UNIT
5

Wheels and Tyres

Contents

KMY3UB

Learning objectives

1. Understanding of different tyres used in vehicles.
2. Understanding the stability of manufactured tubes and tyres.
3. Understanding how wheels are produced with stability and its suitability for use in the vehicle.
4. Understanding how the wheels and tyres withstand the weight of the vehicle on the road and stability of rolling on the road.

5.0 Introduction

It is well known that how important are the wheels and tyres in automobiles. The vehicle can be pulled even with no engine. However, without the wheels the vehicle cannot be moved at all. Furthermore, the wheels and tyres also carry the full load of the vehicle and give smooth ride. Besides that the wheels and tyres help in operating the vehicle in control with the help of the steering.

5.1 Requirements of the wheel

1. Wheel must to bear the full load acting on the vehicle.
2. It must to make the vehicle weight easy to move and steer easy.
3. It must to help to move the vehicle without the engine.
4. It must to withstand vibrations of the road.
5. It must to withstand the braking force when the brake is applied.

5.2 Properties of the wheel

1. It must be able to withstand the full load of the vehicle.
2. The wheels must be at equal in position while driving the vehicle and at rest as well.
3. The weight of the wheels should be less.
4. The wheels must be easy to remove from the axle and fix in the axle.
5. The wheels must be easy to control by steering mechanism.

5.3 Types of wheels

Generally there are three types of wheel. They are

1. Disc wheel
2. Wired wheel
3. Cast wheel

5.3.1 Disc wheel

This type of wheel is commonly used in all automobiles. The Figure 5.3.1 shows the photographic view of disc wheels. Because its structure is very simple and the construction is very strong and cost effective.

Figure 5.3.1 Shows the Photographic view of Disc Wheels

The disc wheel is made of two parts. They are

1. Rim
2. Disc

The structure of the disc wheel can be seen in Figure 5.3.1. The top part of the rim has the provision for fixing the tyre correctly. The disc is connected with the rim by welding. Depending on the size of the wheel and the disc the disc can be made as an integral part of the rim or separate ones. The part of the tyre which is used for place it on the rim is called as the tyre bead. The tyre cannot be removed or fitted if there is no pit in the rim. The tyre fitting area in the rim is generally in tilting angle between 5° and

15°. Therefore, when air is filled in the tyre, the bead makes a tight fit with the rim. In tubeless tyres this tilt structure acts as a tight seal.

The disc in the disc wheel does the work of the spoke. The wheel is fitted on the axle by the bolts. There are holes provided on the wheel disc as shown in the picture. Through these holes air is allowed to enter inside the brake drum and the air cools the brake drum. There is a gap provided for the wheel disc and a hole is made on the rim for placing the tube valve.

Figure 5.3.1.1 Rim and Disc

Advantages

1. The construction of the disc wheel is simple, durable and cheap.
2. Its maintenance is low.
3. It is suitable for all light and heavy vehicles.
4. No curves or bends occur on the wheel.

5.3.2 Wired wheel

Unlike the disc wheel, the hub is located at the center of the wheel and the rim is at the top separately. The rim and the hub are connected by the wires called as spokes. The structure of the wired wheel can be seen in Figure 5.3.2. We can find this type of wheels used in two wheelers such as bicycles and motor cycles. The spokes in the two wheels withstand the vehicle weight, pulling force and braking force. For withstanding these forces the spokes are connected between the wheel hub and the rim. There are splines made in the hub for fixing it on the hub axle. The weight of wired wheel is comparatively lower than the disc wheel and has high cooling efficiency and hence it is used in racing cars.

Figure 5.3.2 Structure of a Spoke / Wired Wheel

Advantages of wired wheel

1. It is lower in weight and has more durability than a disc wheel.
2. It allows the brake drum to cool very quickly and easily.
3. It can be fixed and dismantled easily whenever necessary.

Disadvantages

1. Maintenance cost is high.
2. There are possibilities for bends to occur in the wheel.
3. Tubeless tyres cannot be used because of the holes present in the rim for the spoke wires.

5.3.3 Cast wheel

The modern automotive wheels are generally made up of aluminum or magnesium alloy materials. Figure 5.3.3 shows the photographic view of a cast wheel. Cast wheels are mostly used in cars. The simple structure of this wheel can be seen in figure. Forged wheels are mostly used in heavy vehicles. These types of wheels are less in weight. The wheels made of magnesium alloy are 50% less than the weight of the steel wheel, and the aluminum alloy wheels are 70% less than the weight of the steel wheel. Even though the weight is lower than that of steel wheels these wheels have the strength which is equal to the steel wheels. These metal alloys have the ability to transfer heat and reduce the heat generated in the tyres or brakes. Moreover these materials are used for manufacture the wide rims. This gives more vehicle stability. Magnesium alloy material has the ability to withstand heavy loads. It could also withstand more vibrations and shocks occurred in vehicles.

