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Basic Tyre Appreciation: An Overview

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Abstract:

The usefulness of tyre in a vehicle cannot be over emphasized, yet it is one of the most over looked aspect of a vehicle. Due to the high rate of non-compliance with tyre regulations, a review on the basic tyre information required for its optimum utilization and safety purposes was carried out. This paper, therefore, explores the standard manufacturers' guide and specifications, rules and regulations including other relevant information to increase user's awareness. Also, tyre sidewall markings, (identification/classification), alignment, inflation and major reasons why tyres are black were discussed so as to avail users with one stop bank of basic tyre information.

Keywords: Tyre, users, sidewall markings, tyre material, tyre code

1. Introduction

The modern vehicle is a complex technical system employing subsystems with specific function. Tyre design for any vehicle therefore, depends to a large extent on its intended use. Tires are used on road vehicles, tractors, aircraft and spacecraft landing gear, factory and warehouse machinery wheelbarrow, lawn mower, and on a variety of other vehicles, including shopping carts and baby carriages. A tire (American English) or tyre (British English), made from rubber or plastic, of pneumatic or solid nature, aims to transfer load to the ground (Chisholm, 1911).

The earliest tires were bands of leather. It was placed over the wheel and quenched, causing the metal to contract and fit tightly on the wheel. A skilled worker, known as a wheelwright, carried out this work (Bertman, 2005). In 1845 a Scottish inventor Robert William Thomson patents what appears to be the first known tyre. However, this aerial tyre never went into production (Sir Arthur Du Cros, 1938). The first practical pneumatic tire was made in 1888 by Scots-born John Boyd Dunlop, owner of one of Ireland's most prosperous veterinary practices. Dunlop is credited with 'realizing rubber could withstand the wear and tear of being a tire while retaining its resilience' (Dunlop, 1889). In 1891 Andre and Eduoard Michelin developed the first demountable tyre or the Radial tire method of construction which is more superior till now. This is largely because of its superiority in handling and fuel economy (www.michelin.com). Early tires were totally dependent on natural rubber, which was often poor in quality. During the World War II synthetic rubber was developed and now accounts for about 80% of the rubber used by the tyre industries.

Tires are now made of chemically treated rubber and fabric. Chemicals are compounded into the rubber to help it withstand wear, heat and aging and to produce the desired changes in its characteristics. Fabric is to give the tire body strength and resistance. Steel wire is used in the bead that holds the tire to the rim. Those for indoor use are generally solid rubber with a smooth surface, while those used for outdoors are pneumatic, or hollow and filled with pressurized air, and have a traction pattern cut into the surface. Generally, tires must be durable with simple systems having high resistance to severe overloads and extremes in operating conditions (William Hume, 1938).

The functions/benefits of tyres includes the following: to roll, to carry a load including that of the vehicle, to steer the vehicle (Guide), to transmit braking force and power output, to absorb (noise and mechanical vibration), to handle speed, to be cost effective, to lower noise, low rolling resistance, to look good, etc. Figure 1 shows the various Tyre classification (Source: www.jktyre.com)

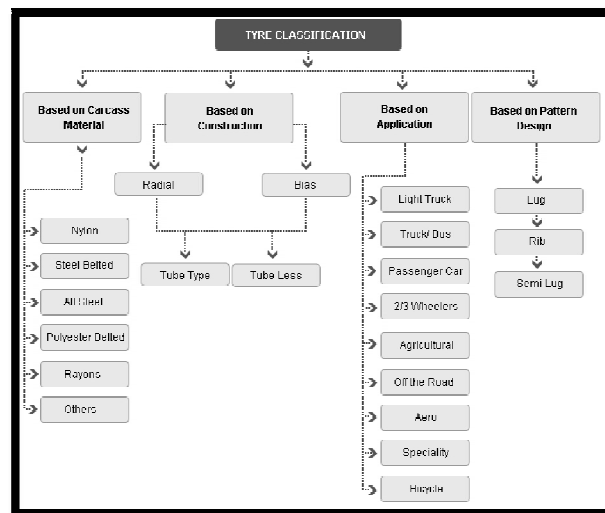


Figure 1: Tyre Classification
Source:www.jktyre.com

2. Tyre Materials and Sizes

Tyre is a highly complex product with more than 200 materials of which over 30 are semi-finished products. These include Sulphur, Silica, Natural and Synthetic Rubbers, Steel cords, Polyester, Nylon, Textile cords, rayon polyaramid, etc. These materials can be divided into two groups, the cords and the elastomer.

2.1. Cords

The cords, composed of steel, natural fibers such as cotton or silk, or synthetic fibers which form the ply and bead and provide the tensile strength necessary to contain the inflation pressure.

