AAEE

ADVANCED
AUTOMOTIVE
ENGINEERING
EDUCATION

AUTOMOTIVE SAFETY AND SECURITY

Together for Road Safety

INDEX:

INTRODUCTION

All type of vehicles are modes of transportation, and they are among the necessities and basics of our present time and cannot be dispensed with and refer to other old alternatives.

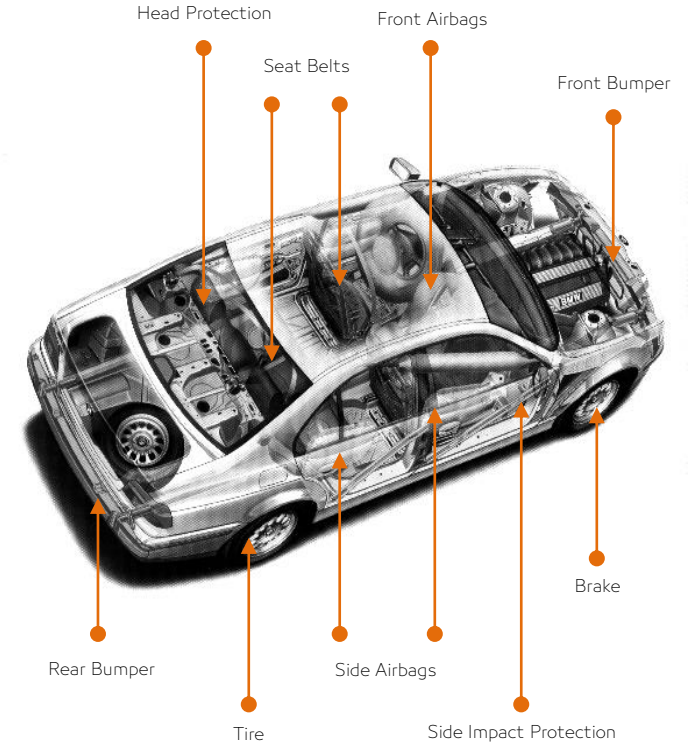
During the past few decades, the automotive industry and technology has developed, but like any other industry, it is not free from risks and side effects. Therefore, Automotive manufacturers are striving to take vigorous steps to reduce as much as possible these risks and side effects by using safety and security systems.

SAFETY AND SECURITY SYSTEMS

All type of vehicles have safety systems and passive systems and specifications in order to avoid vehicle users and road users the risk of accidents as possible, and these specifications and systems differ from one vehicle to another.

However, all automotive companies have long ago applied programs to test their vehicles' ability to withstand collisions and maintain the safety of the driver and passengers.

All Automotive companies apply safety researches that includes simulation of accidents and collisions with the help of computers, as well as real crash tests.



AUTOMOTIVE BODY

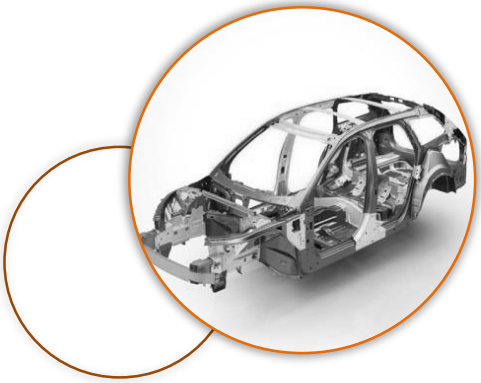
Automotive structure is newly designed in a more sophisticated way than before, so that it greatly contributes in reducing the risk of injury when collision occurs from all sides, by containing the structure of a strong and anti-collision passenger compartment and side protection areas.

We can divide the body of the vehicle into three parts, namely:

Front Structure:
To ensure the maximum protection for occupants, this chassis contains the main features in many vehicles, including a light structure to absorb the collision impact to the lowest degree from the front. Another structure is stiffer to absorb violent shock forces in order to reduce the risk to passengers as little as possible.

