMS warning lamp is flashing on and off the system has detected a fault. Faults could include the following issues:

- Defective wheel sensors, such as a sensor with a dead battery.
- A fault in the receiver, such as in the remote keyless entry module.

Service information should always be checked when performing a relearn procedure. Depending on the vehicle the process can use one of these methods:

- Auto relearn—Install sensors, drive the vehicle for a prescribed amount of time and rate of speed.
- Manual relearn—Enter the vehicle into learn mode by following the instructions found in the owner's manual, trigger all four sensors with an activation tool or scan tool. Figure 23.
- OBD relearn—Scan all four sensors with a scan tool, input the electronic serial number (ESN), and download the ESN into the TPMS ECU.

Figure 23. Triggering the sensor with the vehicle in learn mode.