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Different types of tyres used under different operating conditions

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ABSTRACT

Tyres play an important role in vehicle and passenger safety as they are the first point of contact through which force is exerted on ground. Different road conditions require different traction for vehicle stability and one single tyre cannot fulfil all expectations. Tyres also play a major part in vehicle dynamics which is often neglected. Thus, there is a need to study different types of tyres.

Keywords

Tyres, tires, summer tyres, radial-ply, off-road tyres, sporty tyres

1. INTRODUCTION

A tire (American English) or tyre (British English) is a ring-shaped cushion usually made of rubber or plastic composite that covers the wheel's rim to protect it and enable better vehicle performance. It is either solid or pneumatic. It consists of mainly the outer cover i.e., the tyre proper and the tube inside. It is the air inside the tube that carries the entire load and provides the cushion.

Tyres are essential for safe driving as they are the only contact between a vehicle and the road. Each tyre touches the road surface on an area that is approximately the size of a postcard or the palm of a human hand.

The basic functions of a tyre are:

1. To support the weight of the vehicle.
2. To absorb the vibrations or shocks from the road.
3. To provide grip while braking and acceleration.
4. To provide smooth steering and directional control.

2. NOMENCLATURE

An internationally recognized nomenclature for tyres consists of a string of letters and numbers as follows:

1. An optional letter indicating the intended tyre use.
2. Width of tyre, in mm.
3. A slash i.e. '/'.
4. Aspect Ratio, as a percentage.
5. Nature of the tyre carcass ('D' for cross-ply and 'R' for radial-ply).
6. Diameter of the wheel rim on which tyre is intended to fit, in inches.
7. Load index.
8. Speed rating (See table 1).
9. Additional marks, if any; e.g., traction, tread wear and temperature resistance.

Table 1

Letter Code	Speed(kmph)
P	150
Q	160
R	170
S	180
T	190
U	200
H	210
V	240
W	270
Y	300
ZR	Over 240

For example the code P220/70D1585H represented on a tyre would mean that the tyre is for a passenger car, its section width is 220mm, aspect ratio is 70, is of cross-ply construction, is meant for a 15 inches rim diameter wheel, with load index 85 and is to be used for a maximum of 210 kmph speed.

3. IMPORTANCE

No matter how good an engine a car has, how good a construction it has, what basic speed and acceleration it has, in the end it all comes down to tyres and how they can alter a car's performance on the road. Not only should one pay attention to his/her vehicle tyres, but one should also learn the difference between good tyres and bad tyres, cheap tyres and expensive tyres, sizes of tyres, and the seasons and conditions the tyres are made for.

Gone are the days where one could choose between a set of Bias or Radial tyres. In today's world, the sheer variety of tyres one can buy depending on what their specialist applications are is long and varied. One can easily walk into a tyre showroom and replace the manufacturer provided tyres

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for a set of high performance tyres that can completely change the way the car looks or performs on the road.

4. CLASSIFICATION

The tyres may be classified according of following basis:

1. Based on air-enclosure type
   a) Conventional tubed tyre
   b) Tubeless tyre
   c) Run-flat tyre
2. Based on carcass type
   a) Cross ply or bias ply
   b) Radial ply
   c) Belted-bias
3. Based on the use
   a) All-season tyres
   b) Summer tyres
   c) Wet-weather tyres
   d) Snow-ice tyres
   e) All terrain tyres

Now let us analyze the tyres one by one that can be used to get the best out of a car.

4.1 Tube

Tube tyres have an inner tube in between the rim and the tyre. It's this tube which has the air filled in it. When the tyre is punctured, it's the tube which loses air immediately and the tyre goes flat. This tube is doughnut-shaped and made of rubber. It has a valve which protrudes through a hole in the rim. To repair a punctured tube, it has be taken off from the tyre and rim completely. If a nail punctures the tyre tread, then the tube could have multiple punctures as the tube gets deflated and rotates within the tyre.

Fig1: Tube tyre

4.2 Tubeless

Tubeless tyres work by sealing the spoke well of the rim, either with a specially designed rim and spokes, or with a butyl/plastic strip. The valve is either a separate item sealed with an 'O' ring or part of the rim strip. The tyre is also air tight, this can be done either by adding rubber to the tyre material, or more commonly by coating the inside of the casing with Butyl rubber.

Tubeless tyres deflate slowly rather than suffering from a blowout, which for some drivers improves the safety and reliability of the tyres.

Fig2: Tubeless Tyre

4.3 Run Flat

Run flat tyres are available in premium category (Both in Touring and Sporty types). They are designed to minimize loss of handling of a vehicle after a tyre puncture has occurred. It allows the car to be driven on the punctured tyre so that the driver does not have to change the tyre. However, after a puncture has occurred it can be driven only for a short distance (Typically about 80 kms) and under a limited speed (usually 80 km/h).

