

# Tire Safety for Passenger Vehicles and Light Trucks

Properly maintained tires improve the steering, stopping, traction, and load-carrying capability of vehicles. Underinflated and “bald” tires and overloaded vehicles are a major cause of tire failure. To avoid flat tires and other types of tire failure, vehicle operators should maintain proper tire pressure, observe tire and vehicle load limits, avoid road hazards, and regularly inspect tires. This report reviews the selection and maintenance of tires for passenger vehicles and light trucks.

## Introduction

Studies by the Department of Transportation’s (DOT) National Highway Traffic Safety Administration (NHTSA) conducted in 2001 showed that a significant number of motorists operate vehicles with underinflated and “bald” tires (“bald” tires have tread depth of 1/16 in [1.6 mm] or less). Maintaining proper tire pressure, observing tire and vehicle load limits (not carrying more weight in a vehicle than the tires or vehicle can safely handle), avoiding road hazards, and inspecting tires for cuts, slashes, tread depth, and other irregularities are the most important things to avoid tire failure, such as tread separation, blowout, and flat tires. These actions, along with other care and maintenance activities, can also:

- Improve vehicle handling
- Help avoid breakdowns and accidents
- Improve fuel economy
- Increase the life of tires

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## Tire Pressure and Load Limits

Tire information placards and vehicle certification labels contain information on tires and load limits. Both placards and certification labels are permanently attached to the vehicle door edge, doorpost, glove-box door, or inside of the trunk lid.

These labels provide vehicle manufacturer’s information, including:

- Recommended tire size
- Recommended tire inflation pressure
- Vehicle capacity weight (VCW—the maximum occupant and cargo weight a vehicle is designed to carry)
- Front and rear gross axle weight ratings (GAWR—the maximum weight the axle systems are designed to carry)

The recommended tire pressure and load limit for a vehicle is also included in the vehicle owner’s manual.

Tire inflation pressure is the amount of air pressure, measured in pounds per square inch (psi) or kilopascals (kPa), a tire requires to be properly inflated. The level of air in the tire provides it with load-carrying capacity and affects the overall performance of the vehicle. Manufacturers of passenger vehicles and light trucks determine the tire inflation pressure based on the vehicle's design load limit (i.e., the greatest amount of weight a vehicle can safely carry, and the vehicle's tire size). The proper tire pressure for a vehicle is referred to as the "recommended cold inflation pressure."

Because tires are designed to be used on more than one type of vehicle, tire manufacturers list the "maximum permissible inflation pressure" on the tire sidewall. This number is the greatest amount of air pressure that should ever be put in the tire under normal driving conditions.

## Maintaining Correct Tire Pressure

It is important to check the tire pressure of a vehicle at least once a month for the following reasons:

- Most tires may naturally lose air over time.
- Tires can lose air suddenly if you drive over a pothole or other object, or if you strike a curb when parking.
- With radial tires, it is usually not possible to determine underinflation by visual inspection.

Fully 27 percent of passenger cars on U.S. roadways are driven with one or more substantially underinflated tires, according to a major survey conducted by the NHTSA. In addition, 32 percent of light trucks (including sport utility vehicles, vans, and pickup trucks) are driven with one or more substantially underinflated tires.

The recommended tire inflation pressure provided by vehicle manufacturers reflects the proper pressure when a tire is cold. The term cold does not relate to the outside temperature. Rather, a cold tire is one that has not been driven on for at least three hours. When a vehicle is driven, the tires get warmer, causing the air pressure within them to increase. Therefore, to get an accurate tire pressure reading, tire pressure must be measured when the tires are cold or the extra pressure in warm tires must be compensated for. To properly check cold tire inflation pressure, wait at least three hours after the vehicle has been driven, and then perform the following steps:

**Step 1:** Locate the recommended tire pressure, on the vehicle's tire information placard, certification label, or in the owner's manual.

**Step 2:** Measure and record the tire pressure of all tires.

**Step 3:** If the tire pressure is too high in any of the tires, slowly release air by gently pressing on the tire valve stem with the edge of the tire gauge, until the correct pressure is obtained.

**Step 4:** If the tire pressure is too low, note the difference between the measured tire pressure and the correct tire pressure. These missing pounds of pressure are what must be added.

**Step 5:** Add the missing pounds of air pressure to each tire that is underinflated.

**Step 6:** Check all the tires to make sure they have the same air pressure (except in cases in which the front and rear tires are supposed to have different amounts of pressure).