2.2. Elastomer

The elastomer, a means of pneumatic tire design, forms the tread and encases the cords. Some examples of different tyre sizes include 195/65R15, 205/65R15, P205/60R16, 195R15C, 7.50R14C, 215/75R17.5, 245/70R19.5, 10.00R20, 12.00R20, 295/80R22.5, 315/80R22.5, 12R22.5

3. Tyre Construction/Structure

The most important feature of tyre design is the ply, i.e. the way in which the layers of reinforcing cords in inner carcass are laid, or arranged. The two main construction types are cross ply or bias (nylon) construction and radial construction.

The cross ply or bias (nylon) tyre utilizes body ply cords and can be extended diagonally. The design allows flexibility and smooth ride on rough surfaces. Rolling resistance and less control are some of the disadvantages due to the cushioning characteristic. (www.michelinag.com).

In radial tyre construction type, layers of cords are arranged to lie approximately 11 degree perpendicular to the axis of the tyre tube and parallel to each other, to stabilize the belts directly beneath the tread. The belts may be cord or steel. Fuel economy, more life span, are some advantages whereas, some disadvantages are lower grip ability at low speeds, decreased self-cleaning' (www.mud-throwers.com). In 1968 Consumer Reports announced the superiority of the radial design. Radial tire technology is now the standard design for essentially all automotive tires.

4. Types of Tyres

There are two main types of tyres: (1) those made of metals and (2) those made of rubber. Rubber tyres are further divided into two types: (a) solid tyres (b) pneumatic tyres. Solid rubber tyres are hard, airless and are often adhered directly to the wheel or to a metal band applied to the periphery of the wheel. They are now used mainly on industrial trucks, tractor, lawn mowers, skateboards, carts, military vehicles etc. where tyres are liable to cut or pierced. Pneumatic tyres can function in compressed air. They are used for almost all free-moving vehicles because of their greater cushioning ability and other advantages.

Pneumatic tyres are again divided into two: (i) tube type and (ii) tubeless type. Tube type of tyre as the name implies requires an inner tube. In case of puncture, the air under pressure escapes between the tube and the tyre, so Deflation is instantaneous. Tubeless tires are pneumatic tires that do not require a separate inner tube. In case of puncture, the air under pressure escapes slowly from the nail penetration, hence, deflation is gradual. There are some Semi-pneumatic tires having a hollow center (Jones, Thomas H. 1980).

5. Tyre Specification/Identification

Tyres are embedded with codes, and markings on the sidewall to convey manufacturer-specific detail, size, expected recital, government authorized warning labels, and other consumer information, tire lettering. The main goal of tyre labeling is to provide information to users on the performance of tyre and safety requirement while shopping for a

new tyre. The marking on tyre are words, letters and symbols indicating the size and characteristics of the tyre, the width, height, dimension, tread pattern, load index and speed rating. Tires are described by alphanumeric codes, which are generally molded into the sidewall of the tire. This code specifies the dimensions of the tire, and some of its key limitations, such as load-bearing ability, and maximum speed. Sometimes the inner sidewall contains information not included on the outer sidewall, and vice versa. New automotive tires frequently have ratings for traction; tread wear, and temperature resistance (collectively known as The Uniform Tire Quality Grade (UTQG) ratings). Most tires sizes are given using the ISO Metric sizing system. However, some pickup trucks and SUVs use the Light Truck Numeric or Light Truck High Flotation system. The DOT code, a three-digit code is mandated by the U.S. Department of Transportation (DOT) but is used worldwide. For example, 178 mean's it was manufactured in the 17th week of 8th year of the decade. In this case it means 1988. Other numbers are marketing codes used at the manufacturer's discretion. The DOT Code is also useful in identifying tires in the event of a product recall(www.en.m.wikipedia.org/wiki/tyre).

Tyres are marked on the sidewall based on road conditions the tyres are suitable for. This includes: TL: Tubeless; LT: Light truck tyres; TT Truck Tyres (Rims ≥15mm); C: Commercial (tyres for light trucks); ADV: Tyres for Animal Driven Vehicle, They are off-road tyres; A/S: All-season tyre; A/T: All-terrain tyre; H/T: Highway/terrain tyre for SUVs and 4x4s M+S or M&S: Mud and snow tyre; P: Commercial/Passenger car tyres; RF: Reinforced tyres; TT: Tube type, tyre must be used with an inner tube (Common with truck types); AT: Agricultural Tyres;

CT: Caterpillar Tyres; MT: Motorcycle Tyres; MPT: Moped Tyres; BT: Bicycle Tyres; WT: Wheel Barrow Tyres; Snow tyres; Studded tyres with steel studs sticking above the treads for improved traction on ice and snow. This is an off-road tyre as they damage the roads quickly.