Although run flat tyres with their added stiffness can usually end up improving a car's dynamic properties, they work best in countries with better road conditions. In India where highways are riddled with potholes with razor edges, a simple puncture can end up costing thousands of rupees as a run flat tyre has limited reparability (Maximum 2 punctures allowed with minimum distance between them as 40 cm after thorough inspection for inside damage).

Fig3: Run Flat Tyre

4.4 Cross ply or Bias ply

Tyres where the fabric cords run from one bead to another at an angle with respect to the center line of the tyre are called cross ply or bias ply tyres.

Fig4: Cross ply Tyre

4.5 Radial

Radial tyres don't have belts that cross over each other like cross ply tyres do. Here, parallel plies radiate from one bead to another. They are softer and offer a more comfortable ride. As the ride is soft, the sidewalls are weak and there is no directional stability, and so stiff belts of steel or fabric run

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around the circumference of the tyre between the plies and the tread.

Fig5: Radial Tyre

4.6 Standard

Also known as Stock tyres or General Usage tyres, these are usually the OE fitted tyres one gets with the car. These are the tyres to go for if one is satisfied with the current tyre performance and the expectations from the tyres are not very demanding. Since these are tested and approved by OE manufacturers, most of the performance parameters are optimized for general usage.These tyres generally do not cost as much as premium tyres.

4.7 Touring

Comfort is the main emphasis of these tyres. Comfort not only stands for driving comfort (Less vibrations), but also lower noise levels. Such premium tyres are usually preferred by people using premium cars mainly for going to office or travelling with the family. The tread patterns of touring tyres are less aggressive than Sporty tyres and have certain design features on tread which create lesser noise.

4.8 Sporty / Performance / Summer

These are designed for improving the grip and handling of a vehicle. Made of softer tread compound rubber, they are designed to give maximum grip at high speeds especially during dry and wet weather conditions. Most sports cars come fitted with these superior performance tyres to improve their handling and cornering ability. These tyres are also available in the aftermarket for drivers who want better handling and performance from their vehicles. In fact, for people who use their vehicle in tarmac based motorsport applications, a sporty tyre is the cheapest and most preferred way to cut down on lap times. These tyres usually come with aggressive tread patterns than standard and touring tyres, which make them a bit noisy at high speeds.However, the soft compound on these tyres means that the tyres wear out faster. Also because the groves on these tyres are less, they do not work very well in the rain as the dispersion of water from under the tyres is less. They can be used through the year if it's warm all year round in that region and there is little rain. The driver should be very careful in checking the wear on the tyre because if the tyre is worn out, there will be little or no grip on wet roads. The extreme example of these tyres is used in motor sport.

Fig6: Sporty Tyre

4.9 Snow / Winter

At temperatures below 7°C, the rubber in normal tyres begins to harden, reducing grip on cold, wet roads, ice and snow. Snow / Winter tyres have a larger contact patch and have larger and more pronounced tread patterns than standard tyres, so that there is maximum grip on snow and on loose mud. True snow tyres come with tiny metal studs in the tread for increased grip on loose or fresh snow. These tyres cannot be used on normal road surfaces as they will wear out very quickly and damage the road surface. There is more road noise from the tyres. These tyres are crucial for driving on snow and provide maximum grip while accelerating, cornering and braking on snow. According to Tyresafe, a winter tyre can give up to 60% better grip in cold conditions and can reduce braking distance by as much as six whole car lengths. This makes a big difference in terms of road safety.

Fig7: Winter tyre

4.10 Wet Weather

Wet weather tyres, or rain tyres as they are sometimes referred to, are specifically designed to cope well in rain and wet condition. On a wet road, stopping distances increase, and this is even more the case with worn tyres. Visibility may also be decreased. The risk of sliding is also considerably increased if it has just rained after a long, dry, hot spell as the dust and oil on the road may make the road slippery. The braking distance on a wet road may be up to three times longer than on a dry road. A good wet weather tyre will rapidly expel the rain along its tread away from the contact area of the road. The depth of the tyre tread should be at least 1.6mm deep. The greater the depth, the better the ability to evacuate water.

Fig8: Wet Weather Tyre

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4.11 All Season

As the name suggests, these tyres are suited for all season use although they may not be the ultimate performer in very dry or wet weather conditions and on ice but can be used majority of the year saving costs of having to change the tyres in line with the changing seasons. Tyre patterns used on all season tyres are more complex than those on the summer tyre and they also have more sipes or small slits on the tread blocks of the tyres. All season tread designs provide good traction and stability and the tread bites the surface to give grip in freezing conditions. Though one must remember that they are not the best suited for very cold and icy conditions for which winter tyres are the best solution.

In an ideal world, drivers would fit winter tyres during the winter months and summer tyres during the rest of the year. This is not always practical, and all season tyres can provide the added grip needed during the winter that a summer tyre would not give.

Fig9: All Season Tyre

4.12 4x4

These are designed specifically for four wheel drive vehicles. These are designed for mostly road use with a slightly softer tread compound.

