Tire Basics: What Drivers Should Know About Tires

1. The Function of Tires

Today's passenger-vehicle and light-truck tires contain over 200 separate materials and are engineered to deliver a varying combination of performance benefits suited to different vehicle and driver needs.

The tire and rim assembly is an air chamber, which when inflated to the proper pressure supports the weight of the vehicle. It is important and perhaps surprising to note that the air pressure supports 95 percent of the weight of the vehicle and the tire just 5 percent, making inflation a critical part of a tire's ability to perform.

The primary purpose of the tire is to transfer the driver's actions such as accelerating, steering and braking to the road surface. The part of the tire that rolls on the road is known as the contact patch and is about the size of a postcard. The friction between the road surface and the contact patch is all that ensures the vehicle follows the driver's commands.

The tires also work with the suspension system, helping to absorb the shock of road roughness and, when properly maintained, provide a smooth, safe ride.

Although it is normal for tires to wear out over time, you can take steps to prolong the life of your tires.

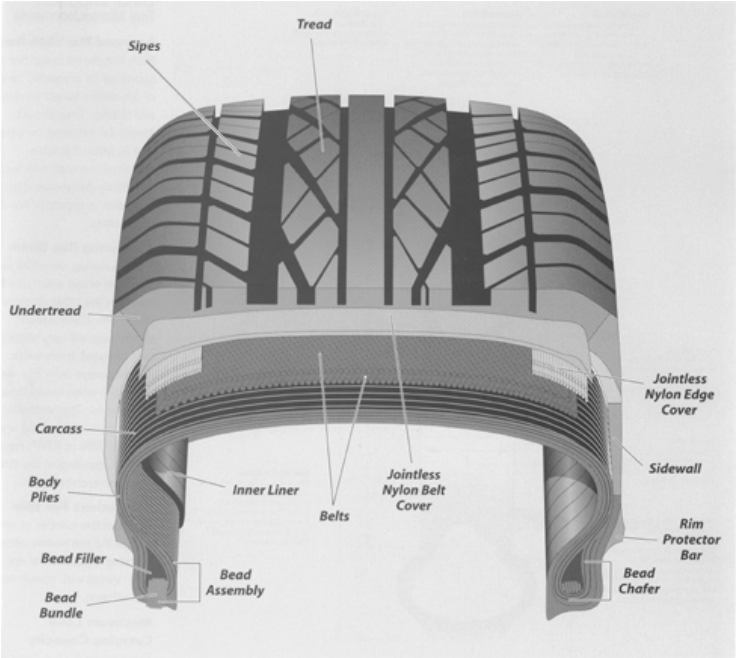
Proper tire inflation and maintenance is not only critical to the safe operation of your vehicle, but will also

- improve fuel economy
- extend tire life
- provide better vehicle handling
- help to prevent avoidable breakdowns and collisions
- reduce exhaust emissions that contribute to environmental, human health and climate change problems

Other regular maintenance procedures such as alignment, balancing and rotating can also save fuel and prolong tire life.

2. The Parts of a Tire

Figure 1: Radial Tire Cross-section



The main parts of a tire, indicated in Figure 1:

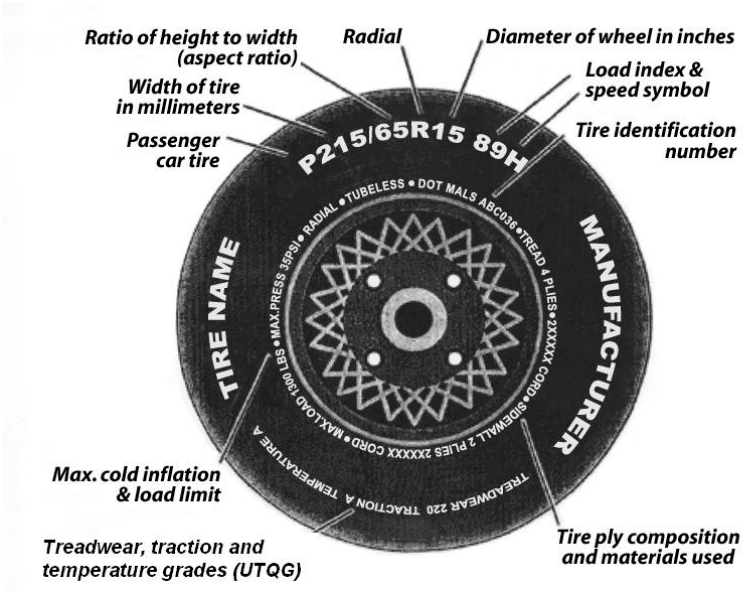
- ***the bead*** fits inside the rim of the wheel and is held in place by tire pressure
- ***the sidewall*** protects the cord plies and has all the tire information printed on it
- ***the tread*** provides strength and stability and is the interface that provides traction to the road surface
- ***the belt plies and body plies of various materials*** give the tire its stability and resistance to road damage
- an ***innerliner*** combats permeability (keeping the air in the tire)
- ***sipes*** are small slits in the tread that improve traction

Almost all passenger vehicle tires sold today are radial tires, which means that the body plies run from one bead to another straight across the tire. They are held stable by the belt plies, which criss-cross at angles.

