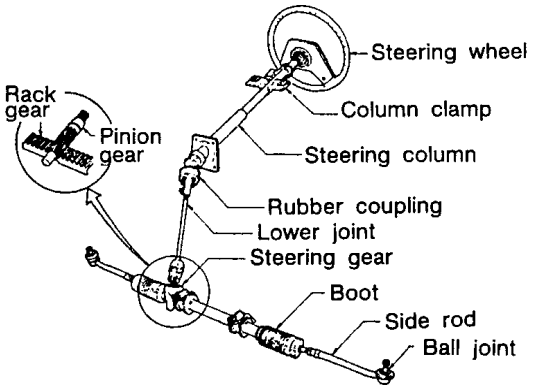
STEERING

1. DESCRIPTION

The steering system determines the direction the vehicle moves. The system is responsible for the smooth, stable and, most importantly, the safe steering of the vehicle. It must be sturdy and completely reliable.

The steering system is made up of the following three structures.



TST001

- **Steering**

The parts that the driver turns to steer the vehicle include the steering wheel, steering shaft, and column.

- **Gear**

Along with reducing the rotation speed of the steering shaft, the gears, transmit the rotation of the steering shaft to the link. The steering gear structure is connected directly to the frame.

- **Linkage**

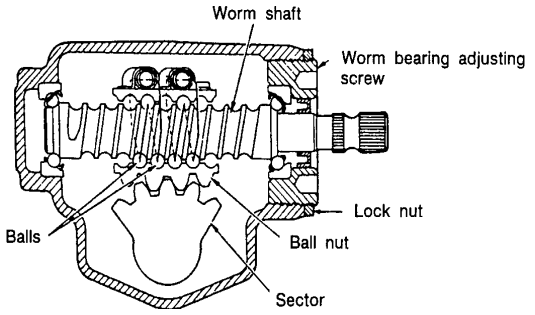
Along with transmitting the gear structure movement to the front wheels, the link structure maintains the correct relationship between the left and right wheels. The structure includes the Pitman arm, drag link, knuckle arm and tie rod.

2. STEERING GEAR

(1) RECIRCULATING BALL TYPE (RB type)

As shown in the figure, on the RB type steering gear there are several balls between the worm shaft and the nut. When the steering wheel is turned, the worm shaft turns the balls, which moves the nut and finally turns the sector.

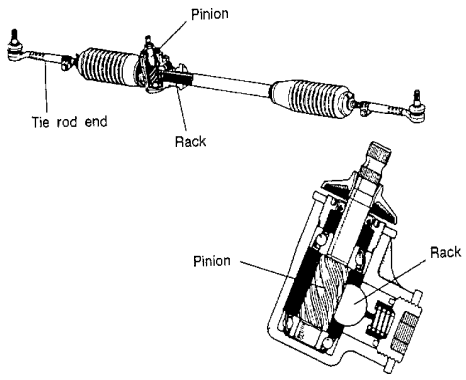
Because there is very little friction with this system, it is endurable and it helps to make steering lighter.



TST002

(2) RACK AND PINION TYPE (R & P TYPE)

On this type, a pinion will be connected to the tip of the column shaft that meshes with a rack and changes the direction of the wheels. Because the rack, which acts as tie rod, is moved directly by the column shaft, the steering is very responsive. The structure of this type is also relatively simple.