While driving a vehicle, if a driver thinks that a tire is underinflated, the driver should fill it to the recommended cold inflation pressure

indicated on the vehicle's tire information placard or certification label as soon as possible. While the tire may still be slightly underinflated... due to the extra pounds of pressure in the warm tire, it is safer to drive with air pressure that is slightly lower than the vehicle manufacturer's recommended cold inflation pressure than to drive with a significantly underinflated tire. Since this is a temporary fix, the pressure of the tire must be corrected when a cold inflation reading can be obtained.

The need for motorists to carry their own tire pressure gage was exemplified in an NHTSA study that showed:

- While well over 90 percent of U.S. gas stations are equipped with air pumps, nearly 10 percent of these pumps are out of order.
- Fewer than half of the pump-equipped gas stations also provide a tire pressure gauge for customer use.
- Nearly 20 percent of the stations providing customers with tire pressure gauges on their air pumps had gauges that overreported the pressure present in a tire by 4 psi (28 kPa) or more. This means that motorists who use such gauges in the belief that they are inflating their tires to the recommended pressure would, in fact, be underinflating them by 4 psi (28 kPa) or more.
- At the pressure levels that are typical for most passenger cars or sport utility vehicles, nearly 10 percent of gas station air pump gauges overreported the pressure by 6 psi (41 kPa) or more.

### **Tire Pressure Monitoring Systems (TPMS)**

Tire pressure monitoring systems (TPMS) continuously monitor the pressure in the tires through sensors located in the tires (direct system) or the use of wheel speed and other vehicle sensors (indirect system). The information collected by the sensors

is transmitted to an on-board processor that interprets the sensor signals and warns the driver when tire pressure is below the minimum acceptable level by illuminating a warning lamp. NHTSA required that all passenger cars, light trucks, and vans (gross weight less than 10,000 pounds) be equipped with a TPMS starting in model year 2008. Due to a phase-in of the requirements, 20 percent of model year 2006 and 70 percent of model year 2007 vehicles are equipped with TPMS.

When the TPMS warning lamp on the instrument panel illuminates while driving, it means that the system has detected at least one tire with a pressure below the accepted minimum psi for the vehicle. The tires should be inspected and the tire pressure checked as soon as possible. The lamp will extinguish after the tires are properly inflated.

### **Tire Size and Tread**

To maintain tire safety, new tires should be the same size as the vehicle's original tires or another size recommended by the manufacturer. The tire information can be found on the placard, the owner's manual, or the sidewall of the tire being replaced. If there is any doubt about the correct size to choose, a tire dealer should be consulted.

According to a major survey conducted by NHTSA, fully 9 percent of passenger cars on U.S. roadways are driven with at least one bald tire, and bald tires, depending on tire location, are between 1.5 and 1.8 times more likely to be underinflated than are tires with deeper tread.

The tire tread provides the gripping action and traction that prevent the vehicle from slipping or sliding, especially when the road is wet or icy. In general, tires are not safe

and should be replaced when the tread is worn down to 1/16 in (1.6 mm). Tires have built-in treadwear indicators that show when it is time to replace tires. These indicators are raised sections spaced intermittently in the bottom of the tread grooves. When they appear even with the outside of the tread, it is time to replace the tires. Another method for checking tread depth is to place a penny in the tread with Lincoln's head upside down and facing the observer. If the top of Lincoln's head can be seen, it is time to replace the tires.

## Tire Balance and Wheel Alignment

To avoid vibration or shaking of the vehicle when a tire rotates, the tire must be properly balanced. This balance is achieved by positioning weights on the wheel to counterbalance heavy spots on the wheel-and-tire assembly.

A wheel alignment adjusts the angles of the wheels so that they are positioned correctly relative to the vehicle's frame. This adjustment maximizes the life of the tires and helps prevent the car from veering to the right or left when driving on a straight, level road.

These adjustments require special equipment and need to be performed by a qualified technician.

## Tire Rotation

Rotating tires from front to back and from side to side can reduce irregular wear (for vehicles that have tires that are all the same size). The vehicle owner's manual should be consulted for information on how frequently the vehicle's tires should be rotated and the best pattern for rotation.

## Tire Repair

The proper repair of a punctured tire requires a plug for the hole and a patch for the area inside the tire that surrounds the puncture hole. Punctures through the tread can be repaired if they are not too large, but punctures to the sidewall should never be repaired. Tires must be removed from the rim to be properly inspected before being plugged and patched.

## Uniform Tire Quality Grading System

To help consumers compare a passenger car tire's treadwear, traction performance, and temperature resistance, the federal government requires tire manufacturers to grade tires in those three areas. This grading system, known as the Uniform Tire Quality Grading System (UTQGS), provides guidelines for making relative comparisons when purchasing new tires.