The all season tyre classification is a compromise between one developed for use on dry and wet roads during summer and winter conditions. They have, however, become ubiquitous as original and replacement equipment on automobiles marketed in resent time, due to their convenience and their adequate performance in most situations.

All-terrain tires are typically used on SUVs and light trucks. These tires often have stiffer sidewalls for greater resistance against puncture when traveling off-road, the tread pattern offers wider spacing than all-season tires to remove mud from the tread. Many tires in the all-terrain category are designed primarily for on-road use, particularly all- terrain tires that are originally sold with the vehicle. Apart from protecting the tyre against punctures, the side wall also carries vital information's about the tyre. The various sidewall markings are shown pictorially as follows:

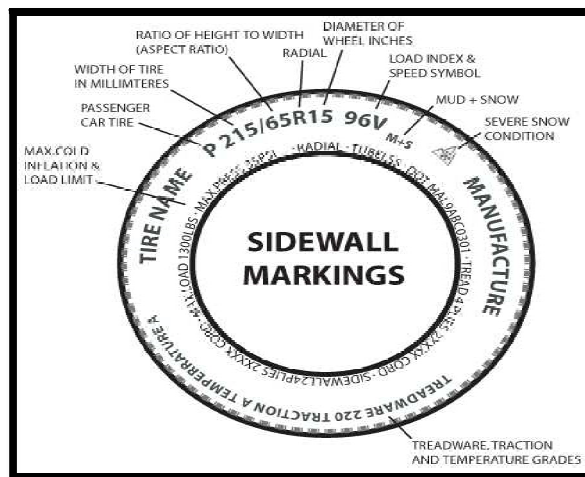


Figure 2

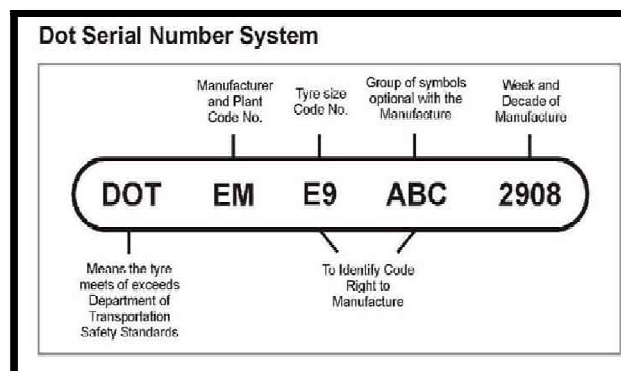


Figure 3

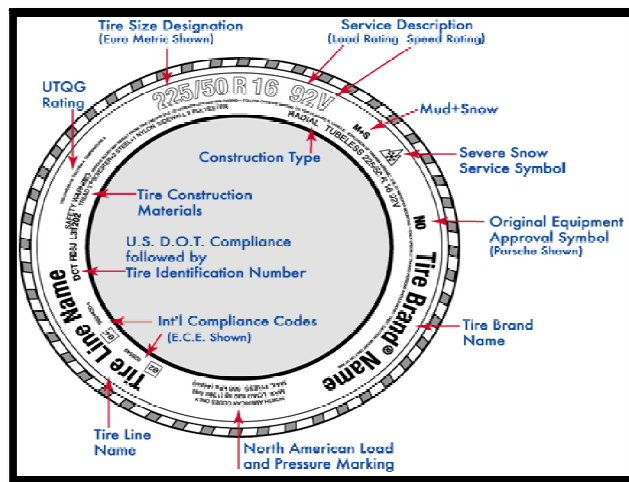


Figure 4

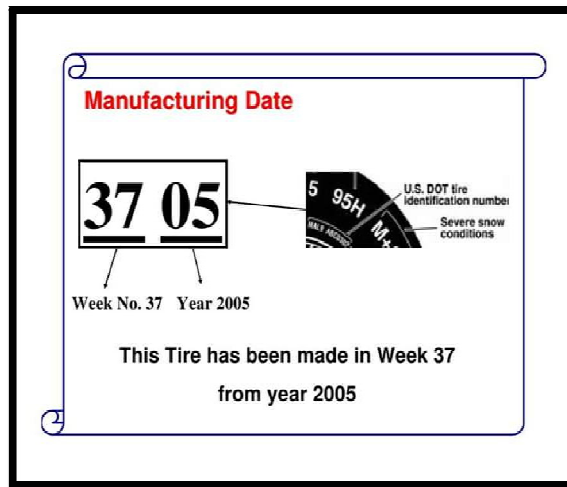


Figure 5

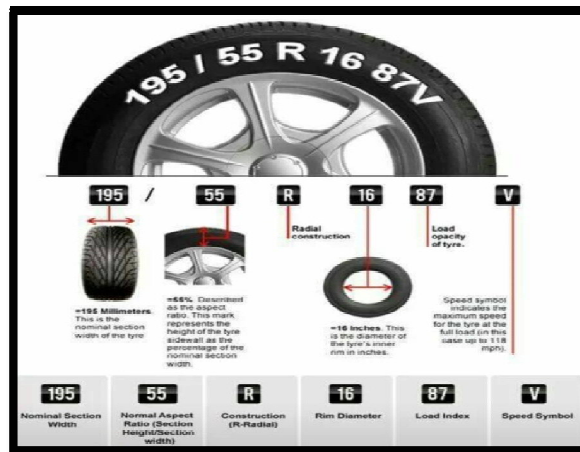


Figure 6



Figure 7

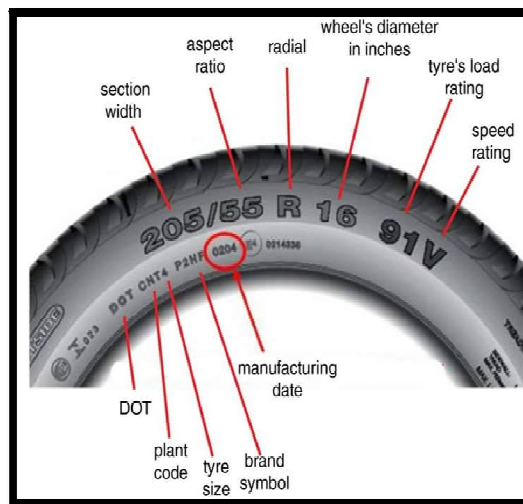


Figure 8

6. Main Causes of Tyre Problems

Road hazards like potholes, glass and rocks are usually unavoidable. Tyre contains anti-oxidizing chemicals to slow the rate of aging, but they need to be in use for these to be effective, hence, infrequent use or poor storage can accelerate the aging process and makes it unroad worth (www.telegraph.co.uk). Proper precautionary measures need to be taken to increase life span of tyres.

6.1. Inflation Pressures

Proper tyre pressure improves your gas mileage and ensures a safe drive. Inflation pressure specifies tyres. It also permits safe operation, load rating and vehicle loading. New designs now have lower height-to-width ratios to increase the road –contact area while maintaining a low standing height for the tyre and consequently the car (Encyclopedia Britannica 2007). Maximum pressure rating is a