TST003

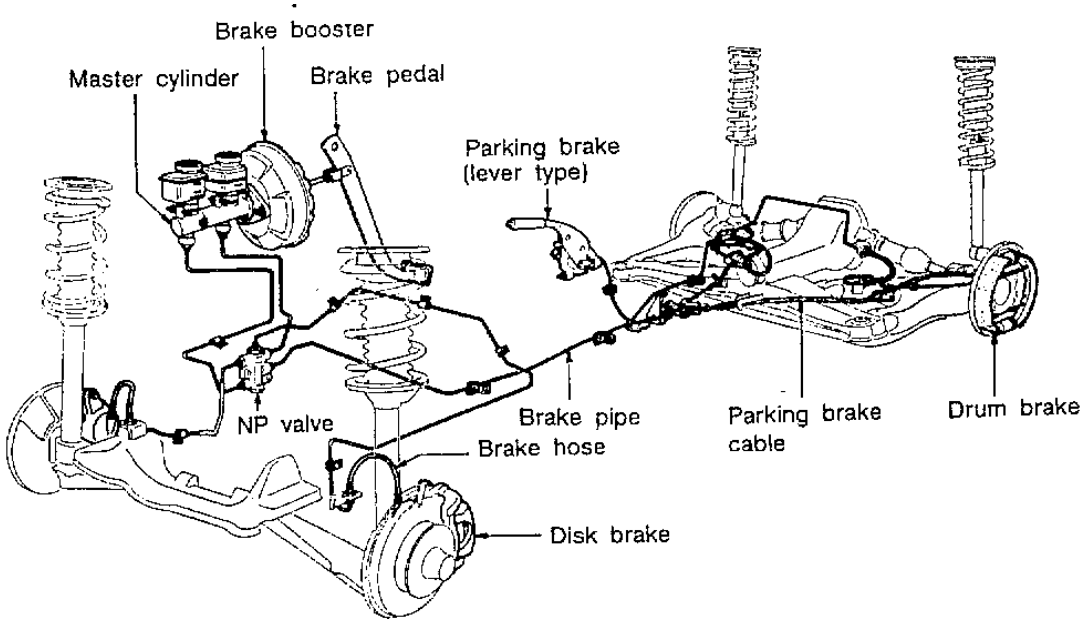
BRAKE

1. DESCRIPTION

Along with slowing or stopping the vehicle, the brake system is also used to hold the vehicle in a stopped position. The brake system does this by converting the movement energy, which generally uses friction, into heat energy. The friction type brake is able to perform its functions by releasing this heat energy. The brake system must include the following features.

- Operation must be completely effective.
- The system must be of superior reliability and durability.
- Inspection and adjustment must be easy.

There are many different types of brake systems, but the basic system includes links and hydraulic devices to improve reliability of the structure to transfer braking power, and the braking device that reacts when this power is received.
Types of brakes are the main brake (foot brake) used when the vehicle is in motion and the parking brake used to hold the vehicle in one position. The main brake is operated by the foot and the parking brake (hand brake) is operated by the hand. Two types of brake systems are mechanical systems which uses rods and wires and hydraulic systems which uses hydraulic devices. The foot brake is generally hydraulic and the parking brake is generally mechanical.



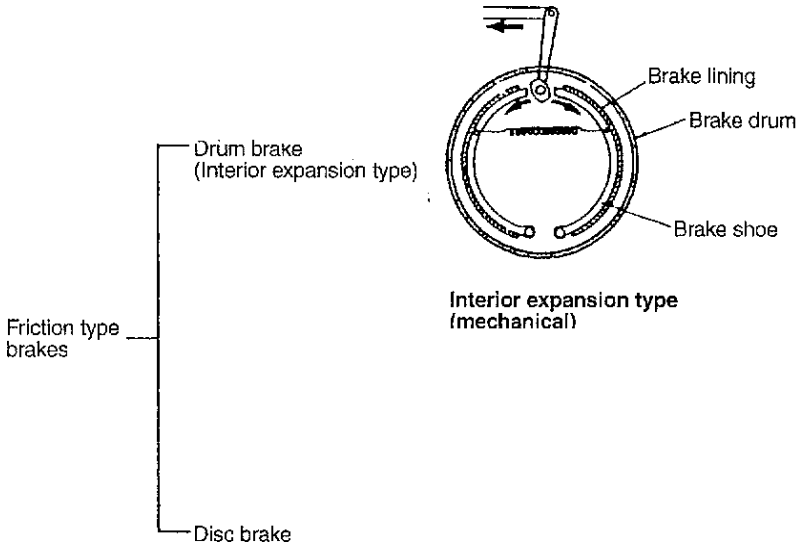
TBR001

2. BRAKE TYPES and FUNCTIONS OF COMPONENTS

Brake
- Foot brake --- hydraulic type
- Parking brake (hand brake) --- mechanical type

2-1. FOOT BRAKE

With the foot brake, a brake drum or brake disc is installed on the interior side of the wheel and has friction material packed into it. Friction is used to stop the vehicle. Braking power is applied at all four wheels form the brake pedal. The actual braking device can be either the drum brake type or the disc brake type.