3. How to Read Your Tire Sidewall

Tires have many letter and number codes moulded into the sidewall. These codes indicate the tire's size, speed rating, maximum rated load and inflation, tread wear, traction and temperature labelling, materials used and the Tire Identification Number.

Figure 2: Typical Sidewall Markings



The following explanations of Figure 2 start at the top left of the tire with the size, and follow the labels clockwise.

A. Size Description

An example of tire size for a car might be a P215/65R15 (you'll find these numbers moulded or printed on the sidewall). They mean:

- **P** "passenger" – cars and most vans and light trucks will use "P" series tires, although some may use a heavier tire designed for light trucks ("LT")
- **215** – the width of the tire from sidewall to sidewall in millimetres
- **65** – the aspect ratio (sidewall height divided by tire width) in percent
- **R** – radial construction
- **15** – the diameter of the wheel in inches

B. Service Description

The combination of the speed symbol (rating) and the load index moulded on the side of a tire is known as the service description. (Figure 2 "89H"). Because the maximum tire load capacity is also moulded on the sidewall, the load index is used as a quick reference.

Individual motorists who think that their driving characteristics vary considerably from the average should consult a tire professional who can advise on alternative tire choices for any vehicle. There is no fuel economy benefit in going to a higher load rating – in fact the added weight of the tire can increase fuel consumption. Don't economize on the load rating either – overloading the tire may reduce vehicle stability during hard cornering or stopping. The tire will also wear out prematurely. Also, when replacing speed rated tires, the same or higher speed rating tires should be used. The driver's safety could be compromised by the choice of tires with a speed rating less than what the vehicle was originally equipped with.

C. Load Index

The load index (Figure 2 "89") is an assigned number ranging from 0 to 279 that corresponds with the load carrying capacity of the tire; that is, how much weight it is certified to carry at maximum inflation pressure. Most passenger car load indexes range from 75 to 105, although some tires carry more. The rating can be matched against a load index chart to determine corresponding maximum weights. A load index rating of **89** indicates a maximum load of **580** kg. (See Table 1.)

Table 1: Load Index Chart

Load Index	Pounds	Kilograms
75	853	387
76	882	400
77	908	412
78	937	425
79	963	437
80	992	450
81	1019	462
82	1047	475
83	1074	487
84	1102	500
85	1135	515
86	1168	530
87	1201	545
88	1235	560
89	1279	580
90	1323	600
91	1356	615
92	1389	630
93	1433	650
94	1477	670
95	1521	690
96	1565	710
97	1609	730
98	1653	750
99	1709	775
100	1764	800
101	1819	825
102	1874	850
103	1929	875
104	1984	900
105	2039	925

***Caution**:* Do not install tires with a load index lower than the manufacturer's recommendation.

D. Speed Symbol

Tire speed ratings are represented by a letter symbol (ranging from A to Z) branded on the side of the tire. It indicates the maximum speed capability of the tire when properly loaded and inflated.

Caution: Driving for prolonged periods on tires that are not properly inflated, or are overloaded, can lead to tire damage or failure.

See Table 2 for the most common passenger car symbols and their kilometre-per-hour equivalents.

Table 2: Speed Rating Chart

Rating Symbol	Maximum Speed (km/h)
Q	160
S	180
T	190
U	200
H	210
V	240
* ZR W	270
Y	300
▼	Over 300

* For an explanation of ZR tires, please see the following section.

ZR Tires

Tires that have a maximum speed capability above 240 km/h ***may*** have "ZR" as part of their size description. Tires that have a maximum speed capability of more than 300 km/h ***must*** have the "ZR" in the size description. In cases where a service description is not evident, check with a tire professional to obtain the manufacturer's recommendation. Refer to Figure 2 for illustrations of size and service descriptions.

Caution: Only install tires with the same or higher speed rating as the vehicle manufacturer's recommendation. Vehicle handling may be adversely altered if tires are installed with a lower speed rating than the manufacturer's recommendation.