Middle Structure:
This structure is designed to be very strong and rigid to absorb the large impact of collision and provide sufficient space for the occupants so that passengers lives are not threatened.

Side Structure:
This body is designed to absorb the actual impact of collision that might result from any accident to the vehicle and provide additional protection to head, neck and chest injuries. The closed section of the roof, front, rear and side pillars are parts of an integrated structure that contribute to the protection provided by the doors, and the availability of support structures in the floor and in the roof of the car are also important for bearing weight and absorbing collision impact.



BRAKE SYSTEM

Brake system is one of the main safety factors in all vehicles. That's why the brake system is now designed to withstand wear, even under extreme stress when high speeds or sudden deceleration occur.

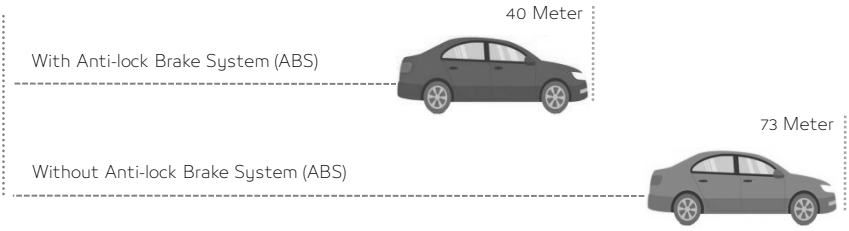
The modern brake system is equipped with a large booster device, a larger diameter master cylinder, and thicker and larger discs, which provide high performance that reduces the need to press the brakes hard and works to absorb energy and resist thermal pressure when pressing the brakes with great force.

Anti-lock Brake System (ABS):

The aim of this system is to ensure that the vehicle's tires are not locked in a dangerous emergency or if the brakes are suddenly pressed when the driver encounters any sudden situation.
When the brake closes, its effectiveness decreases and the driver loses the ability to control the vehicle, causing the vehicle to deviate dangerously. In vehicles equipped with anti-lock braking systems, the driver retains his ability to steer the vehicle and contributes to its stability and stability on the road even when the brakes are pressed hard. This system also reduces the distances that the vehicle stops at when the brakes are applied.

The system works through computer sensors that control the tire speed. Devices are placed at each tire to monitor its rotation movement. The devices monitor any imminent locking of the brakes and prevent their occurrence by reducing the brake pressure at the concerned tire. The best use of the anti-lock braking system is available to you when you fully depress the brake pedal, in which case you can control the vehicle in its lane.

Stopping distance of the vehicle at speed 100 km/h.



TIRE

Tire types:

An automobile tire is a structural tube of fabric or steel mesh mounted on the wheel and inflated with air to transmit the driving force through friction. The tires support the overall weight of the vehicle, and the tires have another function, which is that they reduce road turbulence and give passengers comfort.

Radial tires:

The Radial-ply tire carcass consist of layers of cords bonded together with rubber perpendicular to the circumference. This construction gives the tire great flexibility in the redial direction.

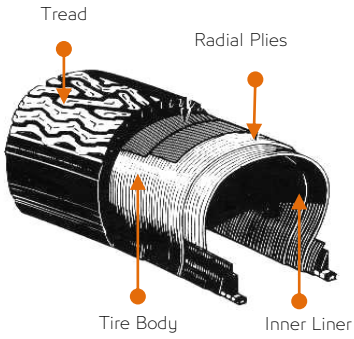
The advantages of radial tires are:

- Less wear out
- Better road stability
- Puncture resistance
- Less heating

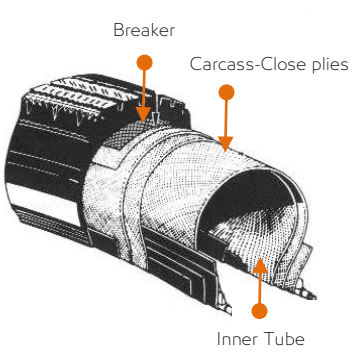
Bias tires:

The Bias-ply tire carcass is made up of alternating lever of ply cords bonded together, and lying at an angle of 30-40 degrees relative to the tires circumferential centerline.