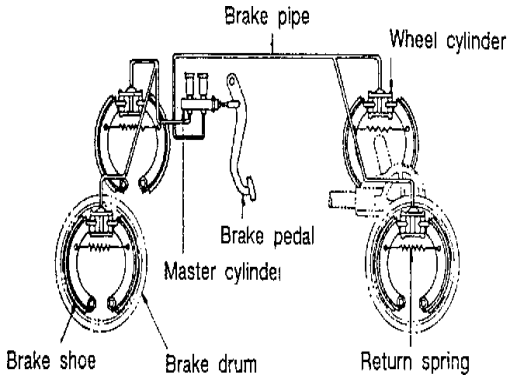


TBR002

FOOT BRAKE

(1) DRUM BRAKE

As shown in the illustration, the general structure for the actual braking device of the hydraulic drum type brake includes the brake shoe (hereafter referred to as shoe) which expands inside the brake drum (hereafter referred to as drum). When the brake pedal is depressed, the piston inside the master cylinder is activated to increase the pressure of the brake fluid.

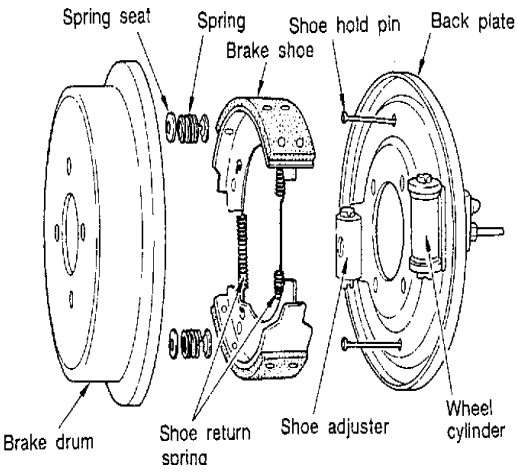


TBR003

GENERAL STRUCTURE FOR HYDRAULIC DRUM BRAKE

The pressure travels through the brake pipe and brake hose to the wheel cylinder. The wheel cylinder uses this hydraulic pressure to push on both sides (or one side) of the piston to force the shoe to press against the drum and create braking force. When the brake pedal is released, the pressure inside the master cylinder is lowered which lowers the pressure inside the wheel cylinder. A return spring pulls the shoe back and braking ceases.

As shown in the figure, the basic structure of the brake itself includes the wheel cylinder, the shoe and back plate and used for installation of the drum. Depending on how the shoe and wheel cylinders are installed, drum-type brakes can be divided into the following classifications.



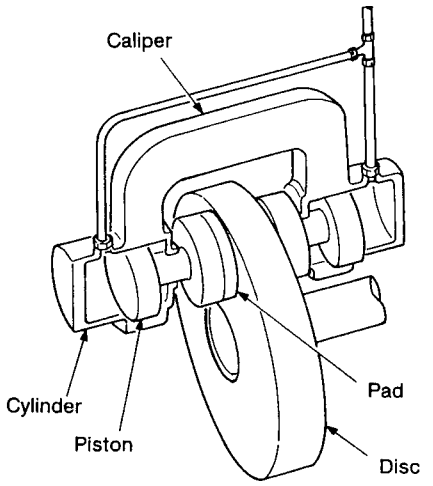
TBR004

DRUM TYPE HYDRAULIC BRAKE

- Drum brake
  - Leading-Trailing type (used often for the rear wheel)
  - Two-Leading type (double acting type is used on the front wheels of large trucks and buses)
  - Uni-Servo brake (used for the front wheel brake, but being replaced by disc brakes)
  - Duo-Servo brake (used for the rear wheel brake on some small trucks and passenger cars)