Figure 5.3.3 A view of Cast Wheel

5.4 Wheel Dimension

The measurement of wheel dimensions could be seen in the Figure 5.4. The wheel dimension has the following letters represented as

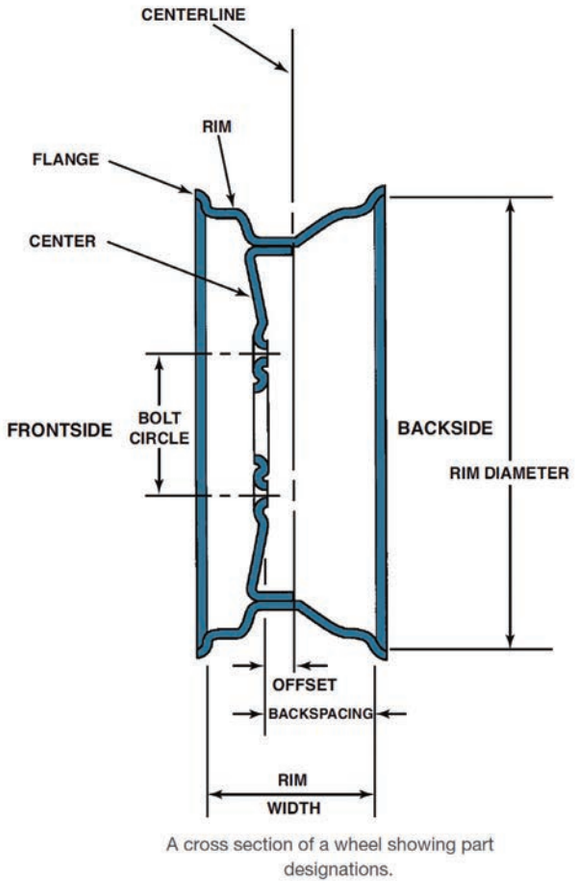


Figure 5.4 Wheel Dimensions

'W' - Width of the wheel.

'D' - Diameter of wheel.

'C' - Type of rim.

Wheels are shown by code number. For example, if the code number of the wheel is given as 5.50 B-13 and 4 ½ J-14 then, it indicates the terms as below.

Wheel Dimensions

Width (W)	Rim type (C)	Diameter (D)
5.50"	B	13"
4 ½"	J	14"

5.5 Tyre

Tyre is fixed on the rim of wheel in the vehicle. The tube in the tyre is filled with air. The tyre carries the weight of the vehicle and gives smooth ride to the vehicle.

5.5.1 Types of tyre

The tyre are classified into the following types,

1. Solid tyre
2. Pneumatic tyre
3. Bullet proof tyre
4. Liquid filled tyre

Solid tyre

This type of tyre is a hard one made up of special type of rubber. There is no tube in it. As it is a solid one it does not withstand vibrations. Hence this type of tyre is mostly not used in automobiles.

Figure View of a Solid Tyre

Pneumatic tyre

This type of tyre is used commonly in all automobiles. The air is filled in the tube of the tyre and hence the tyre is called as pneumatic tyre. The photographic view of a pneumatic tyre can be seen in Figure.

Figure Photographic view of a Pneumatic Tyre

The pneumatic tyre can be classified into two types. They are

1. Tyre with tube
2. Tubeless tyre

Tyre with tube or conventional tyre

The tube assisted tyre is called as the tube tyre. The photographic view of a tube tyre. The cross sectional view of the tube tyre can be seen in the Figure.

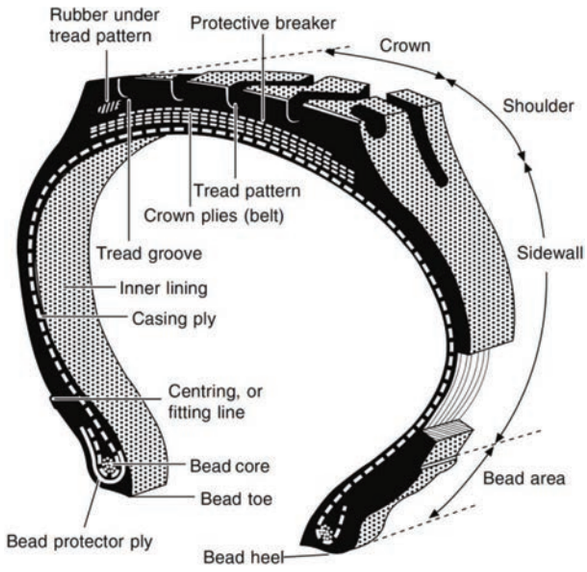


Figure Construction of a Tube Tyre

Tubeless tyre

This tyre does not have any tube inside it. In this type of tyre, the tyre is directly fitted on the rim. The cross sectional view of the tubeless tyre can be seen in the Figure.