Radial Tire



Bias Tire



Number of layers per frame

There are symbols in the tire wall indicating the number of layers to indicate the bearing rate of weights for each tire. The greater the number of layers, the greater the tire's bearing capacity, noting that the number in any frame ranges from 2 to 8 layers.

Tubeless Tire and Tube Tire

Tubeless tire:

This type of tire does not have an inner tube on its wall, as the air pressure is maintained by the inner lining of the tire, noting that this liner is made of thick rubber that does not allow air leakage and the air valve for this type of tire is installed in the wheel direct.

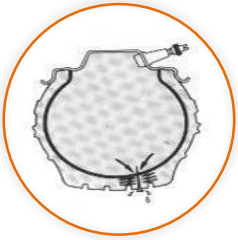
Tube tire:

This type of tire has an inner tube that is filled with air and an air valve is attached to it and in the event of a perforation of the tire it deflates the air quickly.

Features of tubeless tire:-

- Reduce the risk of tire blowout.
- Slow air leakage in case of a tire puncture.
- Better heat dissipation.

NITROGEN GAS:



The air we breathe contains 78% nitrogen and 21% oxygen, and the rest is small amounts of other gases. The defect of tire effectiveness, is one of the most common causes of tire bursting.

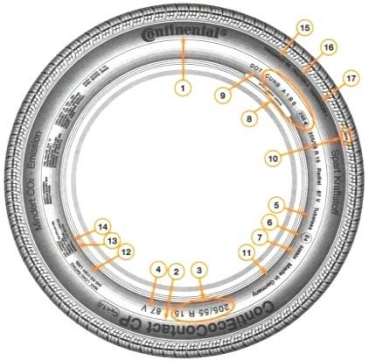
The advantages of using nitrogen gas: -

- Better tire pressure retention.
- Reduces tire burst by 60%.
- Improves fuel economy
- Extends the life of the tires.
- Reduces tire temperature rise by 20%.

Tire information and symbols

The position of the vehicle and its movement on the road is secured by the tires, the air in the tires supports the weight of the vehicle, and absorb shocks when driving. The air inside the tire acts as a spring to the vehicle when starting and stopping through the friction between the tire and the road. The steering wheel rotates the front tires, which helps the vehicle to move in the required direction. If we look at the tire wall, we find on it many information and symbolic letters that give the identity of that tire. the symbol of tire load index, speed symbol and mention of the regular air pressure that is mentioned on the tire wall are very important information for the tire to work under the specified load safely and to extend its life.

Tire heat tolerance symbols	
A	Hot area
B	Medium weather areas
C	Cold area

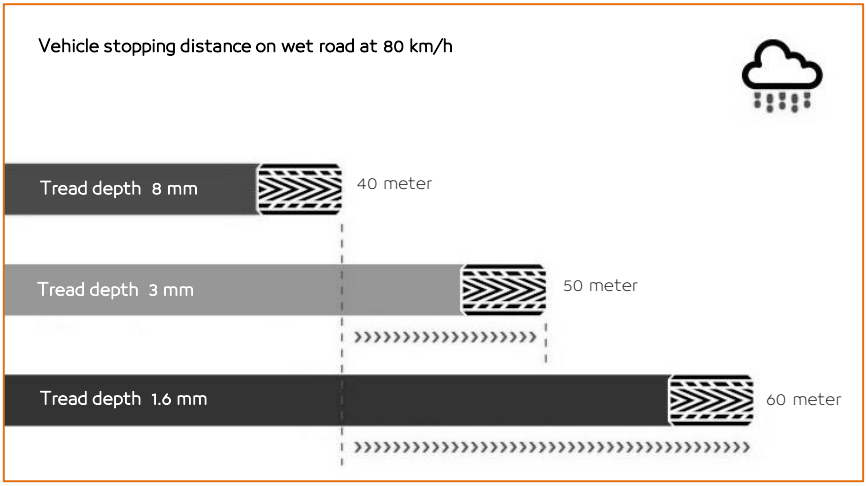


1	Manufacturer logo	9	DOT
2	Product name	10	Tread wear indicator
3	Size designation	12	Country manufacture
4	Load index	13	Loading index
5	Tubeless	14	Tread type
6	Code	15	Inflation pressure
7	Approval number	16	Traction
8	Manufacture date	17	Temperature