(2) DISC BRAKE

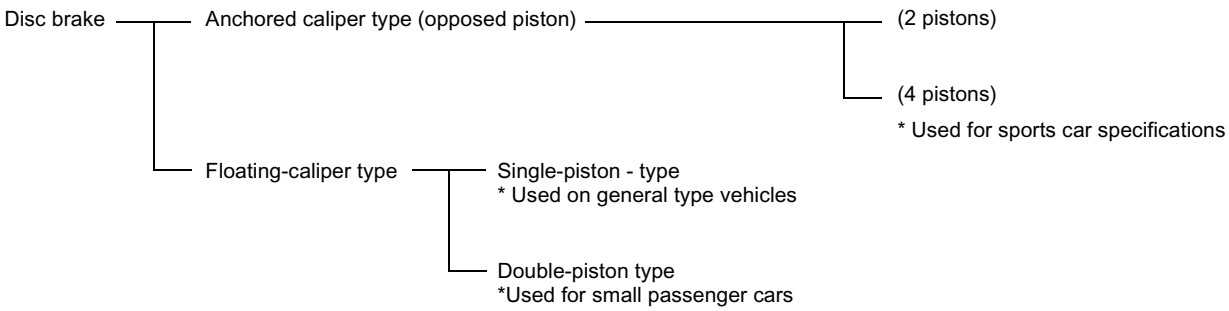
As the figure shows, the disc hydraulic brake (hereafter referred to as disc brake) applies braking power by the use of two strong pads around a disc that rotates with the wheels.
On this type, because the disc is exposed as it rotates, it is heat resistant, shows little performance deterioration during repeated use at high speeds, and provides stable braking power.

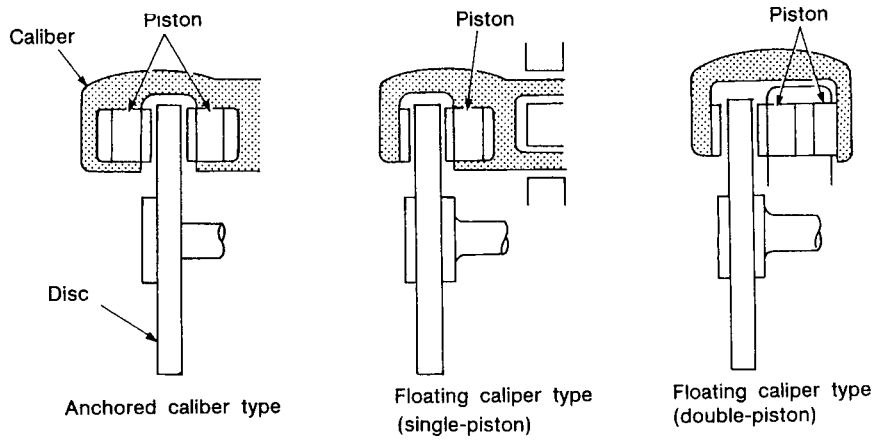


TBR005

1) Types of disc brakes

As shown in the figure, types of disc brakes include the anchored caliper (also called opposed piston) type with a cylinder that squeezes on both sides of the disc and the floating caliper type (one or two pistons) with a cylinder only on one side.





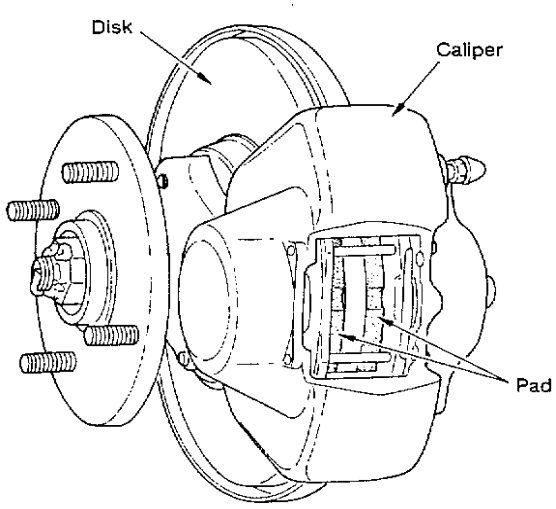
TBR006

TYPES OF DISC BRAKES

(a) Anchored calliper type

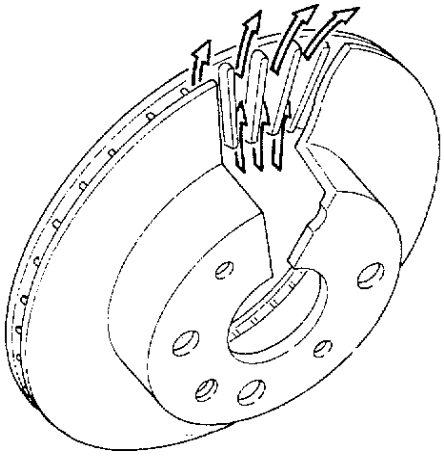
As shown in the illustration, on the anchored calliper, a calliper anchored to the disc rotates with the wheel. There are cylinders on both sides of the calliper. Pistons or self-adjusting devices are installed inside the cylinder to receive the pressure from the master cylinder and in turn squeeze the pads on both sides of the disc to deliver braking power.