Although this rating system is very helpful when buying new tires, it is not a safety rating, or guarantee of how well a tire will perform or how long it will last. Other factors, such as personal driving style, type of vehicle, quality of the roads, and tire maintenance habits, have a significant influence on a tire's performance and longevity.

Treadwear grades are an indication of the relative wear rate of a tire. The higher the treadwear number, the longer it should take the tread to wear down. For example, a tire grade of 400 should wear twice as long as a tire grade of 200.

Traction grades are an indication of a tire's ability to stop on wet pavement. A higher graded tire should allow the vehicle to stop on wet roads in a shorter distance than a tire

with a lower grade. Traction is graded from highest to lowest as “AA,” “A,” “B,” and “C.”

Temperature grades are an indication of a tire’s resistance to heat. Sustained high temperature (e.g., driving long distances in hot weather) can cause a tire to deteriorate, leading to blowouts and tread separation. From highest to lowest, a tire’s resistance to heat is graded as “A,” “B,” and “C.”

### Markings on Passenger Vehicle and Light Truck Tires

Federal law requires tire manufacturers to place standardized information on the sidewall of all tires. This information identifies and describes the fundamental characteristics of the tire, and also provides a tire identification number for safety standard certification and for recalls. Following is a description of markings that may be found on the sidewall.

**A “P”** indicates the tire is for passenger vehicles. The three-digit number following the “P” gives the width in millimeters of the tire from sidewall edge to sidewall edge. In general, the larger the number, the wider the tire. Following this is a two-digit number, known as the aspect ratio, that gives the tire’s ratio of height to width. Numbers of 70 or lower indicate a short sidewall for improved steering response and better overall handling on dry pavement.

**An “R”** stands for radial. Radial ply construction of tires has been the industry standard for the past 20 years. The two-digit number following the “R” is the wheel or rim diameter in inches. A change in wheel size will require the purchase of new tires to match the new wheel diameter. Following this is a two- or three-digit number indicating

the tire’s load index. It is a measurement of how much weight each tire can support. This information may also be found in the vehicle owner’s manual. (Note: The tire’s load index may not be found on all tires because it is not required by law.)

**An “M+S” or “M/S”** indicates that the tire has some mud and snow capability. Most radial tires have these markings; hence, they have some mud and snow capability.

**The “Speed Rating”** denotes the speed at which a tire is designed to be driven for extended periods of time. The ratings range from 99 miles per hour (mph) to 186 mph as indicated in Table 1. (Note: The Speed Rating may not be found on all tires because it is not required by law.)

**Table 1. Speed Rating Markings**

LETTER RATING	SPEED RATING (MPH)	LETTER RATING	SPEED RATING (MPH)
Q	99	H	130
R	106	V	149
S	112	W*	149
T	118	Y*	186
U	124	ZR*	Over 186

\*For tires with a maximum speed capability over 149 mph, tire manufacturers sometimes use the letters ZR.

**The “U.S. DOT Tire Identification Number”** starts with the letters “DOT” and indicates that the tire meets all federal standards. The next two numbers or letters are the plant code where it was manufactured, and the last four numbers represent the week and year the tire was built. For example, the numbers 3197 mean the 31st week of 1997. The other numbers are marketing codes used at the manufacturer’s discretion. This information is used to contact consumers if a tire defect requires a recall.

Tire ply composition and materials used are also marked on the tire. The number of plies indicates the number of layers of rubber-coated fabric in the tire. In general, the greater the number of plies, the more weight a tire can support. Tire manufacturers also must indicate the materials in the tire, which include steel, nylon, polyester, and others.

The **“Maximum Load Rating”** indicates the maximum load in kilograms and pounds that can be carried by the tire.

The **“Maximum Permissible Inflation Pressure”** is the greatest amount of air pressure that should ever be put in the tire under normal driving conditions.

UTQGS information is included for Treadwear number, Traction letter, and Temperature letter.

### Additional Information on Light Truck Tires

Tires for light trucks have other markings besides those found on the sidewalls of passenger tires, as follows:

- An “LT” indicates the tire is for light trucks.
- The “Max. Load Dual kg (lbs) at kPa (psi) Cold” indicates the maximum load and tire pressure when the tire is used as a dual (i.e., when four tires are put on each rear axle [a total of six or more tires on the vehicle]).

- The “Max. Load Single kg (lbs) at kPa (psi) Cold” indicates the maximum load and tire pressure when the tire is used as a single.
- The “Load Range” identifies the tire’s load-carrying capabilities at its inflation limits.

### Snow Tires

In some heavy snow areas, local governments may require true snow tires; those with very deep cut tread patterns. These tires should only be used in pairs or placed on all four wheels. Snow tires should be the same size and construction type as the other tires on the vehicle.

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