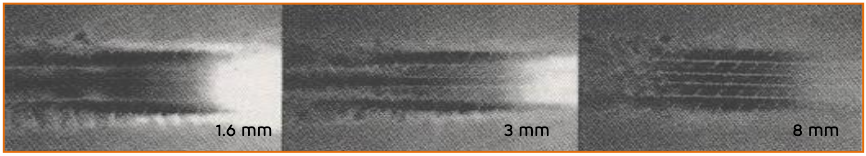
Tire tread depth:

The vehicle slows down and stops when friction is generated between the tires and the road surface, and the degree of brake force depends on: (Road surface, tire type and tire components) and brake performance depends on the coefficient of friction, so the smaller the tread depth is the less friction between the tire and the road.

The table below shows how it is necessary to check the tire depth, given that the braking distance of a tire scanned with a tread length of 1.6 mm is much longer than a tread length of about 8 mm. Therefore, we recommend changing the tires when the tire tread reaches 2 mm, to ensure safety and security for you and the road users.



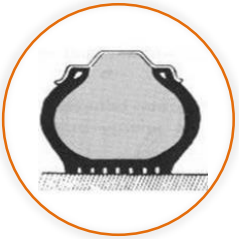
Tread depth and tire track mark		
100 %	50 %	25 %



TIRE PRESSURE

Air pressure enables the tire to carry and support the vehicle, and one of the most important information given in the tire is the air pressure and it is usually mentioned on the tire wall and on the side of the driver's door or in the vehicle's manual. The amount of air pressure is measured based on the tire size, the shape, the inner fabric materials and the speed to be reached, The air pressure is adjusted according to the road and the method of use.

The quality of the tire and the extent of compliance with the tire air pressure not only affect the life of the tire, but also the comfort in driving and first of all on safety. The incorrect air pressure of the tire is often the cause of defects that appear in it. Moreover, it greatly affects the stability of your vehicle on the road. Therefore, the tire pressure must be appropriate and the air pressure must be checked when the tires are cold to obtain the maximum degree of performance.



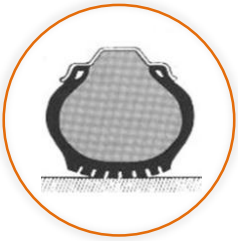
Tire pressure results:

Suitable Air Pressure:

- Guaranteed safety when driving.
- Control the ride, especially when you brake.
- Stability of the vehicle on the road.
- Extends tire life.

Air pressure lower than required:

- Causes overheat in the tire, causing it to explode.
- Decreases tire life.
- Leads to wear out in the tread on both sides.
- More fuel use.
- Causes a sound when turning.



More air pressure than required:

- The tire is more likely to wear out and tear.
- Affects the tire's ability to brake.
- Leads to uncomfortable driving.
- Corrodes the tread at the center.
- Reduces the tire's friction with the ground, resulting in uncontrolled ride.

TIRE ROTATION:

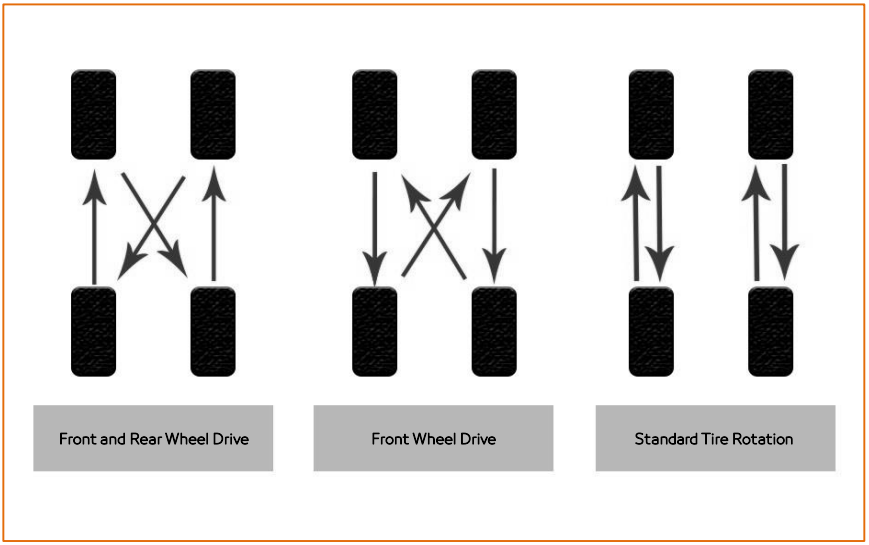
Correctly weighted wheels improve handling and reduce tire wear out. The front tires are subjected to a road friction force that differs in nature from that of the rear tires because they are steered.
The friction force of each tire differs from the other, even if the front or rear is due to use or the presence of a mechanical failure and to avoid tire wear out and to extend the life of the tires, All companies are advised to change their places (Rotation) periodically every 10,000 kilometers.

If you are driving your vehicle and it is not balanced, can you know the source of the vibration?

- If the steering wheel jumps, the two front tires are out of balance.
- If the vehicle seats are shaken, the backs are not balanced
- Wear out may be caused by mismatches in tire and tire angles.

Advice:
Vehicle imbalance can cause a disaster, especially during braking.

Tire Rotation



HEAD REST:

The head restraints are designed to protect the neck from injury that may occur during a sudden stop or a slight rear collision, as well as in a strong collision. In the event of a rear shock, the seat cushion will receive pressure and keep the passenger in place, and the risk in this case is the risk of severely bouncing the head back, so automotive companies have created a headrest for every passenger to protect the neck from fracture.

Correct headrest position:

- Place it directly behind your head, at least level with your ears.
- Do not move more than 10 cm from the head restraint when you are sitting normally.

Notes:

Statistics and reports confirm that using the correct headrest reduces head injuries by 25% due to a rear collision, all other factors holding steady.

Head injuries can occur at very low speeds (10 km/h). For the headrest to have a good effect it must be placed directly behind the head.

Headrest performance stages during a rear accident

1

2

3

SEAT BELTS:

Seat belts:

Seat belts are one of the basics of the vehicle's occupant protection systems. The seat belt locks are designed in a special way so that the position of the belt remains correct regardless of the position of the seat. Also, some vehicles are equipped with seat belts that can be adjusted in height, which ensures that the belt design is correct and appropriate to the size of the passenger. Some other belts are provided with devices for determining the weight and the pre-tensioning feature.

What is the correct way to fasten the belts?

- Pull the seat belt across the thighs and never place it over the stomach.
- Place the shoulder strap across the chest, never place it under the shoulder.
- Do not loosen the seat belt more than 3 cm.
- Sit up straight on the seat.
- The seat belt must be tight close to the body.
- Do not place the shoulder strap under your arm and make sure that the seat belt is not threaded.

Safety belt tips:

- Seat belts must be worn at all times and properly tightened.
- An incorrect seat belt can result in serious injury to passengers.
- Seat belts may not provide you with protection if the seatback is reclined, your legs are bent under you, or your back is away from the seat.
- Sitting in a not upright position while the vehicle is moving is dangerous. If the seatback is overturned, the seat belts will not be able to function properly even if they are fastened.
- The presence of an air bag in the vehicle does not dispense with the seat belt, but the air bag is only effective when used in conjunction with the seat belt.

SEAT BELTS:

Seat belts are your first line of defense against injuries or deaths. All safety studies confirm the fact that seat belts are by far the safest method. Everyone needs safety and security while riding in the vehicle, children and infants need more care and attention. Many children inside vehicles are exposed to injuries due to the lack of attention to safety systems and belts and their own.