The disc is installed on the hub and rotates with the wheel. As shown in the illustration, when the brake is applied, the friction heat in some types of discs (sometimes called ventilated discs) is easily released through openings.



TBR007

ANCHORED CALLIPER TYPE



TBR008

VENTILATED DISC

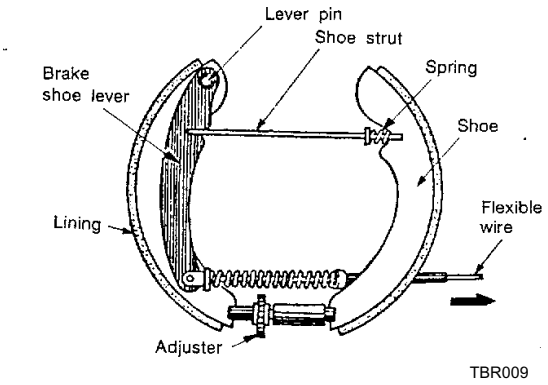
2-2. PARKING BRAKE

(1) REAR-WIHEEL BRAKE TYPE

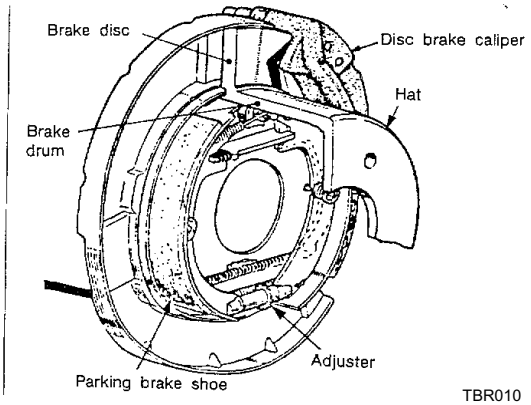
The rear wheel parking brake functions by a mechanical to the foot brake shoe. The general structure is usually similar to that shown in figure below.

1) Brake unit

The brake unit uses the existing structure of the foot brake as shown in the brake shoe. There are also brake systems where the parking brake is attached to the wheel cylinder. The figure shows a rear disc brake. On this type, along with the disc brake for the foot brake, there is also a drum and brake shoe which function as the parking brake. On the brake drum. the hat part of the brake disc is used. The brake shoe can be expanded by using the same structure as that shown in the figure below.



WHEEL BRAKE TYPE HAND BRAKE STRUCTURE



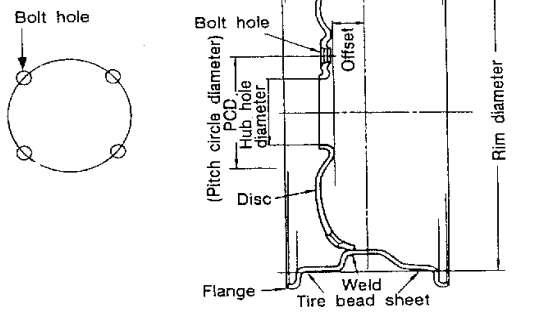
ONE EXAMPLE OF A DISC BRAKE PARKING BRAKE

WHEELS & TIRES

1. WHEEL

As shown in the figure, the wheel includes the rim to secure the tyre and a disc area used to install the wheel to the hub. The shape and size of the wheel is regulated by RS. The various curvatures and structural parts of the tyre must meet various performance and endurance standards depending upon use.

The rim diameter, rim width, flange shape and other dimensions must also meet international standards. As shown below, the wheel size displayed includes the rim size, shape and type.