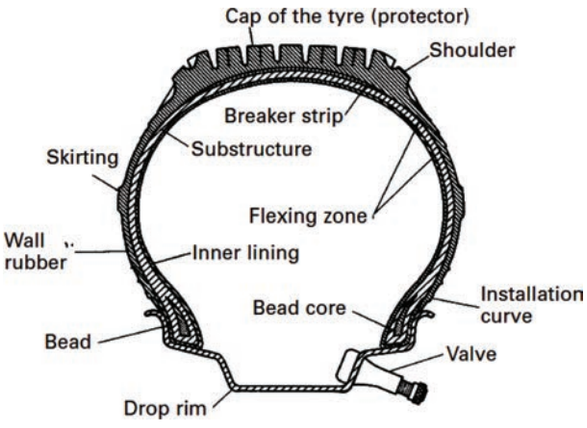


Figure Construction of a tubeless tyre

Advantages

1. Simple in structure.
2. In case of puncture, the tyre can be repaired without removing from the rim.
3. The tyre needs no tube.
4. Maintenance is low.

Bullet proof tyre

In this type of tyres even if the tyre is punctured by the bullet, the air pressure inside the tyre does not decrease and the puncture is automatically corrected by the tyre itself. This type of tyre is used in military vehicles.

Figure Photographic view of the bullet proof tyre

Liquid filled tyre

In this type of tyre the mixture of 15% of calcium chloride 85% of water is used to fill the tyre for about 75% of the total capacity of the tyre. This type of tyre is used in some heavy vehicles and tractors.

5.6 Properties of tyre

The following are the important properties of the tyres

1. It should be more comfort for traveling.
2. It should be able to withstand vibrations of the road sides.
3. The tyre should give stability to the vehicle when the vehicle is negotiating a turn.
4. Vehicle should stop immediately by creating the friction without any slip when applying the brake.
5. It should be able to give very less rolling resistance.
6. The tyre must provide safety to the vehicle when the vehicle moving on the road.
7. The tyre must work for a long period.

5.7 Functions of the tyres

1. It withstands the whole weight of the vehicle.
2. It creates the friction on the road and helps to roll the wheel on the road.
3. It gives road stability for the vehicles.

4. It withstands the vibrations of the vehicle when the vehicle is going on the bumps and pot holes.

5.8 Tyre construction

It consists of the following four parts. They are,

1. The bead region
2. The side wall region
3. The shoulder region
4. The tread region

5.8.1 Bead

Bead is a part of the tyre which is used to fit the tyre on the wheel rim. Bead is made of a circular metal wire placed on both sides of the tyre. In the tyre beads one or more metal wires are covered strongly by the thick nylon or rayon threads around the metal wires. Tyre beads help to keep the tyre shape unchanged.

5.8.2 Side wall region

The side wall of the tyre is constructed to be very flexible. The vertical area between the tyre bead and tyre tread region is called as the side wall region. Wheel tube is fitted inside this region. The tyre marks are made in this side wall area only.

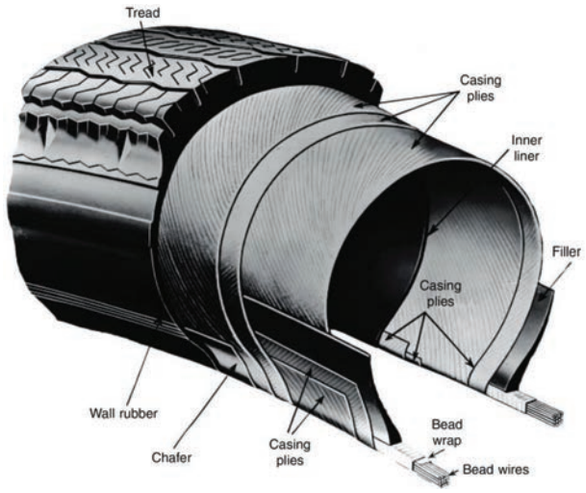


Figure 5.8 Tyre construction

5.8.3 Shoulder region

The horizontal area of region connecting the side walls and the tread is called as the shoulder region. This shoulder region creates a slightly curved look for the tyre area.