There are many factors that should be taken into consideration, including the difference in ages and the choice of a child restraint system according to his age and size. There are three seats for children, namely: 1- The infant seat 2- The children convertible seat 3- The adult child seat.

Child Safety Tips:

- The rear seats are safer to seat children of all ages.
- Safety belts are not suitable for young children. Special safety seats must be used for them.
- Do not carry a child when driving.
- Do not place a child in the front seat where the air bag is located.
- Get used to put the child in his car seat, even if it is a short distance.

Tips for pregnant women:

Seat belts are designed to protect everyone, including pregnant women. Pregnant women may be exposed to injuries if they don't wear seat belts. A pregnant woman should use a stone/shoulder belt and it must be reduced to the maximum possible throughout the pregnancy period. Maternal protection is the best way to protect the fetus and the important point that pregnant women and every person should take into account to wear seat belts in the correct way.

- Move the seat back as far as possible.
- Limit travel, especially during the last months of pregnancy, to avoid accidents.
- Whenever possible, try to be a passenger, not a driver.

Note:

- Seat belts and airbags are designed to provide the best protection for all occupants.
- Seat belts save 50% of injuries.
- Seat belts with air bags save 75% of injuries.

AIR BAGS :

The air bags are an additional protection system called an acronym (SRS), where we often find this symbol written on the steering wheel as well as on the sides of the dashboard and seats in some vehicles.

Front air bags are designed to inflate in the event of a frontal or side collision on the front side, while the side air bags are designed to inflate in a side collision with a vehicle. The air bag does not inflate unless the collision force exceeds the operating level designed for the system, and this level varies according to different vehicles designs. In the event of a collision, the air bag sensor system realizes the vehicle stopped suddenly or senses a side collision effect in the event of an accident from one side, and the sensing system releases the air bag at an extremely fast speed of about 5 to 10 milliseconds.

Seat belts should be used in conjunction with air bags that are designed to enhance the protection provided by seat belts. The air bags distribute the shock force more widely over the upper part of the person sitting in the seat and stop his body more gradually.

The front air bag system has been added as a complement to the initial protection of the seat belt systems for front seat passengers, who are most vulnerable to serious injury or death due to the inflation of the air bags if they do not wear the seat belts properly.

In a sudden collision, the driver and front passenger who are not fastened with seat belts can push forward in the face of the air bags that inflate upon collision. For maximum safety in accidents, the driver and all passengers in the vehicle should wear the seat belts properly.

Properly wearing seat belts reduces the chance of injury and death or being thrown out of the vehicle during an accident. The side air bags open independently of the front bags and the operation of the seat belt devices.

Air bag performance:

During the past years, vehicle manufacturers have made sure that the two airbags for the driver and front passenger are designed to be compatible with the use of seat belts. This means that the front air bags will not open in collision situations where the seat belts provide adequate protection. The air bags open in the event of a serious frontal collision or a front side collision that could cause serious injury.

How do air bags work?

The air bags are released by a small computer called a sensor and diagnostic device. This highly sophisticated device senses changes in the vehicle's structure to detect any frontal collision and is able to distinguish between a minor accident and a severe collision. Side-to-side crashes usually cause the same amount of serious injuries and fatalities as frontal crashes. A side collision is more violent and dangerous due to the passenger's proximity to the door and the object into which it strikes. Side collisions fall into two categories: The first category includes accidents that occur between one vehicle and another at a road crossing, while the second category includes accidents that occur while driving at high speed and occur when the car leaves the road and collides with an object.

Tips to avoid air bag dangers:

- Not to sit close to the air bag while driving, the closest distance should be at least 25 cm.
- Always wear a safety belt as the air bag does not replace a belt.
- Children (under 12 years old) are not placed in the front seats.
- Do not place the leg or knee on the air bag.
- The air bags are designed to be used in conjunction with the seat belts. If there is a collision and the seat belt is not fastened, your injury may be much more serious even if the air bag is inflated.