TWL001

(1) EXPLANATION OF CODE

Example: 5 1/2 — JJ × 13

- 5 1/2: Rim width (inch)
- JJ: Flange shape
- 13: Rim diameter (inch)

(2) FLANGE SHAPE AND NUMBERING SYSTEM (Reference)

The shape of the flange is identified by a letter of the alphabet. A general rule is that the higher the letters (A, B, ...J, K, L ... T,V), the higher the flange, as shown below. Please refer to table 7-1 for standard passenger car heights.

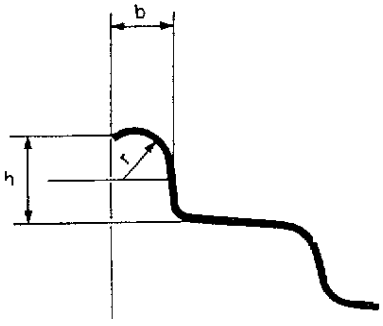
Table 7-1 JK is TRA standards, the rest are JIS standards

TRA: Tire and Rim Association Inc. (United States standards)

Unit: mm (in)

Area / Code	h	b	r
B	$14.0^{+1.0}_{-0.5}$ ($0.551^{+0.039}_{-0.020}$)	10.0 (0.394)	7.5 (0.295)
J	$17.5^{+1.0}_{-0.5}$ ($0.689^{+0.039}_{-0.020}$)	13.0 (0.512)	9.5 (0.374)
JJ	18.0 ± 0.7 (0.689 ± 0.028)	13.0 (0.512)	9.0 (0.354)
JK	$18.0^{+1.2}_{-0}$ ($0.709^{+0.047}_{-0}$)	13.0 (0.512)	9.0 (0.354)
K	$19.5^{+1.0}_{-0.5}$ ($0.768^{+0.039}_{-0.020}$)	13.0 (0.512)	11.0 (0.433)
L	$21.5^{+1.5}_{-0.5}$ ($0.846^{+0.059}_{-0.020}$)	13.5 (0.531)	12.0 (0.472)

SHAPE OF FLANGE



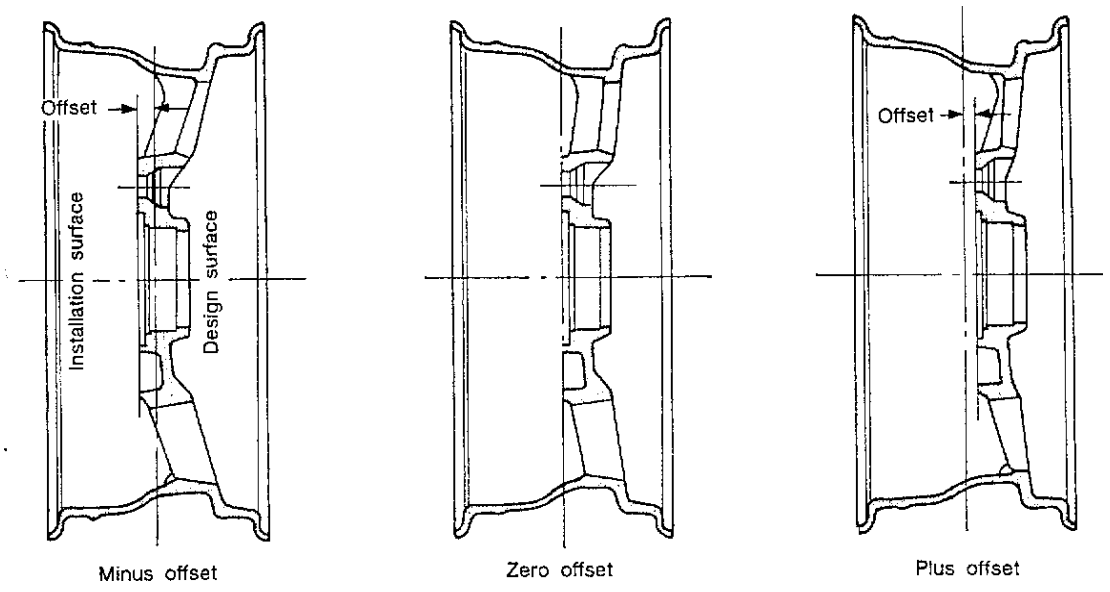
TWL002

(3) PCD (Unit: mm)

PCD refers to Pitch Circle Diameter. Nissan uses 100 nun and 114.3 mm (3.94 and 4.50 in).