5.8.4 Tread region

The top area on the periphery of the wheel that is in contact on the road surface is called as the tread region. For giving good grip on the road, there are different shapes of cross grooves available on this region.

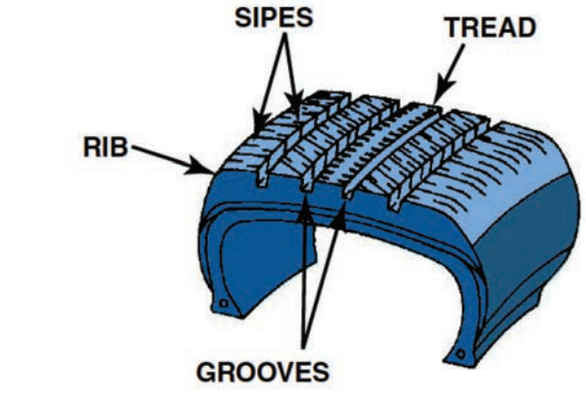


Figure 5.8.4 Tread pattern of a typical tyre

5.9 Tread types

The tread region present in the tyres is of three types. They are

1. Stud type tread
2. Symmetrical type tread
3. Winter type tread

5.9.1 Stud type tread

This type of tread is used in the front tyres of the normal Jeep and tractor. The tyre has small button shapes to be present on the circular area of tyre.

5.9.2 Symmetrical type tread

This type of tread is used in the wheels of light duty vehicles and cars. The cross section of the tread in this tyre is bent over the surface on the circumferential surface of the wheel.

5.9.3 Winter type tread

This type of tread is made on the rear wheels of special vehicles such as tractors and earth movers. The buttons of the tread in this tyre are very large and very height.

5.10 Ply rating

The part of the tyre which is made of cotton or nylon or rayon threads threaded to the tyre is called as the ply of the tyre. As all the plies are wound tightly on the round bead wires which are made of steel the shape of the tyre is not changed. It is always circular in shape.

The strength and thickness of the tyre depend on the number of plies present in the tyre. Increasing the plies increases the strength of the tyre. Scooter, motorcycle and bikes have the tyres with less plies

and the cars have the tyres with more plies. In heavy vehicles the ply rating is more than to that of the car tyres. The air pressure and the tyre size are defined based on the tyre plies. Ply rating is the number which generally indicates the strength and the stability of the tyres.

5.10.1 Tyre size marking

For example at the sideway of the tyre if the tyre is marked as 3.5" x 10" x 4 PR, which represents the tyre size marking. The tyre size is marked as indicated below.