The 4x4 performance tyres are designed to be used in the same way car performance tyres are used, and will give 4x4 drivers fantastic grip on the road.

Traditionally 4x4s have been used in a variety of terrains, and for this tyre manufacturers have designed all terrain 4x4 tyres, which can be used on both the road, and in mud.

All terrain tyres are also well known for the distance they can travel before needing replacement, with the harder tread compound used on such tyres making them wear less

.

Fig10: 4x4 Tyre

4.13 High Speed

High speed tyres are available in Touring and Sporty patterns. Their construction is more durable that can resist high temperatures due to high-speed rolling resistance and deal with strong G forces under hard cornering. Manufacturers often use their findings from motorsport applications to make these high performance tyres for road use. One can often find these high performance tyres fitted on sports cars, supercars and coupes that are capable of higher speeds than a standard family sedan.

One must remember though that although the technology exists for tyres to achieve speeds well above 300kmph, fitting such tyres in an average hatchback is pointless. Due to price constraints in new cars, one will often find manufacturers providing tyres that are capable of handling speeds slightly higher than what that particular car can achieve.

Fig11: High Speed Tyre

4.14 Eco-friendly

Essentially, eco-friendly tyres help in reducing fuel consumption by offering the lowest rolling resistance possible. Low rolling resistance, as the name suggests, is achieved by reducing friction losses in the compounding.

Currently the Eco-friendly tyres use silica to a tyre compound which allows tyre makers to make low-rolling resistance tyres with adequate grip.

The savings through Eco-friendly tyres are much higher than the premium paid for these tyres.

Fig12: Eco-friendly Tyre

4.15 Off-road

These types of tyres are often used on vehicles like SUVs that go off road frequently. The rubber is neither soft compound nor hard compound but is somewhere in between. These tyres have big chunky tread so that it can provide good grip on loose surfaces such as sand and mud. The side walls on these tyres are stiff so that the tyre can cope with uneven surfaces and potholes. These tyres are very noisy when driven on normal road surfaces due to the big gaps in the tread of the tyres. They wear out very quickly on normal roads because there is too much grip from the tyre on the tarmac. It will also

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affect fuel economy due to the extra friction between the tyre and the road.

4.16 All-terrain

All-terrain (A/T) tyres are usually found on utility vehicles that frequently drive on varying surfaces such as tarmac, dirt roads, sand, mud, rivers, rocky terrain, etc. Like off-road tyres, A/T tyres have chunky lugs on the tyre tread, however, the lugs are tighter than that of off-road tyres. The chunky lugs on the tyre tread make it easier for the tyres to find traction on loose surfaces while smaller gaps between the lugs on the tyre tread reduce rolling noise on tarmac giving the user a tradeoff between varying degrees of surfaces. All-terrain tyres are usually made up of harder rubber making them more durable than standard road tyres in comparison. The sidewalls of these tyres are also usually reinforced to withstand impact from sharp rocks and other obstacles that can be encountered on off road trails.

Fig13: All-terrain Tyre

4.17 Mud

At the extreme end of the all-terrain tyre classification are mud tyres. These have massive, super-chunky tread blocks and really shouldn't ever be driven anywhere other than loose mud and dirt. The tread sometimes doesn't even come in blocks any more but looks more like paddles built in to the tyre carcass.

Fig14: Mud Tyre

4.18 Highway-terrain

Highway-terrain (H/T) tyres are usually found OE fitted in Indian made MUV & SUV. These are supposed to run mainly On Road and sometimes off road. Their tread blocks have less chunky lugs than A/T tyres. The sidewalls of H/T tyres are also usually reinforced to withstand impact from sharp rocks and other obstacles that can be encountered on off road trails.

4.19 Highway Luxury / Highway Performance

Highway-Luxury (H/L) or highway-Performance (H/P) tyres are usually found OE fitted in Imported or CKD/SKD premium SUV. These are supposed to run mostly On Road and rarely off road. Their tread blocks may be quite similar to those of Car tyre patterns. Such tyres may not be very effective in gripping loose surfaces like sand or mud. However they provide much better performance in On Road and offer highly comfortable ride at higher speeds. The rubber compound used on the tread is also usually that of car tyres which provides excellent grip braking power in On road application.

Fig15: H/L Tyre

5. CONCLUSION

It should be kept in mind that all four wheels of a vehicle should be equipped with one type of tyre, be it A/T tyres, Sporty tyres, Touring tyres or standard tyres. Different types of tyres on different wheels will provide varying levels of traction, which is dangerous in case of high speed driving, especially on slippery or undulated surfaces like those found in most roads in the country. Similarly, all tyres should also be of the same brand, same size and have exactly the same tread pattern so as to give the car balance in terms of its dynamic properties. One should also remember that using high performance tyres on a car that is not capable of reaching the levels of performance the tyres are meant for is a waste of money and will give no performance gains to the owners.

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