E. Tire Identification Number and Registration

Figure 3: Tire Identification Number

All tires sold in Canada have a tire identification number moulded into the sidewall. (See Figure 3.) This number provides tire retailers specific manufacturing information about when and where the tire was made. The first two characters following DOT indicate the manufacturer and plant code; the third and fourth characters are the tire size code. The fifth, sixth, seventh and eighth are optional. The final four give the manufacturing date. For example, 2602 indicates the twenty-sixth week of 2002.

The maple leaf following the number indicates that the tire was made in Canada and certifies that it meets Transport Canada requirements.

Be sure to fill in and return your tire registration form when you purchase new tires. In the event of a product recall, you will be contacted by the manufacturer. Some manufacturers now have on-line registration.

F. Tire Ply Composition and Materials Used

This section on the tire will indicate the number and types of plies in the tire, for example "Tread plies = 1 polyester + 2 steel; sidewall = 1-ply polyester."

G. Uniform Tire Quality Grade (UTQG) Labelling [1]

The Uniform Tire Quality Grade labelling system is a U.S. Government requirement designed to give drivers consistent and reliable information regarding tire performance. *UTQG is not a Government of Canada requirement.* However, because all tires made for sale in North America have these grades branded on the sidewall, it is useful to know what they mean. The ratings are based on standard tire tests under controlled conditions. Tire manufacturers assign their own ratings, according to agreed-upon criteria.

TREAD WEAR: The tread wear grade is a comparative rating based on the wear rate of the tire when tested under controlled conditions on a specified U.S. Government test course. For example, a tire graded **400** would wear two (2) times as well on the test track as a tire graded **200. The relative performance of tires depends on the actual conditions of their use and may depart significantly from the norm due to variations in driving habits, service practices, road characteristics and climate**.

TRACTION (AA, A, B and C): The traction grades from highest to lowest are AA, A, B and C, and they represent the tire's ability to stop on wet pavement as measured under controlled conditions on specified test track surfaces of asphalt and concrete.

Caution: The traction grade assigned to a tire is based on braking (straight ahead) traction tests and does not include cornering (turning) traction.

TEMPERATURE (A, B and C): The temperature grades are A (the highest), B and C, representing the tire's resistance to the generation of heat and its ability to dissipate heat when tested under controlled conditions on a specified indoor laboratory test wheel. Sustained high temperature can cause the material of the tire to degenerate and reduce tire life, and excessive temperature can lead to sudden tire failure.

Caution: The temperature grade for a tire is established for a tire that is properly inflated and not overloaded. Excessive speed, under inflation, or excessive loading, either separately or in combination, can cause heat build up and possible tire failure.

Caution: The comparative performance of various tires is too complex to be based exclusively on UTQG grades.

1. UTQG grades are not government grades. They are manufacturers' grades and are not based on interbrand testing.
2. Treadwear grades are NOT a guarantee for a given mileage warranty. Treadwear grades are assigned by the manufacturer for comparison purposes within the same brand and construction type.
3. UTQG grades are not safety ratings. Overall tire quality and safety are not graded.

4. One brand name of tires can not be considered superior to another brand name of tires based solely on UTQG grades.
5. UTQG grades are not required for Winter tires or Light Truck tires.

H. Maximum Cold Inflation and Load Limit

The "*maximum tire pressure"* marked on the sidewall refers to the pressure required to carry the maximum load of the tire and is generally **not** the same as the "*recommended tire pressure"* for your specific vehicle. To find the recommended tire pressure for your vehicle's tires, refer to the tire information placard, which is normally located on the edge of the driver's door, the doorpost or other conspicuous location. If you cannot find the tire information placard, check the owner's manual.

Caution: Never exceed the maximum pressure moulded on the tire sidewall. Explosive failure may result leading to property damage, serious injury or death.

4. Tire Categories

Tires for light duty vehicles fall into two major categories, Passenger and Light Truck. Passenger tires are used on almost all cars, as well as many pickups and SUVs that are primarily used as passenger vehicles. Light Truck tires are a more robust tire designed for heavier service and larger load capacity. Both categories are supplied in a variety of tread designs and special applications such as All Season, Winter, Performance, Low Rolling Resistance, etc.

Each tire tread has a unique arrangement of grooves and blocks *(tread elements)* designed to provide traction in different driving conditions. Although there are perhaps thousands of different designs or patterns, they all fit into three main types.