Width of the Rim	Diameter of the Rim	Strength of the tyre
3.5"	10"	4 PR

Note: PR – Ply Rating

5.11 Types of tyres based on carcass

1. Radial ply tyre
2. Cross ply tyre
3. Bias ply tyre

5.11.1 Radial ply tyre

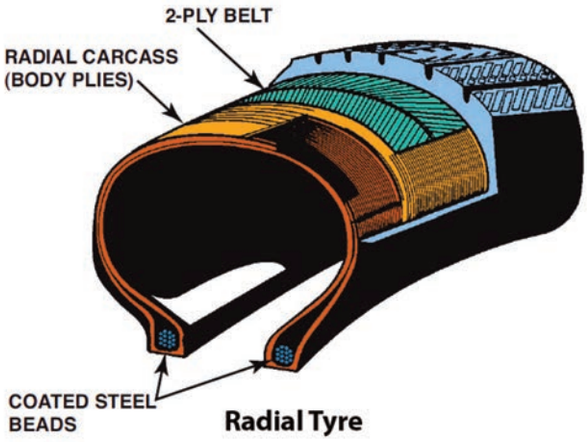


Figure 5.11.1 View of a radial ply tyre

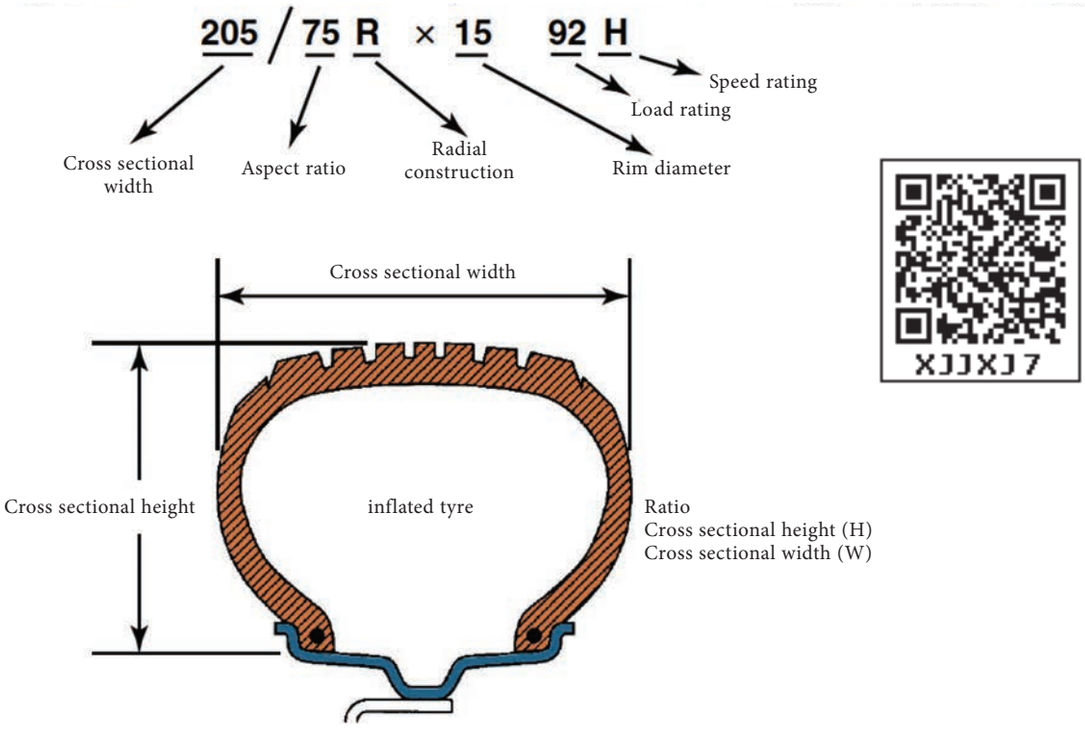


Figure 5.10.1 The tyre specifications.

The nylon or rayon layers which connect the beads on both sides of the tyre are arranged in the same direction. This type of tyre is called as radial ply tyre. In this type of tyres the stability and comfort are more. However, while negotiating a turn on the bends of the road the stability of the tyre is less. Figure 5.11.1 shows the view of a radial ply tyre.

5.11.2 Cross ply tyre

Nylon or rayon layers that connect the beads on both sides of the tyre are arranged in the opposite (at the angle of 40° to 45°) direction. This type of tyre is called as cross ply type tyre. As the tyre is made the plies with cross winding the tyre gets more strength. A view of the cross ply tyre can be seen in Figure 5.11.2.

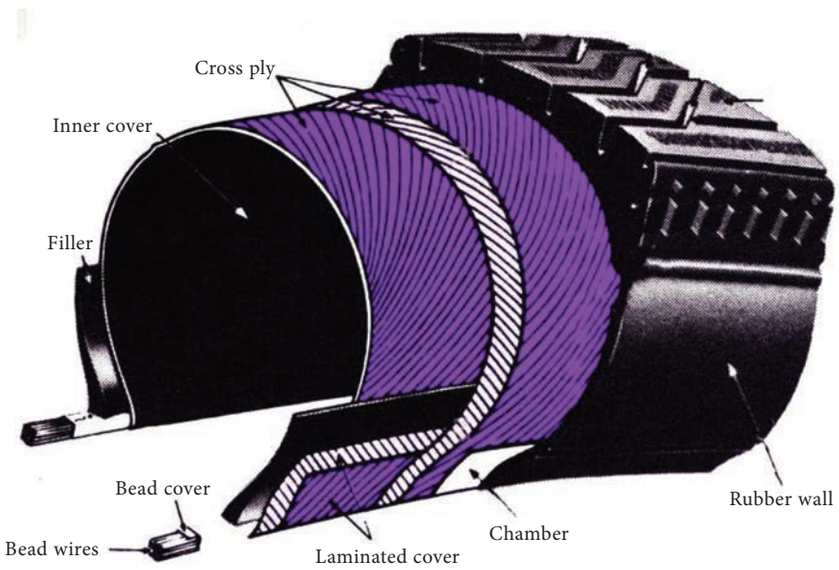


Figure 5.11.2 View of the cross ply tyre

5.11.3 Bias ply tyre

The combination of the tyre construction with radial ply tyre and cross ply tyre is said to be the bias ply tyre. This type of tyre is very strong and has more stability. Figure 5.11.3 shows the concept of bias ply tyre.