common feature for most of the tyres. Ideal tyre pressure determination is causes difficultly for many drivers. Some wonder whether they should inflate the tyres according to the maximum PSI (Pounds per square inch) listed on the sidewalls of the tyre. The maximum is not the right tyre pressure in car. Mostly, the suggested tyre pressure in car is between 30 - 35 PSI. Going lower than this pressure will likely lead to poor fuel economy and can make your tyres prematurely wear off (Tom and Ray Magliozzi 2005). Overheating, premature tread wear, and tread separation can be caused due to under-inflation.

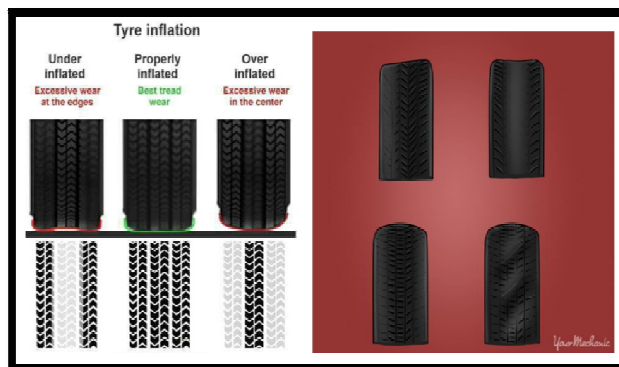


Figure 9



Figure 10

all support needed by the thread. This revolutionary airless tire is a smart move towards sustainability since it will be perfect for all kinds of terrain without fear of burst.

8. Conclusion and Recommendation

Tyre is an integral part of a vehicle. Hence, the manufacturer specification and guide recommended must be followed for outmost performance. And we must regularly check for inflation, wear and alignment. All four tyres should be change at the same time to maintain even tread wear. However, if you are only able to replace two tyres, your focus should be on the rear axle. The reason for this is that the rear axle provides more stability and helps you to maintain better control of your vehicle, especially in wet conditions. The new tyres' deeper treads will be better able to resist aquaplaning and evacuate water more quickly. It is also recommended to rotate your tyres every 10,000km to ensure they wear out evenly. A tyre is recommended for replacement when the tread has worn-out to the indicator level placed around the circumference on the shoulder at six location marked by a triangular symbol. The height of the tread wear indicator is about 1.6mm within the tread groove. Speed rating on tyre should be checked to avoid mixing a high speed and low speed tyre on a car. This is one major cause of tyre bust which eventually result to accident.

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