A. Summer Tires

Designed primarily for dry and some wet driving, Summer tires are not for use in snow, ice or other winter or heavy rain conditions. They are characterized by a very smooth-looking tread design, with minimal or no sipes. Sipes are small slits in the tread that help improve traction.

B. All Season Tires

All Season tires provide a good balance of quiet, comfort and handling for most Canadian drivers. The tread design has more grooves and sipes than Summer tires, providing better wet traction. They can be identified by **"M+S"** branding on the side of the tire and can therefore be used in moderate snow and slush conditions.

C. Winter Tires

A combination of specialized tread designs and compounds provides effective traction in Canada's difficult winter conditions (snow, ice, sleet, rain and low road-surface temperatures). At temperatures below 7°C,[2] standard compound tires begin to lose elasticity, resulting in reduced traction. Winter tire compounds retain elasticity to grip at much lower temperatures.

Typical Winter tread designs have larger grooves and tread blocks that have many more sipes than the typical All Season tire. Tires marked with the Rubber Association of Canada (RAC) "mountain snowflake" (see Figure 4) symbol moulded on the sidewall

have been tested to provide a minimum 10 percent better traction in severe snow conditions. Many Winter tires provide 30 to 50 percent better traction in winter conditions.

Caution: Winter tires should be installed in sets of four. *Failure to follow this recommendation could result in severe and dangerous handling conditions.*

Figure 4: RAC "Mountain Snowflake" Symbol [3]

5. Specialized Segments

In addition to the three main tread design types, there are other segments of passenger and light truck tires that provide further focus on specific driving needs. They are available in one or more of the following tread design types.

A. Performance Tires

Many drivers prefer tires with handling characteristics (especially cornering ability) superior to that of other tires.

True high performance tires are designed to maintain a vehicle's stability and improve response at higher speeds while being able to withstand much higher temperatures. High performance tires are characterized by higher (typically "H" and up) speed ratings, and lower aspect ratio (70 or less). Ride comfort is often sacrificed in part due to the typically "shorter" sidewalls.

B. Low Rolling Resistance Tires

A vehicle's fuel consumption is affected by the tire's rolling resistance, 90–95 percent of which results from the flexing of the tire as it rolls (the rest is from the aerodynamic drag of the tire itself and slippage between the tire and the road).[4] The most significant factors affecting rolling resistance are tire pressure and vehicle loading.

Although there is no EnerGuide label for a tire's rolling resistance,[5] most tire professionals are aware of the importance of rolling resistance and can discuss tire choices accordingly. Generally, a 10 percent reduction in rolling resistance is estimated to result in a 2 percent reduction in fuel consumption. [6]

C. "Run Flat Tires" and Tire Pressure Monitoring Systems

Several tire companies manufacture tires with "Run Flat" capability. In the event of a puncture or other rapid air loss, the driver can continue at speeds of up to 80 km/h, for up to 150 km, even at zero pressure. "Run Flat" tires provide additional safety to motorists and eliminate the cost and weight of a spare tire.

When using "Run Flat" tires, a tire pressure monitoring system is required to alert drivers to the fact that a tire has little or no pressure. Some new vehicles are equipped with these systems, which indicate when a tire becomes under inflated.

Tire pressure monitoring systems do not replace the need to measure air pressure regularly. Some systems provide a warning only when a tire is significantly under inflated; the tire may in fact be close to failure. When a monitoring system warns that pressure is low, measure your tires' pressure as soon as possible. Make sure you understand the tire pressure monitoring system installed on your vehicle by checking your owner's manual.

6. Key Points to Remember

1. The tire maintains vehicle control by gripping the road surface at four "contact patches," one per tire, each about the size of a postcard.
2. Correct tire pressure is critical to safety, tire wear and fuel economy. The correct pressure can be found on the Tire Information Placard, or the owner's manual, but ***NOT*** **on the tire sidewall.**
3. Important service and safety information is moulded on the sidewall of the tire.
4. Replacement tires must maintain, as a minimum, the service description (load index and speed rating) of the original tires supplied by the vehicle manufacturer.
5. Tires are available in a variety of tread designs and specialized applications.
6. Consult the vehicle owner's manual and a tire professional for additional information.

References

[1] National Highway Traffic Safety Administration (NHTSA) (U.S.)

[2] Pirelli & C. S.p.A.

[3] Rubber Association of Canada

[4] Pirelli & C. S.p.A.

[5] EnerGuide is the official Government of Canada mark associated with the labelling and rating of the energy consumption of specific products. EnerGuide is administered by the Department of Natural Resources Canada.

[6] Bosch. Automotive Handbook, 3rd Edition. 1993. Published by SAE.