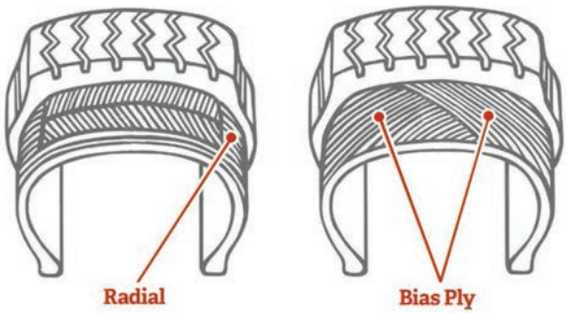


Figure 5.11.3 Bias Ply concept

5.12 Load rating

The tyre's strength, tyre dimensions and it's load carrying capacity are represented by the term called as the load rating.

5.13 Tyre pressure

The air stored at high pressure inside the tyre withstands all the loads

acting on the vehicle. If the air pressure is high or low from its specified pressure then there will be negative effects which will be caused by the tyre to the vehicle. Hence, based on the ply rating, vehicle speed and the load of the vehicle, the air pressure is mentioned or recommended by the vehicle manufacturer.

5.14 Selection of the tyre

The tyre selection for any vehicle is based on the following considerations

1. It should work for a long time.
2. The price of the tyre should be low and should have good quality.
3. The tyre must have the required tread pattern and ply rating for the specific application.
4. The tyre must have the good quality rubber mixture.

5.15 Tyre wear

The tyre wear occurs due to the following reasons,

1. Due to the pressure of the air filled in the tyre is lower or higher than its specified pressure
2. Due to the reasons of suddenly and frequently applying the brake.
3. If the wheel is not fixed properly on the axle.
4. If there are wear on the bearings of the wheels.
5. If the vehicle carry's more loads.
6. The wheel alignment angles such as caster and camber are not set correctly as per the recommendations.
7. If the load on the vehicle is not balanced.

5.16 Maintenance of Tyre

The long life of the tyre could be possible by proper maintenance of the tyres. The following are the points to be followed for good tyre maintenance.

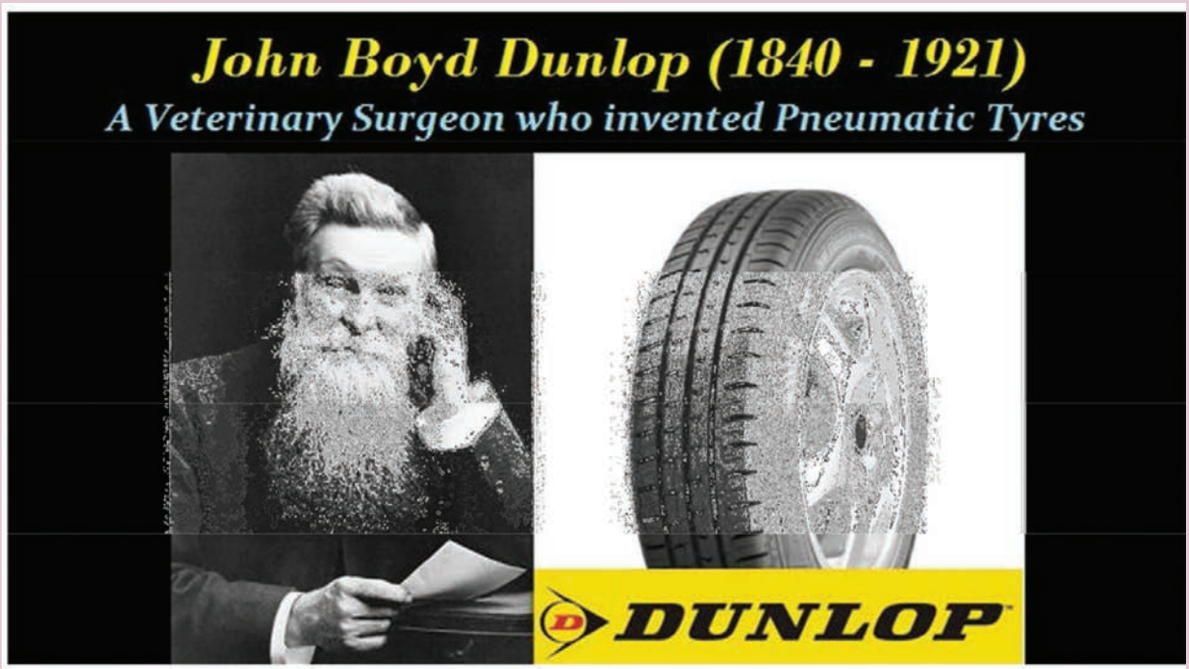
1. The required amount of air should be filled and maintained correctly.
2. The air pressure has to be checked by using the pressure gauge at least once in a week.
3. If there is any grease or oil present in tyre, it must be cleaned.
4. The tyre should not be overloaded.
5. Often braking the vehicle or unnecessarily braking during high speeds of the vehicle have to be avoided.
6. The vehicle should not be turned quickly when running on bends.
7. The tyre must be checked for its position on the axle whether it is placed on the rim with straight and stable condition or not.