(4) OFFSET

Offset is the distance between the rim central line and the surface of the hub install hole. Offset is related to prevention of interference with the brake and wheel alignment.



TWL003

If the offset is large, the center of the tire will lean inwards; if offset is small, the center of the tire will lean outwards. The offset for FR vehicle is approximately between 15 and 40 mm (0.59 and 1.57 in), 35 to 55 mm(1.38 to 2.17 in) for FF vehicles.

2. TIRES

The automobiles of today travel at high speeds. With the demand for higher performance, the tire plays a more important role than ever.

2-1. FUNCTIONS, TYPES, AND STRUCTURE

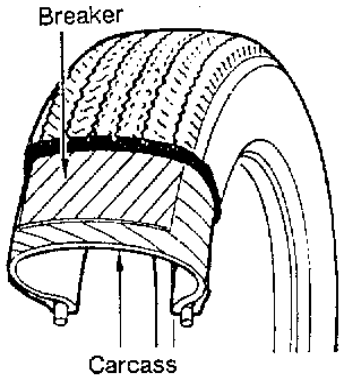
(1) TIRE FUNCTIONS

- Support the weight of the vehicle.
- Transmit rotation and braking torque to the road.
- Absorb vibration from the road surface.
- Maintain change direction when in motion

(2) TYPES OF TYRES

1) Bias tyre

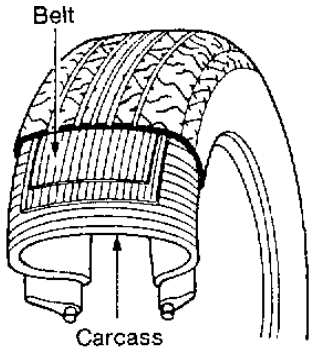
On the bias tyre, carcass plies are laid alternately around the carcass of the tyre on a slant (bias) in the direction of forward rotation. This gives circumferential and radial support to the carcass. This structure is efficient at absorbing road vibration and provides a comfortable ride as the tires deform with the road surface. But because of extra movement against the road surface, it is not as durable as the radial tyre.



BIAS TIRE TWL004

2) Radial tyre

On the radial tyre, the carcass plies are laid at right angles with the direction of forward direction. This gives strong radial support, however, it is necessary for a reinforcing belt to be wrapped around the carcass for circumferential support. The strength of this band allows for little friction with the road meaning that the tread will last longer and have a higher critical speed.



RADIAL TIRE TWL005

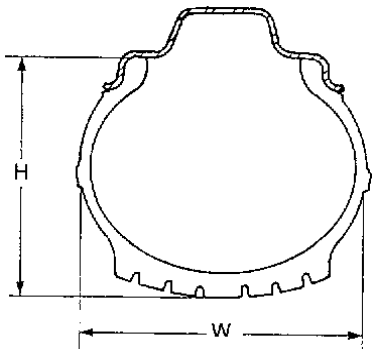
Explanation of tire size

Type		Explanation
Radial-ply	Series 50, 55, 60, 65, 70, 80	205 (Tire width (mm)) / 60 (Aspect percent) R (Radial) 15 (Rim diameter (inch)) 86 (Load-carrying capacity) H (Speed symbol)
Bias-ply	Types 1 - 3	6.45 (Tire width (inch)) — 13 (Rim diameter (inch)) 4RP (Tire strength (ply rating))
	T type	T (For temporary use) 135 (Tire width (mm)) / 70 (Aspect percent) D (Bias) 15 (Rim diameter (inch))

(3) ASPECT RATIO

185/70 HR 14 As shown in the figure, aspect ratio is a comparison of the tires height and the tires width. Aspect ratio = H/W
Aspect percentage = H/W x 100 (%)
W: The width of the tyre (min)
H: The height of the tyre (mm)

* Aspect ratio is usually expressed by percentage.



TWL006

(4) LOAD CARRYING CAPACITY (load index)

195/60R15 86 H
Load carrying capacity: The heaviest load that the tyre can support expressed by the speed symbol (code) for use in standard conditions. The larger the index, the heavier the load carrying capacity.