Stages of the driver airbag performance during an accident

ACCIDENTS WITH INJURIES:

Safety inside the vehicle:

All vehicle passengers and road users need safety and security, but there is a group of people that needs more attention and special care, namely the children. In order to provide maximum security protection for children inside the vehicle, it must depend on their age and not to put them in the places most likely to accidents. All studies indicate that back seats are the safest for children to sit.

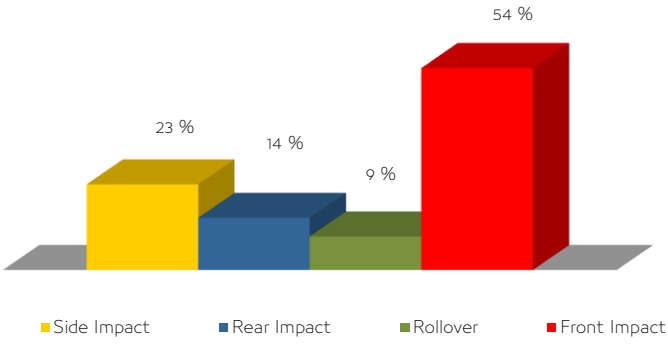
The table below shows the percentage of accidents and injuries in vehicles.

Side Impact

Rear Impact

Rollover

Front Impact



AUTOMOTIVE PARTS:

Original spare parts:

The original spare parts are produced by the vehicle manufacturers directly or in coordination with another company specialized in manufacturing spare parts according to the specifications of the vehicle manufacturers, so that it performs technical control on quality during production, and the parts pass to the vehicle manufacturer to be marked with its name or brand before marketing.

Commercial spare parts are produced by companies specializing in the manufacture of spare parts and according to the standard specifications, taking into account the requirements of the vehicle manufacturer, and these parts are not subject to control or inspection by the vehicle manufacturer and do not bear his name and are marketed through the manufacturer of spare parts directly.

Non original spare parts:

Counterfeit parts imitate the name or trademark of the company that manufactured the vehicle or the spare part, and the imitation is deceptive in the form and lettering of the writing, and these parts can be asserted that their level of quality does not match what is present through the vehicle manufacturers or commercial spare parts. It's is a source of safety risk, moreover, it is a waste of consumer's money, time and effort, and this type of spare part is commercial fraud.

The performance and efficiency of the original spare parts is much more than the performance of counterfeit and commercial spare parts. The risk of using counterfeit and commercial spare parts to is be installed in important and sensitive places in the vehicle as well as in the different quality specifications is not safe to be installed in safety and security systems such as tires, brake system, steering system and suspension system. That danger surrounds the vehicle's occupants, its driver, and all road users in the event of using counterfeit parts.

General Safety Tips:

- Speed is fatal.
- Give the road its due.
- Avoid overloading the tire.
- Do not buy used tires for your safety.
- Be sure to use cues when overtaking or swerving.
- Avoid sudden stops and speeding as much as possible.
- Never leave children alone in the vehicle, no matter what.
- Do not drive while under the influence of alcohol or drugs.
- Your respect for traffic lights is a guide to your awareness.
- Leave enough distance between you and the vehicle ahead.
- Road lines and signs ..You must abide by them for your safety.
- Do not be the cause of losing a human life due to recklessness.
- Respecting traffic signs is a dividing line between death and life.
- Monitor your tire air pressure and make sure it is not over or under.
- Be kind and tolerant of others, as your life is too valuable to sacrifice.
- For your safety and the safety of others, do not use a phone while driving.
- Make sure to check your tires, especially in the summer and before you travel.
- Make sure to inspect your car periodically for the safety of you and road users.
- Using high beams can sometimes endanger other drivers if you use them incorrectly.
- Do not drive at night while the inner lights are a light, this makes the outside vision weak.
- The maximum load weight should not be exceeded in the vehicle, as overloading may damage some parts of the vehicle, affect its stability on the road, and may lead to losing control of the vehicle.