5.17 Tyre repairs and rectification methods

Repairs	Repairing methods
Tyre wear on one side	Correct the wheel alignment
Tyre wear at the center	Maintain the tyre pressure.
The tyre pressure reduced often	Valve in the tube should be corrected
Explosion or scratches occurring in tyre.	Should carry specified load
Tyre wear occurring soon	Correct the wheel alignment

DO YOU KNOW?

In 1888, John Dunlop invented the air-filled or pneumatic tyres.



5.18 Tube

A blanket cover like part which is used for storing the air inside the tyre is called as the tube. It is made up of natural or synthetic rubbers. For injecting and releasing air in the tube, tube valve is used. It is a one way valve which helps to send air to the tube but not allows the air to release or return from the tube.

5.19 Uses of tubes

1. They store the required amount of air.
2. They provide smooth travel for the vehicles.
3. They withstand the weight of vehicle.
4. They withstand the vibrations occurred in between the road and vehicles.

5.20 Puncture

If any sharp objects or things like nails stab the tyre and make the air to leak, then we call it as tyre puncture.

5.21 puncture recovering

The method of repairing or rectifying the effects caused by the holes in the tube or any cut injury in the tube is called as puncture repair. The tube puncture is repaired by three different ways. They are

1. Hot patch method
2. Cold patch method
3. Vulcanizing

5.21.1 Hot patch method

For this method a vulcanizing machine is required. This type of method is often used for repairing large size punctures, tube bursts, and in replacing the mouth in the tube. To repair the puncture, the punctured area on the tube is first noted. The punctured area was rubbed with the help of an emery / file sheet for some and a rubber solution is pasted on it. Based on the size of the puncture hole a small piece of rubber tube was cut and pasted on the punctured area. The pasted area is then placed on the vulcanizing machine and clamped. By supplying the power to the vulcanizing machine by switching on the machine the heating element in the vulcanizing machine heats the punctured area under pressure and makes the hole closed.

5.21.2 Cold patch method

Using an emery sheet or file the punctured area is rubbed on the tube. The rubber paste is applied on the rubbed area and dried for some time. Based on the size of the punctured hole a small piece of rubber tube is binding sticker is pasted on the hole. Nowadays the binding stickers are available for specified sizes also. Mostly small sizes of punctures are repaired by this method.

5.21.3 Vulcanizing

If there is a small hole in tube, it can be repaired by using any one method as discussed above. However, if the hole is very large, or more air is leaked from tube valve, we have to go for vulcanizing method for repairing the puncture. To perform this, initially the both damaged area on the tube and rubber to be pasted are rubbed well. Then the vulcanizing paste is applied on both the rough areas of the tube and the sticker and left for some time to dry. The dried rubber sticker is now pasted on the rubbed area of the tube and pressed well. The pasted tube is now kept on the vulcanizing machine and tightened. Now the vulcanizing machine is switched on and left it for heating the tube area until the indicator light starts to lighten. Then the machine is switched off and the tube is removed from vulcanizing machine. Figure 5.21.3 shows the method of vulcanizing.

Figure 5.21.3 The method of vulcanizing.

5.22 Tube damages and repairing methods

Causes	Remedies
Air leaks in the tube automatically	Correct the tube valve or puncture in the tube.
Oftenly tube puncture	Change new tube.
Tube wear quickly	Fix the flab in between tube and tyre.
Tube bursts	Load the vehicle according to the recommended weight.