(5) SPEED SYMB0L

Under normal conditions (correct tyre pressure, etc.), the appropriate speed for the load capacity represented by the speed symbol is shown in the example chart below. The chart is for 185/70 HR 14, 195/60R15 86H.

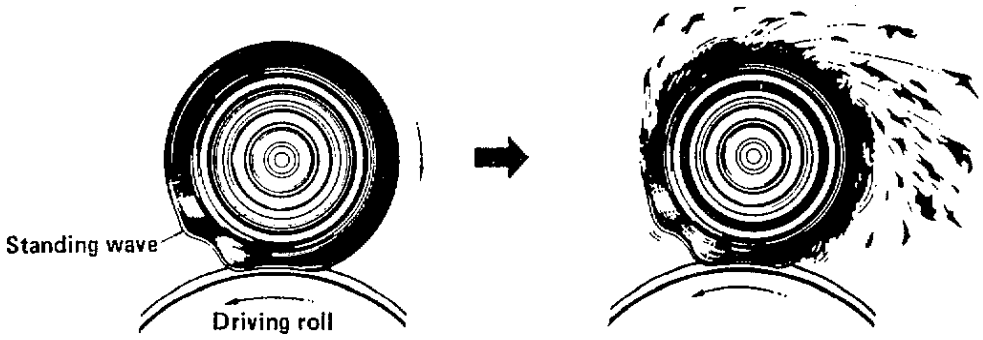
Speed symbol (code)	Speed Km/h (MPH)	Speed symbol (code)	Speed Km/h (MPH)
P	150 (93)	T	190 (190)
Q	160 (99)	H	210 (110)
R	170 (106)	V	240 (140)
S	180 (112)	Z	Over 240 (over 149)

TYRE PROBLEMS

Standing wave

Standing wave is a visible wave phenomenon. In ordinary tires it occurs at vehicle speeds over 150 km/h (93 MPH). Once it occurs, excessive tire surface bending can cause the tyre to burst.
While a tyre is rolling, it changes its shape at the portion where it contacts the road. The tyre then tries to regain its original shape at the point at which it leaves the road. In other words, changes to and recovery of its shape accompany the rolling of the tyre, which are constantly repeated.

As the tyre rolls at high speed, the deformed portion of tyre, caused by contact with the road, will not have time to fully recover before the next revolution. This continuous phenomenon is called a standing wave.
The speed of the car at which this standing wave first occurs is called the boundary speed. Boundary speed will decrease as the tyre inflation pressure decrease and it will vary with the sectional construction of the tyre. In radial tires, the boundary speed is approximately 190 to 200 km /h (118 to 124 MPH).



TWL007

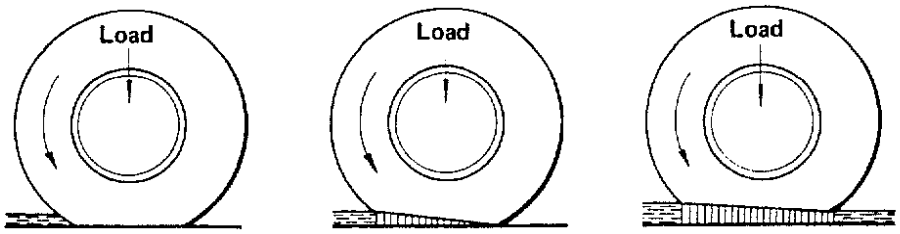
STANDING WAVE

Hydroplaning

As the car moves along a wet road at high speed, the resistance produced by the water causes the tires to float and slide over the water film. This effect is called hydroplaning and employs the same principle as water-skiing. When it occurs, car stability and controllability are adversely affected. The boundary speed, beyond which hydroplaning occurs, is influenced by various factors. Careful attention should be paid to car speed, tyre inflation pressure, road conditions, and tyre wear. The problems indicated below may result from hydroplaning:

- Ineffective braking.
- Insufficient or no traction.
- Ineffective or unreliable steering.
- Side slipping as a result of side winds.

For safety in high speed driving as in preventing standing waves, tires should be inflated somewhat higher than the specified pressure.



Entire contact

Fluid wedge
Water forms a wedge and clings to the tire surface touching the ground.

Hydroplaning
Water forms a wedge causing the tire to become completely detached from the ground.

TWL008

HYDROPLANNING