5.23 Tyre rotation

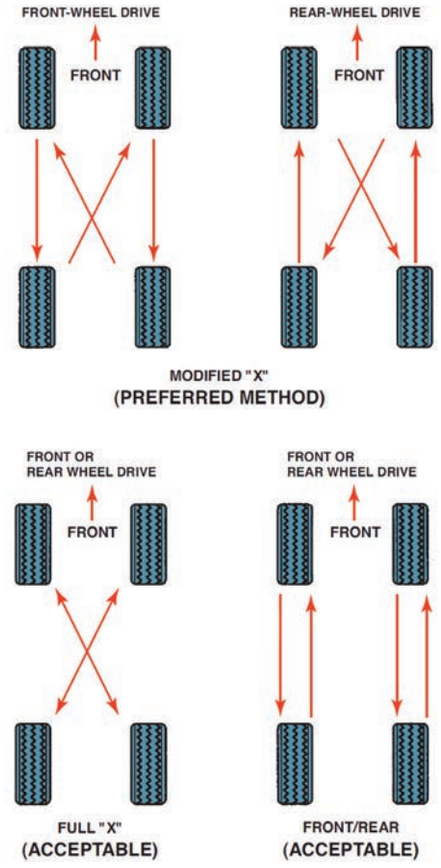


Figure 5.23 Wheel Rotation procedure

In general the tyres in the vehicle are subjected to wear but the amount of wear on the four wheels is not uniform. The tyres in the rear wheels of the vehicle wear more quickly than the front wheels due to the power transmission to the rear axle. Right side wheels generally wear twice in amount than the left wheels. Hence, based on the manufacturers' guidelines tyres are rotated and fitted in the vehicles after the vehicle is travelled to certain kilometers. In cars and commercial vehicles for about 8000 km of the vehicle's travel the tyre is changed based on rotational mode.

The right side of the rear wheel tyre is changed to left front tyre. Left side front tyre is changed to right front tyre. The right front wheel is kept as a spare wheel. The other wheel is changed to right rear wheels. This method of changing the wheels is called as tyre rotation. The figure 5.19 indicates the method of tyre rotation.

5.24 Wheel balancing

If the wheels are allowed to rotate then must rotate uniformly and smoothly without any vibrations. If there is no proper rotation of the wheels the weight of the rim must be balanced for uniform rotation of the wheels and this is method is called as wheel balancing. The rim weight is adjusted by moving different lead metal weights on the rim. Figure 5.24 shows the balance weight placed on the rim

Figure 5.24 Wheel balancing

Advantages of wheel balancing

1. It reduces the tyre wear.
2. It helps in steering the vehicle easily.
3. It reduces wobbling of the vehicle.

Types

1. Static balancing
2. Dynamic balancing

Student Activity

1. Send the students to vulcanizing workshops for observing puncture repairing methods and ask to submit the report.
2. Send the student to workshop for finding the wheel rotation and ask to draw cross sectional view.

Glossary

1.	Wheel	–	சக்கரம்
2.	Hot patch	–	வெப்பப்படுத்தி ஒட்டுதல்
3.	Cold patch	–	குளிரவைத்து ஒட்டுதல்
4.	Vulcanizing	–	வல்கனைசிங்
5.	Wheel balancing	–	சக்கரங்களை சமநிலைப்படுத்துதல்
6.	Spokes wheel	–	கம்பி சக்கரம்
7.	Tyre ply	–	டயரின் அடுக்கு
8.	Cast wheel	–	உருக்குச் சக்கரம்
9.	Disc wheel	–	தட்டுச் சக்கரம்
10.	Dynamic balancing	–	இயக்க நிலை சமன்படுத்துதல்

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Evaluation

AG6S93

PART - A

One mark questions

Choose the correct answer

1. Which one of the following indicate the solidity of the tyre
   a) Carcass
   b) bead
   c) tread
   d) ply

2. Specify the type of tyre which uses the tube
   a) Solid Tyre
   b) Tubeless Tyre
   c) Tubed Tyre
   d) Liquid Filled Tyre

3. The cause of wear in the center portion of tyre is due to the
   a) Low Air
   b) High Air
   c) Wear On Bearings
   d) None Of These

4. If there is an occurrence of leakages in tubes then it is called as
   a) Vulcanizing
   b) hot batch
   c) puncture
   d) tread

5. The basic construction of tyre is said to be
   a) Ply Rating
   b) Tread
   c) Bead
   d) Carcass

6. Types of tyres is.
   a) 2 b) 3
   c) 4 d) 5

7. It is connects the rim with hub.
   a) Wheel
   b) Spokes
   c) Tyre
   d) Tube

8. How many types of treads?
   a) 2
   b) 3
   c) 5
   d) 4

9. Tyre ply rating means
   a) wheel dimension
   b) tyre dimension
   c) tube dimension
   d) tyre strength

10. It is placed at both edges of the tyre.
   a) Bead
   b) Car cass
   c) Ply rating
   d) Tread

Part - B

Three mark questions

1. What is the working of wheel?
2. What is the working of tyre?
3. Answer any two maintenance of the tube.
4. What is meant by carcass?
5. What will happen if the air pressure is low in tyre?

Part - C

Five mark questions

1. Draw the disc wheel diagram and mention its parts.
2. Give any five reasons for wear occurrence in tyres.
3. Describe the tyre rotation?

Part - D

Ten mark questions

1. What are all the methods of repairing puncture of wheels? Explain any one method in detail.
2. Tabulate the faults occurred in tyres and repairing methods.